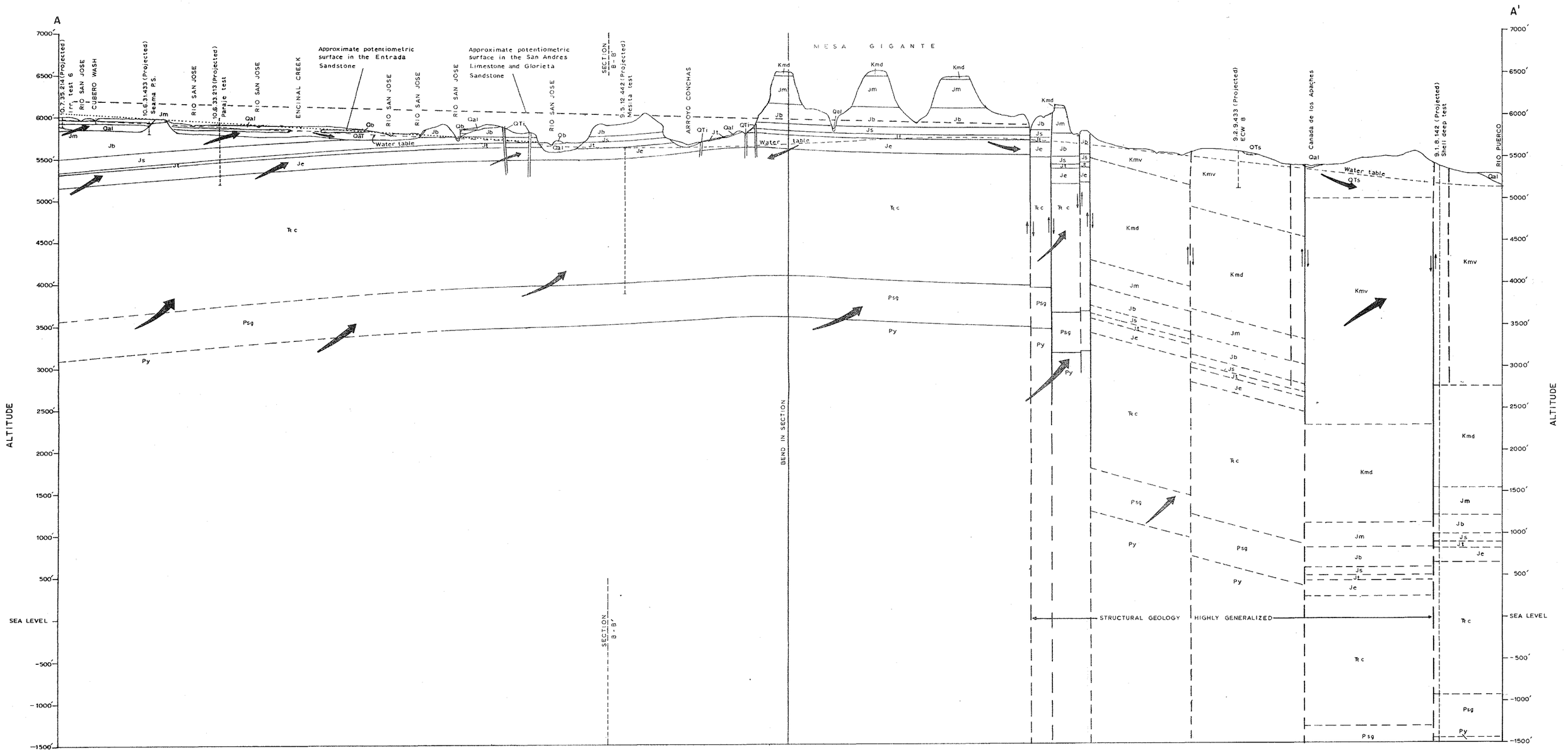

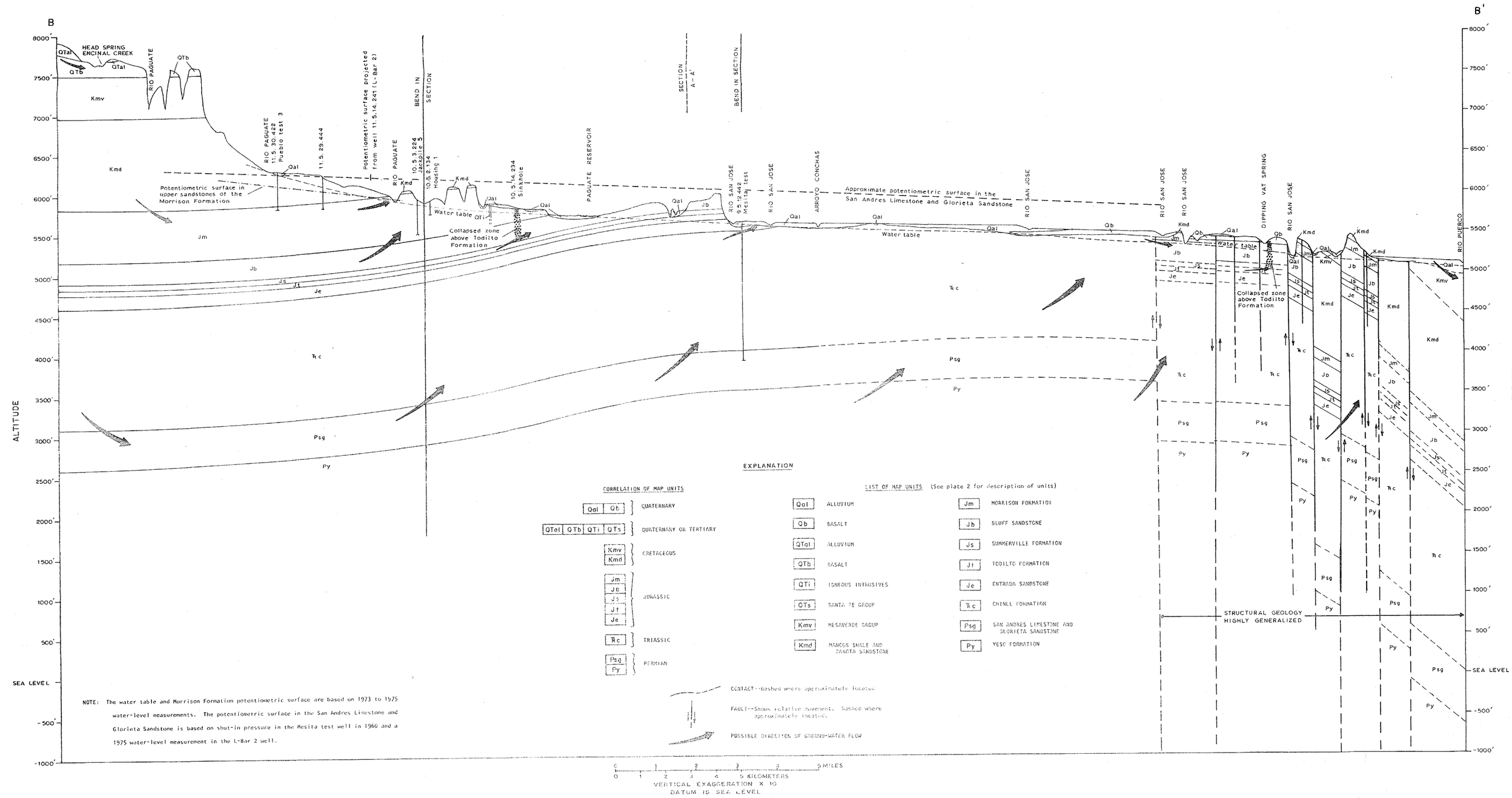

Plate 3.--Geologic sections showing potentiometric surfaces, water table, and possible ground-water-flow directions on and near the Pueblo of Laguna, New Mexico.

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The Anaconda Company
Environmental Monitoring Data
Correspondence

350002182

ANACONDA Minerals Co. ny
New Mexico Operations
P.O. Box 638
Grants, New Mexico 87020
Telephone 505 876 2211

July 3, 1986

Minerals Staff
Rio Puerco Resource Area
Bureau of Land Management
3550 Pan American Freeway, N.E.
P. O. Box 6770
Albuquerque, N.M. 87107

Dear Sir:

Following are the sampling data of the Second Quarter (April-June) 1986 for Anaconda's former Jackpile Minesite leases.

1. Chemical and Radiological Analysis for Surface Water.
2. Maps Showing Surface Water Sampling Locations.
3. Chemical and Radiological Analysis of Groundwater.
4. Map of Groundwater Monitoring Locations.
5. Results of the Air Monitoring Program including radon concentrations.
6. Maps Showing Locations of Air and Radon Monitoring Stations.

Sincerely,

Natver Patel
Staff Chemist

mls

Enclosures

pc: MAS
CDW
CES

ANACONDA MINERALS COMPANY
NEW MEXICO OPERATION

Second quarter 1986 (April-June)

Description	Date	Field pH	Lab pH	Field E.C.	Lab E.C.	HCO_3 mg/l	Cl mg/l	SO_4 mg/l	Na mg/l	K mg/l	Ca mg/l	Mg mg/l	NO_3 mg/l	SiO_2 mg/l	Mn mg/l	U-Nat mg/l	Ra-226 pCi/l
Rio Paguate Upstream	04-01-86	8.35	7.95	685	690	270	9	255	23	3	84	34	< 1	38	.05	.0017	< .20
Rio Moquino Upstream	"	8.48	8.12	1575	1580	284	12	650	141	7	131	80	< 1	16	.01	.0045	< .20
Rio Paguate above Confluence	"	8.51	8.05	720	705	271	9	334	24	4	85	36	< 1	37	.01	.0110	.22±.14
Rio Moquino above confluence	"	8.47	8.10	1600	1700	255	14	837	169	9	132	96	< 1	15	.02	.0218	.47±.18
Ri aguate @ Ford Crossing	"	8.40	8.08	1400	1500	271	13	699	104	7	118	77	< 1	26	.02	.0474	.99±.34
Paguate Reservoir	"	7.48	7.65	1750	1790	298	18	559	152	13	156	84	< 1	11	.10	.0751	.59±.21

	Date	zn mg/l	Pb mg/l	Ni mg/l	Se mg/l	Cu mg/l	Ba mg/l	Fe mg/l		TDS mg/l
Rio Paguate Upstream	04-01-86	< .01	< .01	< .10	< .01	< .01	< .10	.01		546
Rio Moquino Upstream	"	< .01	< .01	< .10	< .01	< .01	< .10	.04		1294
Rio Paguate above confluence	"	< .01	< .01	< .10	< .01	< .01	< .10	.02		562
Ri oquino above confluence	"	< .01	< .01	< .10	< .01	< .01	< .10	.06		1490
Rio Paguate @ Ford crossing	"	< .01	< .01	< .10	< .01	< .01	< .10	.02		1155
Paguate Reservoir	"	< .01	< .01	< .10	< .01	< .01	< .10	.10		1456

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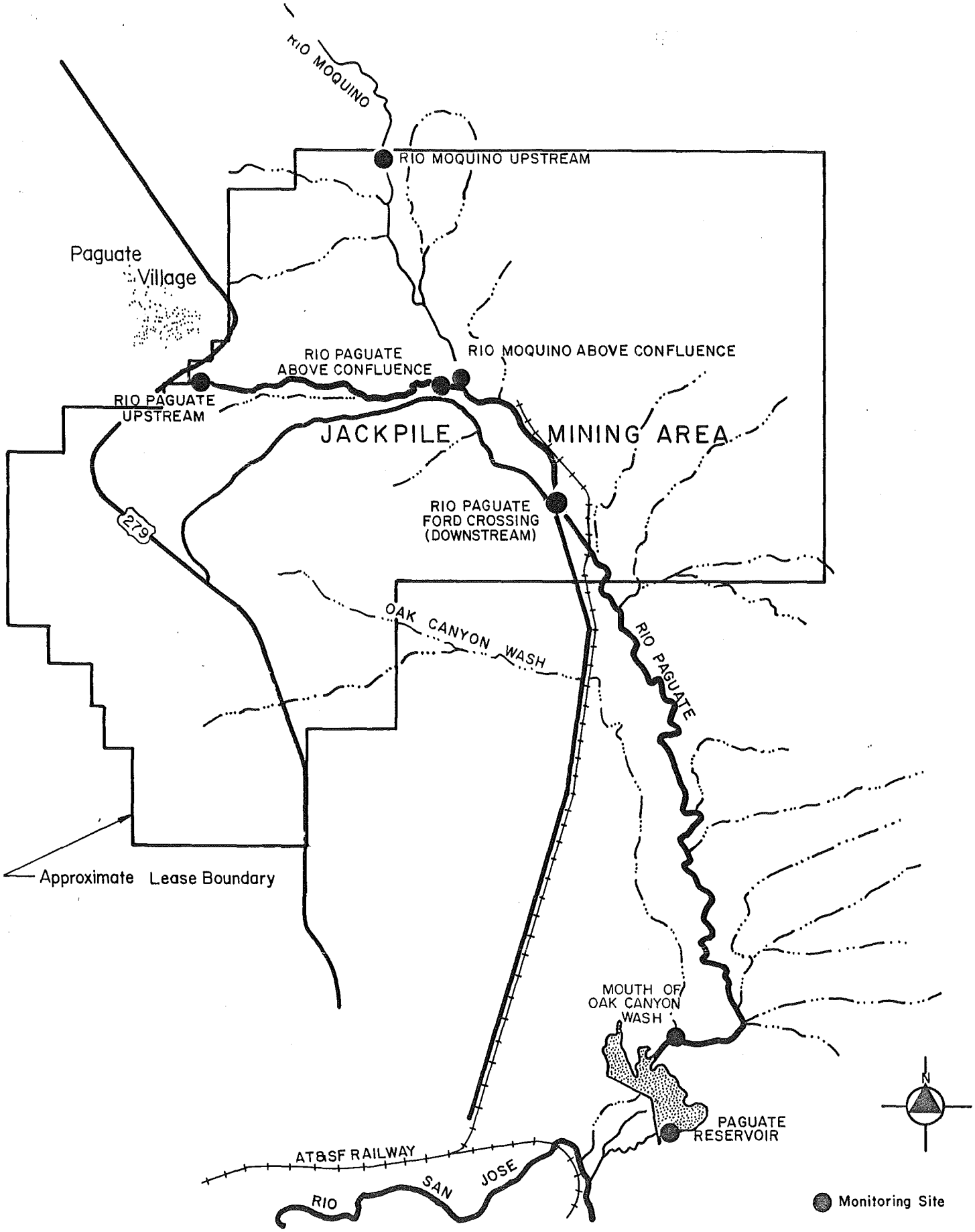

