Closeout Plan Completion Report
Las Conchas Unit of the El Cajete Mine
Permit No. SA001RE

September 2020

THE ESPANOLA MERCANTILE COMPANY
Established in 1905

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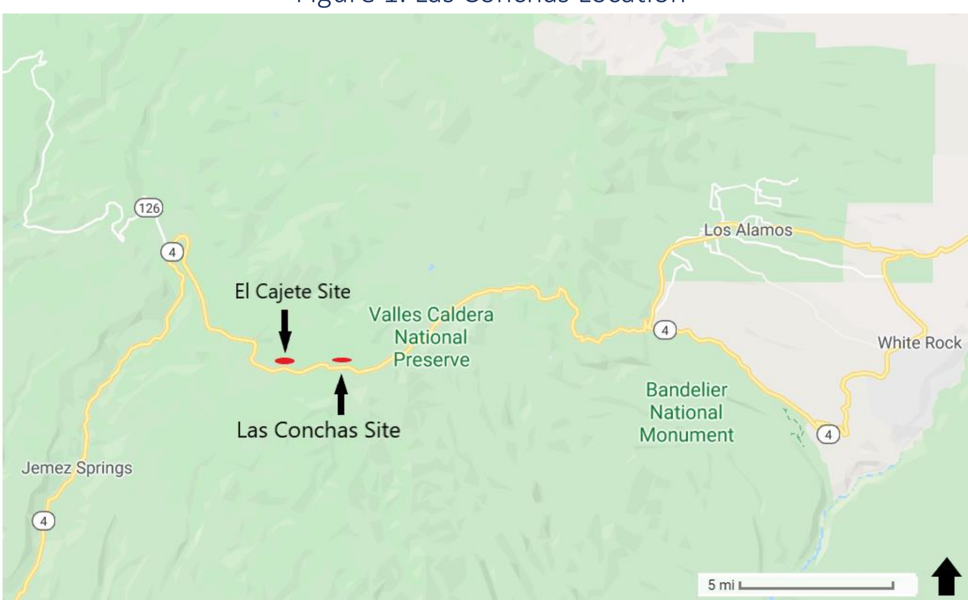
Contents

Introduction

In accordance with 19.10.12.1210 NMAC, The Espanola Mercantile Company requests the release of the financial assurance in the amount of $12,103.00 for the Las Conchas portion of the EL Cajete Mine Permit No. SA001RE. The El Cajete Mine will remain under the jurisdiction of the New Mexico Mining Act NMSA 1978, Section 69-36-1 et. seq. and Permit No. SA001RE until financial assurance in the amount of $78,747.00 is released under 19.10.12 NMAC. This document describes the reclamation or closeout measures completed at the 28 acre Las Conchas site, vegetation reports from 2015 and 2019 prepared by GL Environmental, Inc. and Ecosphere Environmental Services, Inc., respectively, and proof that the notice of application has been provided in accordance with 19.10.9.902 NMAC and 19.10.9.903 NMAC. Enclosed is a check in the amount of $1,000.00 as a permit modification fee in accordance with 19.10.2.201.H NMAC.

The reclaimed Las Conchas Mine is in Section 5, T18N, R4E, SE1/4, Redondo Peak Quadrangle, Sandoval County, New Mexico (Figure 1). The Las Conchas Mine was an open pit pumice mine operated by Copar Pumice Company and began operations in 1989. Over a 6-year period, approximately 400,000 cubic yards of locatable pumice were extracted from the mine. The mine operated from mid-March through November, Monday through Friday, 8 hours per day. Mining was accomplished using a TD 25 International Bulldozer, a 3.5 cubic yard Loader, two 18-wheeled dump trucks, and a portable screening plant. Other support equipment included low-boys, lubrication and fuel trucks, and pick-up trucks. There was no leaching, milling, or chemical processing at the mine site. Reclamation activities of the 28 acres disturbed at the site ran concurrently with mining operations and were completed in 1996.

Figure 1. Las Conchas Location



Schedule of Reclamation

The Under the Forest Service approved Plan of Operations, mining and reclamation activities were planned for 10-acre parcels. Mining began on the west end of the Las Conchas Mine and progressed in an eastward direction. The first 9.5-acre block was reclaimed between 1989 and 1994 and the remaining 18.5 acres were reclaimed between 1994 and 1996.

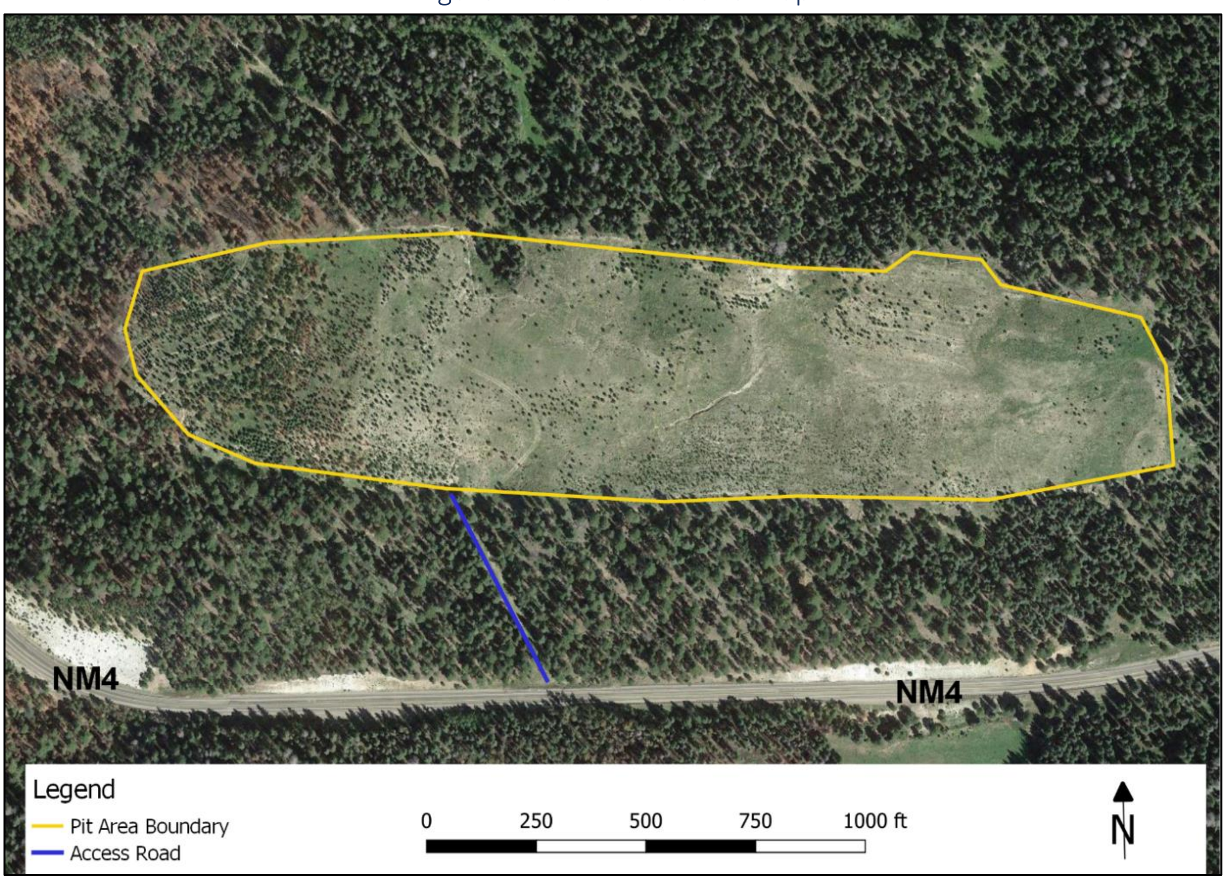
Surface Preparation

The topsoil from the initial 9.5-acre block was removed and stockpiled. The topsoil stripped from successive mining blocks was used to provide topdressing for the disturbed areas where previous mining and backfilling operations had been completed. Disturbed areas were backfilled with common variety pumice and regraded. The slopes within the majority of the reclaimed areas are under 30%, and no slopes are greater than 40%. Topsoil was spread to a minimum depth of six inches, fertilized with phosphorus pentoxide at a rate of 100 pounds per acre, and disked-in to a depth of six inches. On slopes near 30% or greater, 18-inch non-draining contour furrows with hay check dams were installed at intervals of 45 feet or less. The furrows had straw bales staked in at intervals of 100 feet or less. Final grading was completed so that the reclaimed surface has small depressions which concentrate water, promote infiltration, and facilitate the establishment and growth of tree seedlings. Salvage of merchantable timber preceded mining operations. Stockpiled logs remaining after the timber sale were scattered over the reclaimed area at a rate of 4 logs or greater per acre.

Structure and Equipment Removal

No waste dumps, pits, ponds, plant sites, or facilities remain at the Las Conchas site. The original Las Conchas Mine access road from Highway 4 to the mine site is shown on Figure 2. The access road at the time of mine operations was approximately 400 feet in length and 16 feet wide. The access road was deep ripped and seeded with an approved seed mix upon the cessation of mining activity. However, the reclaimed road was used in recent years to support timber harvesting operations. As a result, much of the original haul road has been reestablished and is visible.

Figure 2. Las Conchas Site Map



Soils

According to the Natural Resource Conservation Service (NRCS), soil within the Las Conchas Mine consisted solely of the Cajete series. This soil series are very deep, well drained soils that formed in pumice. The Cajete Soils are on ridge crests of low hills, terraces, and in pockets on mountain slopes. Slopes range from 0 to 30 percent and depth to the base of the soil horizon ranges from 20 to 40 inches.

Due to stripping, stockpiling, and respreading activities, the reclaimed soils have likely been converted from moderately well-developed soil to a younger soil. Reclamation and soil stabilization procedures were completed in accordance with the approved Plan of Operations.

Vegetation

The Las Conchas Mine permit area is classified as an upper montane coniferous forest with intermixed grasslands habitat type. A list of common native plants observed at the Las Conchas site by the United States Forest Service in 1994 is provided below.

Table 1. Observed Species List

Common Name	Scientific Name
Grasses	
Arizona fescue	*Festuca arizonica*
Bottlebrush squirreltail	*Elymus elymoides*
Junegrass	*Koeleria macrantha*
Mountain muhly	*Muhlenbergia montana*
Muttongrass	*Poa fenderiana*
Pine dropseed	*Blepharoneuron tricholepis*
Parry's Oatgrass	*Danthonia parryi*
Thurber's fescue	*Festuqa thurberi*
Forbs	
American vetch	*Vicia americana*
Arizona peavine	*Lathyrus polymorphus*
Beardlip penstemon	*Penstemon barbatus*
Pine thermopsis	*Thermopsis pinetorum*
Rose pussytoes	*Antennaria rosea*
Skyrocket (Scarlet) gilia	*Ipomopsis aggregata*
Strawberry	*Fragaria virginiana*
Western yarrow	*Achillea millefolium*
Shrubs	
Buckbrush	*Ceanothus fendleri*
Common juniper	*Juniperus communis*
Fendler rose	*Rosa fendleri*
Gambel oak	*Quercus gambelii*
NM locust	*Robinia neomexicana*
NM raspberry	*Rubus neomexicanus*
Orange gooseberry	*Ribes pinetorum*
Wax currant	*Ribes cereum*

Revegetation

The Forest Service's recommended seed mixture of grasses, forbs, and shrubs was broadcast seeded after fertilizing and disking while the topsoil was friable. After seeding, straw mulch was spread and crimped into the soil. One-year old container stock of Ponderosa Pine seedlings were planted at a rate of 500 trees per acre in the springtime under prescribed soil moisture and temperature requirements. The mine area was fenced to prevent access to livestock and help the reestablishment of vegetation after reclamation. Livestock were excluded for a period of 3-5 years after revegetation to assure adequate establishment of grasses, forbs, and shrubs.

Table 2. Seed Mix

Common Name	Scientific Name	Pounds per Acre
Grasses		
Arizona Fescue	*Festuca arizonica*	3
Bottlebrush Squirreltail	*Elymus elymoides*	4
Junegrass	*Koeleria macrantha*	3
Mountain Muhly	*Muhlenbergia montana*	2
Pine Dropseed	*Blepharoneuron tricholepis*	5
Sideoats Grama	*Bouteloua curtipendula*	2
Western Wheatgrass	*Pascopyrum smithii*	4
Forbs		
Alsike Clover	*Trifulium hybridum*	1
American Vetch	*Vicea americana*	1
Shrubs		
Wax Current	*Ribes cereum*	4
Wood Rose	*Rosa woodsii*	4
Trees		
Ponderosa Pine	*Pinus ponderosa*	500 trees per acre

The 1996 Las Conchas Closeout Plan states that revegetation will be considered successful when 50 percent ground cover (litter and live vegetation) is achieved. In 2015 and 2019, vegetation monitoring was completed by GL Environmental, Inc. and Ecosphere Environmental Services, Inc. respectively to measure reclamation progress at Las Conchas Pumice Mine. The cover estimates recorded during the monitoring indicates that the reclamation area at the Las Conchas Pumice Mine meets the standard contained in the mine permit Closeout Plan. The vegetation monitoring reports have been included in Attachment 1.

Hydrogeology

Surface Water

The Las Conchas Mine is located within the watershed of the East Fork River. Locally, the site sits on a divide between the East Fork River to the north and an ephemeral drainage to the south. The East Fork River is a perennial stream and the ephemeral drainage to the south flows during spring run-off from melting snow and after heavy summer thunderstorms. Runoff in the area immediately surrounding the reclaimed mine site discharges into the East Fork River and ultimately into the main Jemez River.

The reclaimed mine surface was contoured to retain the majority of the surface water, and therefore has a minimal potential to impact to surface water in the area. To prevent rilling, gullying, and loss of topsoil, slopes were backfilled and regraded at less than 30% and revegetated. An approximate two-acre area in the south-central portion of the reclaimed area does drain externally. Vegetation is well established in this area and there are very little signs of erosion. Additionally, impacts to surface water quality from the reclaimed mine is minimized due to the distance and dense vegetation and litter between the mine and receiving water bodies. Minor reclamation activities were completed in 2019 to address an erosional feature centrally located within the reclaimed area. The reclamation work stabilized the erosional feature's bed and allowed perennial vegetation to become established.

Geology

The rocks in the region in and around the Las Conchas Pumice Mine are comprised of a complex series of Late Tertiary and Quaternary volcanic units underlain by Mississippian, Pennsylvanian, and Permian strata. The volcanic units that possibly underlie the Las Conchas Pumice Mine include (in ascending order) the Bandelier Tuff and the Valles Rhyolite, and all or part of the Tewa Group. The volcanic rocks are in turn underlain by the Permian Abo Formation, Pennsylvanian Madera Limestone, Sandia Formation, and Mississippian strata.

Groundwater

There is a shallow and a deep aquifer in the vicinity of the Las Conchas Mine. The shallow aquifer occurs in the El Cajete Member of the Valles Rhyolite and is confined to the lowest areas of the pre-pumice topography (Conceptual Hydrogeology of the Proposed El Cajete Pumice Mine and Surrounding Area, Sandoval County, New Mexico, June 13, 1994, Robert M. Colpits, Consulting Geologist, Pages 25, Attachment 2). Water sits on a buried soil horizon at the base of the El Cajete pumice and is inhibited from moving down into the underlying rhyolite by the clay layer. Water from this shallow aquifer locally discharges to small springs. The source of the water is apparently from springs on the north-facing slopes of Los Griegos and the highlands that form the southern margin of Vallecitos de los Indios. The deeper aquifer, which supplies water for local residents, is generally 200-300 feet below the land surface and probably produced from fractures in the Valle Grande Member of the Valles Rhyolite (Conceptual Hydrogeology of the Proposed El Cajete Pumice Mine and Surrounding Area, Sandoval County, New Mexico, June 13, 1994, Robert M. Colpits, Consulting Geologist, Pages 25-27, Attachment 2). Core drilling within the Las Conchas pit limit did not reveal any aquifer.

There was no leaching, milling, or chemical processing at the mine site. Additionally, no overburden dumps, plant sites, or facilities remain at the site. Due to the absence of a saturated zone within the pit limit, relatively shallow depth of excavation, chemically inert nature of the disturbed material, and lack of on-site processing, impacts to groundwater quality are unlikely. Additionally, a clay layer at the base of the El Cajete pumice isolates the disturbed area from the deeper aquifer used for water resources. Finally, due the relatively small spatial extent of the mine (28 acres) it is unlikely to be a significant impact on recharge to either the shallow or deep aquifer.

Post Mine Land Use

The Las Conchas Mine is located within the Santa Fe National Forest. The successful reclamation has achieved a post-mining land use of recreation, wildlife habitat, and livestock grazing.

Inspection

The Mining and Minerals Division shall conduct an inspection and evaluation of the reclamation or closeout measures completed. The surface owner of the property, other state and federal agencies, and other persons who have requested advance notice of the inspection shall be given notice of the inspection and may be present.

Public Notice

In accordance 19.10.9.902 NMAC and 19.10.9.903 NMAC the notice of application for financial assurance release has been completed. Documentation of the public notice has been included in Attachment 3.

Summary

In accordance with 19.10.12.1210 NMAC, The Espanola Mercantile Company requests the release of the financial assurance in the amount of $12,103.00 for the Las Conchas portion, 28 acres, of the EL Cajete Mine Permit No. SA001RE. The Las Conchas Unit of the permit area has been reclaimed and achieved a self-sustaining ecosystem appropriate for the life zone of the surrounding areas and a post-mining land use of recreation, wildlife habitat, and livestock grazing. Attachment 1 provides technical justification for meeting the revegetation standards within the original Closeout Plan, approved January 27, 1998 in Permit SA001RE Revision 96-1. The Las Conchas Unit of the permit area has been stabilized to minimize future impact to the environment and protect air and water resources. The vegetative cover estimates recorded during monitoring indicate that the reclamation area meets the standard contained in the mine permit Closeout Plan. Finally, the financial assurance has been maintained for a period that exceeds 12 years after the last year of seeding in compliance with 19.10.12.1204. The El Cajete Unit, 76.2 acres, of the El Cajete Mine will remain under the jurisdiction of the New Mexico Mining Act NMSA 1978, Section 69-36-1 et. seq. and Permit No. SA001RE until financial assurance in the amount of $78,747.00 is released under 19.10.12 NMAC.

Attachment 1

Vegetation Monitoring Reports

Copar Pumice Company -
Las Conchas 2015 Vegetation Report

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1 INTRODUCTION

GL Environmental, Inc. performed vegetation monitoring in order to measure reclamation progress at Copar Pumice Company's Las Conchas Pumice Mine. This report presents the results of that monitoring, as well as estimates of numerical sampling adequacy and statistical tests to demonstrate conformance to the technical revegetation standard as set forth in the Las Conchas Pumice Mine permit issued by the State of New Mexico, Mining and Minerals Division (MMD) of the Energy, Minerals and Natural Resources Department.

2 METHODS

2.1 GIS

The Las Conchas Pumice Mine reclamation area was delimited by a polygon shapefile in ArcGIS (version 10.1, ESRI 2013). The ArcGIS "Aspect" tool analyzed digital elevation data (USGS 2010) to separate the reclamation area into north- and south-facing portions. The "Random" tool was used to assign 10 points at random locations to each of the north- and south-facing slopes (Figure 1). A total of 20 points was generated for the reclamation area.

2.2 Cover estimates

Vegetation monitoring was performed June 9th and 10th, 2015 at the Las Conchas Pumice Mine site by Senior Biologist Jerusha Rawlings and Project Manager Matthew Lane. Vegetative cover was measured by the Line-Intercept Method (Cook and Bonham 1977). At each of the points generated for vegetation monitoring, a 100ft tape was tossed into the air and the direction indicated by the tape's lower point was used as the transect's direction. The 100ft tape, subdivided into 1.0-foot intervals, was stretched from the transect point in the direction of the tossed tape. The sampler moved along the line and for each 1ft interval, recorded the plant species found and the distance it covered along that portion of the line intercept. Measurements of individual plants were read to the nearest inch. The sampler considered only those plants or seedlings touched by the line or lying under or over it. For floral canopies below eye level, the distance each species covered along the line at ground level was measured. For canopies above eye level, the distance covered by the downward projection of the foliage was measured. Multiple vegetation levels are included for cover measurements. Bare ground and litter were also recorded. Annuals and biennials were excluded from calculations of cover, although they were measured in the field.

All calculations, including cover, sample adequacy, and test statistics were performed in MS Excel.

2.3 Sample adequacy

All cover estimates were arcsine square root transformed before analysis. Sample adequacy was determined using the Cochran (1977) formula:

$$n_{\min} = t^2 s^2 / (0.1\bar{x})^2$$

where:

- *t* is the tabular *t* value for a preliminary sample with n-1 degrees of freedom and a two-tailed significance level of α = 0.10 (*P* = 0.90).

- *s* is the standard deviation of the preliminary sample
- $\bar{x}$ is the sample mean of the preliminary sample

2.4 Statistical testing

All cover estimates were arcsine square root transformed before analysis. The cover estimates were compared to the technical standard (50% cover) using the one-sample, one-sided *t* test:

$$t* = \frac{\bar{x} - 0.9(\text{technical standard})}{\mathrm{s}/\sqrt{\mathrm{n}}}$$

where:

- *t** is the calculated *t*-statistic
- $\bar{x}$ is the sample mean
- s is the standard deviation of the sample
- n is the sample size

The α-level of the test is 0.10 by regulation, and the decision rules for testing the reverse null hypothesis are:

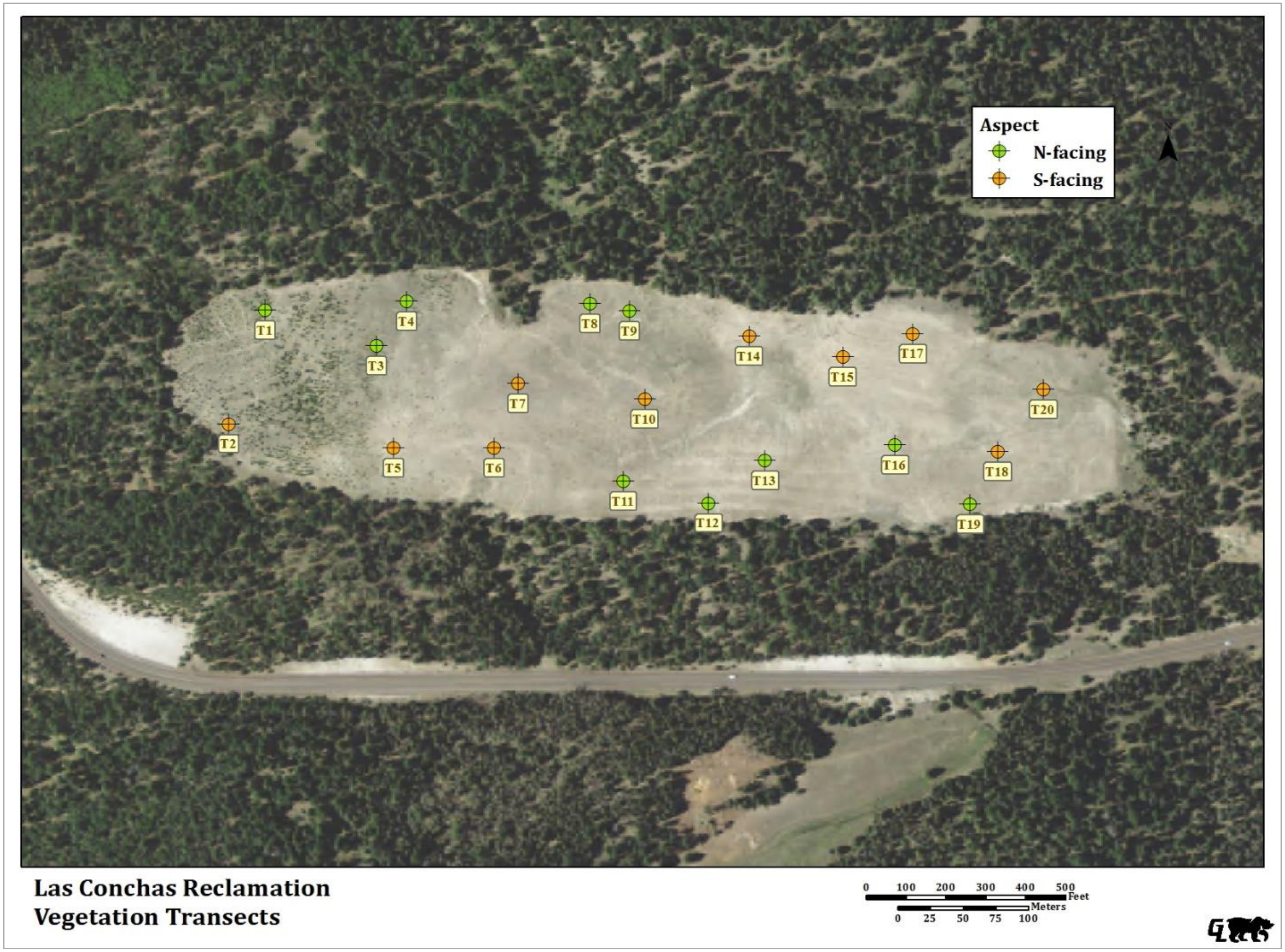
- If $t^* < t\,(1-\alpha\,;\,n-1)$, conclude failure to meet the performance standard
- If $t^* \geq t\,(1-\alpha\,;\,n-1)$, conclude that the performance standard was met

3 Results

3.1 GIS

The locations of the transects generated by ArcGIS are presented in Figure 1. The south-facing slopes comprised approximately 9.1ac and there were 20.4ac of north-facing slopes.

Figure 1. Location of vegetation transects at Las Conchas Pumice Mine, June 2015.



3.2 Cover estimates

27 species of plants were positively identified within the Las Conchas Reclamation Area (Table 1). Most recent nomenclature and duration information was obtained from the PLANTS database (USDA NRCS 2015).

Table 1. Plant species observed at Las Conchas Pumice Mine, June 2015.

Habit	*Scientific Name*	Common Name	Duration
Forbs	*Achillea millefolium*	western yarrow	perennial
	Androsace septentrionalis	pygmyflower rockjasmine	perennial
	Antennaria rosea	rosy pussytoes	perennial
	Arabis ×divaricarpa	spreading rockcress	biennial
	Artemisia frigida	prairie sagewort	perennial
	Erigeron divergens	spreading fleabane	biennial
	Erysimum capitatum	wallflower	biennial
	Fragaria virginiana	Virginia strawberry	perennial
	Hymenoxis richardsonii	pingue rubberweed	perennial
	Potentilla hippiana	woolly cinquefoil	perennial
	Rumex acetosella	common sheep sorrel	perennial
	Taraxacum officinale	common dandelion	perennial
	Thermopsis divaricarpa	spreadfruit goldenbanner	perennial
	Tragopogon dubius	yellow salsify	annual
	Trifolium repens	white clover	perennial
	Verbascum thapsus	common mullein	biennial
	Vicia americana	American vetch	perennial
Grasses	*Festuca arizonica*	Arizona fescue	perennial
	Festuca ovina	sheep fescue	perennial
	Juncus arcticus	mountain rush	perennial
	Muhlenbergia montana	mountain muhly	perennial
	Pascopyrum smithii	western wheatgrass	perennial
	Poa fendleriana	muttongrass	perennial
Trees and shrubs	*Picea engelmannii*	Engelmann spruce	perennial
	Pinus ponderosa	ponderosa pine	perennial
	Ribes aureum	golden currant	perennial
	Rosa woodsii	Wood's rose	perennial

Calculations yielded an overall average of 74% cover. Annuals and biennials were not included in cover calculations; they contributed less than 1% to overall cover. Additionally, litter is included as part of cover as specified in the Las Conchas Pumice Mine MMD permit. North-facing slopes averaged 70% cover and south-facing slopes averaged 78% cover. *Pascopyrum smithii* (western wheatgrass) was the largest contributing species to cover, regardless of aspect (Table 2).

Table 2. Cover estimates for the Las Conchas Pumice Mine, June 2015, *s*=standard deviation.

Habit	*Scientific Name*	Common Name	% cover	*s*
Forbs	*Achillea millefolium*	western yarrow	1.3	0.017
	Androsace septentrionalis	pygmyflower rockjasmine	0.4	0.004
	Antennaria rosea	rosy pussytoes	1.3	0.025
	Artemisia frigida	prairie sagewort	1.5	0.024
	Fragaria virginiana	Virginia strawberry	0.2	0.003
	Hymenoxis richardsonii	pingue rubberweed	0.1	0.001
	Potentilla hippiana	woolly cinquefoil	1.0	0.025
	Rumex acetosella	common sheep sorrel	0.1	0.003
	Taraxacum officinale	common dandelion	1.8	0.016
	Thermopsis divaricarpa	spreadfruit goldenbanner	0.3	0.007
	Trifolium repens	white clover	6.2	0.051
	Vicia americana	American vetch	0.3	0.007
Grasses	*Festuca arizonica*	Arizona fescue	4.1	0.053
	Festuca ovina	sheep fescue	2.9	0.056
	Juncus arcticus	mountain rush	0.2	0.005
	Muhlenbergia montana	mountain muhly	0.2	0.010
	Pascopyrum smithii	western wheatgrass	18.7	0.115
	Poa fendleriana	muttongrass	6.6	0.065
Trees and shrubs	*Picea engelmannii*	Engelmann spruce	2.5	0.065
	Pinus ponderosa	ponderosa pine	1.3	0.022
	Ribes aureum	golden currant	0.2	0.007
	Rosa woodsii	Wood's rose	0.5	0.014
		Perennials	51.8	0.096
		Litter	22.1	0.130
		Bare Ground	26.1	0.102
		Total Cover	73.9	0.102

3.3 Sampling adequacy

Cochran's $n_{\min}$ (calculated for arcsine square root-transformed data) indicated that sampling effort was adequate for all areas (i.e. Cochran's n < sample n; Table 3).

Table 3. Cochran's minimum number of samples required to estimate cover with a 90% confidence that the sample mean for cover lies within 10% of the true population mean.

Area	mean % cover, transformed	s	$t_{(n=20[\text{total}] \text{ or } 10[\text{N,S}],\ \alpha=0.1,\ \text{two-tailed})}$	Cochran's $n_{\min}$	Sample n
Overall	1.039	0.111	1.729	3.395	20
N-facing	0.998	0.134	1.833	6.099	10
S-facing	1.081	0.055	1.833	0.874	10

3.4 Statistical testing

The overall cover data and north-facing cover data were slightly left-skewed, with an abundance of higher cover measures. The south-facing cover data were normally distributed. All data were arcsine square root-transformed for analysis.

The Student's *t*-test of the transformed data indicated that overall cover data as well as north- and south-facing cover data were statistically significantly greater than 0.9*x* of the technical standard under the Las Conchas Pumice Mine permit (i.e., $t_{calculated} > t_{critical}$; Table 4). Thus, we can reject the null hypothesis that vegetative cover is less than the technical standard.

Table 4. Student's *t*-statistics for a one-tailed *t*-test, α=0.1.

Area	% Cover, $\bar{x}$	d.f.	$t_{(critical)}$	$t_{(calculated)}$
Overall	73.9*	19	1.328	11.969
N-facing	70.0*	9	1.383	5.863
S-facing	77.7*	9	1.383	18.803

* These are untransformed data; the Student's *t*-test was performed on transformed data.

4 Conclusions

The cover estimates obtained by GL Environmental, Inc. on June 9th and 10th, 2015 show that the revegetation portion of reclamation at the Las Conchas Pumice Mine meets the standard contained in the MMD permit. This conclusion is supported by analysis of the data, which demonstrated that: 1) enough samples were taken to provide a robust comparison and 2) the estimates of cover were significantly greater than the technical standard.

5 References

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October 2019

2019 Reclamation Monitoring Report

South Pit and Las Conchas Pumice Mine

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1. Introduction

In 2019, Ecosphere Environmental Services, Inc. (Ecosphere) performed vegetation monitoring to measure reclamation progress at Española Mercantile Company's Las Conchas Pumice Mine and South Pit. This report presents the results of that monitoring, as well as estimates of numerical sampling adequacy and statistical tests to demonstrate conformance with the technical revegetation standard as set forth in the Las Conchas Pumice Mine and South Pit Permit issued by the New Mexico Mining and Minerals Division (MMD) of the Energy, Minerals, and Natural Resources Department.

2. Methods

2.1 Cover Estimates

2.1.1 South Pit

On October 10, 2019, Ecosphere biologist C.J. Vialpando conducted vegetation monitoring at the South Pit site. Four points were determined prior to the field investigation using the "Random" tool in ArcGIS (Appendix A, Map 1). Vegetative cover was measured by the Line-Intercept Method (Cook and Bonham 1977). At each point, a 100-foot measuring tape was tossed into the air and the direction indicated by the tape's lower point was used as the transect direction. The 100-foot tape was stretched from the transect point in the direction of the tossed tape and subdivided into 1-foot intervals. All plant species and the distance spanned in each interval were recorded. Measurements of individual plants were read to the nearest 0.1 foot. Only those plants or seedlings touched by the line or lying under or over it were considered. For floral canopies below eye level, the distance each species covered along the line at ground level was measured. For canopies above eye level, the distance covered by the downward projection of the foliage was estimated. Bare ground and litter were also recorded, even though only live vegetation is included in calculations of cover as specified in Española Mercantile Company's South Pit MMD permit.

All calculations, including cover, sample adequacy, and test statistics were performed in Microsoft Excel.

2.1.2 Las Conchas Pumice Mine

On October 11, 2019, Ecosphere biologist C.J. Vialpando conducted vegetation monitoring at the Las Conchas Pumice Mine. In 2015, 20 points were established in the initial field investigation. Sample adequacy calculations performed in 2015 indicated that population variability would be captured by fewer transects (GL Environmental, Inc. 2015). Thus, in 2019, 10 points were surveyed (Appendix A, Map 2). Monitoring conducted in 2019 at the Las Conchas Pumice Mine used the same sampling protocol as described in Section 2.1.1; however, cover calculations for the Las Conchas site exclude annual and biennial vegetation and include litter.

2.2 Sample Adequacy

All cover estimates were arcsine square root transformed before analysis. Sample adequacy was determined using the Cochran (1977) formula:

$$n_{\min} = t^2 s^2 \Big/ (0.1\bar{x})^2$$

where

- *t* is the tabular *t* value for a preliminary sample with *n*-1 degrees of freedom and a two-tailed significance level of $\alpha = 0.10$ ($P = 0.90$),
- *s* is the standard deviation of the preliminary sample, and
- $\bar{x}$ is the sample mean of the preliminary sample.

Sample adequacy is the minimum number of samples required to estimate cover with a 90% confidence that the sample mean for cover represents the true population mean.

2.3 Statistical Testing

All cover estimates were arcsine square root transformed before analysis. The cover estimates were compared to the technical standard (50% cover) using the one-sample, one-sided *t* test:

$$t^* = \frac{\bar{x} - 0.9(\text{technical standard})}{s / \sqrt{n}}$$

where

- t^* is the calculated *t*-statistic,
- $\bar{x}$ is the sample mean,
- *s* is the standard deviation of the sample, and
- *n* is the sample size.

The α-level of the test is 0.10 by regulation, and the decision rules for testing the reverse null hypothesis are as follows:

- if $t^* < t\,(1-\alpha;\, n - 1)$, conclude failure to meet the performance standard
- if $t^* \geq t\,(1-\alpha;\, n - 1)$, conclude that the performance standard was met

3. Results

3.1 Cover Estimates

3.1.1 South Pit

Eighteen species were identified during the 2019 monitoring of the South Pit reclamation area (Table 3-1). Nomenclature and duration information was obtained from the Natural Resources Conservation Service (NRCS) PLANTS database (NRCS 2019).

Table 3-1. Plant Species Observed at South Pit, October 2019

Scientific Name	Common Name	Duration
Forbs		
Achillea millefolium	western yarrow	perennial
Ambrosia dumosa	burrobush	perennial
Androsace septentrionalis	pygmyflower rockjasmine	perennial
Cirsium sp.	thistle	biennial
Erysimum capitatum	western wallflower	biennial
Lupinus neomexicanus	New Mexico lupine	perennial
Penstemon palmeri	Palmer's penstemon	perennial
Potentilla hippiana	woolly cinquefoil	perennial
Taraxacum officinale	common dandelion	perennial
Tragopogon dubius	yellow salsify	annual
Trifolium repens	white clover	perennial
Unknown forb	forb	perennial
Verbascum thapsus	common mullein	perennial
Grasses		
Muhlenbergia montana	mountain muhly	perennial
Pascopyrum smithii	western wheatgrass	perennial
Poa fendleriana	muttongrass	perennial
Shrubs and Trees		
Pinus ponderosa	ponderosa pine	perennial
Rhus sp.	sumac	perennial

Vegetation cover averaged 40.3%. Ponderosa pine contributed the highest cover of any species (12.2%) and western wheatgrass had the greatest cover of any grass species (9.8%) (Table 3-2).

Table 3-2. Cover Estimates for the South Pit, October 2019

Scientific Name	Common Name	Cover (%)	*s*
Forbs			
Achillea millefolium	western yarrow	3.7	0.018
Ambrosia dumosa	burrobush	0.4	0.007
Androsace septentrionalis	pygmyflower rockjasmine	0.9	0.01
Lupinus neomexicanus	New Mexico lupine	2.0	0.012
Penstemon palmeri	Palmer's penstemon	0.0	0
Potentilla hippiana	woolly cinquefoil	0.6	0.007
Taraxacum officinale	common dandelion	0.1	0.001
Trifolium repens	white clover	1.8	0.013
Unknown forb 2	forb	0.1	0.001
Verbascum thapsus	common mullein	1.6	0.013
Grasses			
Muhlenbergia montana	mountain muhly	1.0	0.008
Pascopyrum smithii	western wheatgrass	9.8	0.078
Poa fendleriana	muttongrass	0.2	0.004
Shrubs and Trees			
Pinus ponderosa	ponderosa pine	12.2	0.09
Rhus sp.	sumac	5.6	0.029
Other			
	Vegetation Cover	40.3	0.076
	Litter	16.3	0.039
	Bare Ground	43.5	0.076
	Total Cover	56.2	0.075

Note: *s*=standard deviation

3.1.2 Las Conchas Pumice Mine

A total of 27 plant species were identified within the Las Conchas Reclamation Area during monitoring (Table 3-3). Nomenclature and duration information was obtained from the PLANTS database (NRCS 2019).

Table 3-3. Plant Species Observed at Las Conchas Pumice Mine, October 2019

Scientific Name	Common Name	Duration
Forbs		
Achillea millefolium	western yarrow	perennial
Androsace septentrionalis	pygmyflower rockjasmine	perennial
Ambrosia dumosa	burrobush	perennial
Antennaria rosea	rosy pussytoes	perennial
Artemisia frigida	prairie sagewort	perennial
Erigeron divergens	spreading fleabane	biennial
Erysimum capitatum	western wallflower	biennial
Fragaria virginiana	Virginia strawberry	perennial
Lupinus neomexicanus	New Mexico lupine	perennial
Penstemon palmeri	Palmer’s penstemon	perennial
Taraxacum officinale	common dandelion	perennial
Tragopogon dubius	yellow salsify	annual
Trifolium repens	white clover	perennial
Verbascum thapsus	common mullein	perennial
Grasses		
Bromus sp.	brome	perennial
Festuca arizonica	Arizona fescue	perennial
Festuca ovina	sheep fescue	perennial
Carex sp.	sedge	perennial
Muhlenbergia montana	mountain muhly	perennial
Pascopyrum smithii	western wheatgrass	perennial
Poa fendleriana	muttongrass	perennial

Scientific Name	Common Name	Duration
Thinopyrum intermedium	intermediate wheatgrass	perennial
Shrubs and Trees		
Lycium pallidum	pale wolfberry	perennial
Picea engelmannii	Engelmann spruce	perennial
Picea pungens	blue spruce	perennial
Pinus ponderosa	ponderosa pine	perennial
Rosa woodsii	Woods' rose	perennial

Average vegetation cover recorded during 2019 was 80.8%. Perennial cover was 60.2% and litter cover was 19.7% (Table 3-4). Annuals and biennials contributed 1.8% of the overall coverage, therefore they are not included in the analysis. Western wheatgrass yielded the highest overall cover (13.3%) and the highest cover on north aspects (16.6%). Arizona fescue (*Festuca arizonica*) had the highest cover on south aspects (13.3%).

Table 3-4. Cover Estimates for the Las Conchas Pumice Mine, October 2019

Scientific Name	Common Name	Cover (%)	*s*
Forbs			
Achillea millefolium	western yarrow	1.1	0.015
Androsace septentrionalis	pygmyflower rockjasmine	0.5	0.008
Ambrosia dumosa	burrobush	3.5	0.040
Antennaria rosea	rosy pussytoes	4.1	0.044
Artemisia frigida	prairie sagewort	1.9	0.039
Fragaria virginiana	Virginia strawberry	0.1	0.001
Lupinus neomexicanus	New Mexico lupine	0.6	0.010
Penstemon palmeri	Palmer's penstemon	0.0	0.001
Taraxacum officinale	common dandelion	0.8	0.006
Trifolium repens	white clover	1.8	0.016
Verbascum thapsus	common mullein	1.3	0.027
Grasses			
Bromus sp.	brome	0.4	0.009

Scientific Name	Common Name	Cover (%)	*s*
Festuca arizonica	Arizona fescue	10.8	0.152
Festuca ovina	sheep fescue	0.3	0.008
Carex sp.	sedge	0.0	0.001
Muhlenbergia montana	mountain muhly	0.0	0.001
Pascopyrum smithii	western wheatgrass	13.3	0.113
Poa fendleriana	muttongrass	10.1	0.067
Thinopyrum intermedium	intermediate wheatgrass	0.1	0.020
Shrubs and Trees			
Lycium pallidum	pale wolfberry	0.1	0.002
Picea engelmannii	Engelmann spruce	0.8	0.018
Picea pungens	blue spruce	0.4	0.012
Pinus ponderosa	ponderosa pine	7.9	0.093
Rosa woodsii	Woods' rose	0.3	0.005
Other			
	Perennials	60.2	0.130
	Litter	19.7	0.046
	Bare Ground	18.3	0.061
	Total Cover	80.8	0.068

Note: s=standard deviation

3.2 Sampling Adequacy

3.2.1 South Pit

Table 3-5 presents the sample adequacy calculations for the South Pit 2019 monitoring. The calculated sampling adequacy of Cochran's n_{min} was 4.333. This value is slightly above the Cochran's n_{min} value for sampling adequacy (Table 3-5).

Table 3-5. Sample Adequacy for 2019 Monitoring at South Pit

Area	Mean % Cover, Transformed	*s*	$t_{(n=4,\ p=0.1,\ \text{two-tailed})}$	Cochran's n_{min}
Overall	0.687	0.068	2.353	4.06

3.2.2 Las Conchas Pumice Mine

Table 3-6 presents the sample adequacy calculations for the Las Conchas Pumice Mine 2019 monitoring. Cochran's n_{min} (calculated for arcsine square root-transformed data) indicated that sampling effort was adequate for all areas (i.e., Cochran's n < sample n; Table 3-6).

Table 3-6. Sample Adequacy for 2019 Monitoring at Las Conchas Pumice Mine

Area	Mean % Cover, Transformed	s	$t_{(n=10[\text{total}] \text{ or } 5[\text{N,S}],\ p=0.1,\ \text{two-tailed})}$	Cochran's n_{min}
Overall	1.123	0.087	1.833	2.003
N-facing	1.115	0.074	2.132	2.002
S-facing	0.968	0.056	2.132	1.529

3.3 Statistical Testing

3.3.1 South Pit

For the South Pit, the Student's *t*-test of the transformed data indicated that overall mean percent cover was statistically significantly lower than 0.9*x* of the technical standard under the Las Conchas Pumice Mine permit (i.e., $t_{calculated} < t_{critical}$; Table 3-7). Thus, 2019 vegetative cover does not meet the technical standard.

Table 3-7. Student's t-Statistics for a One-Tailed t-Test, α=0.1

Area	Mean % Cover	Degrees of Freedom	$t_{(critical)}$	$t_{(calculated)}$
Overall	40.3	3	1.638	-1.427

3.3.2 Las Conchas Pumice Mine

Both aspect cover data were close to being normally distributed. All data were arcsine square root-transformed for analysis.

For the Las Conchas Pumice Mine, the Student's *t*-test of the transformed data indicated that overall mean percent cover, as well as north- and south-facing percent cover, were statistically significantly greater than 0.9*x* of the technical standard under the mine permit (i.e., $t_{calculated} > t_{critical}$; Table 3-8). Thus, 2019 vegetative cover exceeds the technical standard.

