1911

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Purpose: CERCLA Site Inspection

Site: Mt. Jackson Mercury Mine
Sweetwater Springs Road
Guerneville, California
Sonoma County

Investigators: Dick Jones, Janet Naito — California Department of Health Services

Original Investigator: Paul Williams

Date of Inspection: February 6, 1989

Report Prepared By: Dick Jones
Janet Naito

Report Date: August 30, 1989

Assessor's Parcel No: 069-120-07

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1.0 INTRODUCTION

The Site Inspection (SI) of the Mt. Jackson Mercury Mine (MJMM) site was prepared by the California Department of Health Services (DHS) for the U.S. Environmental Protection Agency (EPA) under the CERCLA Grant Program. A Preliminary Assessment (PA) of this site was completed on June 27, 1985 by Ecology and Environment, Inc. (E&E), an EPA Field Investigation Team (FIT) Contractor. This PA was reassessed by E&E on February 4, 1988. E&E recommended further investigation due to the large quantity of tailings remaining on-site, the toxicity of mercury, and the nearby population's use of groundwater as a drinking water source.

The site operated intermittently as a mercury mine from approximately 1875 until 1972. From 1979 through 1981, the site was used by a gravel crushing operation. Mercury mine tailings were crushed and the aggregate hauled offsite. The aggregate was used in Sonoma County for road repairs near Ft. Ross and as bedding and backfill material for a sewer line project in Guerneville. Approximately 800,000 tons of mercury mine tailings are still piled on-site.

This report summarizes information obtained from the site inspection, the California Department of Health Services (DHS), the North Coast Regional Water Quality Control Board (RWQCB), the California Department of Fish and Game (DFG), the California Occupational Safety and Health Administration (Cal-OSHA), the Sonoma County Environmental Health Department (EHD), the Sonoma County Public Works Department (PWD), and private individuals. This information is the basis for making recommendations for further action regarding the Mt. Jackson Mercury Mine site. The recommendations are based on an analysis of the available information, with a focus on whether the site poses a public health threat and is eligible for inclusion on the National Priorities List (NPL).

2.0 SITE CHARACTERIZATION

2.1 Site History and Description

The Mt. Jackson Mercury Mine site (MJMM) is located at 18475 Sweetwater Springs Road, approximately three miles north-northeast of the City of Guerneville in Sonoma County, California.(1,2) (See Figure 1, Site Location Map, Township 8B, Range 10W, Sections 8, 9, 16, 17.) The 410 acre site consists of the Mt. Jackson Mine, the Great Eastern - Roaring Lion Mine, the mill buildings, and tailings piles.(2) (See Figure 2, Site Map and Figure 2a, Aerial Photo.) At some point, the Mt. Jackson and the Great Eastern-Roaring Lion Mines, whose shafts are essentially interconnecting, became known simply as the Mt. Jackson Mine. It appears that they were also referred to as the Sonoma Quicksilver mine.(2)

Production at the Mt. Jackson Mine and the Great Eastern-Roaring Lion Mine began about 1875.(3) Originally they operated as two adjacent, but separate mines. From 1888 to 1906, the Mt. Jackson property was leased by the Great Eastern operators.(4) The ore from both mines was hoisted through the Great Eastern shaft and burned in the Great Eastern furnaces. The location of these furnaces is unknown, but are believed to be adjacent to the Great Eastern mineshaft. By 1905, the main Great Eastern shaft had been sunk to a depth of 500 feet and a winze extended 120 feet deeper. Damage caused by the April 18, 1906 earthquake led to the closing of the mines. When they reopened in May 1915, the lower levels were flooded. From 1915 to 1919, mining was carried on only above the hoist level in the Great Eastern mine. Some mining was carried out by several Guerneville townspeople in the Mt. Jackson mine from 1934 to 1939.(4)

Sonoma Mines, Inc. (also known as Sonoma, International) gained control of the mine property in 1940.(4) They began to dewater the mines and rebuilt the plant. Production restarted later that year. In May, 1941, the Great Eastern mine was acquired by Magee Mercury, Inc. This mine was dewatered by pumping out the Mt. Jackson Mine. Its main shaft was cleaned out and retimbered to the 500- foot level.(4) Magee Mercury erected the present plant and began production on July 15, 1941. Production in both mines continued until 1971, when both mines became inactive.(4)

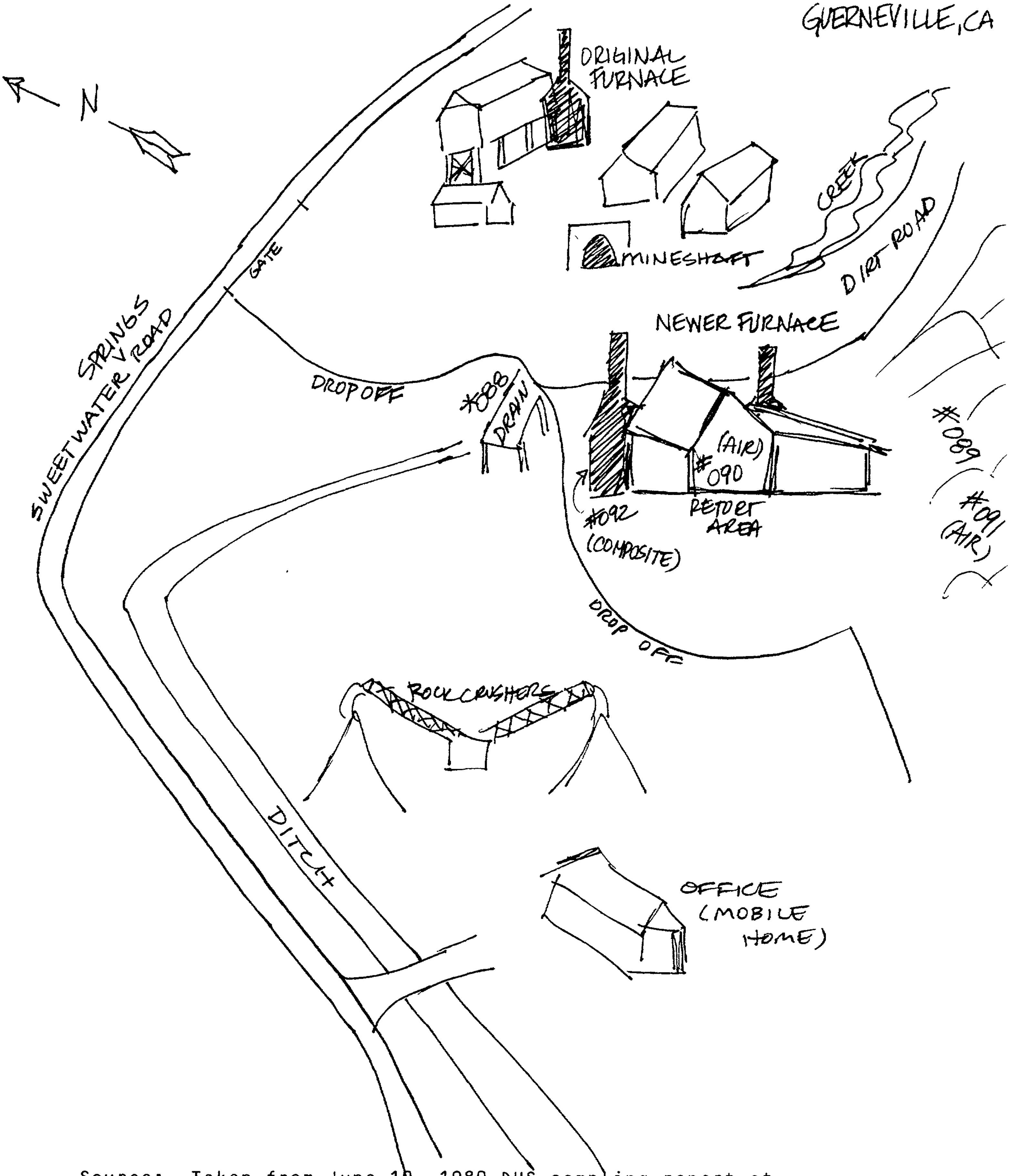
The site with equipment was then sold to Mr. Walter J. Doyle.(5) In 1979, he sold the site without the equipment to the Piombo Corporation of Windsor, California.(5)

The Piombo Corporation acquired MJMM as a source of gravel. Piombo Corporation's subcontractor, Caputo Wagner Company, crushed the mine tailings and hauled out the sorted gravel beginning the summer of 1979 until 1981.(2) The major initial use of the gravel was as bedding and backfill for a sewer line project in Guerneville, California.(2) A quantity of the gravel was hauled to and

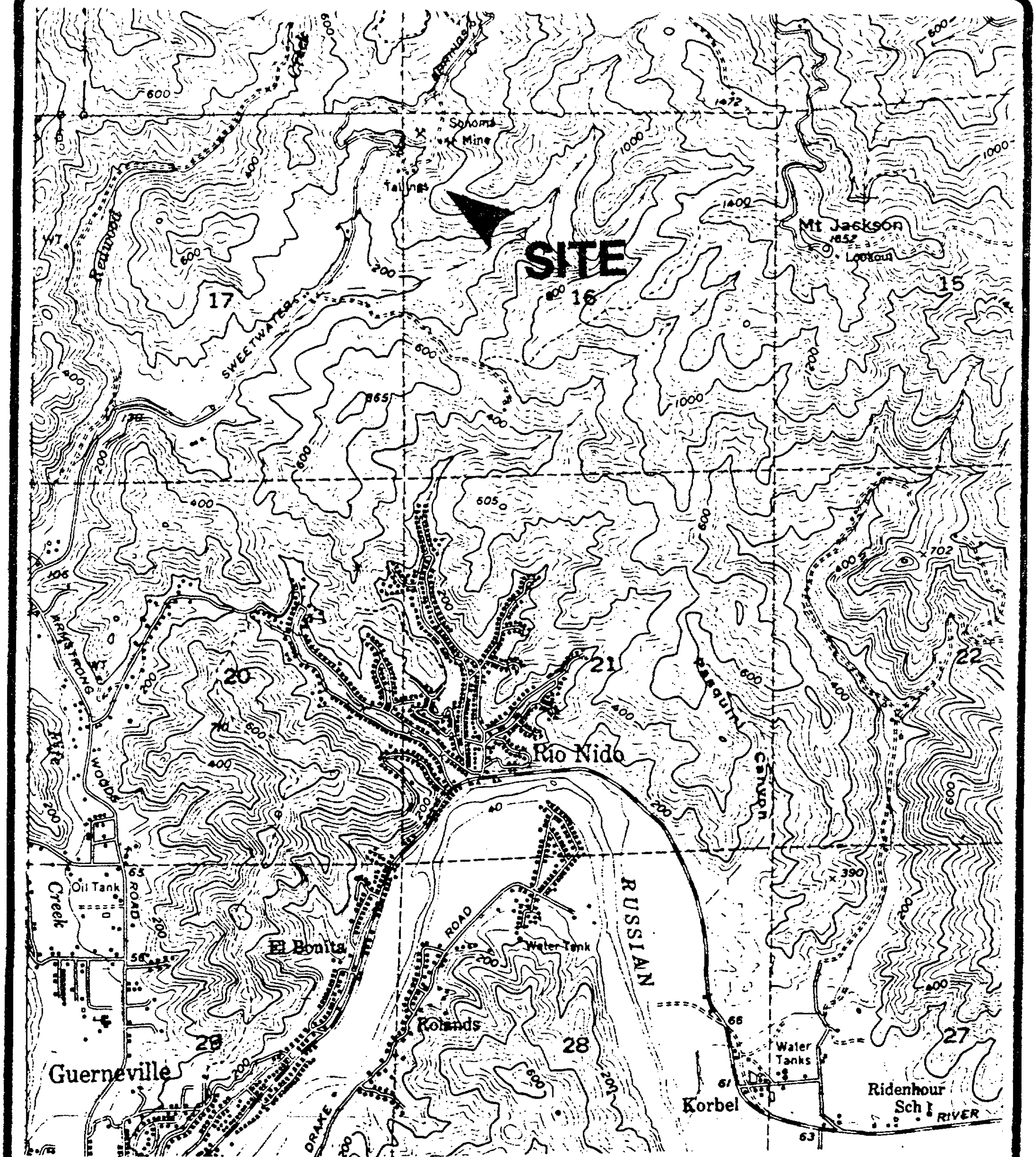
PIMBO QUARRY

GUERNEVILLE, CA

FIGURE 2



Source: Taken from June 10, 1980 DHS sampling report at Mount Jackson Mercury Mine site.



SITE LOCATION MAP

Mt. Jackson Mercury Mine
Sweetwater Springs Road
Guerneville, CA

GN
MN
0°02'
1 MIL
18°
320 MILS

Scale
1/2 mile
CALIF

Source: USGS Guerneville Quad Map

Figure 1

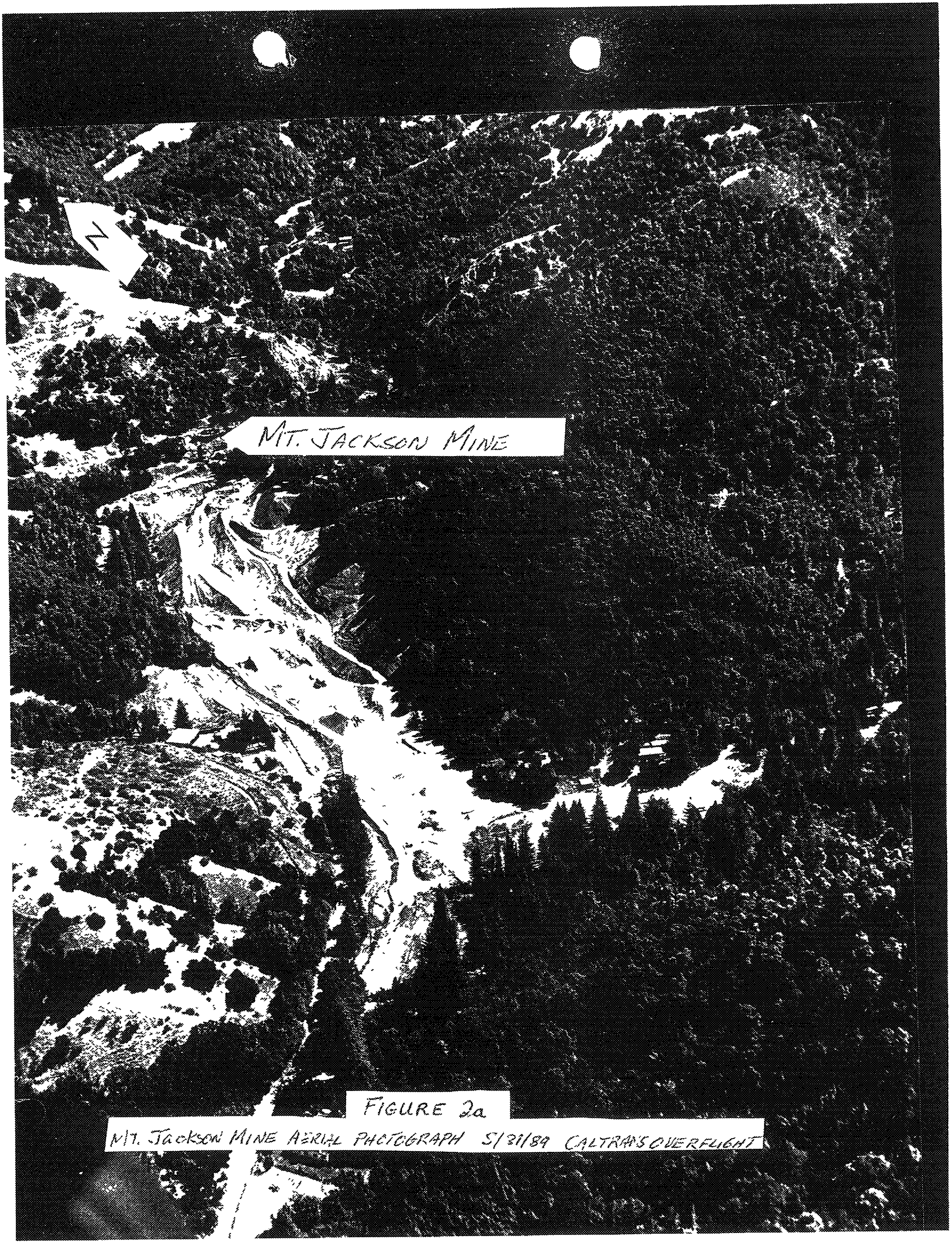


FIGURE 2a

MT. JACKSON MINE AERIAL PHOTOGRAPH 5/31/89 CALTRANS OVERFLIGHT stockpiled along the Seaview Road near Ft. Ross, California for use in road repairs.(1)

In 1986, the property was purchased by Mr. Walter J. Doyle.(6) Although he has considered selling the property, Mr. Doyle remains the current owner.(6,7)

2.2 Process Description

2.2.1 Mount Jackson Mercury Mine

During the mine's operation, ore was extracted from several levels in the mines, the deepest at about 1450 feet below the ground surface. The ore was crushed at the surface to 1-1/2 inches and finer.(3) The crushed ore was conveyed to the rotary kiln, which was capable of processing about 90 tons of crushed ore in 24 hours.(1,3) Typically, the rotary kilns roasted crushed ore in a stream of air or with lime.(2) This causes the mercuric sulfide (HgS) in the ore to decompose to elemental mercury and hydrogen sulfide or calcium sulfate.(2) It is not known whether air or lime was used at MJMM. The vapors were then drawn off at the upper end of the kiln through a cyclone dust collector.(3) The flow of gases was stimulated by a suction fan. Mercury condensed from the vapor in banks of vertical pipes joined alternately at the top and bottom with U- connections.(3) Two D retorts with a total capacity of about one ton per day were used to burn soot from the condensing columns.(1,4) Liquid mercury was collected under water which sealed the hopper openings in the lower pipe connections.(3) The waste rock was deposited parallel to and on the east side of Wilson Creek.(1,2) A dust collector was used to separate the dust from the gases.(1) This in turn was washed out every ten minutes.(1) The resulting slurry was directed to a settling pond.(1)

2.2.2 Caputo & Wagner/Piombo Corporation

The gravel crushing operations utilized the tailings piles for aggregate.(2) A bull-dozer pushed material from the piles into a piled mixture.(8) This material was picked up from these piles by a bucket line for further processing by crushing.(8) The blended aggregate was less red than the material in the burnt ore pile.(8) At the time of the June 10, 1980 DHS inspection, the gravel was not being washed or wet down before loading on the transport trucks.(8) A water sprinkler was used to keep down dust in the areas of traffic within the site.(8,9)

According to the May 5, 1980 RWQCB report on the Piombo aggregate operation, dust control water was obtained from a 40 foot well on the property.(9) Excess dust control water, according to the report, flowed to a small pond at the southeast side of the lower level operations. This small pond (no. 1) also accepted some site runoff and overflowed to a small ditch and then to another Pond.

This pond (no. 2) was installed by the Piombo Corporation at the request of the RWQCB to ensure that all process waters remained on-site. A third small pond (No. 3) received any runoff from Pond No. 2 and some runoff from a storage yard.(9) See Figure 3 for Pond locations.

At its peak, crushed and graded aggregate was removed from the site at a rate of 50 to 200 truck loads a day.(8)

2.3 Waste Management Practices

2.3.1 Mt. Jackson Mercury Mine

Waste management practices at the Mount Jackson Mercury Mine site prior to ownership by Sonoma Mines, Inc. are unknown. During operations by Sonoma Mines, water from the mine workings was pumped directly into Wilson Creek. The water entered the creek just south of the Mt. Jackson tunnel at a rate of up to 145,000 to 150,000 gallons per day.(1,4) In the dry seasons, this dropped to 70,000 gallons per day.(1) A wooden flume was built to carry the water from the mill area over to the area where Wilson Creek drained south again.(4) (See Figure 3) The mine entry road had a culvert under it, which emptied into another wooden flume that placed the water in the discharge area of the first mentioned flume.(4) The culverts and flumes were necessary to prevent erosion of the road and tailings by water.(4)

Processed rock or "clinker" from the rotary kiln was taken from the hot box by a two-car compressed air tram, out to the end of the clinker dump.(4) (See Figure 3.)

About 800 to 1,000 pounds of cyclone dust was mixed with waste water from the mill into a slurry. This slurry was fed through wooden flumes out to a settling pond between the clinker dump and an older dump to the east.(4) The settling pond was dammed and water either evaporated or slowly filtered through dump debris before reaching Wilson Creek.(4) (See Figure 3.)

2.3.2 Piombo Corporation

When the gravel works were in operation, runoff associated with site activities (dust control or cooling water) was directed to a series of three settling ponds.(10) Waste discharge requirements were not established by the RWQCB when the works closed down in 1981.(10) (See Figure 4 for pond locations.)

2.4 Permits

Waste Discharge Requirements (WDR) were issued by the North Coast Regional Water Quality Control Board on November 6, 1969 for the

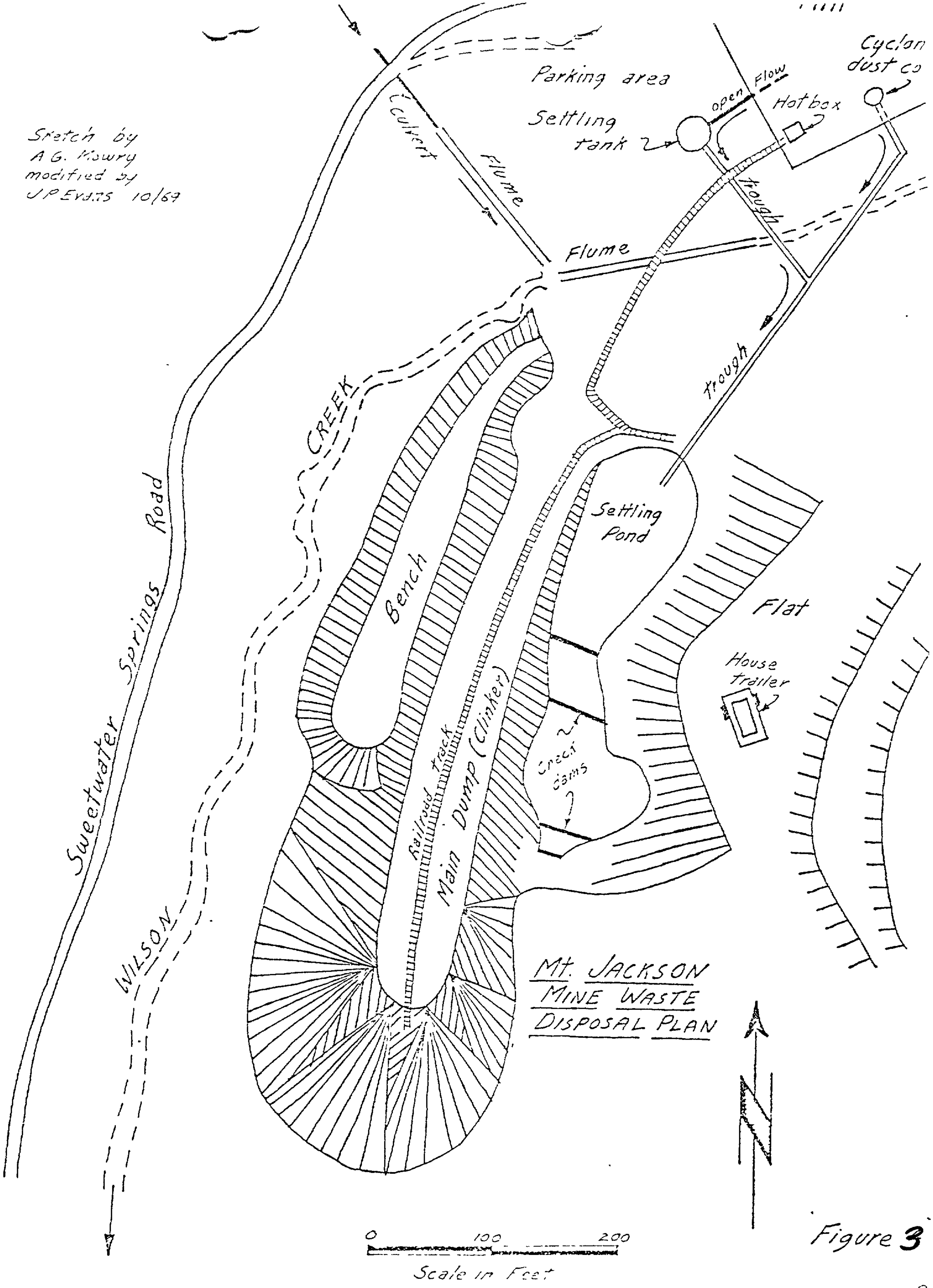

Sketch by
A.G. Mowry
modified by
J.P. Evans 10/69
Parking area
Cyclon dust co
open Flow
Settling tank
Hotbox
Culvert
Flume
Flume
trough
trough
Settling Pond
CREEK
Bench
Railroad track
Main Dump (Clinker)
Check dams
Flat
House trailer
Sweetwater Springs Road
WILSON
Mt. JACKSON
MINE WASTE
DISPOSAL PLAN
N
0
100
200
Scale in Feet

Figure 3

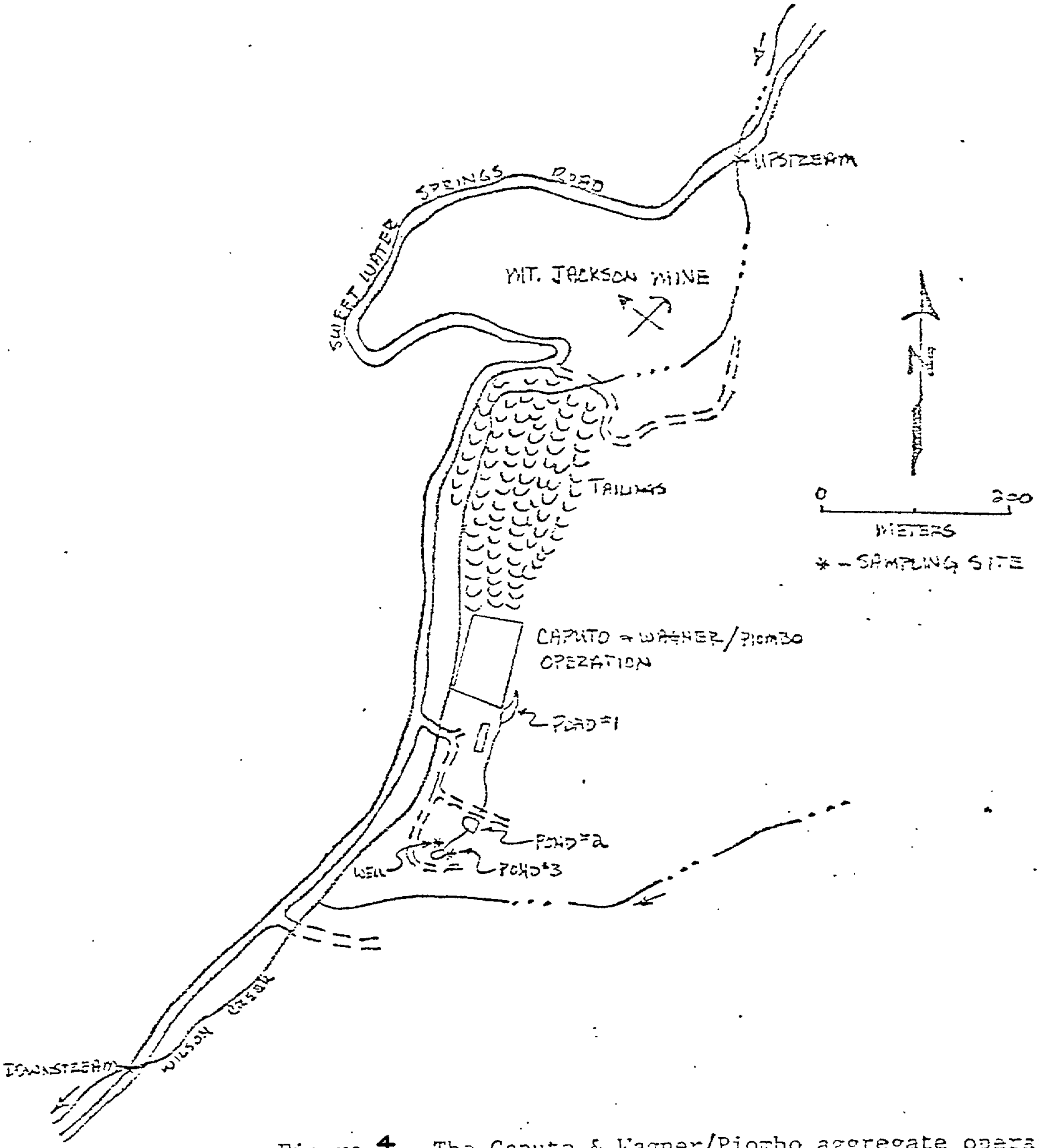


Figure 4 The Caputo & Wagner/Piombo aggregate operation on Wilson Creek in relation to the Mount Jackson Mercury Mine.

Mount Jackson Mercury Mine.(11) The WDR regulated the discharge of process waters, mine drainage, water that had passed over or through solid wastes and had dissolved metals therefrom, and any other liquid materials associated with mercury mine operations that entered Wilson or Fife Creeks.

Although the Regional Water Quality Control Board required the Piombo Corporation to submit the required information for Waste Discharge Requirements, the gravel crushing operation closed before Waste Discharge Requirements could be issued.(10)

According to Section 3005 of the **Resource and Conservation and Recovery Act** (RCRA) and 40 **CFR** Section 261.4(b)(7), solid waste from the extraction, beneficiation, and processing of ores and minerals are exempt from regulation as hazardous wastes under RCRA. The wastes generated at the Mount Jackson Mercury Mine fall under this category. Therefore, the site is not regulated under RCRA.

Tailings from the extraction, beneficiation and processing of ores and minerals are regulated as a special waste by the State of California pursuant to Sections 66740, 66742, and 66746 of the **California Code of Regulations**, Title 22, Division 4.

2.5 Remedial Action

No information was found during Agency file reviews regarding historical remedial actions.

3.0 Environmental Setting

3.1 Surrounding Area

The Mt. Jackson Mercury Mine is located on a steep hillside at 500 feet elevation, overlooking the Wilson Creek drainage.(12,13) This intermittent stream (dry from May through November (DMG)) runs down through four to seven acres of tailings into a valley. Just past the border of the mine tailings, a few houses are on the stream and Sweetwater Springs Road. Several hundred yards downstream, a cluster of houses borders the creek and the road. Finally, about one and a half miles below the mine, Wilson Creek enters Fife Creek and the road ends at Armstrong Woods Road. Both Armstrong Woods road and Fife Creek continue one and a half miles south to Guerneville and the Russian River (12,13)

Brush interspersed with conifers covers the hillsides around the mine. Downstream, vegetation consists of brush interspersed with trees along the stream edges. However, the white and orange tailings piles cover the valley floor below the mine. Although population near the mine site itself is limited to the few houses mentioned, downstream houses and population increase steadily along Armstrong Valley Road. Houses are side by side along the road, down the 1.5 miles to the town of Guerneville.

3.2 Geology

Most of the area north of Guerneville is underlain by sandstone with some interbedded volcanic flows and tuffs, chert, and shale. All these rocks belong to the Franciscan Formation of Upper Jurassic age (145 + 5 million years). After deposition of the rocks, they were folded and probably faulted. A major northwest trending fault zone was developed and serpentinite dikes were intruded into and adjacent to the fault zone. Soon after emplacement of the serpentinite, it was altered by hot, gas-charged mineralizing solutions to cinnabar (mercuric sulfide-HgS)-bearing silica-carbonate rocks. Pyrite (disulfide of iron-FeS_2) is present locally. About 1% is the maximum noted by Myers and Everhart.(2,4) Cinnabar ore shoots dip generally north at about 75°. They are pipe-like and tabular in shape, and are roughly 50 feet by 50 feet by 100-300 feet in length down the dip. Shoots are mostly confined to zones of weakness within the silica-carbonate rocks, which are about 100 to 200 feet thick and extend down dip at least 1,700 feet from the Mount Jackson tunnel level. Grade of ore has varied from 2 pounds to 26 pounds of mercury per ton of silica-carbonate rock. Near the end of the mine's operation, however, the ore ranged from five pounds to six pounds of mercury per ton.(4)

Alluvial materials consisting of unconsolidated clay, silt, sand, and gravel occupy the floors of valleys tributary to the Russian River. The broad, flat-bottomed tributary Armstrong Valley area extends northward from Guerneville for just over a mile. According to Cardwell, this valley area, which contains an isolated bedrock hill in the middle, is an abandoned meander of the ancestral Russian River. The lower portions, below a depth of about 100 feet, probably consist of river-deposited sandstone gravel to a depth of about 300 feet.(14) The more surficial portion of Armstrong Valley, which is drained on the east by Fife Creek, is composed of alluvial silts, clays, and sands. These are typical of sediments found in valleys from weathering of Franciscan Formation rocks. This silt, clay, and sand alluvium is also found in the Wilson Creek Valley below the site. The maximum depths of these materials in Armstrong Valley is not known. The Wilson Creek basin alluvium below the Mine is currently covered with tailings piles.(13)

3.3 Surface Water

Wilson Creek flows down, around, and through the mine property. It then parallels Sweetwater Springs Road down to Armstrong Woods Road, approximately one and a half miles below the site. There, Wilson Creek enters Fife Creek, which flows approximately one and a half miles south to the Russian River at Guerneville. The facility slope and intervening terrain is 70-80%. There are no surface water intakes within three miles downstream of the site. Armstrong Redwoods State Park is approximately 2 miles from the mine in another canyon.(12,13)

The area's large amount of precipitation (1 year/24 hour: 3 inches; annual net: 17 inches (18)) and the high water-holding capacity of the unconsolidated materials provides a source of water for the streams. Thus, the Russian River and its tributaries are "gaining" streams as groundwater moves toward them during most of the year. Underflow from the rocks to the Franciscan Formation and the larger terraces provides an unknown quantity of recharge to overlying adjacent alluvial materials. During high river stages, gradients can become locally reversed, creating losing streams with water moving laterally from the channels into and recharging the groundwater body.(14)

Surface diversions from hillside springs have been attempted but all were taken out of service by the 1970s. Russet Spring (near Sweetwater Tank) was dry in the summer. The Mt. Jackson Spring, built in 1906, has a wet weather flow of about 16 gpm and a dry weather flow of 2 gpm. However, dry weather flow can be negligible and springs are an unreliable water supply. The Mt. Jackson Spring is located roughly 1/2 mile southeast of the Mine in the SE1/4SE1/4 of Section 16. The Spring is at 720 feet elevation on the Mt. Jackson Fault which runs northwest from Forestville to beyond Armstrong Redwoods State Park.(14)

Runoff from the site is tributary to Wilson Creek. During gravel crushing operations in 1979-81, dust control water came from the 40 foot deep well onsite. Excess dust control water flowed to a small pond at the southeast side of the operation. This small pond also accepted some site runoff and overflowed to a small ditch, and then, another pond. A third small pond was constructed to ensure that any overflow was contained. However, it probably only received storage yard runoff during gravel operations, which then flowed to a tributary of Wilson Creek.(2)

3.4 Groundwater

Groundwater is scarce in the immediate Mine area. Water is found in the alluvium below Wilson Creek and in small amounts from springs in the fractured hillside rocks. Surface diversions from hillside springs have been attempted but all were taken out of service by the 1970s. The area is a "zone 4" or groundwater scarce area with mainly "pocket water" sources.(15) Net precipitation for the area is approximately 17 inches.(18)

The aquifer of concern is approximately 10 to 20 feet below Wilson Creek.(14) Permeability of the alluvial silt, clay and sand in the valleys is a high 10^{-3} to 10^{-5} cm/sec.(14) One report places the nearest well 200 yards from the intersection of Sweetwater Springs Road and Wilson Creek.(17) However, there are one or two houses roughly 100 yards from the site which may use spring water.(2,13) Each domestic well serves 3.8 people per HRS guidelines.

Although the approximately 20 homes downstream of the mine have some private wells, they have an alternative drinking water source. A Citizens Utility pipeline brings water over the hill from Rio Nido, enabling service to the valley.(19)

Table 1 and Figure 5 show the 16 wells and 455 connections served within three miles downstream of the site. There are 5 wells along Sweetwater Creek ranging in depth from 10 to 172 feet, and yielding from 1 to 75 gpm. Depth to groundwater is about 20 feet.(17) There are four wells downstream along Fife Creek, near 16800 Armstrong Woods Road, which yield 20 to 60 gpm. They are 111 to 147 feet deep, have depths to water of 10, 12, and 40 feet, and are screened from 50 to 120 feet.

Further down Fife Creek, the Armstrong Valley Water Company (AVWC) currently operates two water wells at its well field located near the intersection of Armstrong Woods Road and Rio Nido Road. This area is about 2-1/2 miles below the Mine and was found to be one of six possible sources for future water supplies by the Citizens Utilities Hydrogeologic Assessment.(14) The two AVWC wells are 15 feet apart and 106 and 122 feet deep. They serve 292 connections and have a reported combined yield of 190 gpm. Well #2 is in at least 100 feet of saturated materials that are half sand and gravel

TABLE 1

WATER WELLS
within 3 miles

No.	Wells	Well Depth (ft)	Bedrock Depth (ft)	Water Depth (ft)	Yield (gpm)	Well Location (T/R-Sctn)	Population Served*
1 - 5	Private Wells Swtwtr Sprgs Rd	10-172				8N/10W-20	19
6	16880 Armstrng Woods Road	118	55	12	35	8N/10W-20M	4
7	16881 Armstrng Woods Road	111	55	40	40	8N/10W-20D	4
8	16603 Armstrng Woods Road	147	110	60		8N/10W-17N	4
9	Armstrng Vly. Water Co. #1	123	>123	27	116	8N/10W-20M4	total 292
10	Armstrng Vly. Water Co. #2	120	119	12	100	8N10/W-20M5	connections
11	Hacienda Wtr. Company						150 connections
12	End of Lghln Road, Guerne	67	>67	10	100	8N/10W-30G	4
13	8/10-29D1	183	120		110	8N/10W-29D1	4
14	14945 River Rd	109	>109	42		8N/10W-29A	4
15	Drake Well	55				8N/10W-29	4
16	Korbel Bros. Winery					8N/10W-27,8	4

(*3.8 per residential well)

SPRINGS

No.	Springs	Wet Weather Flow (gpm)	Reliable Dry Wthr Flow (gpm)	Access	Location (T/R-Sctn)	Remarks
S1	Russet Tank	20	0	Good	8N/10W-16	Near Sweetwater
S2	Mt. Jackson Rd. to within	16	2	Very Poor	8N/10W-16	No road, Logging

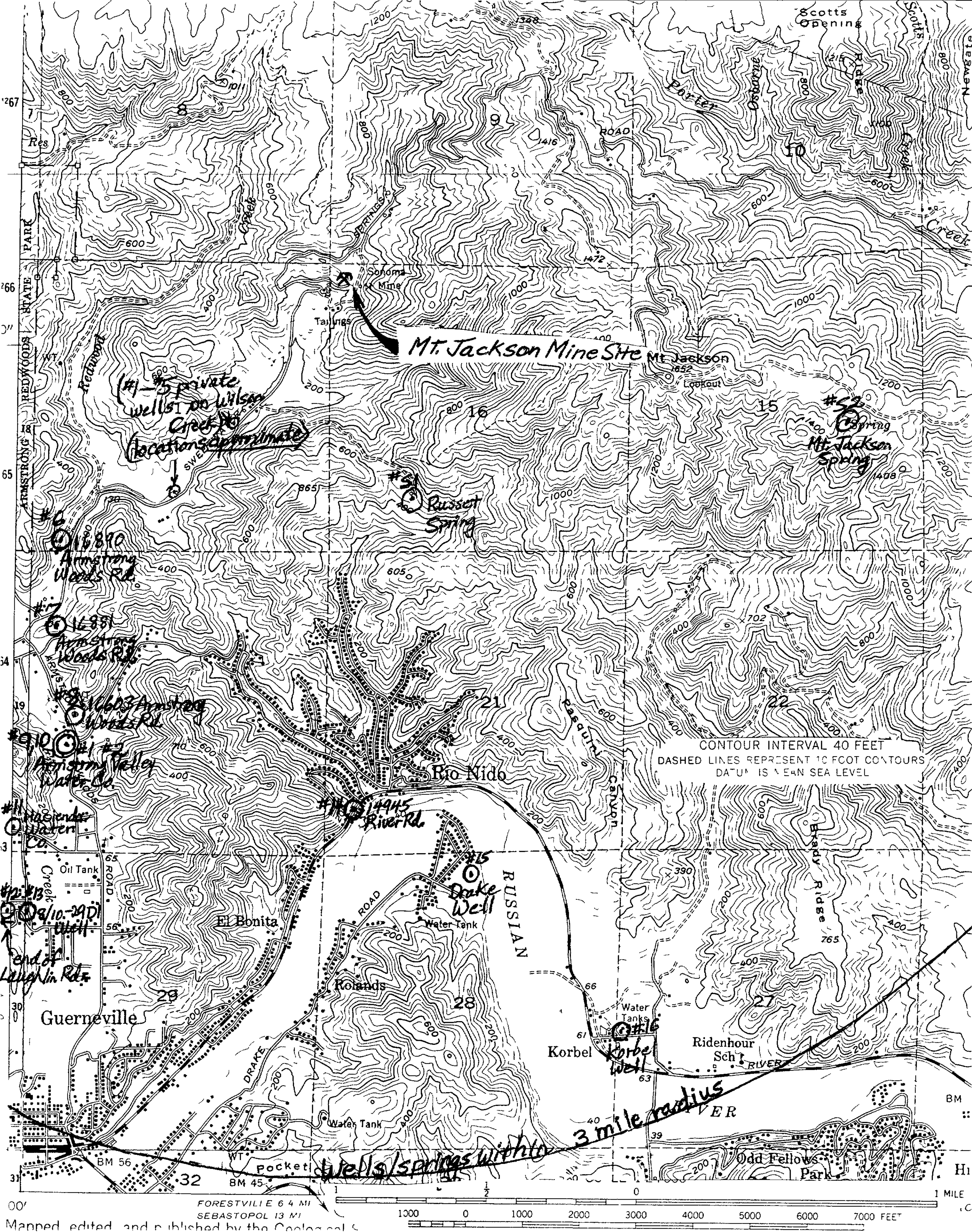

Scotts Opening
Porter
Osborne
Ridge
ROAD
Creek
Newgate
Res
ARMSTRONG REDWOODS STATE PARK
Redwood
Creek
SPRINGS
Sonoma
Mine
Tailings
Mt. Jackson Mine Site
Mt Jackson
1652
Lookout
(#1-#5 private wells) on Wilson Creek
(locations approximate)
#S2
Spring
Mt. Jackson Spring
#S1
Russett Spring
#6 16890 Armstrong Woods Rd.
#7 16881 Armstrong Woods Rd.
#8 16603 Armstrong Woods Rd.
#9,10 #1 #2 Armstrong Valley Water Co.
#11 Hacienda Water Co.
#12 #13 8/10-2901 Well
end of Laughlin Rd.
#14 14945 River Rd.
#15 Drake Well
#16 Korbel Well
Rio Nido
Pasquini Canyon
Brady Ridge
RUSSIAN
RIVER
CONTOUR INTERVAL 40 FEET
DASHED LINES REPRESENT 10 FOOT CONTOURS
DATUM IS MEAN SEA LEVEL
Oil Tank
El Bonita
Water Tank
Rolands
Guerneville
DRAKE
Water Tanks
Korbel
Ridenhour Sch
Odd Fellows Park
Pocket
BM 56
BM 45
WT
Wells/springs within 3 mile radius
FORESTVILLE 6.4 MI
SEBASTOPOL 13 MI
Mapped, edited, and published by the Geological S
1 MILE
7000 FEET
1 KILOMETER

FIGURE 5

and half clay stringers. A pump test at well number 2 yielded 100 gpm with minimal drawdown. Another 120 foot test hole nearby was reportedly dry. The CUCC's 6 main Russian River supply wells include 3 at El Bonito (three miles away), and one each at Monte Rosa, Vacation Beach, and Drake's Bend (more than three miles away).(14) As noted, none have been found to contain mercury above detection limits of 0.2 ppb.(10)

The California Department of Water Resources has confidential well logs on 23 other wells attempted in Franciscan Formation hills above Guerneville. Four were abandoned as dry, one was near dry, and yields on the rest ranged from 1 to 75 gpm. Three were pump tested, but transmissivities and discharges were low at 100 square feet/day and 6 to 17 gpm, respectively. In tributary valleys, such as Armstrong Valley (and Sweetwater Springs Valley), water levels in the wells typically are near the surface. For example, the water in the Armstrong Valley Water Company (AVWC) Well #2 was 12 feet deep at the time of its construction in October, 1982.(14)

The nearest well to the site is a 40 foot deep onsite well used for dust control purposes.(2) The nearest offsite well is a domestic spring located 100 yards from the site. Well sampling by the Regional Water Quality Control Board showed up to 0.7 ppb of mercury. However, the Board staff felt that the contamination was related to the well's turbidity and not to dissolved mercury.(16)

Water quality data suggests that groundwater contamination is not a problem in the Guerneville area. Although iron and manganese are the two principal constituents of concern, they can be removed with well-head treatment. Contamination from human activities is no longer a problem since sanitary sewers were constructed in 1984. (14) Mercury has not been found in any wells of either Citizens Utilities or The Armstrong Valley Water Company.(10)

4.0 SUMMARY OF INVESTIGATIVE EFFORTS

4.1 Previous Activities by Other Agencies/Responsible Party

On March 19, 1980, a resident reported results of total mercury analysis on water from Wilson Creek, mine tailings, and stream sediment to the North Coast Regional Water Quality Control Board (NCRWQCB).(21) The water sample, obtained from the stream adjacent to the operation, contained 6 ug/l (ppb) total mercury.(9,21) Since the drinking water criteria was 2 ppb total mercury, the NCRWQCB decided to conduct further sampling of the stream.(21) The sample results are detailed in Table 2. Sampling locations are shown in Figure 4. In an effort, to locate the source of mercury in Wilson Creek, eight locations along the Creek were sampled.(9) The results are listed in Table 2 and on Figure 6.

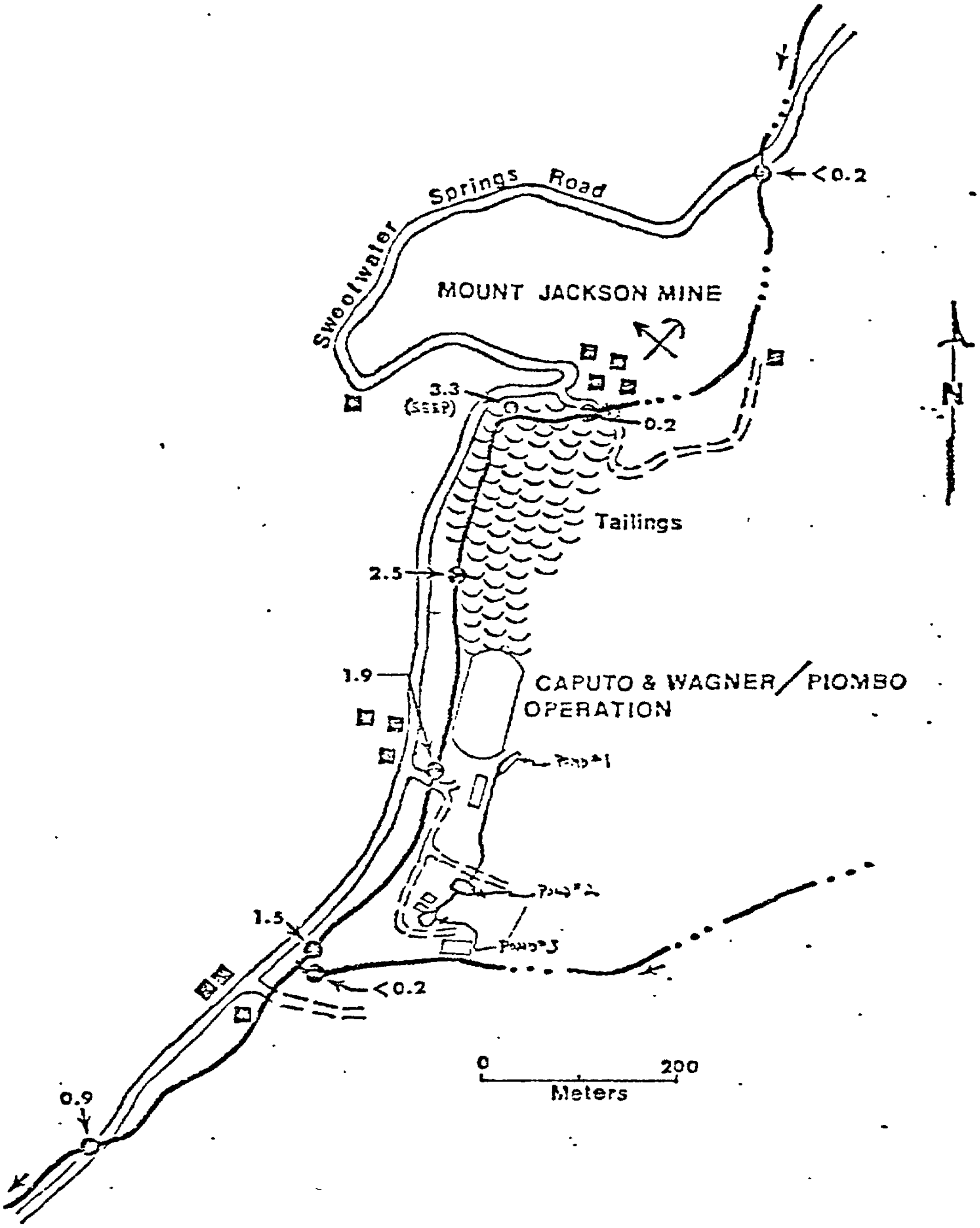
By letter of May 7, 1980, the NCRWQCB formally brought the MJMM site to DHS's attention.(22) Simultaneously, DHS also became involved in the investigation into the deaths of three lambs in April 1980.(2) Three of four lambs kept in a pasture enclosure along the road from the mine died suddenly.(2) Some residents contended that the lambs died of mercury poisoning.(2) Further study indicated the deaths were from acute poisoning, possibly from pesticide-contaminated forage.(2) The DHS Food and Drug Laboratory stated that the mercury content of the liver "was not likely a toxic level."(2)

Residents were concerned that the gravel crushing operation was releasing mercury into the environment. There was also concern expressed over the use of the mine tailings for road repair and sewer backfill projects. Due to this concern, DHS conducted sampling from May 1980 to 1982.(2,23) Staff sampled Wilson Creek, Creek sediments, tailings piles, soils, vegetation, and air at this site and stockpiled gravel from the site along Seaview Road.(2,23) The sample results are listed in Table 3.

CAL-OSHA conducted an inspection of the site on April 3, 1980.(24) The inspector took five samples.(24) Sample results are listed below:

Source	Results (Total Mercury)
Finished material (fine)	72 ppm (dry weight)
Tailings Pile materials	176 ppm (dry weight)
Cone Crusher materials	78 ppm (dry weight)
Slurry at discharge pump	213 ppm (dry weight)
Drinking Water	5.6 ppb (ug/l)

A citation was issued May 7, 1980 to the Piombo Corporation for not providing suitable drinking water for employees.(24) No further information on this site or the citation is contained in CAL-OSHA files.(25)



Results of Wilson Creek mercury sampling expressed in ug/l total mercury (ppb) on April 9, 1980. Note the contribution of 3.3 ppb total mercury from the seep on the north bank downstream of the mine.

Figure 6

TABLE TWO
Regional Water Quality Control Board

		Mercury	
Date	Description of Sample	Total	Dissolved
3/20/80	"Flour" at quarry	210 ppm	
3/20/80	Upstream of Mt. Jackson Mine	0.3 ppb	<0.2 ppb
	Onsite Well	0.7 ppb	0.4 ppb
	Pond	5.6 ppb	0.9 ppb
	Downstream of Mt. Jackson Mine	1.0 ppb	0.9 ppb
3/25/80	Upstream of Mt. Jackson Mine	1.0 ppb	0.7 ppb
	Well onsite	<0.2 ppb	<0.2 ppb
	Pond	5.0 ppb	2.0 ppb
	Downstream	1.0 ppb	1.0 ppb
	Russian River	<0.2 ppb	<0.2 ppb
	Santa Rosa Creek	<0.2 ppb	<0.2 ppb
3/26/80	Fine blend sand	270 ppm	
3/27/80	Upstream of Mt. Jackson Mine	0.72 ppb	<0.2 ppb
	Well onsite	0.33 ppb	<0.2 ppb
	Pond	14 ppb	0.32 ppb
	Downstream	0.9 ppb	<0.2 ppb
3/31/80	Upstream of Mt. Jackson Mine	<0.2 ppb	<0.2 ppb
	Well onsite	<0.2 ppb	<0.2 ppb
	Downstream	0.5 ppb	<0.2 ppb
	Russian River	<0.2 ppb	<0.2 ppb
	Santa Rosa Creek	<0.2 ppb	<0.2 ppb
4/2/80	Upstream of Mt. Jackson Mine	<0.2 ppb	<0.2 ppb
	Well onsite	<0.2 ppb	<0.2 ppb
	Downstream	0.6 ppb	<0.2 ppb
4/9/80	Upstream of Mt. Jackson Mine	<0.2 ppb	<0.2 ppb
	Wilson Creek at mine	0.2 ppb	--
	Seep	3.3 ppb	--
	Wilson Creek at tailings pile	2.5 ppb	--
	Wilson Creek at the Piombo Bridge	1.9 ppb	--
	Upstream Tributary to Wilson Creek	1.5 ppb	--
	Tributary	<0.2 ppb	--
	Downstream	0.9 ppb	0.2 ppb
	Discharge	1.1 ppb	<0.2 ppb
4/21/80	Fife Creek Upstream	1.8 ppm	
	At Piombo	105 ppm	
	Downstream	91 ppm	
5/29/80	Tailings	240 ppm	
	"Chips"	101 ppm	
	"Sands"	70 ppm	

(all samples collected by Robert Klamt)
See Figure 4 for sample locations.