LOCATION OF
SURFACE WATER MONITORING STATIONS

350002185

Anaconda Minerals Company
New Mexico Operations

Second quarter 1986 (April-June)

DESCRIPTION	DATE	WATER LEVEL	pH	ELECT. COND.	HCO_3 ppm	CO_3 ppm	Cl ppm	SO_4 ppm	Na ppm	K ppm	Ca ppm	Mg ppm	Mn ppm	NO_3 ppm	SiO_2 ppm	TDS ppm	U-Nat mg/L	Ra-226 pCi/l		Lab pH	Lab EC
M-2	04-08-86'	5971.13'	8.50	1600	413	1	19	442	372	4	9	3	.05	<1	9	975	.0016	<.20		8.35	1650
M-4	"	5896.44'	7.57	1350	448	-	22	346	157	7	96	49	.06	<1	15	878	.0027	1.42±.43		7.66	1325
M-6	"	5988.60'	8.41	1450	437	-	15	326	322	5	5	2	.04	<1	12	878	.0116	.22±.18		8.20	1410
M-10	"	5958.90'	7.80	2000	418	-	17	656	358	8	52	34	.10	<1	10	1327	.0763	8.07±1.9		7.85	2010
M-14	"	5936.74'	8.93	645	355	10	3	35	175	2	2	1	.01	<1	13	393	.001	.26±.15		8.79	630
M-16	"	5907.63'	7.67	980	410	-	7	145	198	3	16	8	.10	<1	11	684	.0459	.37±.23		7.84	970
J.P.'B'	"	5976.26'	6.20	7600	300	-	25	4967	1570	25	430	240	2.5	<1	24	7450	.001	1.76±1.70		6.55	7800
J.P.'C'	"	5930.31'	6.65	3700	364	-	36	2363	175	13	465	340	1.8	<1	9	3749	1.255	2.98±1.05		6.90	3900
J.P.'D'	"	5848.74'	8.96	5800	1073	101	11	2479	1430	32	7	62	.03	<1	6	4593	.1071	.57±.23		9.05	6000

DESCRIPTION	DATE	As ppm	Ba ppm	Cd ppm	Cr ppm	F ppm	Pb ppm	Hg ppm	Se ppm	Ag ppm	Cu ppm	Fe ppm	Zn ppm	Al ppm	B ppm	Co ppm	Mo ppm	Ni ppm	V ppm	PO_4 ppm AS P		
M-2	04-08-86	<.01	<.10	<.001	<.01	1.20	<.01	<.0004	<.01	<.01	<.01	.06	<.01	<.10	0.50	<.01	<.01	<.10	<.01	<.10		
M-4	"	<.01	<.10	<.001	<.01	6.20	<.01	<.0004	<.01	<.01	<.01	.04	<.01	<.10	0.20	<.01	<.01	<.10	<.01	<.10		
M-6	"	<.01	<.10	<.001	<.01	1.30	<.01	<.0004	<.01	<.01	<.01	.07	<.01	<.10	0.50	<.01	<.01	<.10	<.01	<.10		
M-10	"	<.01	<.10	<.001	<.01	0.90	<.01	<.0004	<.01	<.01	<.01	.05	<.01	<.10	0.30	<.01	<.01	<.10	<.01	<.10		
M-14	"	<.01	<.10	<.001	<.01	0.90	<.01	<.0004	<.01	<.01	<.01	.07	<.01	<.10	0.20	<.01	<.01	<.10	<.01	<.10		
M-16	"	<.01	<.10	<.001	<.01	1.10	<.01	<.0004	<.01	<.01	<.01	.05	<.01	<.10	0.20	<.01	<.01	<.10	<.01	<.10		
J.P.'B'	"	<.01	<.10	<.001	<.01	0.17	<.01	<.0004	.02	<.01	<.01	49.0	<.01	<.10	1.0	.06	<.01	<.10	<.01	<.10		
J.P.'C'	"	<.01	<.10	<.001	<.01	0.27	<.01	<.0004	.01	<.01	<.01	4.8	<.01	<.10	0.30	<.01	<.01	<.10	<.01	<.10		
J.P.'D'	"	<.01	<.10	<.001	<.01	0.19	<.01	<.0004	<.01	<.01	<.01	.06	<.01	<.10	0.40	<.01	<.01	<.10	<.01	<.10		

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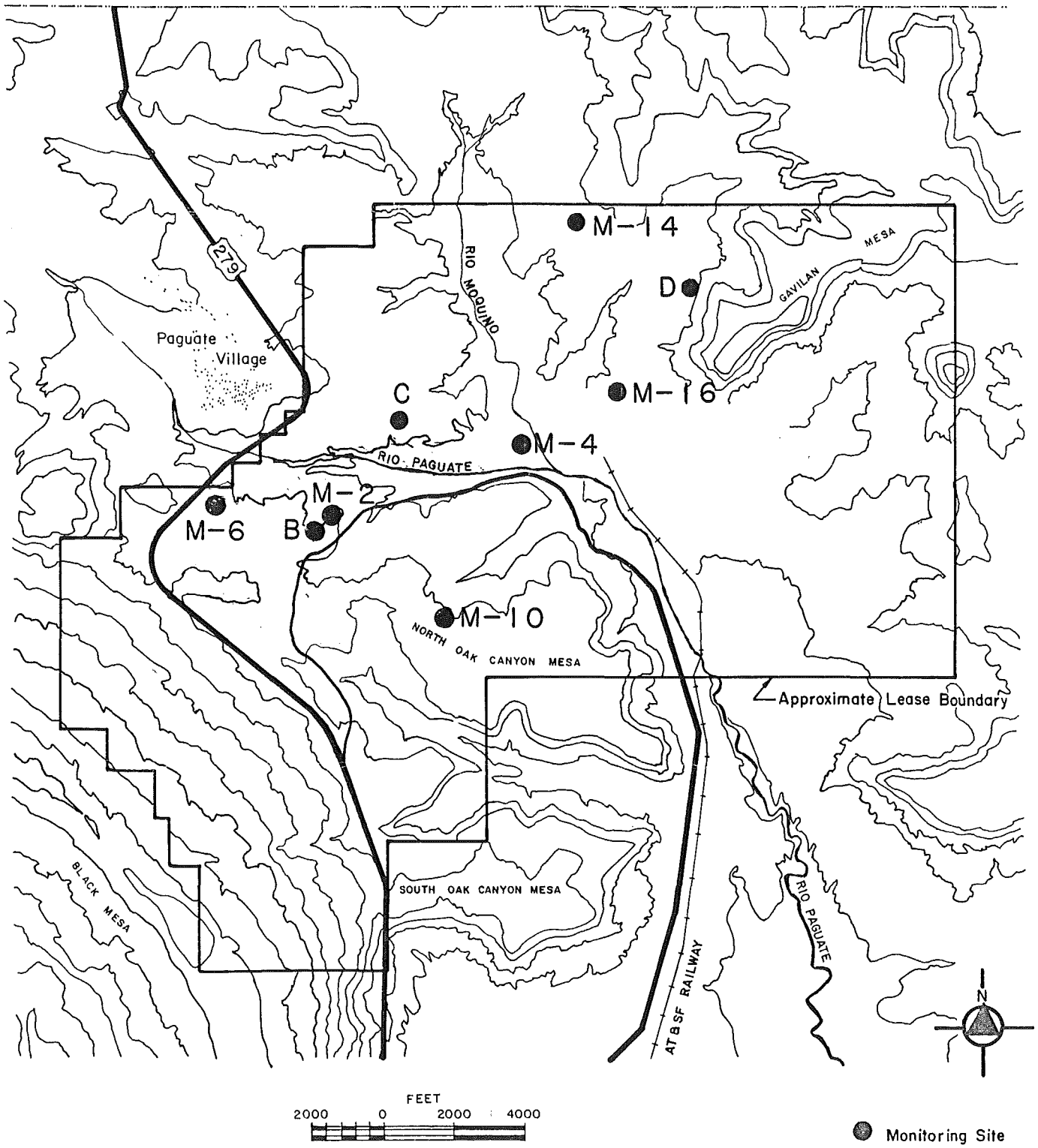
LOCATION OF GROUND WATER MONITORING STATIONS



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JACKPILE - AIR SAMPLING

SECOND QUARTER, 1986

LOCATION	DATE	TOTAL PARTICULATE ugm/M^3	U-Nat. uCi/mlx10-15	Ra-226 uCi/mlx10-15	Th-230 uCi/mlx10-15	Pb-210 uCi/mlx10-15
1. P-10 Area	04/86	13.61	0.23	0.25±0.11	0.42±0.32	24.63±1.30
2. West Gate	04/86	13.81	0.27	0.23±0.13	0.20±0.30	18.86±1.22
3. Well #4	04/86	16.27*	0.27	0.23±0.12	0.55±0.37	20.33±1.23

*This value may include a contribution from a landfill burning adjacent to this station, installed and operated by the Laguna Reservation and Tribe, respectively.

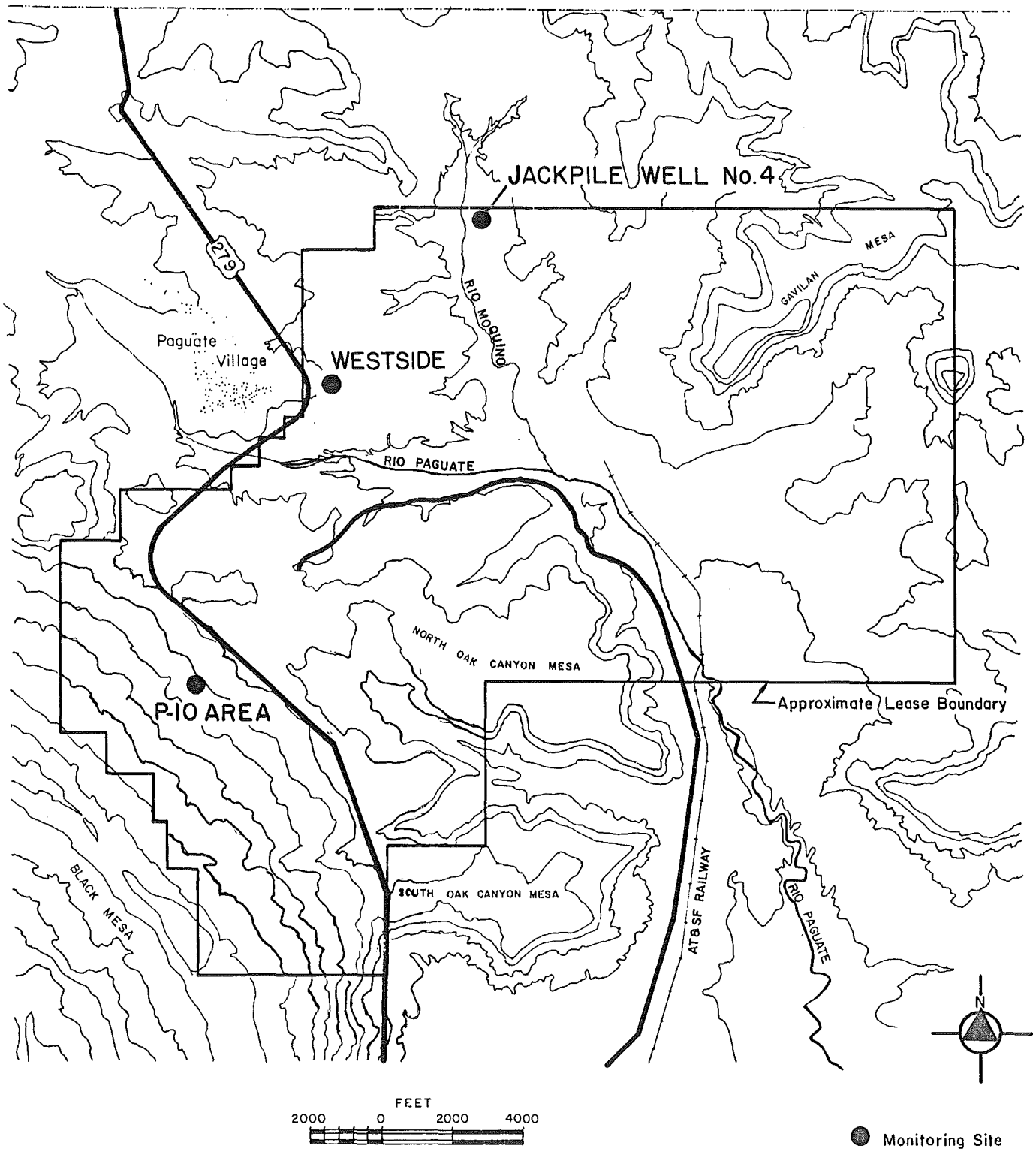
JACKPILE-AMBIENT RADON CONCENTRATION

SECOND QUARTER, 1986

LOCATION	DATE	Rn-222 pCi/L
1. P-10 Area	04/86	1.71
	05/86	1.79
	06/86	1.64
2. Westgate	04/86	0.49
	05/86	0.58
	06/86	0.59
3. Well #4	04/86	0.68
	05/86	0.66**
	06/86	0.84

**10 day $\bar{x}$

LOCATION OF AIR QUALITY MONITORING STATIONS



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ANACONDA Minerals Co[illegible]ny
New Mexico Operations
P.O. Box 638
Grants, New Mexico 87020
Telephone 505 876 2211

April 9, 1986

86 APR 11 A10: 01

ALBUQUERQUE, N.M.

Minerals Staff
Rio Puerco Resource Area
Bureau of Land Management
3550 Pan American Freeway, N.E.
P. O. Box 6770
Albuquerque, N.M. 87107

Dear Sir:

Following are the sampling data of the First Quarter (January-March) 1986 for Anaconda's former Jackpile Minesite leases.