Table 3-8. Student's t-Statistics for a One-Tailed t-Test, α=0.1

Area	Mean % Cover	Degrees of Freedom	$t_{(critical)}$	$t_{(calculated)}$
Overall	80.8	9	1.383	13.547
N-facing	80.3	4	1.533	10.237
S-facing	67.8	4	1.533	8.156

4. Conclusion

4.1 South Pit

The overall vegetation cover for the South Pit site as measured during 2019 monitoring was 40.3%, which is significantly lower than the technical standard of 50% cover. The sampling effort for this site was adequate and captured the site variability for vegetation cover (Cochran's n_{min}= 4.06, n=4).

4.2 Las Conchas Pumice Mine

The cover estimates recorded during 2019 monitoring indicate that the reclamation area at the Las Conchas Pumice Mine meets the standard contained in the mine permit. This conclusion is supported by data demonstrating (1) enough samples were taken to provide a robust comparison and (2) the estimates of cover were significantly greater than the technical standard.

5. Certification

Conclusions are based on actual field examinations and are correct to the best of my knowledge.

Signature of Field Biologist:

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Farmington, NM 87401
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Date: October 31, 2019

6. References

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USDA. 2012. Redondo Peak, NW NAIP (National Agriculture Imagery Program) DOQQ (Digital Orthophoto Quarter Quads) (3510612) – 2011. Accessed from the NM Resource Geographic Information System (RGIS) on September 18, 2014.

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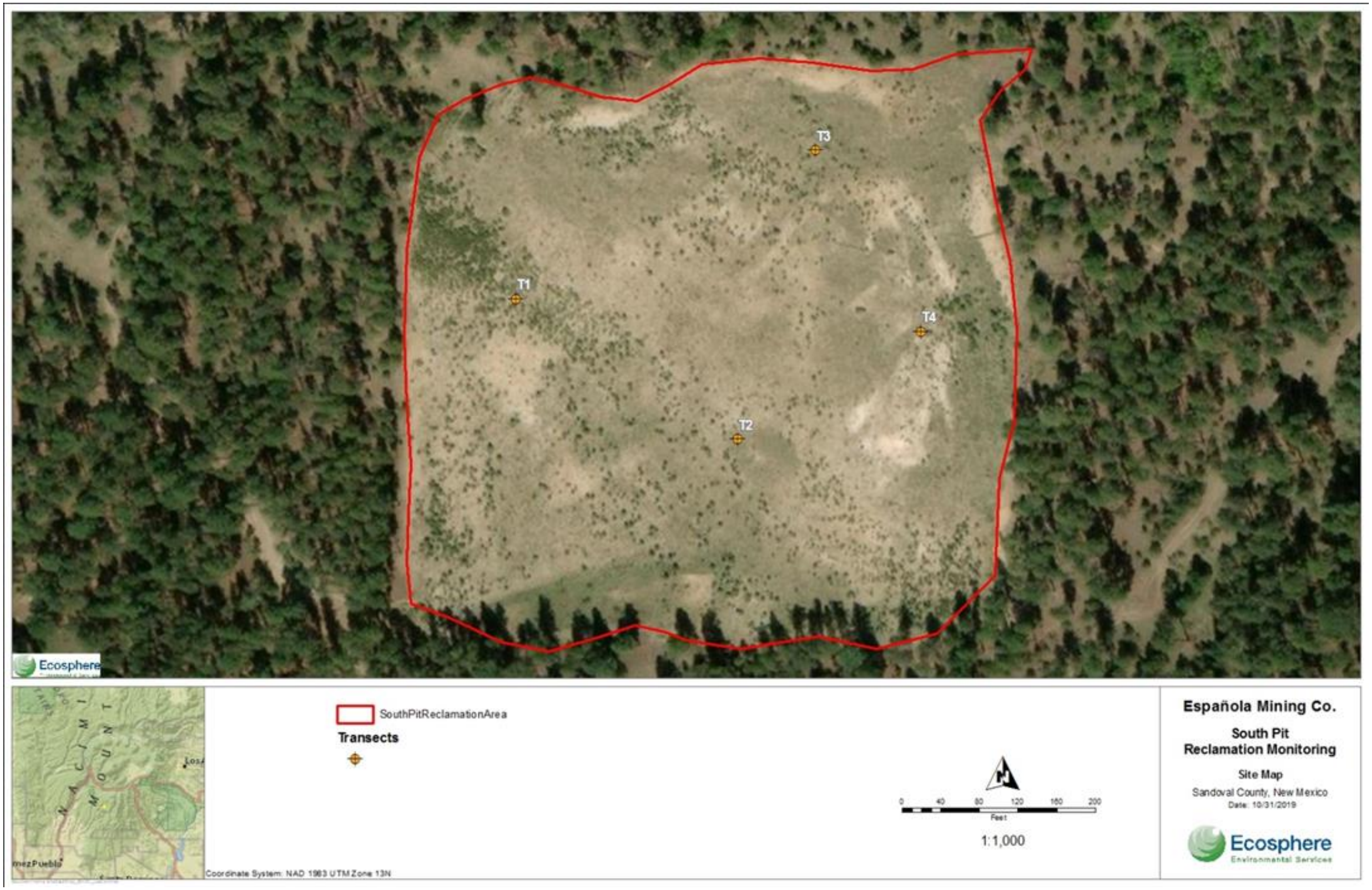
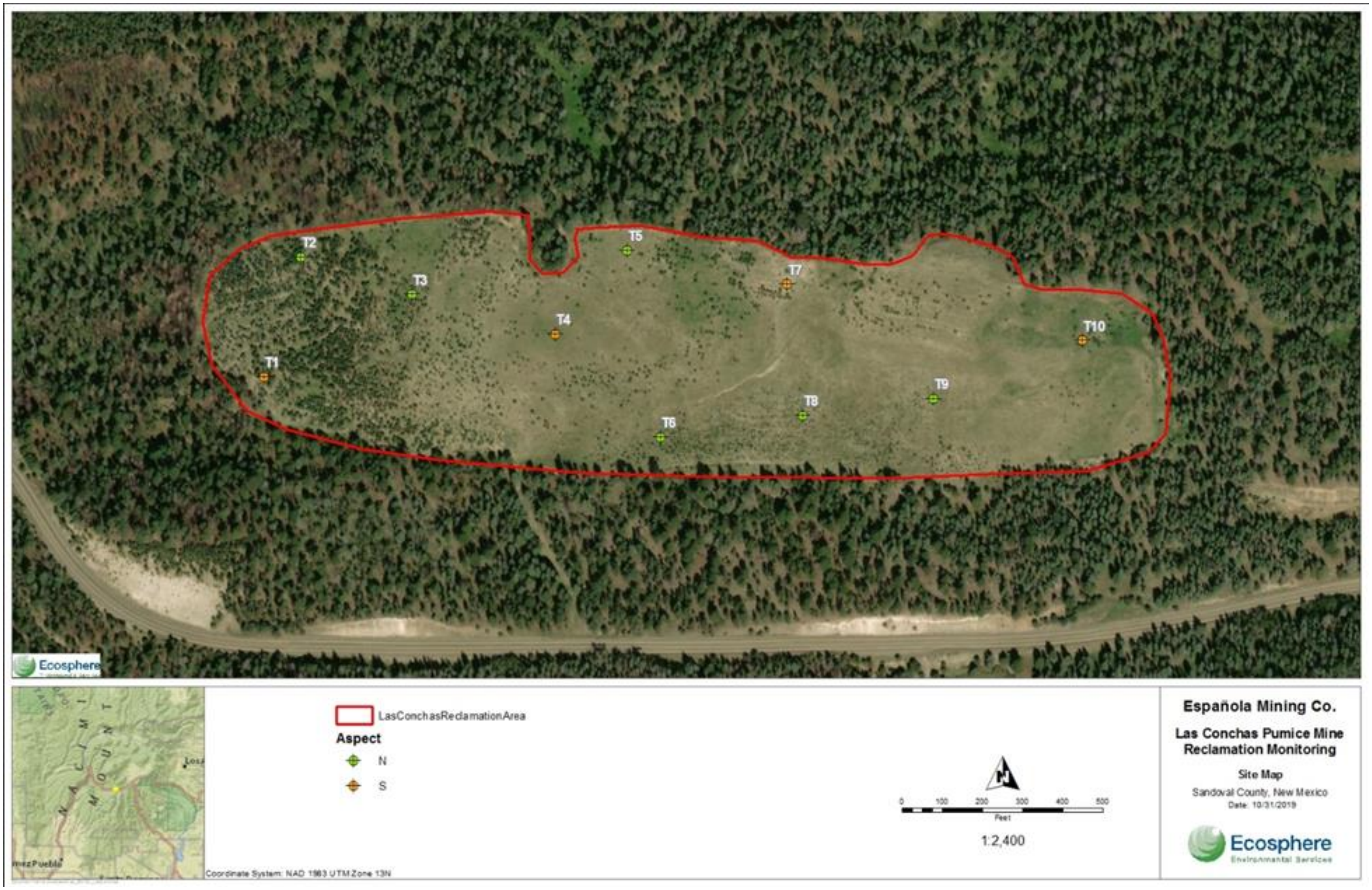
Appendix A – Maps



Map 1. South Pit Transect Locations Sampled in 2019



Map 2. Las Conchas Pumice Mine Transect Locations Sampled in 2019

Attachment 2

Conceptual Hydrogeology of the Proposed El Cajete Pumice Mine and Surrounding Area, Sandoval County, New Mexico

Conceptual Hydrogeology of the Proposed El Cajete Pumice Mine and Surrounding Area, Sandoval County, New Mexico

Prepared For:
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SUMMARY AND CONCLUSIONS

Based on the data available for the proposed El Cajete Pumice Mine, I conclude:

1) There are two aquifers in the region around the proposed mine location: one shallow and one deep. The shallow aquifer occurs in the base of the El Cajete pumice, is highly localized and is confined to paleovalleys on the Valle Grande Member of the Valles Rhyolite. The deep aquifer is in the Valle Grande Member, is 200 to 300 feet below the land surface and supplies water to the Sierra Los Piños subdivision south of the proposed mine location.

2) Water level and water chemistry data from wells in the area of the mine suggest that the mine and the nearby subdivision are situated in the recharge area for the deep rhyolite aquifer.

3) Pumping test and fracture-lineament analyses suggest that water flow in the deep aquifer is probably controlled by fractures in the rhyolite. Field observations indicate that these fractures do not penetrate the overlying clay paleosol or pumice. Water flow in the deep aquifer is generally downward and toward the southwest along those fracture sets. The pumping tests also show that hydraulic conductivity varies widely in the rhyolite and that the variation is most likely due to concentrations of fractures that cross the region.

4) Precipitation, potential evapotranspiration, and stable isotope data suggests that the recharge of the deep aquifer occurs primarily at altitudes above the proposed mine location, that the water flowing through the deep aquifer is at least 30 years old and that the water did not originate at or in the immediate vicinity of the proposed mine.

5) The pumice is highly heterogeneous and there is apparently a very small to insignificant water flux through the fine-grained portions of the pumice; the coarse pumice probably contributes little or no flow because of apparent significant capillary pressure associated with the spinifex glass in the pumice. Any water flux to the underlying rhyolite is inhibited by the presence of the clay paleosol at the base of the pumice.

6) Water in the shallow aquifer is most likely derived from sources other than the pumice, possibly from springs on the north-facing flank of Los Griegos or buried springs in the floor of the valley south of the mine.

7) It is unlikely that the proposed pumice mine will have any adverse effects on the recharge of either the deep or shallow aquifers provided environmentally conscientious and, prudent mining and reclamation practices are followed.

INTRODUCTION

Background

The proposed El Cajete Pumice Mine site is located 7.5 miles (12 km) east of La Cueva, N.M. on New Mexico State Highway 4 in the South ½ of Section 1, Township 18 North, Range 3 East, (New Mexico Principal Meridian). It is situated ½ mile south of the East Fork of the Jemez River and immediately north of State Highway 4 in the Santa Fe National Forest (Figure 1).

During the late summer and fall of 1994, a drilling and water sampling program was carried out by Copar Pumice to establish the geologic and hydrogeologic framework of the proposed mine site and the surrounding area, including the Sierra de los Piños Subdivision, immediately south of State Highway 4. This subdivision covers parts of southern edge of Section 1 and 2, the East ½ of the East ½ of Section 10, all of Section 11, and the West ½ of Section 12. The primary issue is whether pumice mining operations at the new mine will adversely impact the quantity and quality of groundwater available to the adjacent subdivision by disrupting recharge to the underlying water-bearing volcanic rocks.

Purpose and Scope

The primary purpose of this report is to describe the geologic and general hydrogeologic framework of the area in and surrounding the proposed pumice mine site as it relates to potential recharge of the deep aquifer through the pumice. This report presents a brief description of the general geology with emphasis on stratigraphic units and fracture trends in the area. It presents a summary of the hydrologic characteristics of the area including potential for recharge to the water-bearing rocks that underlie the proposed mine and surrounding areas. Finally it presents a discussion on the potential impact that mining might have on any possible local recharge, ground-water flow and chemical characteristics of that water.

The data upon which this report depends is derived from several sources: 1) a test hole drilling and monitoring well installation program carried out during the late summer and early fall of 1994 (summarized in Appendix 1); 2) chemical analyses of the water samples collected from 2 monitoring wells, 2 subdivision wells and 1 private well by John Shomaker and Associates, Inc. in December, 1994 (summarized in Appendix 2); 3) water chemistry and tritium isotope data from samples collected and analyzed by Los Alamos Labs in the spring of 1994; 4) well records obtained from the New Mexico State Engineer's Office; 5) logs from 10 pumice core holes and 3 monitoring wells drilled by Copar Pumice on the proposed mine site; and 6) pump test data from a hydrogeologic report by American Ground Water Consultants, Inc., prepared for Vallecitos de los Indios, Inc. Hydrologic data are sparse but sufficient to develop a conceptual model of the hydrologic characteristics of the area.

Topography and Drainage

Figure 2 is a topographic map of the East Fork Jemez River (hereafter called East Fork River) drainage basin showing the proposed mine site. Altitudes range from 6755 feet at the confluence of

R.M. Colpitts, Consulting Geologist

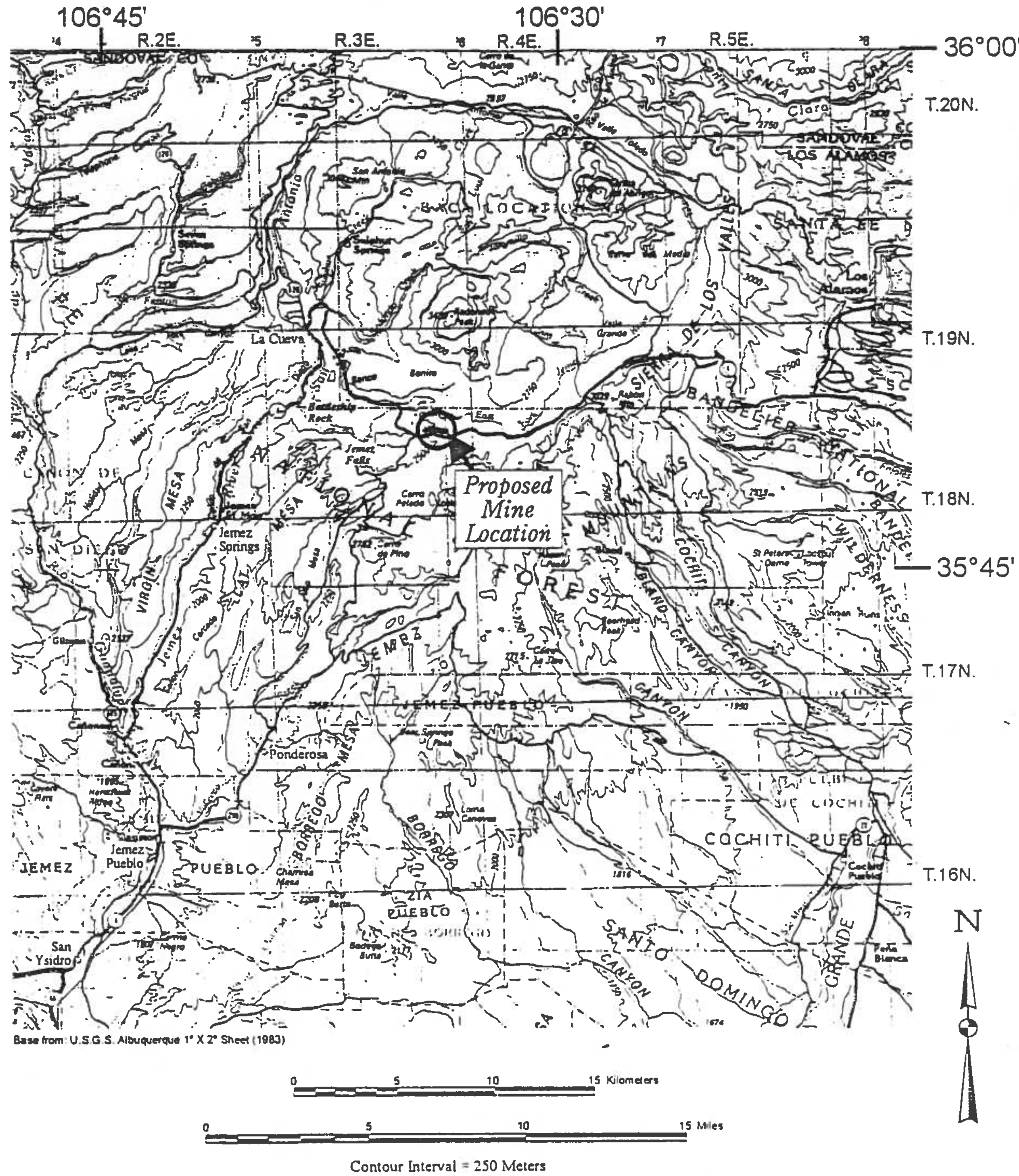
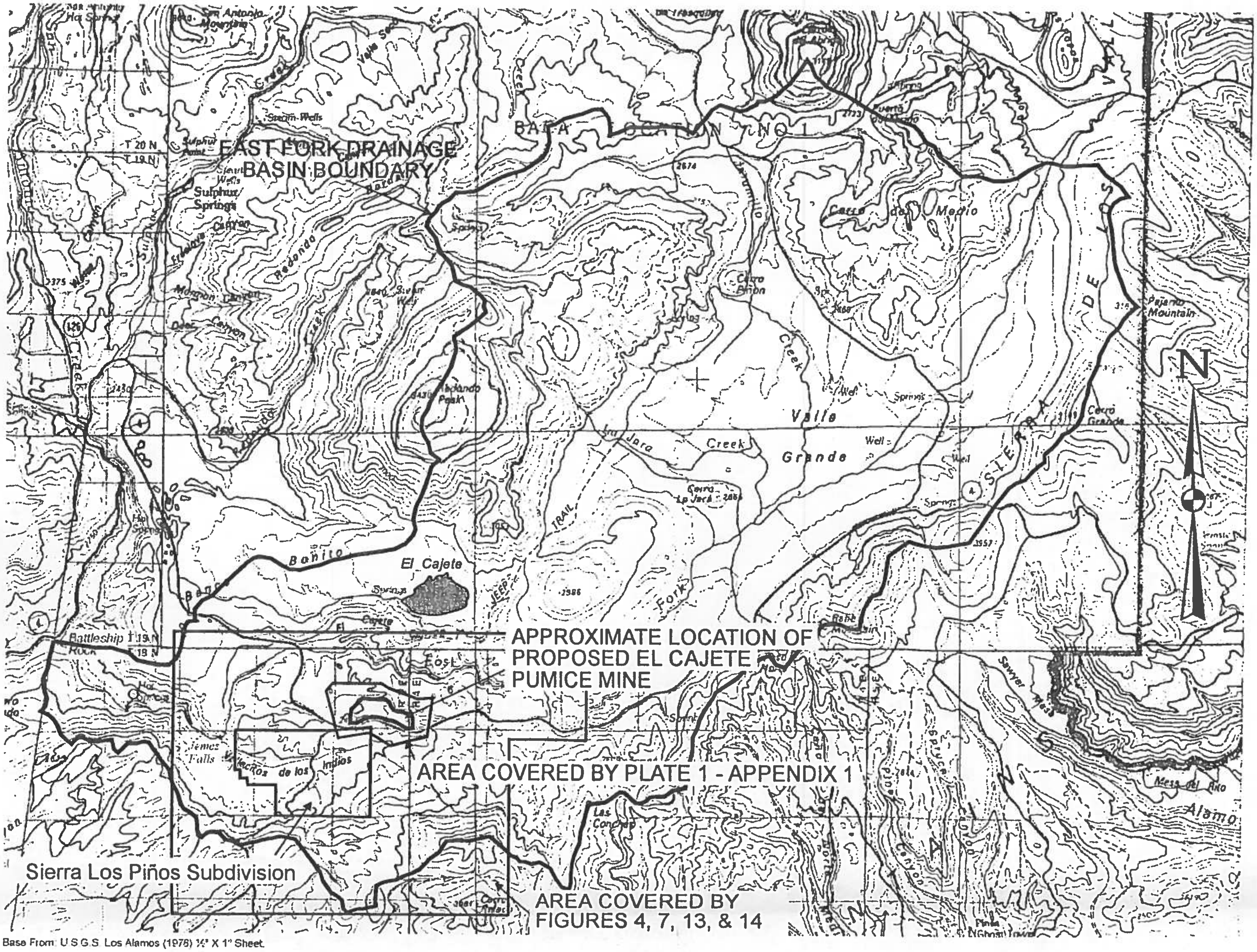


Figure 1-- Location of Proposed El Cajete Pumice Mine in Jemez Mountains, Sandoval County, New Mexico.

R.M. Colpitts, Consulting Geologist



Base From: U.S.G.S. Los Alamos (1976) ½° X 1° Sheet

0 1 2 3 Kilometers

0 1 2 3 Miles

Contour Interval = 50 Meters

Figure 2 -- Topographic map of the East Fork of the Jemez River drainage basin showing the proposed El Cajete Mine, and areas covered by Plate 1 - Appendix 1 and, Figures 4, 7, 13 and 14, Sandoval County, New Mexico.

the East Fork River and San Antonio Creek to 11253 feet on Redondo Peak. The East Fork River originates in the Sierra de Los Valles on the east flank of the Valle Grande and flows west-southwest to where it joins San Antonio Creek at Battleship Rock in Section 32, Township 19 North, Range 3 East. At this confluence it becomes the main stream of the Jemez River which flows south to San Ysidro then east until it discharges into the Rio Grande north of Bernalillo, New Mexico.

The East Fork River and San Antonio Creek are perennial streams. Other streams in the area are either ephemeral, flowing only after heavy summer thunderstorms, during spring run off from melting snow, or are locally perennial where they are fed by springs. All runoff in the area immediately surrounding the proposed mine site ultimately discharges into the East Fork River and finally into the main Jemez River. Drainage patterns are rectilinear and are controlled by fractures in the region.

There are several cold-water springs and at least one warm-water spring in the area. The cold-water springs are present in Vallecitos de los Indios in Sections 11 and 12, and in the SW¼, SW¼ of Section 6, Township 19 North, Range 4 East. One warm-water spring (McCauley Hot Spring) is located in NE¼, SW¼, Section 4, Township 19 North, Range 3 East at an altitude of approximately 7350 feet. This spring is documented by Summers (1976).

GENERALIZED GEOLOGY

The discussion of the stratigraphy and structure that follows is based on three sources: a shallow pumice-hole drilling program, a monitoring well drilling program and, geologic data from the New Mexico Bureau of Mines and Mineral Resources (primarily Bailey and Smith, 1978); papers concerning the volcanic rocks and structure associated with the El Cajete vent (esp. Self et al., 1988 and Goff et al., 1988) and Los Alamos National Labs.

Stratigraphy

The rocks in the region around the proposed El Cajete Pumice mine are comprised of a complex series of Late Tertiary and Quaternary volcanic units underlain by Mississippian, Pennsylvanian and Permian strata (Figure 3). Until recently, the vertical and lateral relationships of these volcanic units were difficult to decipher because of poor surface exposures and very sparse subsurface data. New drill hole data obtained since 1980 from shallow auger holes drilled by Copar Pumice combined with a test hole drilled in the NE ¼ of Section 33, Township 19 North, Range 3 East by the Department of Energy clarifies the distribution of the youngest volcanic units present in and around the Proposed Mine (i.e the Banco Bonito, Battleship Rock, El Cajete and Valle Grande Members of the Valles Rhyolite). The deep test hole shows which Paleozoic units are present under the volcanic sequence west of the mine. This information can be extrapolated eastward into the proposed mine area.

Volcanic units that I believe underlie the proposed mine site include (in ascending order) of the Bandelier Tuff (Tshirege Member [?]) and the Valles Rhyolite all part of the Tewa Group (Self, et al., 1988). The volcanic rocks are in turn underlain by the Permian Abo Formation, Pennsylvanian

			SW NE
Quater-nary	TEWA GROUP	Valles Rhyolite	Banco Bonito Member
			Battleship Rock Member
			El Cajete Member
			Valle Grande Member (a.k.a. South Mountain Rhyolite)
		Bandelier Tuff	Tshirege Member
Tertiary	KERES GROUP	Paliza Canyon Formation	
		Bearhead Rhyolite	
Permian		Abo Formation	
Pennsyl-vanian		Madera Limestone	
		Sandia Formation	
Miss.		Mississippian Undivided	
Precamb.		Precambrian	

Figure 3 -- Summary of Stratigraphic Units in the Area Around the Proposed El Cajete Pumice Mine, Sandoval County, New Mexico.

Madera Limestone and Sandia Formation, and Mississippian strata (divided into the Log Springs Formation and Arroyo Peñasco Group). Along the north-facing flank of Los Griegos and south of Vallecitos de los Indios, units of the Tertiary Keres Group (Paliza Canyon Formation and Bearhead Rhyolite) underlie the El Cajete Member (Hoffer, 1994). Since the Bearhead Rhyolite is not present in the immediate area of the Proposed Mine, it will not be discussed.

TERTIARY STRATA

Paliza Canyon Formation (Lower Part)

The Paliza Canyon Formation is comprised of medium gray andesitic to dacitic intrusive domes. These domes form the high peaks that are part of the southern topographic margin of the Valles Caldera (Las Conchas and Los Griegos). As such, this unit does not underlie the Proposed Mine but does form the southern margin of the East Fork drainage basin.

QUATERNARY STRATA

Bandelier Tuff (Tshirege Member)

The Bandelier Tuff (Tshirege Member) is comprised of light yellowish gray, slightly welded to welded ash flow tuff. This unit lies on top of Permian strata in the region and fills pre-existing topography. In the area around the proposed mine, welded portions are fractured. Unwelded portions erode into hoodoos (conical spires of soft tuff capped by large stones). Cliffs of this unit also display large cavities whose origins are possibly due to gas pocket formation during eruption. The Bandelier Tuff also fills the Valles Caldera north of the proposed mine location to depths exceeding 4950 feet (Goff et al., 1988).

Valles Rhyolite

The Valles Rhyolite overlies the Bandelier Tuff. It is divided into (in ascending order) the Deer Canyon, Redondo Creek, Valle Grande, El Cajete, Battleship Rock and Banco Bonito Members (Figure 3). Of these, only the Valle Grande through Banco Bonito Members are apparently present in the area immediately around the proposed mine location.

Valle Grande Member (South Mountain Rhyolite)-

The Valle Grande Member is comprised of light gray to light brownish gray unwelded to moderately welded ash-flow crystal to vitric tuff. It is apparently exposed in outcrops along the East Fork River. Drilling records and reports by drillers working in the area show that it has numerous voids, some greater than 8 feet in diameter. The geometry of these voids is unknown. The Valle Grande Member is extensively eroded. An old soil horizon (comprised of a thin clay to sandy clay layer with numerous root molds and casts) covers this eroded surface. I interpret this layer as an old soil that formed on the surface of the Valle Grande Member prior to eruption of the El Cajete pumice. This clay is locally absent from buried ridge tops based on drill hole data (Figure 4). The Valle Grande Member fills pre-existing topography on the Bandelier Tuff.

El Cajete Member-

The El Cajete Member is comprised of interbedded air-fall block, lapilli and ash pumice with ash-flow base surge and possible ignimbrite deposits. The regional stratigraphic details are

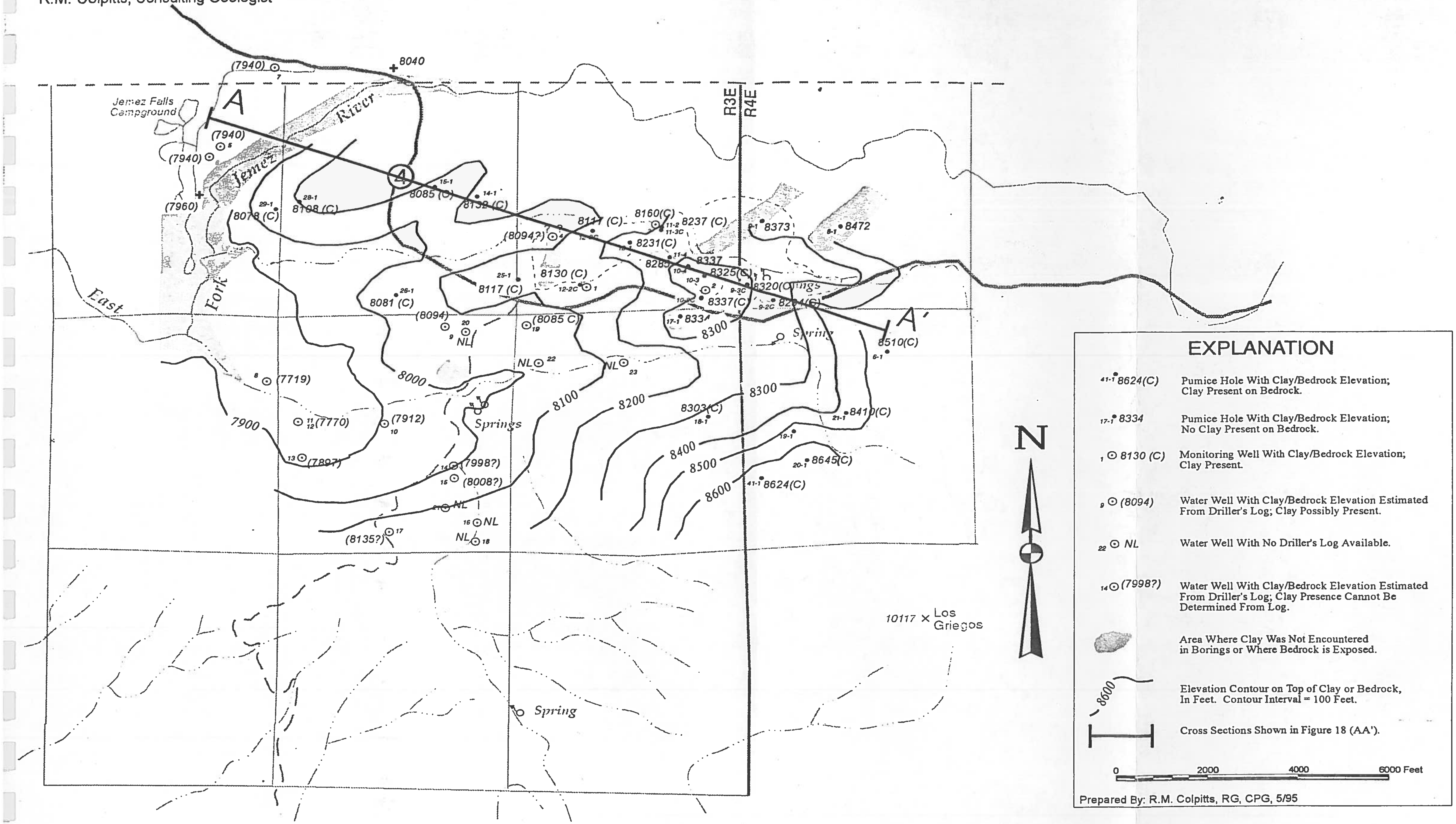


Figure 4 -- Clay/Bedrock Contour Map Showing Areas With No Clay on Bedrock Surface, Proposed El Cajete Pumice Mine, Sandoval County, New Mexico.

summarized by Self et al. (1988). The sequence forms drape deposits on top of the Valle Grande Member. Fragments range from blocks greater than 2 feet in diameter to sand-size (ash). The air-fall block pumice is the material that forms the basis for the proposed mine. Smaller grain sizes are volumetrically minor compared to the coarser sizes as shown by drilling. Fragments become coarser northward to the East Fork River and the source vent at El Cajete. Grain size becomes finer south of Los Griegos. The pumice is typically light gray and mottled grayish orange and orange pink. This grayish orange and orange pink coloration is associated with pumice fragments larger than 5 to 6 inches and may result from sintering due to heat retention in the larger pumice fragments immediately following eruption (Hoffer, oral communication, 1995).

The pumice is mottled and banded moderate brown in the fine-grained upper 10 to 20 feet of the deposit. This is a phenomena common to all pumice drilled in and around the mine site but is confined to ash and lapilli-size pumice that cap the main block pumice deposit; the coarse fragments below this cap are not stained except in very rare instances outside the proposed mine location. The staining is·due to deposition of iron dissolved from iron-bearing minerals in the fine pumice (such as biotite and hornblende).

The pumice is covered by a 3 to 6 inch clay to sandy clay soil. The upper part of this soil is an organic-rich loam.

The El Cajete Member has been extensively eroded and now extends no further west than La Cueva where it is present as a thin remnant below the Battleship Rock Member (Self et al., 1991). To the east, it apparently extends east of Las Conchas Campground in Section 4, Township 18 North, Range 4 East. However, Self et al. (1988) ascribe pumice deposits east and south of this limit to the El Cajete Member, so its original extent was probably beyond the Rio Grande and Santa Fe.

Battleship Rock Member-

Self et al. (1988) correlate the Battleship Rock Member with the base surge and ignimbrite beds in the El Cajete Member. They suggested that the Battleship Rock flows were associated with the El Cajete pumice fall as a coeval eruptive phase. Recent evaluation of outcrop and drill hole data between the proposed mine site and La Cueva (Self, et al., 1991) shows that the Battleship Rock and El Cajete pumice eruptions were separate events and that Battleship Rock flows overlie the El Cajete beds. The Battleship Rock Member is not present under the proposed mine location and so will not be considered further.

Banco Bonito Member-

The Banco Bonito Member is comprised of interbedded black vitrophyre and flow-banded rhyolitic lavas. As described earlier, it overlies the west edge of the El Cajete Member. Because it lies west of the proposed mine site, it will not be discussed further.

Structure

There are two dominant structures in the area around the proposed El Cajete Mine site: faults and joints. Based on field observations, joints are the most significant structural features. As for

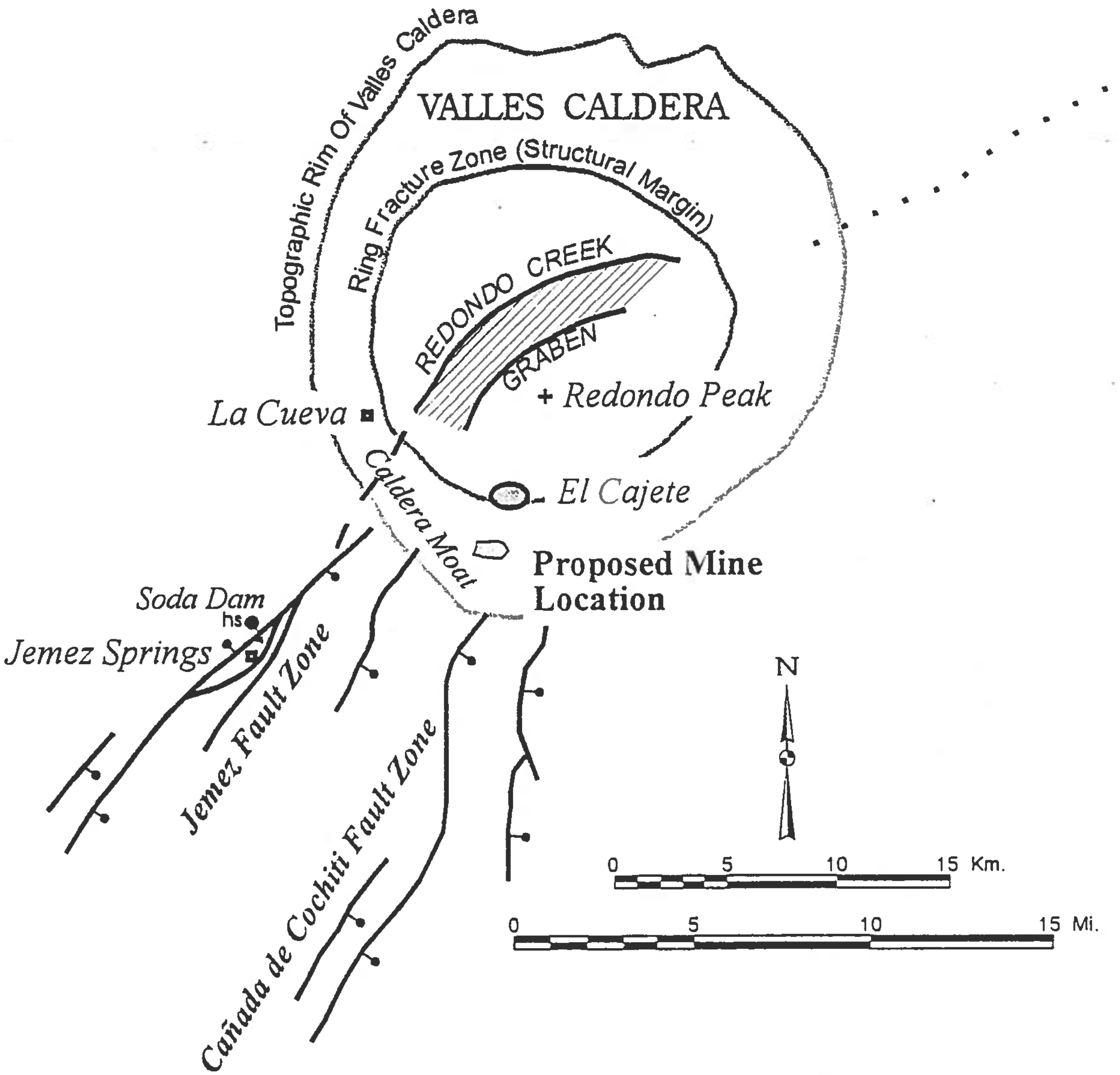


Figure 5 -- Structural Features In The Region Surrounding the Proposed El Cajete Pumice Mine, Sandoval County, New Mexico. (After Hulen and Nielson, 1986)

faults, the Jemez Fault Zone is present a short distance to the west (Figure 5). These structures cut the Valle Grande Member (South Mountain Rhyolite) but apparently do not penetrate the overlying units (Aldrich, 1986). North of the proposed mine location, the Ring Fracture Zone marks the edge of Valles Caldera collapse and is comprised of numerous faults. Orientations of faults, joints and map linears are summarized in Figure 6.

Faults

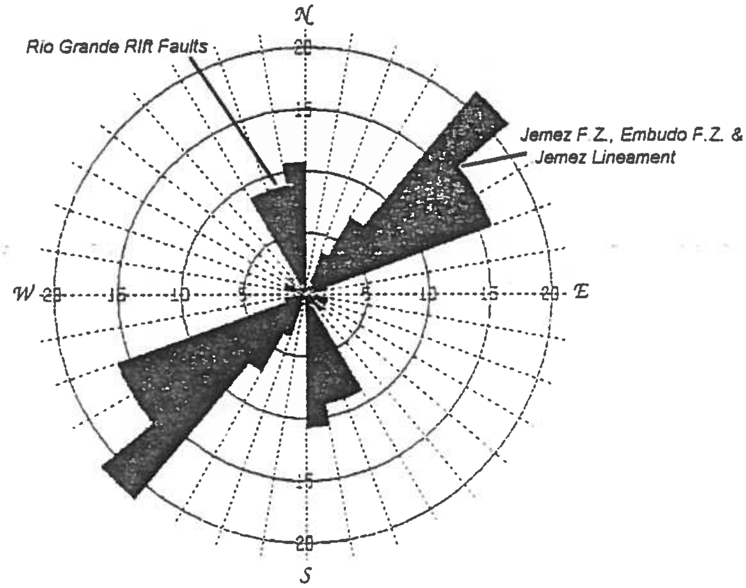
No faults are apparent in and around the proposed El Cajete Mine location. There are faults associated with the Ring Fracture Zone that mark the edge of the collapse of Valles Caldera (Aldrich, 1986; Goff et al., 1988). These structures strike east-west and underlie El Cajete. Other faults are present west (Jemez Fault Zone.) and south (Cañada de Cochiti Fault Zone) of the area covered by this report which affect both Paleozoic sedimentary and, Tertiary and Quaternary volcanic rocks up to the Bandelier Tuff. Based on outcrop and drill hole data, the units of the Valles Rhyolite are apparently unaffected by this faulting. The Jemez Fault Zone and its northern extension, the Redondo Creek Graben, strike North 40° to 60° East (Aldrich, 1986).

Joints

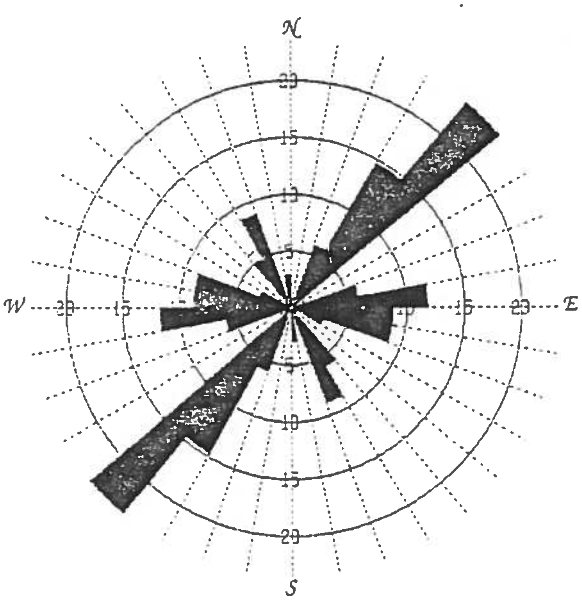
The most significant structural feature in the area of the proposed mine are joints. They form two distinct groups: 1) North 40° to 60° East and 2) North 20° to 40° West; a possible third group should also be present - North 80° to 90° East and should be related to the Ring Fracture Zone. These joint groups in combination with faults, arroyo orientations around the proposed mine location (compare Figure 6a, 6b and 6c, and Figure 7). Drainage patterns are rectilinear throughout the area. Correlation between linear trends produced by arroyos and canyons and joints and faults reflect the location of these joint (or fault) sets and allow additional delineation of their trends. Based on field observations for this study, joints are confined to the rhyolite and underlying units; the pumice is not fractured.

Joint Group 1 is the dominant set and is part of a regional structural grain related to the Jemez Lineament (Aldrich, 1986). It is traceable northeast into the Valle Grande on topographic maps. It is probably the most recent group of fractures to form, possibly predating eruption of the Valles Rhyolite. This set crosses all topographic features and apparently controls the orientations of many primary and minor drainages and topographic features throughout the region (Figure 5). Joints are concentrated in sets that form zones approximately 300 feet wide. Spacing between individual zones is about 3000 feet. Some of the zones the southern part of part of Figure 7 are probably related to the northern termination of the Cañada de Cochiti Fault Zone. Joint Group 1 is parallel to the Jemez Fault Zone in San Diego Canyon and faults that border Redondo Creek Graben (Bailey and Smith, 1978; Hulen and Nielson, 1988) that were active prior to and contemporaneous with volcanism associated with formation of the Valles Caldera.