TABLE THREE
SAMPLE ANALYSES

Department of Health Services

Date	Description of Sample	Total Mercury (ppm)	Dissolved Mercury (ppm)	Test Method
5/7/80	Gravel Stockpile along Seaview Rd. #1 (DP-4)	189	16.5	Nitric Acid
	Small Stockpile along Seaview Rd. (DP-5)	63.6		
	Rock on road near street/pile #1 (DP-6)	34	14.5	Nitric Acid
	Gravel Stockpile along Seaview Rd. #2 (DP-7)	53.9		
5/8/80	Quarry sand (DP-8)	140.6		
		145	43.6	Nitric Acid
	Quarry gravel (DP-9)	70.8		
	Quarry rock (DP-10)	40.5		
6/10/80	White rock (CFW-088)	19.8		
		19.8	1.22	Nitric Acid
	Red tailings (CFW-089)	25.6	15.6	Nitric Acid
	Soil near retorts (CFW-092)	197.5		
	Soil near retorts CFW-092 of less than No. 10 sieve	255	71.1	Nitric Acid
	Soil, Watson's pasture to 2" depth (CFW-093)	4.6	5.0	Nitric Acid
	Vegetation, Watson's pasture (weeds, etc., unrinsed) (CFW-094)	0.63		
		1.7	1.25	Nitric Acid
	Johnston's surface rock (CFW-096)	0.83	0.82	Nitric Acid
	Wilson Creek sediments below mine (CFW-097)	95.9	37.1	Nitric Acid
	Wilson Creek bed, grass, unrinsed (CFW-098)	3.5		
		12.0	4.65	Nitric Acid
	Tailings (PHW-84A)	27.8		
	Air, retort area (CFW-090 a)	<0.25/vol		
	Air, tailings pile (CFW-091 a)	<0.25/vol		
	Air, Andrea Johnston's (CFW-095 a)	<0.25/vol		
6/30/80	Watson's garden, Yellow onions, previous year, unrinsed, air dried (CFW-103)	0.52		
	Soil, Watson's garden, tilled to 8" (CFW-104)	27.8		
	Wilson Creek bed, below mine, algae scum (CFW-105)	24.6		
	Wilson Creek sediments; 1/2 mi. down stream (CFW-106)	51.1		
	Dust by Andrea Johnston's house (CFW-099)	<0.05 mg dust		
	Dust by road at Watson's (CFW-100)	<0.05 mg dust		
	Dust by road opposite crushing operation (CFW-101)	<0.05 mg dust		
7/22/80	Watson's garden, peaches, rinsed (DP-11)	0.012 wet wt.		
	Watson's garden, swiss chard, rinsed (DP-12)	0.016 wet wt.		
	Watson's garden, zuccini, rinsed (DP-13)	0.003 wet wt.		
	Watson's garden, potatoes, rinsed (DP-14)	0.004 wet wt.		
	Watson's pasture, Chinese Stink Plant, rinsed (DP-18)	0.052		
	Soil, Watson's garden, to 8" depth (DP-19)	41.4		
	Soil, Watson's pasture to 8" depth (DP-20)	27.8		
	Wilson Creek bed, dry grass below quarry, air dried (DP-21)	3.9		
	Wilson Creek bed, green grass along bank, air dried (DP-22)	12.4		
11/17/81	Reddish quarry sand (KP-1)	not analyzed	0.01	deionized water (48 hours)
			0.51	buffered citrate (48 hours)
			35.6	Nitric Acid
	Brownish fine gravel (KP-2)	not analyzed	0.01	deionized water (48 hours)
			0.09	buffered citrate (48 hours)
			26	Nitric Acid
1/13/82	Quarry Fines/gravel (PHW-82)	63		
	Quarry Fines/sand (PHW-83)	95	0.084	Citrate
			0.008	Distilled Water
	Quarry Coarse (1/2") gravel (PHW-84)	3.6		
	Quarry red sand/gravel (PHW-85)	72		

Aquatic Toxicity (golden shiner) used Sample #DP-4
Two tests, June 2-6, 1980
96-hour LC-50 is greater than 500 mg/l.

With the closing of the gravel crushing operation in 1982, agency interest in this site waned.

4.1.1 Discussion and Evaluation of Previous Sampling/Testing Results

Summary of Sampling Results

The rock in the Mount Jackson Mercury Mine area contains from two to twenty-six pounds of mercury per ton.(4) Most of the mercury is in the form of mercuric sulfide. The tailings contained from 19.8 to 240 ppm of mercury. The quarry gravel and sands contained up to 101 ppm and 270 ppm, respectively.(23)

Eight stream locations along Wilson Creek as well as a seep area on the north bank of the stream were sampled by the RWQCB to locate the source of mercury in Wilson Creek. The seep sampled was only one of numerous seeps in the area. The origin of these seeps is unknown, but the mine is suspected. The danger of cave-ins prevented further sampling of the seeps.(9)

Mercury was found in Wilson Creek, upgradient of the mine, at up to 0.72 ppb. Downgradient of the mine, mercury was found at up to 1.0 ppb. The seep sampled by the mine contained 3.3 ppb of mercury.(9)

The well samples taken by the RWQCB were all less than 1 ppb total mercury. In fact, four of the five samples were less than 0.5 ppb. All the samples analyzed for dissolved mercury contained less than 0.5 ppb of mercury (the detection limit).(9)

CAL-OSHA conducted sampling at the site of the finished material, tailings pile material, cone crusher material, slurry at discharge sump, and the "drinking water".(24) There is some confusion over the use of the well water on-site. Water Board records indicate that it was used for dust control, while the CAL-OSHA states that it was used for drinking water.(9,24) 5.6 ppb of mercury was detected by CAL-OSHA in the well water.(24)

Air samples were taken on June 29 and June 30, 1980. Sampling did not detect any mercury in the air or dust moving offsite.

Discussion on Test Methodologies

Samples handled by the Hazardous Materials Laboratory (HML), Berkeley, were analyzed for total mercury by digestion with hot nitric acid, or aqua regia, followed by oxidation with potassium permanganate solution, and then by reduction of the mercury to elemental mercury with a stannous salt solution.(2,23) Mercury was determined by cold vapor adsorption.(2,23)

Samples of tailings gravel, rock, and creek sediments, and plants were analyzed for "soluble" mercury (i.e., not present as HgS) by digestion with (1+1) nitric acid at 62 degrees Celsius.(2,23) Preliminary analyses of a laboratory preparation of HgS of calculated 96% purity had demonstrated that under these conditions, HgS was dissolved to the extent of only 0.12%.(2)

Three samples of quarry sand and fines were also subjected to the DHS Waste Extraction Test (WET).(2,23) The procedure used in 1980 consisted of a 30-day extraction with buffered citrate solution, and a separate similar method using deionized water.(23)

A sample of the tailings was taken from the "flour" (small material from the crushing operation) by the RWQCB on March 20, 1980. This sample contained 210,000 ppb of total mercury.(9) 205 grams of that sample was put into a plastic column and one half gallon of tap water percolated through. The total mercury concentration changed from 0.5 ppb to 14 ppb. Dissolved mercury increased from 0.4 ppb to 1.1 ppb after percolation through the material.(9) No further information on sampling methodologies or laboratory analytical techniques is available from the RWQCB files.

No information regarding the sampling procedures or analytical methods used to analyze the CAL-OSHA samples is available.(25)

Discussion on Sampling Results

Section 66699 of Title 22, California Code of Regulations defines mercury-containing wastes as hazardous wastes when the Total Threshold Limit Concentrations (TTLCs) exceed 20 mg/kg wet weight or when the Soluble Threshold Limit Concentrations (STLCs) exceeds 0.2 mg/l. The analyses showed concentrations of mercury above TTLCs in all samples of mine tailings (but one), quarry gravel, and sands. The 30-day WET determination with buffered citric acid on three quarry materials showed extractable mercury above the STLCs in one sample (0.51 ug/g) and well below in the other two (0.084 and 0.09 ug/g). The use of deionized water gave negligible mercury extraction.(2,23) Numerous analyses showed that appreciable amounts of mercury in tailings, quarried products, and soil were extractable by digestion with nitric acid at moderate temperature, indicating the presence of mercury residues in other than HgS or cinnabar form.(2)

On the basis of the single sample tested, the tailings (and probably gravel products) are not likely to be acutely toxic to fish by the DHS aquatic toxicity test.(23)

On the basis of total mercury, the sampling results indicated that the tailings and quarried products would be classified as hazardous waste materials by TTLC, and perhaps some quarried products by the STLC criterion for mercury.

Results of sampling conducted by the RWQCB and DHS of surface waters upstream and downstream of the site showed the average total mercury concentrations in Wilson Creek were greater downstream than upstream.(9,23) However, mercury was probably found in Wilson Creek regardless of the mine.

The results showed the seep area to be the major contributor to elevated mercury concentrations in Wilson Creek.(9) The results showed no measurable input of mercury to the surface water of Wilson Creek from the Piombo aggregate operation.(9) Total mercury concentrations in Wilson Creek decreased after the initial input of mercury from the seep area.(9) The most probable cause for that decrease would be settling of particulates contributing to the total mercury concentration and/or dilution from other water sources.(9)

California's Applied Action Levels (AALs) and the Maximum Contaminant Levels for mercury in drinking water are the same, set at 0.002 mg/l or 2 ug/l. Therefore, the mercury concentrations in Wilson Creek are within drinking water standards, but exceed the EPA suggested maximum of 0.05 ppb for the protection of aquatic life. The problem with this is that in 1980, the detection limit for mercury was 0.2 ppb.(2)

4.2 DHS Site Inspection

4.2.1 DHS Activities (Summary of Reconnaissance and Site Inspection

A Site Reconnaissance and Inspection of the Mount Jackson Mercury Mine site was conducted on February 6, 1989 by Dr. Paul Williams, Susan Solarz, Dick Jones, and Janet Naito of DHS. DHS members met with Greg Doyle, the owner's son, to discuss the purpose of the site inspection, ownership of the site, and the future use of the site. After the meeting, Dr. Williams, one of the original DHS investigators of this site, guided the rest of the group on a tour of the site. Investigators did not enter the plant building or mine area due to the poor condition of the structures. Photo documentation of this tour is included in Reference 13. The following notes and observations were made during the tour and subsequent area reconnaissance.

- The site is located off Sweetwater Springs Road. Its location is marked by an open gate.
- Piles of gravel still remain in the area near the gate.
- There are fences partially surrounding the site along Sweetwater Springs Road. Many of the fences are no longer standing and many areas are not fenced. The fence, where it exists, is approximately 6 feet high with barbed wire on top.
- The mine is cut into the side of a mountain.
- The mine and gravel crushing operations were inactive at the time of the site visit. No operations were occurring at the site at the time of the site visit.
- The retorts have been moved since the 1980 inspection, away from the stream bed.
- Wilson Creek, an intermittent stream, trickles through the mine area. It appears to have eroded the area along its path. The bridge over Wilson Creek has deteriorated, with holes in the floorboards.
- The owner's son lives in a trailer on-site. The owners had wanted to sell the property, but the deal fell through and the future use of the site is uncertain.
- The California Highway Patrol uses the area above the mine to store towed cars.

5.0 HRS FACTORS

Observed Release

There has not been an observed release to the groundwater, surface water, or air. Mercury has been detected in the groundwater well on-site at 0.4 ppb (dissolved).(23) However, no background well could be located for sampling. Because mercury is naturally occurring in the subsurface rock and water is scarce, no background well was drilled.

Mercury was also found in Wilson Creek upgradient of the site at up to 0.72 ppb and downgradient at 1.0 ppb.(9) According to the guidance for hazard ranking a site, this does not constitute an observed release.

Air monitoring for mercury during the gravel crushing operations did not detect any mercury in the dust off-site using a Hi Vol Sampler.(23) A mercury sniffer also did not detect any mercury in the air offsite.(23)

Direct Contact/Fire and Explosion

There have been no documented incidences of direct contact or fire and/or explosion occurring at the Mount Jackson Mercury Mine. Access to the site is limited only by a fence that partially surrounds the site.(13) There is a gate and a road leading to the old gravel crushing operation area off Sweetwater Springs Road. The crumbling buildings of the mine are potentially hazardous to trespassers. The site is unpaved and the tailings piles are visible.(13)

Waste Type/Quantity

There is approximately 750,000 to 800,000 tons of mercury mine tailings left-on-site.(10) These tailings contain up to 240 mg/kg of mercury.(23) No other hazardous wastes were observed during the site inspection. Although there was a report by the Regional Water Quality Control Board of unknown hazardous wastes on-site, there was no documentation of this information in their files.

Groundwater

Groundwater is scarce in the immediate mine area, although some is seasonally found in hillside springs. Aquifers under stream beds are the primary sources of water tapped by wells. The aquifer of concern is approximately 10 to 20 feet deep under Wilson Creek. The nearest offsite well is approximately 100 yards away and one of five small domestic wells reported in the Sweetwater Springs Valley. A 40 foot deep onsite well was used for dust control purposes. There are a total of 16 wells and two springs within 3 miles downgradient of the site, serving approximately 493 people.

Most are 1-1/2 miles or more downgradient on Armstrong Valley Road. Net precipitation for the area is approximately 17 inches.(18) Permeability of the alluvial silt, clay and sand typical of the valley is a moderately high 10^{-3} to 10^{-5} cm/sec.(14)

Surface Water

Wilson Creek flows down around and through the mine property, paralleling Sweetwater Springs Road to Armstrong Woods Road approximately one and a half miles below the site. There it combines with Fife Creek which flows approximately one and a half miles south before joining the Russian River at Guerneville.

Runoff from the site is tributary to Wilson Creek. The facility slope and intervening terrain is 70-80%. There are no surface water intakes within three miles downstream of the site. Armstrong Redwoods State Park is approximately 2 miles from the mine.

The one year maximum 24-hour rainfall is 3 inches.

Air

There have been no documented incidences of air releases at this site. Air monitoring was conducted offsite in 1980 using a Hi Vol Sampler and a mercury sniffer. This monitoring did not detect any mercury in the air or dust during the time the gravel crushing operation was in operation.

There was no monitoring of the air during the mining operations.

HRS SUMMARY

Based on an evaluation of the site using available data and existing HRS guidelines, the Mount Jackson Mercury Mine site will not be eligible for nomination to the National Priorities List (NPL). This is due to the following factors:

- lack of an observed release to contaminants from the site to the groundwater, surface water or air; and
- an insufficient value for the groundwater and surface water route characteristics;

CONCLUSION

The Mount Jackson Mercury Mine operated intermittently as a mercury mine from 1875 until 1972. From 1979 through 1981, the site was used by a gravel crushing operation.

State agencies began investigating the site in March 1980 when citizens brought it to the attention of first the North Coast Regional Water Quality Control Board (RWQCB) and CAL-OSHA, and then to the Department of Health Services (DHS). The Agencies sampled Wilson Creek, vegetation, Creek sediments, the on-site well, the tailings piles, site soil, pond water, seeps, and sand and gravel from the aggregate operation. DHS also conducted air monitoring in June 1980.

The tailings, stream sediments, quarry gravel and quarry sands contain mercury at levels which exceed the total threshold limit concentrations (TTLCs). Therefore, for disposal purposes, it would have to be handled as a special waste.

Most of the mercury contained in the rock, tailings, sediments, gravel and sand is in the form of mercuric sulfide. This compound is fairly insoluble.

Groundwater in the mine region is scarce. Residents around and downgradient of the mine use groundwater to supplement their supplied drinking water. The local water purveyors have not detected mercury in their groundwater wells.

RECOMMENDATION

EPA RECOMMENDATION: No further action under CERCLA

Although mercury is found in the surface water and in the groundwater well on-site, these waters are not consumed. Also mercury is naturally occurring in the rock in this area. There has not been an observed release to the groundwater, surface water, or air. Therefore, based on a preliminary screening of hazard ranking factors, this site is recommended for no further action under CERCLA.

STATE RECOMMENDATION: Site referred

The site should be referred to the North Coast Regional Water Quality Control Board (RWQCB) for further action. Mines fall under the jurisdiction of the RWQCB.

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11. North Coast Regional Water Quality Control Board, Waste Discharge Requirements for the Mt. Jackson Mine Site, November 6, 1969.

12. U.S.G.S. Guerneville Quadrangle Map.

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18. Precipitation Calculation, D. Jones, based on Climatic Atlas, U.S. Department of Commerce, 1983.

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23. California Department of Health Services, Sampling Analysis Reports, dated May 1980 to April 1982.

24. Zavattero, W.J., Cal-OSHA, Citation No. 1 for Piombo Corporation, 1010 Shiloh Road, Windsor, CA 95492, dated May 7, 1980.

25. Callanan, E.F., Cal-OSHA, letter to J. Naito, DHS, March 20, 1989.

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#1-#13

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2. Williams, P.H., DHS, "Summary Report on the Mount Jackson Mine Investigation".

3. California Department of Natural Resources, Division of Mines, Mineral Commodities of California, Bulletin 176, December 1957.

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12. U.S.G.S. Guerneville Quadrangle Map.

13. California Department of Health Services, Site Inspection, February 6, 1989.

REFERENCE 1

Sonoma Mines, Inc.
P. O BOX 226
GUERNEVILLE, CALIFORNIA 95446
PHONE NO AREA CODE 707
869-2013

August 15, 1969

X

North Coastal Regional Water Quality Control Board
P. O. Box 1436
Santa Rosa, California 95403

Attention: Mr. Keith S. Dunbar

6/4/85 BB

Subject: Report of the Mt. Jackson Mercury Mine

Gentlemen:

The Mt. Jackson Mine is located 4 miles north of Guerneville, at 18475 Sweetwater Springs Road, on Wilson Creek.

The operator, Sonoma Mines, Inc., maintains a Gould Rotary Furnace with a capacity of about 90 tons per day, along with 2 small "D" retorts with a capacity of one ton per day.

The waste rock from the mill is deposited parallel to and on the east side of Wilson Creek (see attached sketch).

A dust collector is used to separate the dust from the gasses; this is washed out every ten minutes. It is estimated that about 800 to 1000 lbs. of dust is removed daily. This is delivered to settling ponds as shown on attached sketch.

The water pumped from the mine goes directly into the creek. The average delivery of water to the creek is between 145,000 to 150,000 gallons per day. In the dry season the water drops to a low of 70,000 gallons per day, which goes underground as the creek drys up.

Water analysis has been made, which shows the water to be harmless to man and animal life.

Very truly yours,

SONOMA MINES, INC.

Allen G. Mowry

Allen G. Mowry
General Superintendent

REFERENCE 2

State of California

Department of Health Services

Memorandum

To : Mt. Jackson Mercury Mine File

Date : Nov. 14, 1988

Subject: Mt. Jackson Mercury Mine Investigation

From : P. H. Williams PHW

The Mt. Jackson mercury mine is located about 3 miles from Guerneville, Sonoma County, on the Sweetwater Springs Road about 2 miles from its intersection with the Armstrong Woods Road leading from Guerneville. Wilson Creek flows down around and through the mine property, paralleling Sweetwater Springs Road to Armstrong Woods Road where it combines with Fife Creek, which flows on into the Russian River at Guerneville.

Production at the Mt. Jackson mine and the adjacent Great Eastern - Roaring Lion mine began about 1875 (original ownerships not determined) and continued until 1906 when damage by the earthquake of that year caused the mines to be shut down. The Great Eastern was reopened in 1915 and mining was carried out until 1919. Some mining was carried out by Guerneville people in the Mt. Jackson mine from 1934 to 1939.

Sonoma Mines, Inc. (also known as Sonoma, International) gained control of the 410 acres of the mine property in 1940, began to dewater the mines, rebuilt the plant, and restarted the Mt. Jackson mine later that year. In May, 1941, the Great Eastern mine was acquired by Magee Mercury, Inc. and this mine was dewatered and put into production. Production in both mines continued until 1971, when both mines became inactive.

(At some time, the Mt. Jackson mine and the Great Eastern mine, whose shafts appeared to have been essentially interconnecting, became known simply as the Mt. Jackson mine. It appears that they were sometimes referred to as the Sonoma Quicksilver mine. In the earliest days, the immediate area was known as Mercury, and this is where many of the miners may have lived.)

Over the years, water from the mine workings and dewatering was pumped directly into Wilson Creek just south of the mine tunnels, at a rate reaching 145,000 to 150,000 gallons per day. Wooden flumes were eventually constructed to prevent erosion of the property by these discharges.

The ore in the two mines was basically cinnabar (HgS) in veins in the silica-carbonate rock of the region. Grade of ore varied from about 2 to 26 pounds of mercury per ton of ore, but in latter years from about 5 to 6 pounds of mercury per ton of ore.

Ore was extracted from several levels in the mines, the deepest at about 1450 feet below ground surface. The ore was crushed at the surface to $1\frac{1}{2}$ inches and finer and then conveyed to the rotary kiln capable of processing about 90 tons of crushed ore in 24 hours. Typically, the crushed ore is roasted in the kiln in a stream of air or with lime, in either case causing the HgS to decompose to elemental mercury and hydrogen sulfide or calcium sulfate; which process was used at these mines was not determined. The elemental mercury is passed through retorts for removal of particulates and then condensed and collected as liquid mercury (quicksilver).

Clinker from the rotary kiln was transported to a tailings pile immediately below the mine. Cyclone dust from the operation, as a water slurry, plus water from the mill, was fed through a wooden flume to a dammed settling pond. Water evaporated from the pond, but it also must have slowly filtered through dumped mining debris into Wilson Creek.

Total mercury production figures over the years show that the Mt. Jackson mine was the third largest in California and the fifth largest in the United States.

Further information on the Mt. Jackson mines and their operation and production is given in a publication by J. R. Evans, Geologist, California Division of Mines and Geology, which is appended to this report.

There are at least ten inactive mercury mines in Sonoma County and some ten others in Mendocino, Napa, Yolo, and Marin counties. (See appended listing.) In Sonoma and Napa counties, in addition to the Mt. Jackson mine, important producing areas were the Mayacmas and Oat Hill districts near the towns of Aetna Springs, Middleton, and the Geysers.

In Contra Costa County, the Diablo district mines off Marsh Creek Road were of importance. The Mount Diablo mine, the largest in the district, operated from 1936 to 1946. In Solano County, there is a small quicksilver area north of Sulfur Springs Mountain, about 6 miles northeast of Vallejo; the St. Johns and Hasting mines were the principal producers.

The New Almaden quicksilver district in Santa Clara County has been the most important mercury producer in the United States, and the New Almaden mine is said to have been second only to the Almaden mines of Spain in mercury production.

The New Idria mine in San Benito County ranked second in mercury production in North America, and in 1965 it was the leading producer.

The mercury mining areas are mainly in the Coast Range from Mendocino County to Santa Barbara County, but also in the Klamath Mountain county of Trinity.

(For general information on the aforementioned mines and mine districts see Geologic Guidebook of the San Francisco Bay Counties, Bulletin 154, State of California Department of Natural Resources (1951). For information on the nature and origins of the cinnabar deposites, and the mercury districts within the Coast range, see Mineral Resources of California, Bulletin 191, California Division of Mines and Geology (1966).)

The primary mercury mineral in all of these mining districts is cinnabar, and the production process always has resulted in tailings piles like the tailings pile at the Mt. Jackson mine. And like the Mt. Jackson mine tailings, all undoubtedly contain residual amounts of HgS and traces of other mercury minerals and elemental mercury, with total mercury content ranging from perhaps as low as 25 ppm to 200 ppm or more. The total quantity of such tailings piles must be in the millions of tons.

As far as I know, there has never been an indepth study of the potential of the mercury mine tailings piles for hazard to public health and the environment as static, abandoned wastes or in domestic or commercial use, or through ground water and well contamination from seepage of water through the piles and erosion of the tailings into creeks and onto soils. I have called this to the attention of the ATS some years ago and urged that a study be undertaken by staff toxicologists, but never had a response. (See p. 2 of my memorandum of Feb. 4, 1987, to Laura Yoshii.)

A possible example of contamination of water with mercury from mercury mine tailings is the Marsh Creek Reservoir near Brentwood, where potentially lethal concentrations of mercury have been found in the fish in the reservoir. Some ten miles upstream of the reservoir is an inactive mercury mine on the lower slopes of Mt. Diablo. According to a newspaper account, the mine was very active during World War II and tailings from the operation were dumped into ponds; the ponds were not large enough and during the rainy season spill over and apparently deposit silt in the reservoir. (See Oakland Tribune, Sept. 21, 1980). Whether the tailings were, and are, the primary source of mercury in the reservoir (rather than mine seepage), as far as I know was not established.

Another example of mercury contamination of a reservoir near mercury mines is in the case of the Guadalupe Reservoir in Santa Clara County. Here the Santa Clara Water District has erected a sign warning against the taking of the fish owing to their mercury content. Whether the mercury in the reservoir is a result of seepages from the mines or water drainage through the tailings, or both, may not be known.

There is an instance in which the Alternate Technology Section has taken action in classifying mercury mine tailings, namely those of the St. Johns mine in Solano County. (See ATS letter of March 12, 1987, in Vol. II of this report.) In this case, ATS advised Harding Lawson Associates (whose clients were the Sky Valley Group) that the tailings, because of their content of mercury, would be classified as hazardous, in the sub-category of "special waste" and that the tailings would have to be so managed for disposal. The letter does not indicate that ATS made any special study of the actual properties of mercury mine tailings or considered under what conditions or to what extent they might indeed be a hazard to human health and the environment whether left on the property as a tailings pile, buried on the property, used as a source of gravel (as was undertaken at the Mt. Jackson Mine), or hauled off to a suitable landfill.

The ATS classification action in the case of the St. Johns Mine is, in effect, a determination that the many millions of tons of mercury mine tailings from Trinity County south to Santa Barbara County are hazardous waste and should be so stored, treated, recycled, or disposed of. Yet, as far as I know, there have been no actions whatever within the Toxics Division's regional offices to bring any of the owners or tenants of properties with these vast piles of tailings (which in some cases are perhaps being used as a commercial source of gravel) into compliance with the state's hazardous waste control laws and regulations. The Division seems to be simply ignoring the existence of the piles of tailings.

I think this is a matter of great concern to public health and the environment. The studies at the Mt. Jackson mine and the review of published investigations indicate that mercury mine tailings - even as static abandoned piles - may not be quite as benign and harmless as might be thought. In any case, ATS having declared the tailings at the St. Johns mine to be hazardoys waste, it seems incumbent on the Division to take some followup poistion and action with respect to all such tailings in the state.

Initiation of Aggregate Production at Mt. Jackson Mine

The Mt. Jackson mine property was acquired by Piombo Corporation of Windsor, California, in the late 1970s as a source of gravel, i. e., the mine tailings, which have been guessed as being about 750,000 cuyds. Piombo's subcontractor, Caputo Wagner Company (whose address was the same as that of the mine) began crushing the tailings and hauling out the sorted gravel in the summer of 1979. The major initial use of the gravel was as bedding and back fill for a sewer line project at Guerneville, a use orally approved by the North Coast Regional Water Quality Control Board; about that time, also, a quantity of the gravel was hauled to and stockpiled along the Seaview Road near Ft. Ross for use in road repairs.

The aggregate production operations and the hauling of aggregate on the narrow Sweetwater Springs road soon became of concern to the residents along the road. (One resident reported that there were over 150 trips by 10-wheeler trucks passed his home in one day.) The neighborhood reactions and county Planning Commission and Board of Supervisor actions on the matter are reported in newspaper accounts beginning in an issue of March 21-27, 1980; copies of these newspaper items are appended to this report.

The first newspaper accounts concern a meeting of the Planning Commission on March 6, 1980, which was a hearing on a draft Environmental Impact Report (EIR) on gravel mining operations (i.e., aggregate resources) in Sonoma County and a proposed specific plan for obtaining future aggregate materials; the Mt. Jackson tailings pile was include among these aggregate resources, apparently without particular note that the tailings significantly differ in origin and composition from ordinary quarried aggregate.

It will be seen from subsequent newspaper accounts that the mercury content of the tailings aggregate (which had been assumed had leeched out over the years to an insignificant level) and the potential for mercury contamination of the streams and wells in the area became a matter of concern and debate before the county agencies. An EPA spokesman in Washington D.C., in fact, was reported to have stated that the gravel from the Mt. Jackson operation, as used in sewer construction in the area might poison ground water, thereby endangering wells, drinking water, and the river. In due course, according to the news item in "The Paper" of May 16-22, 1980, the county planners on March 21 removed the Mt. Jackson site from the county-wide hard rock resources plan until "more complete testing of mercury in the area was completed". The Piombo site's future thereupon was in official limbo, although the crushing operation continued and gravel was leaving the site at over 100 truck loads a day, to end up primarily along the sewer line beneath the paved streets of Guerneville.

Up to this point, the following information on mercury levels in the tailings and in creek water and sediments had been reported: Piombo analyses showed 7,400 ppb of Hg in produced gravel in April 1979. Samples taken by neighbors of the mine on March 13, 1980 showed on analysis by Brelje and Race Laboratories 152,000 ppb Hg in the tailings being crushed; 6.0 ppb Hg in water from Fife Creek; and 138,000 ppb Hg in Wilson Creek sediments "taken at the Sweetwater Springs site". (A later report by the Regional Board stated that the water sample showing 6 ppb of Hg was taken from the stream (Wilson Creek) adjacent to the aggregate operation.) There is no indication that consideration was given as to the form (elemental or compounded) of the mercury in the samples, except that it was inorganic in the case of the water sample.

Involvement of Department of Health Services (DHS)

The following are, more or less sequentially, events and actions of the Hazardous Materials Management Section of DHS in the Mt. Jackson Mine matter as given in letters, memoranda, and analytical reports in dated sequence in the Mt. Jackson Mine report.

1. A telephone call was received by HMMS on March 26, 1980 from Mrs. Carol Turchin, 19,000 Sweetwater Springs Road, complaining that the Piombo Corp. was quarrying the mine tailings and that she was concerned as to the mecury in the dust and its possible contamination of the Russian River. She estimated the volume of gravel (produced) to be about 500,000 cuyds per year.

2. By memorandum of May 6, 1980, the North Coast Regional Water Quality Control Board advised Dr. Douglas Price of the DHS office in Santa Rosa of their involvement in the Mt. Jackson Mine matter, and they enclosed a copy of their memorandum of May 5, 1980 on the Piombo gravel operations, and the sampling the Board had undertaken (following a resident's report at the Board office on March 19th) beginning March 20th of stream, well, and pond water near and on the site, and the analytical results obtained.

Significantly increased Hg levels were found in the creek downstream of the mine and may have come from mine seepages rather than the aggregate operation; much higher levels were found in the wastewater discharges to a pond. "Flour" from the crushings was found to contain 210,000 ppb, of which only 14 ppb was leachable with tap water.

(A summary of these results, given by Robert Klamt of the Regional Board, appeared in the April 11-17, 1980, issue of The Paper.)

The memorandum stated that the Regional Board had requested a report of wastes discharge from Piombo and an evaluation of the seep area. They advised DHS that there were serious questions concerning the public health effects of using the crushed tailings in the sewer line construction, as road fill, in asphalt mix, concrete mix, etc.

3. By letter of May 7, 1980 to HMMS, the Regional Board referred to discussions with Doug Price and me concerning the possible hazards of the tailings pile, state that "Our primary interest in these tailings necessarily centers on their potential adverse affects on water quality, but, now recognizing that this material may present a public health problem, we wish to bring the subject to your Department's official attention."

They stated that Doug Price had advised them that based on information available on mercury content and other characteristics of the tailings he identified the tailings as hazardous waste and agreed to investigate further. A copy of the Board's memorandum of May 5, 1980, was enclosed.

4. HMMS received a copy of the Santa Rosa Press Democrat item of May 7, 1980 concerning the stockpile of Mt. Jackson gravel at Seaview Road and the concern of the residents about its mercury content.

5. On May 14, 1980 HMMS received analytical data from the Division of Occupational Safety and Health showing 5.6 ppb of Hg in the drinking water used by employees at the aggregate operation site. (The standard for drinking water is 2 ppb or less.) Data showing Hg contents of the tailings and crushed material and the slurry at the discharge pump were also given.

6. By letter of May 8, 1980 (following a telephone discussion with Louis Gobbi of Piombo Corp.) I sent a letter to Piombo enclosing copies of Chapter 6.5, Div. 20, Health and Safety Code, and Chapter 30, Division 4, Title 22, California Administrative Code. (My telephone conversation with Mr. Gobbi had indicated that they were unaware of any state laws or regulations that might relate to the mine tailings or their use as aggregate.) Our letter stated that under the regulations, mine tailings might be hazardous waste, depending on the Hg content and its leachability by the WET.

With regard to the use of the tailings aggregate in the sewer line project, approved by the Regional Board, we tentatively concurred in this use. We advised that use of the tailings aggregate stockpiled near Ft. Ross for road repairs would be subject to DHS approval, as well as Board approval, if the tailings aggregate was found to be hazardous by DHS criteria. We requested Piombo data on the mercury content of the tailings pursuant to their responsibility under the regulations, and advised that we would also be carrying out analyses.

7. On May 8, 1980, Doug Price took samples of the stockpiles of gravel along Seaview Road, and if tailings, gravel and sand from the Piombo operation at the mine. Analyses reported May 20th showed Hg contents ranging from 34 to 189 ppm. The data on the stockpiled aggregate were conveyed to Al Valentine, Sonoma County Public Works Department, by telephone on May 22nd.

8. A copy of a letter of May 21, 1980, from William I. Ellison, MD, Guerneville to The Paper concerned adverse effects of mercury on the miners while the mine was operating. I had a long converstion by telephone with Dr. Ellison on June 18th to obtain any information that might be helpful in defining the present problem.

9. The death of three lambs kept in a pasturage enclosure along the road from the mine became a matter of great controversy in May, 1980; it was brought to my attention in a telephone discussion with Andrea Johnston on May 20, 1980. The May 30 - June 5 issue of The Paper reported that the California Department of Food and Agriculture, Division of Animal Industry/ Veterinary Services, Petaluma, found high mercury levels in one of three lambs which had died in April on the same day; other sheep had become ill but had recovered. The autopsied lamb showed 1,500 ppb of Hg in the rumen content and 400 ppb in the liver. The report listed symptoms of mercury poisoning: acute gastroenteritis, vomiting, severe diarrheal death in a few hours due to shock and dehydration. The lamb reportedly had a half hour to an hour of convulsions before death.

After learning of the deaths of the lambs, I had telephone discussions with Dr. Tieken, Veterinarian Laboratory and later with a Dr. Chester on these deaths. While Hg found in the kidneys and liver, the nature of the deaths pointed to acute poisoning, possibly from pesticide-contaminated forage. Dr. Alice Ottoboni, Food and Drug, DHS, Berkeley, arranged for histopathic examination of lamb's kidney tissues.

10. June 2, 1980, conference at Berkeley with Andrea Johnston and Steven Spector, residents of Sweetwater Springs Road, and Phil Osborne of The Paper, attended by Dr. Ottoboni and others of Berkeley DHS to discuss the Mt. Jackson Mine/Piombo quarrying problem. Some metallic mercury can be found in soils around mine. Owners of mine are applyimg for 20-year permit to produce and sell the aggregate from the tailings. In the Guerneville area there are houses on tailings. Tailings have been sold to mobile home parks to put between trailers; as aggregate it is called "Deco Rock". It is claimed that tailings in such use keep weeds from growing.

11. On May 30, 1980, we received a copy of a letter of May 26, 1980, from Valerie Byrd, Sweetwater Springs Road, addressed to Gov. Jerry Brown, and on June 13th we received the original letter to the governor for HMMS reply. The letters contained newspaper item enclosures. Ms. Byrd strongly complained about the Piombo operation, their freedom to sell the gravel at Guerneville and about the county, and the death of the lambs, which she seemed to attribute to their drinking of Hg-contaminated well water. The newspaper items showed "evidence of fruitless efforts at the local level.." The letter was published in full in The Paper, June 6-12th, and another letter on the subject in the June 4, 1980, Press Democrat.

12. A letter of June 4, 1980 from the Los Alamos Scientific Laboratories to Mrs. Nancy Atherstone of Sweetwater Springs Road.(not the owner of the lambs) suggested that on the basis of the symptoms of death (convulsions) and the low Hg content of the rumen, the lambs probably died of acute poisoning, as by ingestion of an insecticide of the cholineesterase-inhibitor type, or strychnine, or sodium fluoracetate.

13. A pathology report of June 5, 1980, to Dr. Ottoboni of the DHS Food and Drug Laboratory from the Claremont Veterinary Hospital, Oakland, stated that changes in the liver and kidney specimens of one of the dead lambs was referrible to post mortem decomposition, and no changes typical of mercury poisoning were apparent. It went on to say that the mercury content of the liver (0.4 ppm by weight), was not likely a toxic level.

14. A telephone call on June 11, 1980 to Thomas Lamb of Armstrong Woods Road who was familiar with the circumstances of the lambs' deaths, elicited the information that a younger lamb that did not eat of forage that had been thrown into the lamb enclosure was a lamb that survived. (Tom Lamb was called when the lambs were found to be sick and carried them all into the back yard before the two died.) Tom Lamb thought the lambs may have died from ingesting fertilizer or gopher bait that was in pellets scattered on the ground. The owner of the lambs was James Watson of Sweetwarer Springs Rd.

15. A telephone call to James Watson of Sweetwater Springs Road on June 12, 1980 elicited the information that he did not think the lambs died of Hg poisoning. He seemed to suspect that they may have been poison by something on or with weeds and clippings that were thrown over the fence by a neighbor. The neighbor, however, claims not to have used anything on the vegetation or any rodent control bait or poison. Watson was more concerned about mercury in the meat of a butchered lamb in his freezer (0.12 ppm found in the liver). He had intended to butcher the lambs that died. He was concerned about the level of Hg in the drinking water.

16. A call was made on June 20, 1980 to Charles Andresen, Inspector, Sonoma County Agricultural Commission, who had examined a bag of the uneaten weeds and clippings that James Watson had brought to him. His examination was specifically for the presence of toxic native plants such as milk weed, Crow's feet, and certain others. He also looked for oleander and castor been plants. He found no known toxic vegetation.

17. The county Planning Commission at a meeting of June 5, 1980, unanimously agreed to request the Board of Supervisors to scrutinize the Piombo operation to see if it should be allowed to continue (see Press Democrat clipping of June 6, 1980). We have no information to show that the Supervisors took any specific action on this request.

18. On June 10, 1980, Charlene Williams, Dr. Evaldo Kothny of AIHL, and I visited the Mt. Jackson Mine. We were met there by Doug Price of DHS, Santa Rosa, Jan Meyer, HMMS, Sacramento, Eric Koenigshofer, Chairman, Sonoma County Board of Supervisors, and his aide, Laurie Lehtinen, Andrea Johnston and Steven Spector, local residents, Robert Klamt of the WQCB, and "Kentucky" Pendergrass of Piombo Corp.

The information obtained on the site and its aggregate operations and our observations are summarized in a memorandum of that date.

Charlene Williams took rock, soil, and air samples at the tailings pile and the retort area; soil and plant samples in Watson's pasture where the lambs were enclosed; air and bedrock samples at Andrea Johnston's home overlooking the mine area; and soil and plant samples in the stream bed below the mine. The results of analyses of these samples are given in reports and tables in the appendix to this report.

Regarding uses of the tailings, this material has been used locally for many years as path and ground cover and fill; some claim it inhibits or prevents weed and grass growth. From other sources we learned that in "olden days" people came to the mine and hauled away tailings in wagons for paths and fill and such use can still be seen. We visited a local horse ranch where the red tailings covered paths and roadways to the stables and corrals.

19. My letter of June 20, 1980, to Valerie Byrd replied to her letter of May 26, 1980, to Gov. Brown. Exerpts from this letter appeared on the front page of the June 27-July 3, 1980, issue of The Paper with particular reference to HMMS belief that mercury poisoning was not the cause of death of the three lambs. The letter was printed in full on an interior page.

20. On June 23, 1980, I called Warren Stevenson, Sanitarian, Santa Clara County Environmental Health Department, regarding the New Almaden Mercury Mine and the tailings from that mine and the adjacent Guadalupe Mine. I visited this mining area on June 24, 1980; most of it is now a Park and Historical District. The mine tailings were not then being used as gravel, but had been used widely in the past. I found that the gravel road leading to the Guadalupe Sanitary Landfill had been surfaced in part by reddish gravel; two samples taken analysed at 51.1 and 20.3 ppm Hg. I stopped off at the home of Jim Beltram where I saw a pile of reddish gravel and grading vehicles. The reddish gravel had been used extensively on the driveway and parking areas. Beltram, age 81, had worked as an engineer at Guadalupe Mine. He said that "burned rock" had been widely used all around the area. The idea that it could be harmful was ridiculous. During and after the mining operations, the tailings were hauled off by individuals wherever gravel was needed; Beltram figured that "a million tons" was hauled away for use as gravel cover and fill; none was now being used, at least not from the Guadalupe mine. Beltram had done a lot of fishing in the area, and mercury in the fish was of no concern to him. According to Beltram, the job of dumping the burnt rock on the tailings pile was the worst: the workers got mercury poisoning from the fumes from the hot rock.

A letter of August 17, 1980, from the Director of Public Health of Santa Clara County, in response to my telephone inquiry, stated that she could recall no instance in her 25 years with the department of any report of illness related to the use of mercury mine tailings for roadbeds, paths, etc.

21. Because of great concern by residents near the Piombo operations that there might be mercury vapor and mercury-containated dust in the air, I visited there on Sunday, June 29, 1980 (a day when the operation was idle), with a mercury "sniffer" supplied by AIHL. There was no detectable Hg vapor around or near soils at the James Watson home, except under the house where Watson had spilled some mercury on the ground. At the home of Andrea Johnston overlooking the mine, where there was a breeze coming from the direction of the mine, there was no mercury detectable with the sniffer.

At the mine at the base of a shed by a sign Danger, there showed 0.35 mg of Hg/m^3 within a few inches of the dirt surface. There was no detectable mercury close up to the tailings pile or by any pilings of recently crushed tailings gravel, even though the days was warm to hot. However, in an open area beneath the first conveyor (surrounded by crushed rock) the sniffer showed Hg vapor at 0.25 to 0.3 mg/m3.

22. On June 30, 1980, a day of quarrying operations, pumps and filters for air/dust sampling were set up at the roadside opposite the crushing operations, by the roadside opposite the James Watson house, and at the Andrea Johnston home overlooking the quarry. Each test was run for two hours. The filters were examined by HML and found to contain less than 0.05 mg of dust on each, an insignificant amount for mercury determination.

James Watson's home and garden are immediately below the mine tailings area and alongside Wilson Creek and he was concerned that his garden might have been unusually contaminated with mercury from dust from the operation and from mercury in surface and ground water, and that his garden and orchard produce might contain high levels of mercury. We were also interested in learning if there would be mercury uptake from the mercury-contaminated soil and water. Accoringly, samples were taken of tilled garden soil, creek bed sediment and algae scum, and of some dry onions of the previous year's crop. Analyses of these samples, and of several other vegetable samples taken later, are reported in the Appendix; except for the onions, which were analysed unwashed, the mercury contents of the vegetables and some peaches were acceptably low.[a]

23. A letter of June 27, 1980, from the Department of Fish and Game to Mike Vinatieri, Director of Environmental Health, Sonoma County, and sent to me by the latter, provided information on the concentration of mercury (and other metals and substances) in sediments, benthos, forage and predator fish in the Russian River, and of mercury in predator fish in most of California's rivers during latter years of the 1970s.

24. A letter of June 30, 1980, from the Sonoma County Department of Public Works, pursuant to my telephone inquiry, described how the tailings gravel would be applied and "chip sealed" in the proposed use on Seaview Rd.

25. During the latter part of June, 1980, I undertook a review of literature on the chemistry and biological studies and observations on mercuric sulfide and cinnabar at the University of California Biology and Chemistry libraries, using also the U.C. Public Health library search of two biological sciences data banks.

Owing to the extremely low solubility of mercuric sulfide in water (1 x 10^{-8} g/g of water) and the fact that it can be solubilized only by use of strong acids (hot nitric, aqua regia, or hot hydrochloric acid) and some other reactive inorganic substances, it may be assumed that this substance will not behave in biological systems in the same ways as reasonably water-soluble inorganic mercury salts or organo-mercury compounds. Perhaps

a) D'Itri, Frank M., The Environmental Mercury Problem, CRC Press (Copy in Appendix) because of this low solubility, few studies were found in the literature on the toxicology of mercuric sulfide and its behavior in biological systems. The few studies found in literature to the year 1979 are reviewed in the summary and comments dated July, 1980.

The survey showed three experiments in which mercuric sulfide in single dosages was fed or injected into test animals (rabbits). The results showed considerable distribution of the sulfide in the animal body and possibly some slow solubilization and developing toxic effects. There were no no reports of continued dosages to study possible chronic effects.

There were two reports of experiments with mercuric sulfide in aquarium sediments in which there was mercury pickup by fish, indicating that under aerobic conditions the mercury was slowly released in assimilable form.b) This raises the question as to whether aerobic or anaerobic decompositions might occur slowly in other biologic media (e.g. organic soils, or the human or animal intestines). Some experimentation of the decomposition of mercuric sulfide in moist organic-laden soils seems called for. (See, however, Booer, Ann. Appl. Biol. 31, 340 (1944))

26. On June 20, 1980, I had a call from Eric Koenigshofer of the county Board of Supervisors for him to be brought up to date on our investigations. On June 23, 1980, I called Andrea Johnston to bring her up to date.

27. On July 11, 1980, I met with ten residents of the Ft. Ross/Seaview Road area at the Ft. Ross school, a meeting which was arranged by Mike Singer of that area to discuss particularly the tailings gravel stockpiled along the road for road resurfacing and repairs. It was a friendly meeting and they appeared interested in all the information I could give them on the mercury in the gravel, the chemistry and low water-solubility of mercuric sulfide and the unlikelihood that it could leach from the gravel, particularly once it was sealed on the road with asphalt, and the inforation I had obtained on my literature survey of mercuric sulfide and cinnabar. There was questioning about unknown long-term effects of mercury in the environment, effects that might not show up for years. The audience seemed to appreciate that a diligent effort had been made in the matter, but they remained skeptical. This group represented some 50-60 people who had signed a protest to the Board of Supervisors on the use of the gravel and clearly were not going to give up on the matter. They asked if they would be getting a written report, and I agreed to send such in a letter to Mike Singer. (A memorandum of July 11, 1980, provides much more infomation on this meeting.)

Before leaving the area, some of the persons took me to the stockpiles of gravel nearby, and I was able to show by use of a mercury "sniffer", inserted about a foot into a pile, that there was no detectable mercury vapor. I also took some soil samples off the road and away from the piles to determine the merciry content of the natural soil.

On the afternoon of July 11, 1980, I met with Bob Klamt at the Santa Rosa office of the WQCB to report on my meeting with the Ft. Ross/Seaview Road people, and to discuss the analytical results we had obtained on gravel and tailings at the Mt. Jackson Mine. I learned that the Board had told Piombo that they might require that a culvert be installed at the site to prevent gravel and sediments eroding into Wilson Creek, though it might be too late to have that done this year. In my view, such a culvert would go a long way toward stilling neighborhood concerns about the hazard of the tailings and gravels to their water wells and to the environment in general. (See memorandum of discussion of that date.)

b) Fagerstrom, T., and A. Jernelov and D.C. Gillespie and D. P. Scott (see copies of papers in Appendix).

28. By letter of July 28, 1980, to Eric Koenigshifer I advised the county Board of Supervisors that HMMS had no objection to the use of the Piombo gravel stockpiled on Seaview Road, provided it was chip sealed as proposed by the Public Works Department. They were also told that further study would be needed before we could approve use of the gravel for other raod surfacing in the county. Copies of the letter were sent to Mike Singer, the WQCB, the county Director of Environmental Health, the USEPA, the Piombo Corporation, Dr. Holtzer, County Health officer, and others. On July 28, 1980, I also sent to Mike Singer a long letter detailing the information I had presented at the meeting with the Ft. Ross/Seaview Road people on July 11, 1980. Copies of this letter were also sent to most of the aforementioned persons or agencies.

29. In a letter dated July 30, 1980, to Dr. Collins, Acting Director of HMMS, Dr. Holtzer, Sonoma County Health Officer, commended the Department for professionalism of extremely high quality for our work on the Mt. Jackson Mine matter.

30. By letter of Aug. 1, 1980, I advised Sid Shah, Area Manager, Piombo Corporation, of our studies on the quarry gravels. I asked for information on the proposed uses for the gravels, and at the same time stated that the gravels should not be sold or used for mose applications where gravels are normally used, and asked for their views on the matter, and for any laboratory data that they might have on the composition and properties of the gravels.

31. I received a letter of Aug. 5, 1980, from James Watson raising question as to whether cinnabar,even though insoluble in water, might be suspended in water and thereby be harmful by ingestion or otherwise. Watson offered the use of one of his ewes for studies of the effects of cinnabar or HgS exposure over an extended period of time. I answered Watson's letter by my letter of Aug. 23, 1980, and rejected his offer of his ewe for tests because of the difficulty of conducting controlled feeding and exposure conditions. I also provided the results of analyses of his pasture and garden soils, and of the peaches and several vegetables from his garden. With the exception of the onions (which had not been rinsed before analyses) all of the vegetables had mercury contents within published ranges of those found in other studies.

32. On Aug. 11, 1980, I sent Mike Singer some comments and literature regarding the USEPA Water Quality Standards - 1976 Section that had been handed out at the recent Board of Supervisors meeting. I pointed out that the USEPA report referred to water-soluble forms of mercury, not to mercuric sulfide.

33. I received a copy a copy of a memorandum of Aug. 15, 1980, on the "Road Rock Mercury" which had been prepared for the county Board of Supervisors by the county Public Health Service at the request of the Board. Dr. Holtzer concluded that use of the Piombo gravels as sealed road gravel or "armor coating" would add somewhat to the total mercury along any road where used, but would have no detrimental short or long term effect on public health or the environment.

34. I had learned from William Arnone of the HMMS staff that been used, or considered for use, for trench backfill or other uses in Lake County and I had written to them to learn if this was the case. There letter of Aug. 29, 1980, indicated that there had been some use for sewer trench backfill many years previously, but that apparently this and any other use had been discontinued.

35. A letter of Oct. 11, 1980, to HMMS from Valerie Byrd suggested that "acid rain" might increase the solubility of mercury in the mine tailings.

She complained about the quarrying operations, the use of the asphalt surfacing mix production by Piombo at Windsor, and the need for a culvert so that Wilson Creek would bypass the crushing operation and stockpiles so as to prevent erosion of the materials into the creek.

36. In a telephone discussion of Oct. 22, 1980, Kentucky Pendergrass of Piombo stated that the only gravel being taken from the quarry was for the sewer line project. He stated that Piombo does not have an asphalt mix plant and in any case couldn't afford to haul the gravel to Windsor. The gravel stickpiled on Seaview Road has been hauled away for road use elsewhere. My memorandum of Oct. 27, 1980, of a discussion with Doug Price stated that about one truck load per day was going out of the quarry, all for road use. A memo of discussion with Doug Price on Nov. 18, 1980, states that Caputo Wagner would be through operations in another month, moving at most 50 tons of gravel per day. According to James Watson, on Nov. 17, 1980, a lot of 18 wheelers were going out, hauling gravel to Shiloh Road (the Piombo site at Windsor) for asphalt mix production. Pendergast had told residents that they would move gravel during the week of Nov. 18, and then close down for a while.

37. A letter of Oct. 29, 1980, from Sid Shah, Piombo Corp., requested a variance pursuant to Section 66310, Chapter 30, Div. 4, Title 22, CAC, from the requirements of the chapter for the Mt. Jackson mine gravel operations, on the basis that tests and evaluations of the quarried and accompanying waste materials indicate that such materials "are insignificant as a potential hazard to human health, domestic live stock and wildlife because of its low concentration of mercury and the highly insoluble and biologically inert nature of the mercuric sulfide in those materials". Mr. Shah enclosed a detailed report "substantiating these findings"which consisted in large part of quotations from the HMMS letter of July 28, 1980, to Michael Singer, and other letters, memos. etc. already in our files.

38. A letter of Oct. 29, 1980, from Sid Shah, Piombo Corp, in response to my letter of Aug. 1, 1980, asking for information on proposed uses for the gravel and on composition and properties of the gravel, enclosed another copy of the report sent with Shah's letter of the same date. (This report is entitled "Report on the Nonhazardous Nature of Materials and Wastes Produced at the Mt. Jackson Mine in Guerneville, Sonoma County, California".) In his second letter, Mr. Shah also stated that the only uses which would be inadvisable would be in applications where the materials would be heated to temperatures in excess of 1000°F. He stated that that such applications were not anticipated or probably, and that no past, current, or future uses of the sands and gravel would appear to pose any threat to human or animal health.

39. A letter of Dec. 5, 1980, from Shah to Doug Price, Santa Rosa, responded to his letter of Dec. 1, 1980, (copy not in file) regarding movement of quarry materials to Piombo's Shiloh Road site (near Windsor) for use as asphalt aggregates. Mr. Shah stated that "exaggerated adverse publicity regarding these materials has damaged our ability to sell materials already processed at the quarry site necessitating the movement of a portion of the materials to our Shiloh Road site in order to reduce our unmitigated losses". It appears that they proposed to use the materials in asphalt mixes for hot asphalt applications. Mr. Shah described the conditions of operations of the asphalt mixing plant and enclosed a brochure describing the plant, but it was not clear whether this plant had actually been constructed and in operation. Copies of this letter were shown for the Environmental Health Division of the county Health Department, the Public Health Officer, the Regional WQCB, and HMMS, Sacramento. Price sent a copy of this letter and enclosure to HMMS, Berkeley, with the suggestion that Piombo be given the variance requested in their letter of Oct. 29, 1980.

40. Piombo's variance request by letter of Oct. 29, 1980, was granted by an HMMS, Berkeley letter sent in December, 1980 or early in 1981, followed by a second letter making clearer some limitations on the variance. Copies of these letters were not retained for this file and unfortunately are not immediately available from the Piombo, Windsor, HMMS file since the latter appears to have been sent to archives or was discarded.