1. Chemical and Radiological Analysis for Surface Water.
2. Maps Showing Surface Water Sampling Locations.
3. Chemical and Radiological Analysis of Groundwater.
4. Map of Groundwater Monitoring Locations.
5. Results of the Air Monitoring Program including radon concentrations.
6. Maps Showing Locations of Air and Radon Monitoring Stations.

Sincerely,

Natver Patel

Natver Patel
Staff Chemist

mls

Enclosures

pc: MAS
CDW
CES

ANACONDA MINERALS COMPANY
NEW MEXICO OPERATIONS

1st Quarter 1986

Description	Date	Field pH	Field Cond. umhos	Lab Cond. umhos	HCO4 ppm	Cl ppm	SO4 ppm	Na ppm	K ppm	Ca ppm	Mg ppm	NO3 ppm	F ppm	SiO ppm2	Mn ppm	Fe ppm	TDS ppm	Lab pH
Rio Paguate Upstream	1/2/86	8.20	750	800	275	10	229	30	4	110	41	<1.0		36	<.10	<.10	638	7.98
Rio Moquino Upstream	1/2/86	8.50	1300	1380	248	9	625	99	8	142	71	<1.0		25	<.10	.10	1197	8.22
Rio Paguate Above Confluence	1/2/86	8.30	795	820	272	10	255	34	4.0	107	44	<1.0		32	<.10	<.10	644	8.01
Rio Moquino Above Confluence	1/2/86	8.44	1600	1650	245	12	795	131	10	149	92	<1.0		24	<.10	.10	1330	8.15
io Paguate @ ord Crossing	1/2/86	8.41	1500	1600	257	13	712	118	9	144	88	<1.0		23	<.10	<.10	1336	8.20
Paguate Reser.	1/2/86	7.00	1525	1450	280	28	556	106	18	153	58	<1.0		15	.30	.15	1136	7.80

	Date	Zn ppm	Pb ppm	Ni ppm	Se ppm	Ba ppm	Cu ppm							U-Nat mg/l	Ra-226 pCi/l			
Rio Paguate Upstream	1/2/86													.0028	.21± .10			
Rio Moquino Upstream	1/2/86													.0042	<.20			
Rio Paguate Above Confluence	1/2/86													.0180	.42± .14			
io Moquino Above Confluence	1/2/86													.0219	.41± .19			
Rio Paguate @ Ford Crossing	1/2/86													.0408	.95± .42			
Paguate Reservoir	1/2/86													.0846	.37± .16			

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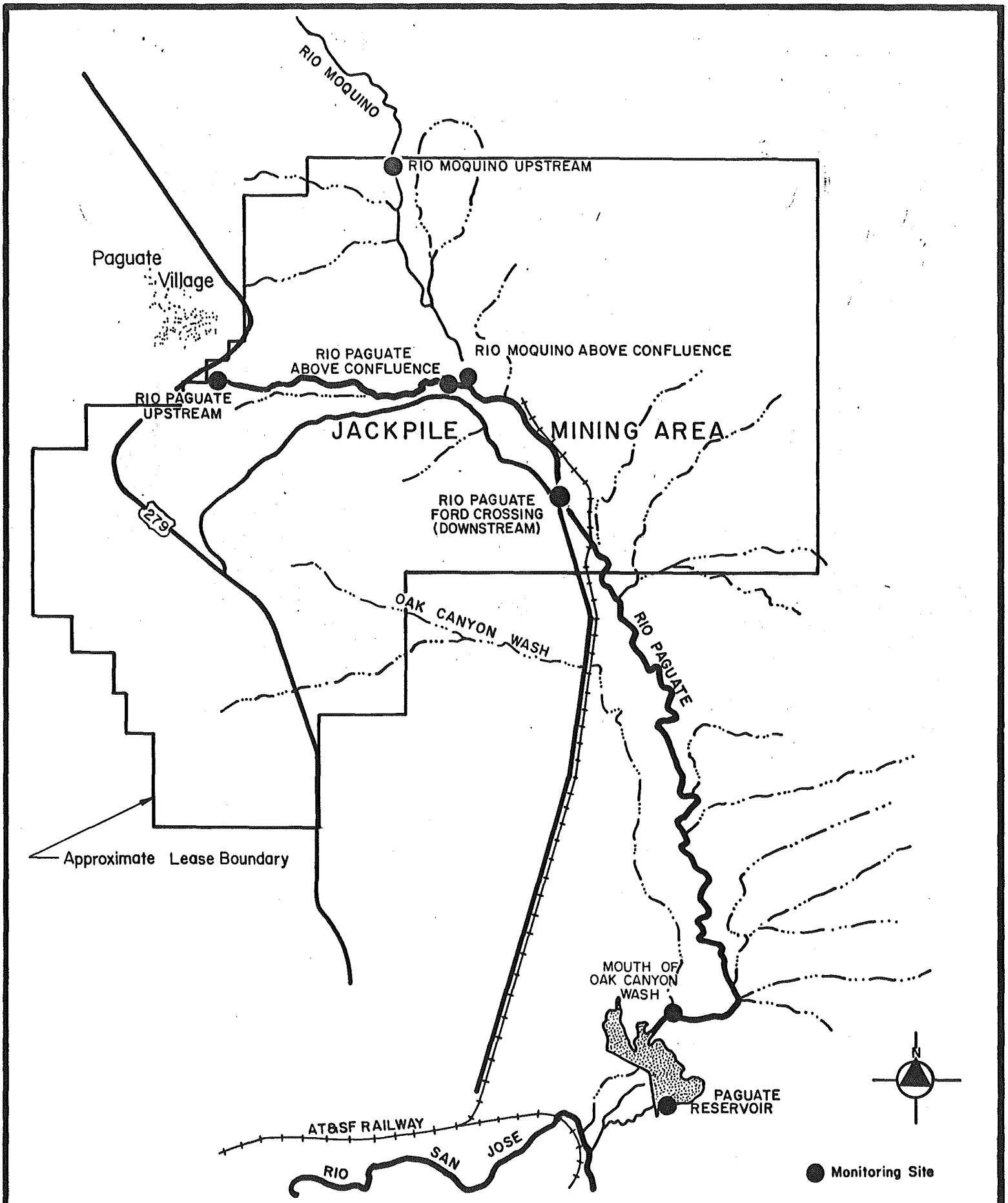


LOCATION OF
SURFACE WATER MONITORING STATIONS

350002192

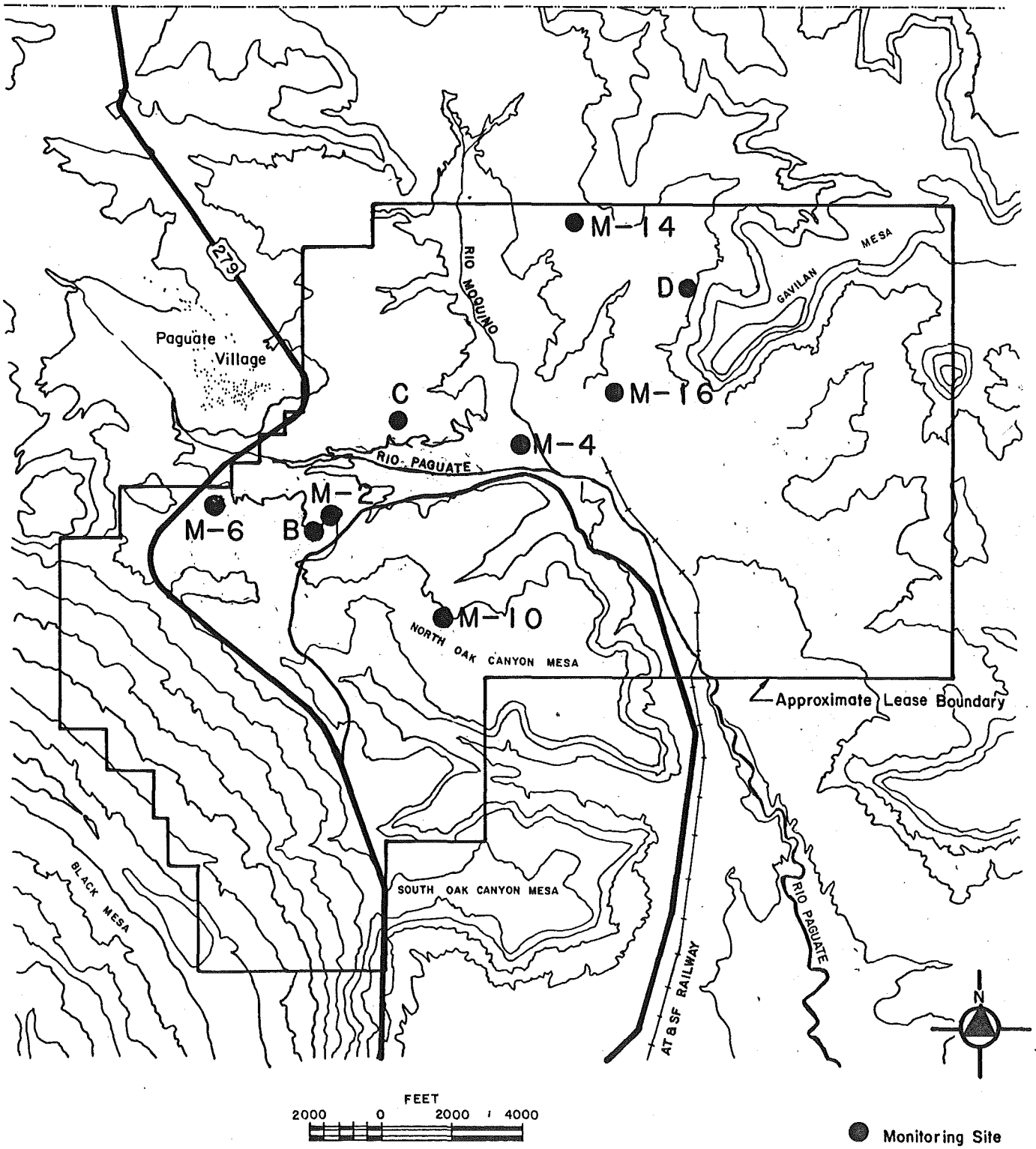
ANACONDA MINERALS COMPANY
NEW MEXICO OPERATIONS

1st Quarter 1986

Description	Date	Water Level	Field pH	Field Temp. °C	Field Elect. Cond.	TDS	SO4	U-Nat mg/l	Ra-226 pCi/L	Field pH	Field EC
M-2	1-9-86	5971.37	8.27	15.0	1600	1048	441	.0034	.29 ± .14	7.75	1690
M-4	1-9-86	5896.39	8.17	15.0	1050	720	281	.0012	.75 ± .25	7.64	1010
M-6	1-9-86	5987.96	8.26	16	1450	963	352	.0021	.42 ± .21	7.99	1450
M-10	1-9-86	5958.80	7.78	15.5	2000	1306	652	.0708	7.69 ± 1.79	7.64	2000
M-14	1-9-86	5937.74	8.86	16.5	650	422	37	.0012	.28 ± .13	8.36	620
M-16	1-9-86	5907.98	7.48	17.0	1000	569	141	.0325	.41 ± .15	7.62	860
"B"	1-9-86	5977.25	6.16	18.5	7750	7616	5039	.0122	2.06 ± 1.54	6.30	7900
"C"	1-9-86	5930.54	6.80	14.0	3800	3987	2436	1.577	4.40 ± 1.18	6.84	4000
"D"	1-9-86	5848.28	8.96	15.0	5800	4606	2467	.1997	0.83 ± .25	9.00	6000

3500002193

LOCATION OF GROUND WATER MONITORING STATIONS



350002194

JACKPILE - AIR SAMPLING

FIRST QUARTER, 1986

LOCATION	DATE	TOTAL PARTICULATE ugm/M^3	U-Nat. uCi/mlx10-15	Ra-226 uCi/mlx10-15	Th-230 uCi/mlx10-15	Pb-210 uCi/mlx10-15
1. P-10 Area	01/86	8.49	.37	.234 ± .129	.922 ± .61	48.59 ± 2.46
2. West Gate	01/86	15.50	.23	.248 ± .130	.868 ± .56	35.96 ± 1.86
3. Well #4	01/86	10.52*	.43	.213 ± .110	1.596 ± .77	31.91 ± 1.77