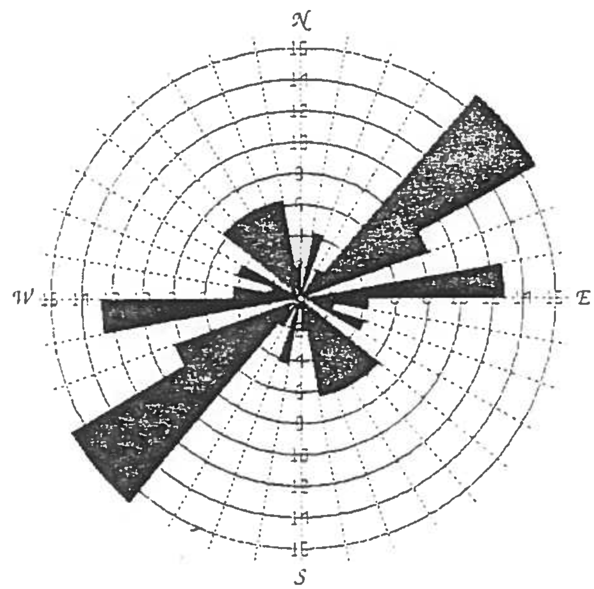
Joint Group 2 is possibly related to Rio Grande rift formation based on their correlation with fault trends attributed to the rift by DuChene (1974), Woodward et al., (1977) and Aldrich (1986) (See Figure 6 for correlation). Group 2 joints are not as prominent as Group 1 joints; their spacing is irregular and is at least 4000+ feet.



(A) Fault Orientations From Aldrich (1986)



(B) Joint Measurements From Proposed Mine Area



(C) Map Linears From Area Around Proposed Mine

Figure 6 -- Rose diagrams showing orientations and dominant trends of (A) Faults, (B) Joints and (C) Linears from topographic maps, Proposed El Cajete Pumice Mine, Sandoval County, New Mexico

R.M. Colpitts, Consulting Geologist

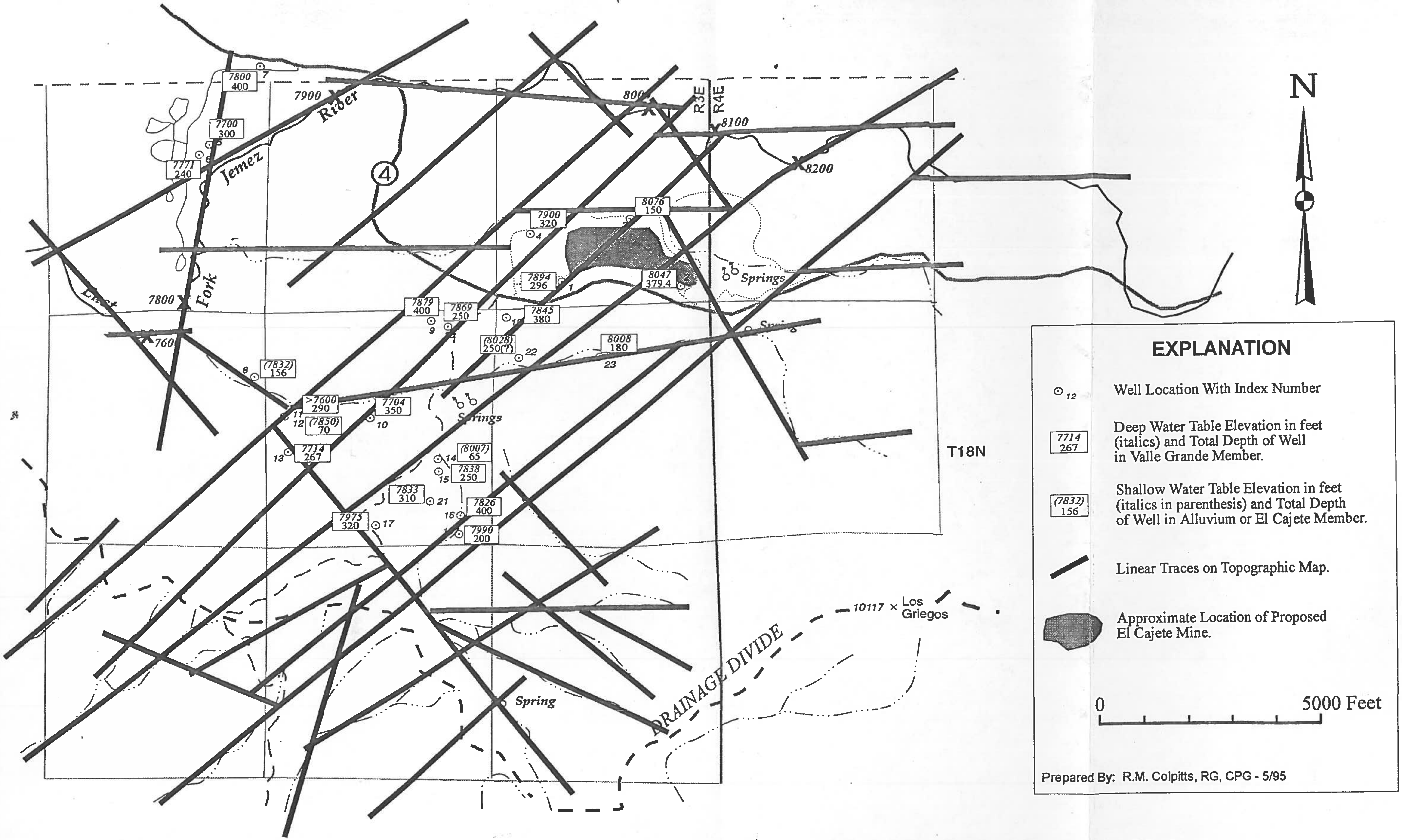


Figure 7 -- Linear Patterns in Bedrock Based on Topographic Map Lineations, Proposed El Cajete Mine, Sandoval County, New Mexico.

Joint Group 3 is apparently associated with collapse of the Valles Caldera and formation of the ring fracture zone and the moat of the caldera. Vallecitos de los Indios proper represents a topographic low part of a portion of the moat; Los Griegos is part of the topographic rim of the caldera (Figure 5). Although this group of joints is not reflected in fault orientations measured from Aldrich (1986), there is a general correlation between map linears and joint measurements collected from outcrops in the canyon north of the proposed mine (Figure 6).

HYDROGEOLOGY

The discussion of the hydrogeology is limited to the area immediately around the proposed El Cajete Mine. Water well data for the region are generally concentrated in areas of home development. These areas include the La Cueva - Jemez Springs area (San Diego Canyon and Redondo Creek) and Vallecitos de los Indios (Sierra Los Piños subdivision). In these developments, water level data are available from driller's records from files in the New Mexico State Engineer's office. Precipitation and potential evapotranspiration data are derived from the summary by Gabin and Lesperance (1977). Hydrogeochemical and isotopic data for the ground water come from a sampling program performed by Copar Pumice in December, 1994 and from analyses of samples collected by Los Alamos National Labs during the last 10 years (see especially Vuataz and Goff, 1986). These data are sufficient to develop a conceptual model of ground water recharge and flow below the mine and to determine whether recharge of the rhyolite through the pumice may be occurring at the proposed mine site or not.

Geomorphic Considerations

The proposed El Cajete Mine is located within a portion of the drainage of the East Fork River. The proposed mine sits on a local divide between ephemeral (seasonal) streams. Local elevations range from approximately 8540 feet northeast of the mine to 7800 feet at Jemez Falls. South of Vallecitos de los Indios there is a topographic divide that is part of the rim of the Valles Caldera that separates surface flow between the East Fork and the Jemez Rivers. Elevations along this latter divide range from 10117 feet on Los Griegos to approximately 8440 feet immediately south of Jemez Falls.

Climatologic Setting

Climatologic data with which I can characterize the climate of the proposed mine location are derived from Gabin and Lesperance (1977). For the vicinity of the proposed mine, there is one station for which climatologic data are available, Lee Ranch Station, located at Latitude 35° 50', Longitude 106° 30' at an elevation 8691 feet (Table 1). This station is approximately 4 miles east-northeast of the proposed mine location and has 17 to 18 years of records as of 1975. This data was combined with data from other weather stations in and around the Jemez Mountains in Sandoval, Rio Arriba and Los Alamos Counties to estimate precipitation and potential evapotranspiration for the Jemez Mountains, East Fork drainage basin and the area of the proposed mine.

STATION: Lee Ranch COUNTY: Sandoval LATITUDE: 35° 50' LONGITUDE: 106° 30'
ELEVATION: 8691 feet

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual
Precipitation													
Years of Record	18	18	18	18	18	18	17	17	17	17	17	17	17
Mean	0.92	1.84	1.64	1.09	1.69	1.61	4.10	3.66	3.05	1.35	1.03	1.09	23.07
Temperature													
Years of Record	18	18	18	18	18	18	18	18	18	17	17	17	17
Mean	20.4	25.1	30.3	38.4	45.9	54.3	58.4	57.2	51.0	41.7	30.5	22.6	39.7
PE	0.27	0.38	0.65	1.18	2.33	3.79	4.53	3.88	2.41	1.22	0.49	0.30	21.43
Surplus	0.65	1.46	0.99						0.64	0.13	0.54	0.79	5.20
Deficit				0.09	0.64	2.18	0.43	0.12					3.46

Table 1 -- Climatologic data summary from Lee Ranch Station, 4 miles east of the proposed El Cajete Mine, Sandoval County, New Mexico (from Gabin and Lesperance, 1977)

Altitude Range (Feet)	Area (Sq. Feet)	Part of Total Area	Precipitation From (P) Figure 8 (Inches)	Potential Evapotranspiration (PE) From Figure 9 (Inches)	Weighted P (Inches)	Weighted PE (Inches)
<7000	2075288	0.0011	14.6	33.4	0.02	0.04
7000 - 8000	76024711	0.0408	17.1	29.1	0.70	1.19
8000 - 9000	1162125588	0.6241	20.7	22.9	12.92	14.29
9000 - 10000	558889516	0.3001	24.3	16.7	7.29	5.01
10000 - 11000	58384765	0.0314	27.9	10.5	0.87	0.33
>11000	4634810	0.0025	30.4	6.1	0.08	0.02
	1862134678	1.0000			21.88	20.87

Table 2 -- Precipitation and Potential Evapotranspiration Values Weighted According To Elevation Range, East Fork Drainage Basin, Sandoval County, NM.

Precipitation (P)

A review of precipitation data show that it is a function of elevation; increasing elevation has increasing precipitation (Figure 8). The rate of increase as determined by linear regression is approximately 3.6 inches per 1000 feet. The correlation coefficient of $r^2 = 0.45$ shows a poor fit due to data scatter. The scattering of points in Figure 8 probably results from orographic effects in and around the mountain range.

For the East Fork drainage basin, Table 2 shows that approximately 99% of the precipitation falls on elevations above 8,000 feet (which covers about 96% of the entire basin) and 92% of the total precipitation falls between 8000 and 10,000 feet elevation (which covers about 92% of the entire basin). The mean precipitation for the entire basin weighted for altitude in the basin is 21.9 inches (Table 2) with the bulk of the precipitation falling during May through September (Table 1). Because about 98% of the precipitation falls above 8000 feet where rates are higher, this weighted average value is too low. From Figure 8, an estimated value of 24.6 inches is probably more appropriate for an average of precipitation for the basin. Thus, in the East Fork drainage basin, the area above 8000 feet covers 64 square miles (40956 square acres), the annual volume of precipitation is about 3.7 x 10^9 feet^3 or 2.8 x 10^{10} gallons. This translates to an instantaneous precipitation rate of approximately 53,000 gallons per minute (gpm) or 118 cubic feet per second (cfs).

Potential Evapotranspiration (PE), Surplus (S), and Deficit (D)

Potential evapotranspiration (PE) is the volume of water that will discharge to the atmosphere by way of plant use and evaporation if the water supply is unlimited. This is the same as consumptive use. Although only an estimate, it is useful for determining an average hydrologic balance for a basin (assuming steady-state conditions) if precipitation and runoff data are available. From this calculation, an estimate of potential recharge is possible. Typically, at higher elevations, precipitation (P) is greater than PE (Table 1) and a surplus (S) of water is present during the fall and winter months. This surplus decreases with decreasing elevation and is very small at lower elevations. In the East Fork drainage basin, surplus water can be stored as snow, infiltrate into the ground or run off into the East Fork of the Jemez River. For the rest of the year PE exceeds P (Table 1) and a deficit (D) exists.

Potential evapotranspiration is usually either estimated by a calculation or determined by actual measurements of consumptive use by plants in irrigated land. Estimates can be made with a calculation utilizing easily obtained climatic factors such as mean temperature, plant consumptive use indices and duration of daylight hours (see especially Blaney and Criddle, 1962 or Thornthwaite, 1948). The Blaney-Criddle equation has a wide following and is still in common use today (Shuttleworth, 1993). Only techniques used by the Weather Bureau better predict evapotranspiration. These techniques require considerably more data than is generally available.

Data used for this study is derived from Gabin and Lesperance (1977). They use the Blaney-Criddle method for their calculations and provide tables with the appropriate coefficients. The Blaney-Criddle method uses alfalfa as the reference crop for the estimate because the climatic coefficients for this plant are well documented and because the consumptive water use of this crop

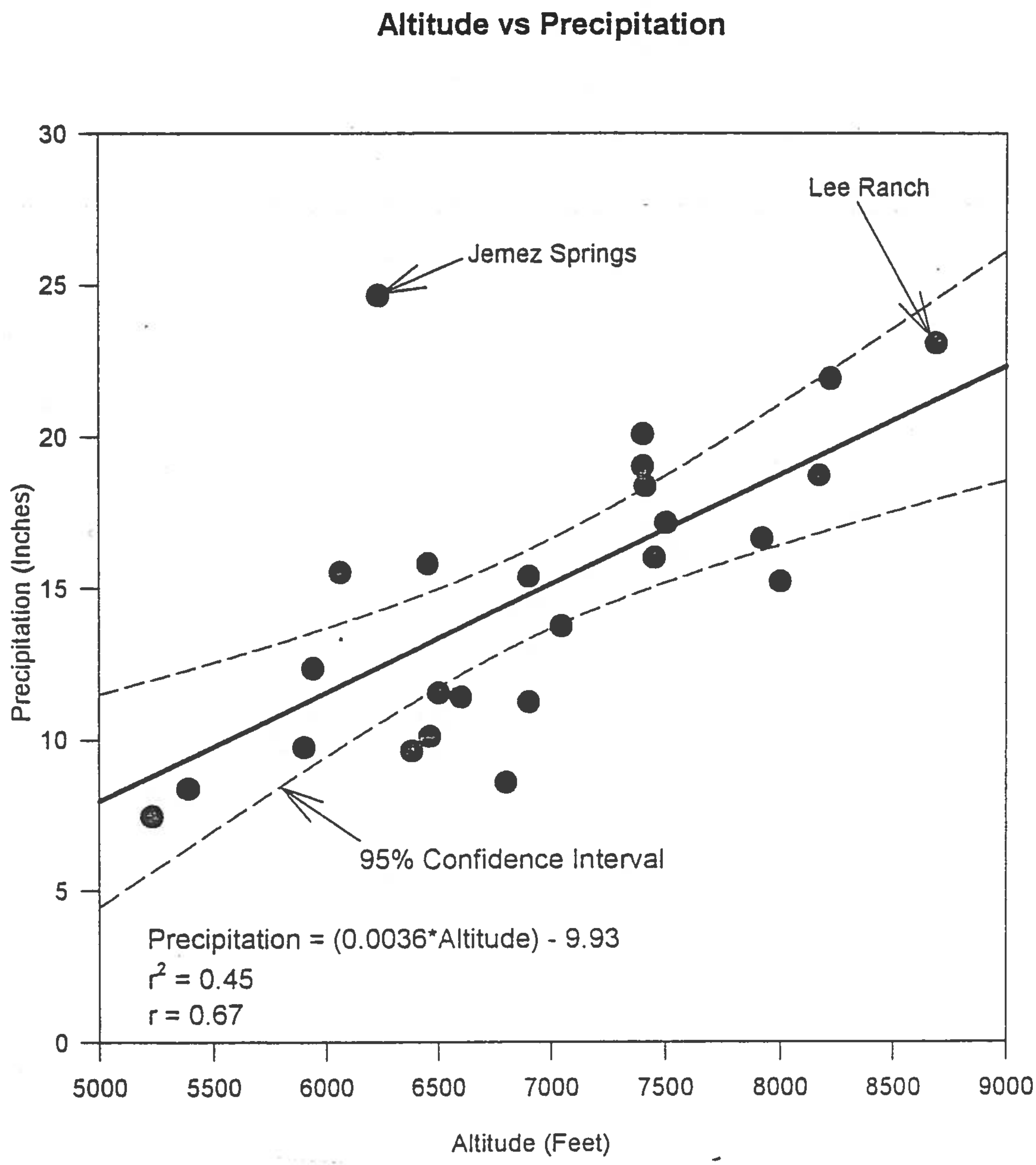


Figure 8 -- Plot of Altitude Versus Precipitation For Sandoval County, New Mexico.
(Data From Gabin and Lesperance, 1977)

(approaching 100%) best estimates use of water by plants in semi-arid environments (Gabin and Lesperance, 1977 and Gray et al., 1970, p. 3.58).

A plot of altitude versus potential evapotranspiration (Figure 9) shows that potential evapotranspiration generally decreases with increasing elevation at a rate of approximately 6.2 inches per 1000 feet. This relationship is based on a linear regression of the data. The fit was reasonably good with a correlation coefficient of $r^2 = 0.85$.

In the basin drained by the East Fork, average PE for elevations above 8000 feet is inferred to be between 15 and 16 inches (Table 2). This leaves about 9 to 10 inches of precipitation available for recharge and/or runoff. This translates to about 1.4×10^9 ft^3 or 1.1×10^{10} gallons and equals an instantaneous flow rate of 20000 gpm or 45 cfs for recharge and/or runoff for the basin above 8000 feet.

Hydrologic Characteristics of the Rocks

Hydrologic Characteristics of the Pumice

As described earlier, the El Cajete pumice is very coarse grained, and is covered by a clayey soil approximately 3 to 6 inches thick. It is also separated from the underlying rhyolite in most places by another clay to sandy clay layer. This second layer represents a paleosol and contains root molds and casts from grasses that were growing at the time of the El Cajete eruption. The bottom clay layer is not everywhere present on the underling rock. Hollow-stem auger drilling reveals that this lower clay is absent from the tops of buried ridges and knobs; it is present on the flanks of these ridges and in the bottoms of adjacent buried valleys. The pumice is unconsolidated and not fractured or faulted.

Hydraulic conductivity (permeability) data for pumice is difficult to come by. There is one published paper on saturated permeability measurements for pumice from Mount Saint Helens (Reda and Hadley, 1985) that provides a lower-limit measurement. Their results a show saturated core of Mount St. Helens pumice has a permeability of 2.76×10^{-8} cm^2 (51 gal/day/ft^2 [gpd/ft^2]) equivalent to a fine-grained clean, unconsolidated sand. Although Reda and Hadley (1985) did not provide any descriptions of the material they tested, I assume it is very fine to silt-sized ash pumice based on its hydraulic conductivity - grain size correlation.

Another way to estimate saturated hydraulic conductivity for material that has not been previously tested is to use either Hazen's Equation or the Kozeny-Carmen Equation (Freeze and Cherry, 1979; Smith and Wheatcraft, 1993). These are:

1. Hazen's Equation:

$$K = Cd_{10}^2 \qquad (1)$$

Where K is in cm/s, d_{10} is the sieved grain size for which 10% of the particles are finer (mm) and C ranges from 0.4 to 0.8 for fine sands, 0.8 to 1.2 for medium to coarse sand and 1.2 to 1.5 for well-sorted coarse sand; and

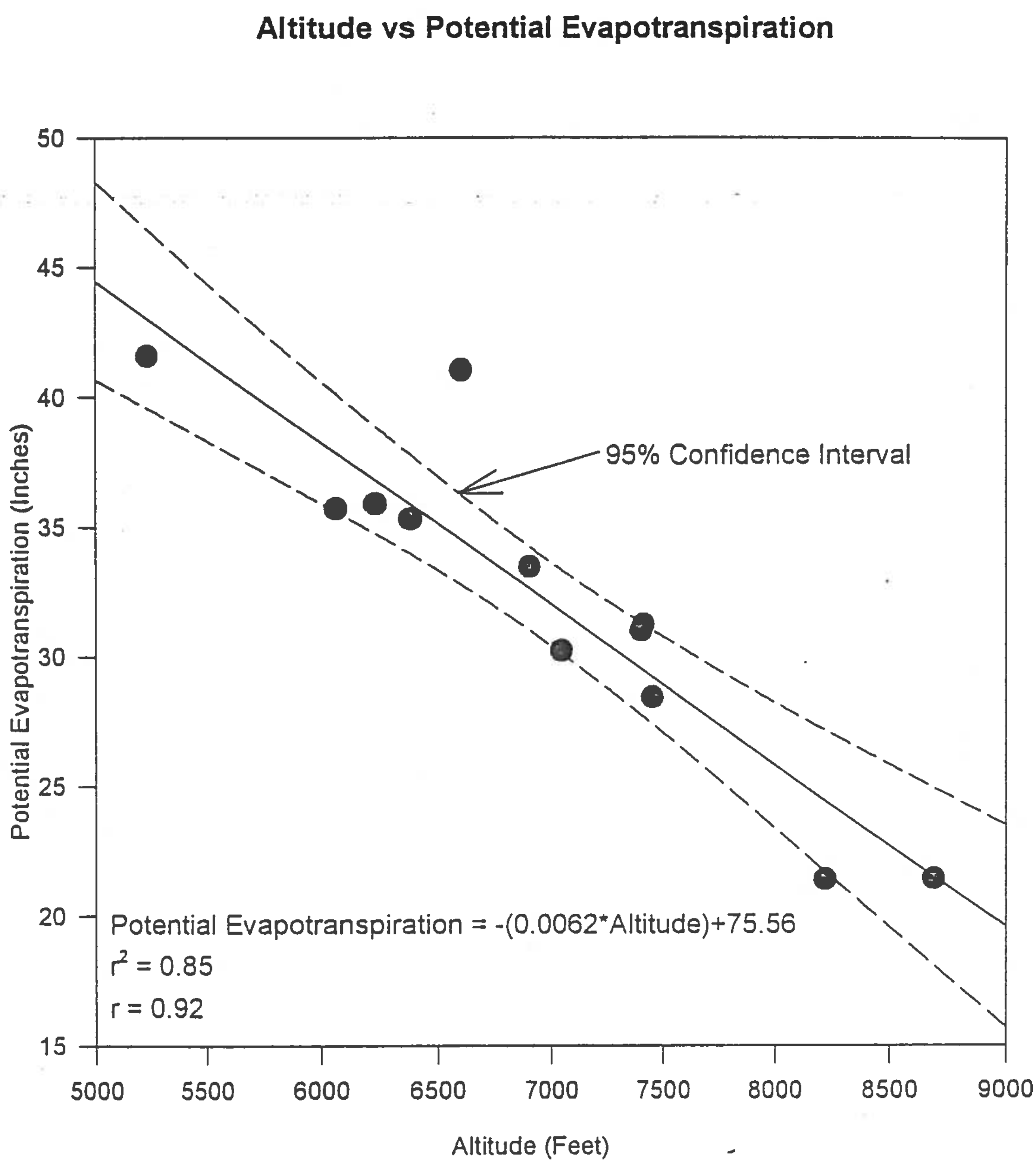


Figure 9 -- Plot of Altitude Versus Potential Evapotranspiration For Sandoval County, New Mexico. (Data From Gabin and Lesperance, 1977)

2. Kozeny-Carmen Equation:

$$K= (\rho g/\mu)(n^3/(1-n)^2)(d_m^2/180) \quad (2)$$

Where K is in cm/s, ρ is the density of water at some temperature, g is the gravitational constant (cm/s), μ is the viscosity of water at some temperature, n is porosity (decimal), and d_m is the mean grain size (mm).

These values of hydraulic conductivity depend on grain-size sieve analyses and require cumulative percent curves to determine the grain-size coefficients in each equation. This makes application of Equation 1 more difficult when grain size analyses are not available. However, a visual estimate of mean grain size should suffice for the d_m coefficient in Equation 2. This should provide satisfactory estimates of order of magnitude hydraulic conductivities in untested saturated materials (like pumice). Unsaturated hydraulic conductivities are not available and are difficult to estimate (Freeze and Cherry, 1979).

Schoeller (in Davis, 1969) reports a general pumice porosity value of 87% . Based on outcrop observation and core logging that I carried out last summer, I believe this is not an unreasonable upper limit estimate for pumice porosity because it should include intragranular and intergranular porosity. Based on pumice collapse packing during hollow-stem auger core drilling, porosities for the block pumice ranged from approximately 40% to 65%. Ash and lapilli showed less collapse, hence lower porosities, generally between 25% to 50%. These values are only estimates and possibly represent only about 1/2 to 3/4 of the actual total porosity of the El Cajete pumice since about 1/4 to 1/2 of the pumice in some samples remained uncrushed. Thus, based on core crushing, porosity in the El Cajete pumice ranges from 25% in the ash pumice to +86% in the block pumice.

Using these porosity ranges in Equation 2 gives estimates of saturated hydraulic conductivities ranging from 10^1 gpd/ft^2 for fine ash to 10^4 gpd/ft^2 for coarse ash. Lapilli ranges from 10^4 to 10^{10} gpd/ft^2 and block pumice ranges from 10^{10} to 10^{13} gpd/ft^2. These figures are only estimates since there are no pumping test data available for any of the water-saturated pumice. However, Reda and Hadley (1985) report a core hydraulic conductivity measurement of 5.1×10^1 gpd/ft^2 for pumice. Although there was no description of grain size of the pumice, it correlated with clean, well-sorted, fine sand. Using their value as a starting point, the estimated permeabilities for the pumice seem reasonable.

The pumice is typically damp to the touch when first removed from a core barrel but dries out rapidly upon exposure to air, losing about 25% to 30% of it's weight (Wayne Brown, personal communication). When freshly excavated pieces of pumice are rubbed on rough steel, they yield free water because of crushing spinifex glass fibers in the pumice. Water is held within the fibers in the pumice by capillary pressure. Dry pumice placed in a shallow dish with water will wick the liquid up very quickly confirming presence of significant capillary pressure.

In only one case was part of the pumice saturated with water - drill hole DH9-2C, east of the eastern edge of the proposed mine site penetrated water-saturated pumice in the lower 10 feet of the hole. This hole is located in a paleovalley in the Valle Grande Member. The water flows down this valley on the clay paleosol at the base of the pumice. The water discharges from Montoya Spring in the valley 550 feet north of the drill hole location at about 5-10 gallons per minute (by visual estimate).

Hydrologic Characteristics of the Rhyolite

As described earlier, the Valle Grande Member (a.k.a. South Mountain Rhyolite) is comprised of fractured light gray to light brownish gray, unwelded to moderately welded rhyolite ash-flow crystal to vitric tuff. The rhyolite also contains numerous cavities and voids. Whether these voids are connected cannot be demonstrated with the data currently available. The rhyolite drill cuttings and auger cores immediately below the pumice were dry to the touch. The rhyolite remained dry until the water table is penetrated.

Freeze and Cherry (1979, Table 2.2) show hydraulic conductivities of unfractured igneous rocks ranges from 10^{-3} to 10^{-7} gpd/ft^2. They also show that hydraulic conductivities of fractured igneous rocks range from 10^{-1} to 10^{3} gpd/ft^2.

Three pumping tests were performed on wells #15, #20 and #23 (Table 3) by American Ground Water Consultants, Inc (1978). Their analyses show that hydraulic conductivities from rocks that supposedly belong to the El Cajete Member range from 78 to 312 gpd/ft^2 (from transmissivities of 3922 to 8745 gpd/ft) south of State Highway 4. Upon further investigation, I discovered that the pumping tests were from wells that produce water from the Valle Grande Member of the Valles Rhyolite not the El Cajete Member as reported.

The transmissivity for well #15 (8745 gpd/ft) is calculated from the recovery data; no drawdown data for this well were recorded in the report. Well #20 only has the results of the data analysis; no drawdown data was presented. Transmissivity for well #20 is reportedly 3922 gpd/ft; hydraulic conductivity is 80 gpd/ft^2. Data from the pumping test on #23 has 5 water levels recorded during drawdown - insufficient for an analysis. Ground Water Consultants, Inc (1978) was unable to analyze the recovery data because they did not fit his conceptual model of a well in saturated pumice. I re-examined the recovery data from wells #15 and #23 in light of the fact that the water is being produced from rhyolite tuff not pumice.

Assuming an unconfined aquifer I made the appropriate Jacob correction of drawdown:

$$s'=s-(s^2/2h_0) \qquad (3)$$

where s' is corrected drawdown, s is drawdown and h_0 is the original static water level prior to pump on. A similar calculation was performed using the data from well #15. I plotted s'/Q (specific drawdown) versus dimensionless time (t/t') in Figures 11 and 12. Analytic and interpretation techniques for recovery data are summarized by Birsoy and Summers (1980) and Williams (1990). From this analysis transmissivity for the rhyolite tuff penetrated by well #15 is 9296 gpd/ft (Figure 11) based on a linear regression of the data ($r^2 = 0.98$); hydraulic conductivity is 336 gpd/ft^2. Transmissivity for the rhyolite tuff penetrated by well #23 (Figure 12) based on a linear regression of the late recovery data ($r^2 = 0.93$) is 30 gpd/ft; hydraulic conductivity is 4.4×10^{-1} gpd/ft^2. The

Well #	Well Name	RG #	Location	Depth-to-Water (Feet)	Total Depth (Feet)	Comments
1	Copar MW #1		18N.3E.1.3342	264	296	
2	Copar MW #2		18N.3E.1.4434	347	378	
3	Copar MW #3		18N.3E.1.4141	139	150	
4	McKeever 1	RG-56938	18N.3E.1.123	280	320	
5	Johnson 1	RG-48121	18N.3E.3	280	300	
6	U.S.Forest Service	RG-51449	18N.3E.3.214	209	240	
7	Baca Land & Cattle 1	RG-46600	19N.3E.34.444	200	400	
8	Wakeman 1	RG-56209	18N.3E.10.242	43	156	
9	Sierra Los Piños 1	RG-30359	18N.3E.11.2122	295	310	LANL Shows 250' TD; 201' DTW
10	West 1	RG-48563	18N.3E.11.144	256	350	
11	Williams 1	RG-26227-S-2	18N.3E.11.133	>290	290	
12	Williams 2	RG-26227-S-2	18N.3E.11.133	40	70	
13	R. B. & K. 1	RG-26103	18N.3E.11.310	226	267	
14	Bootzin 1	RG-31281	18N.3E.11.414	23	65	
15	Bootzin 2	RG-30444	18N.3E.11.414	220	250	T=9296 gpd/ft; K=336 gpd/ft²
16	Sierra Los Piños 2	RG-30359S	18N.3E.11.4414	294	400	
17	Mills #1	RG-47489	18N.3E.11.344	200	320	
18	Hotchkiss #1	RG-31542	18N.3E.11.344	150	200	
19	Flynn #1	RG-55658	18N.3E.12.111	285	380	
20	Turner Loc'n #1	-----	18N.3E.11.214	201	250	T=3922 gpd/ft; K=80 gpd/ft²
21	Turner Loc'n #2	-----	18N.3E.11.432	297	310	Possibly RG-30359 (Well #9)
22	Turner Loc'n #3	-----	18N.3E.11.113	12.5	250 (?)	
23	Turner Loc'n #5	RG-30444S	18N.3E.11.124	112.3	180	T=26 gpd/ft; K=0.38 gpd/ft²

Table 3 -- Summary of Water Wells and Monitoring Wells Drilled in the Area Around the Proposed El Cajete Pumice Mine, Sandoval County, New Mexico. See Figure 10 for Location Method.

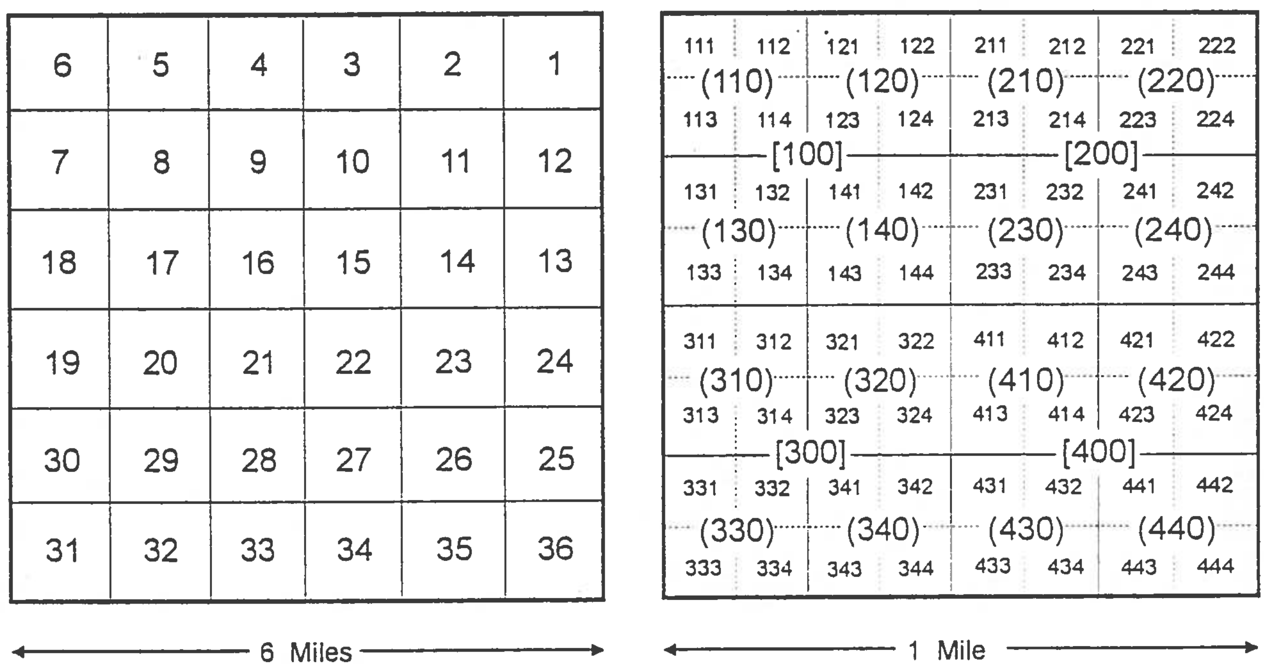


Figure 10 -- Method of Numbering Sections in a Township and Tracts in a Section Used by the New Mexico State Engineer.

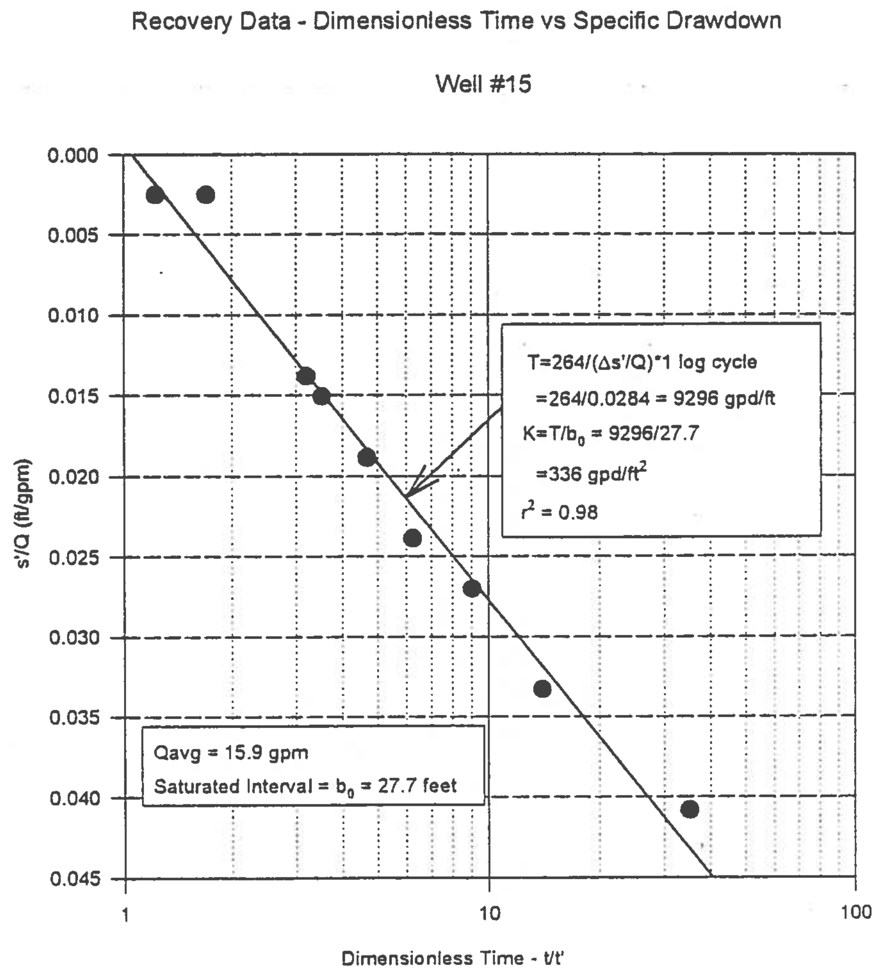


Figure 11 -- Plot of Dimensionless Time (t/t') Versus Specific Drawdown (s'/Q) For Recovery Data From Pumping Test of Well #15, Vallecitos de los Indios, South of the Proposed El Cajete Pumice Mine, Sandoval County, New Mexico. (Data From American Ground Water Consultants, Inc., 1978)

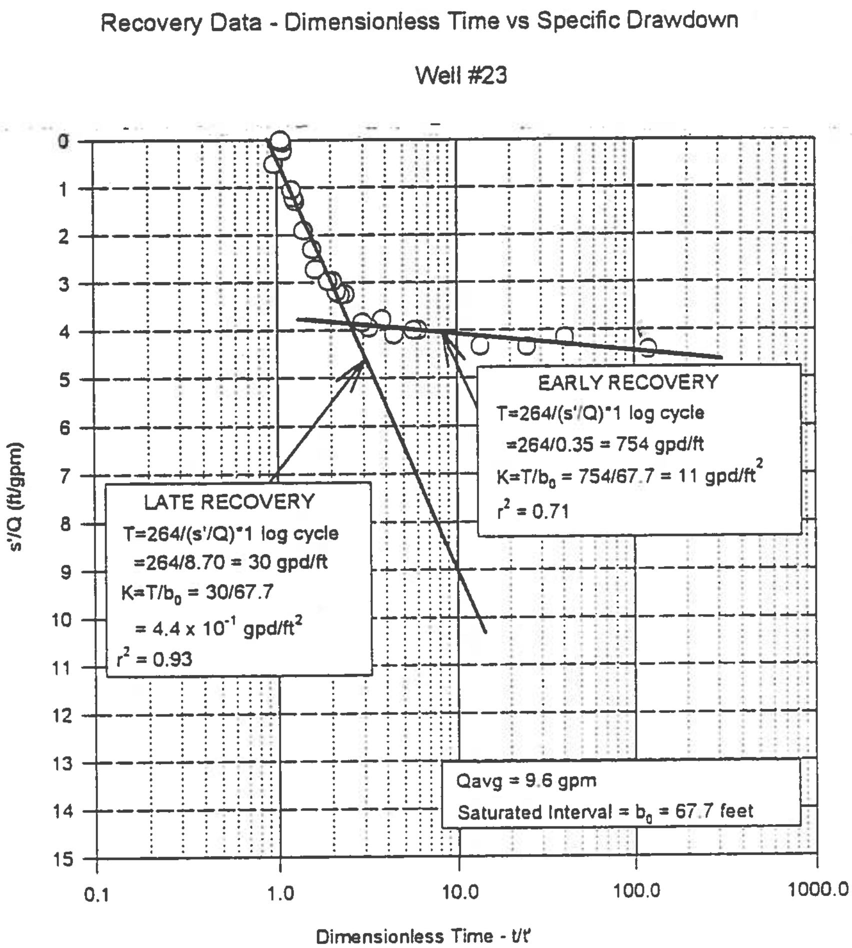


Figure 12 -- Plot of Dimensionless Time (t/t') Versus Specific Drawdown (s'/Q) For Recovery Data From Pumping Test of Well #23, Vallecitos de los Indios, South of the Proposed El Cajete Pumice Mine, Sandoval County, New Mexico. (Data From Ground Water Consultants, Inc, 1978)

transmissivity for well #15 is slightly higher than that calculated by Ground Water Consultants, Inc (1978); the difference is probably due to my use of Jacob corrected drawdown values rather than uncorrected drawdown. The hydraulic conductivities span the range for fractured igneous rock listed in Freeze and Cherry (1979, Table 2.2). Thus, in fractured rhyolite, hydraulic conductivities can be significant, while between fracture sets hydraulic conductivities are several orders of magnitude lower.

Local home owners report that several wells in the Sierra Los Piños subdivision produce water at very low rates confirming that hydraulic conductivities may locally be as low as 10^{-1} to 10^{0} gpd/ft^{2}. This is also confirmed by water production rates from Copar's Monitoring Wells #2 and #3. Well #2 was pumped at a rate of 5.8 gallons per minute during purging and sampling operations performed in December, 1994. The pump broke suction after about 10 minutes and was shut off; the water level apparently recovered slowly. Monitoring Well #2 has an estimated sustained production rate of about 1-2 gallons per minute; no drawdown or recovery data were recorded. Monitoring Well #3 has an estimated production rate of less than ½ gallon per minute; the pump broke suction after less than one minute; no water ever reached the surface and no drawdown data was collected. This information, combined with the results from the test of well #23 shows that the rhyolite between fracture systems probably has hydraulic conductivities several orders of magnitude lower than the fractured rhyolite.

Ground Water

Water Table

There are 2 separate aquifers in the vicinity of the proposed mine: one shallow and one deep. These aquifers supply all of the water for residents of the Sierra Los Piños subdivision. Well data are summarized in Table 3. Locations used in Table 3 are based on the New Mexico State Engineer's well numbering system (Figure 10).

Shallow Water Table-

The shallow water table occurs in the El Cajete Member of the Valles Rhyolite and is confined to the lowest areas (altitude-wise) of the pre-pumice topography (Figures 4 and 13). Water sits on an buried soil horizon at the base of the El Cajete pumice and is inhibited from moving down into the underlying rhyolite by that clay layer. Water from this shallow aquifer locally discharges to small springs, three domestic wells in Sierra Los Piños and to the lower reaches of Vallecitos Creek near Jemez Falls. Flows rates are low, ranging from 2 to 10 gallons per minute (by visual estimate). Source of the water is apparently from springs on the north-facing slopes of Los Griegos and the highlands that form the southern margin of Vallecitos de los Indios. Water possibly flows down arroyos from the springs into the pumice along the clay layer at the pumice/clay/bedrock contact and surfaces again where the modern topographic surface intersects that clay layer. Drillers logs from wells drilled in Vallecitos de los Indios and one pumice hole drilled on the eastern edge of the proposed mine (DH9-2C) confirm this relationship. Auger drilling in Section 1, Township 18 North, Range 3 East shows that this shallow water table is not present below the proposed mine location.

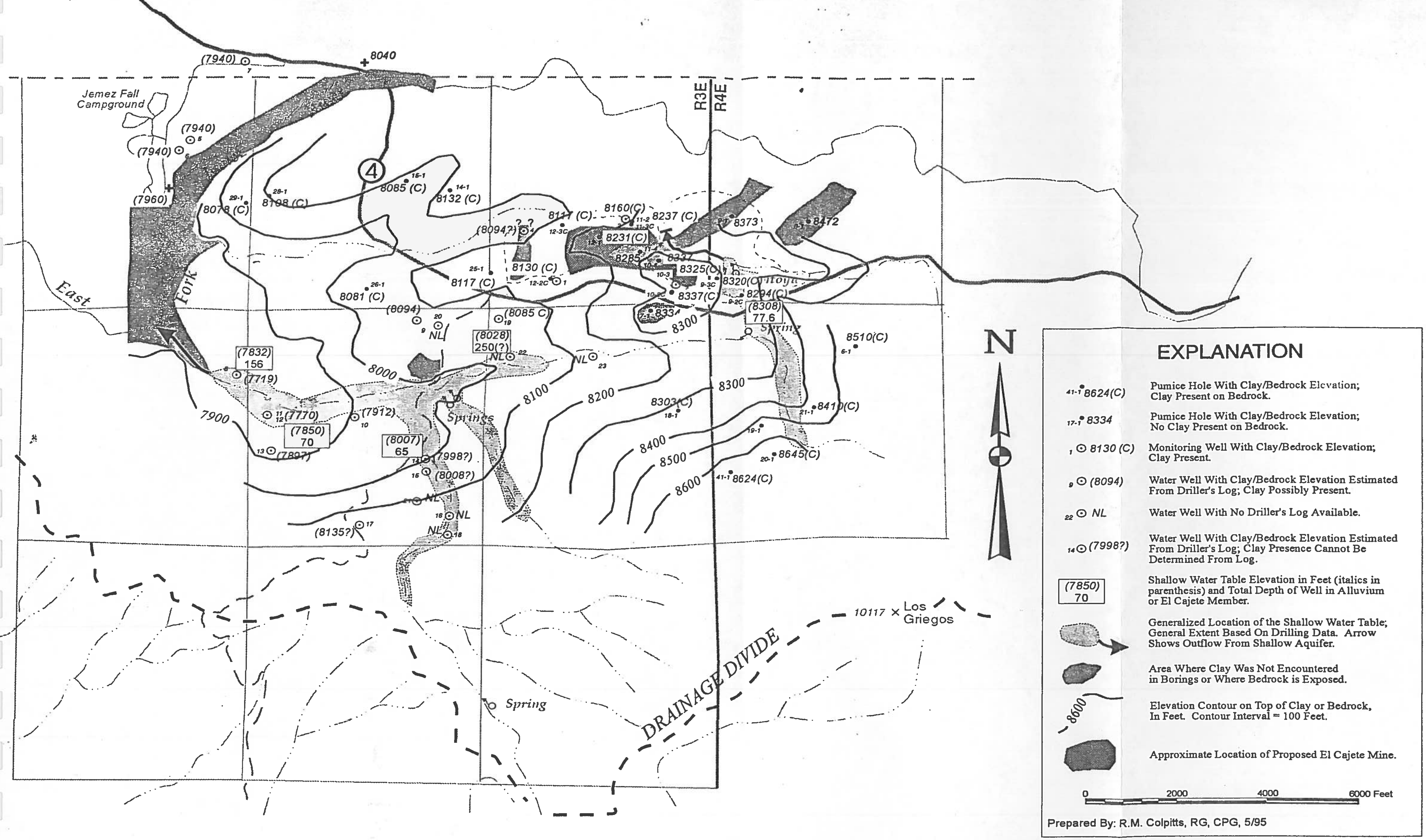


Figure 13 -- Generalized Location of Shallow Aquifer in the Area Surrounding the Proposed El Cajete Pumice Mine, Sandoval County, New Mexico.