41. I was referred by Andrea Granahan of Bodega to a book, "Mercury in the Western Environment", the proceedings of a workshop at Oregon State University, Feb. 25-26, 1971, and I was able to get a copy from U. C. Davis. By letter of Feb. 20, 1981, I advised Ms. Granahan that the book appeared to contain no references to mercuric sulfide studies specifically, but did concern mercury in the natural environment as released from ore formations by natural water seepage or during mining operations. There was also reference to a study of release of mercury, as methyl mercury, from from aquarium sediments containing mercuric chloride, and to other inorganic mercury compounds which are water soluble or will solublize under moderately acidic conditions. A number of the papers dealt with analytical methods, but none mentioned mercuric sulfide. The book did not appear to be pertinent to the matter at hand, the potential for hazard to public health and the environment of the roasted cinnabar ores or their use as gravel.

42. On Nov. 13, 1981, I asked Doug Price to get me a couple more samples of the Mt. Jackson Mine tailings so that I could have some further analses run. Price contacted Bob Harter of Piombo and learned that residents of the area had appealed a ruling by the County Planning Board that Piombo had vested rights to carrying out quarrying of the tailings at the mine, actions of which we were not aware. (See memorandum of call to Harter on Nov. 16, 1981.) In any case, samples of quarried gravel and sand were collected by Kentucky Pendergrass on about Nov. 17 to Price who delivered them to HMMS, Berkeley. Analyses of the two samples were then carried out.

On Nov. 27, 1981, Kentucky Pendergrass was arrested in connection with, and later charged with, the murder of a man and his wife near Sebastopol. Four additional samples of gravel and sand were collected from the quarry by Doug Price on Jan. 13, 1982. These samples were needed for analyses to determine the extractability of mercury by nitric acid and by the HMMS WET procedure to give further information on how readily the mercury in the tailings and the gravels might be leached into streams and soils by rainwater and stream erosion. The results are given in the attached table and mentioned below.

The collection of these samples concluded, at least for the time being, HMMS involvment in the Mt. Jackson Mine quarrying operations, which by then was at least temporarily closed down. About 1986, Doug Price reported that he went by the Mt. Jackson Mine site and observed that there were no apparent operations and noted that Wilson stream had been eroding into the quarrying area, no culvert having been constructed to divert it.

The problem of disposal of tailings from another mercury mine, the St. Johns Mine in Solano County was brought to our attention in 1987 by Harding Lawson Associates for a client who wanted to develop a country club on the site. We referred the matter to Alternate Technology Section, who, on the basis of published data stating that mercuric sulfide is a highly toxic compound by ingestion, inhalation, and skin absorption, classified the tailings as hazardous waste, in the category of special waste, and declared that the tailings must be so managed. I have not looked into the data source for the ATS determination. It may be that the toxicities were based on data for other, water-soluble, mercuric compounds. It is unlikely that the sulfide would be toxic by skin absorption.

43. Analysis of Samples. Samples handled by the Hazardous Materials Laboratory (HML), Berkeley, were analysed for total mercury by digestion with hot nitric acid, or aqua regia, followed by oxidation with potassium permanganate solution, and then by reduction of the mercury to elemental mercury with a stannous salt solution. Mercury was determined by cold vapor adsorption (AAS). The latter determination was subject to inaccuracy and estimation, because of mercury vapor losses, but was improved as time went by.

A few samples of tailings, gravels, rock, creek sediments, and plants were analysed for "soluble" mercury (i.e., not present as HgS) by digestion with (1+1) nitric acid at 62°C; preliminary analyses of a laboratory preparation of HgS of calculated 96 % purity had demonstrated that under these conditions, HgS was dissolved to the extent of only 0.12 %.

Three samples of quarry sand and fines were also subjected to the DHS Waste Extraction Test (WET), using the procedure then followed of 30 days extraction with buffered citrate solution, and a separate similar method using deionized water.

The results of the many analyses by HML, and some of those reported by others, are given in a table attached to this memorandum. Copies of analytical requests and analysis reports are collected in Vol. II of this report.

(Water sample analyses data, as carried out by the WQCB and others, are to be found in Vol. II of this report. HMMS did not sample creek and well waters, since the amount of mercury in these waters was more directly the concern of the WQCB and the residents and not the immediate focus of the HMMS investigation. The methods of analysis for mercury by laboratories other than HML were not determined.)

Analytical Results. The analyses showed appreciable concentrations of mercury in all samples of mine tailings and quarry gravels and sands, the concentrations being well above the TTLC value for mercury then and now in effect. The 30-day WET determinations with buffered citric acid on three quarry materials showed extractable mercury above the STLC value with one sample and well below with the other two; the use of deionized water gave negligible mercury extraction. On the basis of the single sample tested, the tailings (and probably gravel products) are not likely to be acutely toxic to fish by the DHS aquatic toxicity test.

Thus, on the basis of total mercury, the tailings and quarried products would be classed as hazardous waste materials by TTLC, and perhaps some quarried products by the STLC criterion for mercury. (The relatively low extractablility of mercury by the WET, using buffered citric acid, makes it unlikely that the tailings or quarried products would be classed as hazardous waste by the USEPA EP Toxicity test, however.)

Numerous analyses showed that appreciable amounts of mercury in tailings, quarried products, and soil were extractable by the digestions with nitric acid at moderate temperature, indicating the presence of mercury residues in other than HgS or cinnabar form. This is of interest and possible concern because it shows that some of the residual mercury might be leached out slowly from tailings piles or quarried gravels and sand by action of rain water and surface waters, perhaps enhanced by "acid rains" in areas where such conditions might prevail; tailings disposed of in landfills might also be exposed to acidic conditions which would mobilize some of the mercury residue.

Mercury in the one soil sample analysed for nitric acid-soluble mercury, showed that the mercury was conpletely solublized by this reagent, indicating that the mercury was not present as sediments from the mine tailings pile, carried down by surface waters, or simply as native cinnabar dispersed in the soil. The results, however, suggest that HgS in organic soils, whatever its origins, might be converted to more soluble forms by aerobic or anerobic soil conditions.

The only partial solubility in nitric acid of the mercury in two of the vegetative samples analysed was unexpected, since mercury in plant matter would be expected to be in fully solublizable forms. Further testing of plants, as well as soils, for total and solublizable mercury is obviously needed.

Appendix

Sample Analyses (Total Mercury)

Material	Date, Source, Sample Number a)	Hg (ppm)
Tailings, gravel, rock	6/80 - Mt. Jack., Tailings, RK	240
	" " "Chips". RK	101
	" " "Sands", RK	70
	5/8/80 - " " Quarry sand, DP-8	140.6
	" " " gravel, DP-9	70.8
	" " " rock, DP-10	40.5
	6/10/80 - " " White rock, CFW-088	19.8
	" " Red tailings, CFW-089	25.6
	" " Surf. rock, nr Johnston's, CFW-096	0.83
	3/80 - " " Tailings, SS	152
	3/20/80 - " " "Flour" at quarry, RK	210
	6/10/80 " " Tailings, PHW-84A	27.8
	4/24/80 - " " Tailings. Pile, CAL-OSHA-2	176
	" " Finished Material, Fine, CAL-OSHA-1	72
	" " Cone Crusher Material, CAL-OSHA-3	78
	" " Slurry, Disch. Pump., CAL-OSHA-4	213
	1/13/82 - " " Quarry Fines/gravel, DP (PHW-82)	63
	" " Quarry Fines/sand, DP (PHW-83)	95
	" " Quarry Coarse (½") grav., DP (PHW-84)	3.6
	" " Quarry Red sand/gravel, DP (PHW-85)	72
	5/7/80 - Seaview Rd. Gravel Stockpile #1, DP-4	189
	" " Small stockpile, DP-5	63.6
	" " Rock on Rd. nr. St. Pile #1, DP-6	34
	" " Gravel Stockpile #2, DP-7	53.9
	6/24/80 - Guadalupe Mine, Tailings Pile, PHW-01	20.3
	" Sanitary Landfill Rd. gravel, PHW-02	51.1
Soil	6/10/80 -Mt. Jack., Soil, near retorts, CFW-092	197.5
	" " CFW-092 of less than No. 10 sieve	255
	" " Watson Pasture to 2" depth, CFW-093	4.6
	7/22/80 " " Watson Pasture to 8" depth, DP-20	4.6
	6/30/80 " " Watson garden, tilled, to 8", CFW-104	27.8
	7/22/80 " " Watson garden, to 8", DP-19	41.4
	7/11/80 Seaview Rd, Native soil, near road, PHW-03	0.4
Creek Sediments	3/80 Wilson Creek, Below Quarry, SS	138
	" " At quarry, SS	4200
	" " Upstream of mine, SS	5.2
	6/10/80 " " Below mine, CFW-097	95.9
	6/30/80 " " Ca. ½ mile downstream, CFW-106	89.2

a) Sample Collectors: RK = Robert Klamt, Reg. WQCB, Santa Rosa; DP (DWP) = Dr. Douglas Price, DHS, Santa Rosa; SS = Steven Spector, Guerneville; PK = Kentucky Pendergrass of Piombo Corp.; CFW = Charlene Williams; HMMS; PHW = Paul Williams, HMMS.

Appendix

Sample Analyses (Total Mercury)

Material	Date, Source, Sample Number a)	Hg (ppm)
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	" " "Chips". RK	101
	" " "Sands", RK	70
	5/8/80 - " " Quarry sand, DP-8	140.6
	" " " gravel, DP-9	70.8
	" " " rock, DP-10	40.5
	6/10/80 - " " White rock, CFW-088	19.8
	" " Red tailings, CFW-089	25.6
	" " Surf. rock, nr Johnston's, CFW-096	0,83
	3/80 - " " Tailings, SS	152
	3/20/80 - " " "Flour" at quarry, RK	210
	6/10/80 " " Tailings, PHW-84A	27.8
	4/24/80 - " " Tailings. Pile, CAL-OSHA-2	176
	" " Finished Material, Fine, CAL-OSHA-1	72
	" " Cone Crusher Material, CAL-OSHA-3	78
	" " Slurry, Disch. Pump., CAL-OSHA-4	213
	1/13/82 - " " Quarry Fines/gravel, DP (PHW-82)	63.
	" " Quarry Fines/sand, DP (PHW-83)	95
	" " Quarry Coarse (½") grav., DP (PHW-84)	3.6
	" " Quarry Red sand/gravel, DP (PHW-85)	72
	5/7/80 - Seaview Rd. Gravel Stockpile #1, DP-4	189
	" " Small stockpile, DP-5	63.6
	" " Rock on Rd. nr. St.Pile #1, DP-6	34
	" " Gravel Stockpile #2, DP-7	53.9
	6/24/80 - Guadalupe Mine, Tailings Pile, PHW-01	20.3
	" Sanitary Landfill Rd. gravel, PHW-02	51.1
Soil	6/10/80 -Mt. Jack., Soil, near retorts, CFW-092	197.5
	" " CFW-092 of less than No. 10 sieve	255
	" " Watson Pasture to 2" depth, CFW-093	4.6
	7/22/80 " " Watson Pasture to 8" depth, DP-20	4.6
	6/30/80 " " Watson garden, tilled, to 8", CFW-104	27.8
	7/22/80 " " Watson garden, to 8", DP-19	41.4
	7/11/80 Seaview Rd, Native soil, near road, PHW-03	0.4
Creek Sediments	3/80 Wilson Creek, Below Quarry, SS	138
	" " At quarry, SS	4200
	" " Upstream of mine, SS	5.2
	6/10/80 " " Below mine, CFW-097	95.9
	6/30/80 " " Ca. ½ mile downstream, CFW-106	89.2

a) Sample Collectors: RK = Robert Klamt, Reg. WQCB, Santa Rosa; DP (DWP) = Dr. Douglas Price, DHS, Santa Rosa; SS = Steven Spector, Guerneville; PK = Kentucky Pendergrass o Piombo Corp.; CFW = Charlene Williams; HMMS; PHW = Paul Williams, HMMS.

Material	Date, Source, Sample, Sample No.	Hg (ppm)
Vegetation	6/10/80 - Watson Pasture, Weeds, etc.,unrinsed, CFW-094	0.63
	7/22/80 - " " , Chinese Stink Plant, rinsed, DP-18	0.052
	6/10/80 - Wilson Creek bed, grass, unrinsed, CFW-098	3.5
	air dried	12.9
	6/30/80 - " " , below mine, algae scum, CFW-105	24.6
	7/22/80 " " , dry grass below quarry, air dried, DP-21	3.9
	" " , green grass along bank, air dried, DP-22	12.4
	6/30/80 - Watson garden, Yellow onions, previous year, unrinsed, air dried, CFW-103	0.52
	7/22/80 - " " , Peaches, rinsed, DP-11	0.012 wet
	" " , Swiss chard, rinsed, DP-12	0.016 "
	" " , Zuccini, rinsed, DP-13	0.003 "
	" " , Potatoes, rinsed, DP-14	0.004 "
Lamb parts	' '4/80 - Watson lamb that died, age 2 mos, 21 days,	
	rumen content	1.5
	liver	0.4
	3/18/80 - Watson Lamb, slaughtered, age 10 mos., liver	0.12
	" " " (aliquots of 1 chop, ½ heart, 1 kidney) DP-16	0.025
Air/dust	6/10/80 - Mt. Jack., Air, retort area, CFW-090 a)	<0.25/vol.
	" " " , tailings pile, CFW-091 a)	<0.25/vol.
	" " " , Andrea Johnston's, CFW-095 a)	<0.25/vol.
	6/30/80 " " Dust, Andrea Johnston's, CFW-099	<0.05 mg dust
	" " " Road at Watson's, CFW-100	<0.05 mg dust
	" " " Road Opp. crush'g CFW-101	<0.05 mg dust

Special Analyses - Mercury in ppm (mg/kg)

Location, Description/Number of Sample		Nitric Acid	WET Citrate	WET Water	Total
Mt. Jackson Mine,	Quarry sand, DP-8	43.6	-	-	145
" " " ,	White rock, CFW-088	1.22	-	-	19.8
" " " ,	Tailings, CFW-089	15.6	-	-	25.9
" " " ,	Soil, retort area, CFW-092 (Passed No. 10 sieve)	71.1	-	-	255
" " " ,	Coarse Quarry sand, KP-1	35.6	0.51	0.01	-
" " " ,	Fine Quarry sand, KP-2	26	0.09	0.01	-
" " " ,	Johnston's surf. rock, CFW-096	0.82	-	-	0.83
" " " ,	Quarry Fines/Sand (DP) FHW-083	-	0.084	0.008	.95
Seaview Road,	Gravel Stockpile #1, DP-4	16.5	-	-	189
" " ,	Rock on Road, DP-6	14.5	-	-	34
Wilson Creek,	Sediment, below quarry, CFW-097	37.1	-	-	95.9
Watson Pasture,	Soil to 2" depth, CFW-093	5.0	-	-	4.6
Watson Pasture,	Weeds, etc., dried, CFW-094	1.25	-	-	1.7
Wilson Creek,	Bed grass, dried, CFW-098	4.65	-	-	12.0

Aquatic Toxicity (golden shiner), Sample DP-4: two tests, 96 hr LC_{50} 750 mg/liter.

a) Using MSA Charcoal Sample Collection tube.

Material	Date, Source, Sample, Sample No.	Hg (ppm)
Vegetation	6/10/80 - Watson Pasture, Weeds, etc.,unrinsed, CFW-094	0.63
	7/22/80 - " " , Chinese Stink Plant, rinsed, DP-18	0.052
	6/10/80 - Wilson Creek bed, grass, unrinsed, CFW-098	3.5
	air dried	12.9
	6/30/80 - " " " , below mine, algae scum, CFW-105	24.6
	7/22/80 " " , dry grass below quarry, air dried, DP-21	3.9
	" " , green grass along bank, air dried, DP-22	12.4
	6/30/80 - Watson garden, Yellow onions, previous year, unrinsed, air dried, CFW-103	0.52
	7/22/80 - " " , Peaches, rinsed, DP-11	0.012 wet wt
	" " , Swiss chard, rinsed, DP-12	0.016 " "
	" " , Zuccini, rinsed, DP-13	0.003 " "
	" " , Potatoes, rinsed, DP-14	0.004 " "
Lamb parts	' '4/80 - Watson lamb that died, age 2 mos, 21 days,	
	rumen content	1.5
	liver	0.4
	3/18/80 - Watson Lamb, slaughtered, age 10 mos., liver	0.12
	" " " (aliquots of 1 chop, ½ heart, 1 kidney) DP-16	0.025
Air/dust	6/10/80 - Mt. Jack., Air, retort area, CFW-090 a)	<0.25/vol.
	" " " , tailings pile, CFW-091 a)	<0.25/vol.
	" " " , Andrea Johnston's, CFW-095 a)	<0.25/vol.
	6/30/80 " " Dust, Andrea Johnston's, CFW-099	<0.05 mg dust
	" " " Road at Watson's, CFW-100	<0.05 mg dust
	" " " Road Opp. crush'g CFW-101	<0.05 mg dust

Special Analyses - Mercury in ppm (mg/kg)

Location, Description/Number of Sample	Nitric Acid	WET		Total
		Citrate	water	
Mt. Jackson Mine, Quarry sand, DP-8	43.6	-	-	145
" " " , White rock, CFW-088	1.22	-	-	19.8
" " " , Tailings, CFW-089	15.6	-	-	25.9
" " " Soil, retort area, CFW-092 (Passed No. 10 sieve)	71.1	-	-	255
" " " , Coarse Quarry sand, KP-1	35.6	0.51	0.01	-
" " " , Fine Quarry sand, KP-2	26	0.09	0.01	-
" " " , Johnston's surf. rock, CFW-096	0.82	-	-	0.83
" " ", Quarry Fines/Sand (DP) PHW-083	-	0.084	0.008	95
Seaview Road, Gravel Stockpile #1, DP-4	16.5	-	-	189
" " , Rock on Road, DP-6	14.5	-	-	34
Wilson Creek, Sediment, below quarry, CFW-097	37.1	-	-	95.9
Watson Pasture, Soil to 2" depth, CFW-093	5.0	-	-	4.6
Watson Pasture, Weeds, etc., dried, CFW-094	1.25	-	-	1.7
Wilson Creek, Bed grass, dried, CFW-098	4.65	-	-	12.0

Aquatic Toxicity (golden shiner), Sample DP-4: two tests, 96 hr LC_{50} 750 mg/liter.

a) Using MSA Charcoal Sample Collection tube.

REFERENCE 3

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MERCURY *

By Fenelon F. Davis

Approximately 88 percent of the mercury produced in the United States has been obtained from deposits in California which lie mainly in the Coast Ranges. From the beginning of recorded production in 1850 to the end of 1955, the mercury mines of California produced more than $2\frac{1}{2}$ million flasks valued at over $159,000,000. Only gold and copper, among the metallic mineral commodities of the state, have exceeded mercury in value of production.

During World War II slightly more than 70 percent of the domestic mercury production came from California sources, which in the period 1942-45 contributed 113,195 flasks valued at $17,607,320. The 33,948 flasks produced in 1943 represented the highest annual output since 1895. From 1944 to 1950, mercury production dropped sharply, a decline caused largely by the difficulty encountered by domestic operators in meeting foreign competition following World War II. The output of mercury from California mines in 1950 was the smallest in 28 years. Meanwhile the United States was accumulating stocks of this strategic metal from foreign sources.

A renewed stimulus to mercury production was provided in 1950 by the Korean War demand and in 1951 by a U. S. Government program to encourage mercury mine exploration. By 1954 the U. S. Government and many foreign governments had embarked upon atomic energy programs which are rumored to be responsible for a reduction in the available supply of mercury. In addition, the U. S. Government in 1954 instituted a $3\frac{1}{2}$-year fixed-price mercury purchase program which tended to stabilize the market and encourage the development of the mines.

Most of the early production of mercury in California was used in the amalgamation of gold, but in recent years it has found greater use in the manufacture of chemicals, in industrial instruments, in electrical apparatus and in agriculture.

Mineralogy and Geologic Occurrence. Cinnabar (HgS) is by far the most important ore mineral of mercury, but native mercury and metacinnabar (HgS) occur in economic quantities. More than 20 other minerals also contain mercury. Of these, amalgam (AuHg), tiemannite (HgSe), coloradoite (HgTe), calomel (HgCl), eglestonite (Hg_4Cl_2O), and montroydite (HgO), have been noted in California.

Cinnabar is recognized by its red color, red streak, high specific gravity, and adamantine luster. Metacinnabar, a black mercuric sulfide with a black streak, is less common than cinnabar, Native mercury, a silver-colored liquid, has been found in vugs in many California deposits.

Throughout the world, mercury deposits are confined largely to regions of Tertiary or Quaternary volcanic activity. As the mercury mineralization is of relatively low temperature, and few commercial bodies exceed 2,000 feet in depth, the deposits are classed as epithermal.

Mercury ore bodies are irregular and contain cinnabar or metacinnabar that fill fractures or voids, or have replaced the host rock. Schuette (1937) shows that many ore bodies have been formed by the concentration of primary minerals in porous rocks capped by relatively impervious rocks. Others are replacement deposits of silica-carbonate and related rocks; still others have been deposited at or very near the surface by hot springs. Bodies of disseminated ore exist at some mines.

Mercury deposits contain few other metallic minerals. Pyrite or marcasite is generally present, and stibnite is locally abundant. The principal gangue minerals are quartz, opal, chalcedony, calcite and dolomite.

Slightly over 50 percent of the larger mercury deposits in California occur in altered serpentine (silica-carbonate rock), and an additional 30 percent occur in the sedimentary rocks of the Franciscan group (Upper Jurassic?) with which the serpentine is associated.[1] Mercury ores also occur in the Knoxville (Upper Jurassic) sedimentary rocks, and in younger Lower Cretaceous sedimentary and Tertiary volcanic rocks. Relatively small amounts of cinnabar have been obtained from hot springs and placer deposits in the state.

The high degree of fracturing in the Franciscan rocks and in the serpentine has favored deposition in these rocks. In general the mercury minerals have formed in the interstices of porous or brecciated rocks. In many places the ore is especially rich beneath such impervious material as fault-gouge, clay shale, or dense volcanic rock. The silica-carbonate rock with which many deposits of mercury minerals are associated is commonly called "quicksilver rock." This rock is an alteration product of serpentine and is composed largely of chalcedony, quartz, and various carbonates. It is more widespread than the mercury mineralization, however, and cannot be used as a reliable prospecting guide.

Localities. Twenty-nine of the 30 mines that have been the most consistent sources of mercury in California are in the Coast Ranges, and are, in general, confined to areas underlain by rocks of the Franciscan group and associated serpentine. Within this province are 23 mercury districts which are scattered along a 350-mile belt extending from central Lake County southeastward to southeastern Santa Barbara County. Three of these districts, the New Almaden in Santa Clara County, the Mayacmas in Sonoma and Lake Counties, and the New Idria in San Benito County, have been the principal sources of mercury in North America. The Knoxville district in Lake and Napa Counties, the Clear Lake and Guerneville districts in Lake County, and the Oceanic district in San Luis Obispo County, also have been very productive.

Other districts in the Coast Ranges that contain mercury mines with sizeable outputs are: Wilbur Springs, and Vallejo in the counties north of San Francisco Bay; the Mount Diablo in Contra Costa County; and the Adelaida in San Luis Obispo County.

Coast Ranges mercury districts with moderate outputs are: the Oakville in Napa County; the Stayton in Mer-

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* Extracted in part from a report by Richard A. Crippen Jr. in California Div. Mines Bull. 156.

[1] Edgar H. Bailey, personal communication.

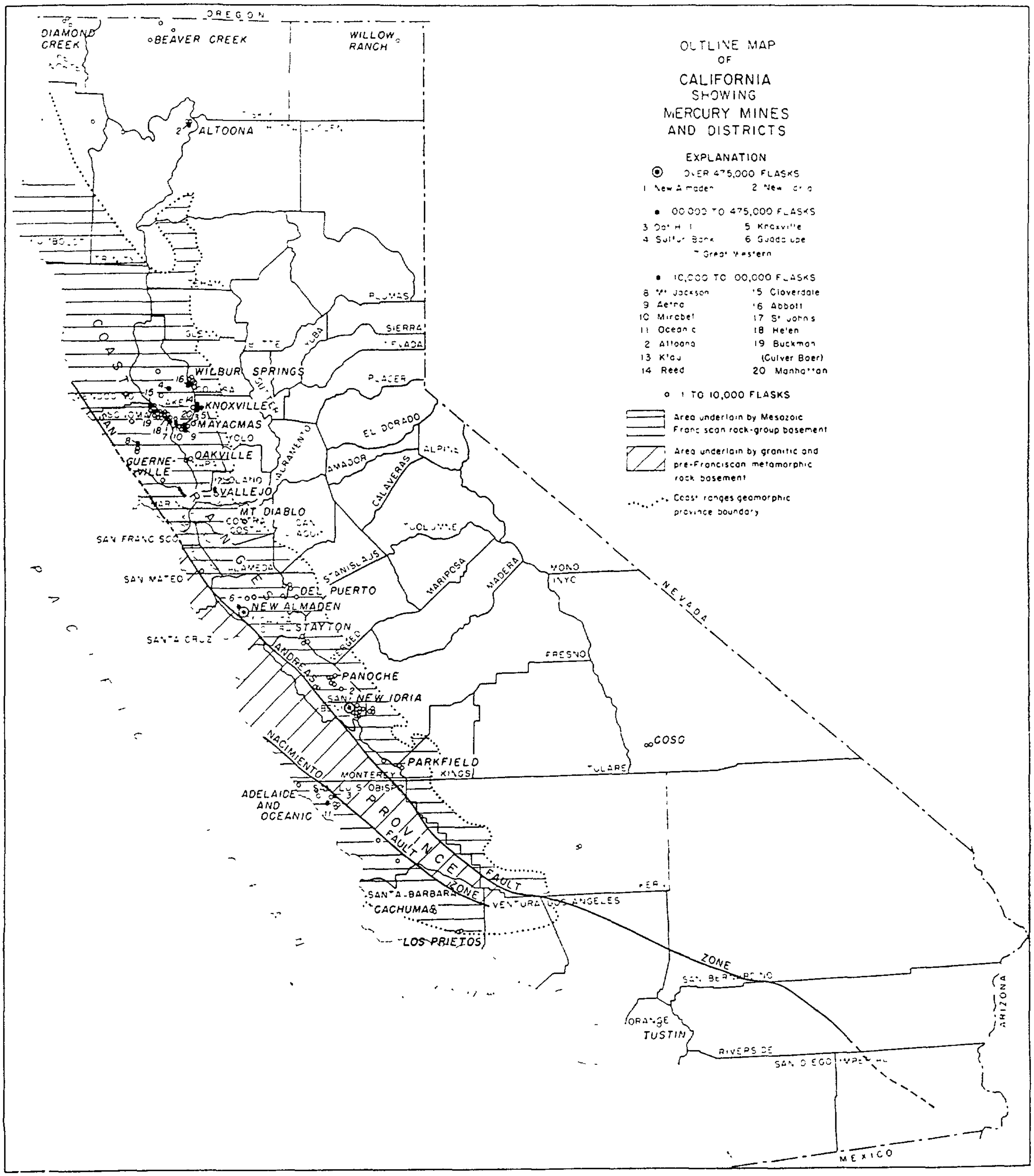

FIGURE 1. Map of California showing the location of mercury mines and the principal mercury districts.

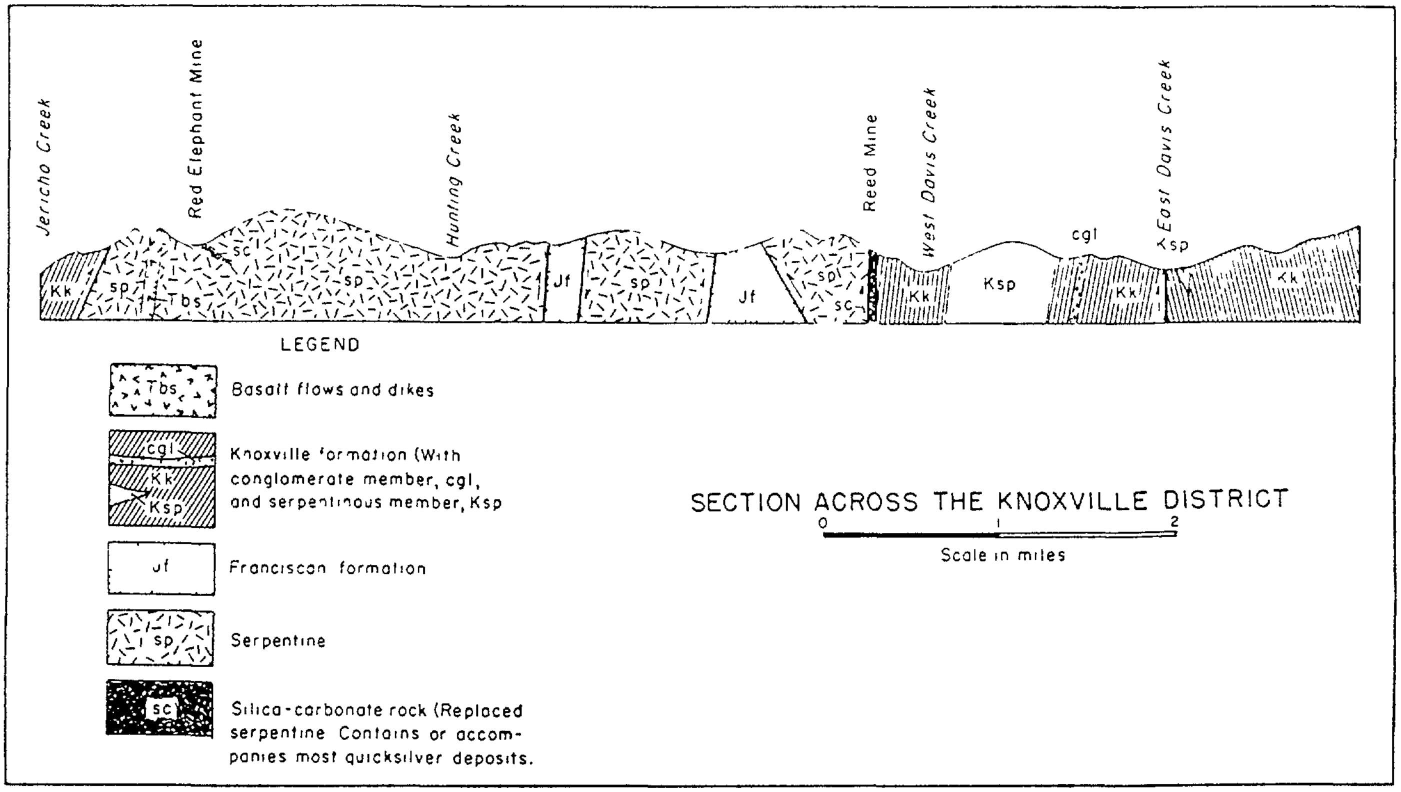

FIGURE 3. Geologic section across the Knoxville district, Lake, Napa, and Yolo Counties. *After Averitt, 1945*

1939 bibliography on California mercury deposits has been provided by Ransome and Kellogg (1939) in a report which summarizes the salient features of most of the mines. During World War II many of the state's mercury-bearing areas were studied in detail by members of the U. S. Geological Survey. In recent years reports of these investigations have been published by the California Division of Mines: Knoxville district, Averitt 1945; Mayacmas district, Bailey 1946; Walibu mine, Bailey and Swinney 1947; New Idria district, Eckel and Myers 1946; New Almaden mine, Bailey 1951; Cachuma district, Skaggs Springs, Everhart 1950; Sulphur Bank mine, 1946; Oakville district, Fix and Swinney 1946: Guerneville district, Myers and Everhart 1948; Altoona mine, Swinney 1950; Panoche district, Yates and Hilpert 1945, Mayacmas district, 1946). Although the mercury deposits of the Coast Ranges province have formed under similar geologic conditions, they show marked differences in the character and grade of the ore and the nature of the gangue and host rock, as well as in the age of the host rock and size of the ore bodies.

The relatively few mercury mines in California that are outside of the Coast Ranges province are even less similar. The mercury deposits in the Diamond Creek area of Del Norte County are reported to occur as fissure fillings in altered diorite; and as replacements in felsite masses intruding sheared serpentine, (Cater and Wells, 1953). In the Beaver Creek area of Siskiyou County, cinnabar has been deposited as fracture fillings in metamorphic rocks. Cinnabar at the Altoona mine in northeastern Trinity County has been deposited in narrow, steeply dipping "veins" along fault zones in porphyritic diorite (Swinney, 1950).

The Walibu (Cuddeback) mine, 10 miles northwest of Tehachapi in Kern County, is the southernmost of several mercury occurrences along the eastern flank of the Sierra Nevada. Here, mercury ore occurs in one of a number of rhyolite dikes which have intruded granitic rocks of the Sierra Nevada batholith. Cinnabar, the only mineral of economic importance, "encrusts fracture walls, fills small breccia veins . . . and is disseminated as minute crystals through the more altered rhyolite" (Bailey and Swinney, 1947).

Small amounts of quicksilver have been obtained from Recent hot spring deposits in the Coso district of southwestern Inyo County. The mercury deposits in this area consist of small irregular cinnabar veins in altered tuffs and altered granite. Silicification and kaolinization of the host rocks has been intense. In a deposit near Tustin, Orange County, cinnabar and native mercury are associated with small veins of barite in country rock of Tertiary sandstone.

Mining and Treatment Methods. As mercury deposits ordinarily occur in poorly defined and irregular zones that generally are parallel to or in fault zones, systematic exploration is difficult. Where cinnabar stringers cross the zone these are first explored by trenches and shallow underground workings. The occasional ore bodies that are thus encountered are worked by conventional stoping methods. The "heavy ground" which is characteristic of Coast Ranges mines requires substantial support, and square-set timbering is employed in large stopes. Small, narrow ore shoots are worked by open stopes or stulled stopes. During World War II the shortage of miners encouraged installation of mechanical loaders, scraper hoists, and "jumbo" drilling equipment for drifting in the larger mines. Since mercury ore bodies are irregular and generally unpredictable in location, size, and grade, few deposits are adaptable to large scale shovel mining. Selective shovel mining has been employed successfully on a limited scale near old shallow underground workings, on dumps and as an aid to field up-grading of very low grade deposits.

The extraction of mercury from its ores is essentially a distillation process commonly referred to as "burning." Heating the ore in the presence of air oxidizes the sulfur and frees the contained mercury as a vapor, which condenses to the pure metal on cooling. The sulfur is discharged to the atmosphere as sulfur dioxide gas. Simple though the process may be in theory, many types of retorts, furnaces and condensers have been used with varying degrees of success. The ore is "burned" in two general ways One method utilizes indirect heat and is similar to baking; the other utilizes direct heat and is termed "roasting."

In the "baking" method, cylindrical or semi-cylindrical iron tubes (retorts), placed horizontally or on a slant over brick fire boxes, are partly filled with ore crushed to minus 1-inch size. Each retort is sealed except for a vapor-outlet pipe in which condensation of mercury can take place. Retorting is a batch process and the operation follows a cycle of charging, heating, cooling, and withdrawal of burned ore. The use of retorts is most adaptable to a small mine producing high-grade ore that averages more than 1 percent mercury. Many retorts have successfully treated three charges, totalling about a ton of ore, per 24 hour day. As a retort can be easily constructed at small expense nearly every mine has its own refinery. Some small mines produce sufficient ore to operate a battery of retorts.

Greater ore capacity and efficiency with more continuous operation is gained in the various mechanical furnaces built to roast ore by direct heat. For this purpose, the horizontally inclined rotary furnace and the stationary vertical furnace are now used almost universally. The Gould rotary kiln was installed first at New Idria in 1918. It revolves on a slightly inclined axis and the ore, crushed minus 2-inch size, usually moves, generally counter-currently, toward the heat source at the lower end. Nearly complete extraction of the mercury is accomplished, and the vapors are drawn off at the upper end through a cyclone dust collector. The flow of gases is stimulated by a suction fan. Mercury condenses from the vapor in banks of vertical pipes joined alternately at the top and bottom with U connections. Liquid mercury is collected under water which seals the hopper openings in the lower pipe connections.

FIGURE 4. Looking eastward along Big Sulfur Creek toward the furnace plant of Buckman Mines near The Big Geysers, Western Mayacmas district, Sonoma County. Buckman Mines has been actively developing and producing from the former Culver Baer and Dewey mines during recent years.

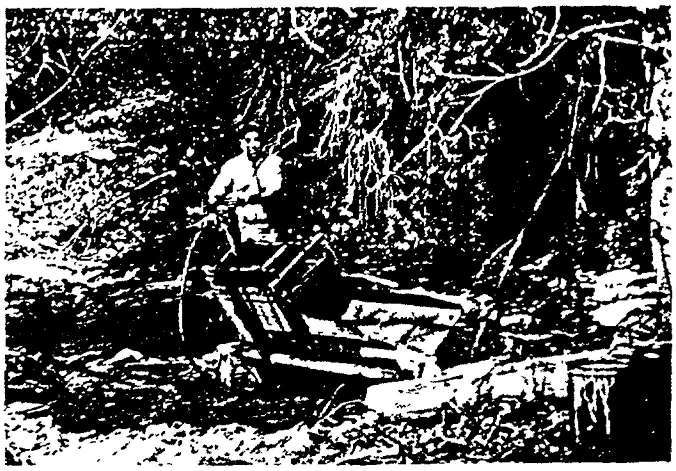

FIGURE 5. Concentrating cinnabar sand by use of a rocker on James Creek, Napa County. James Creek receives drainage from the Oat Hill dump and other mines in the Eastern Mayacmas district.

The rotary kiln operates with increased fuel economy and overall efficiency compared to the older type of furnaces, and in addition eliminates most of the hazards of mercury poisoning which attended their operation. A much lower grade of ore can be profitably handled by a rotary furnace than by a retort. During World War II, when the price of mercury was about $175 per flask, the feed to many rotary furnaces averaged a quarter of a percent mercury, or 5 pounds of mercury per ton of ore. During 1955 when the price of mercury was about $270 per flask many potential operators were seeking large deposits of 3- to 4-pound ore.

The Nichols Herreshoff multiple hearth furnace has been successfully used to treat mercury ores. The furnace operates on a feed of minus 1¼-inch size. It consists essentially of an upright cylinder having a number of horizontal hearths over which the ore passes in traveling from top to bottom of the furnace. Horizontal arms or rabbles attached to a rotating vertical shaft running through the center of the furnace, draw the ore toward openings through which it falls from hearth to hearth. Heated air and ore vapors are drawn through the furnace and delivered to the condensers by a counter-current blower system. This type of furnace is currently in use at the Cordero mine in Nevada.

Marketing. After liquid mercury is recovered from its ores by distillation, it is "bottled" and sent to market in a state of comparatively high purity known as "prime virgin." The U. S. Government in its mercury purchase

Figure 9. Mining native mercury from ground underlying the old Knox brick furnace at the Guadalupe mine, Santa Clara County. The dragline feeds the washing plant where mercury and some cinnabar are recovered in Ainsley bowls.

exceeded the New York quotation. The Engineering and Mining Journal New York quotation of October 7, 1954, was $325-$330 per flask, an all-time high.

History of Price and Production. In 1824 the first recorded discovery of cinnabar in the United States was made in the hills south and west of San Jose, Santa Clara County, California. This locality later became the site of the famous New Almaden mine. The red mineral was not recognized as cinnabar and it was unsuccessfully treated for the recovery of silver. Twenty years passed before it was accurately identified. Mercury was successfully extracted about 1846 and a ready market for the metal was provided by the nearly simultaneous beginning of gold mining in the Sierra Nevada.

Mercury was essential to the placer miner in recovering gold from the pan, the rocker, and the sluice box. As the gold rush grew in importance so also did mercury mining. This trend was manifested by the increase in production from 7,723 flasks in 1850 to an all-time peak of 79,396 flasks in 1877. Much of this metal came from the very rich ore of the New Almaden deposit. In the years following 1850 many other deposits were found in various counties. The first recorded production at the Guadalupe mine was in 1857, the New Idria in 1858, the Knoxville in 1862, and the Aetna mines in 1864, the Great Western in 1873, the Sulphur Bank in 1874, and the Mt. Jackson (Great Eastern) in 1875.

Figure 10. Ledge of resilicified quartz breccia carrying metacinnabar and cinnabar cropping out at surface at Valley View mine, Panoche district, San Benito County. View northwest showing road, ore bin and ore chute from shallow underground workings.

Many other smaller mines contributed to the record production ranging from 50,000 to nearly 80,000 flasks per year during the years 1875-82 inclusive. The price fell rapidly from the $105.18 average of 1874 to $28.23 a flask in 1882, when a 10 percent ad valorem duty was placed on imports of mercury. It was a period of overproduction despite the large consumption for gold amalgamation in hydraulic mining and in pan amalgamation at lode gold mines.

In the following years the duty on imported mercury was changed several times. but the price did not appreciably improve until World War I. An average price of $114 per flask was reached in 1918. but by 1921 it had dropped to $44.56. Following World War I the uncertainty of prices hindered development of the mines and reserves of ore were at a low point. The rich deposits of New Almaden appear to have been nearly exhausted before 1895, but moderate production continued until 1925.

In 1922 the duty was increased to $19 per flask and, with growing industrial activity, a new impetus was given to mercury mining. The price reached an average of $118.34 per flask in 1928, and a moderate gain in production was made up to 1931 when, 13,478 flasks were recovered. Economic conditions forced the price down to $52.30 in 1932. The New Idria mine was the principal source of mercury in California from 1895 until 1932 when operations were greatly curtailed by the depression and the belief that the mine was nearly exhausted.

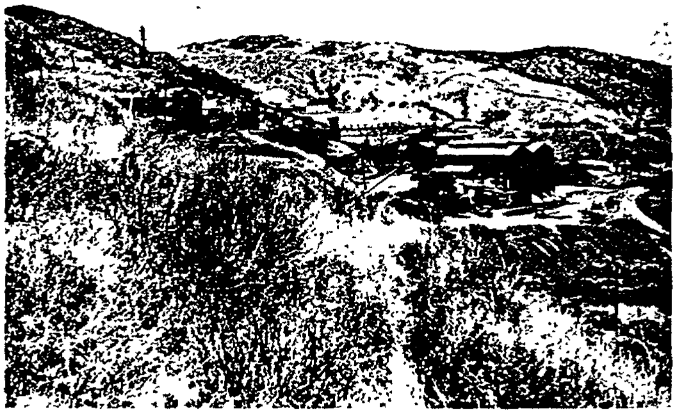

Figure 11. Surface installations at the New Idria mine, San Benito County. This mine is California's largest current producer of mercury. Ore-crushing plant at left, kiln-house at right, camp in upper right background.

The start of Civil War in Spain and growing tension in Europe, however, created a shortage of mercury in the late thirties. Prices rose, mining was stimulated and production climbed from the low point of 4,102 flasks in 1933 to 33,948 flasks in 1943. The price reached $184.58 (average) for 1942. In February 1942 a ceiling price of $191 per flask f.o.b., shipping point, was placed on California mercury by the Federal Office of Price Administration. In the six-year period 1940 to 1945 inclusive, covering the duration of World War II, the price ranged from $113.14 to $184.58, averaging nearly

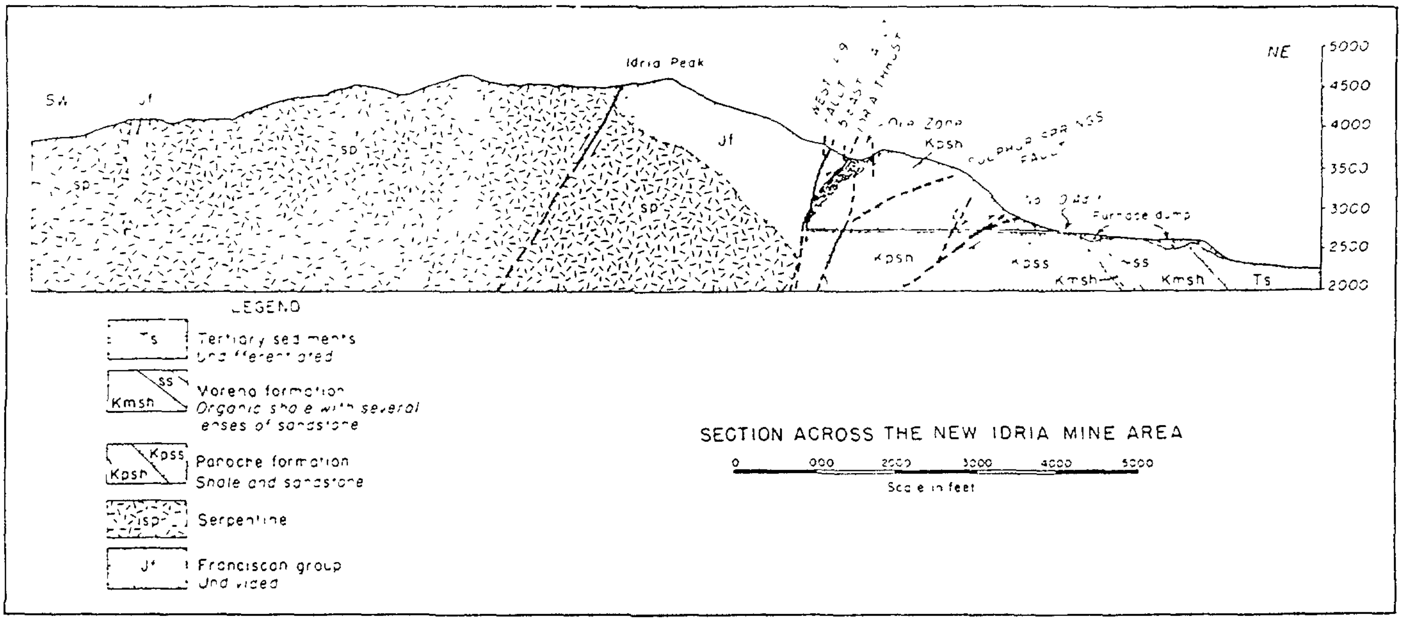

FIGURE 12. Geologic section across the New Idria mine. *From Eckel, Yates, and Myers, 1946.*

$159.00 per flask at San Francisco. For the same period average production was 26,285 flasks per year.

Purchase contracts of the U. S. Government were cancelled in 1944. The price dropped, production declined, and this downward trend in domestic mercury production remained unchecked for 5 years.

After an initial post World War II slump, consumption continued at a higher rate than during any recent peace time period. Virtually all use-classifications shared in this increase, including construction of mercury boiler plants and the construction of chlorine and caustic soda plants which use mercury electrolytic cells. World supplies of mercury were more than ample in the post war period and the increased consumption was largely supplied by metal imported from low-cost mines in Spain, Italy and Yugoslavia.

The pertinent factors influencing the post-war mercury industry were: (1) large stocks of mercury here and abroad, (2) world production capacity at record height, (3) the extreme need of dollar credits by foreign countries, (4) the low production cost of Spanish, Italian, and other foreign producers.

A cartel, Mercurio Europeo, once controlled the marketing of both Spanish and Italian quicksilver. This organization later marketed only the Spanish output which is obtained principally from the fabulous Almaden Mines. The richness of the ore of Almaden exceeds by far any other mercury deposit in the world. With the added advantage of lower labor cost, Spanish mercury can be shipped to the United States, carry a $19.00 per flask import tariff and still be profitably sold at a figure below domestic cost of production.

Low mercury prices accompanied by increased costs of mine operation resulted in the closing of nearly all the domestic mines. By 1950, California production had fallen to 3850 flasks, the lowest level in 28 years; and production in the United States fell to the lowest level in 100 years. Only one major domestic mine, the Mt. Jackson in Sonoma County, was in continuous operation in 1950. In June of the same year the quoted price in New York had fallen to $70-$72 per flask.

The outbreak of war in Korea late in June 1950 resulted in a series of sharp advances in price which culminated in a New York quotation of $225-$227 per flask in January 1951. A few mines were reopened and production increased slightly during the next 2 years.

Under the Defense Production Act of 1950, mercury was classed as a strategic mineral, and mercury mines became eligible for U. S. Government exploration loans. Eight California mines received financial assistance: the Abbott, the Altoona, the Granada, the New Almaden, the New Idria, the Mt. Diablo, the Oceanic, and the Walibu. At New Almaden an unsuccessful drilling exploration program was begun in 1951 and completed in 1952. At New Idria an underground exploration program was begun in 1952 at the northwest end of the mine. This work proved successful and a new ore zone

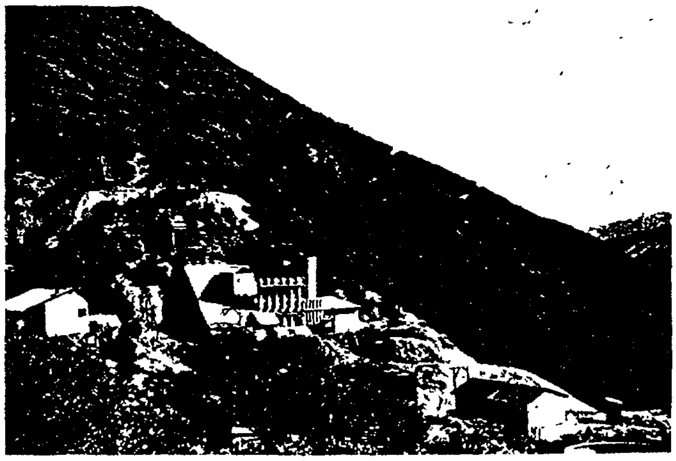

FIGURE 13. Headframe and ore treatment plant at the Lions Den mine, Cachuma district, Santa Barbara County. This mine was a producer during World War II.

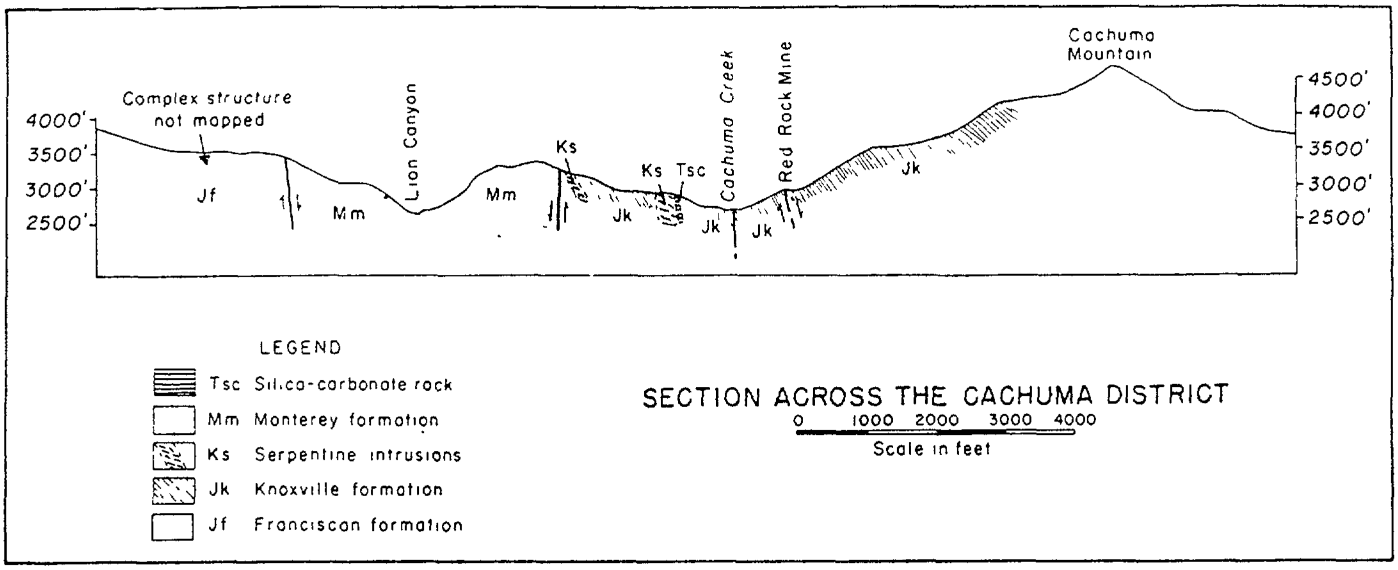

FIGURE 14. Geologic section across the Cachuma district, Santa Barbara County. *After Everhart, 1950.*

was found. Additional loans were granted in 1953 and 1955 to continue exploration in the West Idria and Molino areas. At Mt. Diablo an underground exploration program was begun late in 1953, was suspended during 1954, but was resumed in 1955 after a change in management at the mine; only small showings were discovered The drilling program at the Walibu mine was unsuccessful. A large new ore body was developed under the government program at the Abbott mine. Exploration work at the Altoona mine did not begin until the latter part of 1955. Work is still in progress here as well as at the Granada and Oceanic mines.

The price of mercury hovered around the $200 per flask level during the 3-year period January 1951 to January 1954. The price structure exhibited renewed vigor during the second quarter of 1954 and resumed its upward trend reaching an all-time peak of $330 per flask in October 1954. The belief was widespread that federal purchases of mercury for use in the atomic energy program were reducing the available supply and were responsible for the increase in price during the year.