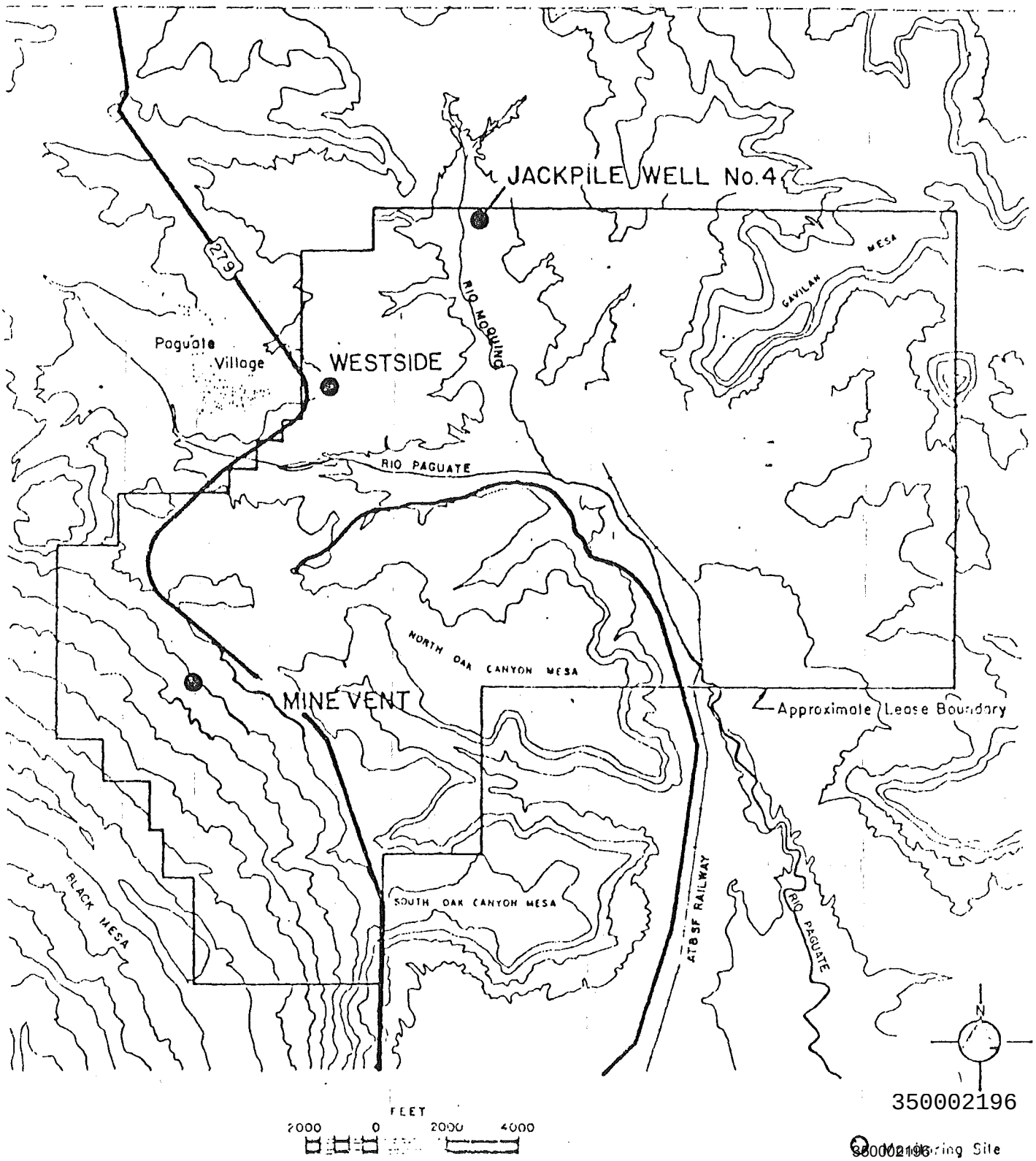
*This value may include a contribution from a landfill burning adjacent to this station, installed and operated by the Laguna Reservation and Tribe, respectively.

JACKPILE-AMBIENT RADON CONCENTRATION

FIRST QUARTER, 1986

LOCATION	DATE	Rn-222 pCi/L
1. P-10 Area	01/86	2.37
	02/86	1.58
	03/86	2.04
2. Westgate	01/86	0.86
	02/86	0.61
	03/86	0.75
3. Well #4	01/86	1.18
	02/86	0.75
	03/86	0.91

LOCATION OF
AIR QUALITY MONITORING STATIONS



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350002196

ANACONDA Minerals Co ny
New Mexico Operations
P.O. Box 638
Grants, New Mexico 87020
Telephone 505 876 2211

BKG 1-10-86

BLM
ALBUQUERQUE
JAN 10 1986

January 7, 1986

Minerals Staff
Rio Puerco Resource Area
Bureau of Land Management
3550 Pan American Freeway, N.E.
P. O. Box 6770
Albuquerque, N.M. 87107

Dear Sir:

Following are the sampling data of the Fourth Quarter (October-December) 1985 for Anaconda's former Jackpile Minesite leases.

1. Chemical and Radiological Analysis for Surface Water.
2. Maps Showing Surface Water Sampling Locations.
3. Chemical and Radiological Analysis of Groundwater.
4. Map of Groundwater Monitoring Locations.
5. Results of the Air Monitoring Program including radon concentrations.
6. Maps Showing Locations of Air and Radon Monitoring Stations.

Sincerely,

Natver Patel

Natver Patel
Staff Chemist

mls

Enclosures

pc: MAS
CDW
CES

ANACONDA MINERALS COMPANY
NEW MEXICO OPERATIONS

4th Quarter (Oct-Dec) 1985

Description	Date	Field pH	Field Cond. umhos	Lab Cond. umhos	HCO_3 ppm	Cl ppm	S04 ppm	Na ppm	K ppm	Ca ppm	Mg ppm	N03 ppm	F ppm	Si0 ppm2	Mn ppm	Fe ppm	TDS ppm	Lab pH
Rio Paguate Upstream	10-1-85	8.33	1000	1030	266	10	228	38	5	114	41	<1.0	0.32	14	0.08	<.01	708	7.25
Rio Moquino Upstream	10-1-85	8.47	1200	1285	182	10	415	86	10	114	42	<1.0	0.47	10	0.02	0.03	966	8.30
Rio Paguate Above Confluence	10-1-85	7.97	3000	3060	403	26	1550	185	13	261	202	<1.0	0.64	8	0.89	<.01	2834	8.16
Rio Moquino Above Confluence	10-1-85	8.32	1630	1640	200	13	520	130	10	141	66	<1.0	0.58	9	0.03	<.01	1250	8.17
Ri Paguate @ Fo Crossing	10-1-85	8.36	2000	2020	226	16	852	152	10	162	91	<1.0	0.60	8	0.08	<.01	1748	8.11
Paguate Reserv.	10-1-85	7.54	1200	1260	209	21	449	84	13	117	34	<1.0	0.62	4	0.07	0.14	930	8.06

	Date	Zn ppm	Pb ppm	Ni ppm	Se ppm	Ba ppm	Cu ppm							U-Nat mg/1	Ra-226 pCi/1			
Rio Paguate Upstream	10-1-85													.0047	.36± .19			
Rio Moquino Upstream	10-1-85													.0036	.16± .14			
Rio Paguate Above Confluence	10-1-85													.8392	6.39± 1.66			
Ri Moquino Above Confluence	10-1-85													.0446	0.70± .35			
Rio Paguate @ Ford Crossing	10-1-85													.0608	2.16± .63			
Paguate Reservoir	10-1-85													.0294	.45± .22			

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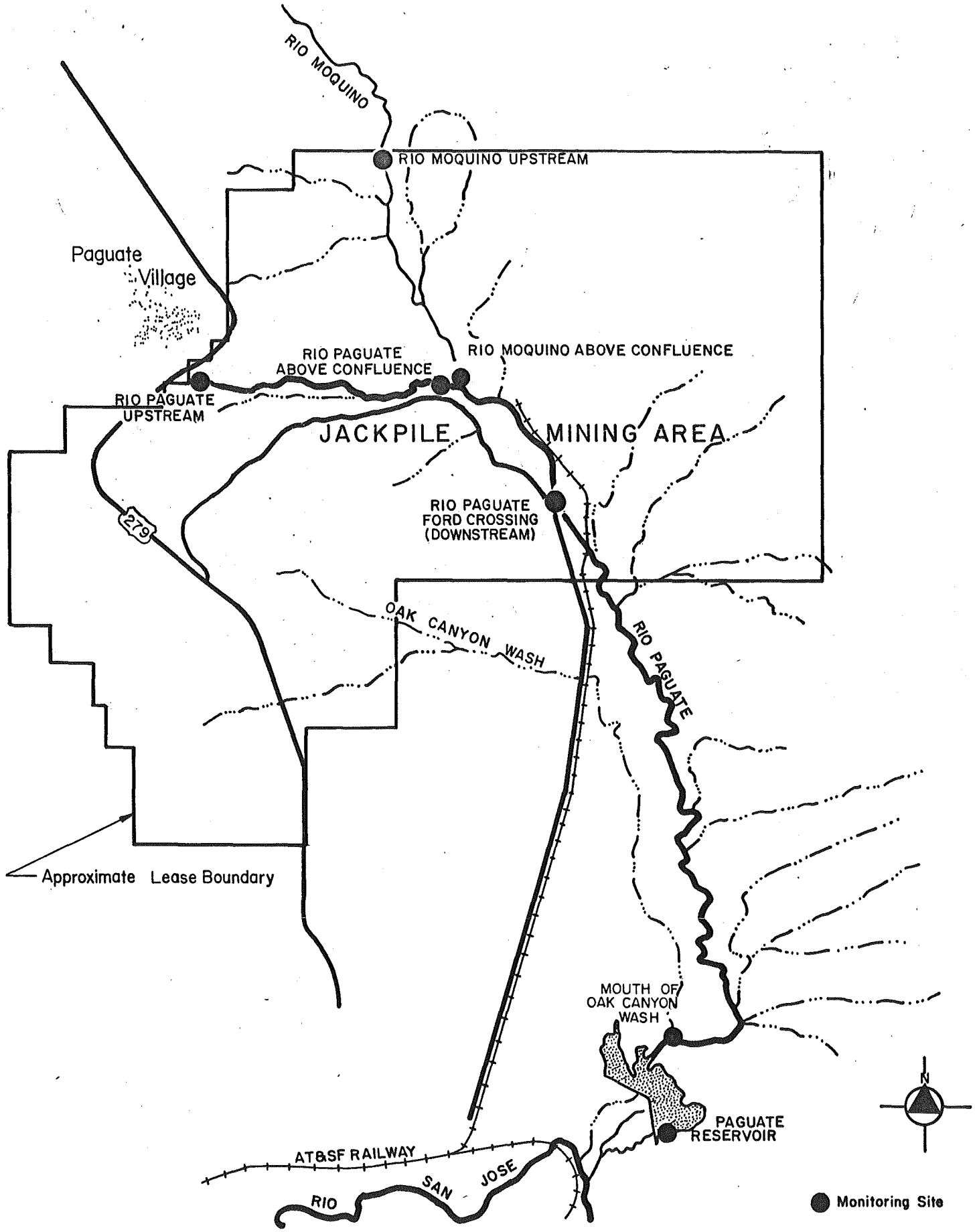

LOCATION OF
SURFACE WATER MONITORING STATIONS

350002199

ANACONDA MINERALS COMPANY
NEW MEXICO OPERATIONS

4th Quarter (Oct-Dec) 1985

Description	Date	Water Level	Field pH	Field Temp. °C	Field Elect. Cond.	TDS	SO4	U-Nat mg/l	Ra-226 pCi/L	Lab pH	Lab EC	
M-2	10-24-85	5971.40	8.46	15.5	1600	1038	420	.0047	0.33 ± .16	7.79	1670	
M-4	10-24-85	5896.33	8.41	16.0	1150	776	320	.0032	1.20 ± .30	7.92	1260	
M-6	10-24-85	5987.47	8.46	16.0	1400	926	320	.0037	0.59 ± .25	7.76	1490	
M-10	10-24-85	5958.87	7.76	16.5	1980	1276	678	.0820	6.7 ± 1.5	7.69	1990	
M-14	10-24-85	5938.04	8.96	17.5	650	408	37	.0005	0.31 ± .14	8.34	680	
M-16	10-24-85	5907.63	7.63	17.5	915	520	147	.0581	0.29 ± .10	9.83	960	
"B"	10-24-85	5978.59	6.07	18.5	7600	7682	4800	.0159	1.85 ± 1.20	6.32	8000	
"C"	10-24-85	5930.73	6.90	14.0	3780	3946	2500	1.078	3.53 ± 1.00	6.31	3860	
"D"	10-24-85	5847.76	9.18	15.0	5600	4458	2400	.2198	0.55 ± .21	8.93	6090	

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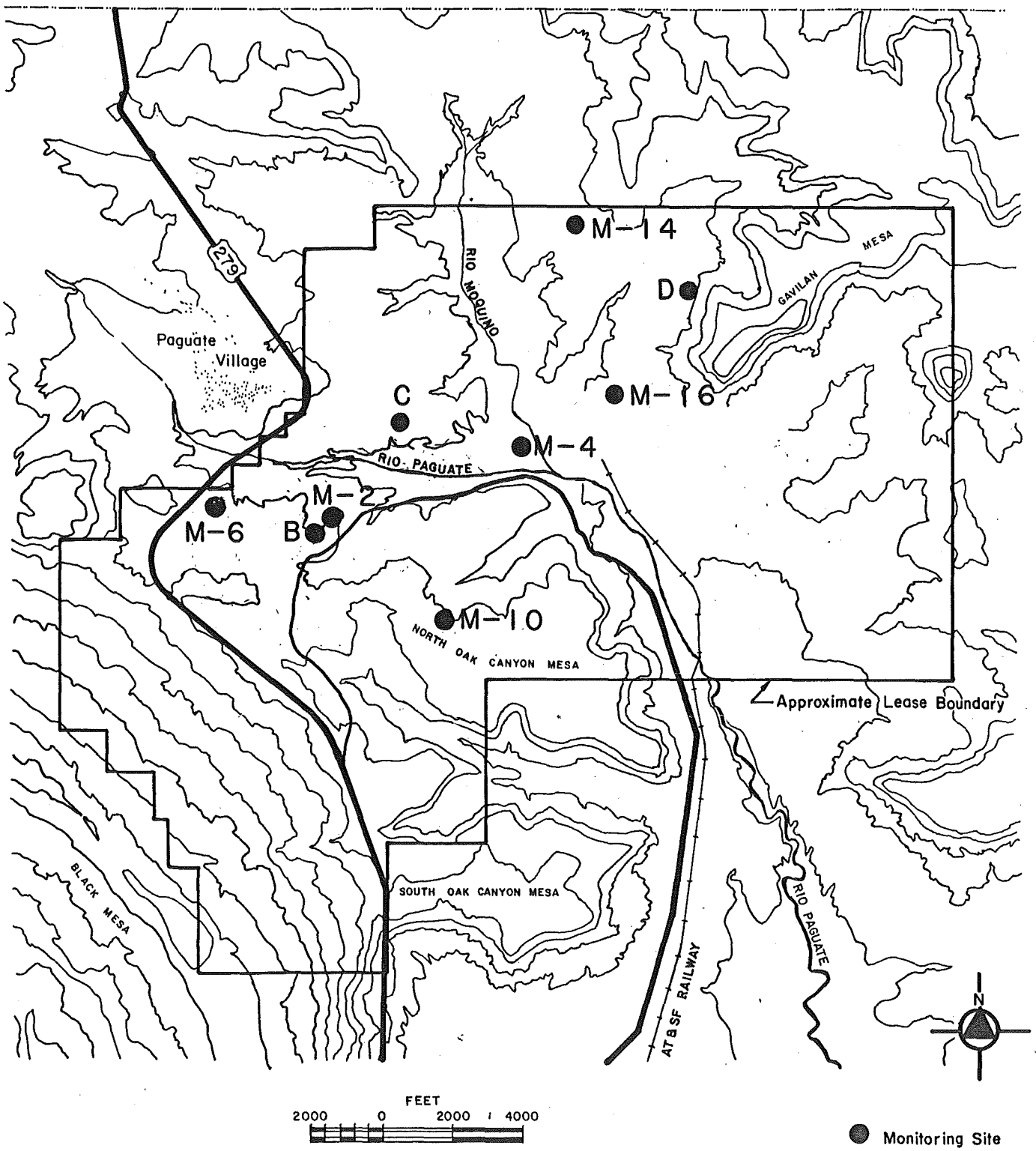
LOCATION OF GROUND WATER MONITORING STATIONS