Deep Water Table-

The deep water table is generally 200 to 300 feet below the land surface. Figure 14 shows the altitude of the piezometric surface of water table for the area immediately adjacent to the proposed mine. These contours are based on data from wells with a total depth of approximately 300 feet (Table 3). These are the data that are plotted in Figure 14. Most of the well locations have not been field checked. Several wells could not be plotted because of poor location information contained in the State Engineer's records.

I used the wells with total depths of 300 feet to construct Figure 14 for 2 reasons. First, many of the wells drilled in the area are approximately 300 feet deep. Second, depth to water and water table elevations vary with the total depth of the well (Figure 15); deeper wells have deeper water tables and shallower wells have shallower water tables, although other factors such as variations in hydraulic conductivity of the rhyolite and well construction (esp. contributing or screened interval) will affect the distribution of points. The relationship between well depth and depth to water suggests that water flow in the rhyolite is directed downward. The shape of the piezometric surface suggests water flow is toward the southwest, away from the proposed mine area and the Sierra Los Piños Subdivision. Figure 15 also suggests that this area is located in a recharge area (Freeze and Cherry, 1979).

Water in the deep water table is probably produced from fractures in the Valle Grande Member of the Valles Rhyolite. Based on drillers records, reports from local residents and the sampling of the Monitoring Wells on the margin of the proposed mine, wells with the highest flow rates (greater than 25 gallons per minute) probably penetrate concentrations or intersections of fractures along trends described earlier (Figure 7). Wells drilled between these major fracture concentrations will have very low flow rates, typically less than 5 gallons per minute. Superimposing the water table elevation contours in Figure 14 on the fracture sets in Figure 7 suggests the shape of the piezometric surface is not only related to topography but is also partially controlled by fracture concentrations.

Recharge

Recharge in the East Fork drainage basin comes from precipitation. Based on estimates of precipitation and potential evapotranspiration that account for elevation and orographic effect, the water available for recharge and/or runoff accounts for 38% of the total precipitation above 8000 feet in the East Fork drainage basin.

Stream Flow Measurements-

Recharge estimation requires measurements of stream flow from the East Fork. Data from the U.S. Forest Service (Bruce Sims, personal communication) shows that the East Fork flow rate measured by spin-flow meter is about 8.8 cfs at Las Conchas Campground. Downstream at Battleship Rock at the confluence of San Antonio Creek and East Fork River, the flow rate is about 15.5 cfs. The East Fork discharge rate at Battleship Rock is based on taking 44% of the averaged flow rates from a gauging station on the Jemez River below Battleship Rock (U.S.G.S. #08321500). The percentage is based on the percent of the area the East Fork drainage basin covers in the Jemez River drainage basin above the gauging station. This percentage is confirmed by flow measurements taken at Battleship Rock by MTK, Inc. The Las Conchas flow rate is based on flow measurements

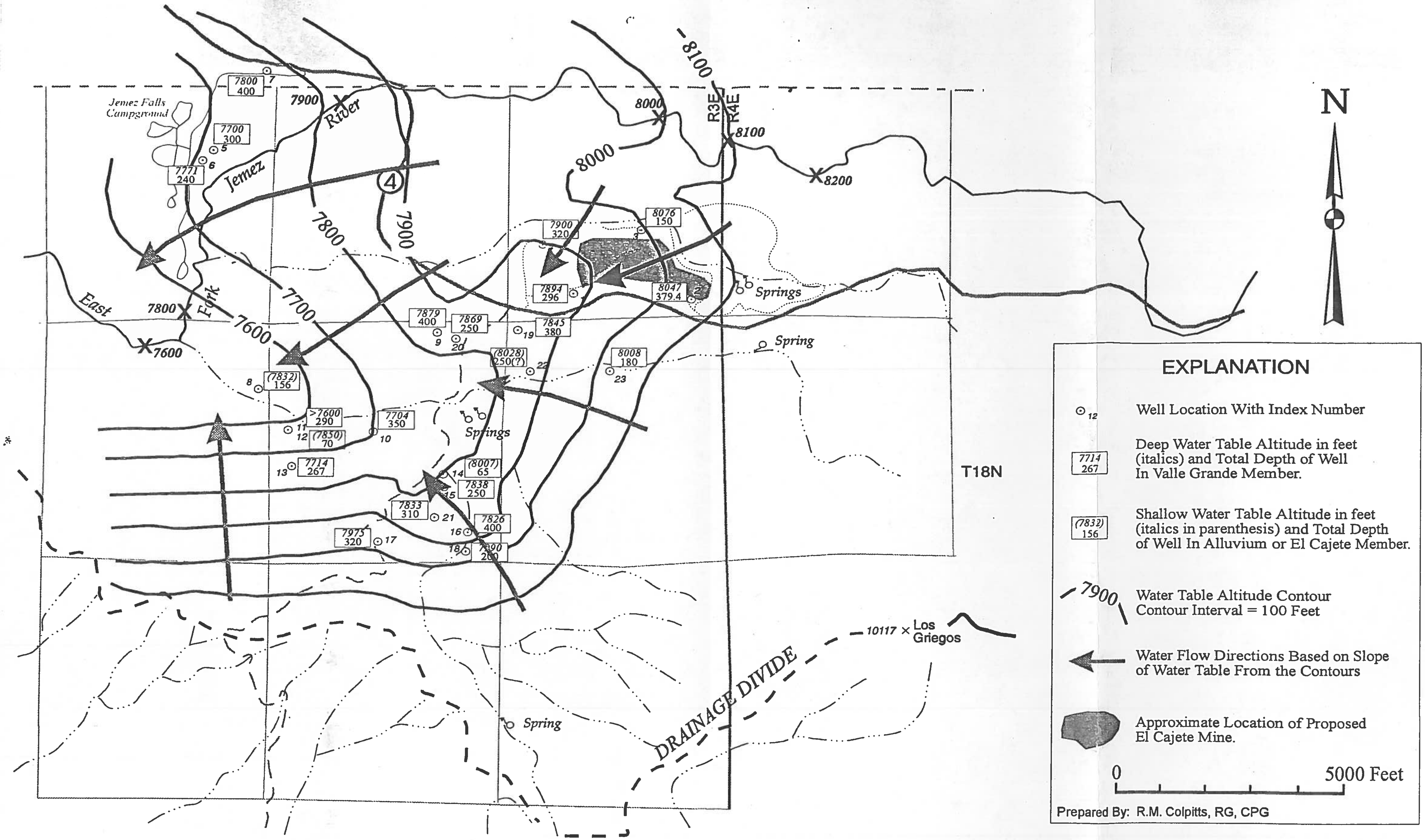


Figure 14 -- Deep Water Table Contour Map of the Area Surrounding the Proposed El Cajete Mine, Sandoval County, New Mexico.

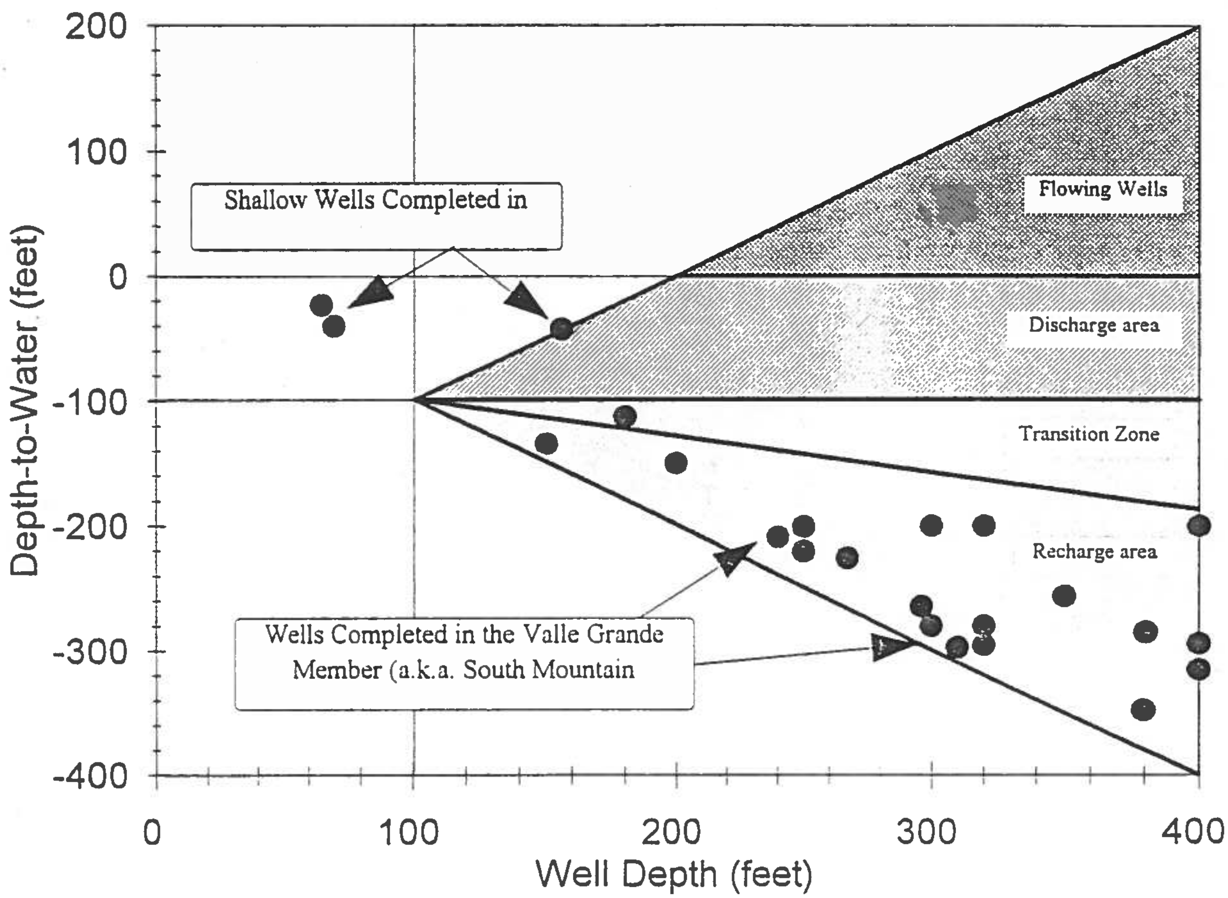


Figure 15 -- Freeze and Cherry Plot of Well Depth Versus Depth To Water For Domestic and Monitoring Wells Near The Proposed El Cajete Pumice Mine, Sandoval County, New Mexico.

taken at Las Conchas Campground by the same contractor; the flow at Las Conchas accounts for about 57% of the total flow in the East Fork.

Recharge Estimates-

The area of the basin above Las Conchas Campground accounts for 70% of the area above 8000 feet. The instantaneous precipitation rate above Las Conchas is approximately 32 cfs (70% of 45 cfs). Subtracting the flow rate at Las Conchas (8.8 cfs) from 32 cfs yields about 23 cfs that goes to recharge in the Valle Grande.

Between 8000 feet and Las Conchas Campground there is 13.4 cfs instantaneous precipitation available for runoff and/or recharge. There is a gain in flow rate of 6.7 cfs downstream from Las Conchas Campground. Part of the additional flow comes from McCauley Warm Springs which discharges between 200 and 368 gallons per minute or .45 to .82 cubic feet per second (Summers, 1976, p. 30) to the East Fork approximately 1.1 miles east of Battleship Rock; the average flow rate from this spring is .64 cfs. Based on flow rates at Battleship Rock less the flow at Las Conchas and average discharge from McCauley Warm Spring (15.5 - 8.8 - 0.6 = 6.1 cfs) deducted from the available precipitation leaves 7.3 cfs available for recharge.

Discharge

Discharge from the ground-water flow system in the East Fork drainage basin is primarily to springs and domestic wells (in Sierra Los Piños). I believe that small stretches of the East Fork may be local discharge areas caused by intersection of floor of East Fork canyon with the regional water table (Figure 14). How much water, if any, is contributed to stream flow by discharge is unknown because there are no flow measurements between Las Conchas Campground and Battleship Rock.

Hydrogeochemistry

Water chemistry data in the vicinity of the proposed mine location are limited but sufficient to make some statements regarding ground water chemistry, origin of recharged water and the age of the ground water in the vicinity of the mine. There are two sets of data that can be incorporated: 5 samples collected by John Shomaker and Associates, Inc. (Appendix 2) and 4 samples collected by Los Alamos National Labs (Table 4). These data are summarized on a Piper Diagram (Figure 16) and a Stiff Diagram (Figure 17). Two of Shomaker's samples come from wells also sampled by Los Alamos. This provides an opportunity compare results from different labs. The primary problem with comparing these sample results includes analytic methods used, and sample collection technique. All samples collected by Shomaker and Associates followed a stricfly supervised sample collection and chain of custody protocol as outlined in ASTM D 4448 - 85a; no field filtering of the water samples was permitted (see Appendix 2 for details). I have no idea whether similar protocols were followed by Los Alamos. Also the samples collected by Shomaker and Associates were analyzed using EPA standard test procedures and techniques; the procedures used by Los Alamos probably did not follow these standards though detection levels were lower.

Sample results plotted on Figure 16 shows several things. First, all water samples cluster in the Bicarbonate field of the Anion plot in the Piper Diagram. Second, water analyses of samples collected north of State Highway 4 (samples 1 - 3) clusters in the Sodium-Type field of the Cation plot in the Piper Diagram. South of the highway there is apparently more Calcium in the water;

Sample Number	Sample ID	RG #	TEMP (°C)	Ag ppm*	As ppm	Ca ppm	Cd ppm	Cl ppm	CO3 ppm	Cr ppm	Cu ppm
MW-1	1	-------	18.9 (F)	<0.01**	<0.005	10.2	<0.0005	1.70	<1	0.059@	<0.010
MW-2	2	-------	15.6 (F)	<0.01	<0.005	11.4	<0.0005	2.60	<1	0.085@	<0.010
McKeever 1	3	56938	17.2 (F)	<0.01	<0.005	10.4	<0.0005	1.70	<1	<0.010	<0.010
RG-30359S	4	30359S	21.1 (F)	<0.01	<0.005	16.4	<0.0005	2.40	<1	<0.010	<0.010
RG-30359	5	30359	14.4 (F)	<0.01	<0.005	17.2	<0.0005	2.50	<1	<0.010	<0.010
VA-408	A	30359S	23.9 (F)	<0.0005	0.004	15.0	<0.0005	3.01	0	<0.002	0.005
VA-409	B	30444	20.3 (F)	<0.0005	0.003	15.3	<0.0005	3.35	0	<0.002	0.003
VA-410	C	30359	15.5 (F)	<0.0005	0.002	16.8	<0.0005	2.56	0	<0.002	0.004
VA-411	D	30444S	17.3 (F)	<0.0005	0.001	22.4	<0.0005	2.22	0	<0.002	0.008
EPA Std.				**<0.05#**	**<0.05**	----	**<0.01**	**<250**	----	**<0.05**	**<1.0**

Sample Number	Sample ID	RG #	F ppm	Hg ppm	HCO3 ppm	K ppm	Mg ppm	Na ppm	Pb ppm	pH (F)	SiO2 ppm
MW-1	1	-------	0.60	<0.0002	56.0	5.00	2.20	13.6	<0.002	6.96	70.2
MW-2	2	-------	0.70	<0.0002	57.0	5.60	2.80	18.4	0.003	7.02	51.3
McKeever 1	3	56938	0.61	<0.0002	57.0	4.50	2.20	14.1	<0.002	6.80	65.7
RG-30359S	4	30359S	0.16	<0.0002	76.0	4.10	5.50	12.9	<0.002	7.19	68.2
RG-30359	5	30359	0.25	<0.0002	72.0	4.80	4.20	13.4	0.004	6.73	67.0
VA-408	A	30359S	0.11	<0.0002	93.4	3.10	4.77	12.6	<0.002	6.50	59.7
VA-409	B	30444	0.10	<0.0002	97.1	3.06	4.82	11.9	<0.002	6.50	53.7
VA-410	C	30359	0.20	<0.0002	90.3	3.99	4.02	12.5	<0.002	6.50	59.9
VA-411	D	30444S	0.17	<0.0002	142	2.62	5.97	20.4	<0.002	6.50	44.5
EPA Std.			**<2.4**	**<0.002**	----	----	----	**<20.0**	**<0.05**	**6.5-8.5**	----

Sample Number	Sample ID	RG #	SO4 ppm	Zn ppm	TDS ppm	O-18 (o/oo)+	Deuterium (o/oo)	Tritium (T.U.)
MW-1	1	-------	<5	<0.050	164.6	------	------	------
MW-2	2	-------	<5	0.128	155.0	------	------	------
McKeever 1	3	56938	<5	<0.050	161.3	------	------	------
RG-30359S	4	30359S	<5	<0.050	190.7	------	------	------
RG-30359	5	30359	<5	0.140	186.5	------	------	------
VA-408	A	30359S	2.79	0.010	197.8	-12.61	-88.7	0.07
VA-409	B	30444	2.89	<0.010	196.3	-12.54	-88.6	0.38
VA-410	C	30359	3.60	0.190	198.3	-12.30	-90.9	0.21
VA-411	D	30444S	8.28	0.070	249.9	-12.62	-87.3	1.18
EPA Std.			**<250**	**<5.0**	**<500**			

*Parts Per Million (=Milligrams/Liter or Milligrams/Kilogram) L=Lab Measurement
F=Field Measurement **Less than symbol in analyses indicates lower detection limit.
+Parts Per Thousand (=Parts Per Mil) #EPA standards show upper allowable limit for drinking water.
@High levels of Chromium in these samples possibly derived from pump impeller erosion during well purging.

Table 4 -- Results of Chemical Analyses of Samples Collected From Water and Monitoring Wells Proposed El Cajete Pumice Mine, Sandoval County, New Mexico.

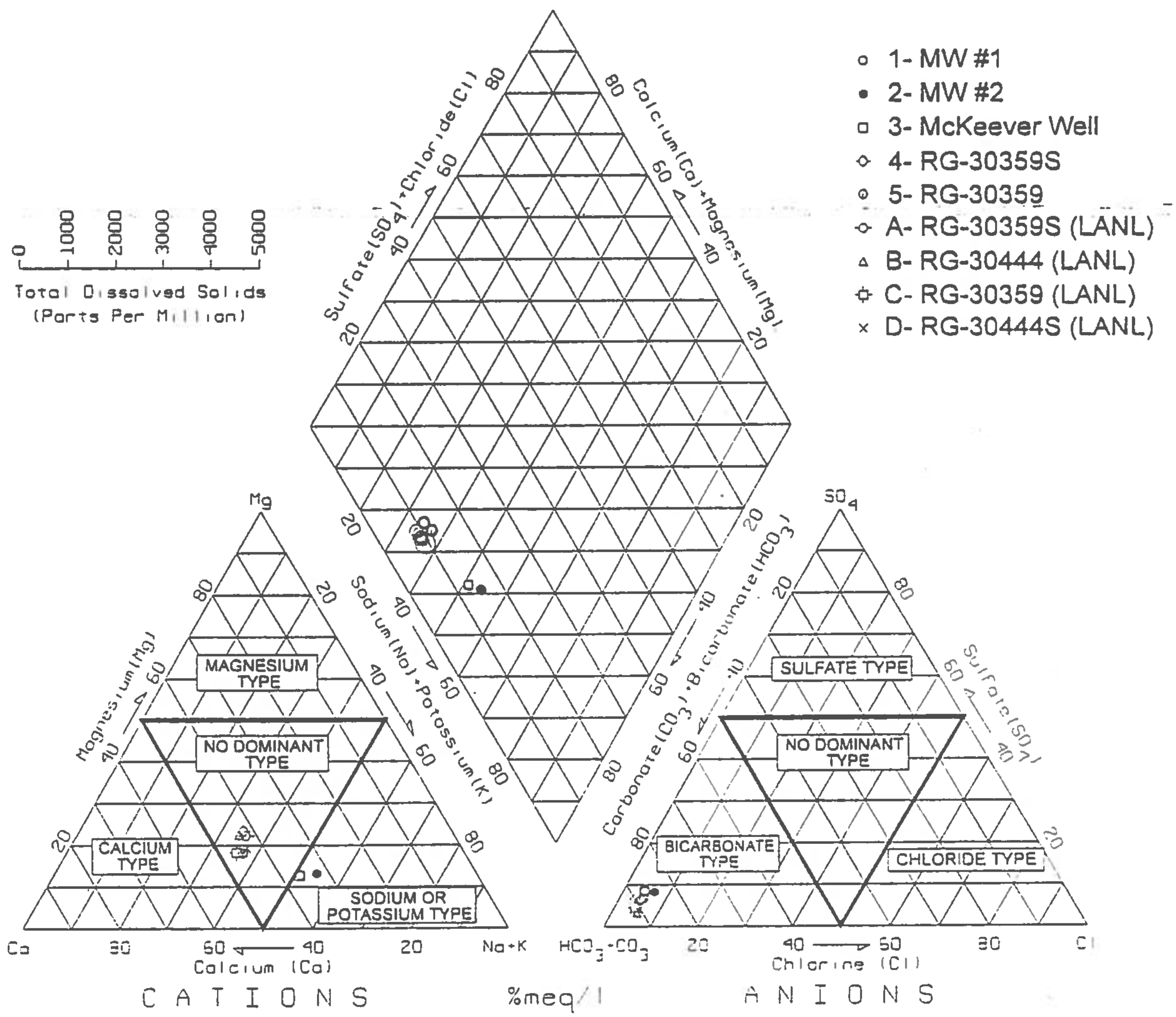


Figure 16 -- Piper Diagram Showing Distribution of Solute Concentrations From Water Samples Collected From Domestic and Monitoring Wells Around the Proposed El Cajete Pumice Mine, Sandoval County, New Mexico

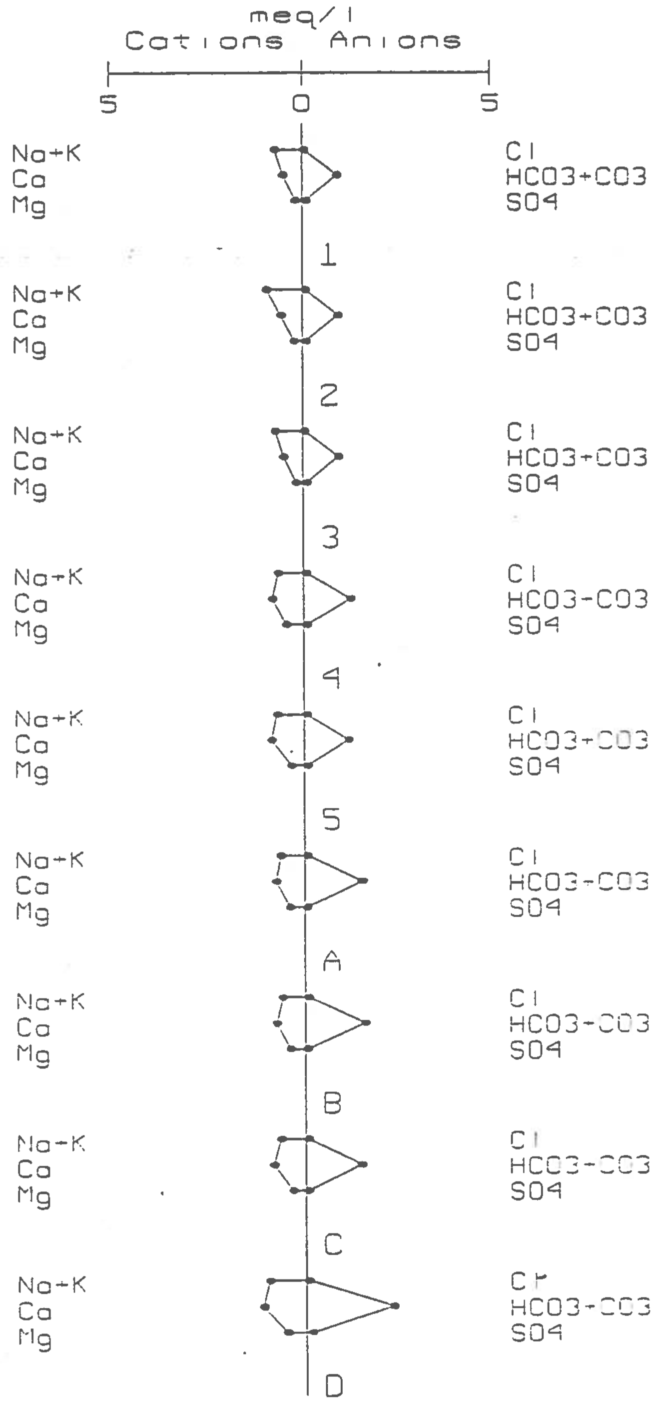


Figure 17 -- Stiff Diagram of Solute Concentrations From Water Samples Collected From Domestic and Monitoring Wells Around the Proposed El Cajete Pumice Mine, Sandoval County, New Mexico.

samples plot into the "No Dominant Type" field but are clustered close to the edge of the Calcium field. Also, there is more Magnesium in the waters south of the highway accompanied by higher concentrations of Total Dissolved Solids. The Stiff Diagram (Figure 17) also confirms the difference between water samples north and south of the highway.

This distribution ion types suggests that water in below the proposed mine and Vallecitos de los Indios is typical for a recharge area or upper zone in a regional flow system (Domenico, 1972; Freeze and Cherry, 1979). Waters in such areas are characterized by Bicarbonate as the dominant anion and low Total Dissolved Solids (in this case, TDS ranges from 155 to 249.9 ppm). Calcium Bicarbonate is the dominant water type south of NM State 4. North of the highway, the waters appear to be a Sodium-Calcium Bicarbonate type of water. While still typical for a recharge area, the presence of higher sodium levels from wells north of Highway 4 suggests either that there maybe mixing of shallow ground water with deeper circulating, older waters from Valles Caldera or leaching of Sodium-bearing minerals in the volcanic rocks the water is flowing through. Sample results from Shomaker and Associates and Los Alamos Labs also show that other metallic ion concentrations are low (Table 4) and are generally well below current EPA Safe Drinking Water Standards.

Chromium levels in monitoring wells MW-1 and MW-2 exceed the EPA limits. This probably reflects erosion of stainless steel pump impellers by fine sand and silt purging and sampling of these wells (Appendix 2). Chromium levels in a nearby producing well are below detection limits and are well below EPA Standards. This suggests that once fines are purged, Chromium levels should return to their natural levels. Sodium also exceeds EPA standards in one well in the Sierra Los Piños subdivision (well #23 in Table 3; Sample ID #D in Table 4). This well has low hydraulic conductivity based on pumping test results. MW-2 also has higher Sodium levels; it apparently has relatively low hydraulic conductivity based on well performance during purging and sampling. Thus there may be a correlation betwen low well yield and high Sodium values in deeper ground water.

CONCEPTUAL MODELS FOR GROUND WATER FLOW AND RECHARGE

Potential Recharge of the Rhyolite Through the Overlying Pumice

To determine if rain water is recharging the rhyolite through the pumice, I utilized:

1) Published regional stable isotope data (Vuataz and Goff, 1986) and stable isotope analytical results from water samples Los Alamos Labs collected from 4 wells in Vallecitos de los Indios; and

2) Published tritium data (Vuataz and Goff, 1986) and tritium results from waters samples Los Alamos Labs collected from the same 4 wells in Vallecitos de los Indios.

The Los Alamos data are summarized in Table 4. The stable isotopes include deuterium (D) and Oxygen-18 (^{18}O). Most useful of the three isotopes listed are deuterium and tritium. With them I can generally estimate the source and a possible age for the water in the rhyolite aquifer.

Source of Recharged Water

Vuataz and Goff (1986) show that deuterium and Oxygen-18 values from cold water springs and wells in the Jemez Mountains generally plot along a Meteoric Water Line ($\delta D = 8*\delta^{18}O + 12$) that is very close to the World Meteoric Line ($\delta D = 8*\delta^{18}O + 10$). Stable isotope (deuterium and Oxygen-18) results from analyses performed by Los Alamos on water samples A-D (Table 4) indicate that waters south of the N.M. Highway 4 plot along the Meteoric Water Line for the Jemez Mountains (see Goff et al., 1988, Fig. 7). These data suggest that waters produced from wells in the Valle Grande Member in Vallecitos de los Indios are derived from rain water that has recharged the aquifer.

Vuataz and Goff (1986) also attempted to relate source elevation (and by implication and extension, the potential recharge elevation) to deuterium and Oxygen-18 content using cold water samples. Of this sample set 7 came from local springs, 1 came from the East Fork River, and 1 came from a well in Vallecitos de los Indios (location unknown). However, they used a "piston" recharge model that, given the geologic framework, is probably not appropriate because of orographic and elevation effects. Also, they did not account for potential mixing of waters from different elevations. This mixing will produce "averaged" values that will only indicate a general elevation or potential elevation range for recharge, a solution that is not unique.

Vautaz and Goff (1986) generated an equation relating deuterium content to elevation:

$$E(\text{Meters}) = -44.9\ (\delta D) - 1154 \qquad (4)$$

Oxygen-18 can be related to elevation with the following regression equation:

$$E(\text{Meters}) = -314\ (\delta^{18}O) - 1161 \qquad (5)$$

Both regressions had correlation coefficients of -0.96 and -0.97 respectively.

Vuataz and Goff (1986) favored using deuterium because it is not subject to alteration by geothermal sources the way Oxygen-18 is (Vuataz and Goff, 1986). Substituting the deuterium (D) values from Table 4 into Equation 4 and incorporating analytical uncertainty (±1‰ for the deuterium and ±0.25‰ for the Oxygen-18 - Goff , 1995, personal communication), we can estimate a range of possible elevations for each water sample from the deep aquifer in Vallecitos de los Indios:

Well	Well #	Recharge Elevation Range
A	RG-30359S	9134 - 9429 feet
B	RG-30444	9117 - 9413 feet
C	RG-30359	9455 - 9751 feet
D	RG-30444S	8927 - 9222 feet

These data show that water from the 4 wells sampled by Los Alamos were possibly recharged somewhere above 8900 feet elevation. Comparison of available precipitation and potential evapotranspiration data (Figures 8 and 9) shows that the approximate altitude where precipitation equals potential evapotranspiration is 8700 feet. Above this altitude there is a surplus of precipitation; below this there is a deficit. In combination, these data suggest that most of the recharge to the deep aquifer occurs above 8700 feet and that the elevation range indicated by the deuterium suggests considerable mixing of waters from higher elevations with waters from lower elevations. However, the elevation range (8900 to about 9800 feet) is reasonably consistent with elevation range where most of the precipitation in the East Fork drainage basin falls (Table 2 - 8700 and 11000 feet) and with location of the dominant recharge areas in the East Fork drainage basin as long as mixing is taken into account.

Age of the Ground Water

Age of the ground water can be generally estimated using tritium values from produced well waters (see Table 4 for list of available data). Precipitation that falls on the Jemez Mountains averages about 10 Tritium Units ±5% (Goff, 1995, personal communication). Tritium has a half-life of 12.43 years. Using the listed data and incorporating the reported uncertainty of ±5% (Goff, 1995, personal communication), the tritium values from well water from Vallecitos de los Indios shows age of the water ranges from about 37 to 87 years. The youngest waters are from the shallowest well (Well D) and the oldest waters are from the deepest well (Well A). However, fixing an exact date is not possible. Many factors affect the readings. Based on information presented by Smith and Wheatcraft (1993, Table 6.7.1) I estimate that water from the rhyolite aquifer is between 30 and 50 years old (pre-atmospheric atomic testing or pre-1957).

Discussion

Based on the available data, several inferences can be made regarding whether the rhyolite is being recharged through the pumice. First, if recharge to the rhyolite aquifer occurs through the pumice at the proposed mine location where elevations range from 8100 to 8400 feet, then we would expect $\delta^{18}O$ values to be higher, ranging from -29.5‰ to -30.4‰ instead of -12.3‰ to -12.6‰ even if mixing is accounted for. Likewise, δD values should also be significantly higher, ranging from -206.1‰ to -212.8‰ instead of -87.3‰ to -90.9‰. The higher value ranges for $\delta^{18}O$ and δD would be consistent with lower average recharge elevations. The data imply that recharge is occurring at elevations above those of the proposed mine location (8700+ feet) and not from the elevations where the proposed mine will be located (8100 to 8400 feet).

Higher tritium values that would be consistent with local recharge are not present; the estimated age of the water in the deep aquifer is at least 30+ years and probably older. These data are consistent with long flow paths and residence time in the rhyolite for recharged meteoric waters (Frazier Goff, personal communication). The springs on the flanks of Las Conchas in Sections 3 and 9, Township 18 North, Range 4 East, east of Los Griegos have tritium values as high as 40 T.U. suggesting that precipitation is almost immediately discharged after it falls (in generally less than 2 years - Vuataz and Goff, 1986).

Potential Water Flow Through The Pumice-

Since localized water flow in the base of the pumice in paleovalleys on the rhyolite forms the basis for the shallow aquifer, where does this water come from and where does it flow to? Some of this water discharges to several springs and wells in the surrounding area and some flows into the East Fork River at Jemez Falls. The closest spring to the proposed mine is Montoya Spring in SW¼, SW¼. sec. 6, Township 18 North, Range 4 East. Water flowing to this spring was encountered in DH9-2C south of the spring. The source of this water flow is somewhat problematic.

There are three possible conceptual models that can be used to describe the source of this water and its connection to recharge (Figure 18):

1) No recharge through the pumice at the proposed mine site; precipitation used consumptively by plants and returned to atmosphere by evapotranspiration. Water flow in the paleovalleys originates from springs on Los Griegos.

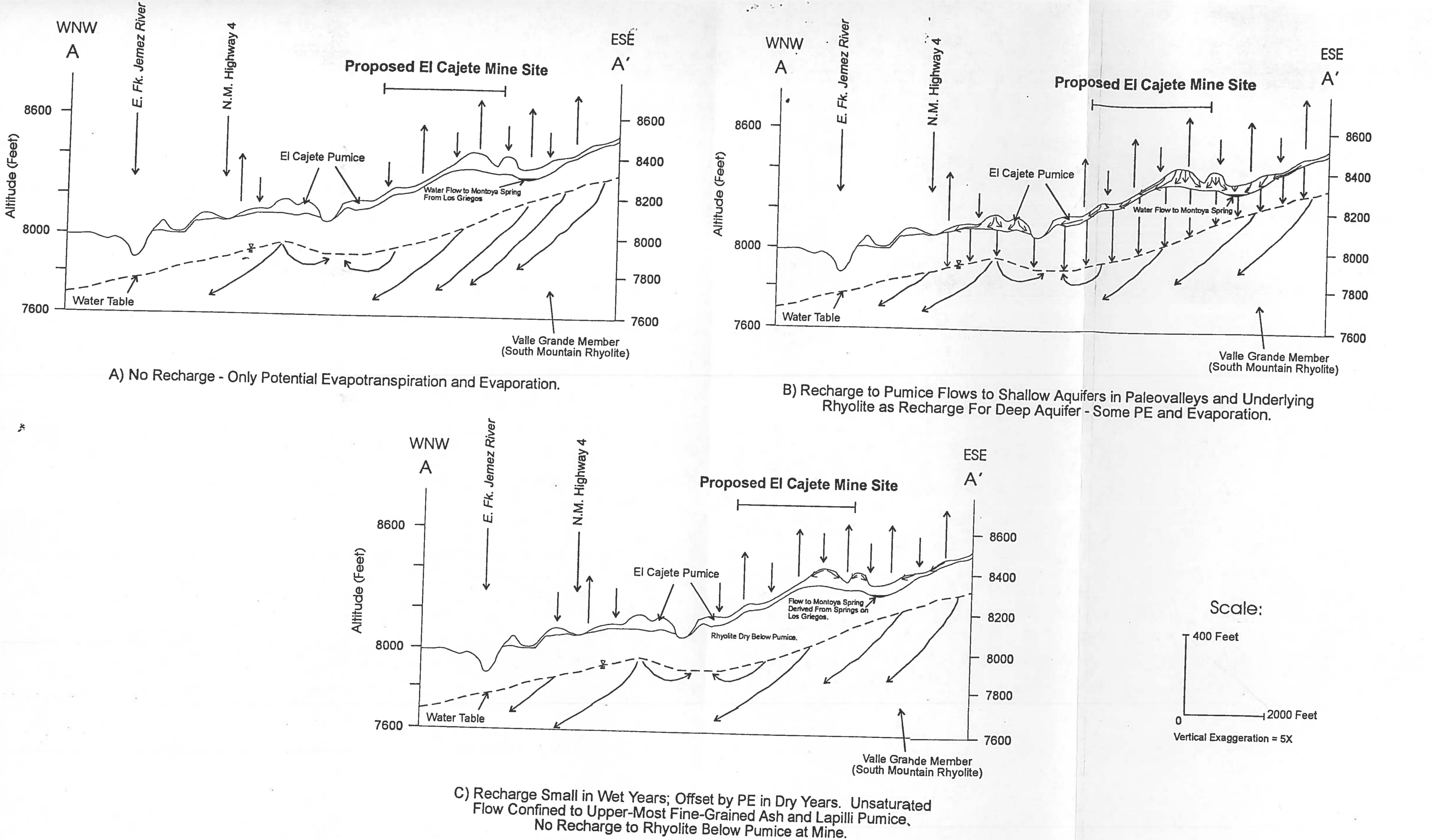
2) Recharge to pumice that flows downward and laterally by unsaturated flow. Part of the flow recharges the shallow aquifer and part recharges to the underlying rhyolite.

3) Some recharge to pumice most of which is used consumptively by the plants and returned to the atmosphere by potential evapotranspiration; remaining water held by capillary pressure in the pumice or discharged to atmosphere by evaporation. Insignificant flow to shallow aquifer; source of water for aquifer is primarily from springs on Los Griegos.

Conceptual model 1 says that all of the precipitation is used by plants or returned to the atmosphere; no moisture goes to the pumice at all (Figure 18a). Of course this does not fit the observed moisture in the pumice or the dampness of the underlying clay paleosol. There must be some sort of water flux to the pumice that is not evaporated or used consumptively by the plants.

Conceptual model 2 assumes little consumptive use or evaporation at the surface. Water from precipitation percolates down through the pumice by unsaturated flow. Part of that flow discharges to the shallow aquifer and then to Montoya Spring while part goes to recharge of the underlying rhyolite (Figure 18b). This model also assumes a large precipitation rate (>potential evapotranspiration), little or no surface runoff and that pumice does not hold water by capillary pressure. This model suggests that the pumice will be much wetter than observed. Also, there would be more moisture on, in and below the clay than observed during drilling; drill cuttings from the rhyolite were dry. It also assumes no outside sources other than recharge from the pumice for the source of the water in the shallow water table (i.e. no contribution to flow from springs on Los Griegos).

Conceptual model 3 assumes some small recharge flux during snow melt in the spring and more during very wet years; part goes to consumptive use and evaporation and part goes to the pumice. Any water flows are confined to the upper unsaturated fine-grained pumice; the coarse pumice absorbs and retains water by capillary pressure in the spinifex glass in each fragment. Any flow through the coarse pumice is probably insignificant (Figure 18c). This model assumes that any water flux reaching the shallow aquifer is very small to insignificant (depending on excess or shortage of precipitation for extended periods of time). Thus, most of the water in the shallow aquifer must



A) No Recharge - Only Potential Evapotranspiration and Evaporation.

B) Recharge to Pumice Flows to Shallow Aquifers in Paleovalleys and Underlying Rhyolite as Recharge For Deep Aquifer - Some PE and Evaporation.

C) Recharge Small in Wet Years; Offset by PE in Dry Years. Unsaturated Flow Confined to Upper-Most Fine-Grained Ash and Lapilli Pumice. No Recharge to Rhyolite Below Pumice at Mine.

Figure 18 -- Conceptual Hydrogeologic Cross Sections Through the Proposed El Cajete Pumice Mine Location, Sandoval County, New Mexico.

come from outside sources such as springs on Los Griegos or, possibly, springs issuing from the rhyolite in the valley floor south of the proposed mine. For the proposed mine location, drill hole DH9-3C is most significant in that it was drilled on the flank of the buried paleovalley penetrated by DH9-2C. No significant moisture was encountered other than dampness in the pumice, clay was present on the rhyolite, a small plug of the underlying rhyolite was dry to the touch and there was no water flow present above the nearby valley. This model is consistent with drilling data in and around the proposed mine location and precipitation-potential evapotranspiration data for the East Fork drainage basin.

Finally, what happens to the outflow from Montoya Springs? During the summer of 1994, I followed the flow down stream from the spring. The stream flows across bedrock and disappeared about 1/3 of a mile downstream after its flow rate steadily decreasing. Water loss is probably due partly to infiltration into joints in the bedrock and partly to consumptive use by plants surrounding the stream. Thus, it seems that some of the discharge from the springs goes either to runoff, consumptive use (including evaporation of the water directly to the atmosphere) or recharge of the underlying rhyolite aquifer. This recharge may account for some small amount of the stable isotope mixing described above but this is not conclusive.

SUMMARY AND CONCLUSIONS

Based on the available data, I conclude:

1) There are two aquifers in the region around the proposed mine location: one shallow and one deep. The shallow aquifer occurs in the base of the El Cajete pumice, is highly localized and is confined to paleovalleys on the Valle Grande Member of the Valles Rhyolite. The deep aquifer is in the Valle Grande Member, is 200 to 300 feet below the land surface and supplies water to the Sierra Los Piños subdivision south of the proposed mine location.

2) Water level and water chemistry data from wells in the area of the mine suggest that the mine and the nearby subdivision are situated in the recharge area for the deep rhyolite aquifer.

3) Pumping test and fracture-lineament analyses suggest that water flow in the deep aquifer is probably controlled by fractures in the rhyolite. Field observations indicate that these fractures do not penetrate the overlying clay paleosol or pumice. Water flow in the deep aquifer is generally downward and toward the southwest along those fracture sets. The pumping tests also show that hydraulic conductivity varies widely in the rhyolite and that the variation is most likely due to concentrations of fractures that cross the region.

4) Precipitation, potential evapotranspiration, and stable isotope data suggests that the recharge of the deep aquifer occurs primarily at altitudes above the proposed mine location, that the water flowing through the deep aquifer is at least 30 years old and that the water did not originate at or in the immediate vicinity of the proposed mine.

5) The pumice is highly heterogeneous and there is apparently a very small to insignificant water flux through the fine-grained portions of the pumice; the coarse pumice probably

contributes little or no flow because of apparent significant capillary pressure associated with the spinifex glass in the pumice. Any water flux to the underlying rhyolite is inhibited by the presence of the clay paleosol at the base of the pumice.

6) Water in the shallow aquifer is most likely derived from sources other than the pumice, possibly from springs on the north-facing flank of Los Griegos or buried springs in the floor of the valley south of the mine.