Meanwhile, on July 6, 1954, the General Services Administration announced a program for the purchase of

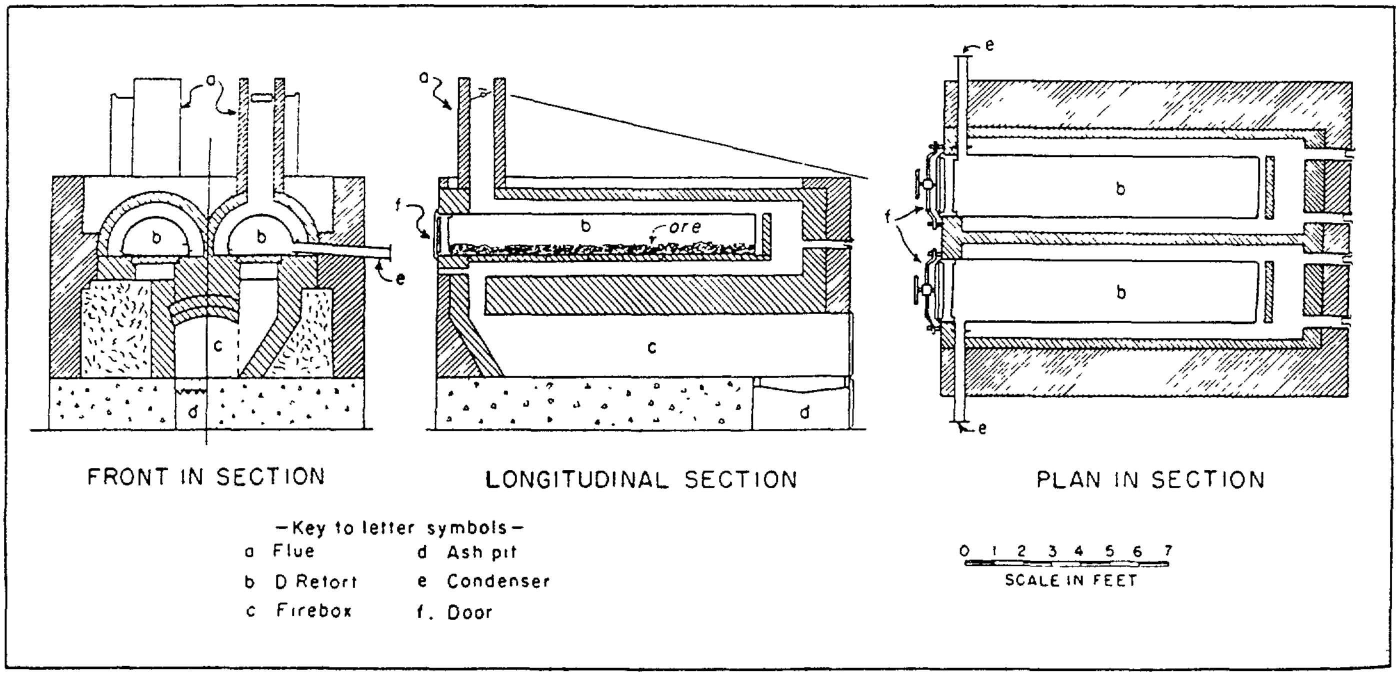

FIGURE 15. Details of a D-retort. *From U.S. Bur. Mines Inf. Circ. 6966.*

Table 1. Annual amount and value of mercury produced in California, 1850-1955.

(Flasks, as tabulated herein, contained 76½ lbs. from 1850 to May 1904, inclusive; 75 lbs. from June 1904 to 1927, inclusive; 76 lbs. from 1928 to date. Sources of information used in preparing this table are: 1850-83, a table by J. B. Randol published in Report 4 of the State Mineralogist, p. 336; 1883-93, reports of the U. S. Geological Survey; 1894-1946, compiled by State Division of Mines; 1947-1955 compiled by U. S. Bur. Mines.

Year	Flasks	Value	Average price per flask	Year	Flasks	Value	Average price per flask
1850	7,723	$768,052	$99.45	1904	28.876	1.086,323	37.62
1851	27,779	1,859,248	66.93	1905	24,655	886,081	35.94
1852	20,000	1,166,600	58.33	1906	19,516	712,334	36.50
1853	22,284	1,235,648	55.45	1907	17,379	663,178	38.16
1854	30,004	1,663,722	55.45	1908	18,039	763,520	42.33
1855	33,000	1,767,150	53.55	1909	16,217	773,788	47.71
1856	30,000	1,549,500	51.65	1910	17,665	799,002	45.23
1857	28,204	1,374,381	48.73	1911	19,109	879,205	46.01
1858	31,000	1,482,730	47.83	1912	20,600	866,024	42.04
1859	13,000	820,690	63.13	1913	15,661	630,042	40.23
1860	10,000	535,500	53.55	1914	11,373	557,846	49.05
1861	35,000	1,471,750	42.05	1915	14,199	1,157,449	81.52
1862	42,000	1,526,700	36.35	1916	21,427	2,003,425	93.50
1863	40,531	1,705,544	42.08	1917	24,382	2,396,466	98.29
1864	47,489	2,179,745	45.90	1918	22,621	2,579,472	114.03
1865	53,000	2,432,700	45.90	1919	15,200	1,353,381	89.04
1866	46,550	2,473,202	53.13	1920	10,278	775,527	75.45
1867	47,000	2,157,300	45.90	1921	3,157	140,666	44.56
1868	47,728	2,190,715	45.90	1922	3,466	191,851	55.35
1869	33,811	1,551,925	45.90	1923	5,458	332,851	60.98
1870	30,077	1,725,818	57.38	1924	7,948	543,080	68.33
1871	31,686	1,999,387	63.10	1925	7,683	621,831	80.81
1872	31,621	2,084,773	65.93	1926	5,892	516,382	87.64
1873	27,642	2,220,482	80.33	1927	6,488	714,418	111.67
1874	27,756	2,919,376	105.18	1928	7,107	844,649	118.84
1875	50,250	4,228,538	84.15	1929	10,152	1,195,705	117.78
1876	75,074	3,303,256	44.00	1930	11,374	1,255,257	110.36
1877	79,396	2,961,471	37.30	1931	13,478	1,121,624	83.22
1878	63,880	2,101,652	32.90	1932	5,349	279,780	52.30
1879	73,684	2,194,674	29.85	1933	4,102	229,472	55.94
1880	59,926	1,857,706	31.00	1934	7,946	534,135	67.22
1881	60,851	1,815,185	29.83	1935	9,353	628,590	67.23
1882	52,732	1,488,624	28.23	1936	8,758	671,055	76.62
1883	46,725	1,343,344	28.75	1937	9,995	837,789	83.82
1884	31,913	973,347	30.50	1938	12,171	846,497	69.55
1885	32,073	986,245	30.75	1939	11,201	1,105,563	98.43
1886	29,981	1,064,326	35.50	1940	18,907	3,209,754	169.77
1887	33,769	1,430,749	42.38	1941	25,612	4,509,041	176.03
1888	33,250	1,413,125	42.50	1942	30,087	5,553,357	184.58
1889	26,464	1,190,880	45.00	1943	33,948	6,177,159	181.96
1890	22,926	1,203,615	52.50	1944	28,097	3,178,969	113.14
1891	22,904	1,036,406	45.25	1945	21,063	2,697,835	128.08
1892	27,993	1,139,595	40.71	1946	17,804	1,648,758	92.61
1893	30,164	1,108,527	36.75	1947	17,165	1,437,397	83.74 (NY)
1894	30,416	934,000	30.70	1948	11,188	855,770	76.49 (NY)
1895	36,104	1,337,131	37.04	1949	4,493	357,014	79.46 (NY)
1896	30,765	1,075,449	34.96	1950	3,850	313,000	81.26 (NY)
1897	26,691	993,445	37.28	1951	4,282	899,777	210.13 (NY)
1898	31,092	1,188,626	38.23	1952	7,241	1,441,683	199.10 (NY)
1899	29,454	1,405,045	47.70	1953	9,290	1,793,249	193.03 (NY)
1900	26,317	1,182,786	44.94	1954	11,262	2,977,560	264.39 (NY)
1901	26,720	1,285,014	48.46	1955	9,500	2,755,500	290.35 (NY)
1902	29,552	1,276,524	43.20				
1903	32,094	1,335,954	42.25	Totals	2,670,100	$159,017,958	

125,000 flasks of domestic mercury by December 31, 1957 at the price of $225 per flask. This announcement had the effect of establishing a floor price on domestic mercury for a 3½-year period and initiated a scramble for inactive deposits. By March 1, 1956, the open market price had declined to $265 per flask. Only a token quantity of domestic mercury was purchased under the stockpile program during the first two years of its operation because the market price was at all times above the Government price. Domestic production, however, is increasing and the outlook for mercury mining appears favorable.

Utilization. The domestic consumption of mercury in 1954 (exclusive of possible unreported atomic energy uses) totaled 42,796 flasks. This total was distributed in generally recognized use categories as follows (U. S. Bur. Mines, 1955): 33 percent in the manufacture of electrical apparatus, 21 percent in the manufacture of industrial and control instruments, 18 percent in agriculture, 7 percent in miscellaneous uses, 5 percent as dental mercury, 5 percent in electrolytic cells, 4 percent in pharmaceuticals, 3 percent in general laboratory use, 1 percent in catalysts, 1 percent in antifouling paint, ½ percent in amalgamation and ½ percent in munitions. This distribution is shown graphically in the accompanying chart. These percentages vary from year to year, and many of the uses annually account for markedly different proportions of the total consumption in the United States.

Mercury is a metal which is obtained from its ores in a high state of purity. Since it is a liquid at ordinary temperatures it may be used where metallic properties are desirable, but where solid metals are unsuitable.

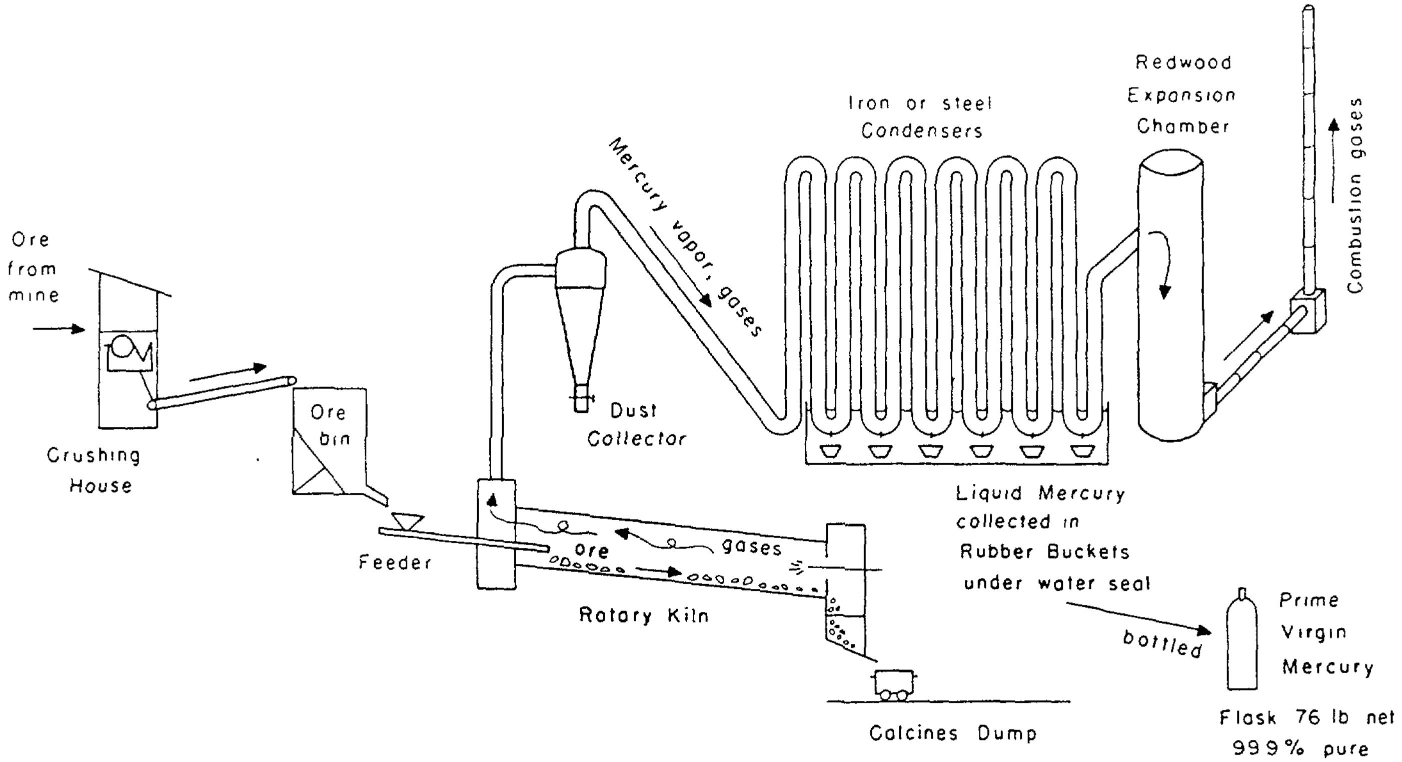

FIGURE 16. Typical flow sheet at a mercury mine.

The useful properties of mercury and the manner in which they are employed can be readily demonstrated by briefly reviewing the use categories mentioned above:

1. **Electrical apparatus.**

As an excellent conductor of electricity, mercury is particularly useful in relay tubes, switches, rectifiers, oscillators, various vapor lamps, neon signs, and batteries.

2. ***Industrial and control instruments.***

The high density of mercury and its property as a conductor of heat are used effectively in thermometers, heat control devices, barometers, weightometers, gas-pressure gages, gas analysis apparatus, flow meters, compensating clock pendulums, vacuum pumps, gyrocompasses, and clutches.

3. **Agriculture.**

As an important element in the manufacture of organic and inorganic compounds used in agriculture, mercury enters into the preparation of seed disinfectants, turf fungicides (ethyl mercury phosphate), and antiseptic plant germicides. Some of these are products used as a fungicide in the paper pulp industry (phenyl mercuric acetate), to prevent the formation of mold in paper pulp. They are used extensively in the paint and varnish industry both as preservatives and as fungicides. During the war they were applied as mildew rot preventatives for fabrics and leather.

4. **Dental Mercury.**

Mercury is a good solvent for gold, silver, bismuth, cadmium, lead, sodium, tin and zinc: consequently it is easily contaminated. Solutions of silver, copper, tin, and zinc in mercury, known as amalgams, are used extensively as dental materials.

5. **Electrolytic cells.**

The electrical conductivity and amalgamation of mercury are utilized in the electrolytic preparation of caustic soda and chlorine from a saline solution. At the mercury cathode a sodium amalgam is produced which immediately is converted into a caustic soda solution of high concentration and purity.

6. **Pharmaceuticals.**

Inorganic compounds of mercury are known as mercury salts. Some inorganic compounds of mercury are poisonous and are used in medicine as antiseptics (mercuric chloride, mercury cyanide), as germicides (mercuric iodide), and as prophylactics. Many organic compounds such as phenyl mercuric acetate, a powerful germicide, are also pharmaceuticals.

7. ***General laboratory.***

Regulators, electrodes, pressure generators, liquid pistons, agitators and seals for water-soluble gases, are some of the devices employing mercury in general laboratory service.

8. **Catalysts.**

Mercury salts are used in the manufacture of some organic compounds such as synthetic acetic acid.

9. **Antifouling paint.**

Mercuric oxide is used in making paint for ship bottoms. Salt in the seawater converts the oxide to poisonous mercuric chloride which kills marine animals that attach themselves to the hull of the ship.

10. **Amalgamation (see 4 above).**

The extraction of gold from its ores by amalgamation with mercury was once the principal use of mercury.

Table 2

	Appearance	Residue on ignition
ACS (American Chemical Society)	Bright, free from scum	0.0005%
NF IX (National Formulary)	Bright, globular	0.01%
ADA (American Dental Association)	" , mirrorlike	0.02%
Military Specifications		
MIL M 191A & B Grade I	" , " , free from scum	0.10%
Grade II	" ,	0.005%
Veterans Administration VA D-	" , " ,	0.02%
USP (U S Pharmacopoeia) This is [illegible] and not brought up to date		

Table 3.

Prime Virgin	Mercury as it comes from the mines, 99 9 percent pure Meets MIL-M 191A Grade I Only available in iron flasks, 76 lbs net No label
Technical	Prime Virgin cleaned and filtered and repacked into 10, 5, and 1 lb jugs It is not "redistilled" or "triple distilled" Meets MIL M 191A Grade I specification No analysis is shown on the label
Cleaned Virgin	"Triple distilled" or "redistilled" mercury meeting NF IX, ADA, MIL-M 191A Grade II, and VA D 23 specifications Only available in lacquer lined iron flasks, 76 lbs net No label (guaranteed "triple distilled" NF IX quality when packed)
Triple Distilled	Meets NF IX MIL M 191A Grade II, and VA D 23 specifications Only available in 10, 5 1 lb bottles or jugs *Label analysis* Maximum impurities—Conforms to NF and ADA Specifications Non volatile ---------------- 0 001% Insoluble in HNO_3 ---------------- 0 000% Base metals ---------------- 0 00%
Reagent Cathodic	Meets ACS specifications Only available in 10, 5, 1 lb. bottles or jugs *Label analysis* Maximum impurities—Conforms to ACS Specifications Non volatile matter -------- 0 0000% Insoluble matter -------- 0 0000% Foreign matter -------- 0 0000%

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REFERENCE 4

MOUNT JACKSON (GREAT EASTERN-ROARING LION)
QUICKSILVER MINE

Location: About 3 miles north-northeast of Guerneville and the Russian River; Sections 8, 9, 16, and 17, T. 8 N., R. 10 W., Healdsburg 15' quadrangle, Sonoma County (see Figure 1). The mine is readily accessible by a paved road.

Ownership: Sonoma Mines, Incorporated, P. O. Box 226 (18475 Sweetwater Springs Road), Guerneville, California 95446 (C.O. Reed, President; A.G. Mowry, General Superintendent), owns 410 acres of fee land and patented mining claims. The mine phone is 707-869-2013. Originally, in the late 1800's, the Mount Jackson and Great Eastern were operated as 2 adjacent, but separate mines. After a few years the mines were operated as a unit (see below).

History and Production: The following section was taken from Myers and Everhart (1948):

> "The Great Eastern and Mount Jackson mines have been worked during three periods, the first beginning in 1875; and at the end of 1945 they had produced 58,467 flasks of quicksilver, which is more than two-thirds the total production of Sonoma County. From 1882 to 1894, when the price of quicksilver ranged between $29 and $52.50 per flask these mines were the only producers in the county."
>
> "The first and longest period of mining extended from 1875 to 1906. Because of the rise of quicksilver prices during World War I, operations were carried on in the upper workings of the Great Eastern mine from May 1915 until early in 1919. The current period of mining began in the summer of 1934."
>
> "During the first few years of production, the two mines were worked independently and each operator reduced his own ore. From 1888 to 1906 the Mount Jackson property was leased by the Great Eastern operators, the ore from both mines was hoisted through the Great Eastern shaft and burned in the Great Eastern furnaces. By 1905 the main shaft of the Great Eastern mine had been sunk from the elevation of the zero level to a depth of 500 feet, and a winze extended 120 feet deeper; levels had been driven, also, at —70 feet, —140 feet, —220 feet, —360 feet, —500 feet, and —620 feet. Damage caused by the earthquake of April 18, 1906, led to the closing of the mines, and when they were reopened in May 1915 the lower levels were flooded. Until operations ceased in 1919, mining was carried on only above the hoist level in the Great Eastern mine."
>
> "From 1934 to 1939, several townspeople of Guerneville worked the adit level of the Mount Jackson mine intermittently and produced a few flasks of quicksilver. Sonoma Quicksilver Mines, Inc., gained control of the property in June 1940, and within a short time they built the plant that is still in use, began to dewater the mines,

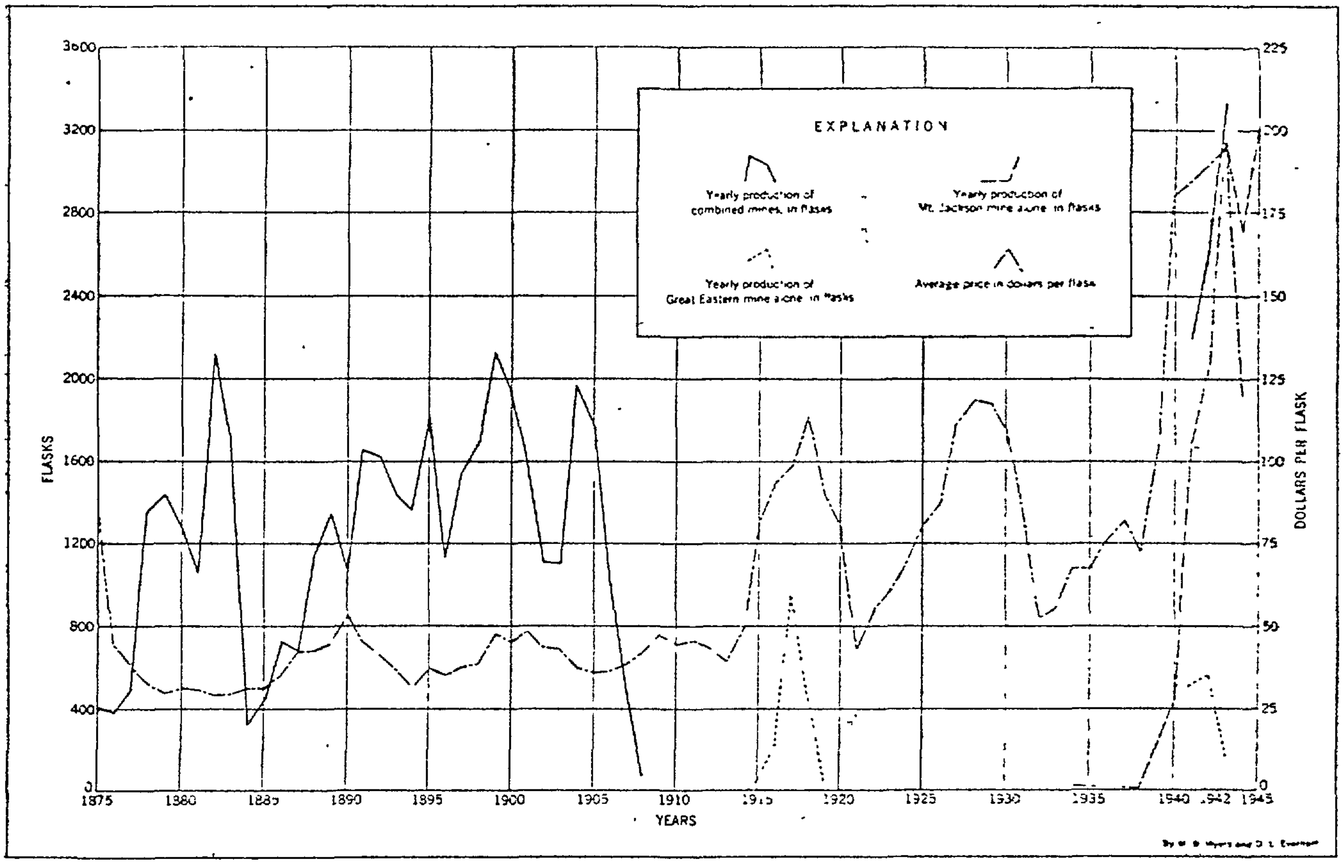

FIGURE 2. Production chart for the Great Eastern and Mount Jackson mines, 1875-1945.

Figure 2. Production of the Great Eastern and Mount Jackson Mines, 1875-1945 (taken from Myers and Everhart, 1948, p. 258). From 1875 to 1906, the data show combined production. During 1915-1919 only the Great Eastern mine was in operation, and from 1934 to 1945 separate and composite data are given.

and sank the Mount Jackson underground shaft from the adit level. They started production on September 9, 1940. In May 1941 the Great Eastern property was acquired by Magee Mercury, Inc., which erected the present plant and began production on July 15, 1941. The Great Eastern mine was dewatered by pumping out the Mount Jackson mine, and its main shaft was cleaned out and retimbered to the —500-foot level."

Figure 2, and Table 1, show production in various ways, and that except for 1963 and 1964, the mine has been in continuous production from 1941 to present. . Total production figures show that this is the third largest producer in California and the fifth largest mercury mine in the United States.

Physiography: The mine area is locally steep, and for the most part rugged. Relief is about 800 feet (see Figure 1). Both mine and mill buildings are adjacent to Wilson Creek, midway between its headwaters and the junction with Fife Creek. Fife Creek joins the Russian River just west of Guerneville. Wilson Creek is dry or nearly so, from May through November; about 6 months of the year. Rainfall data is shown in Table 2. Records show that a maximum rainfall ranges from about 44 to 66 inches per year - the highest in January. Creek flow probably coincides closely with rainfall.

Geology: Most of the area north of Guerneville is underlain by sandstone with some interbedded volcanic flows and tuffs, chert, and shale. All these rocks belong to the Franciscan Formation of Upper Jurassic age (145 ± 5 million years). After deposition of the rocks, they were probably folded, but certainly faulted. A major northwest trending fault zone was developed and serpentinite dikes were intruded into, and adjacent to the fault zone. Soon after emplacement of the serpentinite it was altered by hot, gas-charged mineralizing solutions to cinnabar (mercurious sulfide-HgS)-bearing silica-carbonate rocks. Pyrite (disulfide of iron-FeS_2) is present locally. About 1% is the maximum noted by Myers and Everhart (1948, p. 268). Cinnabar ore shoots dip generally north at about 75°. They are pipe-like and tabular in shape, and are roughly 50 feet by 50 feet by 100-300 feet in length down the dip. Shoots are mostly confined to zones of weakness within the silica-carbonate rocks, which are about 100 to 200 feet thick and extend down dip at least 1,700 feet from the Mount Jackson tunnel level. Grade of ore has varied from 2 pounds to 26 pounds of mercury per ton of silica-carbonate rock. In recent years, however, the ore has ranged from 5 pounds to 6 pounds of mercury per ton (see Table 1).

Mining and Milling: Ore is presently extracted from several levels of the mine (see Figure 3), the deepest is 1,450 feet below the ground surface measured from the collar of the Great Eastern shaft. In the past, ore has been extracted from stopes connected by several thousands of feet of drifts, crosscuts, raises, and winzes (see Figure 3). Ore has been hoisted in the Great Eastern shaft - east of the works shown on Figure 3 - but now all ore is hoisted from the work areas up the Mount Jackson winze (underground shaft) to the Mount Jackson tunnel level. A 1-ton skip brings ore from the 1,450-foot level and other levels to a relay station on the 1,200-foot level. From here, a 2-ton skip brings ore to the tunnel level. It is then placed into a 150-ton storage bin. A 2-car compressed air tram takes ore from the bin along the tunnel, through the portal, and on down to the jaw crusher at the mill. Ore is crushed to 1 1/2 inches and finer, and then passed by gravity to a 30-ton storage bin. A 70-foot conveyor belt then takes ore to the shotgun feeder where it is fed to the rotary kiln. About 90 tons of ore are processed in 24 hours. Two D retorts with a total capacity of about 1 ton are used to burn soot from the condensing columns. Fifty men are employed; 35 underground, 7 in the mill - which runs 24 hours, 5 in the maintenance shops, and 3 in management and supervision.

Water Use and Debris Disposal: Water from the mine workings is pumped directly into Wilson Creek just south of the Mount Jackson tunnel, at a rate of 145,000 to 150,000 gallons per day. Even so, Wilson Creek has little or no surface flow in the dry summer months. When it does have surface flow, it could cause erosion of the mine dumps near the buildings (see Figure 4). Therefore, a wooden flume has been built to carry water from the mill area over to the area where Wilson Creek drains south again. The mine entry road here has a culvert under it, which empties into another wooden flume that places water in the discharge area of the first mentioned flume. The culvert and adjoining flume are necessary to prevent erosion of the road and dump by water from a steep ravine just northwest of the road. Water for mine and mill use is taken from springs, adjacent to the Great Eastern shaft, at a rate of 55 gallons per minute. There are 2 storage tanks near the mill with a total capacity of 20,000 gallons.

Clinker from the rotary kiln is taken from the hot box by a 2-car compressed air tram, out to the end of the clinker dump. About 800 to 1,000 pounds of Cyclone dust, as a water slurry, plus waste water from the mill is fed through wooden flumes out to a settling pond between the new clinker dump and an older dump to the east (see Figure 3). The settling pond is dammed and water either evaporates or slowly filters through dump debris before reaching Wilson Creek.

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J. R. Evans, Geologist
California Division of Mines and Geology
1416 Ninth Street, Room 118
Sacramento
445-5716

Property visit: 9/69

Year	Tons Furnaced	Flasks Produced	Gross Value	Average Price per Flask
1946	30,299	2,741	$ 283,269	$ 98
1947	41,897	3,693	316,845	84
1948	43,066	4,120	315,818	76
1949	36,708	4,271	337,689	79
1950	35,682	3,561	253,471	81
1951	31,789	2,566	377,567	210
1952	42,017	2,448	494,128	200
1953	37,134	3,009	582,660	193
1954	41,497	2,661	522,553	264
1955	43,287	2,345	713,165	290
1956	21,495	1,159	304,034	260
1957	1,072	95	23,521	247
1958	29,721	3,461	794,643	229
1959	30,489	3,925	889,072	227
1960	36,074	3,227	681,022	210
1961	40,478	3,358	666,056	197
1962	25,550	1,423	108,004	191
1963	----------			189
1964	----------			315
1965	19,342	922	475,040	570
1966	27,990	1,971	875,635	441
1967	31,407	2,411	1,149,320	489
1968	33,238	2,305	1,195,612	542
1969	26,170	1,927	1,003,279	

Table 1. Summary of production of mercury from the Mount Jackson Mine.

	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	Jul.	Aug.	Sep.	Total
1948	.92	3.96	9.82	3.16	10.16	15.07	0.28	0.63	0	0	0	0	44.00
1949	0	3.57	4.04	17.94	8.14	6.62	1.86	1.70	0	0	0	0	43.87
1950	4.70	12.03	14.27	12.52	8.63	3.00	1.91	3.52	0	0	0	0	60.58
1951	5.18	12.95	16.76	18.09	5.43	11.12	0.68	0.33	1.18	0	0	0	71.72
1965	4.56	9.96	16.02	10.61	2.55	3.05	7.70	0	0	0	0	0	54.45
1966	0.22	12.71	6.75	14.25	5.89	3.07	1.87	0.22	0.15	0	0.39	0	45.52
1967	0	12.44	10.97	22.08	0.34	9.60	7.60	0.10	2.14	0	0.20	0.20	65.67
1968	1.60	4.79	5.71	12.97	8.82	5.94	1.88	0.51	0	0	0	0	42.22
AVERAGE	2.15	9.05	10.54	13.95	6.24	7.31	2.97	0.87	0.43	0	0.07	0.03	53.46
1969	4.00	5.48	16.00	22.29	16.48	2.29	3.81	0.04	0	0	1.15	0	71.54

Table 2. Rainfall data gathered at the Mount Jackson Mine by A. G. Mowry.

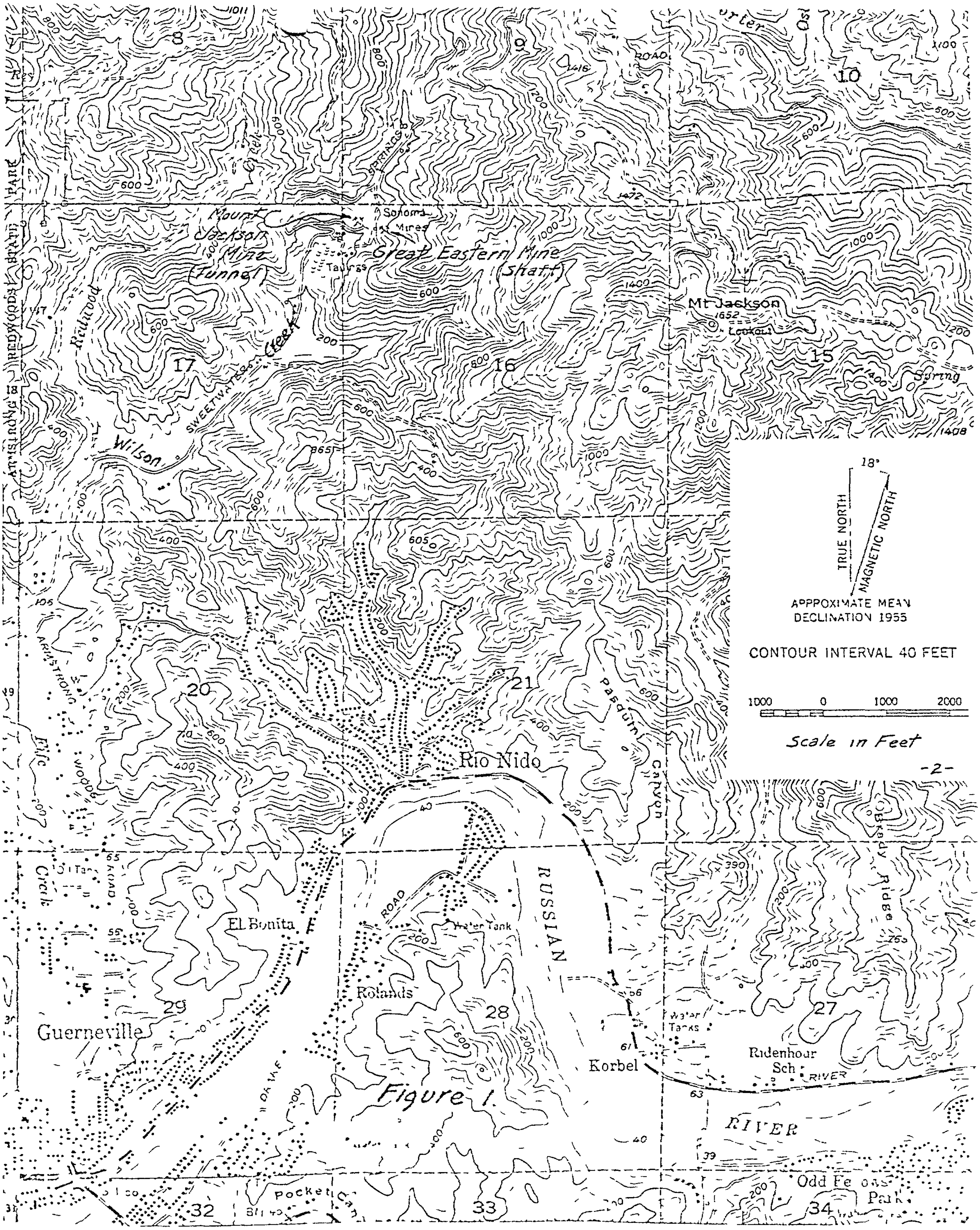
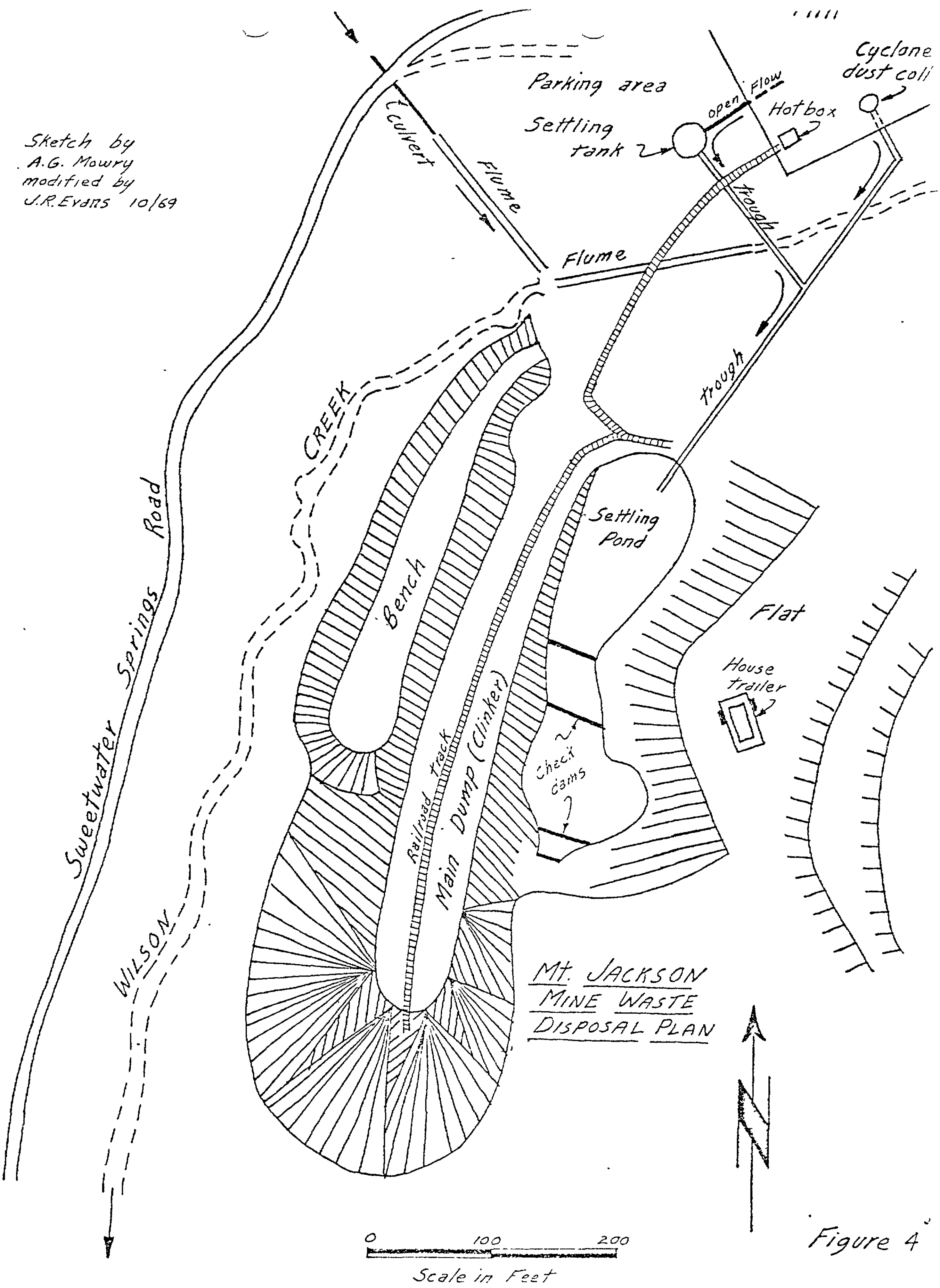

Mount Jackson Mine (Tunnel)
Sonoma Mines
Taurus
Great Eastern Mine (Shaft)
Mt Jackson
1652
Lookout
Spring
Redwood Creek
Sweetwater Creek
Wilson
ARMSTRONG REDWOODS STATE PARK
ARMSTRONG WOODS ROAD
Rio Nido
Pasquini Canyon
RUSSIAN
RIVER
El Bonita
Water Tank
ROAD
Rolands
Water Tanks
Guerneville
Korbel
Ridenhour Sch
Elk Creek
Oil Tank
Pocket Can
Odd Fellows Park
8
9
10
15
16
17
18
20
21
27
28
29
32
33
34
18°
TRUE NORTH
MAGNETIC NORTH
APPROXIMATE MEAN DECLINATION 1955
CONTOUR INTERVAL 40 FEET
1000
0
1000
2000
Scale in Feet

Figure 1.



Sketch by
A.G. Mowry
modified by
J.R. Evans 10/69

MT. JACKSON
MINE WASTE
DISPOSAL PLAN

Figure 4

REFERENCE 5

CONTACT REPORT

AGENCY: County Planning Department

ADDRESS:

PERSON CONTACTED: Greg Carr

PHONE NO.: (707) 527-2412 or 527-3687

FROM: E. Brockman

TO: File

DATE: 6/25/85

SUBJECT: Mt. Jackson Mercury Mine

Greg Carr handles quarry operations for the Planning Department. The gravel operations at the Mt. Jackson Mercury Mine are within his purview.

The last company to run the mercury mine was Sonoma International. They shut down in 1971-72 and sold the site and equipment to Walter Doyle. He in turn sold to Piombo (without the equipment) in 1979.

REFERENCE 6

```
PARCEL NO                 OWNER                                                DOCUMENT DATE / NO.    ASSESSED
             TRA          ADDRESS (*-MAIL, #-PROP LOC, --SAME)          ZIP    SALE DATE / AMOUNT      VALUES
                          PROPERTY DESCRIPTION

069 050 08                MARZALEK MICHAEL STANLEY                              1973   2749-430          8,451 LND
             93 001     * 129 MC BROWN RD, PETALUMA CA                  94952
                          # 19855 SWEETWATER SPGS RD                           USE-560
                        -- HARDWOODS AND CHAPARRAL --
--------------------------------------------------------------------------------------------------------------------
069 050 10                BYRD BENJAMIN B                                      8/03/87 87-072924        86,736 LND
             93 001     * P O BOX 304, HEALDSBURG CA                    95448 11/86      70,000  F     53,374 IMP
                          # 20011 SWEETWATER SPGS RD                          LOAN-      50,000  D    140,110 NET
                        -- HARDWOODS/CHAPARRAL W/IMPROV --                     USE-561
--------------------------------------------------------------------------------------------------------------------
069 050 11                VELLUTINI DAN & MARIE                                 1973   2754-199          5,512 LND
             93 001     * 915 CORBY, SANTA ROSA CA                      95401
                          # 20013 SWEETWATER SPGS RD                           USE-560
                        -- HARDWOODS AND CHAPARRAL --
--------------------------------------------------------------------------------------------------------------------
069 050 14                ZAEHRINGER EVA VELLUTINI & WILLIAM A                  1982   82-045083        22,285 LND
             93 001     * 1564 LAGUNA RD, SANTA ROSA CA                 95401
                          # 20350 SWEETWATER SPGS RD                           USE-560
                        -- HARDWOODS AND CHAPARRAL --
--------------------------------------------------------------------------------------------------------------------
069 050 15                PIZZO STEPHEN P & SUSAN E                             1980   80-010062        13,414 LND
             93 001     * P O BOX 1009, GUERNEVILLE CA                  95446                           59,257 IMP
                          # 17840 SWEETWATER SPGS RD                           USE-051                  72,671 NET
                        -- RURAL RESIDENTIAL - 1 RESID. --
--------------------------------------------------------------------------------------------------------------------
069 050 16                GHILOTTI ERNEST & CONSTANCE                           1980   80-010061        34,139 LND
             93 001     * 234 BAYVIEW ST, SAN RAFAEL CA                 94901
                          # 17500 SWEETWATER SPGS RD                           USE-050
                        -- VACANT - RURAL RESD HOMESITE --
--------------------------------------------------------------------------------------------------------------------
069 050 17                PAYETTE DANIEL & GAIL                                 1980   80-010063        24,138 LND
             93 001     * 550 HART LN, SEBASTOPOL CA                    95472
                          # 17530 SWEETWATER SPGS RD                           USE-050
                        -- VACANT - RURAL RESD HOMESITE --
--------------------------------------------------------------------------------------------------------------------
069 060 01                HILLS OF CALIFORNIA                                   1971   2527-624         61,487 LND
             93 001     * 361 RAQUEL LN, LOS ALTOS CA                   94022
                          # 19000 SWEETWATER SPGS RD                           USE-540
                        -- AG - PASTURE --
--------------------------------------------------------------------------------------------------------------------
069 060 04                CITIZENS UTILITIES CO OF CALIF                               0212-146         18,480 LND
             93 001     * P O BOX 2218, REDDING CALIF                   96001
                          # 16505 SWEETWATER SPGS RD                           USE-557
                        -- TIMBER PRESERVE ZONE  LIST B --
--------------------------------------------------------------------------------------------------------------------
069 060 05                FAYLOR ELIZABETH C                                    1966   2204-853         17,930 LND
             93 001     * 16450 LAUGHLIN RD, GUERNEVILLE CA             95446                              762 IMP
                          # 17004 SWEETWATER SPGS RD                           USE-541                  18,692 NET
                        -- AG - PASTURE W/RESIDENCE --
--------------------------------------------------------------------------------------------------------------------
069 060 07                F KORBEL & BROS                                       1973   2755-175          9,603 LND
             93 001     * GUERNEVILLE CA                                95446                              204 IMP
                          # 16006 SWEETWATER SPGS RD                           USE-560                   9,807 NET
                        -- HARDWOODS AND CHAPARRAL --
--------------------------------------------------------------------------------------------------------------------
069 060 08                DOYLE WALTER J                                        1986   86-013056         3,350 LND
             93 001     * P O BOX 146, PILOT HILL CA                    95664
                          # 18002 SWEETWATER SPGS RD                           USE-821
                        -- MINING RIGHTS --
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PARCEL NO.                OWNER                                                DOCUMENT DATE / NO.    ASSESSED
             TRA          ADDRESS (*-MAIL, #-PROP LOC, =-SAME)          ZIP    SALE DATE / AMOUNT      VALUES
                          PROPERTY DESCRIPTION
--------------------------------------------------------------------------------------------------------------------
069 060 09                DOYLE WALTER J                                        1986   86-013056        17,229 LND
             93 001     * P O BOX 146, PILOT HILL CA                    95664
                          # 18501 SWEETWATER SPGS RD                           USE-820
                        -- MINERAL PRODUCING PROPERTY --
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069 060 11                CITIZENS UTILITIES CO OF CALIF                               0212-146          5,316 LND
             93 001     * P O BOX 2218, REDDING CALIF                   96001
                          # 15507 SWEETWATER SPGS RD                           USE-557
                        -- TIMBER PRESERVE ZONE  LIST B --
--------------------------------------------------------------------------------------------------------------------
069 060 12                STATE OF CALIFORNIA                                          2085-101          1,286 LND
             93 001     * CAPITOL BLDG, SACRAMENTO CA                   95814
                          # 15008 SWEETWATER SPGS RD                           USE-910
                        -- VACANT - STATE GOV. LAND --
--------------------------------------------------------------------------------------------------------------------
069 060 13                DOYLE WALTER J                                        1986   86-013056       122,866 LND
             93 001     * P O BOX 146, PILOT HILL CA                    95664
                          # SWEETWATER SPGS RD                                 USE-050
                        -- VACANT - RURAL RESD HOMESITE --
--------------------------------------------------------------------------------------------------------------------
069 060 15                CARY N DWIGHT                                        7/31/86 86-057440        66,300 LND
             93 001     * P O BOX 1071, GUERNEVILLE CA                  95446 07/86     132,000  F     78,340 IMP
                          # 19333 SWEETWATER SPGS RD                          LOAN-      92,400  D      7,000-HO
                        -- RURAL RESIDENTIAL - 1 RESID. --                     USE-051                 137,640 NET
                                                                               PHN-(415) 776-9142
--------------------------------------------------------------------------------------------------------------------
069 060 19                SALTMARSH ROBERT W ET AL                             7/30/87 87-071722 GD    122,000 LND
             93 001     * 154 BAKER ST, SAN FRANCISCO CA                94117 07/87     190,000  F     68,000 IMP
                          # 17975 SWEETWATER SPGS RD, GUERNEVILLE             LOAN-     152,000  D    190,000 NET
                        -- HARDWOODS/CHAPARRAL W/IMPROV --                     USE-561
--------------------------------------------------------------------------------------------------------------------
069 060 20                GERVAIS MICHAEL                                      6/18/85 85-038346 GD    130,050 LND
             93 001     * 2293 FRANCISCO AV, SANTA ROSA CA              95401 06/85     125,000  F
                          # 17969 SWEETWATER SPGS RD, GUERNEVILLE              USE-560
                        -- HARDWOODS AND CHAPARRAL --
--------------------------------------------------------------------------------------------------------------------
069 060 21                CITIZENS UTILITIES CO OF CALIF                        1979   3655-426          1,169 LND
             93 001     * P O BOX 2218, REDDING CA                      96099
                          # 17975 SWEETWATER SPGS RD, GUERNEVILLE              USE-811
                        -- UTILITY - WATER COMPANY --
--------------------------------------------------------------------------------------------------------------------
069 060 22                WEINER GARY ET AL                                     1979   3524-120         45,402 LND
             93 001     * 19000 SWEETWATER SPRINGS RD, GUERNEVILLE CA   95446                           11,526 IMP
                          # 18990 SWEETWATER SPGS RD                           USE-051                   7,000-HO
                        -- RURAL RESIDENTIAL - 1 RESID. --                                              49,928 NET
--------------------------------------------------------------------------------------------------------------------
069 060 24                KORNFELD JOHN & PROTHRO LAURIE                       8/26/86 86-066132        55,040 LND
             93 001     * P O BOX 82, GUERNEVILLE CA                    95446 08/86      52,000  F     68,850 IMP
                          # 18755 SWEETWATER SPGS RD                           USE-051                 123,890 NET
                        -- RURAL RESIDENTIAL - 1 RESID. --
--------------------------------------------------------------------------------------------------------------------
```

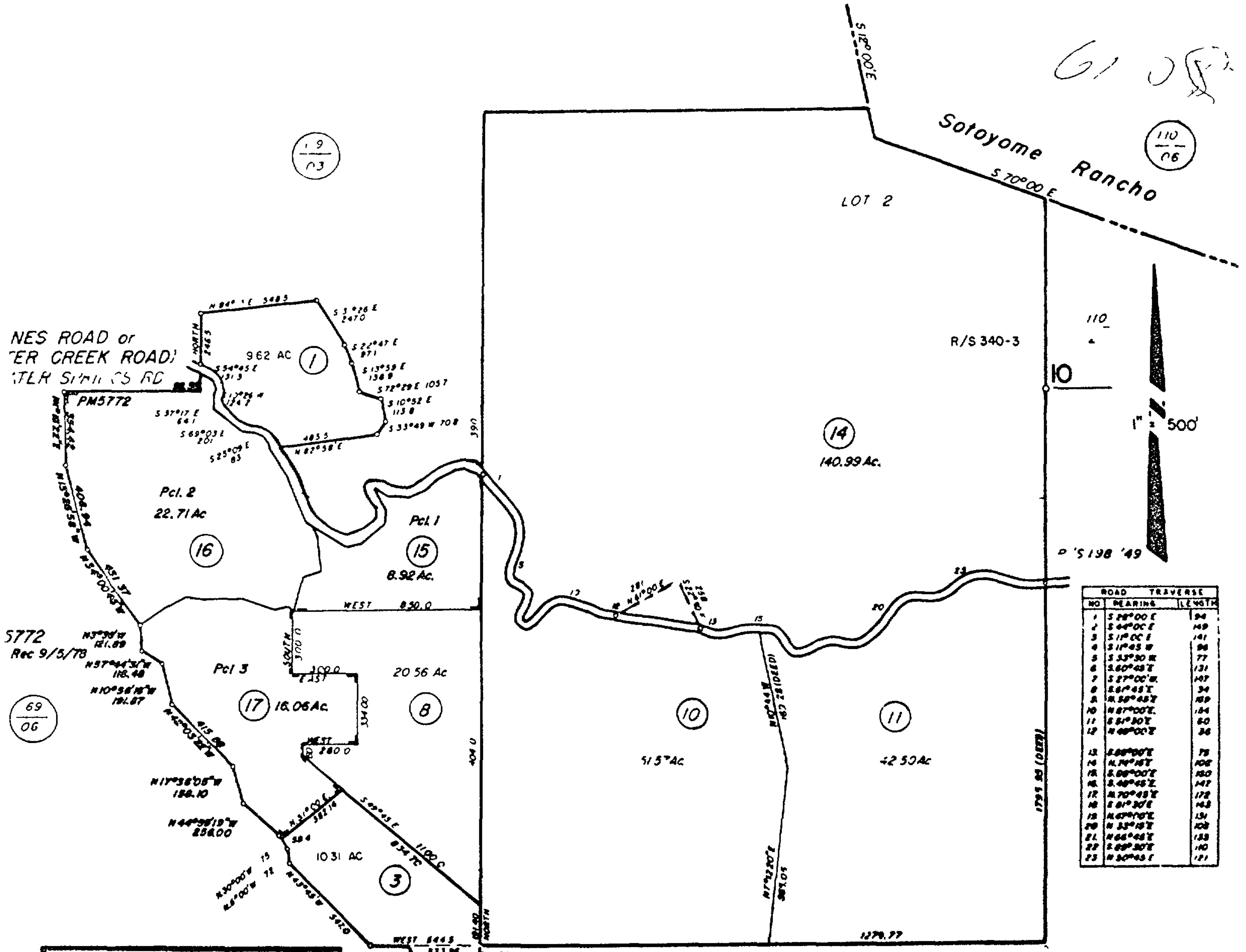
```
          [illegible]   * 135 E SIR FRA     DRAKE, LARKSPUR CA           94939
                  # 19450 MC CRAY      RD, GUERNEVILLE                    USE-560
                -- HARDWOODS AND C   RRAL --
-------------------------------------------------------------------------------------------------
069 030 37          TRUETT HAROLD & LOIS                                  1986   86-018407        62,424 LND
          93 001  * RT 1 RANCHO ENTADO, SAN ANDREAS CA           95429
                -- HARDWOODS AND CHAPARRAL --                        USE-560
-------------------------------------------------------------------------------------------------
[illegible]         COOPERSMITH ANN E                                     1973   2732-549         13,314 LND
          [illegible]  * 158 W BLITHEDALE, MILL VALLEY CA           94941                           5,376 IMP
                -- TIDELANDS --                                      USE-580                   18,690 NET
-------------------------------------------------------------------------------------------------
069 040 13          LUNDBORG BRADFORD W ET AL                             1981   81-033146         5,928 LND
          93 009  * P O BOX 2827, SANTA ROSA CA                  95405
                -- HARDWOODS AND CHAPARRAL --                        USE-560
-------------------------------------------------------------------------------------------------
069 040 14          LARSON GARY L & CAROL ANNE                            1970   2489-692         13,314 LND
          93 009  * 820 QUETTA, SUNNYVALE CA                     94087
                -- HARDWOODS AND CHAPARRAL --                        USE-560
-------------------------------------------------------------------------------------------------
069 040 15          SYMONS MICHAEL JOSEPH & DEBORAH LYNN                  1983   83-078638        24,355 LND
          93 009  * 5356 MILL CREEK RD, HEALDSBURG CA            95448                          44,922 IMP
                -- HARDWOODS/CHAPARRAL W/IMPROV --                   USE-561                   69,277 NET
-------------------------------------------------------------------------------------------------
069 040 16          LUNDBORG BRADFORD W ET AL                             1981   81-033146         2,966 LND
          93 009  * P O BOX 2827, SANTA ROSA CA                  95405
                -- VACANT RES. LOT - UNDEV. --                       USE-000
-------------------------------------------------------------------------------------------------
069 040  8          BREAZEALE GARY E & KATHERINE A                        1982   82-032027        56,307 LND
          93 009  = 5362 MILL CREEK RD, HEALDSBURG CA            95448                          54,541 IMP
                -- SINGLE FAMILY DWELLING --                         USE-010                    7,000-HO
                                                                                              103,848 NET
-------------------------------------------------------------------------------------------------
069 040 22          TAYLOR O P & CONNIE E                                        1747-154         14,219 LND
          93 009  * BOX 5386 MILL CREEK RD, HEALDSBURG CA        95448                           8,573 IMP
                  # PALMER CRK RD                                    USE-056                   22,792 NET
                -- RURAL RESID. W/MOBILEHOME --
-------------------------------------------------------------------------------------------------
069 040 23          GAMBLE RICHARD E                                      1972   2709-156          7,040 LND
          93 009  * C/O ROGER RAICHE, 181 STONEWALL RD, BERKELEY C 94705
                  # PALMER CRK RD                                    USE-050
                -- VACANT - RURAL RESD HOMESITE --
-------------------------------------------------------------------------------------------------
069 040 24          MAZURE KRIS                                           1985   85-007989        19,102 LND
          93 009  = 5360 MILL CREEK RD, HEALDSBURG CA            95448                          41,388 IMP
                -- RURAL RESIDENTIAL - 1 RESID. --                   USE-051                    7,000-HO
                                                                     PHN-(707) 433-4987        53,490 NET
-------------------------------------------------------------------------------------------------
069 050 01          GOODRICH JANICE ROSE & WAYNE CHANDLER & GREGORY D     1986   86-085181        31,212 LND
          93 001  * C/O JAN GOODRICH, 1190 FAIR BROOK DR, MT VIEW  94040                        34,333 IMP
                  # 19600 SWEETWATER SPGS RD                         USE-052                   65,545 NET
                -- RURAL RESIDENTIAL - 2+RESID. --
-------------------------------------------------------------------------------------------------
069 050 03          HAYES STEPHEN RUSSELL                                 1984   84-042804        48,709 LND
          93 001  = 19502 SWEETWATER SPRINGS RD, HEALDSBURG CA   94948                          65,062 IMP
                -- RURAL RESIDENTIAL - 1 RESID. --                   USE-051                  113,771 NET
-------------------------------------------------------------------------------------------------
```

```
 PARCEL NO.                 OWNER                                        DOCUMENT DATE / NO.   ASSESSED
            TRA             ADDRESS (*-MAIL, #-PROP LOC, =-SAME)  ZIP    SALE DATE / AMOUNT    VALUES
                            PROPERTY DESCRIPTION
-------------------------------------------------------------------------------------------------
069 050 08          MARZALEK MICHAEL STANLEY                              1973   2749-430          8,451 LND
          93 001  * 129 MC BROWN RD, PETALUMA CA                 94952
                  # 19855 SWEETWATER SPGS RD                         USE-560
                -- HARDWOODS AND CHAPARRAL --
-------------------------------------------------------------------------------------------------
069 050 10          BYRD BENJAMIN B                                   8/03/87 87-072924        86,736 LND
          93 001  * P O BOX 304, HEALDSBURG CA                   95448 11/86      70,000  F     53,374 IMP
                  # 20011 SWEETWATER SPGS RD                        LOAN-       50,000  D    140,110 NET
                -- HARDWOODS/CHAPARRAL W/IMPROV --                   USE-561
-------------------------------------------------------------------------------------------------
069 050 11          VELLUTINI DAN & MARIE                                 1973   2754-199          5,512 LND
          93 001  * 915 CORBY, SANTA ROSA CA                     95401
                  # 20013 SWEETWATER SPGS RD                         USE-560
                -- HARDWOODS AND CHAPARRAL --
-------------------------------------------------------------------------------------------------
069 050 14          ZAEHRINGER EVA VELLUTINI & WILLIAM A                  1982   82-045083        22,285 LND
          93 001  * 1564 LAGUNA RD, SANTA ROSA CA                95401
                  # 20350 SWEETWATER SPGS RD                         USE-560
                -- HARDWOODS AND CHAPARRAL --
-------------------------------------------------------------------------------------------------
069 050 15          PIZZO STEPHEN P & SUSAN E                             1980   80-010062        13,414 LND
          93 001  * P O BOX 1009, GUERNEVILLE CA                 95446                          59,257 IMP
                  # 17840 SWEETWATER SPGS RD                         USE-051                   72,671 NET
                -- RURAL RESIDENTIAL - 1 RESID. --
-------------------------------------------------------------------------------------------------
069 050 16          GHILOTTI ERNEST & CONSTANCE                           1980   80-010061        34,139 LND
          93 001  * 234 BAYVIEW ST, SAN RAFAEL CA                94901
                  # 17500 SWEETWATER SPGS RD                         USE-050
                -- VACANT - RURAL RESD HOMESITE --
-------------------------------------------------------------------------------------------------
069 050 17          PAYETTE DANIEL & GAIL                                 1980   80-010063        24,138 LND
          93 001  * 550 HART LN, SEBASTOPOL CA                   95472
                  # 17530 SWEETWATER SPGS RD                         USE-050
                -- VACANT - RURAL RESD HOMESITE --
-------------------------------------------------------------------------------------------------
069 060 01          HILLS OF CALIFORNIA                                   1971   2527-624         61,487 LND
          93 001  * 361 RAQUEL LN, LOS ALTOS CA                  94022
                  # 19000 SWEETWATER SPGS RD                         USE-540
                -- AG - PASTURE --
-------------------------------------------------------------------------------------------------
069 060 04          CITIZENS UTILITIES CO OF CALIF                               0212-146         18,480 LND
          93 001  * P O BOX 2218, REDDING CALIF                  96001
                  # 16505 SWEETWATER SPGS RD                         USE-557
                -- TIMBER PRESERVE ZONE  LIST B --
-------------------------------------------------------------------------------------------------
069 060 05          FAYLOR ELIZABETH C                                    1966   2204-853         17,930 LND
          93 001  * 16450 LAUGHLIN RD, GUERNEVILLE CA            95446                             762 IMP
                  # 17004 SWEETWATER SPGS RD                         USE-541                   18,692 NET
                -- AG - PASTURE W/RESIDENCE --
-------------------------------------------------------------------------------------------------
069 060 07          F KORBEL & BROS                                       1973   2755-175          9,603 LND
          93 001  * GUERNEVILLE CA                               95446                             204 IMP
                  # 16006 SWEETWATER SPGS RD                         USE-560                    9,807 NET
                -- HARDWOODS AND CHAPARRAL --
-------------------------------------------------------------------------------------------------
069 060 08          DOYLE WALTER J                                        1986   86-013056         3,350 LND
          93 001  * P O BOX 146, PILOT HILL CA                   95664
                  # 18002 SWEETWATER SPGS RD                         USE-821
                -- MINING RIGHTS --
```

COUNTY ASSESSOR'S PARCEL MAP

TAX CODE AREA
93-001

61 05



ROAD TRAVERSE		
NO	BEARING	LENGTH
1	S 28°00 E	94
2	S 44°00 E	149
3	S 11°00 E	141
4	S 11°45 W	96
5	S 33°30 W	77
6	S 60°45 E	131
7	S 27°00' W	107
8	S 61°45 E	34
9	N 58°45 E	159
10	N 87°00 E	154
11	S 51°30 E	60
12	N 48°00 E	36
13	S 88°00 E	75
14	N 74°15 E	106
15	S 88°00 E	150
16	S 48°45 E	147
17	N 70°45 E	172
18	S 81°30 E	143
19	N 67°15 E	131
20	N 33°15 E	108
21	N 66°45 E	133
22	S 89°30 E	110
23	N 30°45 E	121

NOTE: THIS MAP WAS PREPARED FOR ASSESSMENT PURPOSES ONLY. NO LIABILITY IS ASSUMED FOR THE ACCURACY OF THE DATA DELINEATED HEREON.