350002201

JACKPILE - AIR SAMPLING

FOURTH QUARTER, 1985

LOCATION	DATE	TOTAL PARTICULATE ugm/M^3	U-Nat. uCi/mlx10-15	Ra-226 uCi/mlx10-15	Th-230 uCi/mlx10-15	Pb-210 uCi/mlx10-15
1. P-10 Area	10/85	15.17	0.26	.20 ± .06	0.45 ± .07	45.84 ± 2.58
2. West Gate	10/85	17.89	0.32	0.11 ± .06	0.76 ± .06	30.46 ± 1.90
3. Well #4	10/85	16.84*	0.31	0.16 ± .06	0.75 ± .06	29.94 ± 1.25

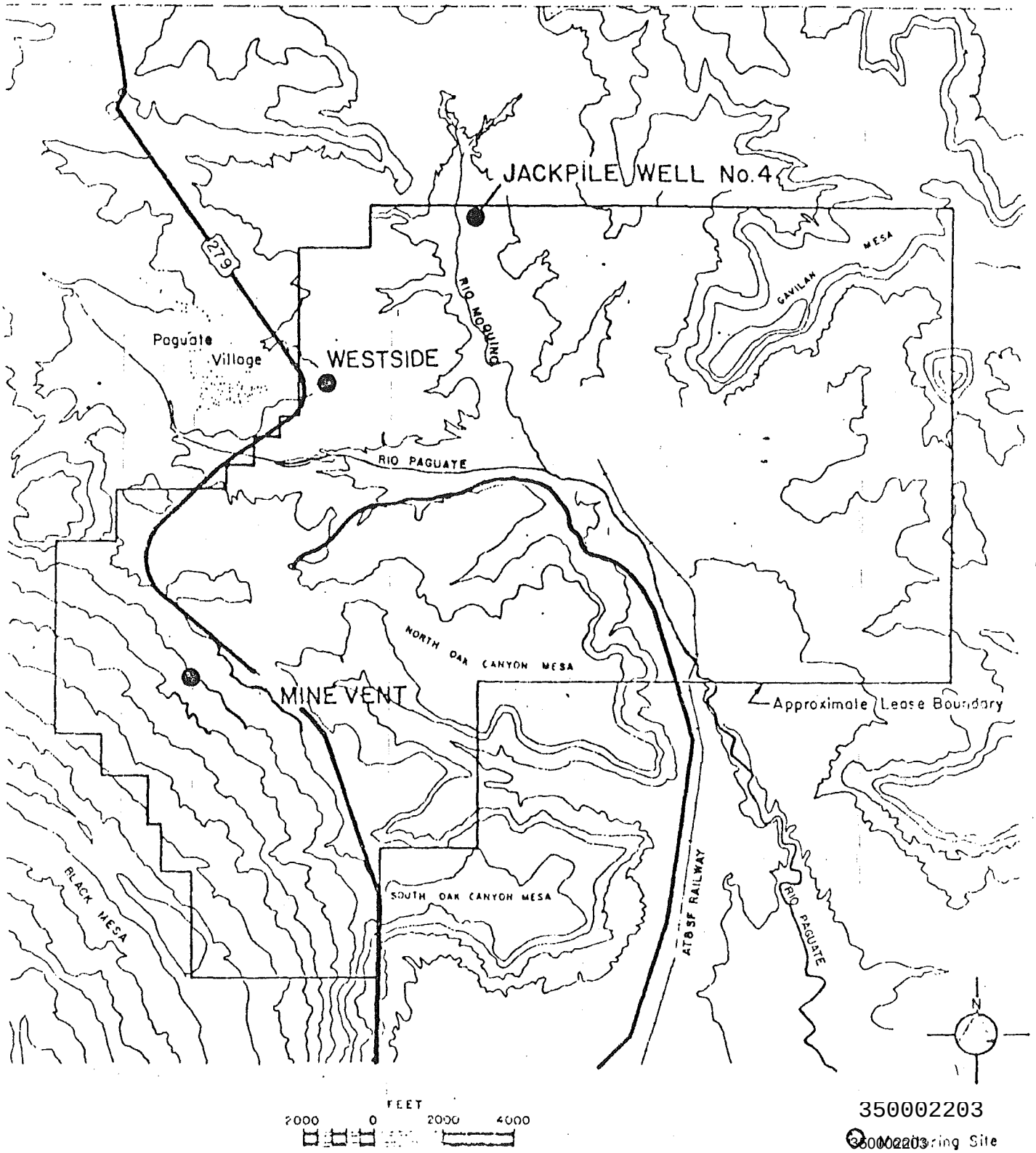
*This value may include a conribution from landfill burning adjacent to this station, installed and operated by Laguna Reservation and Tribe respectively.

JACKPILE-AMBIENT RADON CONCENTRATION

FOURTH QUARTER, 1985

LOCATION	DATE	Rn-222 pCi/L
1. P-10 Area	10/85	2.15
	11/85	1.27
	12/85	2.09
2. Westgate	10/85	0.27
	11/85	0.30
	12/85	0.77
3. Well #4	10/85	1.07
	11/85	1.015
	12/85	1.04

LOCATION OF
AIR QUALITY MONITORING STATIONS



Anaconda Mineral
3570 (017)

FILE COPY
Surname

DEC 23 1985

Mr. Carl D. Woolfolk
Chief, HS&E Engineer
Anaconda Minerals Company
New Mexico Operations
P.O. Box 638
Grants, NM 87020

Dear Mr. Woolfolk:

We have reviewed your request of December 3, 1985, to delete one parameter, fluoride (F), from the sampling requirements for the six surface water sampling locations at the Jackpile/Paguate Mine (Pueblo of Laguna Leases #'s 1, 4 and 8). Your request is approved subject to the stipulation that Anaconda include fluoride in the surface water analysis for the last quarter of 1985.

This office will continue to review all monitoring data and we may require changes in the program if conditions warrant.

Sincerely,

/s/ Herrick E. Hanks

Herrick E. Hanks
Rio Puerco Resource Area
Manager

cc: Area Director, AAO, BIA
Superintendent, Laguna Agency, BIA
Governor, Pueblo of Laguna
Anaconda Comprehensive Mine Plan File
Anaconda Environmental Data File

017:JANDREWS:pg:12/16/85:x3606:WANGID0037Z

350002204

ANACONDA Minerals Cc ıy
New Mexico Operations
P.O. Box 638
Grants, New Mexico 87020
Telephone 505 876 2211

Compliance Mine Plan File
w/ copy in Env. Monitoring File

December 3, 1985

Mr. George K. Laskar
Rio Puerco Resource Area
Bureau of Land Management
3550 Pan American Freeway, NE
P. O. Box 6770
Albuquerque, NM 87107

Dear Mr. Laskar:

Anaconda Minerals Company has been reviewing its obligations for monitoring paramters at the former Jackpile Minesite leases and find that one parameter, fluoride (F), does not have significant applicability for the six surface water sampling locations. These locations are sampled on a quarterly basis.

We respectfully request that fluoride be excluded from our surface water monitoring requirements.

We appreciate your consideration of this matter and, if approved, appreciate the cost savings provided to Anaconda Mienrals Company.

Sincerely,

Carl D. Woolfolk

Carl D. Woolfolk
Chief HS & E Engineer

mls

cc: MAS, CES, NP

350002205

ANACONDA Minerals Co ny
New Mexico Operations
P.O. Box 638
Grants, New Mexico 87020
Telephone 505 876 2211

RECEIVED
BUREAU OF
LAND MANAGEMENT

84 AUG 2 A 9: 22

ALBUQUERQUE DISTRICT
ALBUQUERQUE, N.M.

July 30, 1984

Minerals Staff
Rio Puerco Resource Area
Bureau of Land Management
3550 Pan American Freeway, NE
P.O. Box 6770
Albuquerque, NM 87107

Dear Sir:

The Second Quarter of 1984 sampling data for Anaconda's former Jackpile Minesite leases is submitted as follows:

1. Radiological Analysis of Surface Water;
2. Chemical Analysis of Surface Water;
3. Map showing Surface Water Sampling Locations;
4. Results of the Air Monitoring Program;
5. Results of the Ambient Radon Monitoring Study;
6. Map showing location of Air and Radon Monitoring Stations;
7. Map of Groundwater Monitoring Locations; and,
8. Chemical Analysis of Groundwater Monitoring, Second Quarter.

Sincerely,

Dean L. Roberts

Dean L. Roberts
Chief Environmental Engineer

Enclosures-8

pc: CES
CDW
MAS

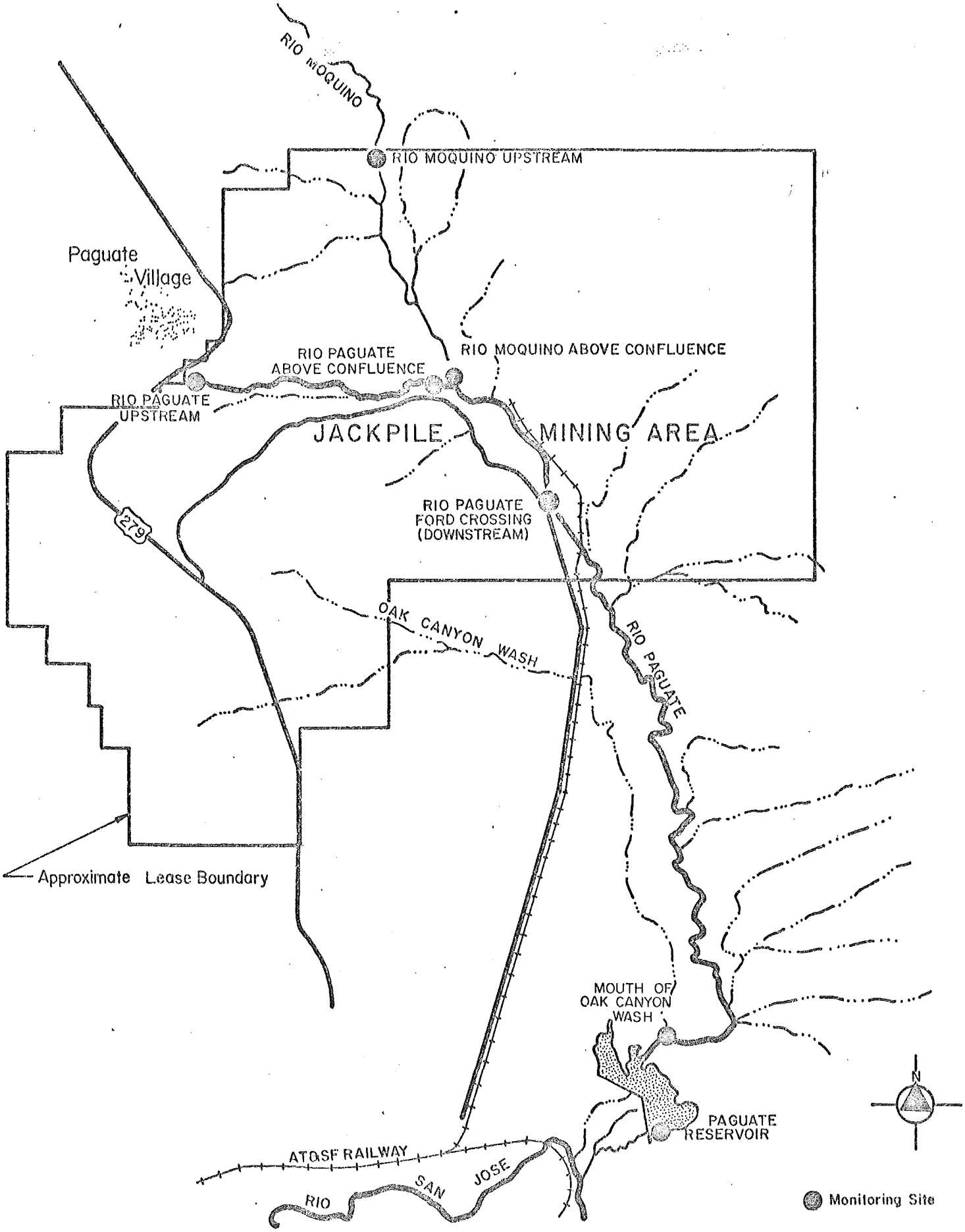
350002206

JACKPILE - WATER RADIOLOGICAL ANALYSIS

(SECOND QUARTER, 1984)

Descriptive Location	Ra-226, pCi/L			Uranium-Natural, ppm		
	Apr	May	Jun	Apr	May	Jun
Rio Paguate Upstream	0.16	0.04	0.15	< 0.003	0.001	0.001
Rio Moquino Upstream	0.23	0.14	0.26	0.006	0.006	0.005
Rio Paguate Above the Confluence	0.94	1.72	1.28	0.015	0.029	0.051
Rio Moquino Above the Confluence	0.74	2.58	0.83	0.015	0.027	0.034
Rio Paguate - Ford Crossing	0.94	3.20	1.64	0.064	0.097	0.130
Paguate Reservoir	0.28	0.38	0.46	0.217	0.265	0.274
Mouth of Oak Canyon Wash	*	*	*	*	*	*

* No Sample because the Mouth of Oak Canyon Wash was dry.