7) It is unlikely that the proposed pumice mine will have any adverse effects on the recharge of either the deep or shallow aquifers provided environmentally conscientious and, prudent mining and reclamation practices are followed.

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APPENDIX 1

Summary Of Drilling And Well Construction With Well Completion Reports From The New Mexico State Engineers Office.

APPENDIX I
Summary of Drilling and Well Construction With Well Completion Records From Vallecitos de los Indios

Introduction-

During the summer and fall of 1994, a 2 phase drilling program was carried out on Claims 9, 10, 11 and 12. The first phase involved drilling a series of auger holes to determine variations in pumice thickness, to map the presence (or absence) of an old clay soil horizon at the pumice/rhyolite contact and to check for presence of free water in the pumice in the area of the proposed mine. The second phase involved drilling, logging and completion of 3 ground water monitoring wells along the margins of the proposed mine site. These wells were subsequently sampled for water quality (see report in Appendix 2).

Logs for each hole are listed following each section (i.e. Hollow-Stem Auger Holes and Monitoring Wells.) Colors listed were determined by comparing samples with the color chips in the Geological Society of America's Rock Color Chart. Pumice grain size was determined from visual inspection of cores and cuttings and follows this classification scheme: Ash- 0.0625 mm up to 2 mm; Lapilli- >2 mm to 19 mm; and Block Pumice- >19 mm. Pumice names are based on predominance of one grain size over all others. Completion reports from wells outside the proposed mine area that I used for water level and geologic data in the report follow the section on Monitoring Wells.

Hollow-Stem Auger Holes-

During the August 1994, a series of hollow-stem auger test holes were drilled in the proposed mine location by North American Environmental and Exploration Drilling Company with a truck-mounted drill rig (Figure I-1). Samples were collected with a 5-foot split-barrel continuous sampler (Figure I-2) from inside the hollow-stem auger. Several holes were cased with Schedule 40 black PVC pipe for future soil moisture profile research. These holes are designated with The logs from these holes presented below. Locations are shown on Plate 1 that accompanies this appendix and in Figures 4 and 13 in thc main body of thc report.

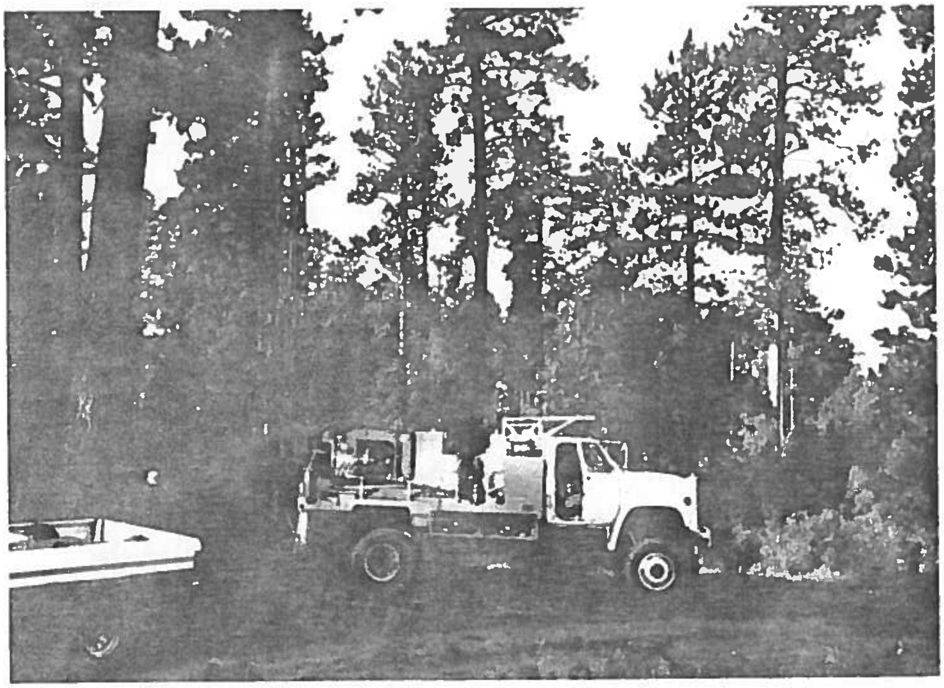

Figure I-1 -- Truck-Mounted Auger Drilling Rig at DH10-2C, Proposed El Cajete Pumice Mine.

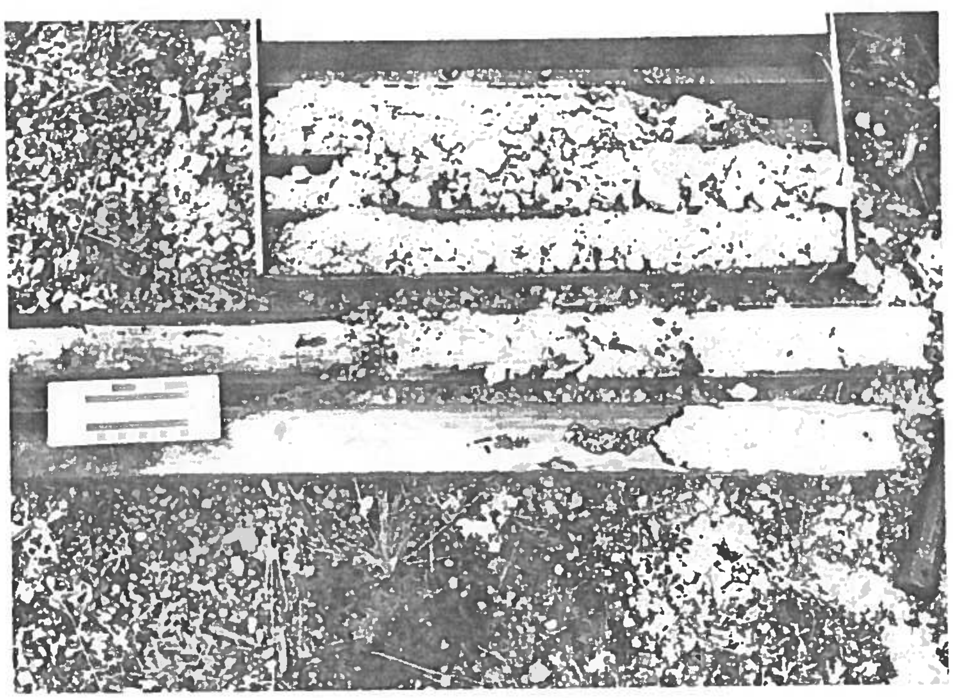

Figure I-2 -- Core Sample in Hollow-Stem Auger Split Barrel Continuous Sampler, Proposed El Cajete Pumice Mine. Scale Bar is 4 Inches Long.

Drill Hole DH9-2C
Lithologic Log

Depth (Feet)	Description
0.0 to 0.5:	TOP SOIL: dark brown clay.
0.5 to 1.2:	LAPILLI: moderate dark brown with some clay.
1.2 to 4.5:	SAND: pale brown to light brownish gray with block pumice.
4.5 to 7.6:	LAPILLI: grayish orange pink banded light to moderate brown, compacted and crushed.
7.6 to 9.6:	BLOCK PUMICE: grayish orange pink banded light brown.
9.6 to 12.6:	LAPILLI: grayish orange pink banded light brown.
12.6 to 13.2:	BLOCK PUMICE: grayish orange pink banded light brown, compressed.
13.2 to 15.2:	ASH: grayish red to pale brown, medium to very coarse grained.
15.2 to 15.9:	BLOCK PUMICE: grayish orange pink.
15.9 to 21.5:	LAPILLI: grayish red with medium to very coarse ash at the top.
21.5 to 27.6:	BLOCK PUMICE: very light gray mottled light brown yellowish gray and grayish orange pink, fragments up to 3 inches.
27.6 to 29.1:	LAPILLI: grayish orange pink with ash and lithic fragments.
29.1 to 29.2:	BLOCK PUMICE: very light gray to light brown, clayey.
29.2 to 37.6:	NO SAMPLE: drive sampler shows interbedded weathered pumice clay and lithic fragments.
37.6 to 39.6:	BLOCK PUMICE: light brown, wet, soupy.
40.0 to 42.6:	NO SAMPLE
42.6 to 47.6:	LAPILLI: very light gray to yellowish gray ash to block pumice-sized fragments. Free water with water level at 42.6' below ground level.
47.6 to 50.6:	ASH: light brownish gray, medium to very coarse grained.

DH9-2C Lithologic Log - Continued

Depth (Feet)	Description
50.6 to 51.6:	LAPILLI: (?) light brownish gray.
51.6 to 53.3:	CLAY: moderate brown, slightly sandy. Wet on top but not below.
53.3 to 54.1:	SAND: grayish brown, medium to coarse grained, well sorted, probable weathered bedrock horizon.
54.1 to 77.6:	RHYOLITE: grayish brown ash-flow rhyolite tuff, moderately welded. Total Depth at 77.6 feet.

Drill Hole DH9-3C
Lithologic Log

Depth (Feet)	Description
0.0 to 0.6:	TOP SOIL: dark brown.
0.6 to 1.0:	SAND: pale yellowish brown with gravel.
1.0 to 4.3:	LAPILLI: light brown mottled very pale orange.
4.3 to 10.7:	LAPILLI: grayish orange pink to very light gray banded light brown.
10.7 to 12.3:	ASH: grayish orange pink, medium to very coarse grained with fine lapilli.
12.3 to 20.7:	BLOCK PUMICE: very light gray with very pale orange discoloration.
20.7 to 21.1:	ASH: grayish orange pink mottled very light gray, medium to very coarse grained with fine lapilli.
21.1 to 21.7:	LAPILLI: very light gray.
21.7 to 21.9:	ASH: grayish orange pink, medium to very coarse grained.
21.9 to 26.9:	BLOCK PUMICE: very light gray, fragments to 2 inches.
26.9 to 31.9:	LAPILLI: very light gray, very crushed, probably block pumice.
31.9 to 35.9:	BLOCK PUMICE: very light gray with traces of very pale orange discoloration.
35.9 to 38.1:	ASH: grayish orange pink, medium to very coarse grained.
38.1 to 46.5:	BLOCK PUMICE: very light gray with very pale orange to moderate orange pink discoloration.
46.5 to 46.9:	ASH: pale yellowish brown.
46.9 to 51.3:	BLOCK PUMICE: very light gray with grayish orange pink discoloration.
51.3 to 86.9:	NO SAMPLE: probable clay layer from 80.1 to 80.9 feet confirmed by moderate brown sandy clay plug in end of auger. Probable ash-flow rhyolite tuff at 80.9 feet. Total Depth at 86.9 feet.

Drill Hole DH10-2C
Lithologic Log

Depth (Feet)	Description
0.0 to 0.4:	TOP SOIL: dark brown.
0.4 to 1.2:	CLAYEY SAND: pale yellowish brown with trace of lapilli.
1.2 to 3.2:	LAPILLI: moderate brown weathered.
3.2 to 10.6:	LAPILLI: very pale orange to light gray, banded & mottled light brown.
10.6 to 12.5:	LAPILLI: light gray banded light brown, very compacted.
12.5 to 14.4:	BLOCK PUMICE: light gray banded light brown.
14.4 to 14.6:	ASH: pale yellowish brown, medium to very coarse-grained.
14.6 to 25.8:	BLOCK PUMICE: very light gray with grayish orange & light brown bands with 0.3 feet spacing, very crushed & compressed.
25.8 to 26.0:	ASH: pale yellowish brown, medium to very coarse grained.
26.0 to 32.5:	BLOCK PUMICE: light gray with grayish orange bands.
32.5 to 41.6:	BLOCK PUMICE: light gray.
41.6 to 41.8:	ASH: pale reddish brown, medium to very coarse grained with a trace of lapilli.
41.8 to 42.5:	LAPILLI: very light gray mottled grayish red.
42.5 to 49.5:	BLOCK PUMICE: very light gray.
49.5 to 50.3:	LAPILLI: light brownish gray to grayish red.
50.3 to 50.5:	CLAYEY SAND: light brown with large lithic fragment (2.5").
50.5 to 51.3:	LAPILLI: grayish red.
51.3 to 55.0:	NO SAMPLE: Completed in ash-flow rhyolite tuff. Moderate brown clay layer present on tuff. Total Depth at 55.0 feet

Drill Hole DH10-3
Lithologic Log

Depth (Feet)	Description
0.0 to 0.2:	TOP SOIL: dark brown sandy clay.
0.2 to 1.9:	CLAYEY SAND: dark yellowish brown.
1.9 to 6.4:	LAPILLI: moderate yellowish brown to very pale orange.
6.4 to 7.2:	ASH: grayish orange pink with 10% lapilli, medium to very coarse grained.
7.2 to 8.1:	LAPILLI: grayish orange pink to very pale orange with light brown sandy clay on top.
8.1 to 8.8:	ASH: pinkish gray fine to coarse grained.
8.8 to 12.5:	LAPILLI: very light gray with very pale orange.
12.5 to 13.2:	ASH: grayish orange pink with lapilli.
13.2 to 17.8:	LAPILLI: very light gray to grayish orange pink.
17.8 to 32.8:	BLOCK PUMICE: light gray with moderate orange pink discoloration, crushed with lapilli and ash interbeds.
32.8 to 37.8:	LAPILLI: very light gray.
37.8 to 45.1:	BLOCK PUMICE: very light gray, pumice crushed and reduced in size, fragments to 2 inches.
45.1 to 49.9:	LAPILLI: grayish orange pink to moderate reddish orange mottled very light gray.
49.9 to 55.8:	BLOCK PUMICE: very light gray with very pale orange discoloration, lithic fragment zone at base.
55.8 to 57.8:	NO SAMPLE: probably block pumice.
57.8 to 67.8:	LAPILLI: grayish orange pink mottled very light gray.

DH10-3 Lithologic Log - Continued

Depth (Feet)	Description
67.8 to 81.5:	BLOCK PUMICE: very light gray with grayish orange pink discoloration, fragments to 5 inches.
81.5 to 82.8:	ASH: grayish orange pink mottled very light gray, medium to very coarse grained.
82.8 to 86.3:	CLAYEY SAND: grayish orange to moderate brown, medium to fine grained, compact with a thin interbed of sandy clay.
86.3 to 86.7:	RHYOLITE: moderate brown weathered and punky.
86.7 to 87.8:	RHYOLITE: grayish orange pink to pale yellowish orange slightly to moderately welded. Total Depth at 87.8 Feet.

Drill Hole DH10-4
Lithologic Log

Depth (Feet)	Description
0.0 to 0.6:	TOP SOIL: dark brown to brownish black.
0.6 to 1.2:	SANDY CLAY: moderate brown with some pumice pebbles.
1.2 to 2.4:	LAPILLI: moderate to dark yellowish brown, interbedded with pale yellowish brown ash.
2.4 to 2.9:	ASH: pale yellowish brown.
2.9 to 7.7:	LAPILLI: dark yellowish brown to pinkish gray, clayey at top.
7.7 to 8.3:	ASH: grayish orange pink mottled very light gray, medium to very coarse grained.
8.3 to 9.8:	LAPILLI: grayish orange pink.
9.8 to 11.8:	ASH: grayish orange pink mottled very light gray.
11.8 to 17.9:	LAPILLI: very light gray with traces of light brown at the top.
17.9 to 22.9:	BLOCK PUMICE: light gray with grayish orange discoloration.
22.9 to 23.4:	LAPILLI: very light gray.
23.4 to 24.0:	ASH: grayish orange pink, medium to very coarse grained.
24.0 to 25.9:	BLOCK PUMICE: very light gray.
25.9 to 27.9:	LAPILLI: very light gray crushed.
27.9 to 41.3:	BLOCK PUMICE: very light gray with very pale orange discoloration.
41.3 to 42.9:	LAPILLI: grayish orange pink mottled very light gray.
42.9 to 47.9:	BLOCK PUMICE: very light gray very crushed and compressed.
47.9 to 48.8:	ASH: numerous lithic fragments.
48.8 to 51.7:	LAPILLI: very light gray numerous lithic fragments.

DH10-4 Lithologic Log - Continued

Depth (Feet)	Description
51.7 to 52.9:	NO SAMPLE: bit refusing on lithic fragments.
52.9 to 54.9:	ASH: grayish orange pink to light brown, medium to very coarse grained.
54.9 to 55.2:	LAPILLI: grayish orange pink.
55.2 to 55.5:	BLOCK PUMICE: grayish orange pink with very light gray fragments up to 2.25 inches.
55.5 to 56.6:	ASH: light brown to grayish orange pink mottled light gray medium to very coarse grained.
56.6 to 57.9:	LAPILLI: very light gray, crushed.
57.9 to 60.2:	BLOCK PUMICE: very light gray, crushed.
60.2 to 67.9:	LAPILLI: very light gray, crushed, probably crushed block pumice fragments up to 2 inches.
67.9 to 68.9:	BLOCK PUMICE: very light gray.
68.9 to 75.8:	NO SAMPLE: Completed in slightly welded ash-flow rhyolite tuff; no clay present. Total Depth at 68.9 feet

Drill Hole DH11-2
Lithologic Log

Depth (Feet)	Description
0.0 to 1.1:	TOP SOIL: dusky brown mottled moderate brown with 5% block pumice.
1.1 to 1.9:	CLAYEY SAND: pale yellowish brown, with lapilli & ash.
1.9 to 6.6:	LAPILLI: pale yellowish brown to pinkish gray.
6.6 to 10.8:	ASH: pinkish gray with light brown mottling.
10.8 to 12.4:	LAPILLI: pinkish gray with medium to very coarse-grained ash.
12.4 to 13.9:	BLOCK PUMICE: pinkish gray.
13.9 to 14.9:	ASH: light brown with lapilli.
14.9 to 30.3:	BLOCK PUMICE: very light gray, very crushed & compressed.
30.3 to 31.7:	ASH: light brown.
31.7 to 32.4:	BLOCK PUMICE: very light gray, solid piece of pumice.
32.4 to 37.4:	LAPILLI: very light gray to very pale yellowish brown, probable block pumice with ash.
37.4 to 48.2:	BLOCK PUMICE: very light gray.
48.2 to 50.3:	LAPILLI: light brownish gray.
50.3 to 57.4:	BLOCK PUMICE: very light gray with grayish orange pink zoning and significant crushing.
57.4 to 60.1:	LAPILLI: very light gray with grayish orange pink. Very crushed.
60.1 to 61.2:	LAPILLI: light gray banded grayish orange pink, with numerous large vitrophyre lithic fragments. Total Depth in lithic fragments at 61.2 feet.

Drill Hole DH11-3C
Lithologic Log

Depth (Feet)	Description
0.0 to 1.3:	TOP SOIL: dark brown clayey sand.
1.3 to 2.1:	LAPILLI: pale brown with ash, weathered.
2.1 to 6.7:	LAPILLI: grayish orange pink to very light gray.
6.7 to 6.9:	LAPILLI: light gray banded light brown, very compacted.
6.9 to 7.5:	LAPILLI: grayish orange pink, very crushed and compacted.
7.5 to 8.5:	ASH: pale yellowish brown, medium to very coarse-grained.
8.5 to 10.8:	BLOCK PUMICE: very light gray, very crushed, layer of lithic fragments at base.
10.8 to 12.5:	LAPILLI: very light gray.
12.5 to 23.2:	BLOCK PUMICE: light gray, crushed and packed into core barrel.
23.2 to 24.6:	ASH: grayish orange pink with lapilli.
24.6 to 27.5:	LAPILLI: very light gray with block pumice, very crushed and reduced in size.
27.5 to 41.2:	BLOCK PUMICE: very light gray, crushed and compacted.
41.2 to 42.5:	LAPILLI: very light gray to pale yellowish brown, crushed and compacted.
42.5 to 55.1:	BLOCK PUMICE: very light gray with pale red and grayish orange pink coloration.
55.1 to 55.4:	CLAYEY SAND: light green large lithic fragments at the base bit refused at 55.4 feet.
55.4 to 75.2:	NO SAMPLE: probably interbedded ash lapilli and block pumice with moderate brown clay at the base.
75.2 to 102.5:	NO SAMPLE: probably ash flow rhyolite tuff. Total Depth at 102.5 feet.

Drill Hole DH11-4
Lithologic Log

Depth (Feet)	Description
0.0 to 0.9:	TOP SOIL: dark brown sandy clay.
0.9 to 1.3:	CLAYEY SAND: light brown with lapilli pumice.
1.3 to 7.0:	LAPILLI: grayish orange pink to moderate yellowish brown banded light brown.
7.0 to 8.5:	ASH: grayish orange pink, medium to very coarse grained.
8.5 to 12.8:	LAPILLI: very light gray banded light brown.
12.8 to 13.9:	ASH: grayish orange pink medium to very coarse grained with large lithic fragments to 2.5 inches.
13.9 to 16.7:	LAPILLI: very light gray, crushed, probable block pumice.
16.7 to 26.2:	BLOCK PUMICE: very light gray with some very pale orange, very crushed with fragments up to 2.5 inches.
26.2 to 26.7:	ASH: pinkish gray mottled very light gray, very coarse grained with 40% lapilli pumice.
26.7 to 29.8:	BLOCK PUMICE: very light gray with some very pale orange.
29.8 to 31.7:	ASH: grayish orange pink, coarse to very coarse grained with fine lapilli.
31.7 to 36.7:	BLOCK PUMICE: very light gray, very crushed with fragments to 2.25 inches.
36.7 to 41.5:	LAPILLI: very light gray, very crushed and compacted.
41.5 to 41.7:	ASH: grayish orange pink mottled very light gray, coarse grained with fine lapilli.
41.7 to 45.8:	BLOCK PUMICE: very light gray with very pale orange discoloration, fragments to 3.25 inches.
45.8 to 46.7:	LAPILLI: (?) very light gray with pale yellowish orange discoloration, very crushed , probable block pumice.

DH11-4 Lithologic Log - Continued

Depth (Feet)	Description
46.7 to 47.5:	BLOCK PUMICE: very light gray mottled light brown, crushed with fragments to 2.25 inches.
47.5 to 51.7:	ASH: grayish orange pink mottled very light gray, with ash.
51.7 to 56.5:	BLOCK PUMICE: very light gray.
56.5 to 68.0:	LAPILLI: very light gray to very pale orange with light brown bands interlaminated with coarse to very coarse ash.
68.0 to 71.7:	BLOCK PUMICE: very light gray, crushed.
71.7 to 77.7:	LAPILLI: very light gray, very crushed.
77.7 to 77.8:	RHYOLITE: pinkish gray unwelded ash flow rhyolite tuff, no clay present. Total Depth at 77.8 feet.

Drill Hole DH12-2C
Lithologic Log

Depth (Feet)	Description
0.0 to 1.7:	TOP SOIL: dusky brown to dark brown, sandy clay with lapilli.
1.7 to 4.5:	LAPILLI: light brown with slightly clayey to clayey sand.
4.5 to 6.8:	CLAYEY SAND: dark yellowish brown.
6.8 to 9.5:	LAPILLI: dark yellowish brown.
9.5 to 11.0:	LAPILLI: yellowish gray mottled light brown.
11.0 to 18.7:	BLOCK PUMICE: yellowish gray to very light gray with light brown bands & fragments up to 3 inches. Very crushed.
18.7 to 22.6:	LAPILLI: very light gray to grayish orange pink banded light to moderate brown.
22.6 to 23.1:	BLOCK PUMICE: very light gray, fragments up to 2 inches.
23.1 to 23.3:	ASH: light brown with lapilli.
23.3 to 23.4:	LAPILLI: very light gray.
23.4 to 23.6:	CLAYEY SAND: moderate yellowish brown with weathered pumice. Damp to wet. Bit refused on lithic fragments. Total Depth at 23.6 feet.

Drill Hole DH12-3C
Lithologic Log

Depth (Feet)	Description
0.0 to 1.1:	TOP SOIL: dark brown sandy clay with 20% lapilli.
1.1 to 7.0:	SAND: pale yellowish brown, slightly clayey with 10-20% lapilli pumice & lithic fragments.
7.0 to 7.9:	LAPILLI: very light gray.
7.9 to 9.8:	BLOCK PUMICE: yellowish gray.
9.8 to 11.0:	LAPILLI: pale yellowish brown.
11.0 to 12.9:	BLOCK PUMICE: light yellowish gray with light brown bands.
12.9 to 26.3:	LAPILLI: very light gray, banded and mottled light brown.
26.3 to 26.7:	LAPILLI: grayish orange pink with coarse to very coarse ash.
26.7 to 27.9:	LAPILLI: very light gray mottled light brown.
27.9 to 32.9:	BLOCK PUMICE: very light gray banded & mottled light brown, very crushed.
32.9 to 37.9:	LAPILLI: very light gray banded light brown.
37.9 to 41.3:	BLOCK PUMICE: very light gray with traces of light brown mottling.
41.3 to 42.9:	LAPILLI: very light gray with light brown.
42.9 to 46.6:	BLOCK PUMICE: very light gray with grayish orange pink discoloration.
46.6 to 50.0:	LAPILLI: grayish orange pink with very light gray.
50.0 to 50.7:	LAPILLI: moderate brown, clayey, weathered old soil horizon?
50.7 to 53.7:	LAPILLI: very light gray to grayish orange pink.
53.7 to 53.9:	ASH: light brownish gray to brownish gray with lithic fragments.
53.9 to 54.7:	LAPILLI: light brownish gray.

DH12-3C Lithologic Log - Continued

Depth (Feet)	Description
54.7 to 55.1:	CLAY: moderate brown silty.
55.1 to 55.4:	LAPILLI: light brownish gray.
55.4 to 57.9:	SANDY CLAY: moderate brown; top of bedrock at 57.9 feet.
57.9 to 77.9:	NO SAMPLE: probably ash-flow rhyolite tuff. Total Depth at 77.9 feet.

Drill Hole DH14-1
Lithologic Log

Depth (Feet)	Description
0.0 to 1.0:	TOP SOIL: dark brown.
1.0 to 4.9:	ASH: light brown to light gray, medium to very coarse-grained.
4.9 to 5.3:	LAPILLI: light to pale brown.
5.3 to 8.8:	ASH: light gray with light brown bands, medium to very coarse-grained.
8.8 to 11.9:	LAPILLI: light gray.
11.9 to 13.3:	ASH: light gray, medium to very coarse-grained.
13.3 to 40.0:	BLOCK PUMICE: light gray.
40.0 to 44.9:	ASH: light gray, medium to very coarse-grained.
44.9 to 45.4:	LAPILLI: light gray with very coarse ash.
45.4 to 47.1:	ASH: light gray brown, very coarse.
47.1 to 53.3:	CLAY: brown, sandy, plastic.
53.3 to 54.5:	RHYOLITE: light brownish gray. Total Depth at 54.5 feet.

Drill Hole DH15-1
Lithologic Log

Depth (Feet)	Description
0.0 to 0.9:	TOP SOIL: dark brown.
0.9 to 5.3:	ASH: moderate to light brown and light gray, medium to coarse ash.
5.3 to 8.2:	BLOCK PUMICE: brownish gray to light gray.
8.2 to 9.4:	LAPILLI: very light brown, very coarse-grained.
9.4 to 13.2:	ASH: grayish pink, medium to very coarse.
13.2 to 34.1:	BLOCK PUMICE: light gray with lapilli.
34.1 to 36.4:	ASH: light gray, pale brown and light brownish gray, very coarse.
36.4 to 38.2:	LAPILLI: light gray, pale brown and light brownish gray.
38.2 to 39.6:	ASH: light brownish gray, medium to very coarse-grained.
39.6 to 39.8:	SANDY CLAY: brown, plastic.
39.8 to 40.5:	RHYOLITE: light gray to yellowish gray, tuff slightly welded with pumice fragments. Total Depth at 40.5 Feet.

Drill Hole DH25-1
Lithologic Log

Depth (Feet)	Description
0.0 to 0.7:	TOP SOIL: dark brown, clayey with 40% pumice.
0.7 to 5.8:	LAPILLI: very pale orange banded light brown.
5.8 to 6.5:	BLOCK PUMICE: very pale orange banded light brown.
6.5 to 7.0:	ASH: pale yellowish brown, medium to very coarse.
7.0 to 10.0:	LAPILLI: very pale orange banded light brown.
10.0 to 15.4:	ASH: grayish orange pink banded light brown, medium to very coarse-grained.
15.4 to 40.4:	BLOCK PUMICE: light gray.
40.4 to 40.7:	ASH: moderate yellowish brown, medium to very coarse-grained.
40.7 to 42.5:	BLOCK PUMICE: light gray with light brown bands, spinifex glass.
42.5 to 46.8:	ASH: grayish orange pink to light brown, medium to very coarse-grained.
46.8 to 47.9:	LAPILLI: white to pinkish gray with medium to very coarse ash.
47.9 to 48.4:	ASH: pale yellowish brown, medium to very coarse.
48.4 to 53.8:	CLAY: brown to moderate brown, sandy at 49.7 to 53.8 feet.
53.8 to 53.9:	RHYOLITE: moderate brown, very welded. Total Depth at 53.9 feet.

Drill Hole DH26-1
Lithologic Road

Depth (Feet)	Description
0.0 to 0.5:	TOP SOIL: moderate to grayish brown.
0.5 to 1.9:	CLAYEY SAND: moderate brown with lapilli.
1.9 to 3.6:	LAPILLI: light to moderate brown.
3.6 to 7.9:	BLOCK PUMICE: grayish orange pink with light brown banding.
7.9 to 8.6:	ASH: grayish orange pink banded light brown, medium to very coarse.
8.6 to 13.2:	LAPILLI: very light gray banded light brown.
13.2 to 26.3:	BLOCK PUMICE: very light gray.
26.3 to 28.2:	ASH: moderate yellowish brown banded light brown with white lapilli, medium to very coarse-grained.
28.2 to 28.6:	BLOCK PUMICE: very light gray to moderate yellowish brown with light brown bands.
28.6 to 29.3:	ASH: moderate yellowish brown to very light gray, medium to very coarse.
29.3 to 37.5:	CLAY: brown to moderate brown, slightly silty & sandy root casts, large pumice fragments near base.
37.5 to 38.2:	RHYOLITE: light brown, rotten. Total Depth at 38.2 feet.

Drill Hole DH28-1
Lithologic Log

Depth (Feet)	Description
0.0 to 0.5:	TOP SOIL: dark brown.
0.5 to 5.9:	LAPILLI: light gray mottled light brown.
5.9 to 13.8:	BLOCK PUMICE: light gray.
13.8 to 14.3:	SANDY CLAY: brown plastic with roots molds.
14.3 to 31.5:	RHYOLITE: light gray to light brownish gray unwelded spinifex glass with small crystals.
31.5 to 31.7:	LAPILLI: light brownish gray, soft.
31.7 to 36.0:	RHYOLITE: light gray to light brown, unwelded, spinifex glass. Total Depth at 36.0 feet.

Drill Hole DH29-1
Lithologic Log

Depth (Feet)	Description
0.0 to 1.2:	TOP SOIL: dark brown.
1.2 to 3.0:	LAPILLI: light gray mottled light brown.
3.0 to 6.6:	BLOCK PUMICE: light gray streaked light brown.
6.6 to 7.2:	LAPILLI: light reddish gray with medium to very coarse-grained ash.
7.2 to 7.6:	SANDY CLAY: brown, plastic.
7.6 to 21.1:	RHYOLITE: light gray with light reddish brown to light brown streaks.
21.1 to 21.7:	LAPILLI: pinkish gray mottled moderate reddish brown.
21.7 to 28.0:	RHYOLITE: light gray, flow banded, unwelded, punky. Total Depth at 28.0 feet.

Monitoring Wells-

Three ground-water monitoring wells were drilled on the margin of the proposed mine location by North American Environmental and Exploration Co. of Phoenix, Arizona using a Schramm Roto-Drill with a pneumatic casing driver (Figure I-3). Each hole was drilled with air-rotary tools; no additives or mist were used to improve hole cleaning. A sheet of enviro-plastic sheeting was placed under the rig to prevent contamination of the ground near the well, the well itself ,or the samples by leaking hydraulic fluid, diesel or motor oil. Air was provided by the rig compressor and two auxiliary compressors. When first moisture was encountered in the samples, the hole was deepened at least 20 feet. Water presence was indicated by back pressure within the drill pipe at the time a connection was made. Samples were collected through a sample cyclone attached to the blewy line (Figure I-4); samples passed uphole to a "T" at the top of the drive casing, then up the blewy line to the cyclone, then out the bottom of the cyclone where the cuttings accumulated on a sheet of enviro-plastic. The samples were then placed in plastic sacks labeled for well name and footage depth. Descriptions of the cuttings are summarized below.

Drilling of Monitoring Well #1 started September 14, 1994 and was completed September 15 at a total depth of 296 feet. The well was cased with 280 feet of 4 inch I.D. Schedule 40 PVC blank pipe with threaded couplings, 10 feet of mill-slotted Schedule 40 PVC pipe (6 rows of horizontal slots with 8 slots/inch and a 9.54 foot slotted interval), a 0.35 foot casing shoe, and a threaded cap. The pipe was set with 2 centralizers and then sand packed with 8 sacks of 10-20 Colorado Silica Sand (10-20 = passed through 10 screen and retained by 20 screen). Four sacks of bentonite chips were poured on top of the sand packing and allowed to hydrate. The well was then grouted with 9 to 9.5 pound per gallon (ppg) bentonite grout (water is 8.4 ppg) to about 5 feet below the surface. Neat cement was poured on top of the bentonite grout to fill the well to the surface for a sanitary seal. A square steel well head protector with a locking cap was then slipped over the PVC protruding above the ground and was pushed down into the wet cement to protect the well from vandalism. Afterward, the well was locked. Figure I-5 summarizes the completion.

Drilling of Monitoring Well #2 started September 17, 1994 and was completed September 27 at a total depth of 379.4 feet. The well was cased with 375 feet of 4 inch I.D. Schedule 40 PVC blank pipe with threaded couplings, 10 feet of mill-slotted Schedule 40 PVC pipe (6 rows of horizontal slots with 8 slots/inch and a 9.54 foot slotted interval), a 0.7 foot casing shoe, and a slip-on cap. The pipe was set with 3 centralizers and then sand packed with 10 sacks of 10-20 Colorado Silica Sand (10-20 = passed through 10 screen and retained by 20 screen). Five sacks of bentonite chips were poured on top of the sand packing and allowed to hydrate. The well was then grouted with 9 to 9.5 pound per gallon (ppg) bentonite grout (water is 8.4 ppg) from the top of the bentonite chips to about 5 feet below the ground surface. Neat cement was poured on top of the bentonite grout to fill the well to the surface for a sanitary seal. A square steel well

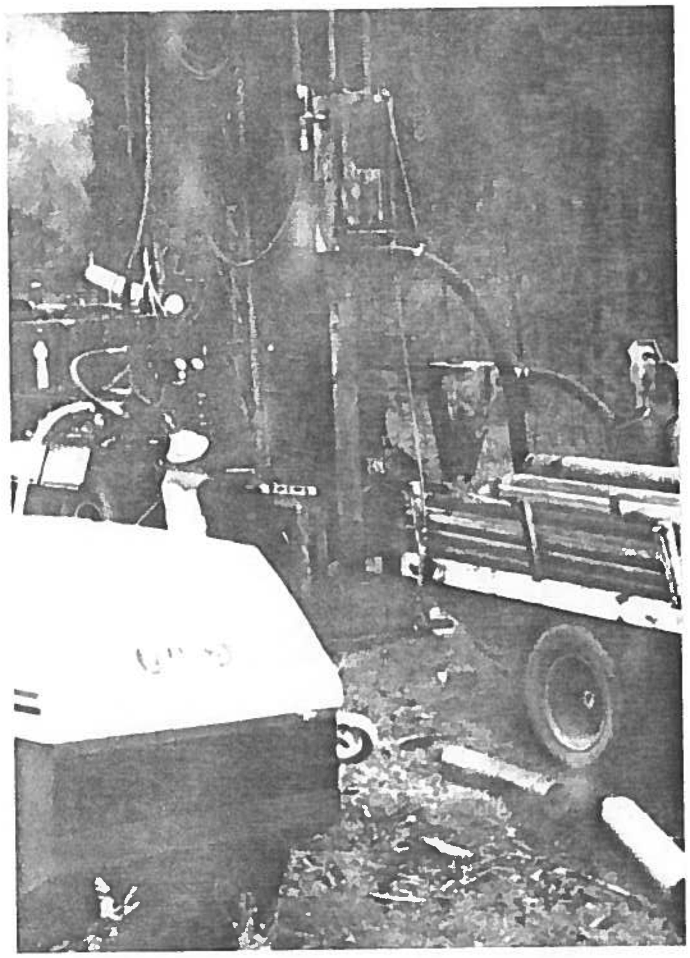

Figure I-3 – Truck-Mounted Schramm Roto-Drill With Casing Banger (Red Box Above Large Hose) With Drive Casing Attached At Monitoring Well #1.

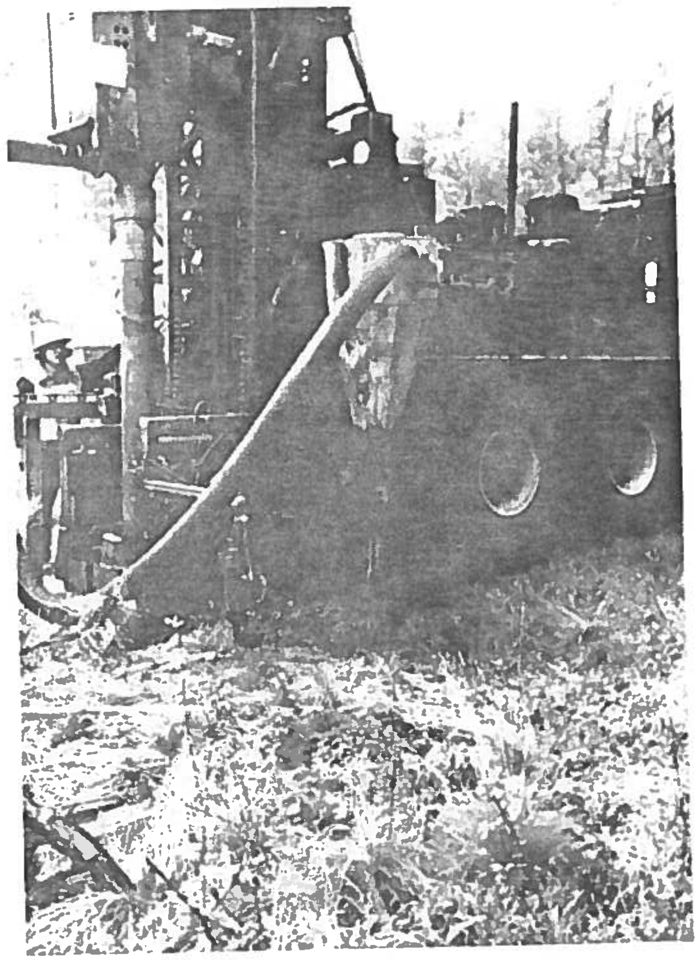

Figure I-4 – Sample Cyclone (Cone-Shaped Device With Large Hose Attached with Soil Falling From Bottom End.

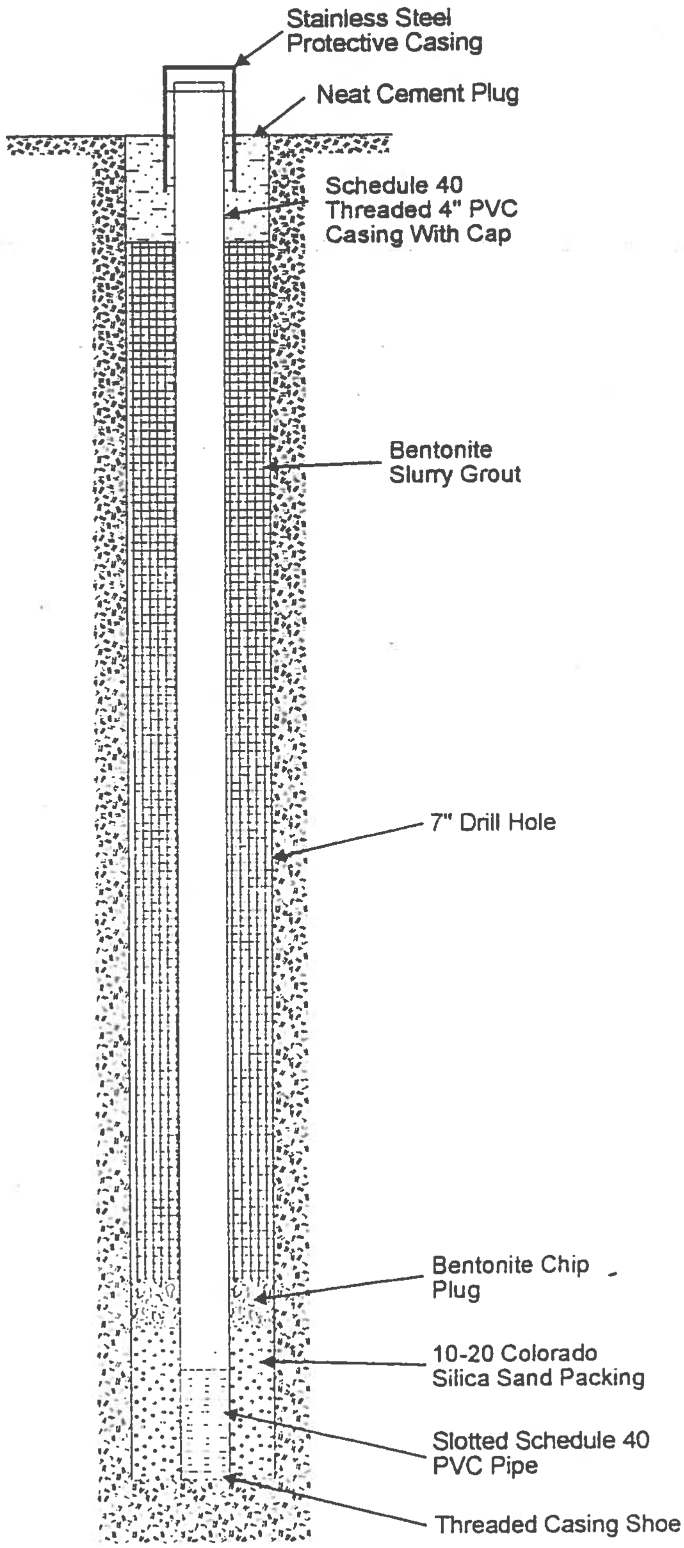

Figure I-5 -- Summary As-Built Diagram For Monitoring Wells #1 and #2, Proposed El Cajete Pumice Mine, Sandoval County, New Mexico.

head protector with a locking cap was then slipped over the PVC protruding above the ground and was pushed down into the wet cement to protect the well from vandalism. Afterward, the well was locked. Figure I-5 summarizes the completion.

Drilling of Monitoring Well #3 started September 29, 1994 and was completed October 1, 1994 at a total depth of 150 feet. The well was cased with 280 feet of 4 inch I.D. Schedule 40 PVC blank pipe with threaded couplings, 10 feet of mill-slotted Schedule 40 PVC pipe (6 rows of horizontal slots with 8 slots/inch and a 9.54 foot slotted interval) and a 0.7 foot casing shoe. The pipe was set with 2 centralizers and then sand packed with 10 sacks of 10-20 Colorado Silica Sand (10-20 = passed through 10 screen and retained by 20 screen). Three sacks of bentonite chips were poured on top of the sand packing and allowed to hydrate. The well was then grouted with 9 to 9.5 pound per gallon (ppg) bentonite grout (water is 8.4 ppg) to about 5 feet below the surface. Neat cement was poured on top of the bentonite grout to fill the well nearly to the surface for a sanitary seal. The casing was cut off slightly below the ground level and bolted protective head with a locking expansion plug was then slipped over the PVC. The protective head was pushed down into the wet cement and then additional cement was poured around the head to form the sanitary seal; the well is completed as a ground level completion to protect the well from vandalism and future emergency forest-fire fighting traffic. Afterward, the expansion plug was locked and the lid was bolted in place. Figure I-6 summarizes the completion.