83/01

Assessor's Map Bk.69 F
Sonoma County, Calif.

SCALE 1 (10/INCH) 0 10 20 30 40 50 60

1:800.527.9663

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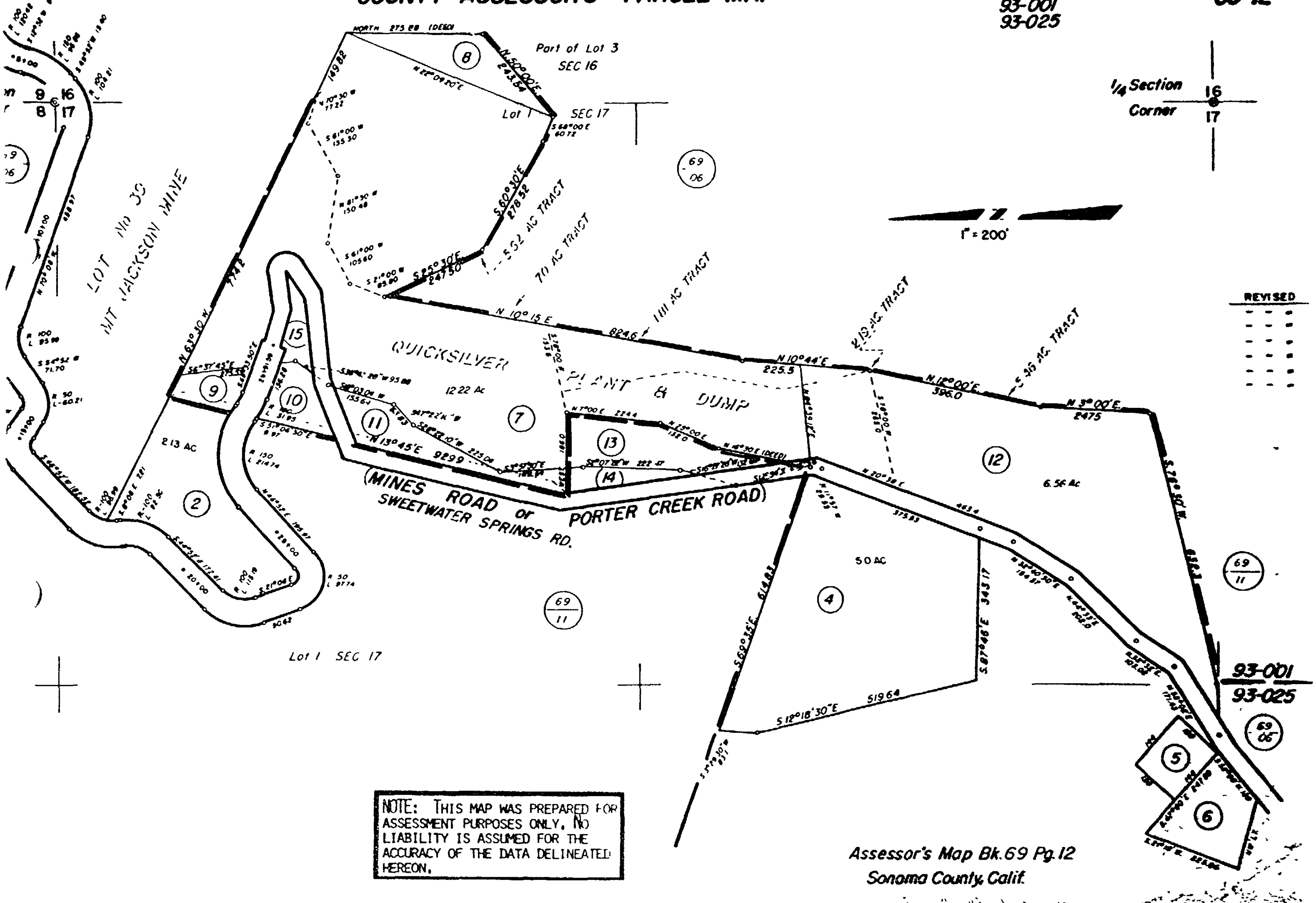
SCALE 1 (10/INCH) 0 10 20 30 40 50 60

1.800.527.5663

COUNTY ASSESSOR'S PARCEL MAP

TAX CODE AREA
93-001
93-025

69-12



NOTE: THIS MAP WAS PREPARED FOR ASSESSMENT PURPOSES ONLY. NO LIABILITY IS ASSUMED FOR THE ACCURACY OF THE DATA DELINEATED HEREON.

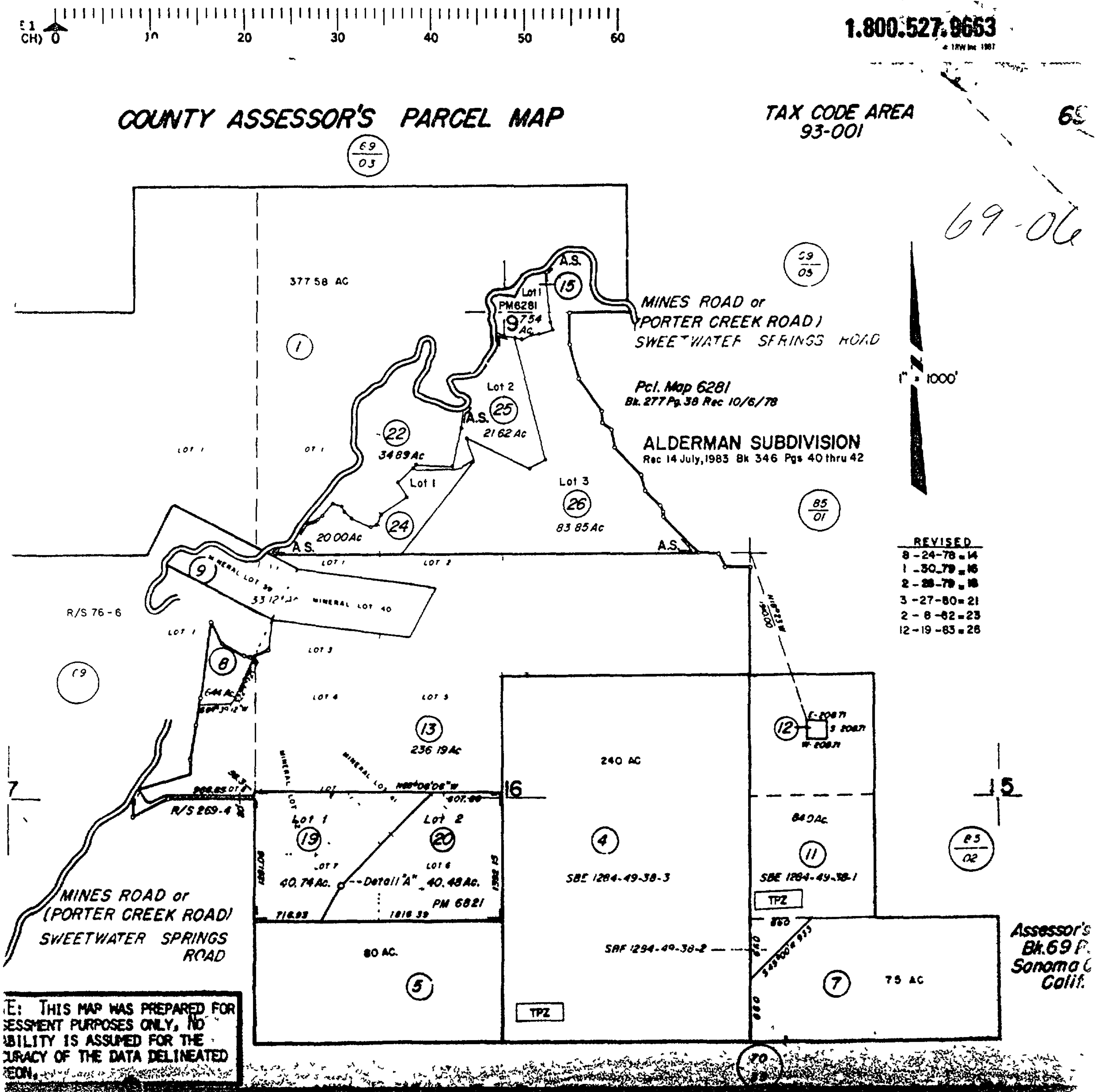
Assessor's Map Bk.69 Pg.12
Sonoma County, Calif.

1.800.527.9653

COUNTY ASSESSOR'S PARCEL MAP

TAX CODE AREA
93-001

69-06



REVISED
8-24-78 = 14
1-30-79 = 16
2-28-79 = 18
3-27-80 = 21
2-8-82 = 23
12-19-83 = 26

Assessor's
Bk. 69 P.
Sonoma C.
Calif.

E: THIS MAP WAS PREPARED FOR
SESSMENT PURPOSES ONLY, NO
BILITY IS ASSUMED FOR THE
URACY OF THE DATA DELINEATED
EON.

REFERENCE 7

CONTACT REPORT

AGENCY: Sonoma County Assessor's Office

ADDRESS: Santa Rosa, CA

PERSON
CONTACTED: woman

PHONE NO.: (707) 527-2541

FROM: Dick Jones

TO: File

DATE: 1-26-89

SUBJECT: Mt. Jackson Mine owner

cc:

I asked the Assessor's representative for the owner of 18475 Sweetwater Springs Road (address furnished by Doug Price of DHS, Santa Rosa). She found the Assessor's Parcel Number to be 069-120-07 and the corresponding owner to be Walter J. Doyle, P.O. Box 146, Pilot Hill, CA 95664. (This corresponded to Dr. Price's report of the "Doyle Mine" sign at the Mt. Jackson site.)

REFERENCE 8

Trip to Guerneville June 10, 1980, leaving 8:50, returning 17:30.

Purpose: Establish credibility of local citizens about noise-dust-toxicity to plant and livestock, generated by a quarring operation at the place of the old Guerneville mercury mine.

People present:

Dr. Williams, W.Mgmt.

Mrs. Williams, W.Mgmt. Mr. Price, Santa Rosa

Dr. Kothny, AIHL

Ms. Lehtinen?, Sacramento

Mr. Kentucky, Piombo quarry public relations.

Mr. and Mrs. Koenigshofer, resident?

Mr. Spector, resident

Mrs. Johnston, resident

The complain:

The 50 to 200 trucks-a-day removing graded rock from the huge tailings pile from the mine, which no longer operates, creates a dust problem. The dust settles onto residents properties (11 residents in the immediate area) and poisons sheep.

A second complain is about mercury from the old tailings percolating into ground water.

A third complain is about mercury emanating from the old tailings and a possible hazard to plant and people.

Observations:

The old tailing consisted of grayish rock, whitish decomposed material and red material. The grayish rock was identified with overburden removed from the interior of the mine and possibly carrying cinnabar in a highly dispersed form. The whitish decomposed material seems to consist of a core of basic rock decaying by weathering o~~n~~f the surface, to~~r~~ what seems to be magnesite. The red material was identified as burnt ore. The quarry uses all of it. A bulldozer dozes the mixture into a pile from which a bucket line picks it up for further processing into different sizes. The finest sized material collects mostly the burnt ore with fines from the other rock types which appears blended into a red looking mixture. This red mixture is locally used in the Guerneville sewer project and is covered by xx asphaltic pavement. However, it is also used as xxxxx gravel cover to keep weeds down on certain areas . Stables in the immediate area used this material extensively and although it keeps weeds down because of its gravely nature, it does not inhibit growth of weeds on open and exposed areas with sufficient light and rain.

Operation of the quarry has improved after complaints about dusting and an extensive watering system has been implemented. Dust on streets is not worse than in other paved areas around the country. Noise is most noticeable at higher elevations, since vegetation blinds off most of it in a straight direction. It is not worse than any city noise and, although one can get used to it, it is a nuisance.

Replies to complaints:
Poisoning of sheep and other livestock may happen from many causes. After the first death, one resident pulled all the grass from a feedlot. However, it is not known if the particular sheep was sick, ate an improper kind of weed, if the grass was treated with some pesticide, or if it died of natural causes. Three other sheep seem to be healthy. Results of laboratory tests of soil, and vegetation will tell if mercury was involved in the death.

Mercury in ground water is a fact. However, the level seems to be within~~g~~ the standard in most areas, except in summer time in the creek above the mine. It is not known if mercury levels in the creek downhill from the mine carries mercury exceeding the standard. Most residents at higher elevations obtain their water from areas different than the creek crossing through the mine. Analysis of the tailings by special methods will tell if mercury may effectively leach from the tailings pile. Since the quarring operation removes more and more of this material, there will be no percolation from this in the near future.

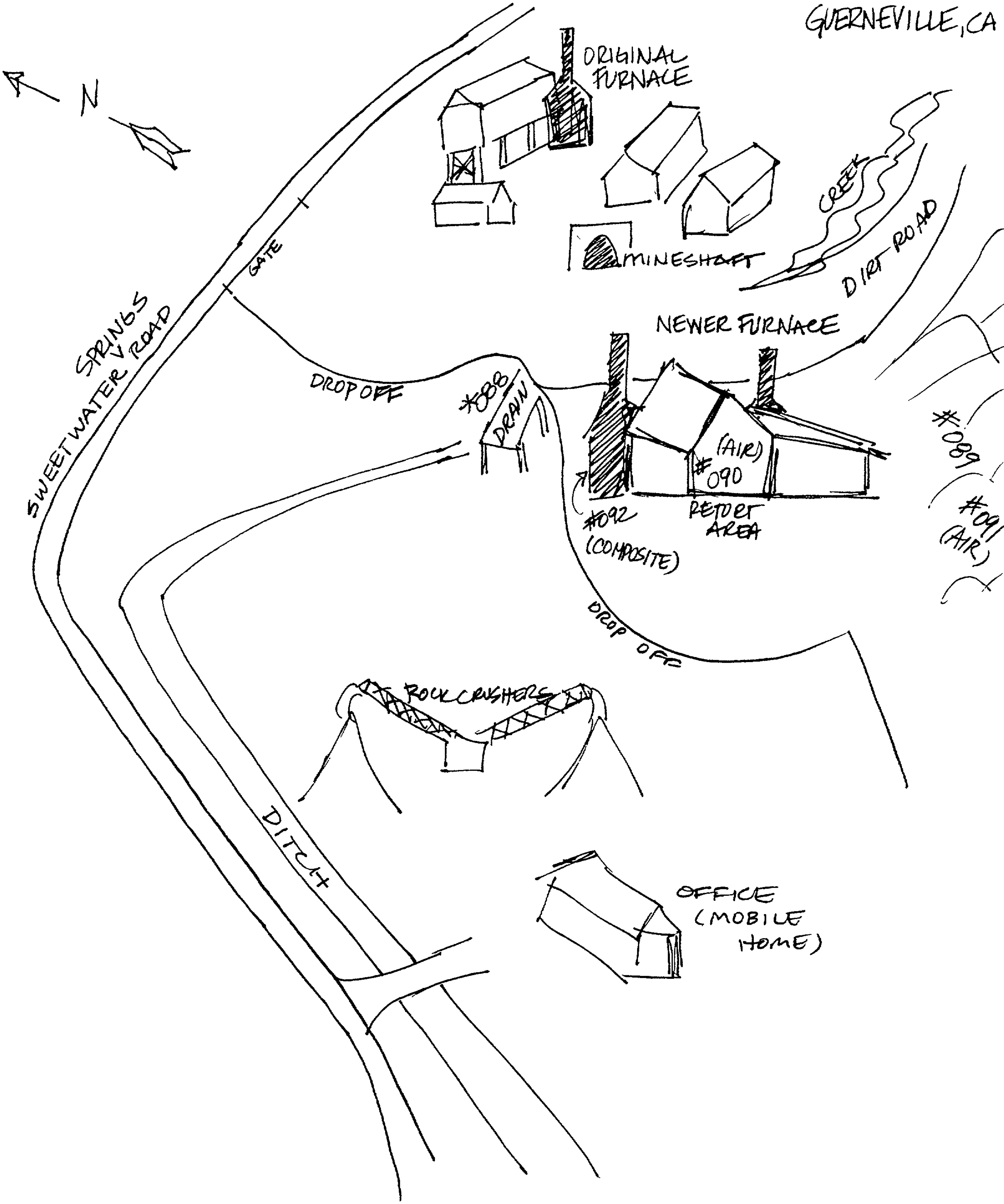
Mercury emanating from old tailings is a possibility, especially from improperly ~~burning~~ heating of the ore. Since fragments used for this operation are generally large (up to 2"), mercury may remain trapped inside after discharging the burnt material onto the pile. Rains and water sprikled onto the pile may effectively conceal this free mercury inside the pile for many years. However, free mercury is not toxic to plant life, and combined mercury is used in golf fields to treat the lawn for mold infection. The amount of mercury inhaled by people is more an hazard. Although this possibility exists, most homes built onto tailings have a ventilated crawling space beneath. It could only be an hazard where such material is used as soil in shacks and this possibility is nowadays very remote. Emanation of mercury from soils and tailings will be established from the laboratory reports once the tests have been finished.

Laboratory tests:
The samples collected will be analyzed for several types of mercury:

1) gaseous mercury. 100 g of representative mixture will be reduced to mesh 10 as quickly as possible, after opening the jar. About 10-20 grams are roughly weighed and filled loosely into a U tube. The tube is inserted into boiling water and a slow air stream is pulled through, collecting the mercury on any suitable substrate for analyzing by your method of choice.
2) Water soluble mercury will be obtained from the sample as treated in 1) using a distilled water solution of 0.1 g/L $NaHCO_3$ + 0.1 g/L KCl + 0.05 g/L oxalic acid.
3) Free mercury will be obtained from the sample as treated in 1) using 8 M HNO_3 at 30 - 40° C for 20 minutes. Filter and analyze.
4) Total mercury will be obtained by your method of choice, e.g. aqua regia.

PIMBO QUARRY

GUERNEVILLE, CA



REFERENCE 9

CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD
North Coast Region

Interoffice Communication

MEMORANDUM

TO: Robert L. Tancreto/David C. Joseph DATE: May 5, 1980

FROM: Robert R. Klamt

SUBJECT: Fife Creek mercury/Piombo Aggregate operation

This is basically a summary of all available information to present with some interpretation of data, and identification of problem areas to be addressed in waste discharge requirements on the aggregate operation and mercury mine.

The Piombo operation, as subcontracted to Caputo & Wagner, consists of crushing and sorting aggregate from the Mt. Jackson Mine tailings pile. Trucks are loaded and weighed on site. At present the aggregate is being used to bed rigid sewer pipe and backfill trenches in the Guerneville sewerage project. An undetermined amount is being sold for various construction purposes throughout Sonoma County. The operation is located adjacent to Wilson Creek, tributary to Fife Creek thence the Russian River, immediately downslope of the mine (Figures 1 & 2). Dust control water is derived from a 40-foot deep well on the property. Excess dust control water flows to a small pond in the southeast side of the operation. This small pond (pond #1) also accepts some site runoff and overflows to a small ditch and thence another pond (pond #2). The latter pond was constructed by Piombo at our request to ensure storage of all process water. A third small pond (pond #3) receives any overflow from pond #2, although that has not yet occurred. At present the third pond only receives some runoff from a storage yard, which then flows to a tributary of Wilson Creek (Figure 2).

On March 19, 1980 a resident of the area came into the office with results of total mercury analysis on water from Wilson Creek, mine tailings, and stream sediments. The water sample, obtained from the stream adjacent to the operation, contained 6 ug/l (ppb) total mercury. As the Title 22 drinking water criteria specify 2 ppb total mercury as an upper limit, I decided to do more intensive monitoring of the stream.

On March 20, 1980 I set up the following sampling sites on and around the mine and operation:

Upstream - at the second crossing of Sweetwater Springs Road upstream of the Mt. Jackson Mercury Mine.

Well - the well located on the Piombo property from which they derive their dust control water (40 feet deep).

Pond - pond #3 adjacent to the well on Piombo property - at the time of sampling received dust control water.

Downstream - at the first crossing of Sweetwater Springs Road downstream of the Mt. Jackson Mercury Mine, the Piombo operation, and a tributary to Wilson Creek.

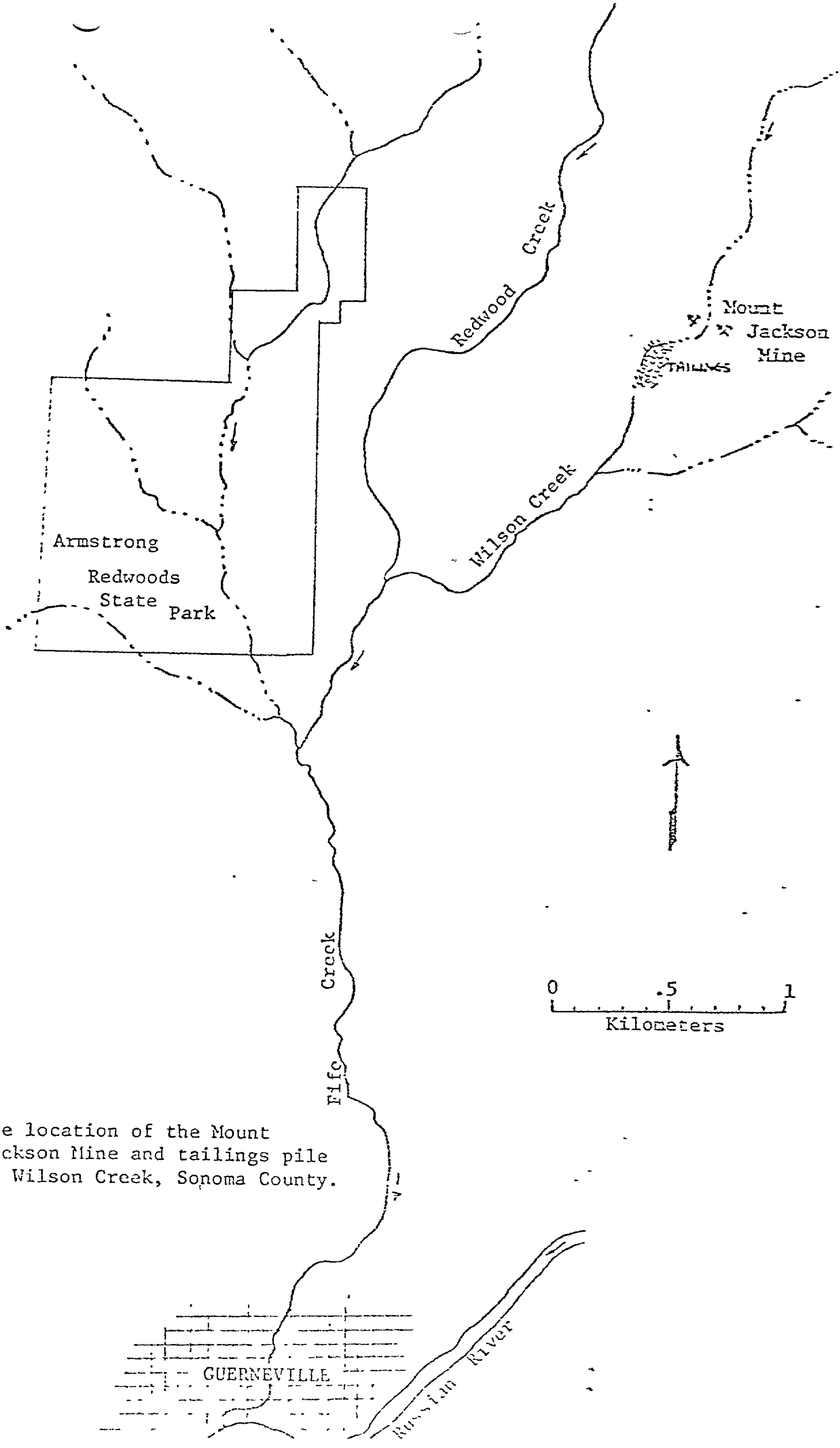


Figure 1. The location of the Mount Jackson Mine and tailings pile on Wilson Creek, Sonoma County.

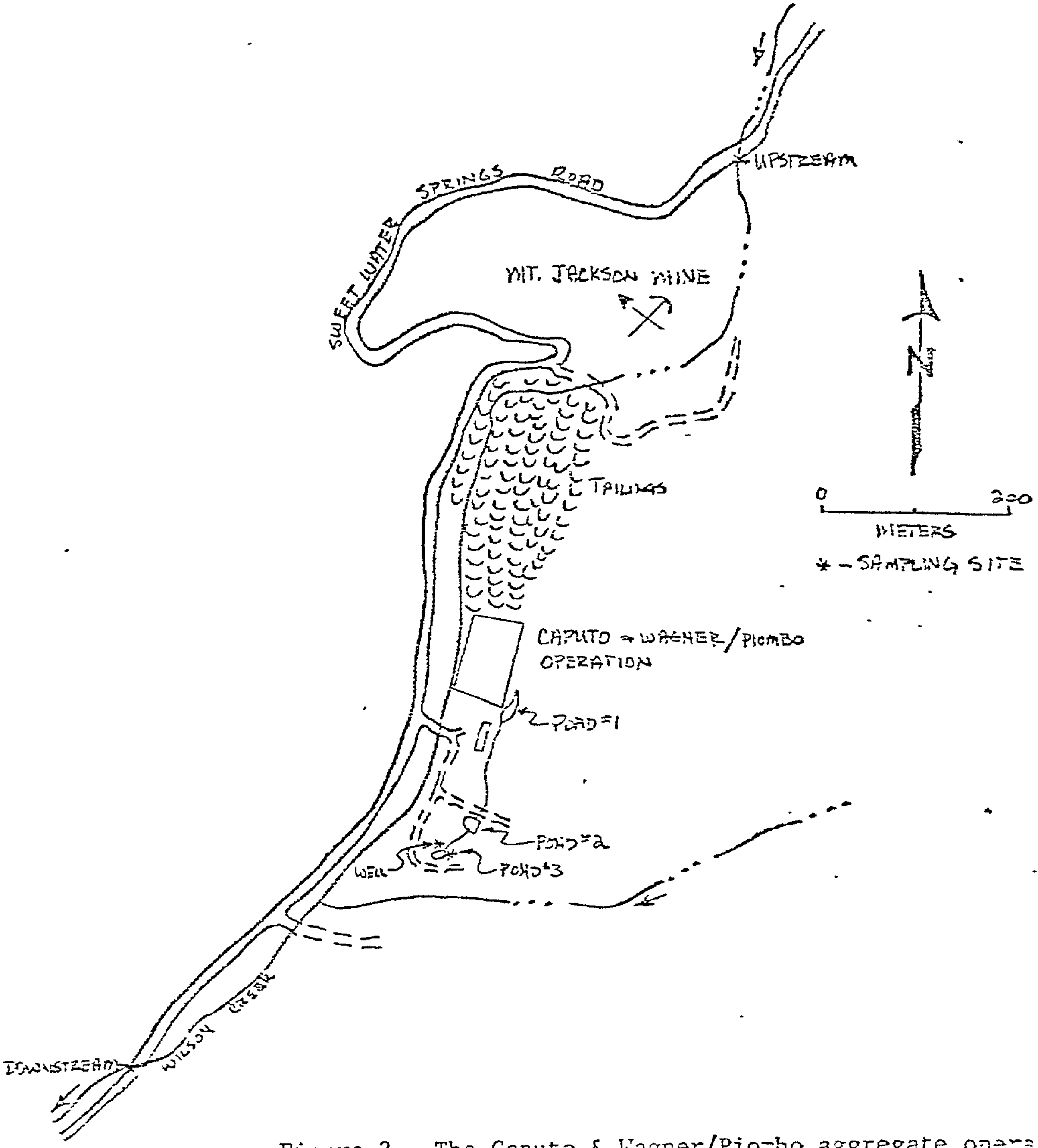


Figure 2. The Caputo & Wagner/Piombo aggregate operation on Wilson Creek in relation to the Mount Jackson Mercury Mine.

Those sampling locations also appear in Figure 2.

Results of six samplings for total and dissolved mercury are enumerated in Table 1. Included for comparison are results from two samplings from the Russian River at Johnson's Beach and Santa Rosa Creek at Pierson Street. Average total mercury concentration in Wilson Creek was larger downstream (0.82 ppb) than upstream (0.44 ppb). To obtain those averages I disregarded the "less than" sign (<) on those values of <0.2 ppb. A paired t-test of the means showed significant difference at the 95% confidence level for total mercury. Dissolved mercury, however, averaged 0.28 ppb at upstream and 0.45 ppb at downstream stations. A paired t-test of the means showed no significant difference in dissolved mercury concentrations at the 95% confidence level.

The well samples were all less than 1 ppb total mercury, in fact four of the five samples were less than 0.5 ppb. All samples for dissolved mercury were less than 0.5 ppb.

Pond #3 was sampled only three times. The total and dissolved mercury concentrations ranged from 5 to 14 ppb and 0.32 to 2.0 ppb, respectively.

One sample of the tailings was taken from the "flour" (small material from the crushing operation). That sample contained 210,000 ppb total mercury. A portion of that sample was put into a plastic column and tap water allowed to perc through. One-half gallon of tap water was percolated through 205 grams of the flour. The change in total mercury concentration was from 0.5 ppb to 14 ppb. Dissolved mercury increased from 0.4 ppb to 1.1 ppb after percolation through the material.

Samples of the benthic invertebrates in Wilson Creek were obtained at the upstream and downstream sites. They contained essentially the same amount of mercury - 720 µg/kg (ppb) upstream and 680 ppb downstream. Two samples of attached algae were also acquired, however the laboratory informed me that they were contaminated with bottom sediments. I rejected the results as invalid.

In an effort to locate the source of mercury in Wilson Creek, I sampled the stream at eight locations as well as a seep area on the north bank of the stream (Figure 3). The seep that was sampled was only one of numerous seeps in the area. Danger of cave-in of the tailings pile prevented further sampling. Those results showed the seep area to be the major contributor to elevated mercury concentrations in Wilson Creek (Table 1). However, those results pointed to no measureable input of mercury to the surface water of Wilson Creek from the Piombo aggregate operation. In fact, total mercury concentrations in Wilson Creek decreased after the initial input of mercury from the seep area (Figure 3). The most probable cause for that decrease would be settling of particulates contributing to the total mercury concentration and/or dilution from other water sources.

Table 1. Mercury concentrations in surface and well waters near the old Mount Jackson Mercury Mine, Spring of 1980.

Date	Sampling Site	Mercury in ug/l (ppb) Total	Dissolved
3/20/80	Upstream	0.3	<0.2
	Well	0.7	0.4
	Pond	5.6	0.9
	Downstream	1.0	0.9
3/25/80	Upstream	1.0	0.7
	Well	<0.2	<0.2
	Pond	5.0	2.0
	Downstream	1.0	1.0
	Russian River	<0.2	<0.2
	Santa Rosa Creek	<0.2	<0.2
3/27/80	Upstream	0.72	<0.2
	Well	0.33	<0.2
	Pond	14.	0.32
	Downstream	0.9	<0.2
3/31/80	Upstream	<0.2	<0.2
	Well	<0.2	<0.2
	Downstream	0.5	<0.2
	Russian River	<0.2	<0.2
	Santa Rosa Creek	<0.2	<0.2
4/2/80	Upstream	<0.2	<0.2
	Well	<0.2	<0.2
	Downstream	0.6	<0.2
4/9/80	Upstream	<0.2	<0.2
	@ Mine	0.2	---
	Seep	3.3	---
	@ Tailings	2.5	---
	@ Piombo Bridge	1.9	---
	Upstream Trib.	1.5	---
	Tributary	<0.2	---
	Downstream	0.9	0.2
	Discharge	1.1	<0.2

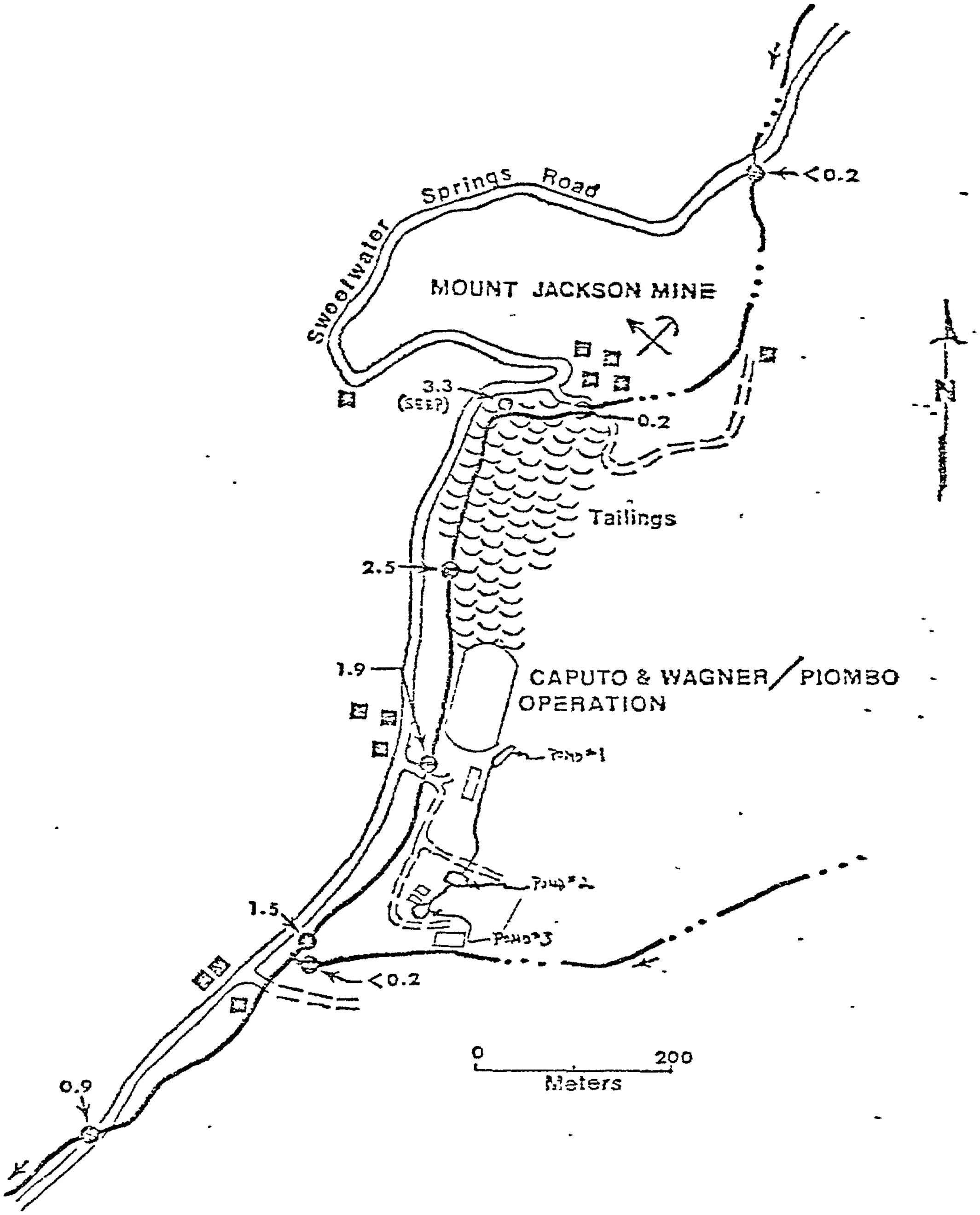


Figure 3. Results of Wilson Creek mercury sampling expressed in ug/l total mercury (ppb) on April 9, 1980. Note the contribution of 3.3 ppb total mercury from the seep on the north bank downstream of the mine.

Numerous conclusions are apparent from the sampling results:

1) Mercury is present in the Wilson Creek watershed. Although average concentrations of total mercury were significantly larger downstream of the mine, mercury occurs in Wilson Creek regardless of the existence of the mine.

2) The elevation in mercury concentration in Wilson Creek from upstream to downstream of the mine was primarily a result of input from the seep area immediately downstream of the mine. The origin of those seeps is unknown but suspected to be from the mine.

3) Our investigations indicate that the elevation in mercury concentrations in Wilson Creek is not a direct result of the present aggregate crushing and sorting operation. Although a pollutional threat exists, good housekeeping and management of the operation should allay any hazard to the beneficial uses of Wilson Creek.

4) Although total mercury concentrations in Wilson Creek are within drinking water standards, those levels exceeded the EPA-suggested maximum of 0.05 ppb for the protection of aquatic life. A problem with that criterion exists in our inability to measure mercury below 0.2 ppb and the existence of mercury at concentrations exceeding that criterion upstream of the mine.

Comparison of the mercury concentrations in Wilson Creek to the literature and EPA-suggested guidelines for the protection of aquatic life is confusing at best. First, the EPA guidelines for the protection of aquatic life state an average of 0.05 ppb total mercury as a maximum. At this time we do not have available to us the capability to measure mercury with reliability below 0.2 ppb. In fact, the EPA methods for analysis state any measure of mercury below 0.2 ppb be listed as less than 0.2 ppb. Secondly, the EPA guidelines comes from the application of a bioconcentration factor salmonids in conjunction with the FDA criterion for food fish. The rationale follows:

> The FDA criterion for edible fish flesh is <0.5 ug/g (ppm) mercury wet weight. A few authors have reported from 4500 to 8500 times concentration of mercury in whole salmonid fish as compared to the water the fish were exposed to. Those studies were not necessarily in nature. By assuming a 10,000 times bioconcentration factor, the allowable maximum in water would be 1/10,000 of 0.5 ppm, or 0.05 ppb. No mention is made of streams which do not contain food fish in reference to actual protection of aquatic life. Also the analyses for mercury were done on whole fish, not just the edible portions.

That criterion is then a very safe level for the protection of public health from the consumption of food fish. However, the criterion does not deal with the protection of aquatic life as the EPA-stated title suggests. Additionally, the first point of our inability to measure mercury in water at such low concentrations dictates that we use a more pragmatic approach -- simply channel efforts to reduce the amount of mercury entering a stream.

The literature varies for a couple of reasons. For one, when mercury contamination came into the spotlight some 10 years ago, the production of mercuric compounds virtually ceased. Thus, few situations existed for the comprehensive study of mercury effects on the aquatic biota in stream systems. Another problem with the existing literature is the lack of standardization. Most work was done in laboratory situations. Some was done in static tests, others in flow -through tests. Some authors report results as mercury per whole fish wet weight, others as whole fish dry weight, and yet others as mercury per weight (wet or dry) of fish flesh. Little work has been done on invertebrates, let alone periphyton. It is apparent that the literature is quite variable and difficult to relate to what may be occurring in nature.

As for problem areas to be addressed in waste discharge requirements, two directly concern the aggregate operation and third concerns the seep areas. Those concerning the aggregate operation are the fine material stockpiled (flour) and the dust control water. Provisions for the containment of the "flour" must ensure no input of mercury into the stream as well as minimize siltation problems. Certainly the "flour" should not be stored or used where rainfall would cause contribution of mercury to a water course. The dust control water does contain significantly-large amounts of mercury. That waste must also be contained on site to ensure no elevation of mercury concentrations in Wilson Creek.

The seep areas need further study to determine their origin and the amount of mercury contributed to Wilson Creek. Piombo Corporation has hired Anatec Lab to evaluate the problem and possibilities for control. Their evaluation will be included in the report of waste discharge. Consideration for methods of control can then be evaluated.

One concern beyond that of water quality is the aggregate itself. Is it safe for all types of construction activities? At what levels of mercury content should certain uses be restricted? Those are questions that we should request answers to and action on from State Health as it involves the public health and safety. The County of Sonoma should then limit the operations in light of State Health's determinations.

At present, I see only one more thing that we can do to shed more light on the situation prior to drafting of waste discharge requirements. That is to perform a dye dilution study to determine if the seeps are contiguous with Wilson Creek, and also determine the dilution rates for mass balances of mercury from the seep areas.

Bob

Robert R. Klamt
Environmental Specialist

RRK:jmr

REFERENCE 10

RECOMMENDATION FOR FURTHER ACTION

DATE: June 27, 1985

PREPARED BY: Emily Brockman, Ecology & Environment, Inc.

SITE: Mt. Jackson Mercury Mine
Sweetwater Springs Road
Guerneville, CA

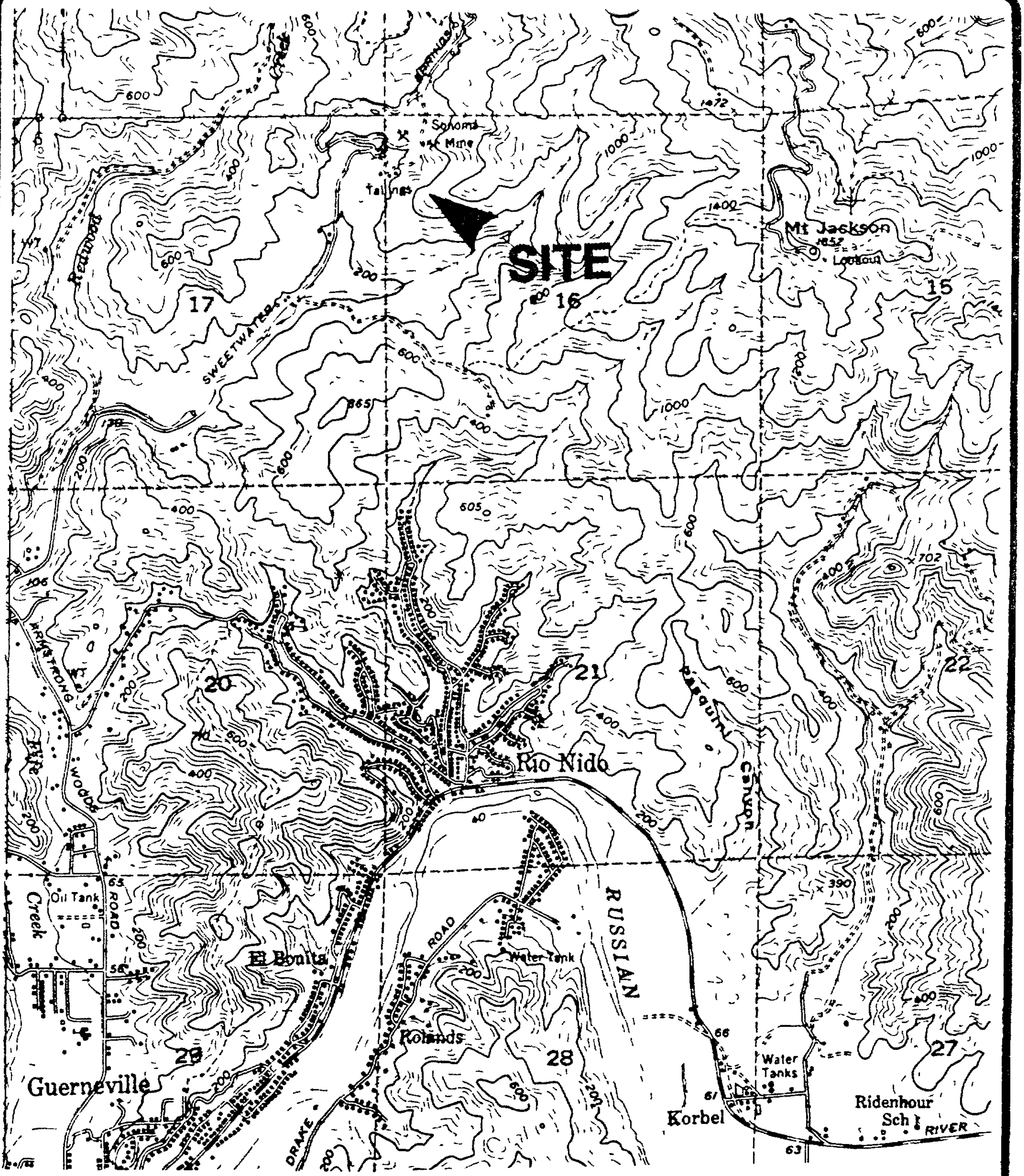
TDD#: R09-8503-25
CAD#: 980736086

1. Initial FIT conclusions and recommendations for further action:

   a) Site Description:

   This site is an inactive mercury mine located in Sonoma County, 3 miles north-northeast of Guerneville along Wilson Creek (See Figure 1). The mine, owned and operated most recently by Sonoma International (formerly Sonoma Mines), was in operation from 1875 through 1972 when falling mercury prices and reduced yield forced it to close. Site activities consisted of drawing the mercury bearing rock (cinnibar)out of the mine shaft, crushing it to increase the surface area and "roasting" it to extract the metal. The processed rock, known as tailings, collected in large piles on site where it was allowed to remain.

   The site became active again in 1979 when new owners, Piombo Corporation, set up mobile crushing equipment to convert the tailings into gravel for use in nearby construction projects on the Guerneville sewers and roads (Contact Report, Robert Klamt, RWQCB, 6/21/85). When the gravel works were in operation (1979-81) runoff associated with site activities (dust control or cooling water) was directed to a series of 3 settling ponds. Waste discharge requirements were not yet established when the works closed down in 1981.



SITE LOCATION MAP

Mt. Jackson Mercury Mine
Sweetwater Springs Road
Guerneville, CA

Source: USGS Guerneville Quad Map

Scale

½ 0

1/2 mile

Figure 1

ecology and environment, inc.

Apparent Problem:

Citizens in the area became concerned at the use of mercury tailings in construction projects and complained to the appropriate agencies (Regional Water Quality Control Board, [RWQCB], Department of Health Services [DOHS], Environmental Protection Agency, [EPA], etc.). The Regional Board and the DOHS had water and soil samples analyzed for mercury content. The DOHS, State and local offices, addressed the risks associated with the use of the tailings in the community; the Regional Board concentrated on the environmental impact of the gravel operation itself. The DOHS analysed the mercury content in gravel samples from various phases of the operations. They found that total mercury in the samples ranged between 34-189 ppm (see Figure 2) but was of a type that was virtually insoluble both chemically and biologically.

> "The mercury in the gravel is present in a form that would not be extracted by rain or flood waters or any other chemical conditions likely to exist in your natural environment" (Paul Williams, Ph.D., DHS, Letter Report to Mr. Michael Singer, July 28, 1980)

The results of sampling efforts by Regional Board showed elevated total mercury levels (3.3 ppb - .2 ppb) in Wilson Creek. Samples were taken upstream and downstream from the tailings operation and from the well and one of the ponds on the property. Results seemed to indicate that the source of the mercury was seeps in the area of the abandoned mine shaft and not the tailings pile or gravel operations which had been the initial cause of concern (See Figure 3).

b) HRS Factors:

o Observed Release

Elevated levels of total mercury measured in Wilson Creek (3.3 ppb - .2 ppb) seem to originate from seeps at the mouth of the abandoned mine shaft and become gradually diluted downstream (See attached) (Memo Report, Robert Klamt, RWQCB, 5/20).

o Waste Type/Waste Quantity:

Approximately 800,000 tons of mercury mine tailings are piled on site. The amount of elemental or soluble mercury contained in these tailings is assumed to be minimal (Memo Report, Robert Holtzer M.D., Public Health Officer, 8/80).