LOCATION OF
SURFACE WATER MONITORING STATIONS

350002208

JACKPILE - AMBIENT RADON SURVEY

(SECOND QUARTER, 1984)

	Location	Date	Rn-222 pCi/L
1.	P-10 Area	4/84	0.41
		5/84	0.47
		6/84	< 0.20
2.	Well #4	4/84	0.58
		5/84	< 0.20
		6/84	0.32
3.	Westgate	4/84	< 0.20
		5/84	< 0.20
		6/84	0.21

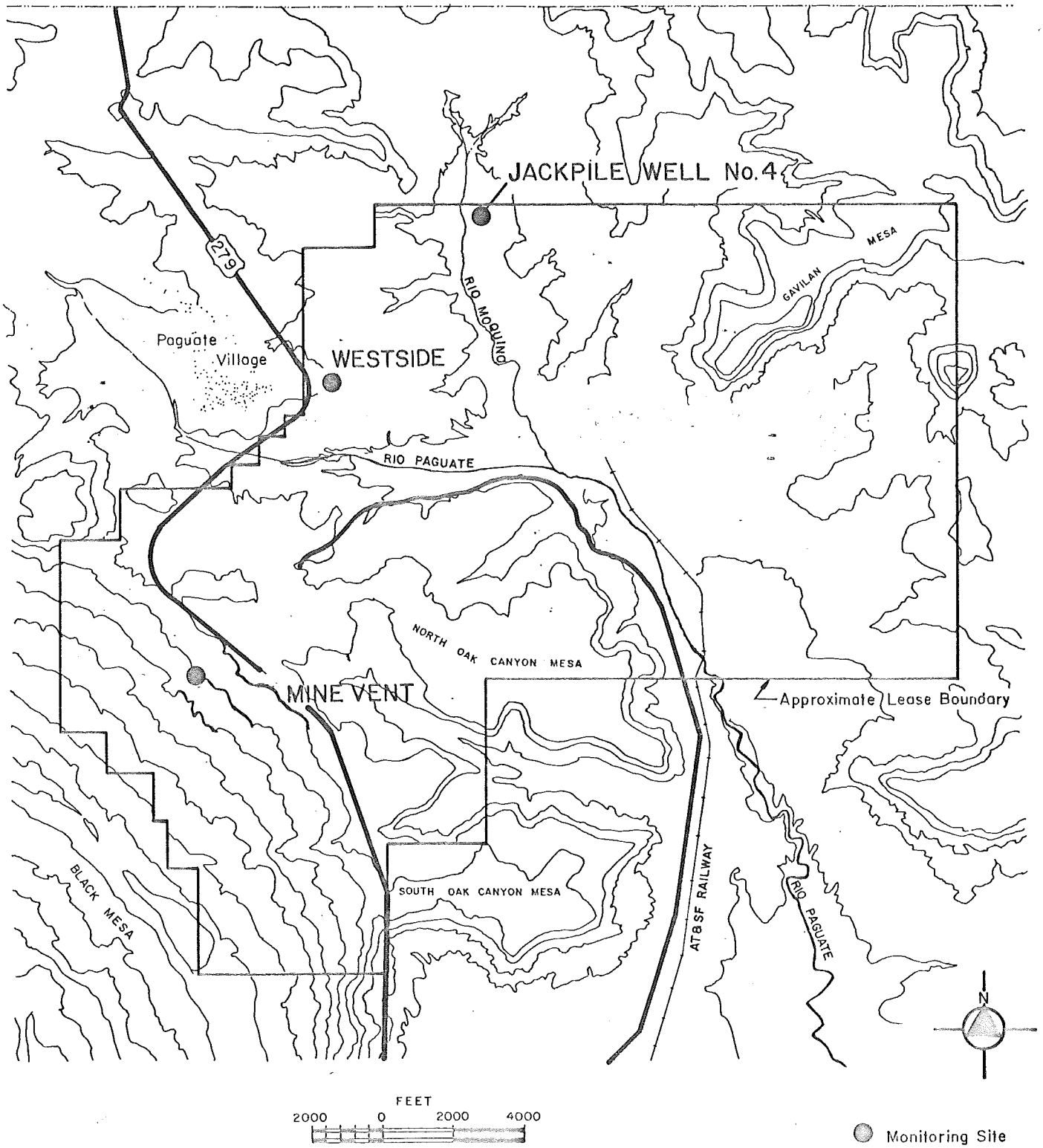
JACKPILE - AIR SAMPLING SURVEY

(SECOND QUARTER, 1984)

	Location	Date	Particulate $\mu gm/m^3$	U-nat. $\mu Ci/ml \times 10^{-15}$	Ra-226 $\mu Ci/ml \times 10^{-15}$	Th-230 $\mu Ci/ml \times 10^{-15}$	Pb-210 $\mu Ci/ml \times 10^{-15}$
1.	P-10 Area	4/84	13.49	< 0.02	<0.06	0.19	28.37
		5/84	29.11	0.58	0.58	2.05	31.99
		6/84	21.42	0.75	0.37	1.36	*
2.	Westgate	4/84	16.03	< 0.02	< 0.08	0.38	19.76
		5/84	30.71	0.23	0.39	1.32	23.98
		6/84	6.21	0.13	0.39	1.05	*
3.	Well #4	4/84	14.99	0.02	0.06	0.32	20.33
		5/84	33.15	0.62	0.44	5.98	35.58
		6/84	27.71	0.21	0.32	0.82	*

*June Pb-210 results will be forwarded to you at a later date.

LOCATION OF AIR QUALITY MONITORING STATIONS



350002211

ANACONDA MINERALS COMPANY
NEW MEXICO OPERATIONS

FOR THE MONTH OF: _____

DESCRIPTION	DATE	pH	TDS ppm	Cond umhos @ Field Temp.	HCO_3^- ppm	Cl^- ppm	$SO_4^=$ ppm	Na^+ ppm	K^+ ppm	Ca^{++} ppm	Mg^{++} ppm	NO_3^- ppm	F^- ppm	SiO_2 ppm	Mn^{++} ppm
Rio Paguate Upstream	4-4-84	8.00	773	730	329	11.5	242	39.4	5.0	101	43	1.7	0.42	77	0.052
Rio Moquino Upstream	4-4-84	8.03	1429	1520	244	12.5	798	133	6.7	148	84	2.0	0.51	45	0.005
Rio Paguate Above the Confluence	4-4-84	8.38	782	760	305	11.5	270	48	5.2	91	49	1.7	0.44	71	0.013
Rio Moquino Above the Confluence	4-4-84	8.36	1685	1680	283	15.0	948	167	7.0	156	106	1.8	0.58	41	0.011
Rio Paguate For Crossing	4-4-84	8.41	1496	1500	305	16.8	788	145	6.9	135	97	1.8	0.60	52	0.028
Paguate Reservoir	4-4-84	7.90	1704	1450	268	27.0	951	170	12.5	183	90	2.0	0.57	34	0.011

	DATE	As ppm	Ba ppm	Cd ppm	Cr ppm	Pb ppm	Hg ppm	Se ppm	Cu ppm	Fe ppm	Zn ppm	Mo ppm	Ni ppm	V ppm
Rio Paguate Upstream	4-4-84	< 0.005	0.06	< 0.001	< 0.005	< 0.01	< 0.0005	< 0.005	0.007	< 0.005	0.003	< 0.01	< 0.005	< 0.05
Rio Moquino Upstream	4-4-84	< 0.005	< 0.05	< 0.001	< 0.005	< 0.01	< 0.0005	< 0.005	0.001	0.008	< 0.001	< 0.01	< 0.005	< 0.05
Rio Paguate Above the Confluence	4-4-84	< 0.005	< 0.05	< 0.001	< 0.005	< 0.01	< 0.0005	< 0.005	< 0.001	0.005	< 0.001	< 0.01	< 0.005	< 0.05
Rio Moquino Above the Confluence	4-4-84	< 0.005	< 0.05	< 0.001	< 0.005	< 0.01	< 0.0005	< 0.005	< 0.001	< 0.005	< 0.001	< 0.01	< 0.005	< 0.05
Rio Paguate Ford Crossing	4-4-84	< 0.005	< 0.05	< 0.001	< 0.005	< 0.01	< 0.0005	< 0.005	0.003	< 0.005	< 0.001	< 0.01	< 0.005	< 0.05
Paguate Reservoir	4-4-84	< 0.005	< 0.05	< 0.001	< 0.005	< 0.01	< 0.0005	< 0.005	0.002	0.015	< 0.001	< 0.01	< 0.005	< 0.05

350002212

ANACONDA MINERALS COMPANY
NEW MEXICO OPERATIONS

FOR THE MONTH OF: _____

DESCRIPTION	DATE	pH	TDS ppm	Cond umhos @ Field Temp.	HCO_3^- ppm	Cl^- ppm	$SO_4^=$ ppm	Na^+ ppm	K^+ ppm	Ca^{++} ppm	Mg^{++} ppm	NO_3^- ppm	F^- ppm	SiO_2 ppm	Mn^{++} ppm
Rio Paguate Upstream	5-1-84	8.23	839	730	315	9.5	291	47.7	5.3	123	45.5	1.3	0.52	56	0.064
Rio Moquino Upstream	5-1-84	8.34	1612	1530	261	11.2	907	171	7.5	152	98	3.1	0.64	36	0.014
Rio Paguate Above the Confluence	5-1-84	8.36	904	910	285	11.1	370	64	5.9	107	58	2.4	0.57	40	0.037
Rio Moquino Above the Confluence	5-1-84	8.58	1893	1830	237	12.9	1132	217	8.0	159	124	1.7	0.79	30	0.032
Rio Paguate Ford Crossing	5-1-84	8.48	1735	2610	278	15.0	988	181	7.5	150	113	1.1	0.76	50	0.040
Paguate Reservoir	5-1-84	7.95	2155	1840	288	27.0	1258	218	13.8	236	111	1.7	0.74	17	0.029

	DATE	As ppm	Ba ppm	Cd ppm	Cr ppm	Pb ppm	Hg ppm	Se ppm	Cu ppm	Fe ppm	Zn ppm	Mo ppm	Ni ppm	V ppm
Rio Paguate Upstream	5-1-84	< 0.005	0.06	< 0.001	< 0.005	< 0.01	< 0.0005	< 0.005	0.002	0.015	0.005	< 0.01	0.005	< 0.05
Rio Moquino Upstream	5-1-84	< 0.005	< 0.05	< 0.001	< 0.005	< 0.01	< 0.0005	< 0.005	0.002	0.024	0.004	< 0.01	0.008	< 0.05
Rio Paguate Above the Confluence	5-1-84	< 0.005	< 0.05	< 0.001	< 0.005	< 0.01	< 0.0005	< 0.005	0.002	0.018	0.003	< 0.01	0.005	< 0.05
Rio Moquino Above the Confluence	5-1-84	< 0.005	< 0.05	< 0.001	< 0.005	< 0.01	< 0.0005	< 0.005	0.007	0.018	0.004	< 0.01	0.008	< 0.05
Rio Paguate Ford Crossing	5-1-84	< 0.005	< 0.05	< 0.001	< 0.005	< 0.01	< 0.0005	< 0.005	0.002	0.015	0.004	< 0.01	0.010	< 0.05
Paguate Reservoir	5-1084	< 0.005	< 0.05	< 0.001	< 0.005	< 0.01	< 0.0005	< 0.005	0.018	0.051	0.012	< 0.01	0.008	< 0.05