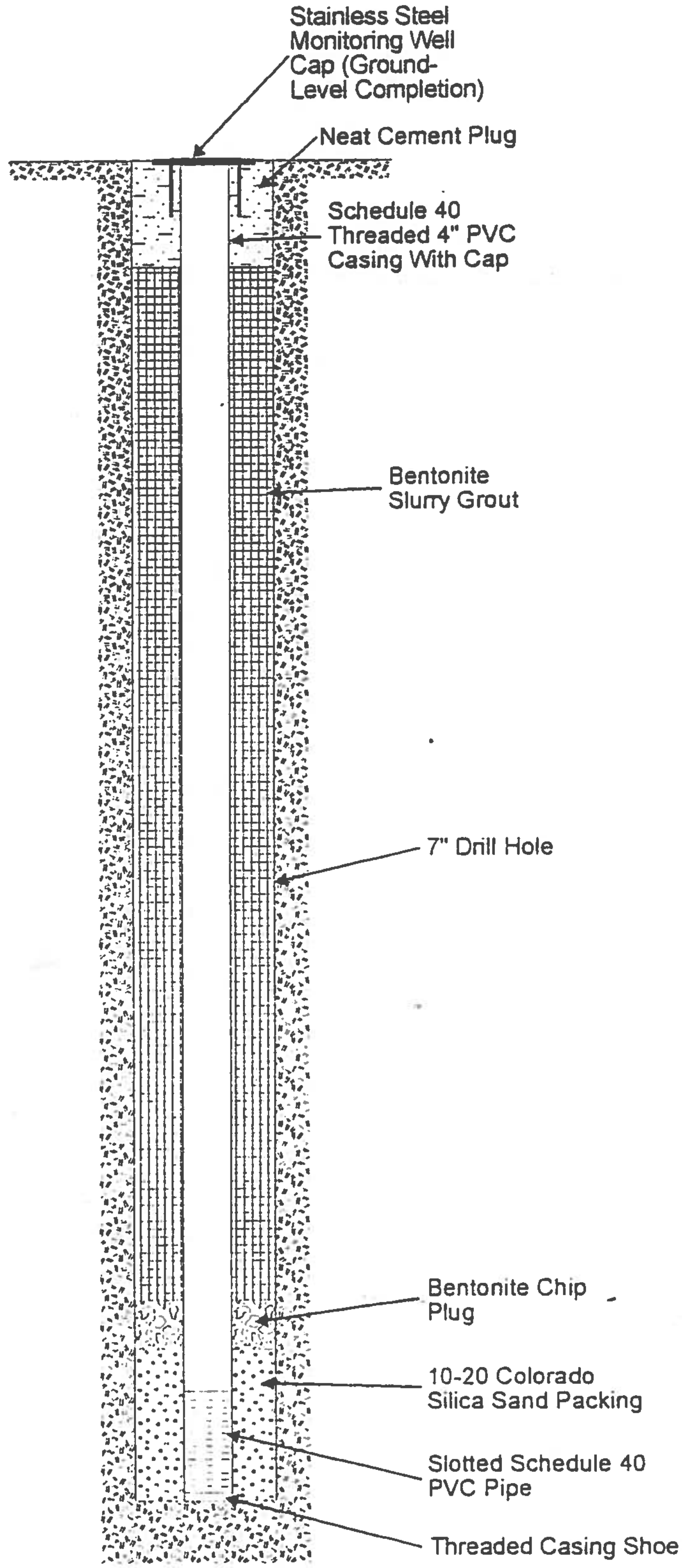

Figure I-6 -- Summary As-Built Diagram For Monitoring Well #3, Proposed El Cajete Pumice Mine, Sandoval County, New Mexico.

Monitoring Well #1
Lithologic Log

Depth (Feet)	Description
0.0 to 0.6	Soil
0.6 to 27.8	Pumice: very light gray, soft. Moderate brown very sandy clay at base.
27.8 to 58.0	Ash-Flow Tuff: very light gray, alternating with light brown and grayish orange pink. Not hard. Samples dry.
58.0 to 81.0	Ash-Flow Tuff: very light brown to grayish orange pink, welded, hard with phenocrysts of clear sanidine, doubly terminated quartz and euhedral biotite. Samples dry.
81.0 to 118.0	Ash-Flow Tuff: very light gray to very pale orange, welded, rhyolitic, crystal poor, trace of biotite, very hard at base. Samples dry.
118.0 to 159.0	Ash-Flow Tuff: light brownish gray to very pale orange, very welded, crystal rich, rhyolitic, golden biotite with chatoyant sanidine and quartz; crystals abraded and rounded. Samples dry.
159.0 to 296.0	Ash-Flow Tuff: brownish gray to gray, very welded and hard. Less crystals with sanidine. Top marked by reddish brown zone. Cuttings damper at 255 feet; water flow encountered at 276 feet.

Total Depth of Monitoring Well #1 = 296.0 Feet.

Monitoring Well #2
Lithologic Log

Depth (Feet)	Description
0.0 to 0.5	Top Soil: dark brown.
0.5 to 63.0	Pumice: block, ash and lapilli sizes.
63.0 to 66.0	Layer of Lithic Fragments in the Pumice.
66.0 to 75.5	Pumice: block, ash and lapilli sizes.
75.5 to 81.0	Ash-Flow Tuff: light brown mottled grayish orange pink, punky and rotten, large sanidine, quartz and biotite phenocrysts.
81.0 to 142.0	Ash-Flow Tuff: very light gray to light pinkish gray, soft, slightly welded, comes up as dust. Cavities in rock at 90 feet, 123 to 129 feet and 136 to 138 feet.
142.0 to 160.0	Ash-Flow Tuff: light brown, hard, rhyolitic, with crystals of sanidine, quartz and biotite. Some spinifex pumice in samples. Poor returns; poor circulation. Partly welded.
160.0 to 332.0	Ash-Flow Tuff: very light gray to light brown, rhyolitic, welded to partly welded, phenocrysts of sanidine, quartz and biotite. Cavity at 161 to 163 feet then softer. Softer again at 268 to 282 feet.
332.0 to 379.4	Ash-Flow Tuff: brownish gray, softer, less welded, phenocrysts of sanidine and quartz. Possible cavities with poor air returns. Possible water flow at 330 to 340 feet.

Total Depth of Monitoring Well #2 = 379.4 Feet.

Monitoring Well #3
Lithologic Log

Depth (Feet)	Description
0.0 to 4.0	Fill Material From Logging Road: dark brown.
4.0 to 6.0	Pumice: ash and lapilli, very light gray.
6.0 to 25.0	Pumice: very light gray, hard driving casing, apparent water at 25 feet; material is wet pumice - road fill?
25.0 to 34.5	Pumice: light brownish gray, dryer.
34.5 to 37.0	Pumice: light brownish gray, with lithic fragments.
37.0 to 38.5	Pumice: yellowish orange gray, finer (lapilli with ash). Hard at 38.5 with more dust.
38.5 to 44.0	Pumice: with large lithic fragments (>1"). Softer at 43.0 feet.
44.0 to 49.5	Lapilli and ash with numerous lithic fragments.
49.5 to 56.5	Ash-Flow Tuff: moderate brown, coarsely crystalline, with pumice fragments, very weathered and soft, some small cavities.
56.5 to 57.5	Ash-Flow Tuff: brownish gray, more welded.
57.5 to 57.8	Ash-Flow Tuff: light gray, welded, with sanidine phenocrysts.
57.8 to 64.5	Ash-Flow Tuff: light gray, very welded and hard with light brown staining. Phenocrysts of sanidine, quartz and biotite.
64.5 to 68.0	Cavity with moderate brown, rotten rhyolite ash-flow tuff, very soft. Dusty cuttings.
68.0 to 73.0	Ash-Flow Tuff: light gray to light brownish gray, sanidine, quartz and biotite phenocrysts, slightly welded, vuggy, pumaceous, poor returns.
73.0 to 100.0	Ash-Flow Tuff: brownish gray to light gray, coarsely crystalline with phenocrysts of sanidine, quartz and biotite, matrix leached and vuggy. Cavities at 74.0 to 79.0 feet and 89.0 to 93.5 feet.

Monitoring Well #3 - Lithologic Log - Continued

Depth (Feet)	Description
100.0 to 128.0	No Returns, No Samples. Drills like a welded tuff, no air return at all with the 3 compressors running wide open.
128.0 to 150.0	Ash-Flow Tuff: coarsely crystalline, brownish gray to light gray, damp, leached, slightly welded, vuggy, fractured. Water level at 126.0 to 127.0 feet.

Total Depth of Monitoring Well #3 = 150 Feet.

Well Completion Records -
Vallecitos de los Indios

4

STATE ENGINEER OFFICE

WELL RECORD

Section 1. GENERAL INFORMATION

(A) Owner of well Tom McKeever Owner's Well No. 1

Street or Post Office Address 1731 Trinity Dr.

City and State Los Alamos NM 87544

Well was drilled under Permit No. RG-56938 and is located in the:

a. ____ ¼ ~~SW~~ SE ¼ ~~NE~~ NW ¼ ~~NW~~ SW ¼ of Section 1 Township 18N Range 3E N.M.P.M.

WRONG LOCATION!

b. Tract No. ____ of Map No. ____ of the ____

c. Lot No. ____ of Block No. ____ of the ____ Subdivision, recorded in Sandoval County.

d. X= ____ feet, Y= ____ feet, N.M. Coordinate System ____ Zone in the ____ Grant.

(B) Drilling Contractor Spencers Well Drilling License No. WD1224

Address PO Box 214 Los Alamos NM 87544-0214

Drilling Began Dec 2, 1992 Completed Jan 2, 1993 Type tools rotary Size of hole 6 5/8 in.

Elevation of land surface or 7,500 at well is same ft. Total depth of well 320 ft.

Completed well is [X] shallow [ ] artesian. Depth to water upon completion of well 280 ft.

Section 2. PRINCIPAL WATER-BEARING STRATA

Depth in Feet From	Depth in Feet To	Thickness in Feet	Description of Water-Bearing Formation	Estimated Yield (gallons per minute)
278	320	42	volcanic rock	15

Section 3. RECORD OF CASING

Diameter (inches)	Pounds per foot	Threads per in.	Depth in Feet Top	Depth in Feet Bottom	Length (feet)	Type of Shoe	Perforations From	Perforations To
6 5/8	12.93	N/A	0	320	320	carbon	280	320

Section 4. RECORD OF MUDDING AND CEMENTING

Depth in Feet From	Depth in Feet To	Hole Diameter	Sacks of Mud	Cubic Feet of Cement	Method of Placement

1993 MAR 30 AM 11 45
DISTRICT 1 OFFICE
ALBUQUERQUE, N. MEX.

Section 5. PLUGGING RECORD

Plugging Contractor ____

Address ____

Plugging Method ____

Date Well Plugged ____

Plugging approved by:

____ State Engineer Representative

No.	Depth in Feet Top	Depth in Feet Bottom	Cubic Feet of Cement
1			
2			
3			
4			

FOR USE OF STATE ENGINEER ONLY

Date Received 3-30-93

Quad ____ FWL ____ FSL ____

File No. RG-56938 Use Dom Location No. 18N.3E.1.123 (Sandoval)

Depth in Feet From	To	Thickness in Feet	Color and Type of Material Encountered
0	3	3	top soil
3	168	165	pumice
168	320	152	red volcanic rock

Section 7. REMARKS AND ADDITIONAL INFORMATION

he undersigned hereby certifies that, to the best of his knowledge and belief, the foregoing is a true and correct record of the above escribed hole.

Kevin L. Spencer
Driller

NSTRUCTIONS: This form should be executed in triplicate, preferably typewritten, and submitted to the appropriate district office f the State Engineer. All sections, except Section 5, shall be answered as completely and accurately as possible when any well is rilled, repaired or deepened. When this form is used as a plugging record, only Section 1(a) and Section 5 need be completed.

WELL RECORD

5-(2)

Section 1. GENERAL INFORMATION

(A) Owner of well Terry L. Johnson Owner's Well No. RG 48121
Street or Post Office Address 3516 Ridgeway
City and State Los Alamos NM 87544

Well was drilled under Permit No. ______ and is located in the:

a. ___ ¼ ___ ¼ ___ ¼ ___ ¼ of Section 3 Township 18N Range R3E N.M.P.M.

b. Tract No. B2 of Map No. ______ of the ______

c. Lot No. ______ of Block No. ______ of the ______
Subdivision, recorded in ______ County.

d. X= ______ feet, Y= ______ feet, N.M. Coordinate System ______ Zone in the ______ Grant.

(B) Drilling Contractor Garcias Drilling License No. WD-539

Address ST.RT. Box 327 Tijeras NM 87059

Drilling Began ______ Completed ______ Type tools Rotary Size of hole 7 in.

Elevation of land surface or ______ at well is ______ ft. Total depth of well 300 ft.

Completed well is ☒ shallow ☐ artesian. Depth to water upon completion of well 280 ft.

Section 2. PRINCIPAL WATER-BEARING STRATA

Depth in Feet		Thickness in Feet	Description of Water-Bearing Formation	Estimated Yield (gallons per minute)
From	To			
250	280		Hard Rock	12
			"	

Section 3. RECORD OF CASING

Diameter (inches)	Pounds per foot	Threads per in.	Depth in Feet		Length (feet)	Type of Shoe	Perforations	
			Top	Bottom			From	To
5		pvc	1	300	20	cup		

Section 4. RECORD OF MUDDING AND CEMENTING

Depth in Feet		Hole Diameter	Sacks of Mud	Cubic Feet of Cement	Method of Placement
From	To				

88 SEP 28 P 2:01
ALBUQUERQUE, N. MEX.

Section 5. PLUGGING RECORD

Plugging Contractor ______
Address ______
Plugging Method ______
Date Well Plugged ______
Plugging approved by:
______
State Engineer Representative

No.	Depth in Feet		Cubic Feet of Cement
	Top	Bottom	
1			
2			
3			
4			

FOR USE OF STATE ENGINEER ONLY

Date Received 9-28-88

Quad ______ FWL ______ FSL ______

File No. RG-48121 Use Dom-San Location No. 18N.3E.3.TR.B
(Sandoval)

Depth in Feet		Thickness in Feet	Color and Type of Material Encountered
From	To		
1	60		
60	300		Hard Rock

Section 7. REMARKS AND ADDITIONAL INFORMATION

The undersigned hereby certifies that, to the best of his knowledge and belief, the foregoing is a true and correct record of the above described hole.

Raymond Garcia
Driller

INSTRUCTIONS: This form should be executed in triplicate, preferably typewritten, and submitted to the appropriate district office of the State Engineer. All sections, except Section 5, shall be answered as completely and accurately as possible when any well is drilled, repaired or deepened. When this form is used as a plugging record, only Section 1(a) and Section 5 need be completed.

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RG-51448

WELL RECORD

Section 1. GENERAL INFORMATION

(A) Owner of well U.S. FOREST SERVICE c/o P & M Construction Owner's Well No. RG-51448

Street or Post Office Address Box 189

City and State Pondreosa, NM 87044

Well was drilled under Permit No. RG-51448 and is located in the:

a. ____ ¼ SE ¼ NW ¼ NE ¼ of Section 3 Township 18N Range 3E N.M.P.M.

b. Tract No. ____ of Map No. ____ of the ____

c. Lot No. ____ of Block No. ____ of the ____ Subdivision, recorded in Sandoval County.

d. X= ____ feet, Y= ____ feet, N.M. Coordinate System ____ Zone in the ____ Grant.

(B) Drilling Contractor Garcia Drilling License No. WD-539

Address ST.RT. BOX 327 Tijeras, NM 87059

Drilling Began 11-15-89 Completed 11-20-89 Type tools Rotary Size of hole 6 5/8 in.

Elevation of land surface or ____ at well is ____ ft. Total depth of well 240 ft.

Completed well is ☒ shallow ☐ artesian. Depth to water upon completion of well 209 ft.

Section 2. PRINCIPAL WATER-BEARING STRATA

Depth in Feet From	Depth in Feet To	Thickness in Feet	Description of Water-Bearing Formation	Estimated Yield (gallons per minute)
185	240	55	Yellow & White Rock	20 Gal Min

Section 3. RECORD OF CASING

Diameter (inches)	Pounds per foot	Threads per in.	Depth in Feet Top	Depth in Feet Bottom	Length (feet)	Type of Shoe	Perforations From	Perforations To
6 5/8		PVC	1	240	20	CUP	180	200

Section 4. RECORD OF MUDDING AND CEMENTING

Depth in Feet From	Depth in Feet To	Hole Diameter	Sacks of Mud	Cubic Feet of Cement	Method of Placement

Section 5. PLUGGING RECORD

Plugging Contractor ____

Address ____

Plugging Method ____

Date Well Plugged ____

Plugging approved by:

____ State Engineer Representative

No.	Depth in Feet Top	Depth in Feet Bottom	Cubic Feet of Cement
1			
2			
3			
4			

FOR USE OF STATE ENGINEER ONLY

Date Received 12-19-89

Quad ____ FWL ____ FSL ____

File No. RG-51448 Use Dom. San Location No. 18N.3E.3.214

(Sand.)

From	To	in Feet	
1	5	5	Brown Clay
5	7	2	Sand & BrownClay
7	40	33	White Gravel
40	50	10	Brown Clay
50	65	15	Red Clay
65	85	20	Gray Rock
85	95	10	Brown Clay
95	100	5	Red Clay
100	105	5	Gray Rock
105	110	5	Red Clay
110	125	15	Gray rock & Red Clay
1125	140	15	Brown Clay
140	185	45	Gra & White Rock
185	240	55	Yellow & White Ropck

Section 7. REMARKS AND ADDITIONAL INFORMATION

The undersigned hereby certifies that, to the best of his knowledge and belief, the foregoing is a true and correct record of the above described hole.

Raymond Garcia
Driller

INSTRUCTIONS: This form should be executed in triplicate, preferably typewritten, and submitted to the appropriate district office of the State Engineer. All sections, except Section 5, shall be answered as completely and accurately as possible when any well is drilled, repaired or deepened. When this form is used as a plugging record, only Section 1(a) and Section 5 need be completed.

Revised June 1972

STATE ENGINEER OFFICE

WELL RECORD

7

Section 1. GENERAL INFORMATION

(A) Owner of well Baca Land & Cattle Co., Inc. Owner's Well No. RG-46600
Street or Post Office Address P.O.BOX 872
City and State Los Alamos, NM 87544

Well was drilled under Permit No. RG-46600 and is located in the:

a. ____ ¼ SE ¼ SE ¼ SE ¼ of Section 34 Township 19N Range 3E N.M.P.M.

b. Tract No. ____ of Map No. ____ of the ____

c. Lot No. ____ of Block No. ____ of the ____
Subdivision, recorded in Sandoval County.

d. X= ____ feet, Y= ____ feet, N.M. Coordinate System ____ Zone in the ____ Grant.

(B) Drilling Contractor Garcia's Drilling License No. WD-539

Address ST.RT. Box 327 Tijeras, NM 87059

Drilling Began 10-26-86 Completed 10-31-86 Type tools Rotry Size of hole 6½ in.

Elevation of land surface or ____ at well is ____ ft. Total depth of well 400 ft.

Completed well is ☒ shallow ☐ artesian. Depth to water upon completion of well 200 ft.

Section 2. PRINCIPAL WATER-BEARING STRATA

Depth in Feet From	Depth in Feet To	Thickness in Feet	Description of Water-Bearing Formation	Estimated Yield (gallons per minute)
250	300	50	red sand rock	15 gal min

Section 3. RECORD OF CASING

Diameter (inches)	Pounds per foot	Threads per in.	Depth in Feet Top	Depth in Feet Bottom	Length (feet)	Type of Shoe	Perforations From	Perforations To
5			1	400	20	cup	240	260
							360	400

Section 4. RECORD OF MUDDING AND CEMENTING

Depth in Feet From	Depth in Feet To	Hole Diameter	Sacks of Mud	Cubic Feet of Cement	Method of Placement

Section 5. PLUGGING RECORD

Plugging Contractor ____
Address ____
Plugging Method ____
Date Well Plugged ____
Plugging approved by:

____
State Engineer Representative

No.	Depth in Feet Top	Depth in Feet Bottom	Cubic Feet of Cement
1			
2			
3			
4			

FOR USE OF STATE ENGINEER ONLY

Date Received

Quad ____ FWL ____ FSL ____

File No. RG-46600 Use Dom Location No. 19.3.34.444

Section 6. LOG OF HOLE

Depth in Feet		Thickness in Feet	Color and Type of Material Encountered
From	To		
1	60	60	brown clay
60	150	90	white rock
150	200	50	brown rock
200	250	50	white rock
250	300	50	red sand rock
300	400	100	brown sand rock

Section 7. REMARKS AND ADDITIONAL INFORMATION

The undersigned hereby certifies that, to the best of his knowledge and belief, the foregoing is a true and correct record of the above described hole.

Driller

INSTRUCTIONS: This form should be executed in triplicate, preferably typewritten, and submitted to the [illegible] State Engineer [illegible] sections except Section 5, shall be answered as completely [illegible] for any well is [illegible] required or [illegible] When [illegible] only 5

STATE ENGINEER OFFICE

WELL RECORD

8

Section 1. GENERAL INFORMATION

(A) Owner of well Jim Wakeman Owner's Well No. 1

Street or Post Office Address PO Box 810

City and State Corrales NM 87048

Well was drilled under Permit No. RG-56209 and is located in the:

a. ____ ¼ NE ¼ SE ¼ NE ¼ of Section 10 Township 18N Range 3E N.M.P.M.

b. Tract No. ____ of Map No. ____ of the ____

c. Lot No. 976 of Block No. ____ of the Vallecitos de los Indios Subdivision, recorded in Sandoval County.

d. X= ____ feet, Y= ____ feet, N.M. Coordinate System ____ Zone in the ____ Grant.

(B) Drilling Contractor Spencers Well Drilling License No. WD1224

Address PO Box 214 Los Alamos NM 87544-0214

Drilling Began 9-13-92 Completed 10-22-92 Type tools rotary Size of hole 6 5/8 in.

Elevation of land surface or 8500 at well is ____ ft. Total depth of well 156 ft.

Completed well is [X] shallow [ ] artesian. Depth to water upon completion of well 43 ft.

Section 2. PRINCIPAL WATER-BEARING STRATA

Depth in Feet		Thickness in Feet	Description of Water-Bearing Formation	Estimated Yield (gallons per minute)
From	To			
90	140	50	pumice, sand	2

Section 3. RECORD OF CASING

Diameter (inches)	Pounds per foot	Threads per in.	Depth in Feet		Length (feet)	Type of Shoe	Perforations	
			Top	Bottom			From	To
6 5/8	12.93	N/A	33	-	33	carbon	N/A	N/A
4½PVC	sch .40	N/A		130	130	none	100	120

Section 4. RECORD OF MUDDING AND CEMENTING

Depth in Feet		Hole Diameter	Sacks of Mud	Cubic Feet of Cement	Method of Placement
From	To				

92 NOV 24 PM 1:30
STATE ENGINEER OFFICE
ALBUQUERQUE, N. MEX.

Section 5. PLUGGING RECORD

Plugging Contractor ____
Address ____
Plugging Method ____
Date Well Plugged ____
Plugging approved by:

____
State Engineer Representative

No.	Depth in Feet		Cubic Feet of Cement
	Top	Bottom	
1			
2			
3			
4			

FOR USE OF STATE ENGINEER ONLY

Date Received 11/24/92 Quad ____ FWL ____ FSL ____

File No. RG-56209 Use dom Location No. 18N.3E.10.242 (Sand)

Sec. LOG OF HOLE

Depth in Feet From	To	Thickness in Feet	Color and Type of Material Encountered
0	33	33	brown topsoil with pumice
33	45	12	yellow clay
45	95	50	grey clay
95	156	61	pumice and sand

Section 7. REMARKS AND ADDITIONAL INFORMATION

The undersigned hereby certifies that, to the best of his knowledge and belief, the foregoing is a true and correct record of the above described hole.

Ken L Spence
Driller

INSTRUCTIONS. This form should be executed in triplicate, preferably typewritten, and submitted to the appropriate district office of the State Engineer. All sections, except Section 5, shall be answered as completely and accurately as possible when any well is drilled, repaired or deepened. When this form is used as a plugging record, only Section 1(a) and Section 5 need be completed.

Revised June 1972

STATE ENGINEER OFFICE

WELL RECORD

9

Section 1. GENERAL INFORMATION

(A) Owner of well Sierra Los Pinos Property Owners Assoc. Owner's Well No. 1
Street or Post Office Address P.O. Box 674
City and State Los Alamos, New Mexico 87544

Well was drilled under Permit No. RG-30359 and is located in the:

a. W½ ¼ NE ¼ NE ¼ ___ ¼ of Section 11 Township 13N 18N Range 3E N.M.P.M.
Sandoval County

b. Tract No. ______ of Map No. ______ of the ______

c. Lot No. ______ of Block No. ______ of the ______
Subdivision, recorded in ______ County.

d. X= ______ feet, Y= ______ feet, N.M. Coordinate System ______ Zone in the ______ Grant.

(B) Drilling Contractor Pioneer Drilling License No. WD-906

Address P.O. Box 162 Abiquiu, New Mexico 87510

Drilling Began 11-9-88 Completed 12-23-88 Type tools Air Rotary Size of hole 10 in.

Elevation of land surface or ______ at well is ______ ft. Total depth of well 400 ft.

Completed well is ☒ shallow ☐ artesian. Depth to water upon completion of well 294 ft.

Section 2. PRINCIPAL WATER-BEARING STRATA

Depth in Feet		Thickness in Feet	Description of Water-Bearing Formation	Estimated Yield (gallons per minute)
From	To			
310	320	10	Conglomerated Basalts	32

Section 3. RECORD OF CASING

Diameter (inches)	Pounds per foot	Threads per in.	Depth in Feet		Length (feet)	Type of Shoe	Perforations	
			Top	Bottom			From	To
6	Sch 40 pvc	-	+2	400	402	NONE	340	360
							380	400

Section 4. RECORD OF MUDDING AND CEMENTING

Depth in Feet		Hole Diameter	Sacks of Mud	Cubic Feet of Cement	Method of Placement
From	To				
6	30	10		25	Pumped through tremmie

Section 5. PLUGGING RECORD

Plugging Contractor ______
Address ______
Plugging Method ______
Date Well Plugged ______
Plugging approved by:

______
State Engineer Representative

No.	Depth in Feet		Cubic Feet of Cement
	Top	Bottom	
1			
2			
3			
4			

FOR USE OF STATE ENGINEER ONLY

Date Received 1-10-89

Quad W½NE¼NE¼ FWL ______ FSL ______

File No. RG-30359 Use Municipal Location No. 18N.03E.11

Section 6. LOG OF HOLE.

Depth in Feet		Thickness in Feet	Color and Type of Material Encountered
From	To		
0	3	3	Top Soil Brown
3	80	77	Sandy Clay Brown
[illegible] 80	310	230	Black & Red Basalts
310	400	90	Black Sandy Basalt

380 400

Section 7. REMARKS AND ADDITIONAL INFORMATION

The undersigned hereby certifies that, to the best of his knowledge and belief, the foregoing is a true and correct record of the above described hole.

Driller

INSTRUCTIONS: This form should be executed in triplicate, preferably typewritten, and submitted to the appropriate district office of the State Engineer. All sections, except Section 5, shall be answered as completely and accurately as possible when any well is drilled, repaired or deepened. When this [illegible] is used as a plugging record, only Section 1([illegible] d Section 5 need be completed.

10

STATE ENGINEER OFFICE

WELL RECORD

31 JUL 22 P 1:03

Section 1. GENERAL INFORMATION

(A) Owner of well Linda West Owner's Well No. RG-48563
Street or Post Office Address Mountain Route Bx 109
City and State Jemez Springs, N.M. 87025

Well was drilled under Permit No. RG-48563 and is located in the:

a. SE ¼ SE ¼ NW ¼ ____ ¼ of Section 11 Township 18N Range 3E N.M.P.M.

b. Tract No. ____ of Map No. ____ of the ____

c. Lot No. ____ of Block No. ____ of the ____
Subdivision, recorded in Sandoval County.

d. X= ____ feet, Y= ____ feet, N.M. Coordinate System ____ Zone in
the ____ Grant.

(B) Drilling Contractor Spencer's Well Drilling License No. WD1224

Address P.O. Box 214, Los Alamos, N.M. 87544

Drilling Began 11/15/90 Completed 3/28/91 Type tools Rotary Size of hole 6⅛ in.

Elevation of land surface or 8,550 at well is Same ft. Total depth of well 350 ft.

Completed well is [X] shallow [ ] artesian. Depth to water upon completion of well 256 ft.

Section 2. PRINCIPAL WATER-BEARING STRATA

Depth in Feet		Thickness in Feet	Description of Water-Bearing Formation	Estimated Yield (gallons per minute)
From	To			
310	350	40	Black Basalt	10-15

Section 3. RECORD OF CASING

Diameter (inches)	Pounds per foot	Threads per in.	Depth in Feet		Length (feet)	Type of Shoe	Perforations	
			Top	Bottom			From	To
4½ PVC	N/A	N/A	2	310	312	None	290	310

Section 4. RECORD OF MUDDING AND CEMENTING

Depth in Feet		Hole Diameter	Sacks of Mud	Cubic Feet of Cement	Method of Placement
From	To				

Section 5. PLUGGING RECORD

Plugging Contractor ____
Address ____
Plugging Method ____
Date Well Plugged ____
Plugging approved by:

____
State Engineer Representative

No.	Depth in Feet		Cubic Feet of Cement
	Top	Bottom	
1			
2			
3			
4			

FOR USE OF STATE ENGINEER ONLY

Date Received 7-22-91

Quad ____ FWL ____ FSL ____

File No. RG-48563 Use Dom Location No. 18N.3E.11.144 (Sandoval)

From	To	In Feet	
0′	48′	48′	White Pumice
48′	165′	117′	Red Conglomerate Rock
165′	205′	40′	Black Basalt
205′	310′	105′	Red Conglomerate Rock
310′	350′	40′	Black Basalt

31 JUL 22 P[illegible]:03

Section 7. REMARKS AND ADDITIONAL INFORMATION

The undersigned hereby certifies that, to the best of his knowledge and belief, the foregoing is a true and correct record of the above described hole.

Kevin Spencer
Driller

INSTRUCTIONS: This form should be executed in triplicate, preferably typewritten, and submitted to the appropriate district office of the State Engineer. All sections, except Section 5, shall be answered as completely and accurately as possible when any well is drilled, repaired or deepened. When this form is used as a plugging record, only Section 1(a) and Section 5 need be completed.

STATE ENGINEER OFFICE

WELL RECORD

11

Section 1. GENERAL INFORMATION

(A) Owner of well Bob and Zaida Williams — Owner's Well No. 1

Street or Post Office Address P.O. Box 222

City and State Bernalillo, New Mexico 87004

Well was drilled under Permit No. RG-26227-S-2 and is located in the:

a. ____ ¼ SW ¼ SW ¼ NW ¼ of Section 11 Township 18N Range 3E N.M.P.M.

b. Tract No. ____ of Map No. ____ of the Rio Grande Underwater Basin, on land owned by Mildred Larrussoux & Zaida Williams

c. Lot No. ____ of Block No. ____ of the ____ Subdivision, recorded in Sandoval County.

d. X= ____ feet, Y= ____ feet, N.M. Coordinate System ____ Zone in the ____ Grant.

(B) Drilling Contractor Ronnie's Water Wells — License No. WD 1163

Address P. O. Box 100, Cuba, N.M. 87013

Drilling Began 9-4-88 Completed 9-10-88 Type tools Rotary Size of hole 6¼ in.

Elevation of land surface or ____ at well is ____ ft. Total depth of well 220 ft.

Completed well is [X] shallow [ ] artesian. Depth to water upon completion of well -0- ft.

Section 2. PRINCIPAL WATER-BEARING STRATA

Depth in Feet		Thickness in Feet	Description of Water-Bearing Formation	Estimated Yield (gallons per minute)
From	To			
			DRY HOLE	

Section 3. RECORD OF CASING

Diameter (inches)	Pounds per foot	Threads per in.	Depth in Feet		Length (feet)	Type of Shoe	Perforations	
			Top	Bottom			From	To
			DRY HOLE					

STATE ENGINEER OFFICE
DISTRICT I
ALBUQUERQUE, N. MEX.

88 OCT 4 P 3:05

Section 4. RECORD OF MUDDING AND CEMENTING

Depth in Feet		Hole Diameter	Sacks of Mud	Cubic Feet of Cement	Method of Placement
From	To				

Section 5. PLUGGING RECORD

Plugging Contractor ____

Address ____

Plugging Method ____

Date Well Plugged ____

Plugging approved by:

____
State Engineer Representative

No.	Depth in Feet		Cubic Feet of Cement
	Top	Bottom	
1			
2			
3			
4			

FOR USE OF STATE ENGINEER ONLY

Date Received 10-4-88

Quad SW¼ SW¼ NW¼ FWL ____ FSL ____

File No. RG-26227-S-2 Use Irrig. Location No. 18N.03E.11

✓

Section 6. LOG OF HOLE

Depth in Feet		Thickness in Feet	Color and Type of Material Encountered
From	To		
0	5	5	Bentonite
5	35	30	Gravel
35	120	85	Coarse sand and gravel
120	130	10	Green sand and clay
130	140	10	Brown sand and clay
140	150	10	Fawn-colored sand and clay
150	167	17	White sand and coarse gravel
167	208	41	Black Limestone and Hard Shale
208	290	82	Fractured Black Limestone and red sandstone and gravel

Section 7. REMARKS AND ADDITIONAL INFORMATION

The undersigned hereby certifies that, to the best of his knowledge and belief, the foregoing is a true and correct record of the above described hole.

Driller

INSTRUCTIONS: This form should be executed in triplicate, preferably typewritten, and submitted to the appropriate district office of the State Engineer. All sections, except Section 5, shall be answered as completely and accurately as possible when any well is drilled, repaired or deepened. When this form is used as a plugging record, only Section 1(a) and Section 5 need be completed.

STATE ENGINEER OFFICE

WELL RECORD

12

Section 1. GENERAL INFORMATION

(A) Owner of well Bob and Zelda Williams Owner's Well No. 2
Street or Post Office Address P. O. Box 222
City and State Corrales, New Mexico 87004

Well was drilled under Permit No. RG-26227-S-2 and is located in the:

a. ____ ¼ SW ¼ SW ¼ NW ¼ of Section 11 Township 18N Range 3E N.M.P.M.

b. Tract No. ____ of Map No. ____ of the Rio Grande Underground Basin, on land owned by Mildred Larrasseaux & Zelda Williams

c. Lot No. ____ of Block No. ____ of the ____
Subdivision, recorded in ____ County.

d. X= ____ feet, Y= ____ feet, N.M. Coordinate System ____ Zone in the ____ Grant.

(B) Drilling Contractor Ronnie's Water Wells License No. WD1163

Address P. O. Box 100, Cuba, New Mexico 87013

Drilling Began 9-16-88 Completed 9-17-88 Type tools Rotary Size of hole 6¼ in.

Elevation of land surface or ____ at well is ____ ft. Total depth of well 70 ft.

Completed well is [x] shallow [ ] artesian. Depth to water upon completion of well 40 ft.

Section 2. PRINCIPAL WATER-BEARING STRATA

Depth in Feet From	Depth in Feet To	Thickness in Feet	Description of Water-Bearing Formation	Estimated Yield (gallons per minute)
55	56	1	Gravel and small rock	12

Section 3. RECORD OF CASING

Diameter (inches)	Pounds per foot	Threads per in.	Depth in Feet Top	Depth in Feet Bottom	Length (feet)	Type of Shoe	Perforations From	Perforations To
5			0	60	60		40	60

Section 4. RECORD OF MUDDING AND CEMENTING

Depth in Feet From	Depth in Feet To	Hole Diameter	Sacks of Mud	Cubic Feet of Cement	Method of Placement

88 OCT 4 P 3:05
STATE ENGINEER OFFICE
DISTRICT I
ALBUQUERQUE, N. MEX.

Section 5. PLUGGING RECORD

Plugging Contractor ____
Address ____
Plugging Method ____
Date Well Plugged ____
Plugging approved by:
____ State Engineer Representative

No.	Depth in Feet Top	Depth in Feet Bottom	Cubic Feet of Cement
1			
2			
3			
4			

FOR USE OF STATE ENGINEER ONLY

Date Received 10-2-88

Quad SW¼ SW¼ NW¼ FWL ____ FSL ____

File No. RG-26227-S-2 Use Irrig Location No. 18N.03E.11

Depth in Feet From	To	Thickness in Feet	Color and Type of Material Encountered
0	5	5	Rock and fill dirt
5	10	5	Gravel
10	55	45	Sand and clay
55	70	15	Gravel and small rock

Section 7. REMARKS AND ADDITIONAL INFORMATION

The undersigned hereby certifies that, to the best of his knowledge and belief, the foregoing is a true and correct record of the above described hole.

Driller

INSTRUCTIONS: This form should be executed in triplicate, preferably typewritten, and submitted to the appropriate district office of the State Engineer. All sections, except Section 5, shall be answered as completely and accurately as possible when any well is drilled, repaired or deepened. When this form is used as a plugging record, only Section 1(a) and Section 5 need be completed.

13 (A)

STATE ENGINEER OFFICE
WELL RECORD

Section 1. GENERAL INFORMATION

(A) Owner of well Reeves Burke and King Owner's Well No. 1
Street or Post Office Address General Delivery
City and State Jemez Springs N.M.

Well was drilled under Permit No. R6-26103 and is located in the:

a. NE ¼ SW ¼ ____ ¼ ____ ¼ of Section 11 Township 18 N Range 3 E N.M.P.M.

b. Tract No. ____ of Map No. ____ of the ____

c. Lot No. ____ of Block No. ____ of the ____
Subdivision, recorded in Sandoval County.

d. X= ____ feet, Y= ____ feet, N.M. Coordinate System ____ Zone in the ____ Grant.

(B) Drilling Contractor W. L. Miller License No. WD 613

Address 3109 General Chennault NE Albuquerque N.M.

Drilling Began June 13 Completed June 19 Type tools Cable Size of hole 7 in.

Elevation of land surface or Elevation at well is 5400 ft. Total depth of well 267 ft.

Completed well is ☒ shallow ☐ artesian. Depth to water upon completion of well 221 ft.

Section 2. PRINCIPAL WATER-BEARING STRATA

Depth in Feet		Thickness in Feet	Description of Water-Bearing Formation	Estimated Yield (gallons per minute)
From	To			
243	267	24	Hard gray sand	18

Section 3. RECORD OF CASING

Diameter (inches)	Pounds per foot	Threads per in.	Depth in Feet		Length (feet)	Type of Shoe	Perforations	
			Top	Bottom			From	To
5	2.32				265	none	247	265

Section 4. RECORD OF MUDDING AND CEMENTING

Depth in Feet		Hole Diameter	Sacks of Mud	Cubic Feet of Cement	Method of Placement
From	To				

JUN 25 AM 11 37

Section 5. PLUGGING RECORD

Plugging Contractor ____
Address ____
Plugging Method ____
Date Well Plugged ____
Plugging approved by:

____
State Engineer Representative

No.	Depth in Feet		Cubic Feet of Cement
	Top	Bottom	
1			
2			
3			
4			

FOR USE OF STATE ENGINEER ONLY

Date Received

Quad ____ FWL ____ FSL ____

File No. R6-26103 Use Dom Location No. 18.3.11.310

Section 6. LOG OF HOLE

Depth in Feet		Thickness in Feet	Color and Type of Material Encountered
From	To		
0	12	12	Black surface dirt
12	43	31	Light tan pumice
43	51	8	Black lava rock
51	74	23	Lava pumice mixed
74	101	27	Pumice & Conglomeration
101	127	26	Multi Colored Cinders
127	154	27	Black Lava & ash
154	176	22	Hard Brown Sandstone
176	214	38	Pumice
214	223	9	Hard Brown Sandstone
223	243	20	Lava rock
243	267	20	Hard gray sand (water bearing)

Section 7. REMARKS AND ADDITIONAL INFORMATION

The undersigned hereby certifies that, to the best of his knowledge and belief, the foregoing is a true and correct record of the above described hole.

L. G. Miller
Driller

INSTRUCTIONS: This form should be executed in triplicate, preferably typewritten, and submitted to the appropriate district office of the State Engineer. All sections, except Section 5, shall be answered as completely and accurately as possible when any well is drilled, repaired or deepened. When this form is used as a plugging record, only Section 1(a) and Section 5 need be completed.

STATE ENGINEER OFFICE

WELL RECORD

14

Section 1. GENERAL INFORMATION

(A) Owner of well R. J. Bootzin Owner's Well No. 1
Street or Post Office Address Mtn. Route, Box 29
City and State Jemez Springs, New Mexico 87025

Well was drilled under Permit No. RG-31281 and is located in the:

a. ____ ¼ SE ¼ NW ¼ SE ¼ of Section 11 Township 18N Range 3E N.M.P.M.

b. Tract No. ____ of Map No. ____ of the ____

c. Lot No. ____ of Block No. ____ of the ____
Subdivision, recorded in Sandoval County.

d. X= ____ feet, Y= ____ feet, N.M. Coordinate System ____ Zone in the ____ Grant.

(B) Drilling Contractor Donald L. Magnusson License No. WD-937

Address P. O. Box 617 - Jemez Springs, New Mexico

Drilling Began 8-1-85 Completed 8-4-85 Type tools cable Size of hole 6 in.

Elevation of land surface or 8,020 at well is - ft. Total depth of well 65 ft.

Completed well is ☒ shallow ☐ artesian. Depth to water upon completion of well 23 ft.

Section 2. PRINCIPAL WATER-BEARING STRATA

Depth in Feet From	Depth in Feet To	Thickness in Feet	Description of Water-Bearing Formation	Estimated Yield (gallons per minute)
25	28	3	White Pumice GrAVEL	1
47	53	6	BLACK + RED GrAVEL	1

Section 3. RECORD OF CASING

Diameter (inches)	Pounds per foot	Threads per in.	Depth in Feet Top	Depth in Feet Bottom	Length (feet)	Type of Shoe	Perforations From	Perforations To
5					65	-	23	63

Section 4. RECORD OF MUDDING AND CEMENTING

Depth in Feet From	Depth in Feet To	Hole Diameter	Sacks of Mud	Cubic Feet of Cement	Method of Placement

Section 5. PLUGGING RECORD

Plugging Contractor ____
Address ____
Plugging Method ____
Date Well Plugged ____
Plugging approved by:

____
State Engineer Representative

No.	Depth in Feet Top	Depth in Feet Bottom	Cubic Feet of Cement
1			
2			
3			
4			

FOR USE OF STATE ENGINEER ONLY

Date Received

Quad ____ FWL ____ FSL ____

File No. RG-31281 Use Dom Location No. 18.3.11.414

Section 6. LOG OF HOLE

Depth in Feet		Thickness in Feet	Color and Type of Material Encountered
From	To		
0	10	10	Top soil
10	25	15	Pumice
25	28	3	[illegible]
28	32	[illegible]	[illegible] clay
[illegible]	[illegible]	5	[illegible]
[illegible]7	[illegible]7	[illegible]	[illegible] clay [illegible]
[illegible]7	[illegible]	6	[illegible] gravel
[illegible]	[illegible]3	10	[illegible] clay [illegible]
63	65	2	[illegible]

Section 7. REMARKS AND ADDITIONAL INFORMATION

The undersigned hereby certifies that, to the best of his knowledge and belief, the foregoing is a true and correct record of the above described hole.

Driller

INSTRUCTIONS: This form should be executed in triplicate, preferably typewritten, and submitted to the appropriate district office of the State Engineer. All sections, except Section 5, shall be answered as completely and accurately as possible when any well is drilled, repaired or deepened. When this form is used as a plugging record, only Section 1(a) and Section 5 need be completed.

Well tested by AGW in June, 1978

15 (4)

STATE ENGINEER OFFICE
WELL RECORD

Section 1. GENERAL INFORMATION

(A) Owner of well Bob Bootzin — Owner's Well No. HC-30444
Street or Post Office Address Mountain Route, Box 29
City and State Jemez Springs, NM 87025

Well was drilled under Permit No. RG 30444 and is located in the:

a. SE ¼ NW ¼ ___ ¼ SE ¼ of Section 11 Township 18N Range 3E N.M.P.M.

b. Tract No. ______ of Map No. ______ of the ______

c. Lot No. ______ of Block No. ______ of the ______
Subdivision, recorded in ______ County.

d. X= ______ feet, Y= ______ feet, N.M. Coordinate System ______ Zone in the ______ Grant.

(B) Drilling Contractor Earl R. Taute dba Earl & Sons, Inc. License No. 583

Address P.O. Box 3, Cedar Crest, NM 87008

Drilling Began 4-27-78 Completed 5-16-78 Type tools Rotary Size of hole 6½ in.

Elevation of land surface or ______ at well is 8000 ft. Total depth of well 250 ft.

Completed well is [x] shallow [ ] artesian. Depth to water upon completion of well 220 ft.