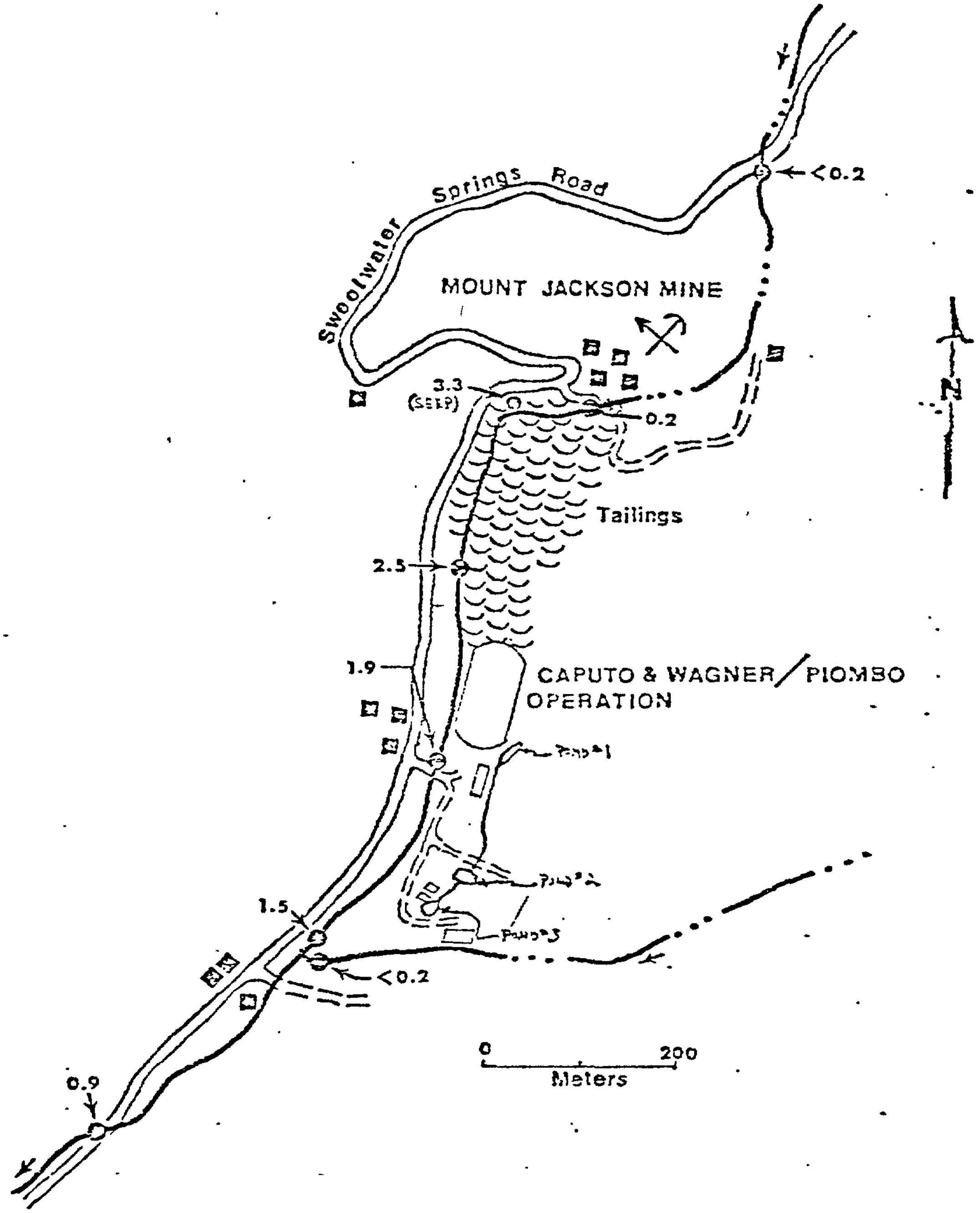


Figure 3. Results of Wilson Creek mercury sampling expressed in ug/l total mercury (ppb) on April 9, 1980. Note the contribution of 3.3 ppb total mercury from the seep on the north bank downstream of the mine.

Figure 3

Waste generated by the gravel works consisted of cooling and dust control water. This was directed into a series of 3 settling ponds on site. Runoff from the first would flow into the second and runoff from the second into the third. This third pond was tributary to Wilson Creek and was included in the sampling efforts of the Regional Board. (Memo Report, Robert Klamt, RWQCB, May 5, 1980).

- Groundwater:

  Use of groundwater in the area includes domestic and municipal supply. There are approximately a dozen residences along Sweetwater Springs Road. It is unknown how many use private wells and how many are hooked up to a local water system. The nearest municipal wells are adjacent to Fife Creek, to which Wilson Creek is tributary, about 2 miles downstream from the mine and its tailings piles (see Figure 1).

  Of sampled wells, only the 40' well on the mine site itself has had mercury levels higher than the detection limit of 0.2 ppb. It has registered 0.4 ppb at times. (Memo Report, Robert Klamt, RWQCB, 5/80).

- Surface Water

  Net precipitation in the area is approximately 24" during the 6 months between November and April. Runoff from the site is tributary to Wilson Creek.

Other Factors:

Much recent mercury research has concentrated on the bioaccumulation of the extremely toxic methyl mercury in the flesh of fish. There are certain microorganisms that have the ability to convert organic or inorganic forms of mercury into methyl or dimethyl mercury; thus, any form of mercury is potentially hazardous. However, the same source states:

> The evidence indicates that intake of mercury from drinking water is toxicologically negligible. Human exposure to the most hazardous form of this metal, methyl mercury, is almost exclusively via consumption of fish. (Priority Toxic Pollutants Environmental Health Review No. 1 Noyes Data Corporation, 1980, pg 267).

Conclusion/Recommendations

Further sampling is needed to accurately assess the hazard posed by this abandoned mine site. Though the total mercury levels in Wilson Creek are higher at times than the 2 ppb MCL stated in Title 22, the level quickly drops to around 0.9 ppb about 1/2 mile downstream from the tailings pile. Wells in the area show no evidence of contamination (i.e. 0.2 ppb detection limit) other than the 0.4 ppb result from the well on the mine site. Currently available data are inconclusive; readings upstream of the mine are sometimes equal to the readings downstream; soluble mercury results are sometimes missing. Further sampling is necessary to determine the sources of mercury and whether there is evidence of methyl mercury leaching into the stream and ultimately into the Russian River water system.

Site Determination:

It seems that a SI should be done by FIT here to close out the question of on going contamination. If this can only be done with sampling, then plans should be prepared. It seems that a considerable amount of work has already been done by DHS + RWQCB, and I expect this to be used to best advantage to 1) draw conclusions, or 2) set up appropriate sample points.

Active. medium priority for SI.

Paul [illegible]
6-1-86

REFERENCE 11

SONOMA COUNTY November 6, 1969

Mt. Jackson Mine

WASTE DISCHARGE REQUIREMENTS

1. The waste discharge* shall not contain concentrations of materials which are detrimental to human, plant, animal, aquatic life or to the aquatic habitat.

2. The toxicity of the waste discharge* shall not be such that its concentration in the receiving waters** exceeds 1/10 the 96-hour TL_m value as determined on a free swimming stage of the most susceptible resident salmonid species. An index fish species or other test organism may be substituted for the salmonid test species subject to the approval of the Regional Board and the Department of Fish and Game.

3. The waste discharge shall not cause conspicuous color, odor, taste, foam, nor visible oil or grease slicks in the receiving waters.

4. No phase of the operation shall increase the turbidity of the receiving waters more than 20 percent over the existing upstream level.

5. The waste discharge shall not depress the dissolved oxygen content of the receiving waters below seven parts per million where such receiving waters have previously been determined to have in excess of this amount. Should the receiving waters have a dissolved oxygen content of less than seven parts per million prior to the introduction of effluent, said effluent shall not depress the dissolved oxygen content below the existing level.

6. The concentration of settleable solids in the waste discharge shall not exceed that of the receiving waters; nor shall the waste discharge cause deposits of silt, sand nor organic debris in the receiving streams.

7. The waste discharge shall not cause the pH of the receiving waters to be depressed below 6.5 scalar units nor to be increased above 8.5 scalar units.

8. Solid wastes including smelter tailings shall be controlled so that they could not reasonably be expected to be carried into the receiving waters. Road construction and other construction and maintenance operations shall be conducted in such manner as to minimize erosion and deposition of soil and debris in the receiving streams.

9. At the request of the Board, the discharger shall provide sufficient self-monitoring data if it deems it necessary.

*For the purpose of these requirements, "waste discharge" shall include the direct discharge of process waters and mine drainage, water that has passed over or through solid wastes and has dissolved minerals therefrom, and any other liquid materials associated with mercury mining operations.

**For the purpose of these requirements, "receiving waters" shall include: Wilson Creek and Fife Creek.

DOCUMENT SOURCE
DOHS
RWQCB ✓
OTHER
6/4/88

All laboratory tests for determining compliance with waste discharge requirements established by this Board shall be determined in accordance with the latest edition of "Standard Methods for the Examination of Water and Waste Water".

The foregoing requirements do not authorize any infringement of federal, state or local laws or regulations, nor the commission of any act resulting in injury to the property of another.

Section 13001 of the Water Quality Control Act provides that no provision in the foregoing requirements is a limitation:

(a) On the power of a city or county to adopt and enforce additional regulations not in conflict therewith imposing further conditions, restrictions, or limitations with respect to the disposal of sewage or other waste or any other activity which might result in the pollution of water.

(b) On the power of any city or county to declare, prohibit, and abate nuisances.

(c) On the power of a state agency in the enforcement or administration of any provision in law which it is specifically permitted or required to enforce or administer.

(d) On the right of any person to maintain at any time any appropriate action for relief against any private nuisance as defined in the Civil Code or for relief against any contamination or pollution.

Section 13054 of the Water Quality Control Act provides that the above requirements may be revised from time to time if conditions change.

EXPLANATION OF REQUIREMENTS

1. The waste discharge shall not contain concentrations of materials which are detrimental to human, plant, animal, aquatic life or to the aquatic habitat.

   As used in this requirement, materials include suspended, settleable and dissolved substances. This all-inclusive requirement is necessary to insure that the aquatic life and its habitat and the downstream water uses are not affected by the waste discharge especially during periods of low flow when the waste discharge does not readily become dispersed throughout the receiving stream.

2. The toxicity of the waste discharge shall be such that its concentration in the receiving waters does not exceed 1/10 the 96 hour TL_m values as determined on a free swimming stage of the most susceptible resident salmonid species. An index fish species or other test organism may be substituted for the salmonid test species subject to the approval of the Regional Board and the Department of Fish and Game.

   Obviously, this requirement is designed primarily for the protection of fish and aquatic life. The term 96 hour TL_m (tolerance limit, median) is used to designate the concentration required to kill 50 percent of the test organisms after 96 hours of exposure. Unfortunately, there is no simple application factor or formula to convert the 96 hour TL_m data to concentrations that are considered safe for long-term exposure. However, the general practice in California is to use the simple factor of 1/10 which has been found to be generally safe.

3. The waste discharge shall not cause conspicuous color, odor, taste, foam, nor visible oil or grease slicks in the receiving waters.

   This requirement is designed primarily to prevent a public nuisance in the receiving waters due to the disposal of waste.

4. No phase of the operation shall increase the turbidity of the receiving waters more than 20 percent over the existing upstream level.

   High turbidity levels can be directly harmful to fish and aquatic life due to external abrasion and gill damage. Also, even moderate turbidity blocks light penetration and thus can modify the desirable ecological conditions of the stream bottom. This requirement is designed to restrict a turbid discharge during periods when the receiving waters are clear. However, it does recognize that during the high flow periods the receiving waters will be turbid and at that time a slightly more turbid discharge would not be detrimental.

5. The waste discharge shall not depress the dissolved oxygen content of the receiving waters below seven parts per million where such receiving waters have previously been determined to have in excess of this amount.

Should the receiving waters have a dissolved oxygen content of less than seven parts per million prior to the introduction of effluent, said effluent shall not depress the dissolved oxygen content below the existing level.

Maintenance of adequate levels of dissolved oxygen is of vital importance for the development and maintenance of desirable aquatic life. The Department of Fish and Game and other authorities believe that a dissolved oxygen level of 7.0 ppm is necessary to maintain a healthy environment for the salmonid species that utilize these waters.

6. The concentration of settleable solids in the waste discharge shall not exceed that of the receiving waters; nor shall the waste discharge cause deposits of silt, sand nor organic debris in the receiving streams.

Silt and other fine sediments hinder fish production, smother food organisms, destroy spawning grounds, and fill pools. Therefore, it is the intent of this requirement to protect the very important benthic organisms, spawning beds, and nursery areas.

7. The waste discharge shall not cause the pH of the receiving waters to be depressed below 6.5 scalar units nor to be increased above 8.5 scalar units.

The permissible range of pH for fish and other aquatic life depends upon many other factors (e.g., temperature and dissolved oxygen). However, a range from 6.5 to 8.5 will provide a healthy environment for fish and aquatic life under most conditions.

8. Solid wastes including smelter tailings shall be controlled so that they could not reasonably be expected to be carried into the receiving waters. Road construction and other construction and maintenance operations shall be conducted in such manner as to minimize erosion and deposition of soil and debris in the receiving waters.

Solid wastes, as well as fine sediments, can smother food organisms, destroy spawning beds, and fill pools. Therefore, this requirement is also designed to protect the very important benthic organisms, spawning beds, and nursery areas.

9. At the request of the Board, the discharger shall provide sufficient self-monitoring data to insure compliance with the above requirements.

This requirement is to inform the discharger that according to Section 13055 of the "Water Quality Control Act" the Board may require self-monitoring data if it deems it necessary.

[illegible]/11/71 Mine partly closed down. No flow : Fife Creek. Meeting requirements

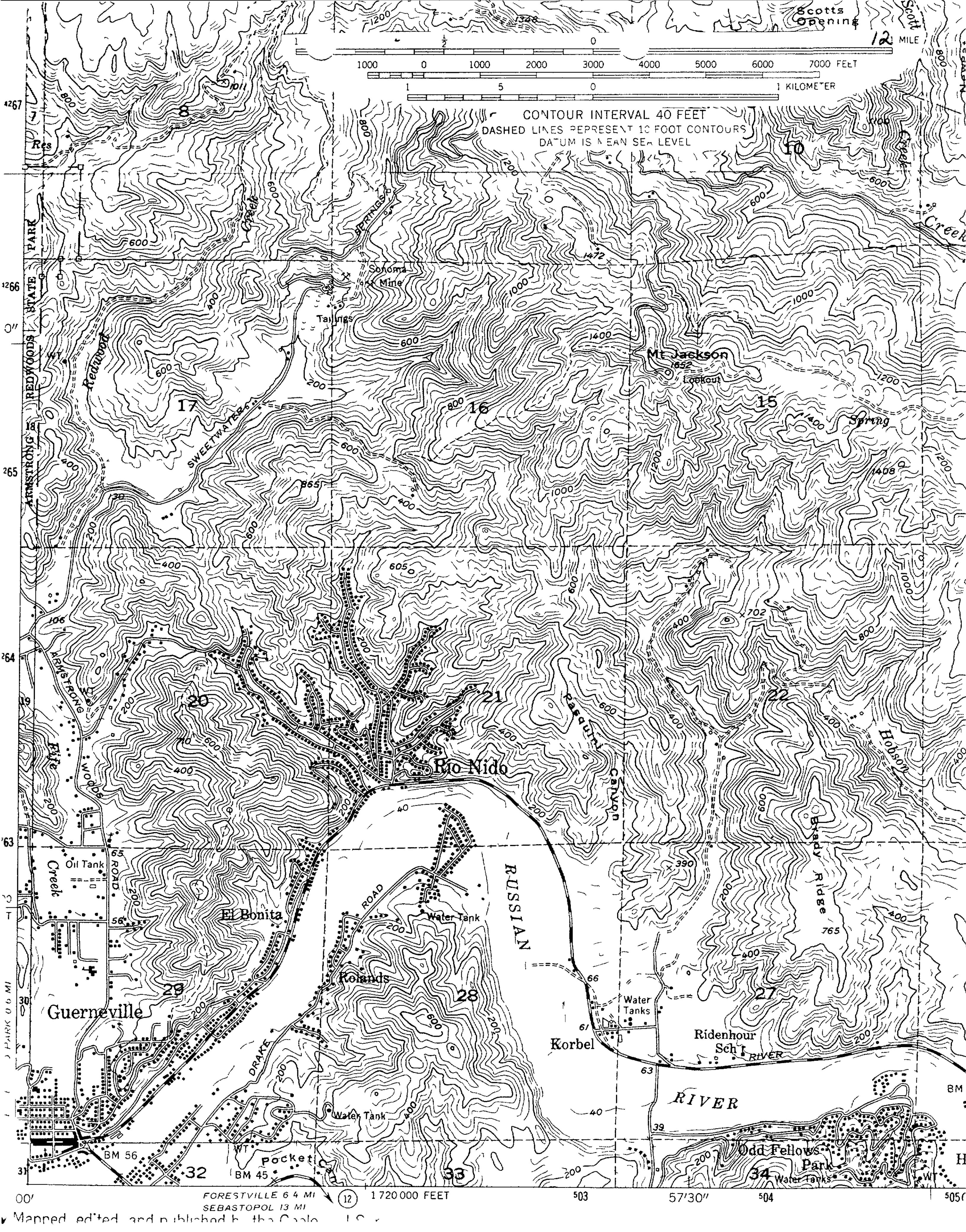
11/17/71 Smelter operating about 10 to 12 days a month. Meeting requirements. Fife Creek was dry

5/18/72 Mine has closed down as a result of low mercury price

12/1/72 Equipment at mine to be used to manufact activated carbon.

X
OTHER
6/4/85 EB

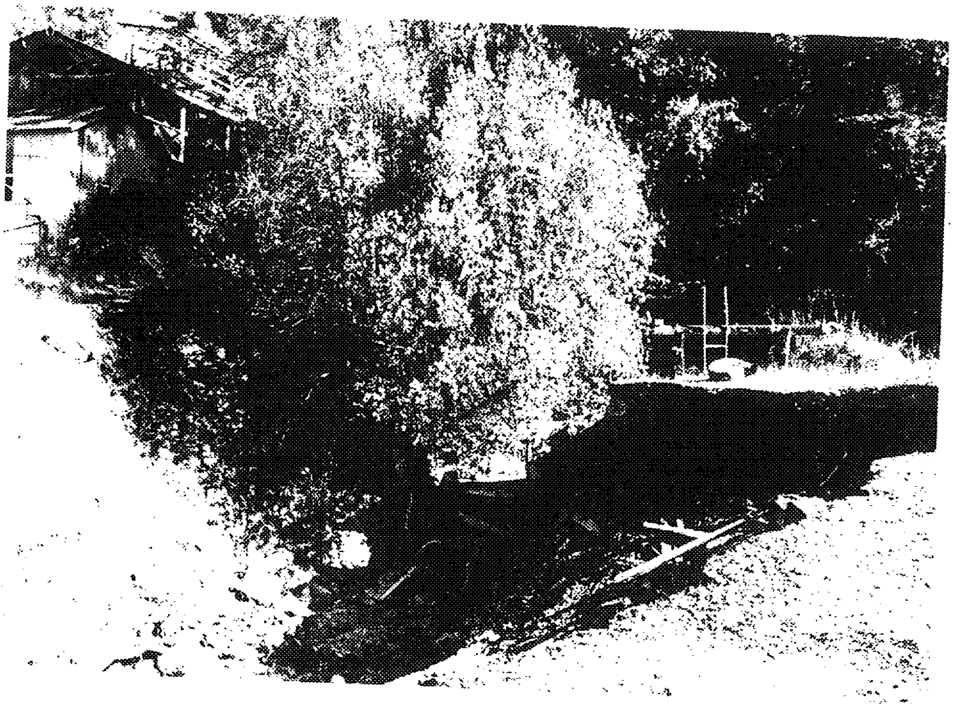
REFERENCE 12



Mapped, edited, and published by the Geolo

REFERENCE 13

FIELD PHOTOGRAPHY LOG SHEET



DATE 2-6-89

TIME 11 A.M. (~~P.M.~~)

DIRECTION: N NNE NE ENE
[✓ E] ESE SE SSE
S SSW SW WSW
W WNW NW NNW

WEATHER Clear 60°F

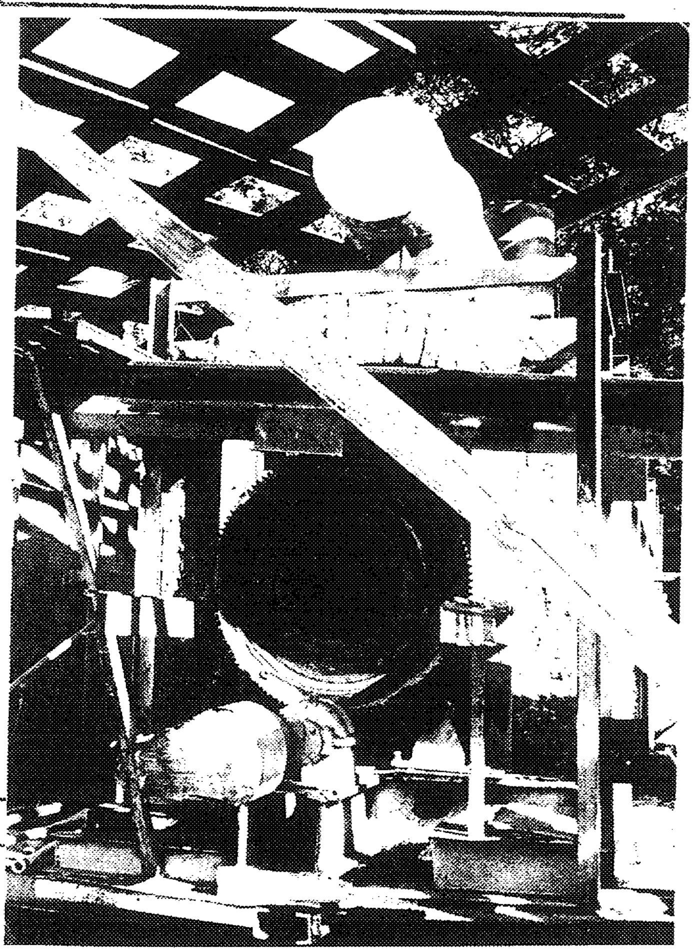
SITE Mt. Jackson Mercury Mine

PHOTOGRAPHED BY:

Dick Jones

SAMPLE ID# (if applicable)

DESCRIPTION: Trickling creek adjacent to Mt. Jackson Mine 2-6-89 Site Inspection



DATE 2-6-89

TIME 11 A.M. (~~P.M.~~)

DIRECTION: N NNE NE ENE
[✓ E] ESE SE SSE
S SSW SW WSW
W WNW NW NNW

WEATHER Clear, 60°F

SITE Mt. Jackson Mine

PHOTOGRAPHED BY:

Dick Jones

SAMPLE ID# (if applicable)

DESCRIPTION: Rotary Kiln ~~Retort furnace~~ for roasting ore; abandoned near Mt. Jackson Mine. 2-6-89 Site Inspection

Page 1 of 2

FIELD PHOTOGRAPHY LOG SHEET

DATE 2-6-89

TIME 11 A.M. ~~(P.M.)~~

DIRECTION: N NNE NE [✓ ENE]
[✓ E] ESE SE SSE
S SSW SW WSW
W WNW NW NNW

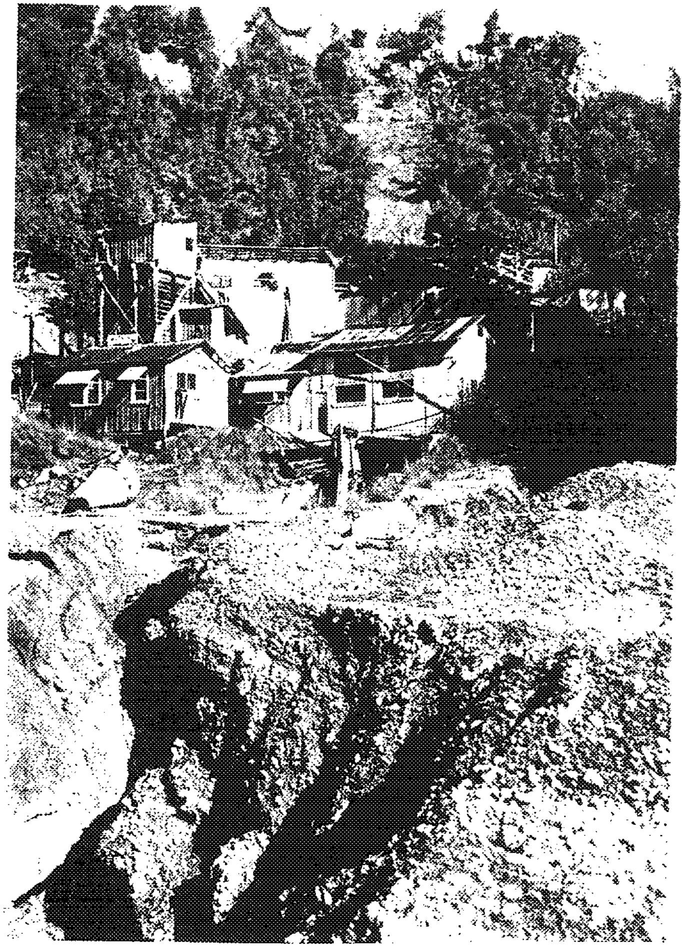
WEATHER Clear ~60°

SITE Mt. Jackson Mine

PHOTOGRAPHED BY:

Dick Jones

SAMPLE ID# (if applicable)



DESCRIPTION: Mt. Jackson Mine + tailings - 2-6-89 Site Inspection

DATE 2-6-89

TIME 11 A.M. ~~(P.M.)~~

DIRECTION: N NNE NE [✓ ENE]
E ESE SE SSE
S SSW SW WSW
W WNW NW NNW

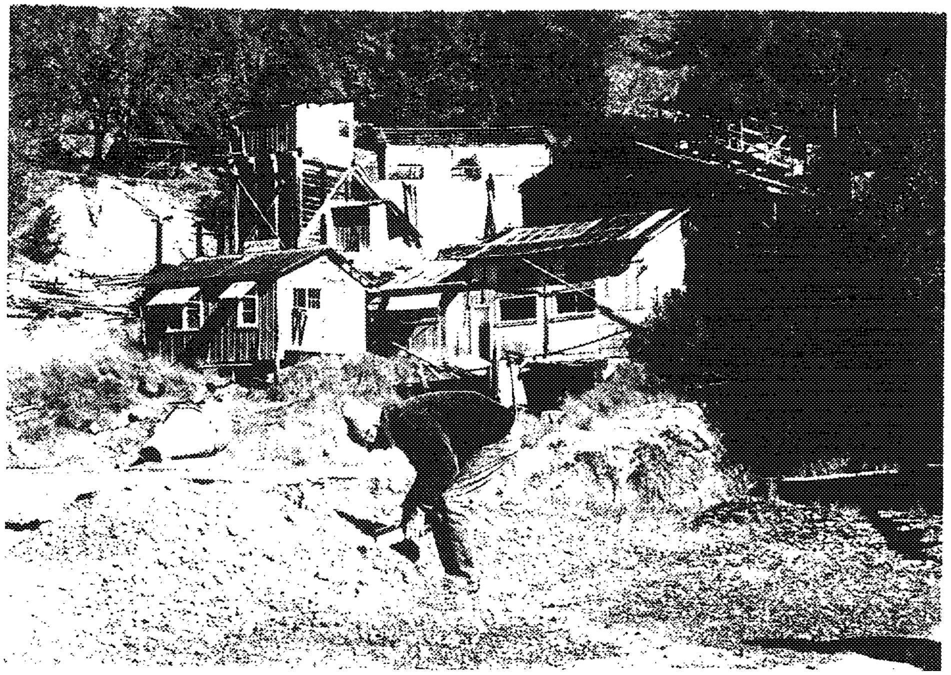
WEATHER Clear 60°F

SITE Mt. Jackson Mine

PHOTOGRAPHED BY:

Dick Jones

SAMPLE ID# (if applicable)



DESCRIPTION: Paul Williams using mercury "sniffer" in tailings.
2-6-89 Site Inspection

REFERENCES

#14-#25

APPENDICES

A - Contact Log
B - Aerial Photos

REFERENCES (cont.)

14. "Hydro-geologic Assessment of the Citizens Utilities Company of California's Guerneville Service Area," Herzog Co., 1988.

15. Jones, D., DHS, telephone communication with R. Addis, Sonoma County, Division of Environmental Health, May 5-17, 1989.

16. Jones, D., DHS, telephone communication with B. Tancredo, NCRWQCB, May 15, 1989.

17. Noffke, J., Ecology & Environment, Inc., telephone communication with R. Klampt, NCRWQCB, January 15, 1988.

18. Precipitation Calculation, D. Jones, based on Climatic Atlas, U.S. Department of Commerce, 1983.

19. Armstrong Valley, and Citizen's Utilities Water Companies Contact Log, D. Jones, 8-4-89.

21. Klamt, R., North Coast Region, Regional Water Quality Control Board, Complaint, dated March 19, 1980.

22. Kor, B.D., letter to D.L. Storm, Hazardous Materials Management Section, California Department of Health Services, May 7, 1980.

23. California Department of Health Services, Sampling Analysis Reports, dated May 1980 to April 1982.

24. Zavattero, W.J., Cal-OSHA, Citation No. 1 for Piombo Corporation, 1010 Shiloh Road, Windsor, CA 95492, dated May 7, 1980.

25. Callanan, E.F., Cal-OSHA, letter to J. Naito, DHS, March 20, 1989.

REFERENCE 14

14

PHASE I REPORT - APPENDICES
HYDROGEOLOGIC ASSESSMENT
GUERNEVLLE, CALIFORNIA

Prepared for

Citizens Utilities Company of California
Mr. H. E. Niederberger, Jr.
3335 Longview Drive
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Prepared by

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(916) 924-3293

Job Number 34014.01-00-9

In association with

Brelje & Race Consulting
Civil Engineers
5341 Skylane Boulevard
Santa Rosa, CA 95402
(707) 576-1322

E.H. Boudreau, "Geology and Ground Water Potential of the Lower Russian River Area", August 15, 1985.

Also review all other available published and unpublished hydrogeologic and engineering reports, data, and other material relating to ground water and water supply in the Guerneville area.

Product: All three referenced reports were thoroughly reviewed. Supporting documents used in this study are referenced in Section 2.4, "Previous Investigations and Reports" and in Chapter 14.0, "References". Additional supporting material was obtained from files of CUCC as well as from the files of DWR.

Task 3: Determine relationship between CUCC-Guerneville service area and Armstrong Valley Water Company (AVWC) service area.

Conclusion: The relationship is discussed in Section 7.5.3. We have concluded that the operation of the AVWC wells are not affected by, nor do they affect the operation of the existing CUCC wells. Furthermore, no future CUCC wells placed within or adjacent to the CUCC service area will affect, or be affected by the present AVWC wells.

Task 4: Perform geologic and hydrogeologic field reconnaissance of CUCC service area, adjacent valley areas, and adjacent upland watershed area.

Product: The geology and hydrogeology of the CUCC-Guerneville service area, which is based on field reconnaissance and literature review, is discussed in Chapter 4.0, "Geology and Hydrogeology".

the inclusion of the Monte Rosa Well on the list of Identified Hazardous Waste Sites was a "false positive" and should be ignored. As noted in Chapter 6.0, "Ground Water Quality", iron and manganese are the two principal constituents of concern; these can be removed or significantly reduced at the well head. Other water quality problems experienced in the area are directly attributable to poor well design and construction practices.

Task 9: Obtain and analyze data from AVWC wells.

Product: All available pertinent data were obtained from AVWC. A discussion of the AVWC wells, based on these data, appears in Section 5.4.2., "AVWC Wells".

Task 10: Analyze all pertinent available data from CUCC service area.

Product: Available pertinent data were obtained for the CUCC wells from the files of CUCC and DWR. These data are presented in Appendix A, "CUCC Well Data".

Task 11: Develop maps of water-bearing zones showing depth, thickness, specific yield, transmissivity, specific capacity of wells, amount of ground water in storage, water quality, and other parameters. The individual maps and the amount of detail presented on each map will be dependent on available data.

Product: The geologic map depicted on Figure 1 2? shows areas of coarse gravels and also sands and gravels, collectively identified as River Channel Deposits. These deposits are the primary water-yielding portion of this valley, which is drained on the east by Fife Creek and on the west by Livereau Creek, is composed of silts, clays, and sands typical of materials found in valleys which have received sediments from the weathering of Franciscan Formation rocks. The maximum depth of these materials is not known, but it can be assumed that the lower portions, below a depth of about 100 feet, probably consist of river-deposited sands and gravels to a depth of about 300 feet. One well drilled along Fife Creek, just north of the valley area, entered Franciscan Formation rocks at a depth of 120 feet. The well reportedly produces 100 gpm from sand and gravel zones occurring at a depth of from 73 to 100 feet.

Most ground water occurring in the tributary alluvium is expected to be of good to excellent quality. Quality problems may be encountered in shallow zones as a result of contaminants entering the ground water body from surface sources.

4.4 Younger Alluvium

Younger alluvium occurs in discontinuous zones adjacent to the channel of Russian River. It was deposited during high river stages and consists of loose sand, silt, clay, and some gravel. It varies in thickness, being at most 25 feet thick in certain areas. It overlies mixed stream channel and older alluvial deposits.

(natural and developed) in the study area. The El Bonita wells produce on the order of 500 gpm, whereas reported spring capacity (Table 2) is no higher than 40 gpm.

When seasonable productivity variations are considered, the differences in productivity are even greater. As Table 2 illustrates, the productivity of springs in the area decreases by an order of magnitude between wet weather and dry weather flow. For example, wet weather flow for Mt. Jackson Spring is reported to be 16 gpm whereas our observations of dry weather flow for this study indicate the flow is approximately 2 gpm. A total of 11 springs in the area are reported to have a combined wet weather flow of 271 gpm, however their combined reliable dry weather flow is only 24 gpm. This high seasonal variation in spring flow is a function of the low storativity of the bedrock (a measure of the amount of water taken into or released from the water-yielding zone per unit change in head) and the source of the water (seasonal precipitation, most of which leaves the watershed via runoff to the river where the alluvial materials are recharged).

The great variation in seasonal productivity has been a problem for users that have attempted to rely on springs as a water resource in the area. Camp Meeker, a small community to the south of Guerneville, obtains its water supply from a number of developed springs in the Franciscan bedrock. They have had chronic water testing of this kind is known to have been performed for any wells in the Guerneville area.

Less rigorous methods of estimating well yields would include conducting a pump test with drawdown and/or recovery measurements made only in the pumping well, and estimating well yield based on hydraulic characteristics estimated from driller's logs and generic aquifer characteristics for similar materials in similar hydrogeologic environments. As discussed in Sections 7.3 and 7.4, limited, short term and/or informal test data for wells in the Guerneville area, or in similar materials up-river from Guerneville, indicate relatively high yields for the alluvial water-yielding zones along the Russian River. For example, a 24-hour pump test on El Bonita Well #2 conducted by PG&E for CUCC demonstrated a yield of 535 gpm for 24 hours with 18 feet of drawdown at the well. The well is in an area where the water-yielding materials are unconfined and there is substantial recharge from the river. In the tributary valleys where the overlying alluvial deposits are finer-grained, have lower vertical transmissivity, and where recharge effects from the river are less, well yields would be expected to be less. The AVWC Well #2 had a short-term pump test wherein the well yielded just over 100 gpm with minimal drawdown at the well.

9.4 Pumping Pattern Simulations

In order to make a preliminary evaluation of the area of influence of new production wells that might be constructed to replace existing CUCC

10.5.1 River Areas

The best potential areas for development of new ground water sources appears to be in the alluvial areas along the floor of the Russian River canyon. Here, coarse-grained water-yielding sediments are abundant, and yields in excess of 500 gpm should be attainable if a well is carefully located, properly designed, and carefully constructed and developed. Even though iron and manganese may render untreated ground water unsatisfactory for public supply, such water quality problems can be overcome by proper treatment. The required treatment for water containing such undesirable constituents is discussed in a subsequent portion of this report.

Because of potential flood problems, wells should be placed in the Russian River canyon above the elevation of the 100-year flood if possible. In the case of a well tapping the thalweg, however, this may not be possible. Hence, such a well must be constructed with the wellhead and its appurtenances in a flood-proof vault. Likewise, electrical and transmission connections also must be below-ground.

10.5.2 Tributary Valley Areas

Good potential well sites appear to be possible near Fife Creek, near Livereau Creek, and below the confluence of Mays Canyon and Pocket Canyon. Here, carefully located and designed wells may produce from 200 to 500 gpm. Iron and manganese may present water quality problems, but in a manner similar to that along the Russian River, such constituents can be removed through treatment. Flooding also may present a problem, but it should not be as serious as that along the Russian River. Still, it would be wise, if possible, to site any production well above the limit of the 100-year flood for the particular tributary involved. In any case, vaulted wellhead construction is advised.

10.5.3 Upland Watershed

After evaluation of the springs in the general area of the CUCC-Guerneville area, and based on our general knowledge of the hydrogeology of the area, we have concluded that the surrounding upland watershed and its springs do not constitute an adequate, dependable, or economic source of water for the CUCC-Guerneville service area. This conclusion is based principally on the observed very low flows at the end of a dry summer (the best spring was observed flowing at only 5 gpm) and the great length of transmission lines that would be needed to tap such low flows at a number of widely separated locations (see Chapter 12.0).

In addition, a discussion of upland horizontal wells with Richard Rogers, local Guerneville well driller, revealed the following:

a. To develop a spring using a horizontal well, it usually is necessary to drill 100 to 200 feet into the hillside. Including setting casing, the cost is about $600 to $1,200 for one horizontal well at a spring site.

b. To drill a horizontal well where there is no existing spring, it normally would be necessary to drill 150 to 300 feet into the hillside. Including setting casing, the cost in this case would be about $900 to $1,800 for one horizontal well.

In both of the above cases, Rogers assumed that there would be adequate access to the drill site for his drill rig. In the case of some of the more remote spring areas (e.g., Mount Jackson Spring, etc.), construction of an access road (which would be needed for construction of the transmission line and the treatment facility) could cost more than the horizontal well. Furthermore, Rogers noted that at any area, horizontal well productivity would be low, and in a non-spring area, there would be only about a 70 percent chance of finding water.

TABLE 1
WATER WELL DATA

Project Well No	Approximate Well Location or Name	Total Depth (feet)	Screened Interval (feet below surface)	Depth to Bedrock (feet)	Depth to Water Begin Test (feet)	Depth to Water End Test (feet)	Test Yield (gpm)	Test Duration (hours)	Well Location (T/R-Section)
1	Armstrong Woods Rd & 116	120	29-49, 59-119	57	10	100	20	1	8N/10W-29N
2	16603 Armstrong Woods Rd	118	58-118	55	12	60	35	1	8N/10W-20M
3	16881 Armstrong Woods Rd.	111	28-108	55	40	55	40	2.5	8N/10W-20D
4	16890 Armstrong Woods Rd	147	67-87, 127-147	110	(no data)	(no data)	60	(no data)	8N/10W-17N
5	11339 Highway 116	198	(no data)	0	(no data)	80	0.3	(no data)	8N/10W-34N
6	13250 River Rd.	107	45-80, 90-95	98	28	55	900	6 to 8	8N/10W-28Q
7	8/10-22D	176	56-176	4	50	175	2	1	8N/10W-22D
8	Off Old Cazadero Rd.	85	(no data)	78	dry	(no data)	(no data)	(no data)	8N/10W-31F
9	Guernewood Dr., 0.5 mi. south of Guerneville	112	92-112	>112	45	60	30	(no data)	8N/10W-31H
10	Off Odd Fellows Park Rd.	248	100-206, 225-248	58	31	220	30	1	8N/10W-34D
11	Off Odd Fellows Park Rd	117	66-81	74	42	80	35	2	8N/10W-34D
12	Off Odd Fellows Park Rd.	61	41-61	55-61	20	(no data)	(no data)	(no data)	8N/10W-34D
13	12445 Mays Canyon Rd	164	(no data)	5	dry	(no data)	(no data)	(no data)	8N/10W-32L
14	End of Laughlin Rd., Guerne.	67	27-67	>67	10	20	100	(no data)	8N/10W-30G
15	Monte Rio Fire Station	30	20-30+/-	25+/-	(no data)	(no data)	(no data)	(no data)	7N/11W-11H
16	River Meadows	100+/-	(no data)	(no data)	(no data)	(no data)	105	(no data)	7N/11W-11I
17	Monte Rio #1	120	40-55, 67-71 80-84, 94-115	>120	(no data)	(no data)	(no data)	(no data)	7N/10W-7D1
18	Monte Rio #2	160	98-154	(no data)	36	(no data)	(no data)	(no data)	7N/10W-7D2
19	Monte Rio #3	165	90-160	>165	58	75	580	24	7N/10W-7D3
20	Monte Rio #4	146	73-132	>146	34	(no data)	(no data)	(no data)	7N/10W-7D4
21	Vacation Beach	100	30-100	>100	30	46	920	24	8N/10W-31N
22	Monte Rosa	50	(no data)	(no data)	(no data)	(no data)	60	(no data)	8N/11W-25P
23	El Bonita #1	125	42-88+	(no data)	25	26	225	(no data)	8N/10W-29H1
24	El Bonita #2	125	56-110	>125	26	39.5	400	(no data)	8N/10W-29H2
25	El Bonita #3	119+	41-119+	(no data)	27	38.8	223	(no data)	8N/10W-29H3
26	Armstrong Valley Water Co. #1	123	104-123	>123	27	27	116	(no data)	8N/10W-20M4
27	Armstrong Valley Water Co. #2	120	73-78, 90-100	119	12	21	100	12	8N/10W-20M5
28	Drake Well	55	35-55	(no data)	(no data)	(no data)	(no data)	(no data)	8N/10W-21P
29	Noel Heights	15	9 to 15	>15	approx. 10	(no data)	20-30	(no data)	8N/10W-34M
30	8/10-29D1	183	60-80, 143-183	120	(no data)	50' drawdown	110	(no data)	8N/10W-29D1
31	River Rd. & Brookside Ln.	90	82-88	>90	15	29	200	(no data)	8N/10W-29N1
32	7/11-11J1	136	108-136	>136	26	(no data)	500	(no data)	7N/11W-11J1
33	Northwood Golf Course	136	106-136	>136	42	45	150	2	7N/10W-5L
34	14945 River Road	109	0 to 55	>109	42	(no data)	(no data)	(no data)	8N/10W-29A
35	15689 River Road	100	0 to 55	>100	(no data)	(no data)	(no data)	(no data)	8N/10W-29Q

References: Brown and Caldwell, 1985; Herzog Associates (this study);
Weeks Drilling Inc.; Citizens Utilities Company
See Figure 3 for approximate well locations.

TABLE 2
SPRINGS IN UPLAND AREA SURFACE DIVERSIONS

NAME	LOCATION	WET (b,c) WEATHER FLOW, gpm	RELIABLE DRY WEATHER FLOW, gpm	Fe/Mn(b) mg/L	ACCESS(a2)	REMARKS(a2)
MT. JACKSON ROAD, TO WITHIN	T8N,R10W,S16	16	2(a1)	N/A	VERY POOR	NO ROAD, LOGGING 0.75 MILES
SHERIDAN	T7N,R11W,S12	30	1(c)	N/A	POOR	NO ROAD WITHIN 0.5 MILES
TYRONE CREEK	T7N,R10W,S19	40	1(c)	N/A	POOR	0.5 MILE FROM ROAD
STARRETT	T7N,R10W,S18	30	<1(a1,c)	.05/0.5	POOR	0.5 MILE FROM ROAD
LOWER HIDDEN VALLEY (LOWER HUT) TANK	T8N,R11W,S36	35	5(a1)	.02/.05	POOR	0.5 MILES TO ROAD AND HIDDEN VALLEY
UPPER HIDDEN VALLEY (UPPER HUT)	T8N,R11W,S36	20	5(a1)	.02/.05	POOR	0.5 MILES TO ROAD AND HIDDEN VALLEY TANK
SPRING GULCH	T8N,R11W,S36	20	5(a1)	N/A	FAIR	UNPAVED ROAD
RUSSET TANK	T8N,R10W,S16	20	0(a1,c)	N/A	GOOD	NEAR SWEETWATER
LOWER SCHOOL HOUSE	T7N,R10W,S7	10	<2	N/A	GOOD	NEAR ROADS
HARRISON GULCH	T7N,R10W,S7	20	1(c)	0.2/0.05	GOOD	NEAR ROADS
UPPER & LITTLE VILLA GRANDE	T7N,R11W,S12	30	1	N/A	POOR	NEAR ROADS
	TOTALS:	271 gpm	<24 gpm			

INFORMATION SOURCES:

(a1)	HERZOG ASSOCIATES FIELD OBSERVATION SEPTEMBER, 1988
(a2)	HERZOG ASSOCIATES (THIS STUDY)
(b)	BROWN AND CALDWELL, 1985
(c)	CUCC MEASUREMENTS

TABLE 3A
PARTIAL MINERAL ANALYSES OF GROUND WATER
(in milligrams per liter[1])

Well	Date Sampled	Total Hardness	Ca	HCO_3	pH	TDS	Fe	Mn
CUCC System								
El Bonita #1	4-13-81[2]	160	65	170	7.0	210	-	-
El Bonita #2	7-10-53[3]	149	25	212	7.3	184	0.0	0.6
	12-27-29[2]	150	60	160	7.4	190	1.0	0.25
El Bonita #3	5-1-87[2]	150	60	180	6.4	210	0.4	0.17
Vacation Beach	5-1-84[2]	170	93	190	7.3	220	1.1	1.014
Monte Rosa	8-8-84[2]	51	35	64	6.9	78	0.17	0.01
Monte Rio #1	7-11-50[3]	132	18	167	7.4	135	0.0	0.0
	5-9-84[2]	140	43	160	7.5	190	0.7	0.29
Monte Rio #2	5-9-84[2]	140	43	160	7.5	190	0.7	0.29
Monte Rio #3	4-19-78[2]	144	43	147	7.6	182	0.01	0.44
AVWC System								
#1	2- -49[3]	149	27	-	6.2	-	0.1	-
	12-6-85[2]	-	-	-	-	-	0.1	-
#2	12-6-85[2]	89	19	48	7.1	120	0.23	-
Noel Heights	11-4-86[2]	-	-	-	6.1	80	0.14	0.05

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[1] pH expressed in units

[2] From Brown & Caldwell

[3] From U.S.G.S.

TABLE 6
HARD ROCK WELLS TESTED BY BAILING

Area	Number of wells	Depth Range (feet)	Yield Range (gpm)	Number of dry holes
Sweetwater Creek	5	10-172	1-75	1
Mt. Jackson	3	160-193	2-8	1
Rio Nido	1	20	0.16[1]	-
Guerneville	1	97	3	-
Pool Ridge	3	82-300	3-40	1
Mays Canyon	3	13-300	2-7	1
Hurlbut Creek-Hidden Valley	4	54-195	2-5	-

---

[1] Well abandoned because of insufficient yield

TABLE 9
INDIVIDUAL COLLECTION SYSTEM UPLAND WATERSHED AREA

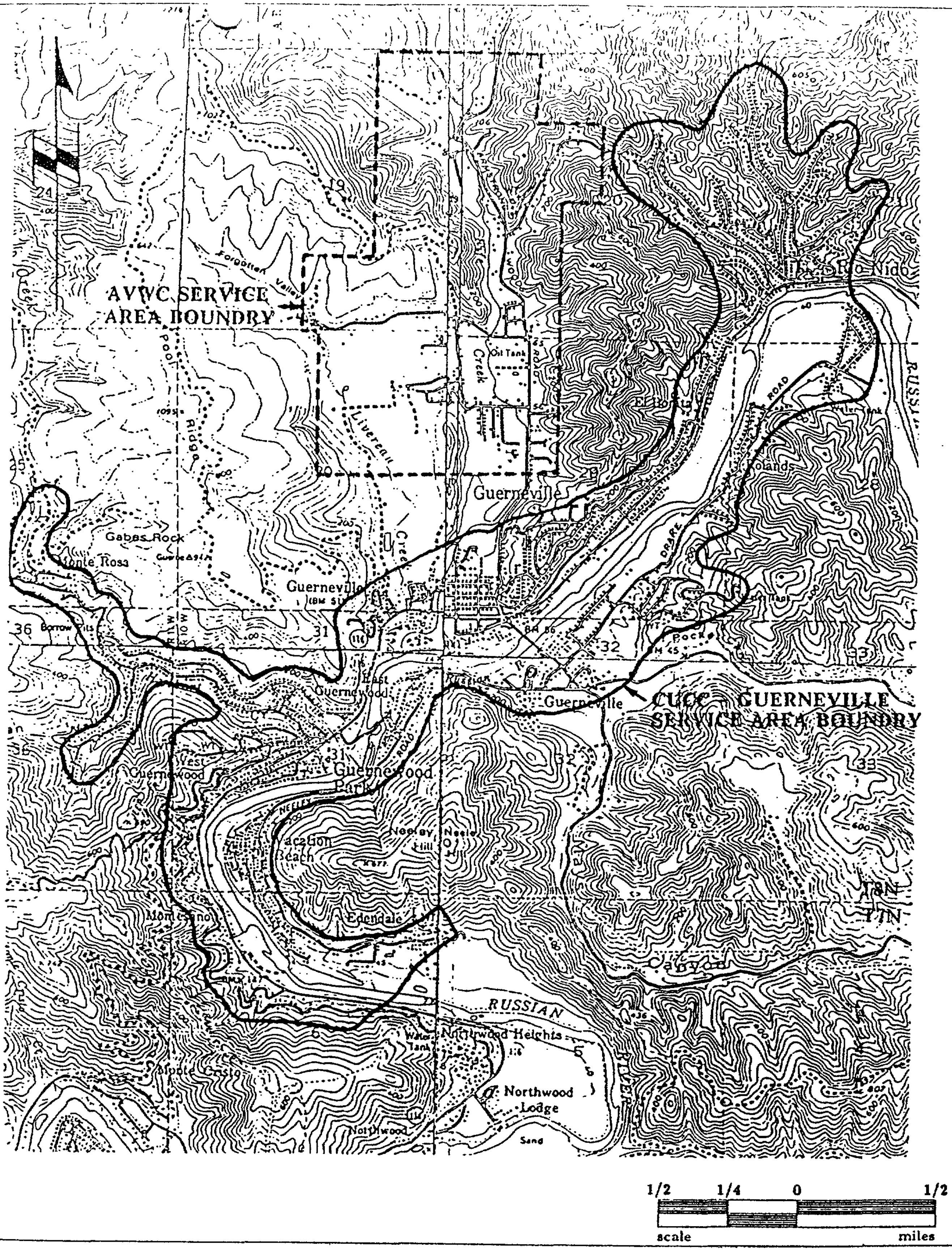
Source	Pipe Size (inches)	Approximate Lengths (feet)	Preliminary Cost Estimates*
Guerneville Area			
Mt. Jackson	1 1/2	5,000	$ 33,000
Russet	1 1/2	2,000	13,000
Spring Gulch	1 1/2	1,500	10,000
Upper Hut	1 1/2	1,000	7,000
Lower Hut	3	500	6,000
Monte Rio Area			
Sheridan	1 1/2	2,000	13,000
Villa Grande	1 1/2	2,000	13,000
Harrison Gulch	1 1/2	100	700
Lower School House	1 1/2	2,000	13,000
Starrett	1 1/2	2,000	13,000
Tyrone Creek	2	3,000	23,000
Intertie	6	8,000	$315,000

* Includes 30% for contingencies, engineering and miscellaneous. Excludes costs for rights-of-way or easements.

TABLE 10
COMBINED COLLECTION SYSTEM
UPLAND WATERSHED AREA

Source	Pipe Size (inches)	Approximate Lengths (feet)	Preliminary Cost Estimates*
Guerneville Area			
Mt. Jackson/Russett	2	8,000	$ 62,000
Spring Gulch/Lower & Upper Hut	1 1/2	1,000	7,000
	2	7,000	55,000
	3	500	6,000
		TOTAL	$ 68,000
Monte Rio Area			
Sheridan/Villa Grande	1 1/2	2,000	13,000
	2	2,000	32,000
		TOTAL	$ 45,000
Harrison Gulch/School House Starrett/Tyrone	1 1/2	6,000	39,000
	2	3,000	24,000
	2 1/2	7,000	64,000
		TOTAL	$127,000
Intertie	6	8,000	$315,000

* Includes 30% for contingencies, engineering and miscellaneous. Excludes costs for rights-of-way or easements.