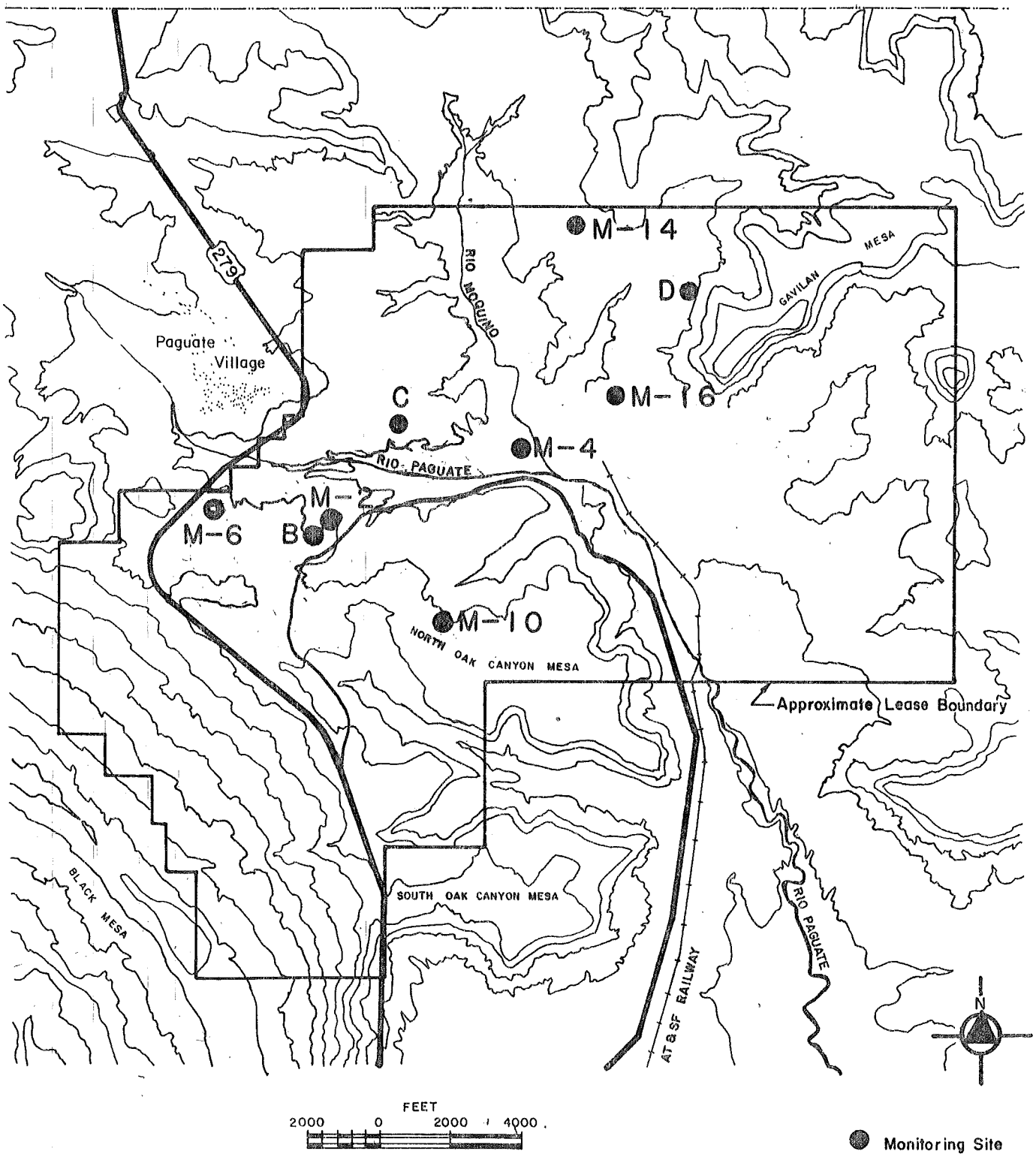
350002213

DESCRIPTION	DATE	pH	TDS ppm	Cond umhos @ Field Temp.	HCO_3^- ppm	Cl^- ppm	$SO_4^=$ ppm	Na^+ ppm	K^+ ppm	Ca^{++} ppm	Mg^{++} ppm	NO_3^- ppm	F^- ppm	SiO_2 ppm	Mn^{++} ppm
Rio Paguate Upstream	6-4-84	8.37	777	730	317	9.6	247	47	7.0	112	36	1.2	0.42	37.3	0.035
Rio Moquino Upstream	6-4-84	7.90	1719	1900	244	13.5	989	200	11.4	157	102	1.4	0.58	19.5	0.007
Rio Paguate Above the Confluence	6-4-84	7.85	953	1020	285	13.1	400	80	8.4	107	57	1.8	0.55	30.0	0.027
Rio Moquino Above the Confluence	6-4-84	7.91	2134	2150	276	16.1	1246	253	12.1	197	131	1.8	0.76	18.1	0.027
R[illegible] Paguate [illegible]d Crossing	6-4-84	7.84	1844	2090	283	17.9	1044	217	11.3	150	118	1.6	0.74	21.5	0.042
Paguate Reservoir	6-4-84	7.56	2568	2550	212	31.8	1606	296	22.2	257	140	1.6	0.72	12.9	0.15

	DATE	As ppm	Ba ppm	Cd ppm	Cr ppm	Pb ppm	Hg ppm	Se ppm	Cu ppm	Fe ppm	Zn ppm	Mo ppm	Ni ppm	V ppm
Rio Paguate Upstream	6-4-84	<0.005	<0.05	<0.001	<0.005	<0.01	<0.0005	<0.005	0.011	0.037	<0.001	<0.01	0.006	<0.05
R[illegible] Moquino [illegible]tream	6-4-84	<0.005	<0.05	<0.001	<0.005	0.01	<0.0005	<0.005	0.007	0.02	<0.001	<0.01	<0.005	<0.05
Rio Paguate Above the Confluence	6-4-84	<0.005	<0.05	<0.001	<0.005	<0.01	<0.0005	<0.005	0.006	0.044	<0.001	<0.01	0.007	<0.05
Rio Moquino Above the Confluence	6-4-84	<0.005	<0.05	<0.001	<0.005	0.01	<0.0005	<0.005	0.008	0.054	<0.001	<0.01	<0.005	<0.05
Rio Paguate Ford Crossing	6-4-84	<0.005	<0.05	<0.001	<0.005	<0.01	<0.0005	<0.005	0.006	0.24	<0.001	<0.01	<0.005	<0.05
Paguate Reservoir	6-4-84	<0.005	<0.05	<0.001	<0.005	0.01	<0.0005	<0.005	0.007	0.26	<0.001	<0.01	<0.005	0.05

350002214

LOCATION OF GROUND WATER MONITORING STATIONS



350002215

Anaconda Minerals Company
New Mexico Operations

JACKPILE GROUNDWATER--ANNUALLY

DESCRIPTION	DATE	WATER LEVEL	Field pH	Field ELECT. COND.*	HCO_3 ppm	CO_3 ppm	Cl ppm	SO_4 ppm	Na ppm	K ppm	Ca ppm	Mg ppm	Mn ppm	NO_3 ppm	SiO_2 ppm	TDS ppm	U-Nat mg/L	Ra-226 pCi/L	Temp. °C			
M-2	5-15-84	5970.84	8.17	1350	471	Nil	19.5	436	374	2.2	8.5	2.3	0.081	1.7	8.6	1317	0.002	0.20	17.5			
M-4	4-24-84	5896.71	7.19	1250	425	Nil	29.1	318	140	5.4	104	43.6	0.10	0.79	17.8	1067	0.004	1.70	19.0			
M-6	5-21-84	5984.22	8.14	1230	459	Nil	13.0	352	352	2.5	5.1	1.3	0.029	2.7	13.6	1190	0.002	0.30	18.5			
M-10	5-21-84	5959.26	7.67	1750	451	Nil	15.0	711	403	4.5	49.9	29.8	0.12	2.7	13.5	1668	0.043	9.90	18.5			
M-14	5-21-84	5934.38	8.60	560	390	Nil	2.8	44.4	173	0.8	1.6	0.4	0.015	2.6	13.2	617	0.001	0.16	20.0			
M-16	5-21-84	5908.49	7.43	850	415	Nil	1.2	155	215	1.7	9.9	4.9	0.15	2.5	10.0	807	0.016	0.78	20.0			
"B"	5-15-84	5976.56	6.09	5800	182	Nil	23.2	4963	1640	18.5	398	185	2.1	1.5	31	7452	0.003	1.05	20.0			
"C"	4-24-84	5929.96	6.61	3390	539	Nil	38.4	2625	220	13.5	467	407	1.3	0.81	12.2	4313	2.155	4.0	16.0			
"D"	4-24-84	5842.14	7.26	5500	1196	Nil	0.9	2151	1330	16.0	40	32.4	0.11	1.1	8.7	4768	3.092	4.0	17.5			

DESCRIPTION	DATE	As ppm	Ba ppm	Cd ppm	Cr ppm	F ppm	Pb ppm	Hg ppm	Se ppm	Ag ppm	Cu ppm	Fe ppm	Zn ppm	Al ppm	B ppm	Co ppm	Mo ppm	Ni ppm	V ppm	PO_4 ppm		
M-2	5-15-84	<0.005	<0.05	<0.001	<0.005	1.2	<0.01	<0.0005	<0.005	<0.005	0.009	0.75	0.005	<0.05	0.42	<0.005	<0.01	<0.005	<0.05	<0.10		
M-4	4-24-84	<0.005	<0.05	<0.001	<0.005	0.77	<0.01	<0.0005	<0.005	<0.005	0.007	0.038	0.007	<0.05	<0.20	<0.005	<0.01	<0.005	<0.05	<0.10		
M-6	5-21-84	<0.005	<0.05	<0.001	<0.005	1.5	<0.01	<0.0005	<0.005	<0.005	0.005	0.29	0.007	<0.05	0.38	<0.005	<0.01	0.005	<0.05	<0.10		
M-10	5-21-84	<0.005	<0.05	<0.001	<0.005	1.1	0.03	<0.0005	<0.005	<0.005	0.004	0.014	0.006	<0.05	0.29	<0.005	<0.01	<0.005	<0.05	<0.10		
M-14	5-21-84	<0.005	<0.05	<0.001	<0.005	0.94	<0.01	<0.0005	<0.005	<0.005	0.004	0.019	0.006	<0.05	<0.20	<0.005	<0.01	<0.005	<0.05	<0.10		
M-16	5-21-84	<0.005	<0.05	<0.001	<0.005	1.1	<0.01	<0.0005	<0.005	<0.005	0.003	0.031	0.008	<0.05	0.21	<0.005	<0.01	0.005	<0.05	<0.10		
"B"	5-15-84	0.038	<0.05	<0.001	<0.005	0.14	0.03	<0.0005	<0.005	<0.005	<0.001	38	0.14	<0.05	1.1	0.13	<0.01	0.20	<0.05	<0.10		
"C"	4-24-84	<0.005	<0.05	<0.001	<0.005	0.33	<0.01	<0.0005	<0.005	<0.005	0.003	0.23	<0.001	<0.05	0.23	0.008	<0.01	0.020	<0.05	<0.10		
"D"	4-24-84	<0.005	<0.05	<0.001	<0.005	0.20	<0.01	<0.0005	<0.005	<0.005	0.003	0.30	0.003	<0.05	0.26	<0.005	<0.01	0.009	<0.05	<0.10		

* At Field Temperature

350002216

ANACONDA Minerals Co. ..ıy
New Mexico Operations
P.O. Box 638
Grants, New Mexico 87020
Telephone 505 876 2211

MAY 7 AM 36

Minerals Staff
Rio Puerco Resource Area
Bureau of Land Management
3550 Pan American Freeway, NE
P. O. Box 6770
Albuquerque, NM 87107

Dear Sir:

The First Quarter of 1984 sampling data for Anaconda's former Jackpile minesite leases is submitted as follows:

1. Radiological Analysis of Surface Water;
2. Chemical Analysis of Surface Water;
3. Map showing Surface Water Sampling Locations;
4. Results of the Air Monitoring Program;
5. Results of the Ambient Radon Monitoring Study;
6. Map showing location of Air and Radon Monitoring Stations;
7. Map of Groundwater Monitoring Locations; and,
8. Chemical Analysis of Groundwater Monitoring, First Quarter.

Sincerely,

Meade A. Stirland
General Manager

MINERALS, RIO PUERCO RA
RECEIVED
MAY 07 1984
BUREAU OF LAND MANAGEMENT
ALBUQUERQUE, NEW MEXICO

Enclosures - 8

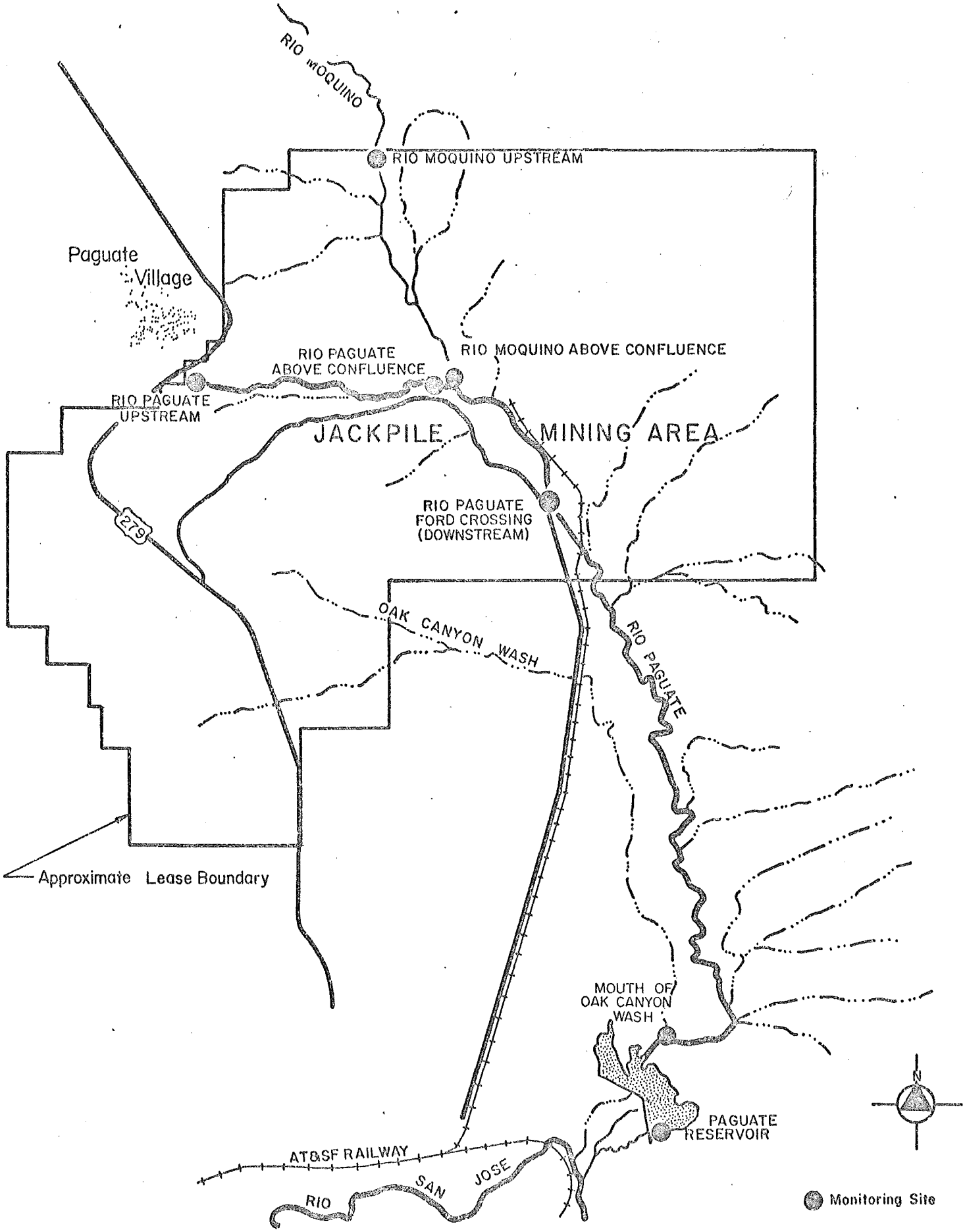
pc: DLR
CES
CDW

JACKPILE-WATER RADIOLOGICAL ANALYSIS

(First Quarter, 1984)

Descriptive Location	Radium-226, pCi/L			Uranium-Natural, ppm		
	Jan.	Feb.	Mar.	Jan.	Feb.	Mar.
Rio Paguate Upstream	0.33	0.62	$<$ 0.05	0.0039	0.004	0.002
Rio Moquino Upstream	0.48	0.53	$<$ 0.05	0.0039	0.002	0.021
Rio Paguate Above the Confluence	1.17	1.73	0.95	0.0242	0.0252	0.036
Rio Moquino Above the Confluence	1.56	1.12	0.15	0.0203	0.130	0.008
Rio Paguate - Ford Crossing	0.68	1.37	0.24	0.0745	0.0535	0.052
Paguate Reservoir	0.32	0.59	0.31	0.6632	0.7016	0.246
Mouth of Oak Canyon Wash	*	*	*	*	*	*

*No sample because the Mouth of Oak Canyon Wash was dry.