Section 2. PRINCIPAL WATER-BEARING STRATA

Depth in Feet		Thickness in Feet	Description of Water-Bearing Formation	Estimated Yield (gallons per minute)
From	To			
210	240	30	volcanic flow	20

Section 3. RECORD OF CASING

Diameter (inches)	Pounds per foot	Threads per in.	Depth in Feet		Length (feet)	Type of Shoe	Perforations	
			Top	Bottom			From	To
5	160		0	245	245		210	245

Section 4. RECORD OF MUDDING AND CEMENTING

Depth in Feet		Hole Diameter	Sacks of Mud	Cubic Feet of Cement	Method of Placement
From	To				
0	145	6½			Foam

78 MAY 23 PM 1:02
STATE ENGINEER OFFICE
DISTRICT I
ALBUQUERQUE, N.M.

Section 5. PLUGGING RECORD

Plugging Contractor ______
Address ______
Plugging Method ______
Date Well Plugged ______
Plugging approved by:

______
State Engineer Representative

No.	Depth in Feet		Cubic Feet of Cement
	Top	Bottom	
1			
2			
3			
4			

FOR USE OF STATE ENGINEER ONLY

Date Received 5-23-78

Quad ______ FWL ______ FSL ______

File No. RG-3044 Use Subd. Location No. 18N.3E.11. SE NW SE

18N.3E.11. 414

Depth in Feet		Thickness in Feet	Color and Type of Material Encountered
From	To		
~~0~~	~~5~~	~~5~~	~~Top soil, brown~~
5	20	15	Clobbers, clay
20	50	30	Clay, brown
50	75	25	Pumice, gray
75	80	5	Pumice and gravel, gray
80	100	20	Pumice, gray
100	200	100	Pumice
200	245	45	Volcanic flow

Section 7. REMARKS AND ADDITIONAL INFORMATION

Well was started 4-27-78. Rig moved off when it was discovered owner did not have permit. Well completed after permit was obtained.

The undersigned hereby certifies that, to the best of his knowledge and belief, the foregoing is a true and correct record of the above described hole.

Earl & Sons, Inc.

By: [signature]

Driller

INSTRUCTIONS: This form should be executed in triplicate, preferably typewritten, and submitted to the appropriate district office of the State Engineer. All sections, except Section 5, shall be answered as completely and accurately as possible when any well is drilled, repaired or deepened. When this form is used as a plugging record, only Section 1(a) and Section 5 need be completed.

HC #71473
$2.00

(14)

Revised December 1975

IMPORTANT — READ INSTRUCTIONS ON BACK BEFORE FILLING OUT THIS FORM.

Declaration of Owner of Underground Water Right

renumbered RG-30359-S

Rio Grande UndergroundWater Basin
BASIN NAME

Declaration No. RG-30360 Date received January 17, 1978

STATEMENT

1. Name of Declarant Sierra Los Pinos Property Owners Association
   Mailing Address P.O. Box 674, Los Alamos, New Mexico 87544
   County of Sandoval, State of New Mexico
2. Source of water supply Shallow water aquifer (artesian or shallow water aquifer)
3. Describe well location under one of the following subheadings:
   a. N 1/2 ¼ SE ¼ SE ¼ of Sec. 11 Twp. 15N Rge. 3E N.M.P.M., in Sandoval County.
   b. Tract No. ____ of Map No. ____ of the ____
   c. X = ____ feet, Y = ____ feet, N. M. Coordinate System ____ Zone in the ____ Grant.
   On land owned by ____
4. Description of well: date drilled Summer 1972 driller Gonzales depth 310 feet. outside diameter of casing 6 5/8 1st. 250 ft. + 4 1/2 for 60ft. inches; original capacity 15 gal. per min.; present capacity 15 gal. per min.; pumping lift 520 feet; static water level 295 feet (above) (below) land surface; make and type of pump Airmotor Submergeable #25D18P301 2 HP
   make, type, horsepower, etc., of power plant 2HP
   Fractitional or percentage interest claimed in well 100%
5. Quantity of water appropriated and beneficially used ____ (acre feet per acre) 7.5 (acre feet per annum) for domestic consumption for rural water association purposes.
6. Acreage actually irrigated 0 acres, located and described as follows (describe only lands actually irrigated):

Subdivision	Sec.	Twp.	Range	Acres Irrigated	Owner

78 JAN 17 PM 1:24
STATE ENGINEER OFFICE
ALBUQUERQUE, N. MEX.

(Note: location of well and acreage actually irrigated must be shown on plat on reverse side.)

7. Water was first applied to beneficial use Summer 1978 (1972) month day year and since that time has been used fully and continuously on all of the above described lands or for the above described purposes except as follows: Usage increased from one family in 1975 to eleven families in 1977. Water used for irrigation for growing feed for cattle from 1972 to 1975. Since 1975 water has been used for domestic consumption
8. Additional statements or explanations ____

I, Paul R. Kintzinger being first duly sworn upon my oath, depose and say that the above is a full and complete statement prepared in accordance with the instructions on the reverse side of this form and submitted in evidence of ownership of a valid underground water right, that I have carefully read each and all of the items contained therein and that the same are true to the best of my knowledge and belief.

Sierra los Pinos Property Owners Association, Inc., declarant.

by Paul Kintzinger, President

Subscribed and sworn to before me this 14th day of Jan. A.D. 19 78

[signature] Notary Public

Revised June 1972

17

STATE ENGINEER OFFICE

WELL RECORD

Section 1. GENERAL INFORMATION

(A) Owner of well Charles a. Mills Owner's Well No. ______
Street or Post Office Address 906 Tewa Loop
City and State Los Alamos, New Mexico 87544

Well was drilled under Permit No. RG-47489 and is located in the:

a. SE ¼ SE ¼ SW ¼ ____ ¼ of Section 11 Township 18N Range 3E N.M.P.M.

b. Tract No. ______ of Map No. ______ of the ______

c. Lot No. ______ of Block No. ______ of the ______
Subdivision, recorded in ______ County.

d. X= ______ feet, Y= ______ feet, N.M. Coordinate System ______ Zone in the ______ Grant.

(B) Drilling Contractor Thompson Water Wells License No. WD-622

Address Rte. 5, Box 266- B Santa Fe, New Mexico 87501

Drilling Began 5/1/87 Completed 5/4/87 Type tools rotary mud Size of hole 6¼ in.

Elevation of land surface or ______ at well is ______ ft. Total depth of well 320 ft.

Completed well is [X] shallow [ ] artesian. Depth to water upon completion of well 200 ft.

Section 2. PRINCIPAL WATER-BEARING STRATA

Depth in Feet From	Depth in Feet To	Thickness in Feet	Description of Water-Bearing Formation	Estimated Yield (gallons per minute)
320	240	80	gray sand with bron shale streaks	6-8

Section 3. RECORD OF CASING

Diameter (inches)	Pounds per foot	Threads per in.	Depth in Feet Top	Depth in Feet Bottom	Length (feet)	Type of Shoe	Perforations From	Perforations To
4½PVC					320		300	320
							260	280

Section 4. RECORD OF MUDDING AND CEMENTING

Depth in Feet From	Depth in Feet To	Hole Diameter	Sacks of Mud	Cubic Feet of Cement	Method of Placement

87 MAY 14 PM 1:08

Section 5. PLUGGING RECORD

Plugging Contractor ______
Address ______
Plugging Method ______
Date Well Plugged ______
Plugging approved by:

______
State Engineer Representative

No.	Depth in Feet Top	Depth in Feet Bottom	Cubic Feet of Cement
1			
2			
3			
4			

87 MAY 15 PM 1:46

FOR USE OF STATE ENGINEER ONLY

Date Received

Quad ______ FWL ______ FSL ______

File No. RG-47489 Use Dom Location No. 18.3.11.344

Section 6. LOG OF HOLE

Depth in Feet		Thickness in Feet	Color and Type of Material Encountered
From	To		
0	40	40	surface sandy clay
40	190	150	light and dark brown and white sandstones
190	320	130	gray sand with brown shale streaks

Section 7. REMARKS AND ADDITIONAL INFORMATION

The undersigned hereby certifies that, to the best of his knowledge and belief, the foregoing is a true and correct record of the above described hole.

Driller

INSTRUCTIONS: This form should be executed in triplicate, preferably typewritten, and submitted to the appropriate district office of the State Engineer. All sections, except Section 5, shall be answered as completely and accurately as possible when any well is drilled, repaired or deepened. When this form is used as a plugging record, only Section 1(a) and Section 5 need be completed.

Revised June 1972

18

STATE ENGINEER OFFICE

WELL RECORD

Section 1. GENERAL INFORMATION

(A) Owner of well Robert Hotchkiss Owner's Well No. RG-31542

Street or Post Office Address 4214 B Arizona

City and State Los Alamos, New Mexico 87544

Well was drilled under Permit No. RG-31542 and is located in the: Sandoval County

a. [illegible] ¼ [illegible] ¼ [illegible] ¼ ______ ¼ of Section 11 Township 18N Range 3E N.M.P.M.

Reversed order of ¼, ¼, ¼'s

b. Tract No. ______ of Map No. ______ of the ______

c. Lot No. ______ of Block No. ______ of the ______

Subdivision, recorded in Sandoval County.

d. X= ______ feet, Y= ______ feet, N.M. Coordinate System ______ Zone in the ______ Grant.

(B) Drilling Contractor Garcia Drilling Co. License No. WD 559

Address Star Rte., Box 327 Tijeras, N.M. 87059

Drilling Began 12-11-78 Completed 12-13-78 Type tools Rotary Size of hole 6 in.

Elevation of land surface or ______ at well is ______ ft. Total depth of well 200 ft.

Completed well is ☐ shallow ☐ artesian. Depth to water upon completion of well 150 ft.

Section 2. PRINCIPAL WATER-BEARING STRATA

Depth in Feet		Thickness in Feet	Description of Water-Bearing Formation	Estimated Yield (gallons per minute)
From	To			
190	192	2	Gravel	5-6 gal./min.

Section 3. RECORD OF CASING

Diameter (inches)	Pounds per foot	Threads per in.	Depth in Feet		Length (feet)	Type of Shoe	Perforations	
			Top	Bottom			From	To
5			1	200	200	Cup	180	200

Section 4. RECORD OF MUDDING AND CEMENTING

Depth in Feet		Hole Diameter	Sacks of Mud	Cubic Feet of Cement	Method of Placement
From	To				

Section 5. PLUGGING RECORD

Plugging Contractor ______

Address ______

Plugging Method ______

Date Well Plugged ______

Plugging approved by: ______

State Engineer Representative

STATE ENGINEER OFFICE ALBUQUERQUE

79 MAR 29 P 4: 35

No.	Depth in Feet		Cubic Feet of Cement
	Top	Bottom	
1			
2			
3			
4			

FOR USE OF STATE ENGINEER ONLY

Date Received March 29, 1979

Quad ______ FWL ______ FSL ______

File No. RG-31542 Use dom Location No. 87 SE SW 18N.3E.11

Section 6. LOG OF HOLE

Depth in Feet		Thickness in Feet	Color and Type of Material Encountered
From	To		
1	100	100	Brown clay
100	160	60	Sand rock and clay
160	180	20	Brown clay
180	182	2	Brown gravel
182	200	18	Brown sand clay

Section 7. REMARKS AND ADDITIONAL INFORMATION

The undersigned hereby certifies that, to the best of his knowledge and belief, the foregoing is a true and correct record of the above described hole.

____
Driller

INSTRUCTIONS: This form should be executed in triplicate, preferably typewritten, and submitted to the appropriate district office of the State Engineer. All sections, except Section 5, shall be answered as completely and accurately as possible when any well is drilled, repaired or deepened. When this form is used as a plugging record, only Section 1(a) and Section 5 need be completed.

STATE ENGINEER OFFICE

WELL RECORD

'92 AUG 17 AM 11 04

19

Section 1. GENERAL INFORMATION

(A) Owner of well Ed Flynn Owner's Well No. ____

Street or Post Office Address 291 Cascabel

City and State Los Alamos, N.M. 87544

Well was drilled under Permit No. RG-55658 and is located in the:

a. NW ¼ NE ¼ NW ¼ 12 ¼ of Section 12 Township 18N Range 3E N.M.P.M.

b. Tract No. ____ of Map No. ____ of the ____

c. Lot No. ____ of Block No. ____ of the ____
Subdivision, recorded in Sandoval County.

d. X= ____ feet, Y= ____ feet, N.M. Coordinate System ____ Zone in the ____ Grant.

(B) Drilling Contractor Thompson Drilling Inc. License No. [illegible]

Address [illegible] Santa Fe, N.M. [illegible]

Drilling Began [illegible] Completed [illegible] Type tools [illegible] Size of hole [illegible]" in.

Elevation of land surface or ____ at well is ____ ft. Total depth of well [illegible] ft.

Completed well is ☐ shallow ☐ artesian. Depth to water upon completion of well [illegible] ft.

Section 2. PRINCIPAL WATER-BEARING STRATA

Depth in Feet From	Depth in Feet To	Thickness in Feet	Description of Water-Bearing Formation	Estimated Yield (gallons per minute)
280	380	100	decomposed red/sandstone streaks	

Section 3. RECORD OF CASING

Diameter (inches)	Pounds per foot	Threads per in.	Depth in Feet Top	Depth in Feet Bottom	Length (feet)	Type of Shoe	Perforations From	Perforations To
[illegible]" PVC					[illegible]		[illegible]	[illegible]

Section 4. RECORD OF MUDDING AND CEMENTING

Depth in Feet From	Depth in Feet To	Hole Diameter	Sacks of Mud	Cubic Feet of Cement	Method of Placement

Section 5. PLUGGING RECORD

Plugging Contractor ____

Address ____

Plugging Method ____

Date Well Plugged ____

Plugging approved by:

____ State Engineer Representative

No.	Depth in Feet Top	Depth in Feet Bottom	Cubic Feet of Cement
1			
2			
3			
4			

FOR USE OF STATE ENGINEER ONLY

Date Received 8-17-92

Quad ____ FWL ____ FSL ____

File No. RG-55658 Use Dom. Sani Location No. 18N.3E.12.111 (Sandoval)

Depth in Feet		Thickness in Feet	Color and Type of Material Encountered
From	To		
0	3	3	surface
3	25	22	sand
25	45	20	pumice
45	55	10	clay
55	165	110	decomposed red and black
165	280	128	sandstone
280	380	100	decompoes red/sandstne streaks

Section 7. REMARKS AND ADDITIONAL INFORMATION

The undersigned hereby certifies that, to the best of his knowledge and belief, the foregoing is a true and correct record of the above described hole.

Driller

INSTRUCTIONS: This form should be executed in triplicate, preferably typewritten, and submitted to the appropriate district office of the State Engineer. All sections, except Section 5, shall be answered as completely and accurately as possible when any well is drilled, repaired or deepened. When this form is used as a plugging record, only Section 1(a) and Section 5 need be completed.

Revised June 1972

STATE ENGINEER OFFICE

WELL RECORD

(2)

10-24-89

Section 1. GENERAL INFORMATION

(A) Owner of well Thomas McKeever Owner's Well No. RG-48671
Street or Post Office Address 3585 Pueblo
City and State Los Alamos, NM 87544

Well was drilled under Permit No. RG-48671 and is located in the:

a. ___ ¼ ___ ¼ E½ ¼ W½ ¼ of Section 11 Township 18N Range 3E N.M.P.M.

b. Tract No. ___ of Map No. ___ of the ___

c. Lot No. ___ of Block No. ___ of the ___
Subdivision, recorded in Sandoval County.

d. X= ___ feet, Y= ___ feet, N.M. Coordinate System ___ Zone in the ___ Grant.

(B) Drilling Contractor Garcia Drilling License No. WD-539

Address ST.RT. BOX 327 Tijeras, NM 87059

Drilling Began 9-15-88 Completed 9-18-88 Type tools Rotary Size of hole 5 in.

Elevation of land surface or ___ at well is ___ ft. Total depth of well 300 ft.

Completed well is [XX] shallow [ ] artesian. Depth to water upon completion of well 200 ft.

Section 2. PRINCIPAL WATER-BEARING STRATA

Depth in Feet		Thickness in Feet	Description of Water-Bearing Formation	Estimated Yield (gallons per minute)
From	To			
200	300±	100	Gray Clay & Rock	10-15 gal min

Section 3. RECORD OF CASING

Diameter (inches)	Pounds per foot	Threads per in.	Depth in Feet		Length (feet)	Type of Shoe	Perforations	
			Top	Bottom			From	To
4		PVC	1	300	20	Cup	240	300

Section 4. RECORD OF MUDDING AND CEMENTING

Depth in Feet		Hole Diameter	Sacks of Mud	Cubic Feet of Cement	Method of Placement
From	To				

1989 OCT 27 P 3:54
STATE ENGINEER OFFICE
ALBUQUERQUE, N.MEX.

Section 5. PLUGGING RECORD

Plugging Contractor ___
Address ___
Plugging Method ___
Date Well Plugged ___
Plugging approved by:

___
State Engineer Representative

No.	Depth in Feet		Cubic Feet of Cement
	Top	Bottom	
1			
2			
3			
4			

FOR USE OF STATE ENGINEER ONLY

Date Received Oct. 27, 1989

Quad ___ FWL ___ FSL ___

File No. RG-48671 Use dom Location No. 18N.3E.11. E½W½ (Sand)

DUPLICATE REPORT

Depth in Feet From	Depth in Feet To	Thickness in Feet	Color and Type of Material Encountered
1	5	5	Brown SHell
5	55	50	Whitye Limestone
55	60	5	Brown Limestone
60	110	50	White Limestone
110	125	15	Brown SHell
125	135	10	White Limestone
135	137	2	Brown SHell
137	139	2	Yellow SHell
139	170	31	Brown SHell
170	173	3	White Limestone
173	176	3	Brown SHell
176	200	24	White Limestone
200	300	100	Gray Clay &Rock

Section 7. REMARKS AND ADDITIONAL INFORMATION

The undersigned hereby certifies that, to the best of his knowledge and belief, the foregoing is a true and correct record of the above described hole.

Raymond Garcia
Driller

INSTRUCTIONS: This form should be executed in triplicate, preferably typewritten, and submitted to the appropriate district office of the State Engineer. All sections, except Section 5, shall be answered as completely and accurately as possible when any well is drilled, repaired or deepened. When this form is used as a plugging record, only Section 1(a) and Section 5 need be completed.

(2)

WELL RECORD

Section 1. GENERAL INFORMATION

(A) Owner of well Tom E. Bucholz Owner's Well No. RG-40391

Street or Post Office Address Mtn Rt. Box 177

City and State Jemez Springs, NM 87025

Well was drilled under Permit No. RG-40391 and is located in the:

a. ____ ¼ E½ ¼ W½ ¼ ____ ¼ of Section 11 Township 18N Range 3E N.M.P.M.

b. Tract No. C-1 of Map No. ____ of the ____

c. Lot No. ____ of Block No. ____ of the ____ Subdivision, recorded in Sandoval County.

d. X= ____ feet, Y= ____ feet, N.M. Coordinate System ____ Zone in the ____ Grant.

(B) Drilling Contractor GARCIA DRILLING License No. WD-539

Address ST.RT. BOX 327 Tijeras, NM 87059

Drilling Began 4-29-88 Completed 5-4-88 Type tools Rotary Size of hole 7 in.

Elevation of land surface or ____ at well is ____ ft. Total depth of well 300 ft.

Completed well is [X] shallow [ ] artesian. Depth to water upon completion of well 200 ft.

Section 2. PRINCIPAL WATER-BEARING STRATA

Depth in Feet From	Depth in Feet To	Thickness in Feet	Description of Water-Bearing Formation	Estimated Yield (gallons per minute)
180	200	20	White Limestone	5-8 Gal Min
270	300	30	White LImestone	10-15 Gal Min

Section 3. RECORD OF CASING

Diameter (inches)	Pounds per foot	Threads per in.	Depth in Feet Top	Depth in Feet Bottom	Length (feet)	Type of Shoe	Perforations From	Perforations To
5		PVC	1	300	20	Cup	200	300

Section 4. RECORD OF MUDDING AND CEMENTING

Depth in Feet From	Depth in Feet To	Hole Diameter	Sacks of Mud	Cubic Feet of Cement	Method of Placement

89 SEP 21 PM 1:36
STATE ENGINEER OFFICE
DISTRICT I
ALBUQUERQUE, N.MEX.

Section 5. PLUGGING RECORD

Plugging Contractor ____

Address ____

Plugging Method ____

Date Well Plugged ____

Plugging approved by:

____
State Engineer Representative

No.	Depth in Feet Top	Depth in Feet Bottom	Cubic Feet of Cement
1			
2			
3			
4			

FOR USE OF STATE ENGINEER ONLY

Date Received 9-21-89

Quad ____ FWL ____ FSL ____

File No. RG-40391 Use Dom. San. Location No. E½, W½, T18N, R3E, Sec. 11

(Sand.)

Depth in Feet		Thickness in Feet	Color and Type of Material Encountered
From	To		
1	30	30	White Shell
30	45	15	Yellow SHell
45	50	5	White LImestone
50	70	20	Yellow SHell
70	90	20	Brown SHell
90	110	20	White Limestone
110	120	10	Gray SHell
120	125	5	White Limestone
125	155	30	Gray HSell
155	170	15	White Limestone
170	175	5	Gray SHell
175	180	5	Brown HSell
180	200	20	White LImestone
200	215	15	Brown Shell
215	220	5	Gray Limestone
220	230	10	Brown SHell
230	260	30	White LImestone
260	270	10	Gray SHell
270	300	30	White Limestone

Section 7. REMARKS AND ADDITIONAL INFORMATION

The undersigned hereby certifies that, to the best of his knowledge and belief, the foregoing is a true and correct record of the above described hole.

Raymond Garcia
Driller

INSTRUCTIONS: This form should be executed in triplicate, preferably typewritten, and submitted to the appropriate district office of the State Engineer. All sections, except Section 5, shall be answered as completely and accurately as possible when any well is drilled, repaired or deepened. When this form is used as a plugging record, only Section 1(a) and Section 5 need be completed.

STATE ENGINEER OFFICE

WELL RECORD

(2)

Section 1. GENERAL INFORMATION

(A) Owner of well Hassan Dayem Owner's Well No. 1

Street or Post Office Address 1985 Cumbres Patio Ct

City and State Los Alamos NM 87544

Well was drilled under Permit No. RG-50943 and is located in the:

a. N/A ¼ E½ ¼ W½ ¼ ____ ¼ of Section 11 Township 18N Range 3E N.M.P.M.

b. Tract No. N/A of Map No. ____ of the ____

c. Lot No. ____ of Block No. ____ of the Cierros Los Piños Subdivision, recorded in Sandoval County.

d. X= ____ feet, Y= ____ feet, N.M. Coordinate System ____ Zone in the ____ Grant.

(B) Drilling Contractor Spencers Well Drilling License No. Wd1224

Address PO Box 214 Los Alamos NM 87544-0214

Drilling Began 6-29-90 Completed 6-14-91 Type tools cabel/rotary Size of hole 6 1/8 in.

Elevation of land surface or 8,215 ft at well is same ft. Total depth of well 400 ft.

Completed well is [X] shallow [ ] artesian. Depth to water upon completion of well 315 ft.

Section 2. PRINCIPAL WATER-BEARING STRATA

Depth in Feet From	Depth in Feet To	Thickness in Feet	Description of Water-Bearing Formation	Estimated Yield (gallons per minute)
320	400	80	Basalt	8 gpm

Section 3. RECORD OF CASING

Diameter (inches)	Pounds per foot	Threads per in.	Depth in Feet Top	Depth in Feet Bottom	Length (feet)	Type of Shoe	Perforations From	Perforations To
4½	N/A	N/A	18"	345		none	345	325

Section 4. RECORD OF MUDDING AND CEMENTING

Depth in Feet From	Depth in Feet To	Hole Diameter	Sacks of Mud	Cubic Feet of Cement	Method of Placement
N/A	N/A	N/A	N/A	N/A	N/A

MAR 31 ... 58

Section 5. PLUGGING RECORD

Plugging Contractor ____

Address ____

Plugging Method ____

Date Well Plugged ____

Plugging approved by:

____ State Engineer Representative

No.	Depth in Feet Top	Depth in Feet Bottom	Cubic Feet of Cement
1			
2			
3			
4			

FOR USE OF STATE ENGINEER ONLY

Date Received 3-31-92

Quad ____ FWL ____ FSL ____

File No. RG-50943 Use Dom Location No. 18N.3E.11

(Cierros Los Pinos Subd. (Sandoval)

Depth in Feet		Thickness in Feet	Color and Type of Material Encountered
From	To		
0	18	18	Pumice
18	48	30	red unconsoledated basalt
48	110	62	black basalt
110	113	3	grey clay
113	225	12	red unconsoledated basalt
225	400	175	black basalt
400	415	15	swelling sands brown

Section 7. REMARKS AND ADDITIONAL INFORMATION

The undersigned hereby certifies that, to the best of his knowledge and belief, the foregoing is a true and correct record of the above described hole.

Driller

INSTRUCTIONS: This form should be executed in triplicate, preferably typewritten, and submitted to the appropriate district office of the State Engineer. All sections, except Section 5, shall be answered as completely and accurately as possible when any well is drilled, repaired or deepened. When this form is used as a plugging record, only Section 1(a) and Section 5 need be completed.

2

WELL RECORD

Section 1. GENERAL INFORMATION

(A) Owner of well Thomas McKeever Owner's Well No. RG-48671
Street or Post Office Address 3585 Pueblo
City and State Los Alamos NMM 87544

Well was drilled under Permit No. RG-48671 and is located in the:

a. ___ ¼ ___ ¼ E½ ¼ W½ ¼ of Section 11 Township 18N Range 3E N.M.P.M.

b. Tract No. ___ of Map No. ___ of the ___

c. Lot No. ___ of Block No. ___ of the ___
Subdivision, recorded in ___ County.

d. X= ___ feet, Y= ___ feet, N.M. Coordinate System ___ Zone in the ___ Grant.

(B) Drilling Contractor Garcias Drilling License No. WD-539

Address ST RT Box 327 Tijeras NM 87059

Drilling Began 9-15-88 Completed 9-18-88 Type tools rotary Size of hole 5 in.

Elevation of land surface or ___ at well is ___ ft. Total depth of well 300 ft.

Completed well is ☒ shallow ☐ artesian. Depth to water upon completion of well 200 ft.

Section 2. PRINCIPAL WATER-BEARING STRATA

Depth in Feet From	Depth in Feet To	Thickness in Feet	Description of Water-Bearing Formation	Estimated Yield (gallons per minute)
200	300	100	Gray Rock	10 to 15

Section 3. RECORD OF CASING

Diameter (inches)	Pounds per foot	Threads per in.	Depth in Feet Top	Depth in Feet Bottom	Length (feet)	Type of Shoe	Perforations From	Perforations To
5	pvc		1	300	20	cup	280	200

Section 4. RECORD OF MUDDING AND CEMENTING

Depth in Feet From	Depth in Feet To	Hole Diameter	Sacks of Mud	Cubic Feet of Cement	Method of Placement

89 APR 12 AM 10 24
STATE ENGINEER OFFICE
DISTRICT I
ALBUQUERQUE, N. MEX.

Section 5. PLUGGING RECORD

Plugging Contractor ___
Address ___
Plugging Method ___
Date Well Plugged ___
Plugging approved by:
___
State Engineer Representative

No.	Depth in Feet Top	Depth in Feet Bottom	Cubic Feet of Cement
1			
2			
3			
4			

FOR USE OF STATE ENGINEER ONLY

Date Received 4-12-89

Quad ___ FWL ___ FSL ___

File No. RG-48671 Use Dom Location No. E½, W½, T18N, R3E, Sec 11

(SANDOVAL)

Section 6. LOG OF HOLE

Depth in Feet		Thickness in Feet	Color and Type of Material Encountered
From	To		
1	5		BrownShell
5	55		Whiteelimestone
55	60		Brown Limestone
60	110		White Limestone
110	125		Brown Shell
125	135		White a Limestone
135	137		Brown Shell
137	139		Yellow Shell
139	170		Brown Shell
170	173		White Limestone
173	176		Brown Shell
176	200		White Limestone
200	300		Gray Rock

Section 7. REMARKS AND ADDITIONAL INFORMATION

The undersigned hereby certifies that, to the best of his knowledge and belief, the foregoing is a true and correct record of the above described hole.

[signature]
Driller

INSTRUCTIONS: This form should be executed in triplicate, preferably typewritten, and submitted to the appropriate district office of the State Engineer. All sections, except Section 5, shall be answered as completely and accurately as possible when any well is drilled, repaired or deepened. When this form is used as a plugging record, only Section 1(a) and Section 5 need be completed.

APPENDIX 2

Results of Water Sampling Event of
December 13, 1994 to December 15, 1994

**RESULTS FROM GROUND-WATER SAMPLING
AT PROPOSED EL CAJETE PUMICE MINE
SANDOVAL COUNTY, NEW MEXICO**

by

Steven T. Finch, Jr.

JOHN SHOMAKER & ASSOCIATES, INC.
Albuquerque, New Mexico

February 10, 1995

Mr. Robert Colpitts, Consulting Geologists to Copar Pumice Company, contacted John Shomaker & Associates, Inc. (JSAI) to provide a proposal for ground-water sampling tasks at the proposed El Cajete Pumice Mine. JSAI was selected to perform the work, and a professional service agreement was signed with Copar Pumice Company. The field related work started on December 13, 1994 and ended December 15, 1995.

The scope of work described in the contract with Copar Pumice Company included collecting water samples from three monitor wells and two domestic wells near La Cueva. This work included measuring the static water level in each well; setting a submersible pump near the bottom of each of the three monitor wells; purging a minimum of three well volumes of water from each well prior to sample collection; monitoring specific conductance, temperature, and pH during purging of the monitor wells; and sample collection. This report summarizes the work we performed and the analytical results.

Sampling Methods

Monitor wells MW-1 and MW-2 were purged and sampled with 1-1/2 HP stainless steel submersible pumps set with a pump rig and crew provided by T-P Pumps, Inc., Albuquerque, New Mexico. We set a pump in MW-3, but were unable to bring water to the surface, most likely a result of low well yield. Monitor well MW-3 did not produce any water and we were unable to collect a sample from this well. At the direction of Mr. Robert Colpitts, we abandoned our efforts to sample MW-3, and collected ground-water samples from three nearby domestic wells instead of two.

The three domestic water supply wells were sampled from the wellhead or from a discharge that was plumbed directly off the wellhead. All domestic wells were equipped with submersible pumps and in service.

For pumps installed in MW-1 and MW-2, we used dedicated 1-inch PVC drop pipe threaded with PVC couplings and Teflon tape. Before installation, the equipment was cleaned by the supplier and the section of drop pipe to be submersed was rinsed with deionized water. After sampling was completed, the drop-pipe and pump were removed from each monitor well and the wells were secured with locking caps.

During purging and sampling, pumped water was discharged to the ground surface approximately 10 feet from the wellhead. Samples were collected after purging a minimum of three well volumes and after the discharge became clear. Clear water indicated the well was developed and producing water from the surrounding rock. Also, trends observed in field chemical measurements during purging verified the wells were adequately developed. Specific well data are summarized in Table 1.

Table 1. Well depths, static-water levels, pump settings, and volumes purged from wells sampled at and near proposed El Cajete Pumice Mine Sandoval County, New Mexico.

well ID	well depth ft(bgl)	water level ft(bgl)	pumping setting ft(bgl)	volume purged gallons
MW-1	296	264.13[a]	290	400
MW-2	379	346.71[a]	370	60
MW-3	150	139.30[b]	148	0
RG-30359	400	294.00[c]	n/a	200
RG-30359S	400	300.00c	360	400
McKeever	n/a	280.00c	n/a	300

a measured by R. M. Colpitts on 10/7/94
b measured by JSAI on 12/13/94
c from SEO well record
n/a data not available
bgl below ground level

Static water levels for MW-1, MW-2, and MW-3 were provided by Mr. Robert Colpitts. These measurement were taken on October 10, 1994. Prior to purging, I attempted to measure static water levels in MW-1 and MW-2, but were unsuccessful due to excessive condensation inside the well casing. A water level of 139.30 ft below measuring point was measured in MW-3. Static water levels were not measured in the domestic wells because the wells were being pumping during the visit.

Field measurements of temperature, specific conductivity, pH, alkalinity, and acidity were made during purging and sampling of the monitoring wells, results are provided in Table 2. The domestic wells were assumed to be purged prior to sampling, therefore field measurements were not made during purging.

Temperature, specific conductivity, and pH were made with instruments provided by JSAI. The instruments were serviced and calibrated prior to this job. In the field, the pH meter was calibrated with fresh pH buffers between collecting samples. Measurements of total alkalinity and total acidity were made using titration kits purchased from the Hach Company.

Table 2. Field measurements of temperature, specific conductivity, pH, alkalinity, and acidity from wells sampled at and near proposed El Cajete Pumice Mine Sandoval County, New Mexico.

well id	temp. °F	pH	conductivity µmhos/cm	alkalinity mg/l	acidity mg/l
MW-1	66	6.96	110	65	<20
MW-2	60	7.02	160	90	<20
MW-3	n/a	n/a	n/a	n/a	n/a
RG-30359	58	6.77	170	80	<20
RG-30359S	70	7.19	160	80	<20
McKeever	63	6.79	120	70	<20

Sample collection and handling were performed by Steven Finch of JSAI. Laboratory analysis were performed by Analytical Technologies, Inc. (ATI). Sample bottles, preservatives, labels, and chain of custody forms were provided by ATI. Sample bottles were labeled in the field upon sample collection and custody seals were placed on each bottle. Samples were collected on December 14, 1994 and December 15, 1994, and delivered to the ATI laboratory in Albuquerque on December 19, 1994, within acceptable holding times for the analyses performed. During the holding time the samples were kept refrigerated at the JSAI office in Albuquerque. Analytical results and Chain-of-Custody documentation are appended to this report.

Ground-water samples from each well were collected in five bottles: one 1,000-ml plastic bottle without preservative for general chemistry analysis; one 125-ml plastic bottle without preservative for pH analysis; one 1,000-ml plastic bottle preserved with nitric acid, for metal analysis; and two 40-ml vials preserved with hydrochloric acid, for analysis of total petroleum hydrocarbons.

Sampling Results

Laboratory analyses on the ground-water samples included pH, specific conductance, calcium, magnesium, sodium, potassium, chloride, sulfate, alkalinity, chromium, copper, cadmium, lead, silver, mercury, zinc, arsenic, fluoride, silica, and total petroleum hydrocarbons (Environmental Protection Agency method modified 8015(D)). The samples were analyzed using Environmental Protection Agency or equivalent methods. The relative percent difference for quality control duplicate analysis met ATI acceptance criteria.

All of the monitor wells and domestic wells sampled have similar ground-water chemistry. Ground-water in the vicinity of the wells sampled appears to be low-ionic-strength sodium-bicarbonate or calcium-bicarbonate type water. Total dissolved solids ranged from 90 to 118 mg/l. Field measurements of specific conductance, pH, and alkalinity were compared to the laboratory measurements. Specific conductivity measurements were almost identical, but as expected, pH measurements were lower in the field than in the lab and alkalinity measurements were approximately 20 percent higher in the field than in the lab. The difference is probably due to changes in temperature and atmospheric pressure between the sample location and laboratory.

Relatively high concentrations of chromium were found in samples from MW-1 (0.059 mg/l) and MW-2 (0.085 mg/l). These chromium concentrations are above the New Mexico Ground-Water Quality Standard of 0.05 mg/l, but below the U. S. Environmental Protection Agency drinking water standards of 0.1 mg/l. I suspect that the high concentrations of chromium was a result of erosion of the stainless steel pump impellers. It is possible that during development and subsequent pumping of sand, the impellers, bearings, and bushings were eroded resulting in traces of chrome in the discharge. Water from the domestic wells had similar chemistries, but did not have detectable chromium.

APPENDIX

Analytical Results

Analytical Technologies, Inc.

2709-D Pan American Freeway, NE Albuquerque, NM 87107
Phone (505) 344-3777 FAX (505) 344-4413

ATI I.D. 412389

January 9, 1995

John Shomaker & Associates
2703-D Broadbent Parkway NE
Albuquerque, NM 87107

Project Name/Number: COPAR

Attention: Steve Finch

On **12/19/94**, Analytical Technologies, Inc., (ADHS License No. AZ0015), received a request to analyze **aqueous** samples. The samples were analyzed with EPA methodology or equivalent methods. The results of these analyses and the quality control data, which follow each set of analyses, are enclosed.

The relative percent difference (RPD) for quality control duplicate analyses for lead meets ATI acceptance criteria; the results are <5X the reporting limit.

EPA Method 150.1 (pH) and EPA Method 8015 analyses were performed by Analytical Technologies, Inc., Albuquerque, NM.

All other analyses were performed by Analytical Technologies, Inc., 9830 S. 51st Street, Suite B-113, Phoenix, AZ.

If you have any questions or comments, please do not hesitate to contact us at (505) 344-3777.

Letitia Krakowski, Ph.D.
Project Manager

H. Mitchell Rubenstein, Ph.D.
Laboratory Manager

MR:jt

Enclosure

Analytical Technologies, Inc.

CLIENT	: JOHN SHOMAKER & ASSOC.	DATE RECEIVED	: 12/19/94
PROJECT #	: (NONE)		
PROJECT NAME	: COPAR	REPORT DATE	: 01/09/95

ATI ID: 412389

ATI #	CLIENT DESCRIPTION	MATRIX	DATE COLLECTED
01	MW-1	AQUEOUS	12/15/94
02	MW-2	AQUEOUS	12/14/94
03	MCKEEVER #1	AQUEOUS	12/14/94
04	RG-30359S	AQUEOUS	12/14/94
05	RG-30359	AQUEOUS	12/14/94

---TOTALS---

MATRIX	#SAMPLES
AQUEOUS	5

ATI STANDARD DISPOSAL PRACTICE

The samples from this project will be disposed of in thirty (30) days from the date of this report. If an extended storage period is required, please contact our sample control department before the scheduled disposal date.

Analytical Technologies, Inc.

GENERAL CHEMISTRY RESULTS

CLIENT	: JOHN SHOMAKER & ASSOC.	ATI I.D.	: 412389
PROJECT #	: (NONE)	DATE RECEIVED	: 12/19/94
PROJECT NAME	: COPAR	DATE ANALYZED	: 12/20/94

PARAMETER	UNITS	01	02	03	04
PH (150.1)	UNITS	8.21	7.90	7.88	7.95

Analytical Technologies, Inc.

GENERAL CHEMISTRY RESULTS

CLIENT	: JOHN SHOMAKER & ASSOC.	ATI I.D.	: 412389
PROJECT #	: (NONE)	DATE RECEIVED	: 12/19/94
PROJECT NAME	: COPAR	DATE ANALYZED	: 12/20/94

PARAMETER	UNITS	05
PH (150.1)	UNITS	7.63

Analytical Technologies, Inc.

GENERAL CHEMISTRY - QUALITY CONTROL

CLIENT : JOHN SHOMAKER & ASSOC.
PROJECT # : (NONE)
PROJECT NAME : COPAR

ATI I.D. : 412389
SAMPLE MATRIX : AQUEOUS

PARAMETER	UNITS	ATI I.D.	SAMPLE RESULT	DUP. RESULT	RPD	SPIKED SAMPLE	SPIKE CONC.	% REC
PH	UNITS	41236104	8.91	8.97	0.7	NA	NA	NA

$$\% \text{ Recovery} = \frac{(\text{Spike Sample Result} - \text{Sample Result})}{\text{Spike Concentration}} \times 100$$

$$\text{RPD (Relative Percent Difference)} = \frac{(\text{Sample Result} - \text{Duplicate Result})}{\text{Average Result}} \times 100$$

Analytical Technologies, Inc.

GENERAL CHEMISTRY RESULTS

ATI I.D. : 412389

LIENT : JOHN W. SHOMAKER, INC.
DATE RECEIVED : 12/19/94

OJECT # : (NONE)

OJECT NAME : COPAR
REPORT DATE : 01/09/95

ARAMETER	UNITS	01	02	03	04	05
RBONATE (CACO3)	MG/L	<1	<1	<1	<1	<1
ICARBONATE (CACO3)	MG/L	56	57	57	76	72
DROXIDE (CACO3)	MG/L	<1	<1	<1	<1	<1
TAL ALKALINITY (AS CACO3)	MG/L	56	57	57	76	72
LORIDE (EPA 325.2)	MG/L	1.7	2.6	1.7	2.4	2.5
ONDUCTIVITY, (UMHOS/CM)		122	155	125	162	165
JORIDE (EPA 340.2)	MG/L	0.60	0.70	0.61	0.16	0.25
LFATE (EPA 375.2)	MG/L	<5	<5	<5	<5	<5

Analytical Technologies, Inc.

GENERAL CHEMISTRY - QUALITY CONTROL

CLIENT : JOHN W. SHOMAKER, INC.
PROJECT # : (NONE)
PROJECT NAME : COPAR

ATI I.D. : 412389

PARAMETER	UNITS	ATI I.D.	SAMPLE RESULT	DUP. RESULT	RPD	SPIKED SAMPLE	SPIKE CONC	% REC
CARBONATE	MG/L	41238901	<1	<1	NA	NA	NA	NA
BICARBONATE	MG/L		56	55	2	NA	NA	NA
HYDROXIDE	MG/L		<1	<1	NA	NA	NA	NA
TOTAL ALKALINITY	MG/L		56	55	2	NA	NA	NA
CHLORIDE	MG/L	41272101	330	330	0	720	400	98
CHLORIDE	MG/L	41238904	2.4	2.5	4	12.2	10.0	98
CONDUCTIVITY(UMHOS/CM)		41238902	155	156	0.6	NA	NA	NA
CONDUCTIVITY(UMHOS/CM)		41273003	674	688	2	NA	NA	NA
FLUORIDE	MG/L	41238905	0.25	0.26	4	0.79	0.50	108
SULFATE	MG/L	41250907	7	7	0	24	20	85

$$\% \text{ Recovery} = \frac{(\text{Spike Sample Result} - \text{Sample Result})}{\text{Spike Concentration}} \times 100$$

$$\text{RPD (Relative Percent Difference)} = \frac{(\text{Sample Result} - \text{Duplicate Result})}{\text{Average Result}} \times 100$$

Analytical Technologies, Inc.

METALS RESULTS

ATI I.D. : 412389

IENT : JOHN W. SHOMAKER, INC. DATE RECEIVED : 12/19/94
JECT # : (NONE)
JECT NAME : COPAR REPORT DATE : 01/09/95

RAMETER	UNITS	01	02	03	04	05
VER (EPA 200.7/6010)	MG/L	<0.010	<0.010	<0.010	<0.010	<0.010
SENIC (EPA 206.2/7060)	MG/L	<0.005	<0.005	<0.005	<0.005	<0.005
CIUM (EPA 200.7/6010)	MG/L	10.2	11.4	10.4	16.4	17.2
MIUM (EPA 213.2/7131)	MG/L	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
ROMIUM (EPA 200.7/6010)	MG/L	0.059	0.085	<0.010	<0.010	<0.010
PPER (EPA 200.7/6010)	MG/L	<0.010	<0.010	<0.010	<0.010	<0.010
RCURY (EPA 245.1/7470)	MG/L	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
TASSIUM (EPA 200.7/6010)	MG/L	5.0	5.6	4.5	4.1	4.8
GNESIUM (EPA 200.7/6010)	MG/L	2.2	2.8	2.2	5.5	4.2
DIUM (EPA 200.7/6010)	MG/L	13.6	18.4	14.1	12.9	13.4
AD (EPA 239.2/7421)	MG/L	<0.002	0.003	<0.002	<0.002	0.004
LICA (EPA 200.7/6010)	MG/L	70.2	51.3	65.7	68.2	67.0
NC (EPA 200.7/6010)	MG/L	<0.050	0.128	<0.050	<0.050	0.140

Analytical Technologies, Inc.