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Geoscientists

Job No: 34014.1.0.9

Appr:

Drwn: PD

Date: OCT. 1988

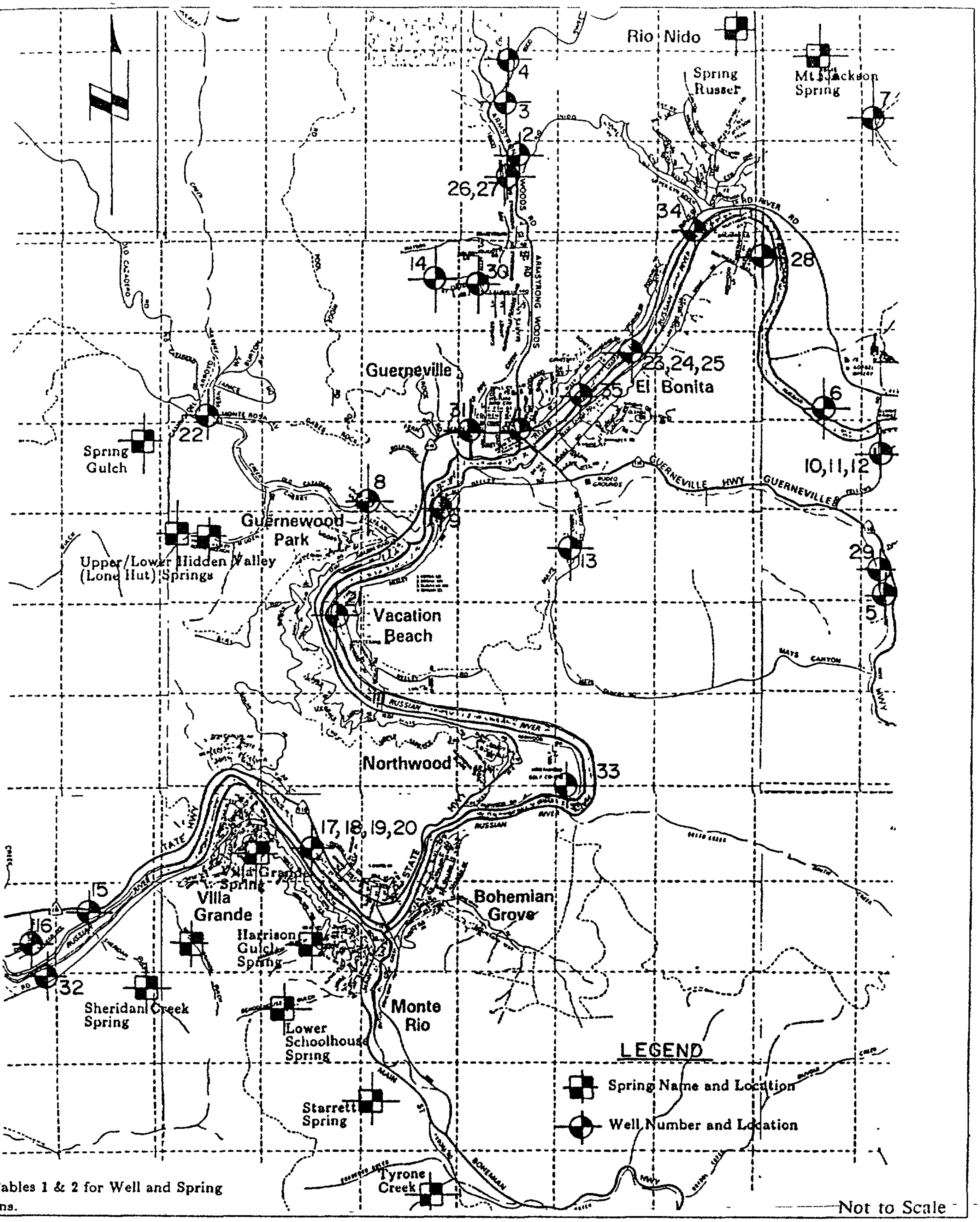
PROJECT LOCATION -
CUCC and AVWC Service Areas

Hydrogeologic Assessment, Guerneville

Guerneville, California

FIGURE

1



* Refer to Tables 1 & 2 for Well and Spring descriptions.

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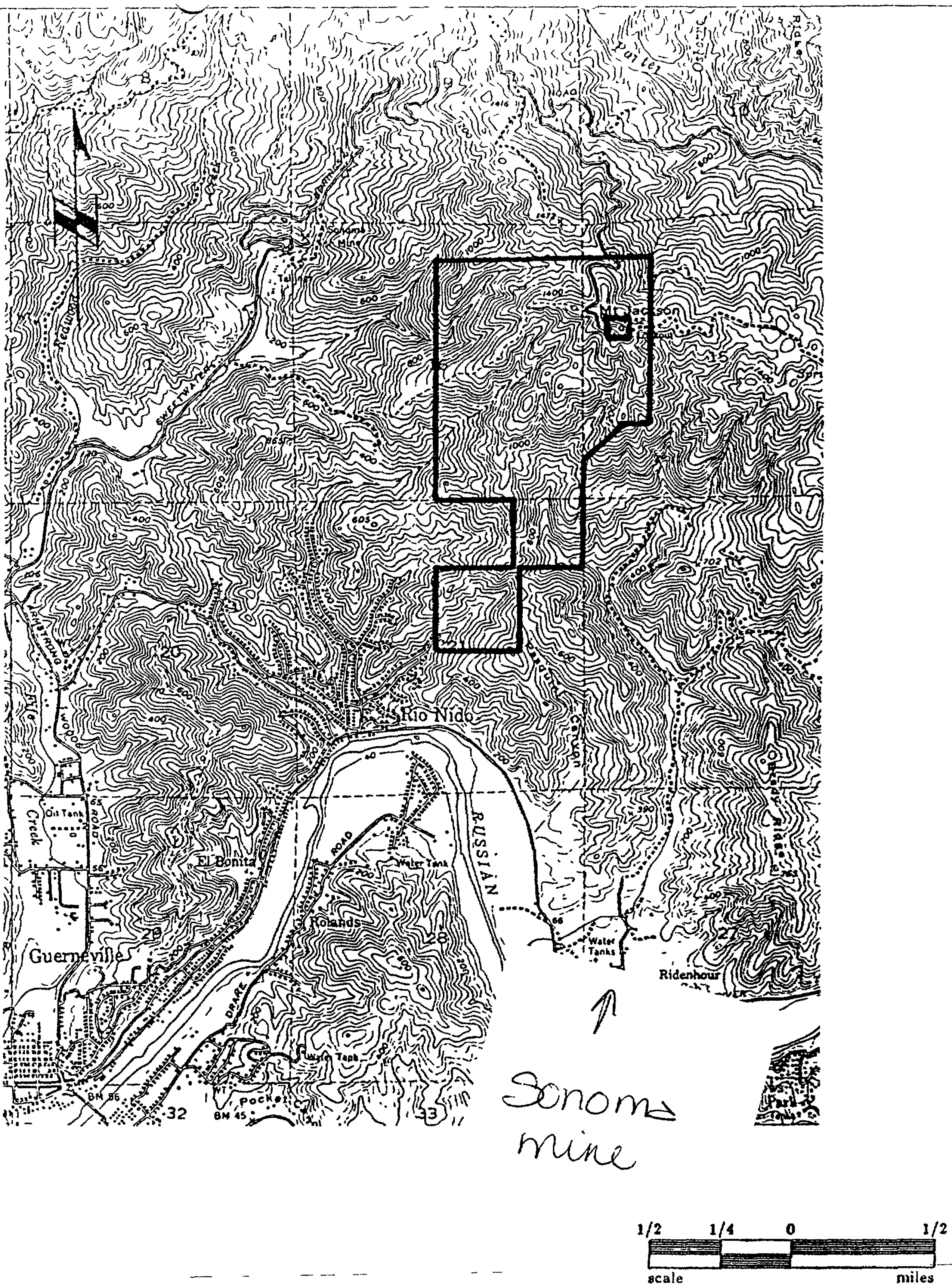
Approximate Locations of Wells and Springs *

Hydrogeologic Assessment, Guerneville

Guerneville, California

FIGURE

3



Sonoma mine

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Date: OCT 1988

Upland Areas Owned By CUCC, Mt. Jackson Area

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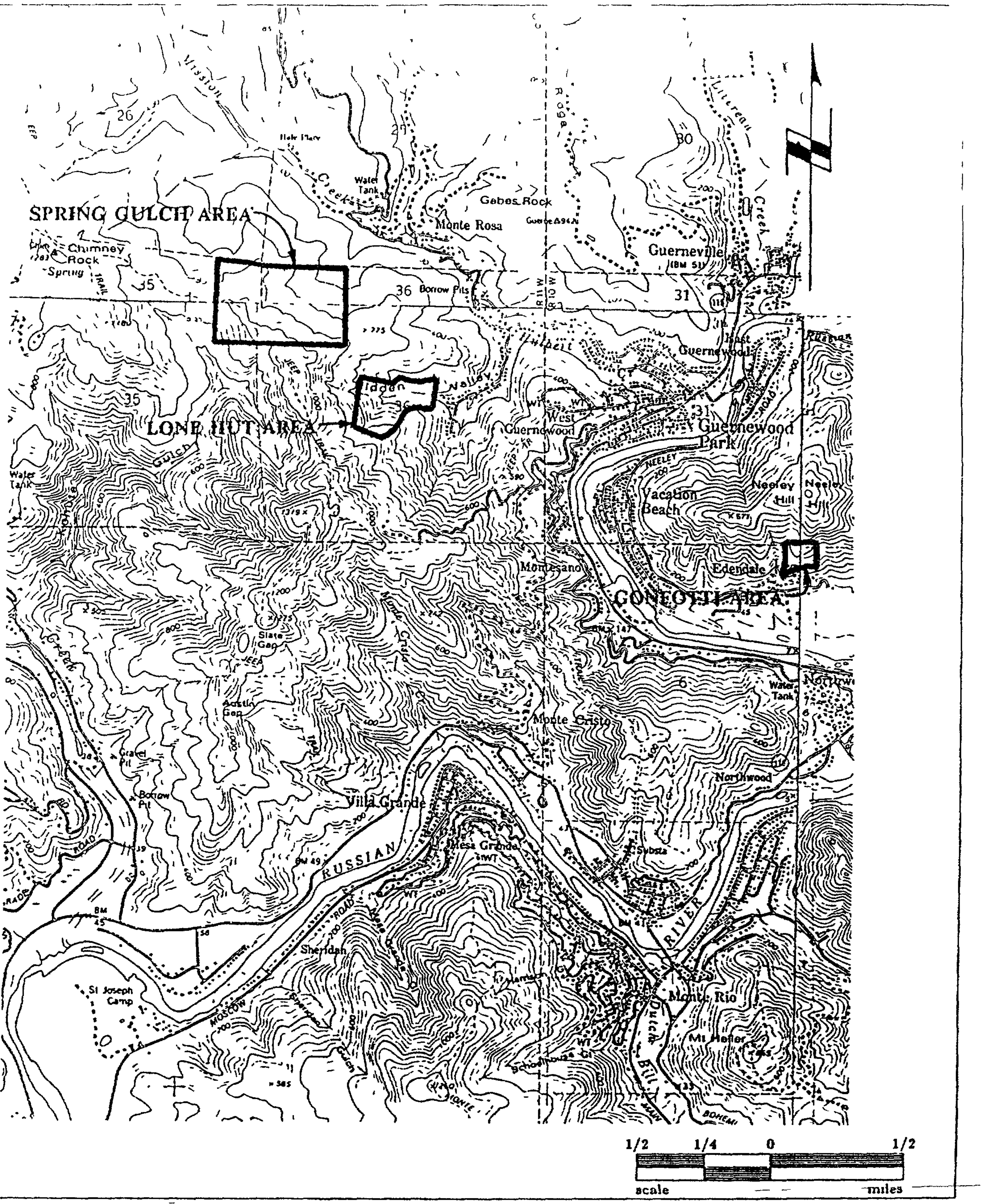
Guerneville, California

FIGURE

4A



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Date: OCT 1988

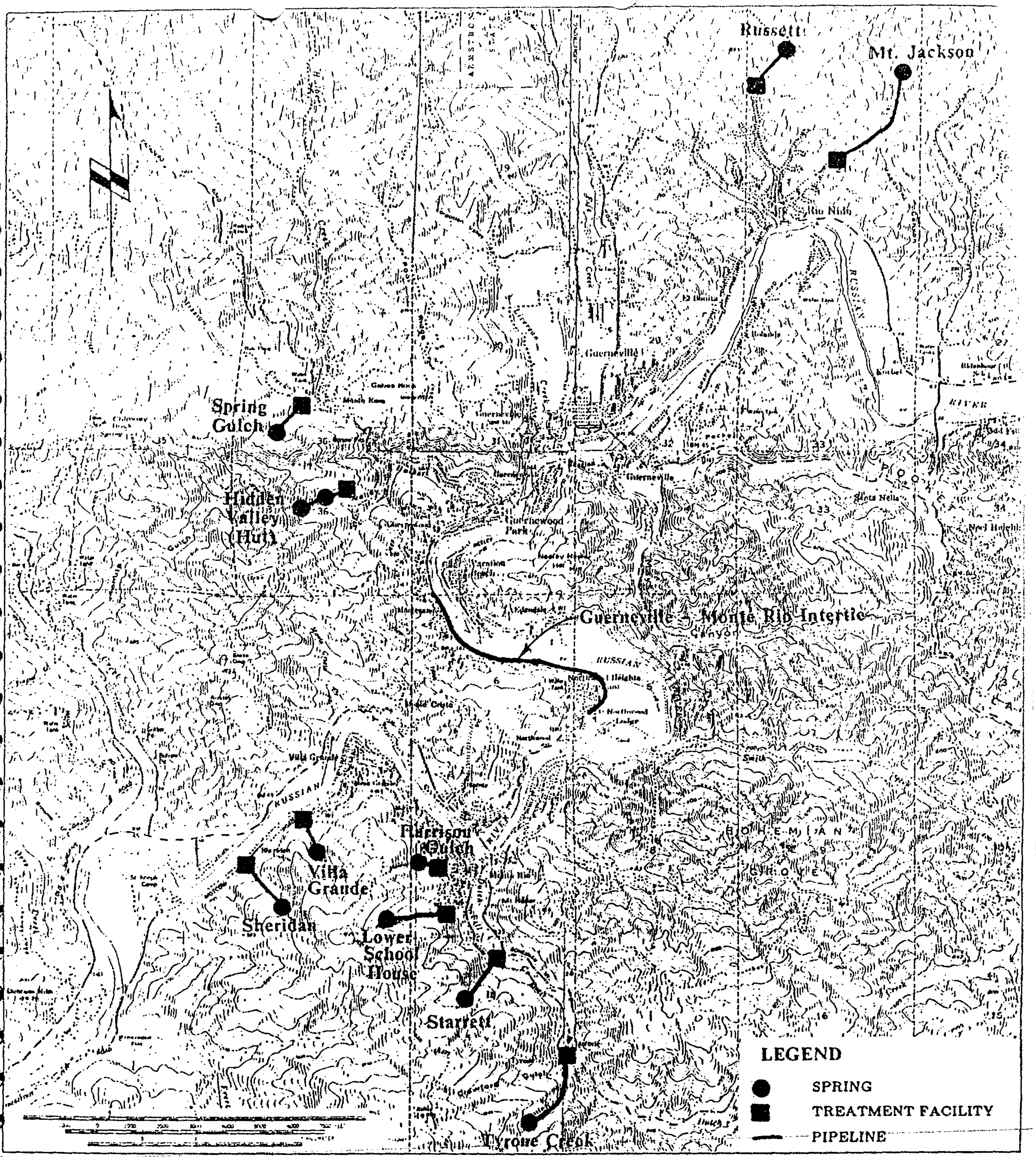
Upland Areas Owned By CUCC, Spring Gulch - Gonfotti Areas

Hydrogeo'ogic Assessment, Guerneville

Guerneville, California

FIGURE

4B



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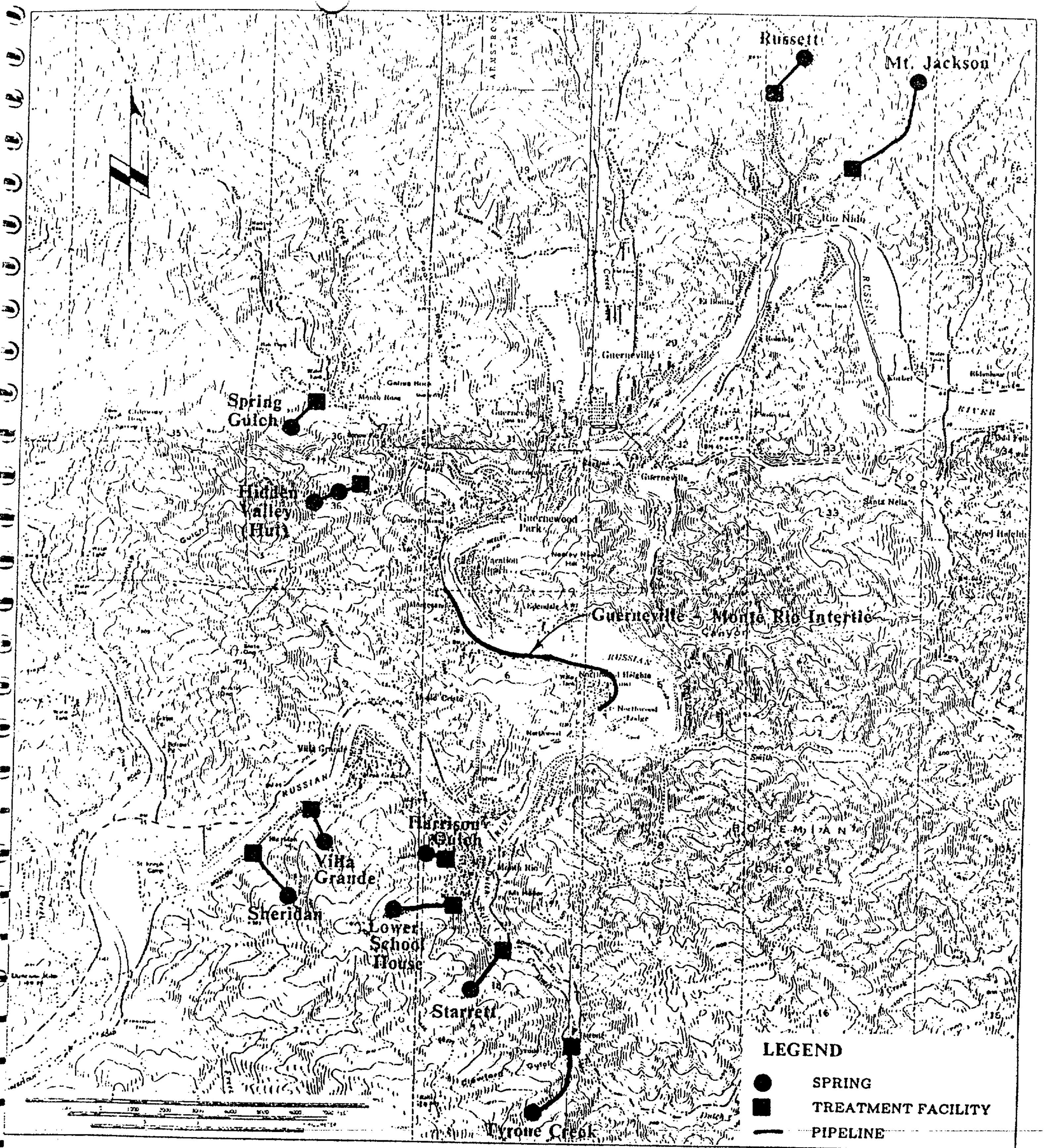
Date: NOV 1988

Individual Collection System
Upland Water Sources

Hydrogeologic Assessment, Guerneville

Guerneville, California

PLATE
8



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Job No: 34014.1.0.9
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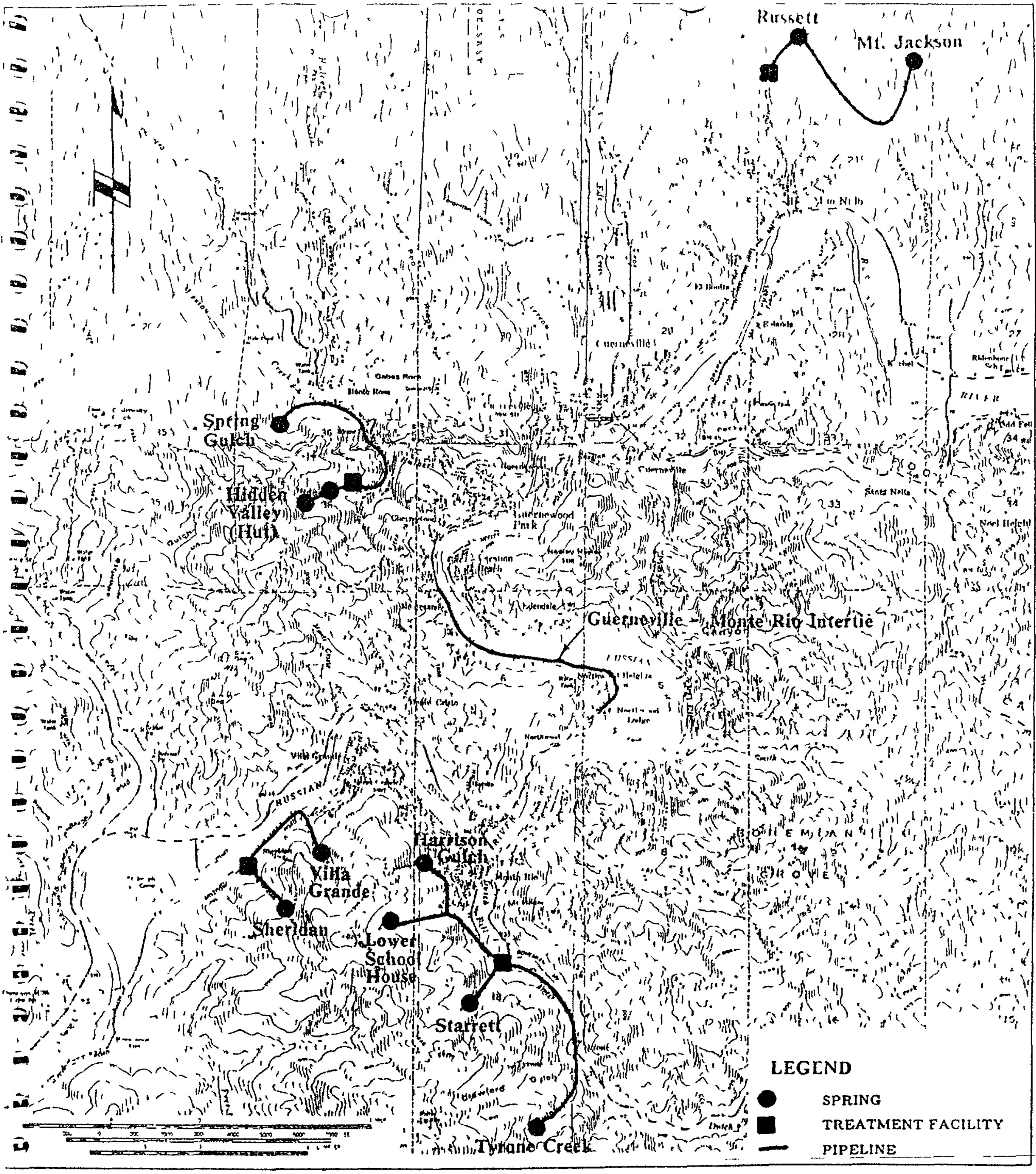
Drwn: PD
Date: NOV 1988

Individual Collection System Upland Water Sources

Hydrogeologic Assessment, Guerneville

Guerneville, California

PLATE
8



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Job No: 34014 1 0 9
Appr:
Drwn: PD
Date. NOV 1988

Combined Collection System
Upland Water Sources

Hydrogeologic Assessment, Guerneville
Guerneville, California

PLATE
9

7.1 El Bonita Wells

There are three wells at El Bonita, as shown on Figure 2. Well #1 is located approximately 100 feet southwesterly from the intersection of River Road and the western end of Orchard Road. Well #2 is located approximately 50 feet southwesterly from river Road and about 100 feet northwesterly from Well #1. Well #3 is located approximately 50 feet southwesterly from Well #2. All three wells are completed in river alluvial gravels; available data on these wells are presented in Section 16 of these specifications. Access to the wells is from River Road.

7.2 Monte Rosa Well

The Monte Rosa well is located near the bend of Hurlbut Creek, just north of its confluence with Mission Creek and about 300 feet upstream from the Fern Way Bridge as shown on Figure 3. The well is of unknown depth (about 50 feet). The bottom portion presumably is in fractured bedrock (Franciscan Formation). Access to the well is from Camino Del Arroyo.

7.3 Vacation Beach Well

The Vacation Beach Well is located on alluvial materials near the channel of Russian River, near the end of River Lane, and about 700 feet north of Neeley Road as shown on Figure 4. The well is 100 feet in depth and was completed in river sands and gravels. Access to the well is from River Lane. The log of this well is presented in Section 16 of these specifications.

SIMULATION NO. 3
Armstrong/Guerneville Area
Seven Days Pumping

Conditions and assumptions:

Aquifer Horiz. Hydr. Cond. (GPD/FT^2) = 10000.00
Aquifer Vert. Hydr. Cond. (GPD/FT^2) = 1.0000D+00
Aquifer Thickness (FT) = 225.00
Aquitard Thickness (FT) = 50.00
Artesian Aquifer Storativity (DIM) = 9.0000D-03
Water Table Storativity (DIM) = 0.0090
Product. Well Effective Radius (FT) = 0.750
Top of Aquifer Depth (FT) = 50.00
Base of Aquifer Depth (FT) = 275.00
Initial Water Level Depth (FT) = 12.00
Infinite Aquifer System
Production Well Discharge Rate (GPM) = 500.00

Time-drawdown (water level) values, in feet, after 7 days of continuous pumping:

	SELECTED DISTANCES (FT)					
TIME(MIN)	0.75	118.87	298.58	750.00	1883.91	4732.18
0.15	12.24	12.01	12.00	12.00	12.00	12.00
0.24	12.25	12.01	12.00	12.00	12.00	12.00
0.38	12.26	12.02	12.00	12.00	12.00	12.00
0.61	12.28	12.02	12.00	12.00	12.00	12.00
0.96	12.29	12.03	12.01	12.00	12.00	12.00
1.52	12.30	12.04	12.01	12.00	12.00	12.00
2.41	12.31	12.05	12.02	12.00	12.00	12.00
3.82	12.32	12.07	12.02	12.00	12.00	12.00
6.06	12.33	12.08	12.03	12.01	12.00	12.00
9.60	12.35	12.09	12.04	12.01	12.00	12.00
15.22	12.36	12.10	12.05	12.02	12.00	12.00
24.12	12.37	12.11	12.07	12.02	12.00	12.00
38.23	12.38	12.12	12.08	12.03	12.01	12.00
60.59	12.39	12.14	12.09	12.04	12.01	12.00
96.03	12.40	12.15	12.10	12.05	12.02	12.00
152.19	12.42	12.16	12.11	12.07	12.02	12.00
241.21	12.43	12.17	12.12	12.08	12.03	12.01
382.28	12.44	12.18	12.13	12.09	12.04	12.01
605.88	12.45	12.19	12.14	12.10	12.05	12.02
960.26	12.46	12.20	12.15	12.11	12.06	12.02
1521.90	12.47	12.21	12.16	12.12	12.07	12.03
2412.05	12.48	12.22	12.17	12.13	12.08	12.04
3822.85	12.48	12.23	12.18	12.13	12.09	12.04
6058.80	12.49	12.23	12.18	12.14	12.09	12.05
9602.55	12.49	12.23	12.19	12.14	12.09	12.05
10080.00	12.49	12.23	12.19	12.14	12.09	12.05

Distance-drawdown (water level) values, in feet, at end of 7-day pumping period:

NODE NO	RADIUS(FT)	DRAWDOWN OR WATER LEVEL (FT)
2	0.75	12.49
3	1.19	12.47
4	1.88	12.45
5	2.99	12.42
6	4.73	12.40
7	7.50	12.38
8	11.89	12.35
9	18.84	12.33
10	29.86	12.30
11	47.32	12.28
12	75.00	12.26
13	118.87	12.23
14	188.39	12.21
15	298.58	12.19
16	473.22	12.16
17	750.00	12.14
18	1188.67	12.12
19	1883.91	12.09
20	2985.80	12.07
21	4732.18	12.05
22	7500.00	12.03
23	11886.70	12.02
24	18839.15	12.01
25	29858.04	12.00

SIMULATION NO. 4
Armstrong/Guerneville Area
Ninety Days Pumping

Conditions and assumptions:

Aquifer Horiz. Hydr. Cond. (GPD/FT^2) = 10000.00
Aquifer Vert. Hydr. Cond. (GPD/FT^2) = 1.0000D+00
Aquifer Thickness (FT) = 225.00
Aquitard Thickness (FT) = 50.00
Artesian Aquifer Storativity (DIM) = 9.0000D-03
Water Table Storativity (DIM) = 0.0090
Product. Well Effective Radius (FT) = 0.750
Top of Aquifer Depth (FT) = 50.00
Base of Aquifer Depth (FT) = 275.00
Initial Water Level Depth (FT) = 12.00
Infinite Aquifer System
Production Well Discharge Rate (GPM) = 500.00

Time-drawdown (water level) values, in feet, after 90 days of continuous pumping:

	SELECTED DISTANCES (FT)					
TIME(MIN)	0.75	118.87	298.58	750.00	1883.91	4732.18
0.15	12.24	12.01	12.00	12.00	12.00	12.00
0.24	12.25	12.01	12.00	12.00	12.00	12.00
0.38	12.26	12.02	12.00	12.00	12.00	12.00
0.61	12.28	12.02	12.00	12.00	12.00	12.00
0.96	12.29	12.03	12.01	12.00	12.00	12.00
1.52	12.30	12.04	12.01	12.00	12.00	12.00
2.41	12.31	12.05	12.02	12.00	12.00	12.00
3.82	12.32	12.07	12.02	12.00	12.00	12.00
6.06	12.33	12.08	12.03	12.01	12.00	12.00
9.60	12.35	12.09	12.04	12.01	12.00	12.00
15.22	12.36	12.10	12.05	12.02	12.00	12.00
24.12	12.37	12.11	12.07	12.02	12.00	12.00
38.23	12.38	12.12	12.08	12.03	12.01	12.00
60.59	12.39	12.14	12.09	12.04	12.01	12.00
96.03	12.40	12.15	12.10	12.05	12.02	12.00
152.19	12.42	12.16	12.11	12.07	12.02	12.00
241.21	12.43	12.17	12.12	12.08	12.03	12.01
382.28	12.44	12.18	12.13	12.09	12.04	12.01
605.88	12.45	12.19	12.14	12.10	12.05	12.02
960.26	12.46	12.20	12.15	12.11	12.06	12.02
1521.90	12.47	12.21	12.16	12.12	12.07	12.03
2412.05	12.48	12.22	12.17	12.13	12.08	12.04
3822.85	12.48	12.23	12.18	12.13	12.09	12.04
6058.80	12.49	12.23	12.18	12.14	12.09	12.05
9602.55	12.49	12.23	12.19	12.14	12.09	12.05
15219.02	12.49	12.24	12.19	12.14	12.10	12.05
24120.52	12.49	12.23	12.19	12.14	12.10	12.05
38228.45	12.49	12.24	12.19	12.14	12.10	12.05
60588.01	12.49	12.23	12.19	12.14	12.10	12.05
96025.53	12.49	12.24	12.19	12.14	12.10	12.05
129600.00	12.49	12.23	12.19	12.14	12.09	12.05

REFERENCE 15

CONTACT REPORT

AGENCY: Sonoma County Division of Environmental Health

ADDRESS: Santa Rosa, CA

PERSON
CONTACTED: Ron Addis

PHONE NO.: (707) 576-4765

FROM: Dick Jones

TO: File

DATE: 5-17-89

SUBJECT:

cc:

I asked Mr. Addis about groundwater in the Mt. Jackson Mine/Guerneville area. He said there are only small water systems in this rural area. Citizens Utilities serves the Russian River area and draws from both the river and the springs in the Sweetwater Springs area. Another small system, Armstrong Valley Water Company, draws from Fife Creek along Armstrong Valley Road. He said these small systems were under the State and Dave Clark's group in the Public Water Supply office (707) 576-2145.

I asked Mr. Addis about groundwater aquifers in the area. He said there are not any good confining strata and thus most water did come from shallow wells below the creek beds. The majority of the water was probably creek surface flow only.

Mr. Addis said the question of water quality arose when the mine was used for the sewer project in Guerneville. He said Dr. Holser did research on the mercury in water issue back then, and he would look for the correspondence.

Mr. Addis said their groundwater availability map showed the area to be a water scarce area. The area from Sweetwater Springs Road down to Armstrong Valley Road is a zone 4 or water scarce area. Mr. Addis said water is mainly pocket water and hard to come by. (New residents) are required to prove spring output of at least one gallon per minute.

REFERENCE 16

CONTACT REPORT

AGENCY: North Coast Regional Water Quality Control Board

ADDRESS: Santa Rosa, CA

PERSON
CONTACTED: Bob Tancredo

PHONE NO.: (707) 520-2220

FROM: Dick Jones

TO: File

DATE: 5-15-89

SUBJECT: Mt. Jackson Mine Water Board information

cc:

5-15-89

Mr. Tancredo said although the Water Board had sampling information on surface water at the site, they did not have much groundwater information. He said the onsite well's mercury contamination was probably of mineral origin since the well was turbid. He suggested talking to Ron Addis of the County Environmental Health Division for information on small water systems.

REFERENCE 17

17

CONTACT REPORT

AGENCY: Regional Water Quality Control Board (RWQCB)

ADDRESS:

PERSON CONTACTED: Robert Klamt

PHONE NO.: (707) 576-2220

FROM: Julie Noffke

TO: File

DATE: 1/15/88

SUBJECT:

The Mt. Jackson Mercury Mine is one of five largest mercury mines in the United States.

The closest private well is located 200 yards from the intersection of the Sweetwater Springs Road and Wilson Creek.

Depth to groundwater is approximately 20 feet. Wells in the area are no deeper than 100 feet.

There are approximately 20 homes in the vicinity of the mine and along Sweetwater Creek. These homes have private wells and have no alternative drinking water sources.

Facility slope and intervening terrain is 70%-80%. The Armstrong Redwoods State Park is approximately 2 miles from the mine.

The mine area is fenced, but its rural setting allows access to locals.

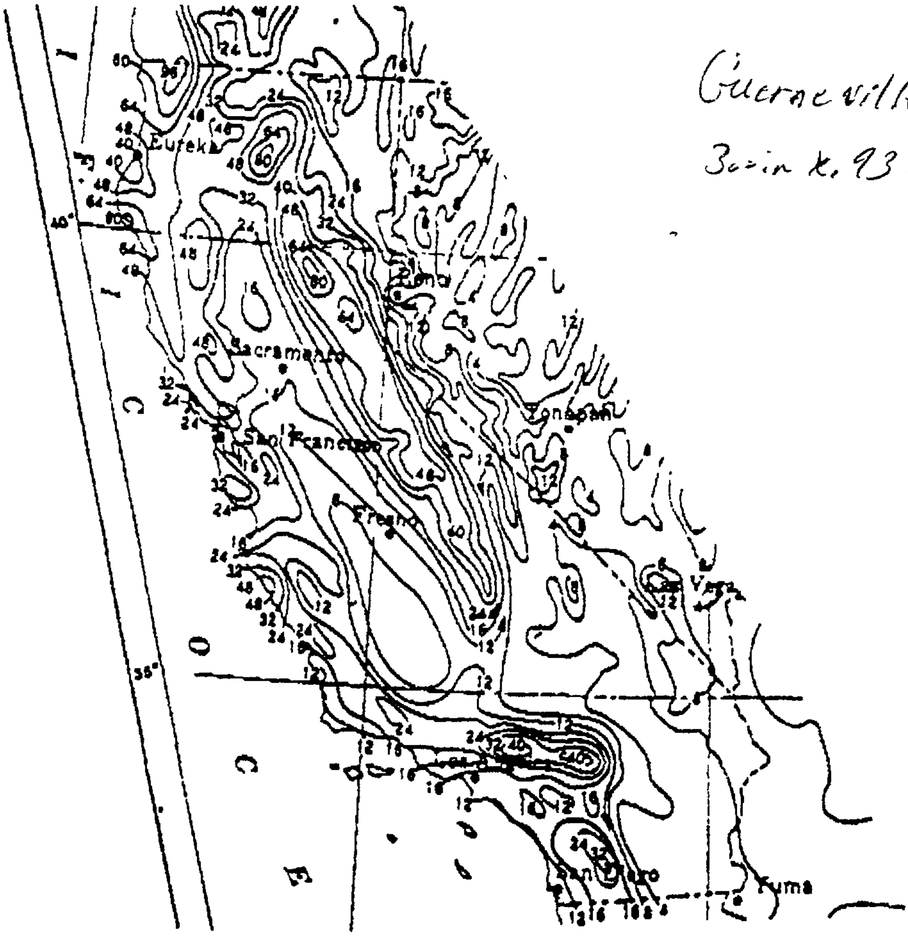
California Department of Health Services (DOHS) air sampling results did not show any detectable levels of mercury.

t/merc/para/jan

REFERENCE 18

Site Specific Approximation

Attached is the site specific map of annual rainfall from the Climatic Atlas. The precipitation numbers could be roughly modified from annual to seasonal by multiplying by the seasonal fraction, 0.93*. This is the ratio of seasonal to annual precipitation for the Bay Area and South (pgs. 45-47). Then subtract the seasonal evaporation number, 12.6 in., for the net precipitation.



Guerneville Net Precipitation
32 in x .93 = 29.8 precip.
-12.6 evap.
17.2 in
Net Precipitation

Example

For the South Bay, read 16 in. annual precipitation from the map. Multiply by .93, the seasonal precipitation fraction, to get 14.9 in. Finally, subtracting the 12.6 in. evaporation, gives 2.3 in. net seasonal precipitation.

*seasonal fraction = Nov-Apr/Annual = <u>0.93</u>
precipitation 19.45 / 21.

FIT calcs. -7.1 in net for S. Bay. How? Probably using 1st FIT method.

REFERENCE 19

CONTACT REPORT

AGENCY:	Citizen's Utilities Co.	Armstrong Valley Water Co.
ADDRESS:	Guerneville, CA	Guerneville, CA
PERSON CONTACTED:	Secretary	Gay Guodotti
PHONE NO.:	(707) 869-2545	(707) 869-2848
FROM:	Dick Jones	
TO:	File	
DATE:	8-4-89	7-10-89
SUBJECT:	Sweetwater Springs Road Water purveyor	
cc:		

Armstrong Valley Water Co. Contact 7-10-89

Ms. Guodotti reported that Armstrong's 2 wells in Armstrong Valley were tested every 3 years. She said Sweetwater Springs Road was mainly served by Citizen's Utilities. They have a storage tank up on Sweetwater Springs Road fed by pipe from Rio Nido.

Citizen's Utilities Contact 8-4-89

The secretary said they do serve the Rio Nido (upper) part of Sweetwater Springs Road.

REFERENCE 20

REFERENCE 21

PRIORITY ☐
(explain)

HML NO. ____ to ____

HAZARDOUS MATERIALS SAMPLE ANALYSIS REQUEST

PART I: FIELD SECTION

COLLECTOR D.W. Price DATE SAMPLED 7/22/80 TIME 1530 HOURS

LOCATION OF SAMPLING:

NAME Caputo-Wagner Quarry TEL NO. (707) 869-0673

ADDRESS 18500 Sweetwater Springs Rd. Guerneville CA 95446
number street state zip

HML NO. (Lab only)	COLLECTOR'S SAMPLE NO.	TYPE OF SAMPLE*	FIELD INFORMATION**
	DWP-21	grass	Dry grass along banks of Wilson Creek below quarry
	DWP-22	grass	Green grass along banks of Wilson Creek

ANALYSIS REQUESTED: Mercury

[illegible]

CHAIN OF CUSTODY:

1. D.W. Price ____ 7/22/80 - 7/23/80
signature title inclusive dates

2. ____ ____ ____ - ____
signature title inclusive dates

3. ____ ____ ____ - ____
signature title inclusive dates

4. ____ ____ ____ - ____
signature title inclusive dates

SPECIAL REMARKS ____
(e.g. duplicate sample given to company, etc.)

PART II: LABORATORY SECTION

RECEIVED BY ____ TITLE ____ DATE ____

SAMPLE ALLOCATION: ☐ HML ☐ SCBL ☐ LBL ☐ OTHER ____ DATE ____

ANALYSIS REQUIRED ____

*Indicate whether sample is sludge, soil, etc.; **Use back of page for additional info

CALIFORNIA DEPT. OF HEALTH SERVICES-HAZARDOUS MATERIALS LABORATORY--June 1979
Revised April 1980

ERD

PRIORITY ☐
(explain)

HML NO. ____ to ____

HAZARDOUS MATERIALS SAMPLE ANALYSIS REQUEST

PART I: FIELD SECTION

COLLECTOR D.W. Price DATE SAMPLED 7/22/80 TIME 1500 HOURS

LOCATION OF SAMPLING:

NAME Jim Watson Residence TEL NO. ____

ADDRESS 17895 Sweetwater Springs Rd., Guerneville CA 95446
number street state zip

HML NO. (Lab only)	COLLECTOR'S SAMPLE NO.	TYPE OF SAMPLE*	FIELD INFORMATION**
	DWP-11	Peaches	Fresh crops ex: garden
	DWP-12	Chard	" " "
	DWP-13	Squash	" " "
	DWP-14	Potatoes	" " "
	DWP-15	Blackberries	" " "
	DWP-16	Lamb parts	- Frozen - 1979 Lamb

ANALYSIS REQUESTED:

Mercury

CHAIN OF CUSTODY:

1. D.W. Price ____ 7/22/80 - 7/23/80
signature title inclusive dates

2. ____ ____ ____ - ____
signature title inclusive dates

3. ____ ____ ____ - ____
signature title inclusive dates

4. ____ ____ ____ - ____
signature title inclusive dates

SPECIAL REMARKS ____
(e.g. duplicate sample given to company, etc.)

PART II: LABORATORY SECTION

RECEIVED BY ____ TITLE ____ DATE ____

SAMPLE ALLOCATION: ☐ HML ☐ SCBL ☐ LBL ☐ OTHER ____ DATE ____

ANALYSIS REQUIRED ____

---

*Indicate whether sample is sludge, soil, etc.; **Use back of page for additional inf

CALIFORNIA DEPT. OF HEALTH SERVICES-HAZARDOUS MATERIALS LABORATORY--June 1979
Revised April 1980 ERD

(explain)

to

HAZARDOUS MATERIALS SAMPLE ANALYSIS REQUEST

PART I: FIELD SECTION

COLLECTOR D.W. Price DATE SAMPLED 7/22/80 TIME 1500 HOURS

LOCATION OF SAMPLING:

NAME Jim Watson Residence TEL NO.

ADDRESS 17895 Sweetwater Springs Rd. Guerneville

number street state zip CA 95446

HML NO. (Lab only)	COLLECTOR'S SAMPLE NO.	TYPE OF SAMPLE*	FIELD INFORMATION**
	DWP 17	Weed	From Watson's Pasture*
	DWP 18	Weed	Chinese Stink Plant from Watson
			sheep pasture
			(* sample not included -
			will be sent in in
			a few days.)

ANALYSIS REQUESTED: Mercury

CHAIN OF CUSTODY:

1. D W Price | title | 7/22/80 - 7/23/80 inclusive dates
   signature
2. signature | title | - inclusive dates
3. signature | title | - inclusive dates
4. signature | title | - inclusive dates

SPECIAL REMARKS

(e.g. dupicate sample given to company, etc.)

PART II: LABORATORY SECTION

RECEIVED BY TITLE DATE

SAMPLE ALLOCATION: ☐ HML ☐ SCBL ☐ LBL ☐ OTHER DATE

ANALYSIS REQUIRED

*Indicate whether sample is sludge, soil, etc.; **Use back of page for additional info.

CALIFORNIA DEPARTMENT OF HEALTH SERVICES-HAZARDOUS MATERIALS LABORATORY-June 1979
Revised January 1980

ERD

PRIORITY ☐
(explain)

HML NO.
to

HAZARDOUS MATERIALS SAMPLE ANALYSIS REQUEST

PART I: FIELD SECTION

COLLECTOR D.W. Price DATE SAMPLED 7/22/80 TIME 1500 HOURS

LOCATION OF SAMPLING:

NAME Jim Watson's Residence TEL NO.

ADDRESS 17895 Sweetwater Springs Rd., Guerneville
number street state zip CA 95446

HML NO. (Lab only)	COLLECTOR'S SAMPLE NO.	TYPE OF SAMPLE*	FIELD INFORMATION**
	DWP 19a	soil	Garden Soil 0-3"
	DWP 19b	soil	" " 3-6"
	DWP 19c	soil	" " 6-9"
	DWP 20a	soil	Pasture Soil 0-3"
	DWP 20b	soil	" " 3-6"
	DWP 20c	soil	" " 6-9"

ANALYSIS REQUESTED:

Mercury

CHAIN OF CUSTODY:

1. D.W. Price signature | title | 7/22/80 - 7/23/80 inclusive dates
2. signature | title | - inclusive dates
3. signature | title | - inclusive dates
4. signature | title | - inclusive dates

SPECIAL REMARKS
(e.g. duplicate sample given to company, etc.)

PART II: LABORATORY SECTION

RECEIVED BY TITLE DATE

SAMPLE ALLOCATION: ☐ HML ☐ SCBL ☐ LBL ☐ OTHER DATE

ANALYSIS REQUIRED

---

*Indicate whether sample is sludge, soil, etc.; **Use back of page for additional inf

CALIFORNIA DEPT. OF HEALTH SERVICES-HAZARDOUS MATERIALS LABORATORY--June 1979
Revised April 1980

ERD

ZARDOUS MATERIALS LABORATO

LABORATORY REPORT

1928 - 1934

TO: P.H. Williams (name of person requesting analysis)

HML # ☐☐☐☐☐

COPY TO Charlene Williams

COLLECTOR'S SAMPLE # CFW-088 - CFW-094

DATE OF REPORT 8 15 80

LOCATION OF SAMPLE COLLECTION:

DATE COLLECTED Various (mo day yr)

NAME

ADDRESS (number street city state zip)

ANALYTICAL PROCEDURES USED: Cold Vapor Mercury Analysis by AAS.

[illegible] & 17°

REFERENCE:

ANALYSIS RESULTS:

HNO_3 1:1 62°C max

	HML #	INSP #	SAMPLE TYPE	TOTAL MERCURY ug/g	Soluble Mercury ug/g	Elemental Mercury
white rock	1928	CFW-088	ROCK-Grnd to pass 40#	19.8	1.22	—
red rock	1929	CFW-089	ROCK-Grnd to pass 40#	25.6	15.6	—
retort area [illegible]	1930	CFW-090*	MSA Charcoal sample collection tube-air*	—	—	<0.25 ug Hg volume air
[illegible]	1931	CFW-091*	MSA Charcoal sample collect tube - air*	—	—	<0.25 ug Hg vol. air sampled
retort area soil	1932	CFW-092	Soil - only what passes 10 #	255	71.1	—
Pasture	1933	CFW-093	soil	4.6	5.0	—
[illegible] plant	1934	Vegetation air dried + blended	CFW-094	1.7 *	1.25	—

*Value represents estimate of Mercury content based on 50% recovery in digestion

ANALYSTS' SIGNATURES:

1. 8.15.80 date

2. date

SIGNATURE OF SUPERVISING CHEMIST

8/15/80 date

California Department of Health Services - Hazardous Materials Laboratory

ARDOUS MATERIALS LABORATO

LABORATORY REPORT

1963, 1964, 2018
1935 - 1938

TO: P. H. Williams
(name of person requesting analysis)

HML # ☐☐☐☐☐

COPY TO CF Williams

COLLECTOR'S SAMPLE # CFW 095-098, PHW-1, PHW-2, CFW103

DATE OF REPORT 8 15 80

LOCATION OF SAMPLE COLLECTION:

DATE COLLECTED various
mo day yr

NAME

ADDRESS
number street city state zip

ANALYTICAL PROCEDURES USED: Cold Vapor Mercury by AAS.

REFERENCE:

ANALYSIS RESULTS:

	HML #	INSP. #	SAMPLE TYPE & TREATMENT	TOTAL MERCURY ug/g	Soluble Mercury ug/g	Elemental Hg.
air at address	1935	CFW-095 *	MSA Charcoal sample collect tube - air	—	—	<0.25 ug Hg / volume Air Sampled
Bedrock sample at address	1936	CFW-096	rock - ground to 40#	0.83	0.82	—
creek bed below mine	1937	CFW-097	rock - ground to 40#	95.9	37.1	—
plants in creek bed	1938	CFW-098	Vegetation air dried & blended	12.0*	4.65	—
[illegible]	1963	PHW-1	Aggregate ground to pass 40#	20.3	—	—
[illegible]	1964	PHW-2	Aggregate ground to pass 40#	51.1	—	—
mine	2018	CFW-103	yellow onion air dried & blended	0.52*	—	—

* Value represents estimate of Mercury content based on 50% recovery in digestion

ANALYSTS' SIGNATURES:

1. 8.15.80
date

2.
date

SIGNATURE OF SUPERVISING CHEMIST

Emil R. de Vera 8/18/80
date

California Department of Health Services - Hazardous Materials Laboratory

ZARDOUS MATERIALS LABORATC

LABORATORY REPORT

2152 - 2154
2019 - 2021, 2028

TO: P.H. Williams
(name of person requesting analysis)

HML # ☐☐☐☐☐

COPY TO CF Williams or Doug Price

COLLECTOR'S SAMPLE # DP-11 - DP-13 CFW 104 - CFW 106, PHW-3

DATE OF REPORT 8 15 80

LOCATION OF SAMPLE COLLECTION:

DATE COLLECTED various
mo day yr

NAME

ADDRESS
number street city state zip

ANALYTICAL PROCEDURES USED: Cold Vapor Mercury analysis by AAS

REFERENCE:

ANALYSIS RESULTS:

Garden soil [illegible]

algae from creek

creek soil

Soil at Seaview

HML #	Insp. #	Sample type & treatment	Total Mercury ug/g	Soluble Mercury ug/g	Elemental Mercury
2019	CFW 104	Soil-passes 10# sieve	27.8	—	—
2020	CFW 105	Vegetation	246*	—	—
2021	CFW106	rock-grind to pass. 40#	51.1	—	—
2028	PHW-3	soil passes 10# sieve	0.4	—	—
2152	DP - 11	peaches-rinsed and blended no pits	0.012*	—	—
2153	DP - 12	swiss chard rinsed and blended	0.016*	—	—
2154	DP-13	zuccini rinsed and blended	0.003*	—	—

1.3
0.3
0.16
0.07 [illegible]

* value reported is estimate of Mercury content bases on 50% recovery in digestion

ANALYSTS' SIGNATURES:

1. 8.15.80
date

2.
date

SIGNATURE OF SUPERVISING CHEMIST

[illegible]
date

California Department of Health Services - Hazardous Materials Laboratory

ZARDOUS MATERIALS LABORATO

LABORATORY REPORT

2155 - 2161

TO: P. H. Williams
(name of person requesting analysis)

HML # ☐☐☐☐☐

COPY TO DOUG PRICE

COLLECTOR'S SAMPLE # DP-14, DP-16, DP18-DP-22

DATE OF REPORT 8 | | 1 | 5 | 8 | 0

LOCATION OF SAMPLE COLLECTION:

DATE COLLECTED ☐☐☐☐☐☐ mo day yr

NAME

ADDRESS
number street city state zip

ANALYTICAL PROCEDURES USED: Cold Vapor Mercury Analysis by AAS

REFERENCE:

ANALYSIS RESULTS:

HML #	Inspectors #	Sample Type & treatment	Total Mercury ug/g	Solubility ug/g	Elemental Mercury
2155	DP 14	Potatoes: rinsed and blended	0.004*	—	—
2156	DP 16	LAMB PARTS: ½ heart 1 kidney, 1 chop	0.025*	—	—
2157	DP 18	Chinese stink plant. Rinsed and blended	0.052*	—	—
2158	BP 19	Soil: composite of 3 depths passed #10	41.4	—	—
2159	DP 20	Soil: composite of 3 depths passed #10	4.6	—	—
2160	DP 21	Grass-air dried & blended	3.9*	—	—
2161	DP 22	Grass: air dried and blended	12.4*	—	—

Wilson Creek

" "
(same area)

* Value is estimate of mercury content based on 50% recovery in digestion

ANALYSTS' SIGNATURES:

1. 8.15.80
date

2.
date

SIGNATURE OF SUPERVISING CHEMIST

8/18/80
date

California Department of Health Services - Hazardous Materials Laboratory

ZARDOUS MATERIALS LABORAT

LABORATORY REPORT

TO: DOUG PRICE
(name of person requesting analysis)

HML # 1 6 9 1 10
1697

COPY TO

COLLECTOR'S SAMPLE # DWP-4 thru DWP-10

DATE OF REPORT 5 20 80

LOCATION OF SAMPLE COLLECTION:

DATE COLLECTED 5 8 80
mo day yr

NAME Guerneville Rock Products

ADDRESS Sweetwater Springs Rd. Guerneville Ca
number street city state zip

ANALYTICAL PROCEDURES USED: Cold Vapor Mercury Analysis by AAS
"METHODS FOR CHEMICAL ANALYSIS OF WATER AND WASTES" p 134.1

REFERENCE:

ANALYSIS RESULTS:

HML#	COLLECTORS SAMPLE #	Hg ppm	
1691	DPW 4	189	Seaview Stockpile #1
1692	DWP 5	636	" Small Stockpile
1693	DWP 6	34.0	" Stockpile #2
1694	DWP 7	539	" , Rock from road
1695	DWP 8	1406*	Quarry Rock
1696	DWP 9	70.8	Quarry, Gravel
1697	DWP 10	40.5*	Quarry "Sand"

* Average of 2 determinations

ANALYSTS' SIGNATURES:

1. 5 20.80
date

2.
date

SIGNATURE OF SUPERVISING CHEMIST

Emil Severa/Jr. 5-20-80
date

California Department of Health Services - Hazardous Materials Laboratory

ZARDOUS MATERIALS LABORATO

LABORATORY REPORT

TO: P. A. Williams (name of person requesting analysis)

HML # 1695

COPY TO Doug PRICE

COLLECTOR'S SAMPLE # ~~DPW~~ DWP-8 *

DATE OF REPORT 8 15 80

LOCATION OF SAMPLE COLLECTION:

DATE COLLECTED mo day yr

NAME JACKSON MERCURY MINE

ADDRESS SWEETWATER SPRINGS Rd. Guerneville (number street city state zip)

ANALYTICAL PROCEDURES USED: WASTE EXTRACTION TEST + X-RAY FLUORESCENT SPECTROSCOPY.

REFERENCE:

ANALYSIS RESULTS:

CITRATE EXTRACT (ppm)

Mn	141.4 ± 40.5
Fe	8017 ± 802
Ni	491.0 ± 48.4
Zn	18.6 ± 11.2
Ge	9.3 ± 7.4
Br	167 ± 7.4
Sr.	87.4 ± 11.2

DEIONIZED WATER EXTRACT (ppm)

Fe	26.88 ± 19.2
Br	5.8 ± 3.8

*. Contained [illegible] ppm Hg by [illegible] digestion [illegible]

ANALYSTS' SIGNATURES:

1. 8.15.80 date

2. date

SIGNATURE OF SUPERVISING CHEMIST [illegible] date

California Department of Health Services - Hazardous Materials Laboratory

8.15.80

NOTE ON Mercury in Vegetation.

all vegetation samples were digested with $HNO_3 + HClO_4$ and heat, some Mercury is lost in this process.
National Bureau of Standards Standard Reference Material 1571 – Orchard leaves was digested as above four times giving Mercury values as below

1	0.05 ug/g
2	0.06 "
3	0.07 "
4	0.10 "
ave.	0.07 "

The reported value for this material is 0.155 ± 0.015 ug/g

Therefore Mercury values reported on Vegetation samples are adjusted for 50% recovery in the digestion.

ARTHUR HORREN

COMPLAINT FORM

Complainant: Steve Spector Date: 3/19/80

Address: Guerneville Phone No: 869-0765

Regarding: Cupito + Wagner gravel operation @ old Mercury mine on Fife Creek

Date of Occurrence: Time:

Description: Complainant had sample results of creek water in excess of drinking water standards intimating degradation of Fife Creek water supplies by high mercury levels as a result of gravel screening activity in old mercury mine tailings

Other Agencies Notified:

Complaint Taken By: Robert R Klamt

Referred To:

Action Recommended: Investigation of Cupito + Wagner operation, sampling of Fife Creek + any discharge or Guerneville supply wells. Contact Spector of results. [illegible]

Action Taken: [illegible] [illegible] [illegible] [illegible] order ([illegible]) [illegible]

Disposition: [illegible] data [illegible]

Complainant notified of Disposition by: R Klamt

Dated: 3/24/80

received from RWQCB

REFERENCE 22

May 7, 1980

6/4/85 RB

Dr. David L. Storm
Regional Administrator, Berkeley
Hazardous Materials Management Section
Department of Health Services
2151 Berkeley Way
Berkeley, California 94704

Dear Dr. Storm:

We have been in communication with Paul Williams and Douglas Price of your Section concerning the possible hazardous nature of a large pile of mercury mine tailings located at the Mt. Jackson Mine near Guerneville in Sonoma County. Our primary interest in these tailings necessarily centers on their potential adverse affects on water quality, but, now recognizing that this material may present a public health problem, we wish to bring the subject to your Department's official attention.

Dr. Price has inspected the tailings pile and reviewed information we have compiled on the characteristics (including mercury content) and current uses of this material. Based on this knowledge, Dr. Price tentatively identified the tailings as hazardous material, and he agreed to investigate the matter further. We would like to receive your Section's determinations about the Mt. Jackson Mine tailings as soon as they are available.

A copy of our internal memorandum, which summarizes the pertinent information about the subject mercury mine tailings, is enclosed for your records.

Thank you for taking this matter under advisement.

Sincerely,

Benjamin D. Kor
Assistant Executive Officer

BDK:RLC:ph
Enclosure

REFERENCE 23

ARDOUS MATERIALS LABORATORY

LABORATORY REPORT

TO: P H Williams (name of person requesting analysis)

HML # 4855

COPY TO

COLLECTOR'S SAMPLE # PHW - 84A

DATE OF REPORT 122981

LOCATION OF SAMPLE COLLECTION:

DATE COLLECTED 06 10 80 (mo day yr)

NAME Mercury mine

ADDRESS (number street city state zip)

ANALYTICAL PROCEDURES USED: Sample was oxidized ē HNO_3 and $KMnO_4$ on steam then treated ē hydroxylamine HCl then ē $SnSO_4$ and Hg cold vapor was measured by AA flameless.

REFERENCE: HML Method

ANALYSIS RESULTS:

HML # 4855

PHW-84A

Hg = 27.8 μg/g

(This sample was submitted mainly for WET value, but since total Hg was low, WET was not run.)

ANALYSTS' SIGNATURES:

1. 12.29.81 date

2. date

SIGNATURE OF SUPERVISING CHEMIST

12-29-81 date

California Department of Health Services - Hazardous Materials Laboratory

PRIORITY ☐
(explain)

HML NO. ______ to ______

HAZARDOUS MATERIALS SAMPLE ANALYSIS REQUEST

PART I: FIELD SECTION

COLLECTOR C Williams DATE SAMPLED 6-30-80 TIME ______ HOURS

LOCATION OF SAMPLING:

NAME along Sweetwater Springs Rd. TEL NO. ______

ADDRESS Guerneville, CA

number street state zip

HML NO. (Lab only)	COLLECTOR'S SAMPLE NO.	TYPE OF SAMPLE*	FIELD INFORMATION**
	CFW-~~103~~ 104	soil	tilled garden soil to 8" depth. Jim Watson's yard.
	CFW-~~104~~ 103	solid	last year's onions - Jim Watson's yard.
	CFW-105	solid	surface scum from creek west of Jim Watson's property on Sweetwater Springs Rd.
	CFW-106	soil	creek soil below surface scum.

ANALYSIS REQUESTED: samples CFW 105 and CFW 106 taken in front of house with address of 17090 (?)

Total Hg.

CHAIN OF COUNTY:

1. ______ signature ______ title ______ - ______ inclusive dates
2. ______ signature ______ title ______ - ______ inclusive dates
3. ______ signature ______ title ______ - ______ inclusive dates
4. ______ signature ______ title ______ - ______ inclusive dates

SPECIAL REMARKS Please save samples
(e.g. duplicate sample given to company, etc.)

PART II: LABORATORY SECTION

RECEIVED BY ______ TITLE ______ DATE ______

SAMPLE ALLOCATION: ☐ HML ☐ SCBL ☐ LBL ☐ OTHER ______ DATE ______

ANALYSIS REQUIRED ______

*Indicate whether sample is sludge, soil, etc.; **Use back of page for additio

CALIFORNIA DEPT. OF HEALTH SERVICES-HAZARDOUS MATERIALS LABORATORY--June 1979
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E

(explain)

HAZARDOUS MATERIALS SAMPLE ANALYSIS REQUEST

PART I: FIELD SECTION

COLLECTOR Doug Price DATE SAMPLED May 8 1980 TIME ______ HOURS

LOCATION OF SAMPLING:

NAME Gravel Stockpile, Seaview Road TEL NO. ______

ADDRESS Near Ft. Ross, Sonoma County

number street state zip

HML NO. (Lab only)	COLLECTOR'S SAMPLE NO.	TYPE OF SAMPLE*	FIELD INFORMATION**
1691	DWP 4	Gravel	From Stockpile No. 1

ANALYSIS REQUESTED: I want to either relate sulfur content (as sulfide) to the mercury content of the sample or establish that the mercury is present as HgS. This can be done by burning the HgS off at 580 C to give Hg^0 plus SO_2 with both Hg^0 and SO_2 determined; or isolate HgS by dissolving away all other mineral content.

CHAIN OF CUSTODY: Analysis to ± 1 or 2 % is acceptable. H Williams 8/4/80

1. ______ signature ______ title ______ - ______ inclusive dates
2. ______ signature ______ title ______ - ______ inclusive dates
3. Arthur [illegible] signature Grad. Asst Chem. title 8.11.80 - ______ inclusive dates
4. ______ signature ______ title ______ - ______ inclusive dates

SPECIAL REMARKS ______
(e.g. duplicate sample given to company, etc.)

PART II: LABORATORY SECTION

RECEIVED BY [illegible] TITLE Lab Supr DATE 8/4/80

SAMPLE ALLOCATION: ☐ HML ☐ SCBL ☐ LBL ☐ OTHER ______ DATE ______

ANALYSIS REQUIRED $S^=$ (Isolate HgS, then determine $S^=$ or Hg)

---

*Indicate whether sample is sludge, soil, etc.; **Use back of page for additional info and purpose of sampling.

CALIFORNIA DEPT. OF HEALTH SERVICES-HAZARDOUS MATERIALS LABORATORY--June 1979
Revised April 1980 ERD

ARDOUS MATERIALS LABORAT

LABORATORY REPORT

TO: Doug Price
(name of person requesting analysis)

HML # | 1 | 6 | 9 | 1 | |

COPY TO

COLLECTOR'S SAMPLE # DWP 4

DATE OF REPORT | | 9 | 1 | 8 | 8 | 0 |

LOCATION OF SAMPLE COLLECTION:

DATE COLLECTED | | 5 | | 8 | 8 | 0 |
mo day yr

NAME Gravel Stockpile, Seaview Road

ADDRESS Near Fort Ross, Sonoma County
number street city state zip

ANALYTICAL PROCEDURES USED: Mercury by cold vapor method, ~~digested with (1 + 1) HNO_3 at 62°C.~~ Soluble & insoluble mercury by digestion with (1+1) HNO_3 followed by mercury analyses of filtrate and sediment.

REFERENCE: Standard Method, 14th Edition, p. 156-159

ANALYSIS RESULTS: HML 1691 (DWP 4)&mercuric sulfide (HgS) ~~standard~~ were analyzed for total mercury, soluble mercury and insoluble mercury.

To determine soluble and insoluble mercury, the sample and mercuric sulfide (0.05 - 0.10 g) were digested in 25 ml of (1 + 1) HNO_3 at 62°C for 2.5 hours, diluted to known volume, and filtered. The filtrate was analyzed for soluble mercury and the sediments were analyzed for insoluble mercury. Soluble, insoluble and total mercury are reported as micrograms of mercury per gram of sample.

Generally inorganic mercuric compounds,except HgS,are soluble in nitric acid. With the experimental conditions used, it is assumed that no other nitric acid insoluble mercury compounds remained in the sediment. The mercury found in the sediments may be related to the mercuric sulfide content of the sample.

The following results were obtained for HML #1691:

HML #1691	Soluble Mercury	Insoluble Mercury	Total Mercury	HgS*
Trial 1	6 ppm	218 ppm	230 ppm	253 ppm
Trial 2	7 ppm	231 ppm	242 ppm	268 ppm
Ave ± Ave deviation	6 ± 1 ppm	224 ± 8 ppm	236 ± 6 ppm	260 ± 8 ppm

(*Calculated value using the insoluble mercury results.)

The total mercury results (236 ± 6 ppm) is in agreement with the sum of soluble and insoluble mercury values and offer a convenient check on the validity of the method employed.

ANALYSTS' SIGNATURES:

1. William S Lum 10/6/80 date

2. date

SIGNATURE OF SUPERVISING CHEMIST

10/10/80 date

California Department of Health Services - Hazardous Materials Laboratory

A mercury sulfide preparation, purity unknown, was previously prepared by Evaldo Kothny of the Air and Industrial Hygiene Laboratory. Analysis of the preparation indicated a total mercury content of 82.7 ± 0.1%, corresponding to a mercuric sulfide content of 95.9 ± 0.2%:

Mercuric Sulfide Preparation	Total % Mercury	% Mercury Sulfide Calculated
Trial 1	82.8	96.0
Trial 2	82.6	95.9
Ave ± Ave Deviation	82.7 ± 0.1%	95.9 ± 0.2%

The behavior of mercuric sulfide ~~standard~~ in (1 + 1) HNO_3 was subsequently investigated by determining insoluble and soluble mercury as previously described. Results are as follows:

Mercuric Sulfide Preparation	Soluble Mercury	Insoluble Mercury
Trial 1	1020 ppm*	82.4%
Trial 2	932 ppm	81.7%
Ave	976 ± 42 ppm	82.0 ± 0.3%

*ppm = ug of Hg per gram of HgS preparation.

Employing a HgS purity of 95.9% for the mercuric sulfide preparation, 1020 ugs of soluble mercury were found per gram of HgS under the experimental conditions. Mercuric sulfide is thus about 0.12% soluble in (1 + 1) HNO_3 solution.

The extremely low solubility of HgS in nitric acid indicates that in the absence of insoluble mercury compounds other than HgS, nitric acid-insoluble mercury may be used as an indication of mercuric sulfide content for HML sample #1691.

WSL
10 6 90

HML # 1691 to ______

HAZARDOUS MATERIALS LABORATORY

LABORATORY REPORT

TO: DOUG PRICE
(name of person requesting analysis)

DATE OF REPORT: 6·30·80

COLLECTOR'S SAMPLE #: DWP 4 to ______

DATE COLLECTED: 5·8·80

LOCATION OF SAMPLING:

NAME Guerneville Rock Products

TEL. NO. ______

ADDRESS Sweetwater Springs Rd. Guerneville Ca
(number) (street) (city) (state) (zip)

ANALYTICAL PROCEDURES USED: CITRATE (IA) AND DEIONIZED WATER (IB) WASTE EXTRACTION ANALIZED FOR METALS BY X-RAY FLUORESCENCE ANAL. Hg Det'n by Cold Vapor AAS.

REFERENCES: ______

ANALYSIS RESULTS

Metal analysis: PPM*

HML #	1691 (IA)	1691 (IB)		
Insp. Spl #	DPW 4	DPW 4		
Ag	—	—		
As	—	—		
Ba	—	—		
Bi	—	—		
Cd	—	—		
Co	—	68 1±63*		
Cr	—	—		
Cu	—	—		
Fe	5420±542	—		
Hg	—	—		
Mn	61.9±30.9	—		
Mo		—		
Ni	3958±39.6	—		
Pb	—	—		
Sb	—	—		
Se	—	—		
Sn	—	—		
Sr	32 69±10 3	—		
Tl		—		
V	—	—		
Zn	18.93±9 5	—		
Br	1377±69	—		

(Sample of stockpiled gravel at Sa[illegible] Rd Total Hg = 187 ppm)

* Our X-Ray Fluorescence metal scans are run by the Lawrence Livermore Lab. The sample was not resubmitted to check the cobalt value. It is probably an anomaly and of no significance.

Note: (—): below detection limit of instrument
(blank): not determined

Analyst: Art Holden / EKB 6/30/80
signature date

Supervising Chemist: Carl Vera 7/3/80
signature date

* By X-Ray Fluorescence except Hg, which was determined by Atomic Absorption

California Department of Health Services---Hazardous Materials Laboratory

HML # 1691 to

HAZARDOUS MATERIALS LABORATORY

LABORATORY REPORT

TO: DOUG PRICE
(name of person requesting analysis)
DATE OF REPORT: 6·30·80

COLLECTOR'S SAMPLE #: DWP 4 to
DATE COLLECTED: 5·8 80

LOCATION OF SAMPLING:
NAME Guerneville Rock Products
TEL. NO.
ADDRESS Sweetwater Springs Rd. Guerneville Ca
(number) (street) (city) (state) (zip)

ANALYTICAL PROCEDURES USED: CITRATE (IA) AND DEIONIZED WATER (IB) WASTE EXTRACTION ANALIZED FOR METALS BY X-RAY FLUORESCENCE ANAL. Hg Det'n by Cold Vapor AAS.

REFERENCES:

ANALYSIS RESULTS

Metal analysis: PPM*

HML #	1691(IA)	1691(IB)		
Insp. Spl #	DPW 4	DPW 4		
Ag	—	—		
As	—	—		
Ba	—	—		
Bi	—	—		
Cd	—	—		
Co	—	68.1±6.3		
Cr	—	—		
Cu	—	—		
Fe	5420±542	—		
Hg	—	—		
Mn	619±30.9	—		
Mo		—		
Ni	395.8±39.6	—		
Pb	—	—		
Sb	—	—		
Se	—	—		
Sn	—	—		
Sr	32.69±10.3	—		
Tl		—		
V	—	—		
Zn	18.93±9.5	—		
Br	13.77±6.9	—		

Note: (—): below detection limit of instrument
(blank): not determined

Other analyses

Hg on Nitric acid digests.

HML	Coll #	Found ppm	total Hg ppm* reported earlier
1691	DPW4	16.46 ppm 16.5 Rnd	189
1693	DPW 6	~~14.45~~ 14.5 Rnd	34
1695	DPW 8	43.6	145

* see report on total Hg in Sample WML 015 p 45-46.

Analyst: signature 6/30/80 date

Supervising Chemist: signature 7/3/80 date

* By X-Ray Fluorescence except Hg which was determined by Atomic Absorption

California Department of Health Services---Hazardous Materials Laboratory

PRIORITY ☐

(Explain) ______

HML No. ______ To ______

HAZARDOUS MATERIALS SAMPLE ANALYSIS REQUEST

PART I: FIELD SECTION

Collector [illegible] Date Sampled [illegible] Time ______ Hours

LOCATION OF SAMPLING :

Name [illegible] Tel. No. ______

Address [illegible]
Number Street State Zip

HML No. (Lab Only)	Collector's Sample No.	Type Of Sample*	FIELD INFORMATION**
	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]

Analysis Requested: [illegible]

Chain of Custody:

1. [illegible] Signature ______ Title ______ — ______ Inclusive Dates
2. [illegible] Signature ______ Title [illegible] — ______ Inclusive Dates
3. ______ Signature [illegible] Title [illegible] — ______ Inclusive Dates
4. ______ Signature ______ Title ______ — ______ Inclusive Dates

Special Remarks ______
(e.g., duplicate sample given to company, etc.)

PART II: LABORATORY SECTION

Received By ______ Title ______ Date ______

Sample Allocation: ☐ HML ☐ SCBL ☐ LBL ☐ Other ______ Date ______

Analysis Required ______

*Indicate whether sample is sludge, soil, etc.; Use back of page for additional information.;

DHS 8002 (5/80) Orig.—Lab. Dup.—File Trip.—Inspector

15084 449 7 80 3M CAM OSP

HAZARDOUS MATERIALS LABORATORY

LABORATORY REPORT

TO: Doug Price
(name of person requesting analysis)

HML # 5021
-5024

COPY TO P. H. Williams

COLLECTOR'S SAMPLE # PHW 082 - PHW 085

DATE OF REPORT 02 02 82

LOCATION OF SAMPLE COLLECTION:

DATE COLLECTED 01 13 82
mo day yr

NAME Piombo Guerneville Quarry

ADDRESS Springwater Rd., Guerneville CA
number street city state zip

ANALYTICAL PROCEDURES USED: Aqua regia + $KMnO_4$ digestions; cold-vapor AA analysis for Hg

REFERENCE: HML Methods

ANALYSIS RESULTS:

HML #	Collector's Sample #	Sample Mass	Hg Mass	Hg * Conc.
5021	PHW 082	0.01 g	0.63 μg	63 μg/g
5022	PHW 083	0.01	0.95	95
5023	PHW 084	0.05	0.18	3.6
5024	PHW 085	0.01	0.72	72

* TLC = 2 μg/g total Hg

ANALYSTS' SIGNATURES:

1. William R. Pifer 2/2/82
date

2. ______________ ______
date

SIGNATURE OF SUPERVISING CHEMIST

JNV H.L 2-2-82
date

California Department of Health Services - Hazardous Materials Laboratory

State of California—Health and Welfare Agency Department of Health Services

PRIORITY ☐ — Supplementary

(Explain) ______

HML No. ______ To ______

HAZARDOUS MATERIALS SAMPLE ANALYSIS REQUEST

PART I: FIELD SECTION

Collector Doug Price / Ron Williams Date Sampled 1/13/82 Time ______ Hours

LOCATION OF SAMPLING :

Name Piombo Guerneville Site Tel. No. ______

Address [illegible] Road Guerneville (Number, Street, State, Zip)

HML No. (Lab Only)	Collector's Sample No.	Type Of Sample*	FIELD INFORMATION**
5022	Pi: W-283	Fine gravel	

Analysis Requested: Hg by WET - both citrate buffered and deionized water. Run 30 days

HML has sample. Analysis shows 95 ug/g Hg total

Chain of Custody:

1. HML has sample (Signature) ______ (Title) ______ — ______ (Inclusive Dates)
2. ______ (Signature) ______ (Title) ______ — ______ (Inclusive Dates)
3. ______ (Signature) ______ (Title) ______ — ______ (Inclusive Dates)
4. ______ (Signature) ______ (Title) ______ — ______ (Inclusive Dates)

Special Remarks ______
(e.g., duplicate sample given to company, etc.)

PART II: LABORATORY SECTION

Received By ______ Title ______ Date ______

Sample Allocation: ☐ HML ☐ SCBL ☐ LBL ☐ Other ______ Date ______

Analysis Required ______

*Indicate whether sample is sludge, soil, etc.; Use back of page for additional information.;

DHS 8002 (5/80) Orig.—Lab. Dup.—File Trip.—Inspector 15084 449 7 80 3M CAM OSP

H ARDOUS MATERIALS LABORATORY

LABORATORY REPORT

TO: P. H. Williams
(name of person requesting analysis)

HML # 5 0 2 2

COPY TO

COLLECTOR'S SAMPLE # PHW-083

DATE OF REPORT 0 4 1 4 8 2

LOCATION OF SAMPLE COLLECTION:

DATE COLLECTED 0 1 1 3 8 2
mo day yr

NAME

ADDRESS
number street city state zip

ANALYTICAL PROCEDURES USED: Hg by wet both citrate buffered and deionized water for 30 days extraction. Hg was determined by using the flameless AA

REFERENCE: HML method

ANALYSIS RESULTS:

[illegible]

Sample # PHW-083	Individual extraction time				
HML # 5022	2 days	4 days	8 days	16 days	Total
A Extracted by buffer citrate	µg/g 0.053	µg/g 0.02	µg/g 0.01	µg/g 0.0016	µg/g 0.084 ppm
B Extracted by deionized H_2O	µg/g 0.003	µg/g 0.002	µg/g 0.003	µg/g <0.0001	0.008 ppm

ANALYSTS' SIGNATURES:

1. _______ 4.14.82
date

2. _______
date

SIGNATURE OF SUPERVISING CHEMIST

_______ 4-16-82
date

California Department of Health Services - Hazardous Materials Laboratory

Mt. Jackson Mercury Mine File

(PHW notes transcribed by PHW on 10/27/88)

(Tests at Mt. Jackson Mine for mercury vapor using instruments supplied by AIHL - Berkeley.)

Jim Watson's , Sweetwater Springs Road, Guerneville Sunday, June 29, 1980 (10:40 am)

Hg tests - both instruments. No Hg detected

(Note: this apparently was an air test near Watson house.)

(Spilled Hg in dirt under house readily detected by sniffer)

Bill/Andrea Johnson 11:30 am

(Note: Johnson house is on hill above mine)

Sun shining. Breeze from direction of mine. No detectable mercury by Hg Sniffer.

At Quarry 12:00 Noon

Soil at base of shed by sign Danger. Level within few inches of dirt 0.35 mgs/m3. Sunny, warm. No detectable close up to tailings.

Hot weather. No detectable Hg at any piles, in creek bed - 12-1:00 pm disturbed piles. Only detectable was in (?) beneath 1st conveyor (largest rock)- 0.25 0.3 mg/m^3

(Note: Reference is to machinery used to grade crushed tailings into gravel sizes. Open area beneath first conveyor was tested and found positive for Hg.)

Jim Watson's, Guerneville June 30, 1980

Filter/pumps put in place for 2 hrs each at roadside by Jim Watson's/ , at roadside (opposite) across from quarry crushing/loading operations/ and at Andrea Johnson's. Pumps regulated and recorded for airflow about every 15-20 mins.

(Later analyses of filters showed no significan dust collection and no detectable Hg.)

California State Department of Health
Air and Industrial Hygiene Laboratory
2151 Berkeley Way, Berkeley, CA 94704

Date Received 11/2/80

LABORATORY SERVICE REQUEST

[illegible] 2C5N

Plant or Place ______________________ No. of Persons Exposed 3

Address ______________________

Submitting Agency HWMS Phone No. x2053

Date Submitted 7/2/80

Send Analytical Report to Phil Williams

Field No.	Date Coll.	Type of Sample (Air, Material)	Vol.	Field Information	Analysis Requested
WF-	099			FZC-2A	Weight
-	100			↓	
-	101			↓	

Description of Problem:

Dean D. Gas samples.

Form IAHL 600
(2-74)

SEND ORIGINAL AND ONE CARBON COPY TO AIR AND INDUSTRIAL HYG. LAB. [illegible]

Hazardous Waste Management Section

DIS ☐ District ☐

Name Paul Williams

1 IS Inspection/I.H. Investigation Identification:

I. D. No.					Rpt. No.			Yr.	

2. **Name of Establishment**

Address

3. **Date This Report:**

Mo.		Day		Yr.	
0	7	1	0	8	0

4. **Laboratory Results**

Lab. No. *For Lab. Use Only*	Field No.	Laboratory Results
	CWF-	
01205	099	Weight of Dust: less than 0.05 milligrams.
	100	" " " : less than 0.05 milligrams.
	101	" " " : less than 0.05 milligrams.

5. **Signatures of Chemists Involved**

D. Uchimoto

6. **Signature of Supervising Chemist**

G Jeung

CAL/OSHA H-11

6/16/

WATER POLLUTION CONTROL LABORATORY

Request for Chemical Analysis and/or Bioassay Findings on Materials Submitted

NOTE: This form will be returned to you. Please type or print legibly with black ink in triplicate as completely as possible.

Paul Williams
NAME
2151 Berkeley Way
NUMBER STREET
Berkeley, CA 94704
CITY STATE ZIP

(FOR LABORATORY USE ONLY)
W.P.C.L. NO. L-154-80
RECEIVED BY Catherine Reiner
DATE RECEIVED 5-30-80
DATE COMPLETED 6-07-80

Description of Sample Cinibar ore

Source of Sample Crushed rock from Guerneville Mercury Mine

Detailed Description of Problem possible leachate problem

I HEREBY CERTIFY THAT THE ANALYSIS REQUESTED IS NECESSARY IN CONNECTION WITH MATTERS RELATING TO MY OFFICIAL DUTIES.

By Ned Therien Region/Branch HMMS- Date 5-30-80

Delivered By "

Date Analysis Required ASAP Reason Enforcement action pending

Analysis Required ( ) **Chemical** ( ) **Quant.** ( ) **Qual.** (X) **Bioassay**	**Laboratory Findings**
Method: Five grams of the sample was mixed by 2 methods. Method A consisted of sonication with a sonicator-cell disrupter for 6 min. on a 50% pulse mode and continuously for 2 minutes. Meter readings during mixing were 40. Method B consisted of shaking on a wrist-action shaker for 24 hours. Final test concentration equaled 500 mg/1; 10 fish per test; total volume was 10 liters.	Sample L-154-80 (HML #1691) as received was found to have a 96-hr LC50 value greater than 500 mg/1. The test species was golden shiner, Notemigonus crysoleucas (data attached)

HAZARDOUS MATERIALS MANAGEMENT SECTION
JUN 16 1980
CALIFORNIA DEPARTMENT OF HEALTH SERVICES
BERKELEY

Laboratory Director

C.R. Reiner
Chemist/Biologist

FISH AND WILDLIFE WATER POLLUTION CONTROL LABORATORY

Bioassay Results

HML #1691

Concentration of 750 mg/1	**in**		
Dilution Water Source American River	**Total Hardness**	**Total Alkalinity**	

WPCL Number L-154-80

Title of Test Hazardous Waste

Type of Bioassay 96 hr. Static

Test Species Golden Shiner

Region

		Initial			**24 hr**				**48 hr**				**72 hr**				**96 hr**			
		Date 6-2-80			6-3-80				6-4-80				6-5-80				6-6-80			
		Time 16:00			14:00				15:00				15:00				16:00			
Concentration of Test Solution		**D.O.**	**pH**	**°C**	**No. Dead**	**D.O.**	**pH**	**°C**	**No. Dead**	**D.O.**	**pH**	**°C**	**No. Dead**	**D.O.**	**pH**	**°C**	**No. Dead**	**D.O.**	**pH**	**°C**
Control		8.8	7.0	17	0	8.0	7.0	19	0	7.4	7.0	20	0	7.6	7.3	20	0	7.3	7.4	21
1	Soni.	8.9	8.0	17	0	8.3	7.6	18	0	7.8	7.5	19	0	8.2	7.6	20	0	7.7	7.7	20
2			6-3-80			6-4-80				6-5-80				6-6-80				6-7-80		
3	Shake	8.5	7.5	18	0	8.2	7.6	19	1	8.5	7.8	20	0	8.1	7.8	21	0	8.3	7.8	20
4																				
5																				
6																				
7																				
8																				
9																				

RECAP

Test No.	**No. Dead**	**% Mort.**	**% Survi**
C	0	0	100
1	0	0	100
2			
3	1	10	
4			
5			
6			
7			
8			
9			

Note: Soni= Mixing by sonication 6 min.; 50% pulse; 20-40 meter reading: plus 2 minutes continuous; 40 meter reading. Sample was hot after mixing.

STATE OF CALIFORNIA
DEPARTMENT OF INDUSTRIAL RELATIONS
DIVISION OF OCCUPATIONAL SAFETY AND HEALTH

2424 Arden Way, Suite 107
Sacramento, California 95825
Telephone: (916) 920-6361

HAZARDOUS MATERIALS MANAGEMENT SECTION
MAY 14 1980
CALIFORNIA DEPARTMENT OF HEALTH SERVICES
BERKELEY

CITATION

Page 1 of 1

2
Piombo Corporation
1010 Shiloh Road
Windsor, CA 95492
Attn: Mr. L. Gobbi, Supt.

Type of alleged violation(s): General

5. Citation number 1

6. An inspection/investigation of a place of employment located at 18500 Sweetwater Rd., Guerneville, Sonoma, CA was conducted by W. J. Zavattero on 4-7-80. This citation is being issued in accordance with California Labor Code Section 6317 for alleged violations as shown below that were found during the inspection/investigation. (CAC refers to California Administrative Code. LC refers to California Labor Code.)

7a. Item No	7b. No. of Instances	8. Standard, rule, order, or regulation allegedly violated	9. Description of alleged violation	10. Date by which alleged violation must be corrected
1	1	8 CAC 6925(a)	Drinking Water	5-13-80
			The employer neglected to provide suitable drinking	
			water for employees. Employee drinking water has been	
			provided from a well at the plant site. Laboratory	
			test (see attached) revealed that this drinking water	
			contained 5.6 PPB of Mercury. The standard for	
			drinking water is 2 PPB. Reference for the standard	
			is Title 22 CAC Section 64435.	

11. Signature W. J. Zavattero
Safety Engineer/Industrial Hygienist

12. Signature
District Manager/Senior Industrial Hygienist

13. 5-7-80
Date of Issuance

Citation(s) or a copy thereof must be prominently posted upon receipt by the employer at or near the location of each alleged violation until the unsafe condition is corrected or for three working days, whichever is longer.

Violations of the provisions of the California Labor Code or of safety and health standards, orders or regulations promulgated under the Labor Code may result in a civil penalty imposed on the employer and may result in some instances in a prosecution for a misdemeanor. If a monetary penalty is assessed, the employer will be notified promptly. The employer has 15 working days after receipt of the above citation within which to notify in writing the California Occupational Safety and Health Appeals Board, 1006 – 4th Street, Sacramento, CA 95814, of his intention to contest any alleged violation or abatement period. The above citation will become a final order of the Appeals Board not subject to review or appeal unless contested by the employer, an employee or employee's representative. Failure to abate the unsafe condition within the time specified may result in an additional proposed penalty of up to $1,000 being assessed for each day beyond the abatement period the unsafe condition is not abated.

An employee or his representative may contest in writing to the California Occupational Safety and Health Appeals Board the reasonableness of the abatement period within 15 working days from the date of issuance of the citation. Forms for use by an employee or the employer in presenting appeals to the Board are available from District Offices, Division of Occupational Safety and Health.

14.

REGION	DISTRICT	IDENTIFICATION NO.	CAL/OSHA REPORT NO.	FISCAL YR.
[illegible]	4	3-4102	622	80

CAL/OSHA 2 A
Rev June 1979

LABORATORY REPORT

TO: OH ☒ DIS ☐

Region 2

District 9

Name W.J. Zavattoro

1. DIS Inspection/I.H. Investigation Identification:

I. D. No.					Rpt. No.		Yr.			
2	4	1	9	2	6	2	7	8	0	7

2. Name of Establishment Piombo Corp. , (Mount Jackson Mine)

Address 18500 Sweetwater Road, Guerneville, Calif.

3. Date This Report:

Mo.		Day		Yr.	
0	4	2	4	8	0

4. Laboratory Results

Lab. No. For Lab. Use Only	Field No.	Laboratory Results	
			Microgram mercury per gram material, dried weight. •
00643	1	Finished Material (Fine)	72 PPM
	2	Tailing Pile Material	176 PPM
	3	Cone Crusher Material	78 PPM
	4	Slurry at Discharge Sump	213 PPM
	5	Drinking Water	5.6 microgram/liter of water (PPB)

• A similar sample aliquot was dried in hot air oven at 105°C to determine the moisture content and therefore the dried weight.

5. Signatures of Chemists Involved

P. Uchimoto

PDR

6. Signature of Supervising Chemist

State of California - Department of Health
Health Protection System - Occupational Health Section

REFERENCE 24

REFERENCE 25

STATE OF CALIFORNIA GEORGE DEUKMEJIAN, *Governor*

DEPARTMENT OF INDUSTRIAL RELATIONS
DIVISION OF OCCUPATIONAL SAFETY AND HEALTH
525 GOLDEN GATE AVENUE
SAN FRANCISCO

ADDRESS REPLY TO:
P.O. BOX 603
SAN FRANCISCO, CA 94101

MAR 27 '89

March 20, 1989

Log No. 2291

Department of Health Services
TOXIC SUBSTANCES CONTROL DIVISION
2151 Berkeley Way, Annex 7
Berkeley, CA 94704

Attention: Janet Naito

Subject : Employer: Piombo Corporation
Location: Swcetater (sic) Road aka
Sweetwater Springs Road
Guerneville

Dear Ms. Naito

This is to acknowledge your letter dated March 7, 1989 in which you request a copy of an inspection report of the above facility.

A search of the files was conducted under my direction which revealed NO RECORD of such inspection.

Please let us know if we can be of further service.

Sincerely,

Edw F Callanan

Edward F. Callanan
Custodian of Records

/gg

S-677

Appendix A

Contact Reports

CONTACT LOG

Name	Affiliation & Phone Number	Date	Information
Secretary	Sonoma County Assessor's Office (707)527-2541	1/26/89	Site Owners (Ref. 7)
Jean	Mine Safety & Health Admin. (415)273-7457	2/17/89	No informtn on site
Bob Tancredo	North Coast Region, RWQCB (707)520-2220	5/15/89	Onsite well (Ref. 16)
Ron Addis	Sonoma County, Div. of Env. Health (707)576-4765	5/17/89	Groundwater (Ref. 15)
Tricia Bedrosian	California Dept. of Forestry (707) 520-2275	6/1/89	No informtn on site
Gay Guodotti	Armstrong Valley Water Co. (707) 869-2848	7/10/89	Water Testing, Service (Ref. 19)
Secretary	Citizen's Utilities Co. (707) 869-2545	8/4/89	Water Service (Ref. 19)

CONTACT REPORT

AGENCY: Sonoma County Assessor's Office

ADDRESS: Santa Rosa, CA

PERSON
CONTACTED: woman

PHONE NO.: (707) 527-2541

FROM: Dick Jones

TO: File

DATE: 1-26-89

SUBJECT: Mt. Jackson Mine owner

cc:

I asked the Assessor's representative for the owner of 18475 Sweetwater Springs Road (address furnished by Doug Price of DHS, Santa Rosa). She found the Assessor's Parcel Number to be 069-120-07 and the corresponding owner to be Walter J. Doyle, P.O. Box 146, Pilot Hill, CA 95664. (This corresponded to Dr. Price's report of the "Doyle Mine" sign at the Mt. Jackson site.)

CONTACT REPORT

AGENCY: North Coast Regional Water Quality Control Board

ADDRESS: Santa Rosa, CA

PERSON
CONTACTED: Bob Tancredo

PHONE NO.: (707) 520-2220

FROM: Dick Jones

TO: File

DATE: 5-15-89

SUBJECT: Mt. Jackson Mine Water Board information

cc:

5-15-89

Mr. Tancredo said although the Water Board had sampling information on surface water at the site, they did not have much groundwater information. He said the onsite well's mercury contamination was probably of mineral origin since the well was turbid. He suggested talking to Ron Addis of the County Environmental Health Division for information on small water systems.

CONTACT REPORT

AGENCY: Sonoma County Division of Environmental Health

ADDRESS: Santa Rosa, CA

PERSON
CONTACTED: Ron Addis

PHONE NO.: (707) 576-4765

FROM: Dick Jones

TO: File

DATE: 5-17-89

SUBJECT:

cc:

I asked Mr. Addis about groundwater in the Mt. Jackson Mine/Guerneville area. He said there are only small water systems in this rural area. Citizens Utilities serves the Russian River area and draws from both the river and the springs in the Sweetwater Springs area. Another small system, Armstrong Valley Water Company, draws from Fife Creek along Armstrong Valley Road. He said these small systems were under the State and Dave Clark's group in the Public Water Supply office (707) 576-2145.

I asked Mr. Addis about groundwater aquifers in the area. He said there are not any good confining strata and thus most water did come from shallow wells below the creek beds. The majority of the water was probably creek surface flow only.

Mr. Addis said the question of water quality arose when the mine was used for the sewer project in Guerneville. He said Dr. Holser did research on the mercury in water issue back then, and he would look for the correspondence.

Mr. Addis said their groundwater availability map showed the area to be a water scarce area. The area from Sweetwater Springs Road down to Armstrong Valley Road is a zone 4 or water scarce area. Mr. Addis said water is mainly pocket water and hard to come by. (New residents) are required to prove spring output of at least one gallon per minute.

CONTACT REPORT

AGENCY: California Department of Forestry

ADDRESS: Sonoma HQ, Santa Rosa, CA

PERSON
CONTACTED: Trinda Bedrosian

PHONE NO.: (707) 520-2275

FROM: Dick Jones

TO: File

DATE: 6-1-89

SUBJECT: Mt. Jackson Mine groundwater information

cc:

Ms. Bedrosian said they did not have much information on groundwater in the Mt. Jackson area. She suggested I call Water Quality or the Mine Relamation Program folks, Jim Pompy at 8-473-8565.

CONTACT REPORT

AGENCY:	Citizen's Utilities Co.	Armstrong Valley Water Co.
ADDRESS:	Guerneville, CA	Guerneville, CA
PERSON CONTACTED:	Secretary	Gay Guodotti
PHONE NO.:	(707) 869-2545	(707) 869-~~2848~~ 0050
FROM:	Dick Jones	
TO:`	File	
DATE:	8-4-89	7-10-89
SUBJECT:	Sweetwater Springs Road Water purveyor	
cc:		

Armstrong Valley Water Co. Contact 7-10-89

Ms. Guodotti reported that Armstrong's 2 wells in Armstrong Valley were tested every 3 years. She said Sweetwater Springs Road was mainly served by Citizen's Utilities. They have a storage tank up on Sweetwater Springs Road fed by pipe from Rio Nido.

Citizen's Utilities Contact 8-4-89

The secretary said they do serve the Rio Nido (upper) part of Sweetwater Springs Road.

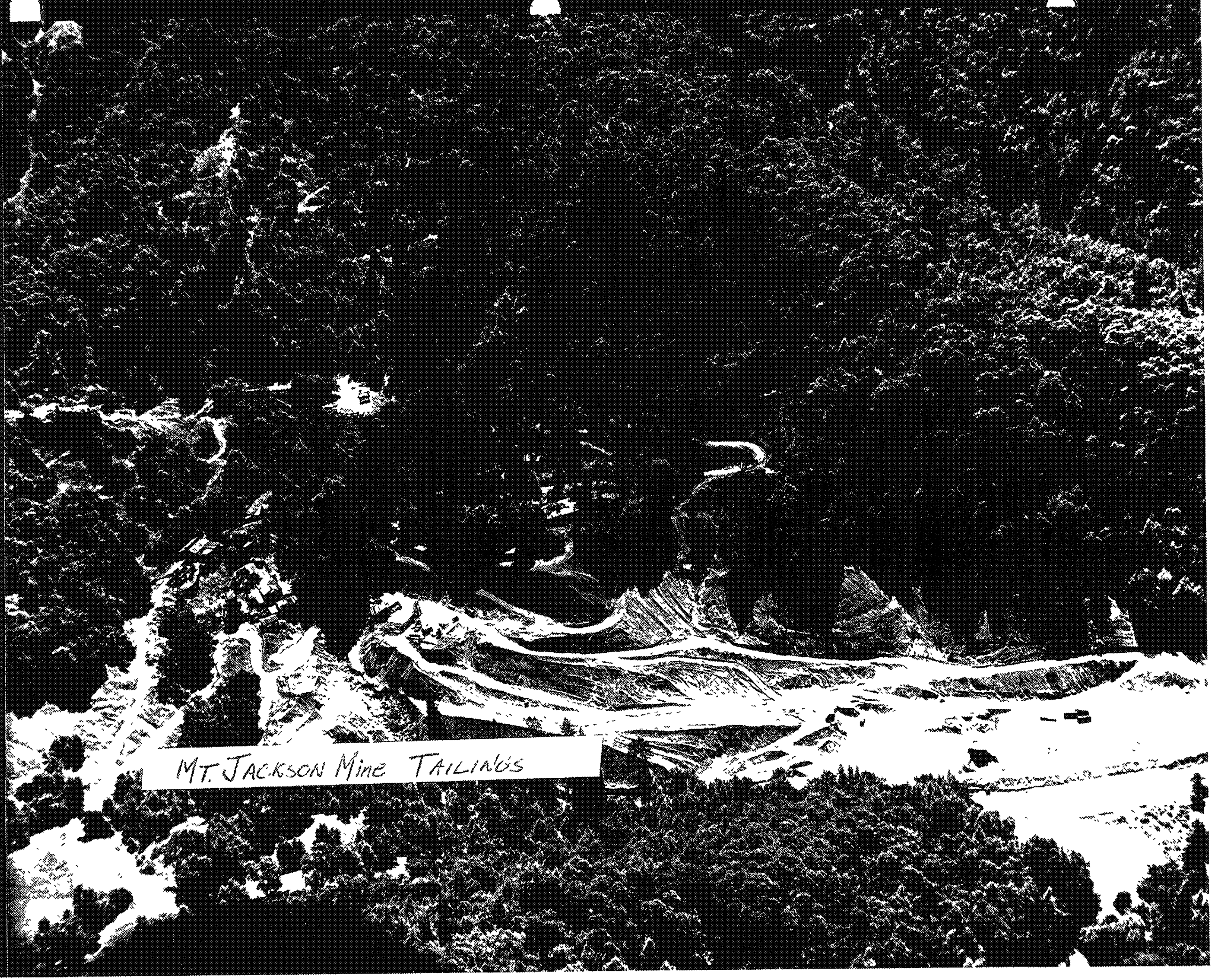
Appendix B

Mt. Jackson Mine

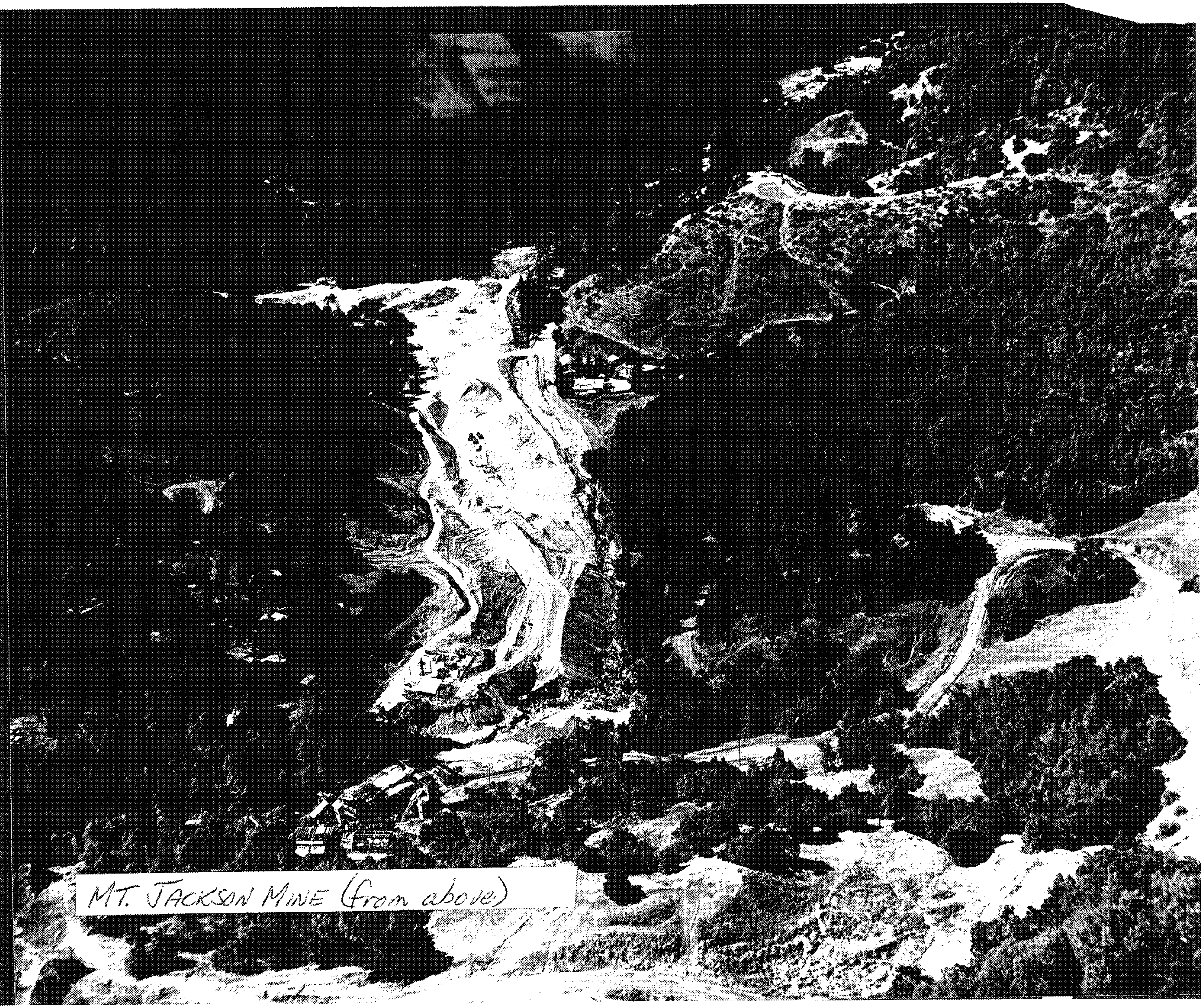
Aerial Photographs

5-31-89

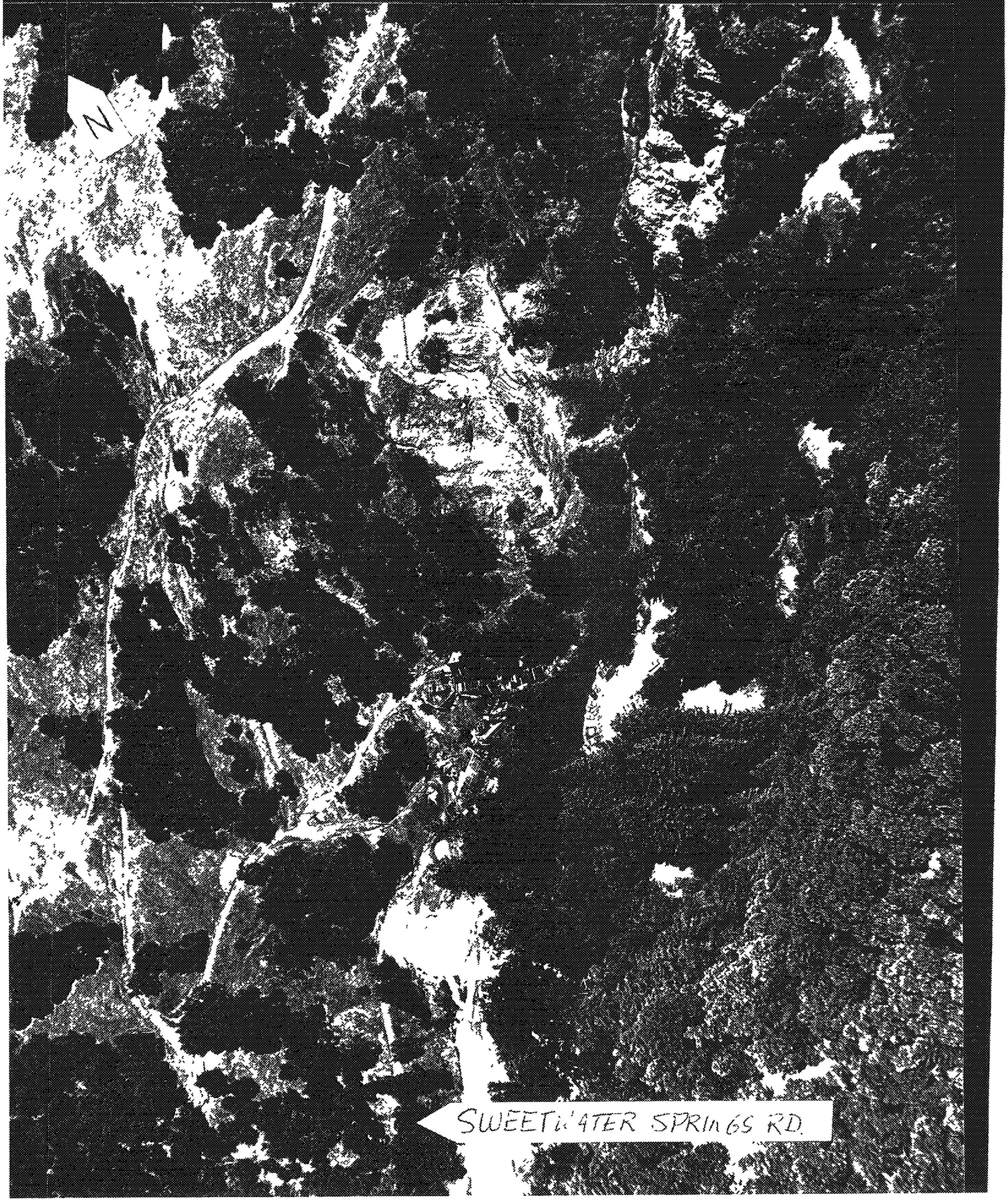
(Caltrans Overflight)

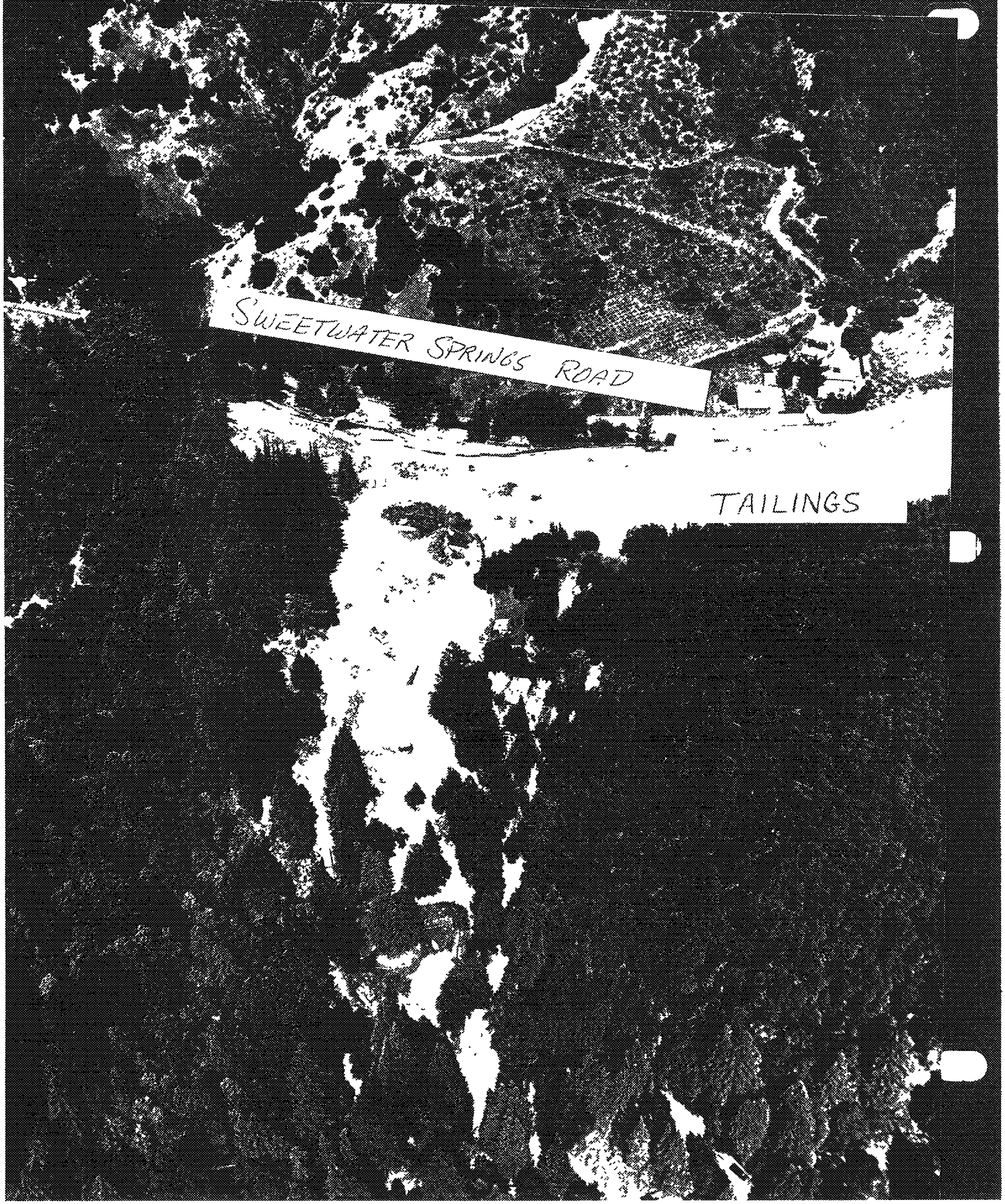


MT. JACKSON Mine TAILINGS



MT. JACKSON MINE (from above)


N
SWEETWATER SPRINGS RD.


SWEETWATER SPRINGS ROAD
TAILINGS