METALS - QUALITY CONTROL

IENT : JOHN W. SHOMAKER, INC.
OJECT # : (NONE)
ROJECT NAME : COPAR   ATI I.D. : 412389

ARAMETER	UNITS	ATI I.D.	SAMPLE RESULT	DUP. RESULT	RPD	SPIKED SAMPLE	SPIKE CONC	% REC
LVER	MG/L	41238903	<0.010	<0.010	NA	0.477	0.500	95
RSENIC	MG/L	41238902	<0.005	<0.005	NA	0.050	0.050	100
LCIUM	MG/L	41238903	10.4	10.5	1	64.4	50.0	108
DMIUM	MG/L	41238902	<0.0005	<0.0005	NA	0.0045	0.0050	90
HROMIUM	MG/L	41238903	<0.010	<0.010	NA	1.04	1.00	104
PPER	MG/L	41238903	<0.010	<0.010	NA	0.487	0.500	97
RCURY	MG/L	41238905	<0.0002	<0.0002	NA	0.0052	0.0050	104
TASSIUM	MG/L	41238903	4.5	4.9	9	54.2	50.0	99
AGNESIUM	MG/L	41238903	2.2	2.2	0	29.0	25.0	107
DIUM	MG/L	41238903	14.1	14.3	1	63.9	50.0	100
AD	MG/L	41238902	0.003	0.004	29	0.051	0.050	96
ILICA	MG/L	41238903	65.7	65.9	0.3	86.0	21.4	95
NC	MG/L	41238903	<0.050	<0.050	NA	0.548	0.500	110

$$\text{Recovery} = \frac{\text{(Spike Sample Result - Sample Result)}}{\text{Spike Concentration}} \times 100$$

$$\text{D (Relative Percent Difference)} = \frac{\text{(Sample Result - Duplicate Result)}}{\text{Average Result}} \times 100$$

Analytical Technologies, Inc.

GAS CHROMATOGRAPHY RESULTS

TEST : EPA 8015 MODIFIED
CLIENT : JOHN SHOMAKER & ASSOC. ATI I.D.: 412389
PROJECT # : (NONE)
PROJECT NAME : COPAR

SAMPLE ID. #	CLIENT I.D.	MATRIX	DATE SAMPLED	DATE EXTRACTED	DATE ANALYZED	DIL. FACTOR
04	RG-30359S	AQUEOUS	12/14/94	12/21/94	12/23/94	1
05	RG-30359	AQUEOUS	12/14/94	12/21/94	12/24/94	1

PARAMETER	UNITS	04	05
FUEL HYDROCARBONS	MG/L	<1	<1
HYDROCARBON RANGE		-	-
HYDROCARBONS QUANTITATED USING		-	-
SURROGATE:			
O-TERPHENYL (%)		110	110

Analytical Technologies, Inc.

GAS CHROMATOGRAPHY RESULTS

REAGENT BLANK

TEST	: EPA 8015 MODIFIED	ATI I.D.	: 412389
BLANK I.D.	: 122194B	MATRIX	: AQUEOUS
CLIENT	: JOHN SHOMAKER & ASSOC.	DATE EXTRACTED	: 12/21/94
PROJECT #	: (NONE)	DATE ANALYZED	: 12/23/94
PROJECT NAME	: COPAR	DILUTION FACTOR	: 1

PARAMETER	UNITS	
FUEL HYDROCARBONS	MG/L	<1
HYDROCARBON RANGE		-
HYDROCARBONS QUANTITATED USING		-
SURROGATE:		
O-TERPHENYL (%)		108

Analytical Technologies, Inc.

GAS CHROMATOGRAPHY - QUALITY CONTROL

MSMSD

TEST	: EPA 8015 MODIFIED		
MSMSD #	: 122194B	ATI I.D.	: 412389
CLIENT	: JOHN SHOMAKER & ASSOC.	DATE EXTRACTED	: 12/21/94
PROJECT #	: (NONE)	DATE ANALYZED	: 12/23/94
PROJECT NAME	: COPAR	SAMPLE MATRIX	: AQUEOUS
REF. I.D.	: 122194B	UNITS	: MG/L

PARAMETER	SAMPLE RESULT	CONC SPIKE	SPIKED SAMPLE	% REC	DUP SPIKE	DUP % REC	RPD
FUEL HYDROCARBONS	<1	34	36	106	35	103	3

$$\% \text{ Recovery} = \frac{(\text{Spike Sample Result} - \text{Sample Result})}{\text{Spike Concentration}} \times 100$$

$$\text{RPD (Relative Percent Difference)} = \frac{(\text{Sample Result} - \text{Duplicate Result})}{\text{Average Result}} \times 100$$

Analytical Technologies, Inc., Albuquerque, NM
San Diego • Phoenix • Seattle • Pensacola • Ft. Collins • Portland • Albuquerque

CHAIN OF CUSTODY

DATE: 12/19/94 PAGE 1 OF 1

ATI LAB I.D. 412389

PLEASE FILL THIS FORM IN COMPLETELY. SHADED AREAS ARE FOR LAB USE ONLY.

PROJECT MANAGER: Steve Finch

COMPANY: John Shomaker & Assoc.
ADDRESS: 2703-B Broadbent Parkway NE
Albuquerque, NM 87107
PHONE: (505) 345-3407
FAX: (505) 345-9920

BILL TO:
COMPANY:
ADDRESS:

ANALYSIS REQUEST

SAMPLE ID	DATE	TIME	MATRIX	LAB ID	Petroleum Hydrocarbons (418.1)	(MOD 8015) Gas/Diesel (d)	Diesel/Gasoline/BTXE/MTBE (MOD 8015/8020)	BTXE/MTBE (8020)	pH Specific Cond	Ca, Mg, Na, K, Cl, SO4, Alk	Chlorinated Hydrocarbons (601/8010)	Aromatic Hydrocarbons (602/8020)	SDWA Volatiles (502.1/503.1), 502.2 Reg. & Unreg.	Cr, Cu, Cd, Pb, Ag, Zn, As, Hg	Flouride, Silica	Pesticides/PCB (608/8080)	Herbicides (615/8150)	Base/Neutral/Acid Compounds GC/MS (625/8270)	Volatile Organics GC/MS (624/8240)	Polynuclear Aromatics (610/8310)	SDWA Primary Standards - Arizona	SDWA Secondary Standards - Arizona	SDWA Primary Standards - Federal	SDWA Secondary Standards - Federal	The 13 Priority Pollutant Metals	RCRA Metals by Total Digestion	RCRA Metals by TCLP (1311)
MW-1	12/15/94	13:00	water	01		X			X	X				X	X												
MW-2	12/14/94	13:30	water	02		X			X	X				X	X												
McKeever #1	12/14/94	13:40	water	03		X			X	X				X	X												
RG-303595	12/14/94	11:30	water	04		X			X	X				X	X												
RG 30359	12/14/94	15:10	water	05		X			X	X				X	X												

PROJECT INFORMATION

PROJ NO:
PROJ NAME: COPAR
P.O. NO.:
SHIPPED VIA:

SAMPLE RECEIPT

NO CONTAINERS: 25
CUSTODY SEALS: (Y) / N / NA
RECEIVED INTACT: Y
RECEIVED COLD: Y

PRIOR AUTHORIZATION IS REQUIRED FOR RUSH PROJECTS

(RUSH) ☐ 24hr ☐ 48hr ☐ 72hr ☐ 1 WEEK (NORMAL) ☑ 2 WEEK

Comments:

SAMPLED & RELINQUISHED BY: 1.
Signature: [signature] Time: 13 50
Printed Name: Steve Finch Date: 12/19/94
Company: Phone:

RELINQUISHED BY: 2.
Signature: Time:
Printed Name: Date:
Company:

RELINQUISHED BY: 3.
Signature: Time:
Printed Name: Date:
Company:

RECEIVED BY: 1.
Signature: Time:
Printed Name: Date:
Company:

RECEIVED BY: 2.
Signature: Time:
Printed Name: Date:
Company:

RECEIVED BY: (LAB) 3.
Signature: D. Cutler Time: 1330
Printed Name: Diann Cutler Date: 12/19/
Analytical Technologies, Inc.

Chain of Custody

DATE 12/19/94 PAGE 1 OF 1

NETWORK PROJECT MANAGER: LETITIA KRAKOWSKI

COMPANY: Analytical Technologies, Inc.
ADDRESS: 2709-D Pan American Freeway, NE
Albuquerque, NM 87107

* Ph Checked

CLIENT PROJECT MANAGER:

ANALYSIS REQUEST

SAMPLE ID	DATE	TIME	MATRIX	LAB ID	EC, Alk, SO4, Cl, K, Na, Mg, Ca	Cr, Cd, Pb, Fe, Mn, As, Hg	Fl, Silica	NUMBER OF CONTAINERS
412369-01	12/15	1300	AQ	1	✓	X	X	2
-02	12/14	1330	↓	2	✓	X	X	2
-03	↓	1540	↓	3	✓	X	X	2
-04	↓	1420	↓	4	✓	X	X	2
-05	↓	1510	↓	5	✓	X	X	2

Other analysis columns (no entries): TOX; TOC; ORGANIC LEAD; SULFIDE; SURFACTANTS (MBAS); 632/632 MOD; 619/619 MOD; 610/8310; 8240 (TCLP 1311) ZHE; Diesel/Gasoline/BTXE/MTBE/ (MOD 8015/8020); Volatile Organics GC/MS (624/8240); NACE; ASBESTOS; BOD; TOTAL COLIFORM; FECAL COLIFORM; GROSS ALPHA/BETA; RADIUM 226/228; AIR - O2, CO2, METHANE; AIR/Diesel/Gasoline/BTXE/ (MOD 8015/8020)

PROJECT INFORMATION

PROJECT NUMBER: 412369
PROJECT NAME: [illegible] STW
QC LEVEL: (STD.) IV
QC REQUIRED: MS MSD BLANK
TAT: (STANDARD) RUSH!
DUE DATE: 1/4
RUSH SURCHARGE: 0
CLIENT DISCOUNT: 10 %

SAMPLE RECEIPT

TOTAL NUMBER OF CONTAINERS	10
CHAIN OF CUSTODY SEALS	✓
INTACT?	✓
RECEIVED GOOD COND./COLD	✓
LAB NUMBER	412389

WO# LK[illegible] 1183

SAMPLES SENT TO

SAN DIEGO
FT. COLLINS
RENTON
PENSACOLA
PORTLAND
PHOENIX X
FIBERQUANT

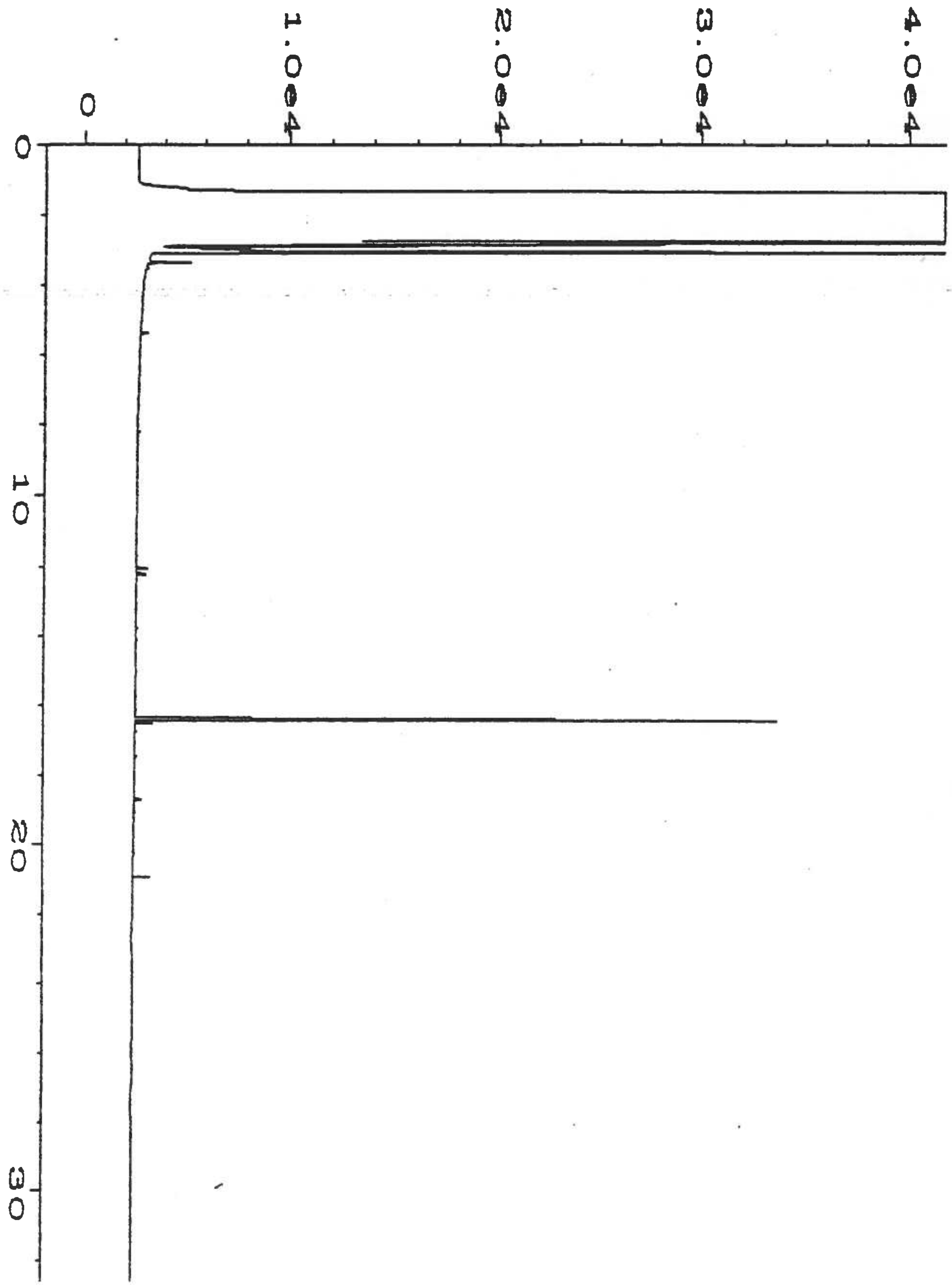
RELINQUISHED BY: 1.
Signature: [signature] Time: 1730
Printed Name: Dianne Cutler Date: 12/19/94
Analytical Technologies, Inc.
Albuquerque

RECEIVED BY: (LAB) 1.
Signature: Time:
Printed Name: Date:
Company:

RELINQUISHED BY: 2.
Signature: Time:
Printed Name: Date
Company:

RECEIVED BY: (LAB) 2.
Signature: [signature] Time: 957A
Printed Name: Linda Eshelman Date: 12/20/94
Company: ATI

ATI Labs: San Diego (619) 458-9141 • Phoenix (602) 496-4400 • Seattle (206) 228-8335 • Pensacola (904) 474-1001 • Portland (503) 684-0447 • Albuquerque (505) 344-3777 DISTRIBUTION: White, Canary - ATI • Pink - ORIGINATOR

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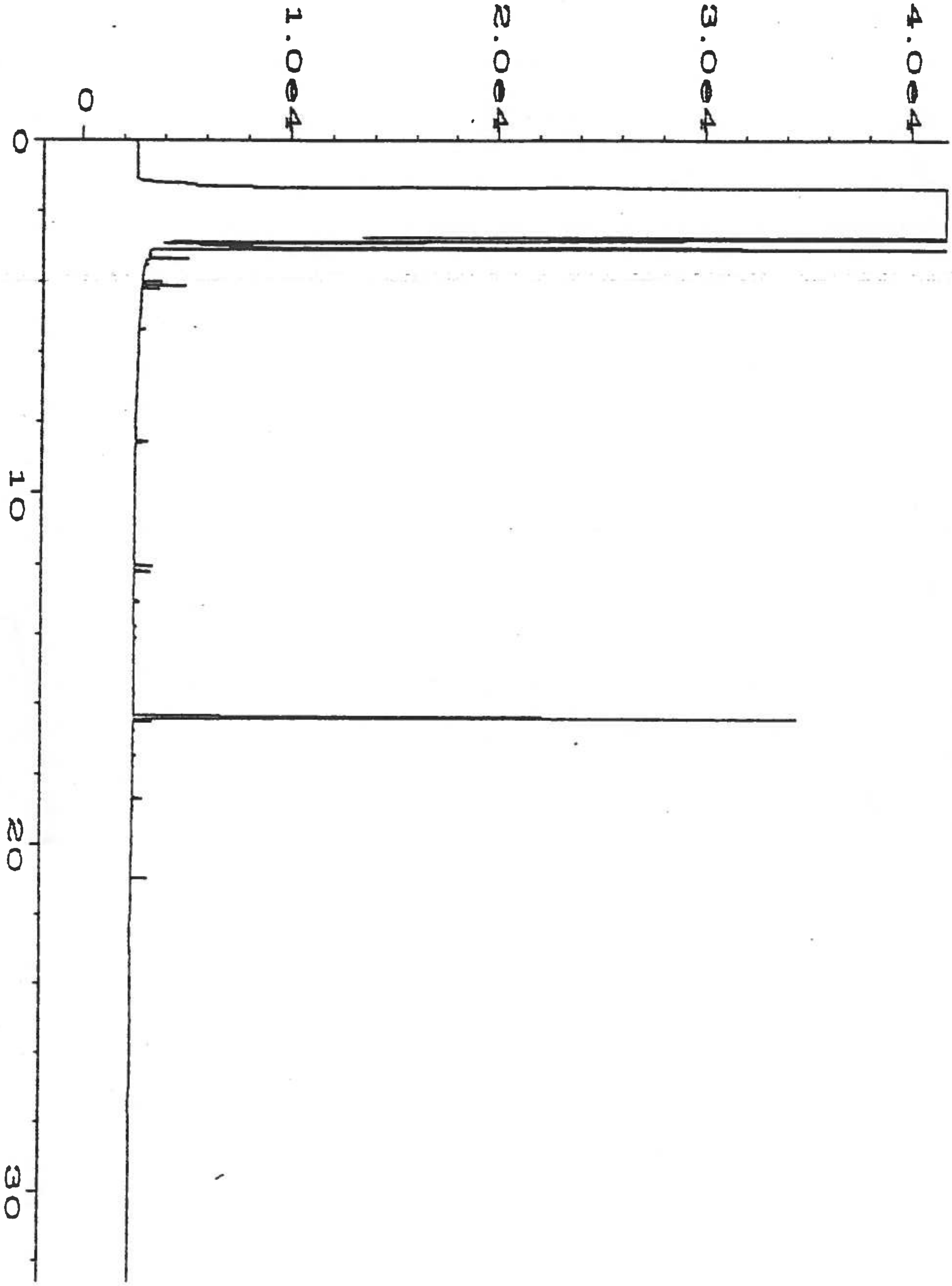

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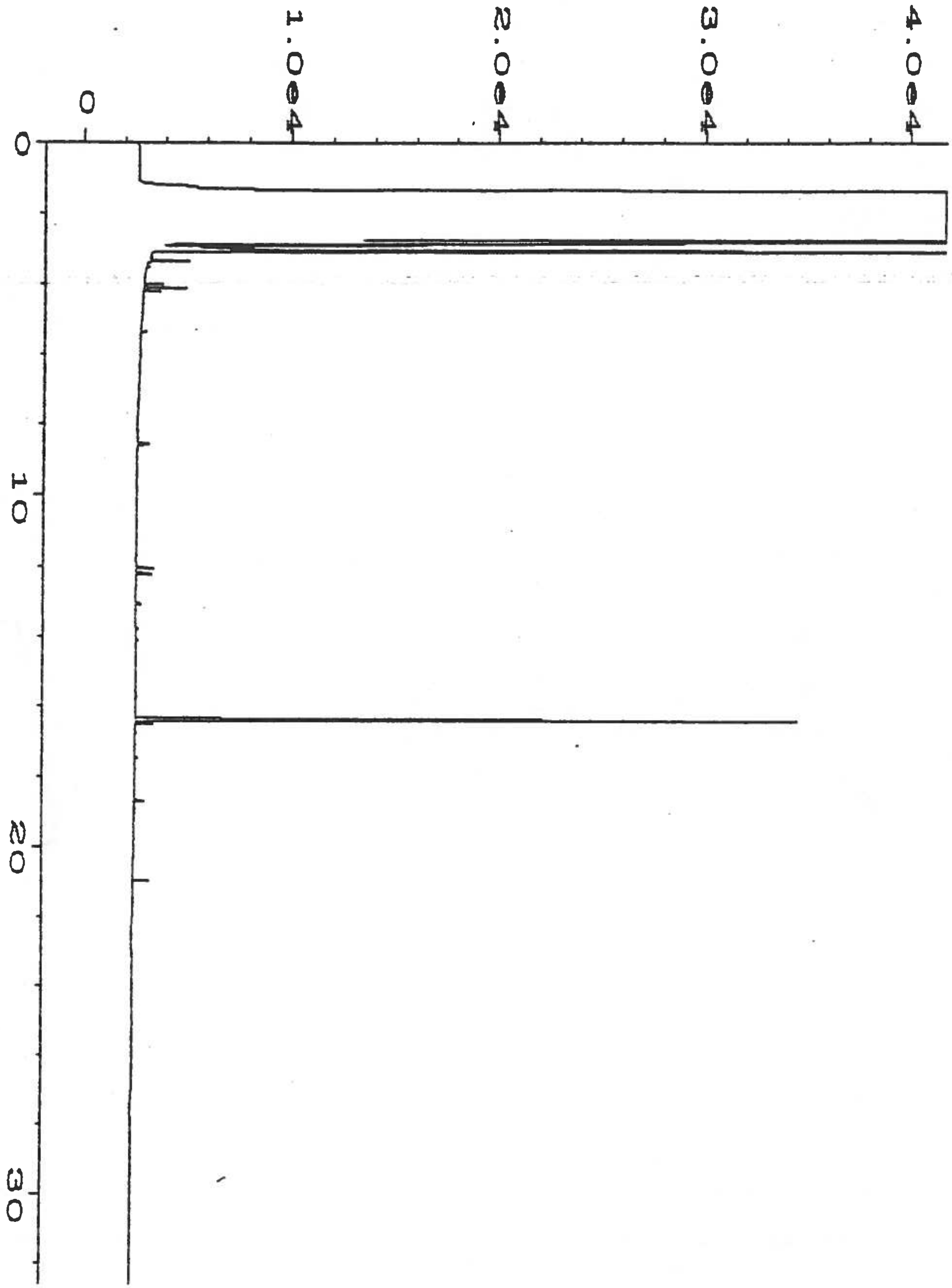

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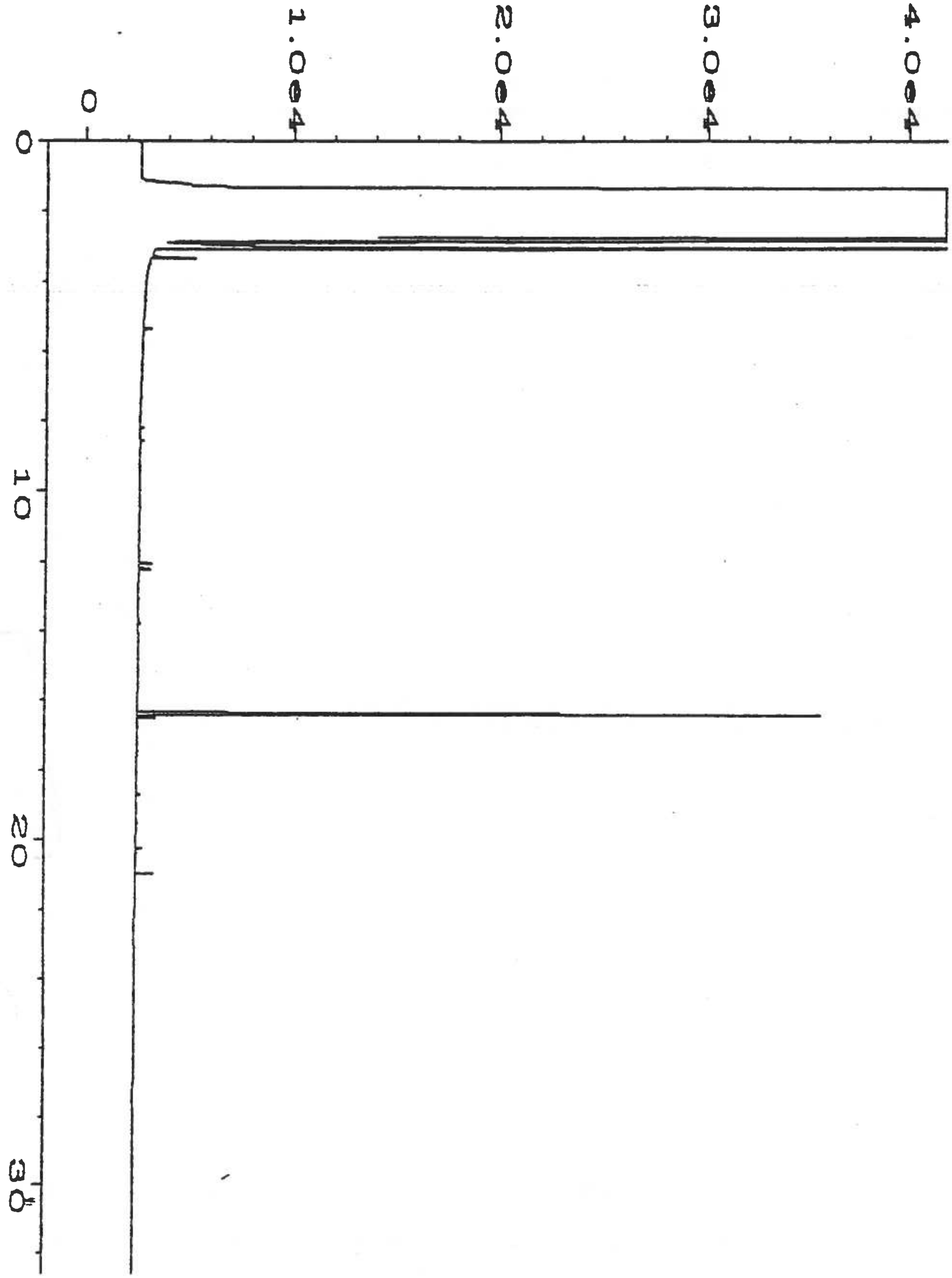

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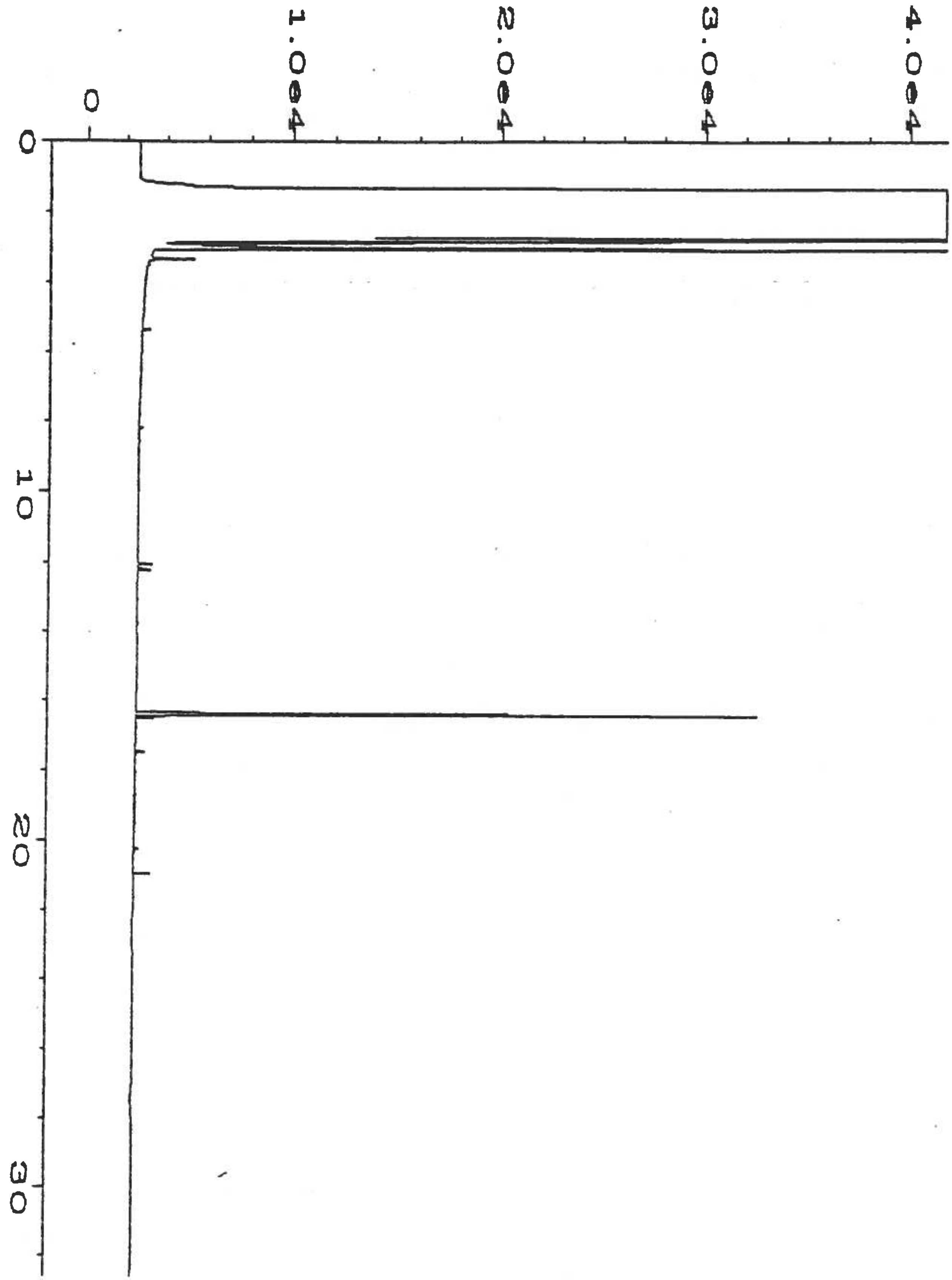

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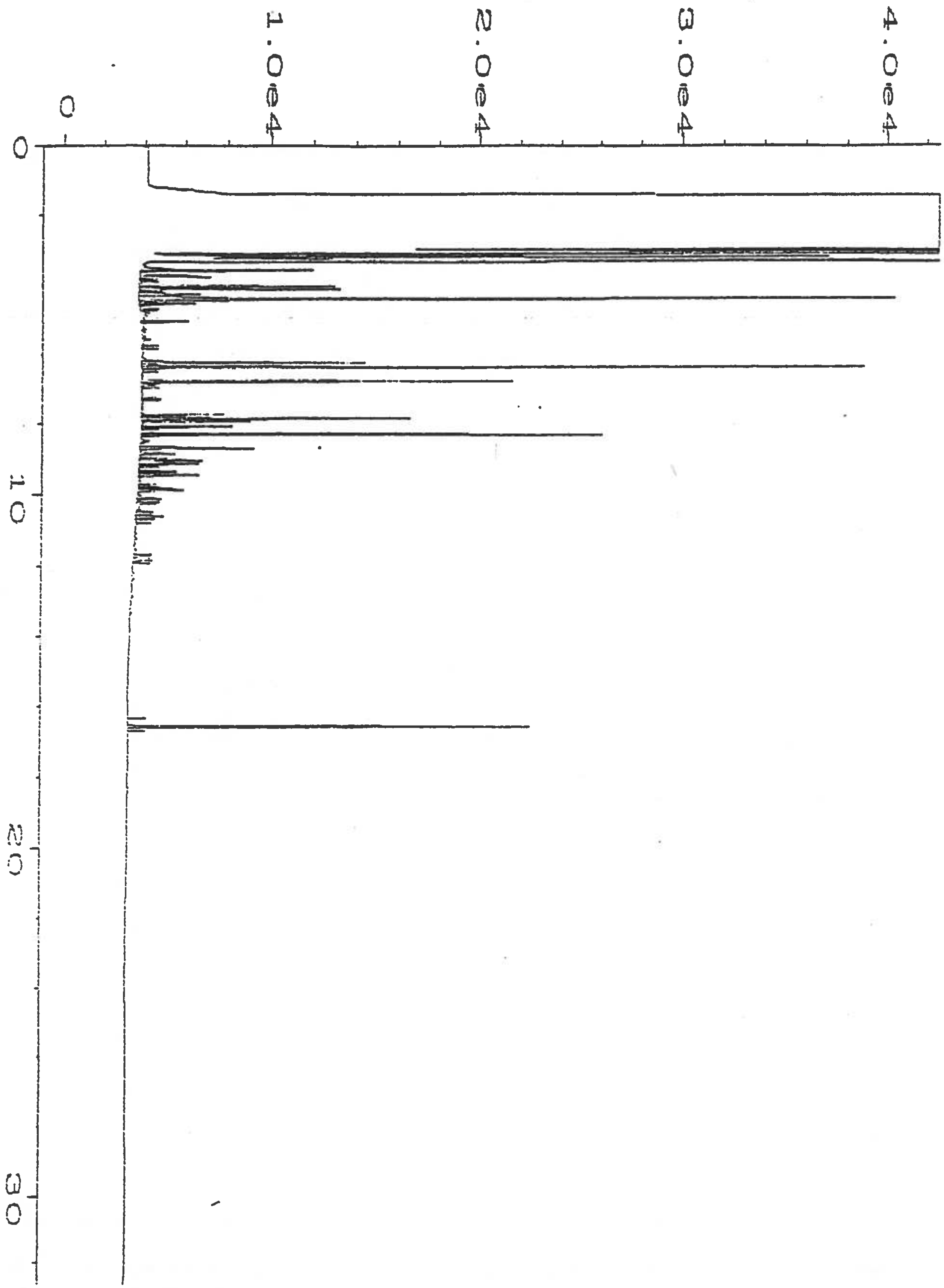

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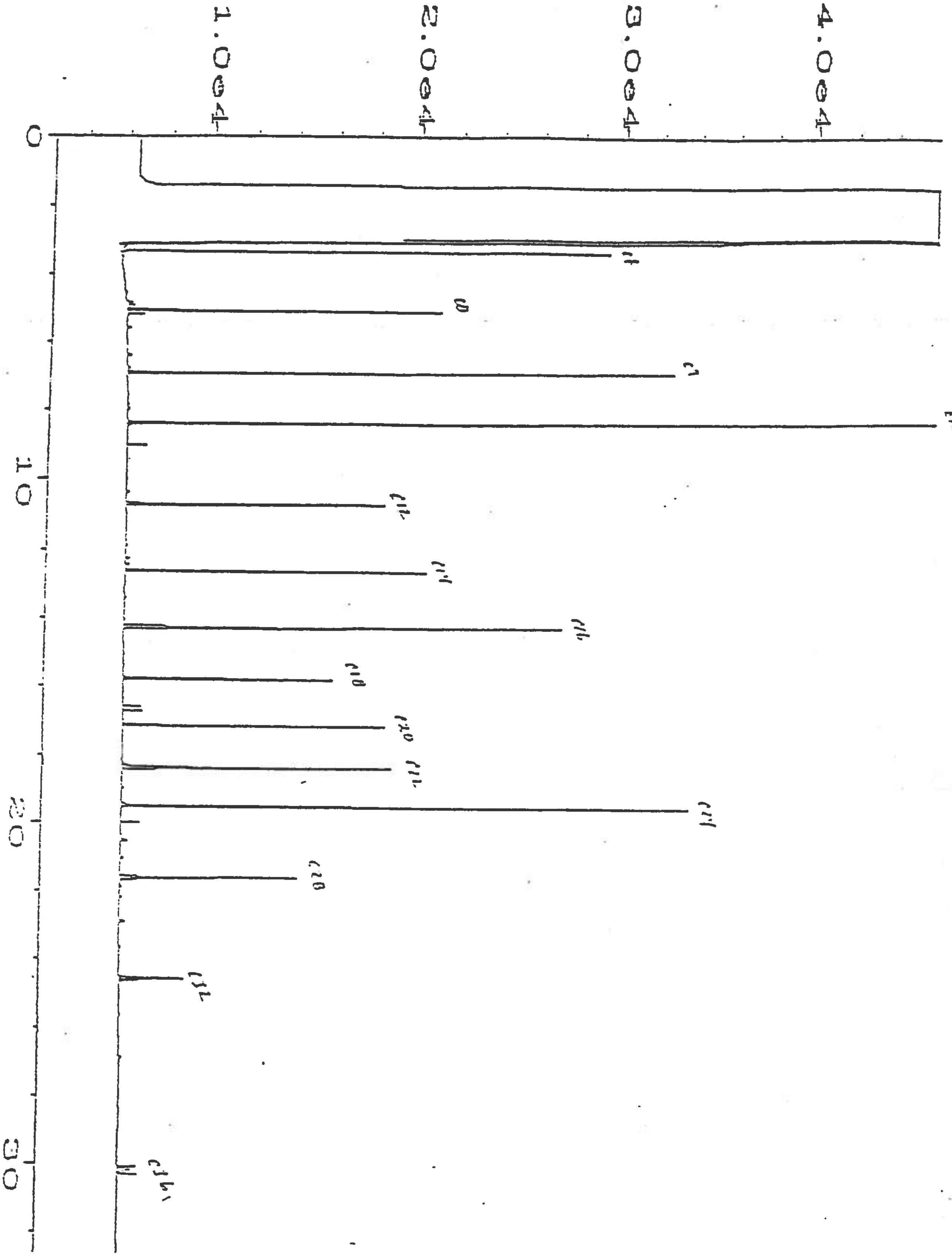

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Report Created on: 01 Apr 94 07:03 PM
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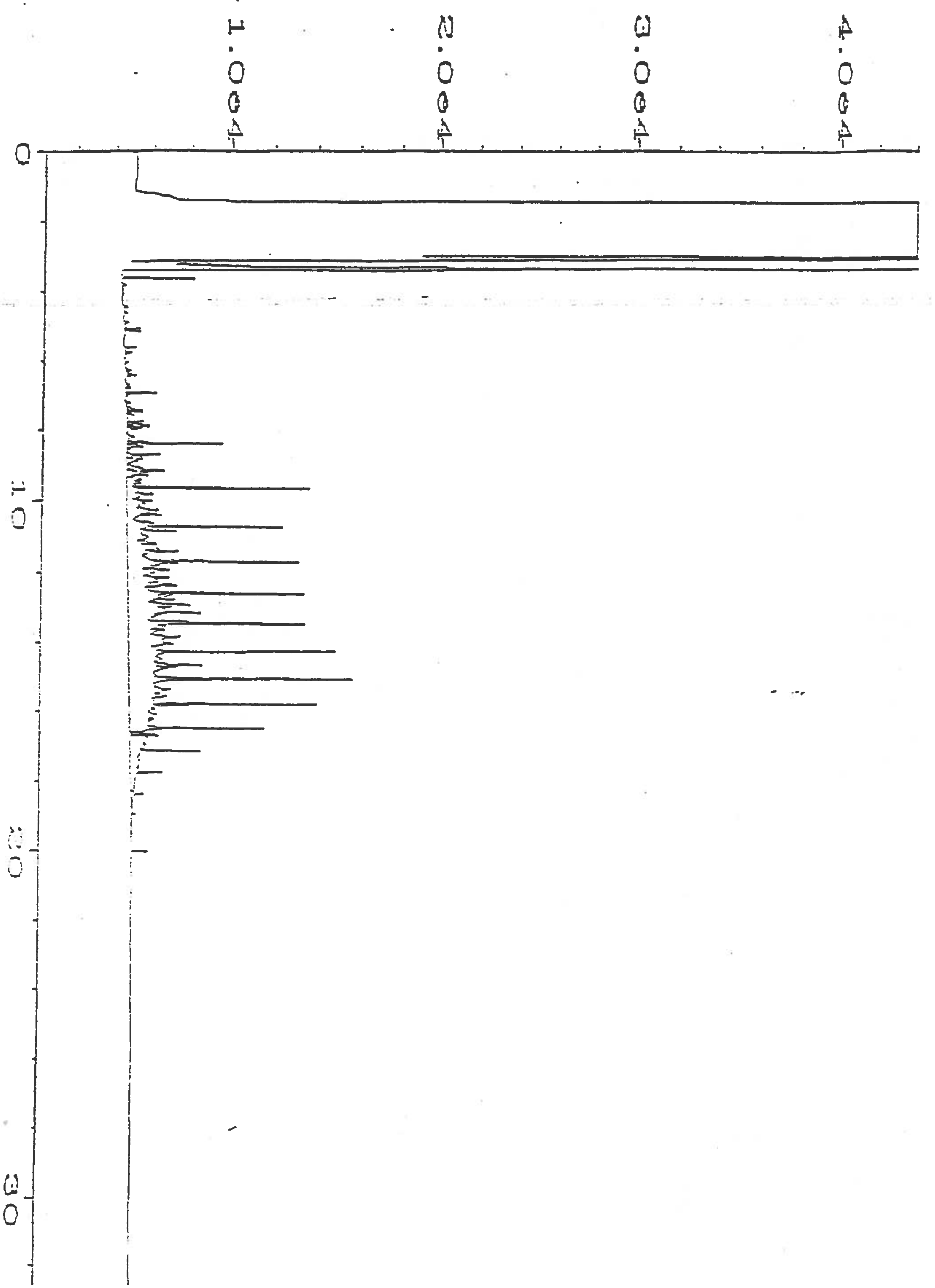

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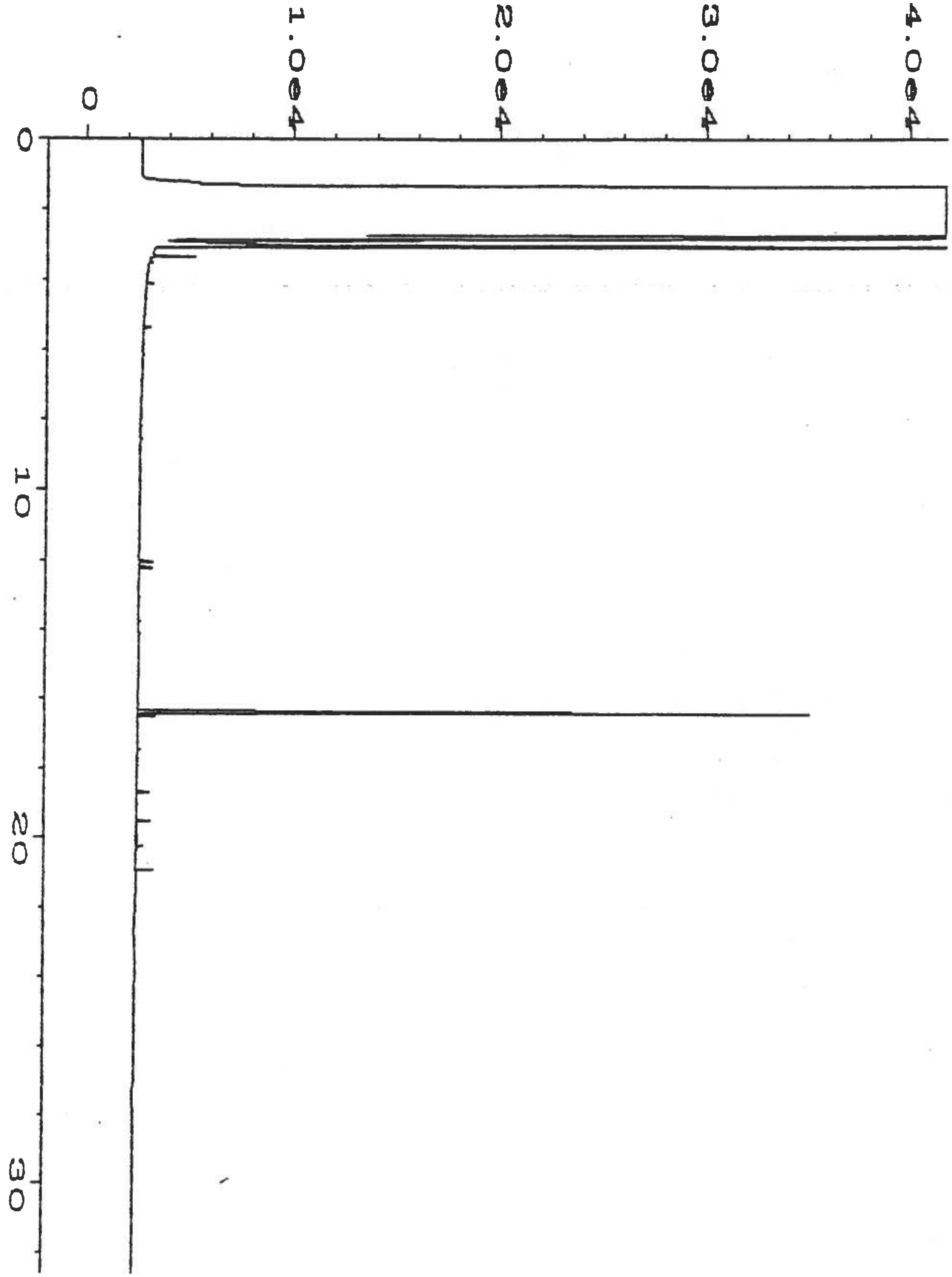

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Report Created on:	24 Dec 94 01:23 AM	Analysis Method	: SDF1219.MTH

Attachment 3

Proof of Public Notice