LOCATION OF
SURFACE WATER MONITORING STATIONS

350002219

JACKPILE-AMBIENT RADON SURVEY

(First Quarter, 1984)

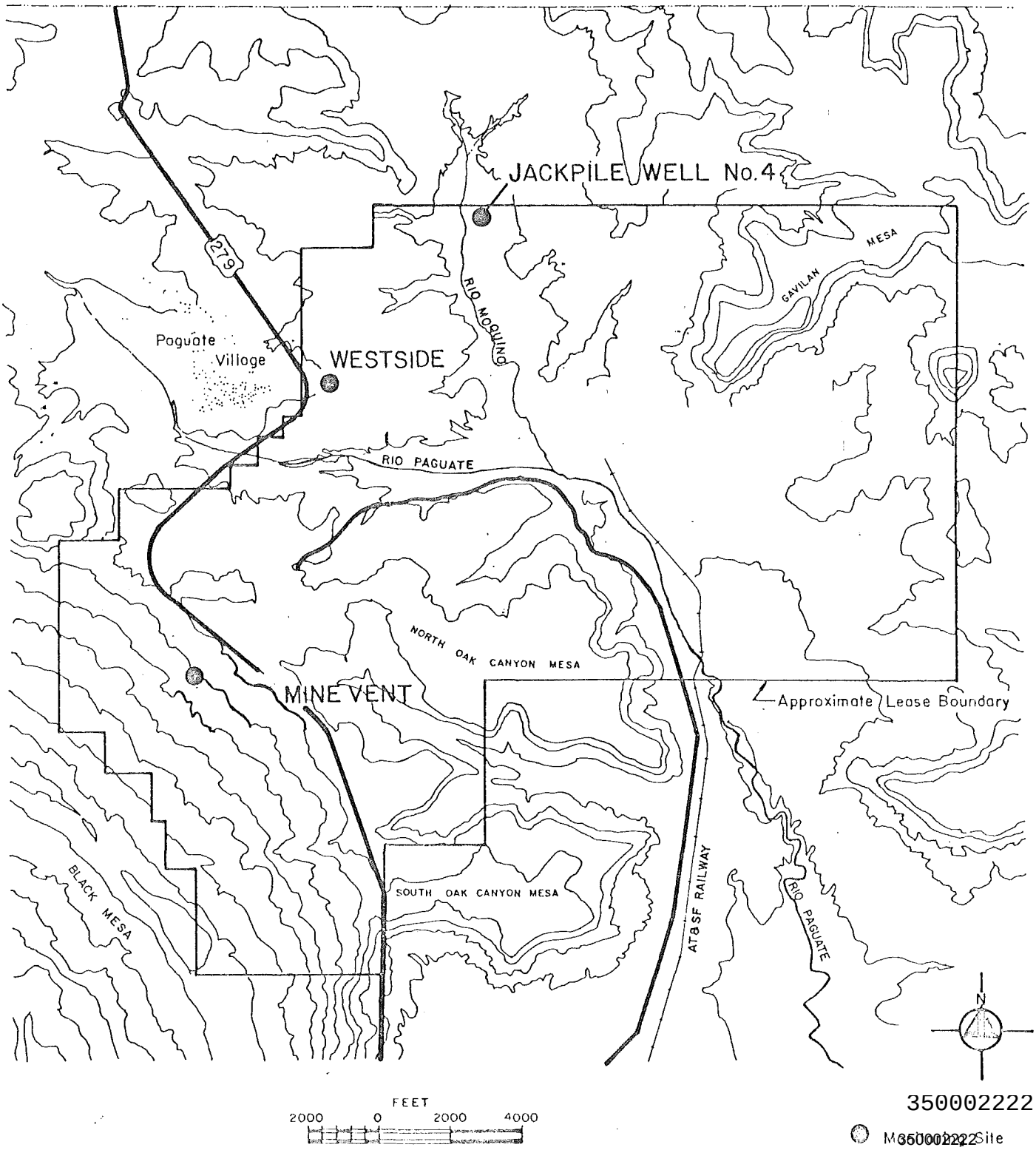
Location	Date	Rn-222 pCi/L
1. P-10 Area	1/84	1.72
	2/84	1.40
	3/84	1.16
2. Well #4	1/84	1.06
	2/84	0.89
	3/84	0.69
3. Westgate	1/84	$<$ 0.20
	2/84	$<$ 0.20
	3/84	$<$ 0.20

JACKPILE-AIR SAMPLING SURVEY

(First Quarter, 1984)

Location	Date	Total Particulate $\mu gm/m^3$	U-Nat. $\mu Ci/ml x 10^{-15}$	Ra-226 $\mu Ci/ml x 10^{-15}$	Th-230 $\mu Ci/ml x 10^{-15}$	Pb-210 $\mu Ci/ml x 10^{-15}$
1. P-10 Area	1/84	8.50	1.21	0.30	3.28	85.58
	2/84	14.94	0.61	0.24	0.37	65.26
	3/84	18.86	<1.24	0.32	0.87	35.86
2. Westgate	1/84	17.48	4.01	0.34	5.80	66.51
	2/84	27.51	2.29	0.23	1.30	51.96
	3/84	25.54	<1.70	0.26	1.53	31.50
3. Well #4	1/84	13.04	2.10	1.02	8.15	59.82
	2/84	18.73	0.85	0.26	1.18	53.25
	3/84	22.52	<1.31	<0.06	0.26	31.33

LOCATION OF
AIR QUALITY MONITORING STATIONS



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350002222

ANACONDA MINERALS COMPANY
NEW MEXICO OPERATIONS

FOR THE MONTH OF: January, 84

DESCRIPTION	DATE	pH	TDS ppm	Cond umhos	HCO_3^- ppm	Cl^- ppm	$SO_4^=$ ppm	Na^+ ppm	K^+ ppm	Ca^{++} ppm	Mg^{++} ppm	NO_3^- ppm	F^- ppm	SiO_2 ppm	Mn^{++} ppm
Rio Paguate Upstream	01-03-84	8.30	575	440	271	9.3	148	31.5	4.6	75	32.5	2.4	0.33	42.4	0.073
Rio Moquino Upstream	01-03-84	8.40	1666	1140	342	8.0	869	170	7.5	165	100	3.6	0.54	21.7	0.014
Rio Paguate Above the Confluence	01-03-84	8.47	682	445	305	9.4	196	40.9	4.9	80	42.6	3.0	0.39	38.9	0.054
Rio Moquino Above the Confluence	01-03-84	8.35	2076	1400	325	16.8	1188	217	7.2	180	139	2.2	0.75	17.5	0.051
Rio Paguate Ford Crossing	01-03-84	8.28	1393	1000	320	16.6	690	134	6.1	127	95	3.8	0.54	26.1	0.083
Paguate Reservoir	01-03-84	7.68	2503	1840	293	33.9	1490	239	17.6	308	118	2.6	0.80	7.2	0.021

	DATE	As ppm	Ba ppm	Cd ppm	Cr ppm	Pb ppm	Hg ppm	Se ppm	Cu ppm	Fe ppm	Zn ppm	Mo ppm	Ni ppm	V ppm
Rio Paguate Upstream	01-03-84	<0.005	0.05	<0.001	<0.005	<0.01	<0.0005	<0.005	0.004	0.019	0.009	<0.01	0.005	<0.05
Rio Moquino Upstream	01-03-84	<0.005	<0.05	<0.001	<0.005	<0.01	<0.0005	<0.005	0.005	0.009	0.014	<0.01	0.010	<0.05
Rio Paguate Above the Confluence	01-03-84	<0.005	<0.05	<0.001	<0.005	<0.01	<0.0005	<0.005	0.002	0.015	0.002	<0.01	<0.005	<0.05
Rio Moquino Above the Confluence	01-03-84	<0.005	<0.05	<0.001	<0.005	<0.01	<0.0005	<0.005	0.003	0.008	0.001	<0.01	<0.005	<0.05
Rio Paguate Ford Crossing	01-03-84	<0.005	<0.05	<0.001	<0.005	<0.01	<0.0005	<0.005	0.002	0.010	0.021	<0.01	<0.005	<0.05
Paguate Reservoir	01-03-84	<0.005	<0.05	0.001	<0.005	<0.01	<0.0005	<0.005	0.005	0.011	0.007	<0.01	0.006	<0.05

350002223

ANACONDA MINERALS COMPANY
NEW MEXICO OPERATIONS

FOR THE MONTH OF: February 84

DESCRIPTION	DATE	pH	TDS ppm	Cond umhos	HCO_3^- ppm	Cl^- ppm	$SO_4^=$ ppm	Na^+ ppm	K^+ ppm	Ca^{++} ppm	Mg^{++} ppm	NO_3^- ppm	F^- ppm	SiO_2 ppm	Mn^{++} ppm
Rio Paguate Upstream	02-01-84	8.41	596	400	283	9.2	153	29.5	4.6	82	32.4	1.5	0.36	40.2	0.071
Rio Moquino Upstream	02-01-84	8.44	1577	1060	305	14.0	839	145	6.8	175	90	1.7	0.53	17	0.016
Rio Paguate Above the Confluence	02-01-84	8.54	719	455	305	10.0	227	40.1	4.8	88	41.8	1.5	0.39	35.3	0.060
Rio Moquino Above the Confluence	02-01-84	8.50	1877	1240	295	15	1076	192	6.9	172	118	1.6	0.66	16.2	0.039
Rio Paguate Ford Crossing	02-01-84	8.46	1377	1020	303	14.0	701	132	6.0	134	85	1.6	0.54	23.7	0.065
Paguate Reservoir	02-01-84	7.44	2651	1710	293	32.5	1597	255	17.7	325	128	1.6	0.68	11.6	0.08

	DATE	As ppm	Ba ppm	Cd ppm	Cr ppm	Pb ppm	Hg ppm	Se ppm	Cu ppm	Fe ppm	Zn ppm	Mo ppm	Ni ppm	V ppm
Rio Paguate Upstream	02-01-84	<0.005	<0.05	<0.001	<0.005	<0.01	<0.0005	<0.005	0.006	0.020	0.009	<0.01	<0.005	<0.05
Rio Moquino Upstream	02-01-84	<0.005	<0.05	<0.001	<0.005	<0.01	<0.0005	<0.005	0.003	0.008	0.003	<0.01	0.006	<0.05
Rio Paguate Above the Confluence	02-01-84	<0.005	<0.05	<0.001	<0.005	<0.01	<0.0005	<0.005	0.002	0.016	0.005	<0.01	<0.005	<0.05
Rio Moquino Above the Confluence	02-01-84	<0.005	<0.05	<0.001	<0.005	<0.01	<0.0005	<0.005	0.002	0.011	0.004	<0.01	<0.005	<0.05
Rio Paguate Ford Crossing	02-01-84	<0.005	<0.05	<0.001	<0.005	<0.01	<0.0005	<0.005	0.001	0.017	0.008	<0.01	<0.005	<0.05
Paguate Reservoir	02-01-84	<0.005	<0.05	<0.001	<0.005	<0.01	<0.0005	<0.005	0.003	0.018	0.007	<0.01	<0.005	<0.05

350002224

ANACONDA MINERALS COMPANY
NEW MEXICO OPERATIONS

FOR THE MONTH OF: March 84

DESCRIPTION	DATE	pH	TDS ppm	Cond umhos	HCO_3^- ppm	Cl^- ppm	$SO_4^=$ ppm	Na^+ ppm	K^+ ppm	Ca^{++} ppm	Mg^{++} ppm	NO_3^- ppm	F^- ppm	SiO_2 ppm	Mn^{++} ppm
Rio Paguate Upstream	03-01-84	8.52	820	750	381	11.3	232	37	6.3	100	51	0.91	0.40	35.3	0.13
Rio Moquino Upstream	03-01-84	8.40	1326	1280	234	13.1	730	122	7.2	127	90	2.1	0.48	20.3	0.036
Rio Paguate Above the Confluence	03-01-84	8.23	951	780	359	13.0	334	68	6.7	101	66	2.3	0.45	30.2	0.072
Rio Moquino Above the Confluence	03-01-84	8.11	1568	1470	288	16.1	852	145	7.8	132	123	3.1	0.58	15.8	0.021
Rio Paguate Ford Crossing	03-01-84	8.28	1565	1420	337	16.3	798	142	7.6	138	123	1.8	0.58	22.9	0.047
Paguate Reservoir	03-01-84	7.49	1879	1410	317	30.6	1029	187	12.6	194	107	0.86	0.60	17.3	0.014

	DATE	As ppm	Ba ppm	Cd ppm	Cr ppm	Pb ppm	Hg ppm	Se ppm	Cu ppm	Fe ppm	Zn ppm	Mo ppm	Ni ppm	V ppm
Rio Paguate Upstream	03-01-84	<0.005	0.06	<0.001	<0.005	0.01	<0.0005	<0.005	0.006	0.023	0.018	<0.01	0.005	<0.05
Rio Moquino Upstream	03-01-84	<0.005	<0.05	<0.001	<0.005	<0.01	<0.0005	<0.005	0.010	0.025	0.081	<0.01	0.006	<0.05
Rio Paguate Above the Confluence	03-01-84	<0.005	<0.05	<0.001	<0.005	<0.01	<0.0005	<0.005	0.007	0.006	0.005	<0.01	0.008	<0.05
Rio Moquino Above the Confluence	03-01-84	<0.005	<0.05	<0.001	<0.005	<0.01	<0.0005	<0.005	0.043	0.038	0.28	<0.01	0.007	<0.05
Rio Paguate Ford Crossing	03-01-84	<0.005	<0.05	<0.001	<0.005	<0.01	<0.0005	<0.005	0.003	0.008	0.003	<0.01	<0.005	<0.05
Paguate Reservoir	03-01-84	<0.005	<0.05	0.001	<0.005	<0.01	<0.0005	<0.005	0.005	0.011	0.007	<0.01	0.006	<0.05

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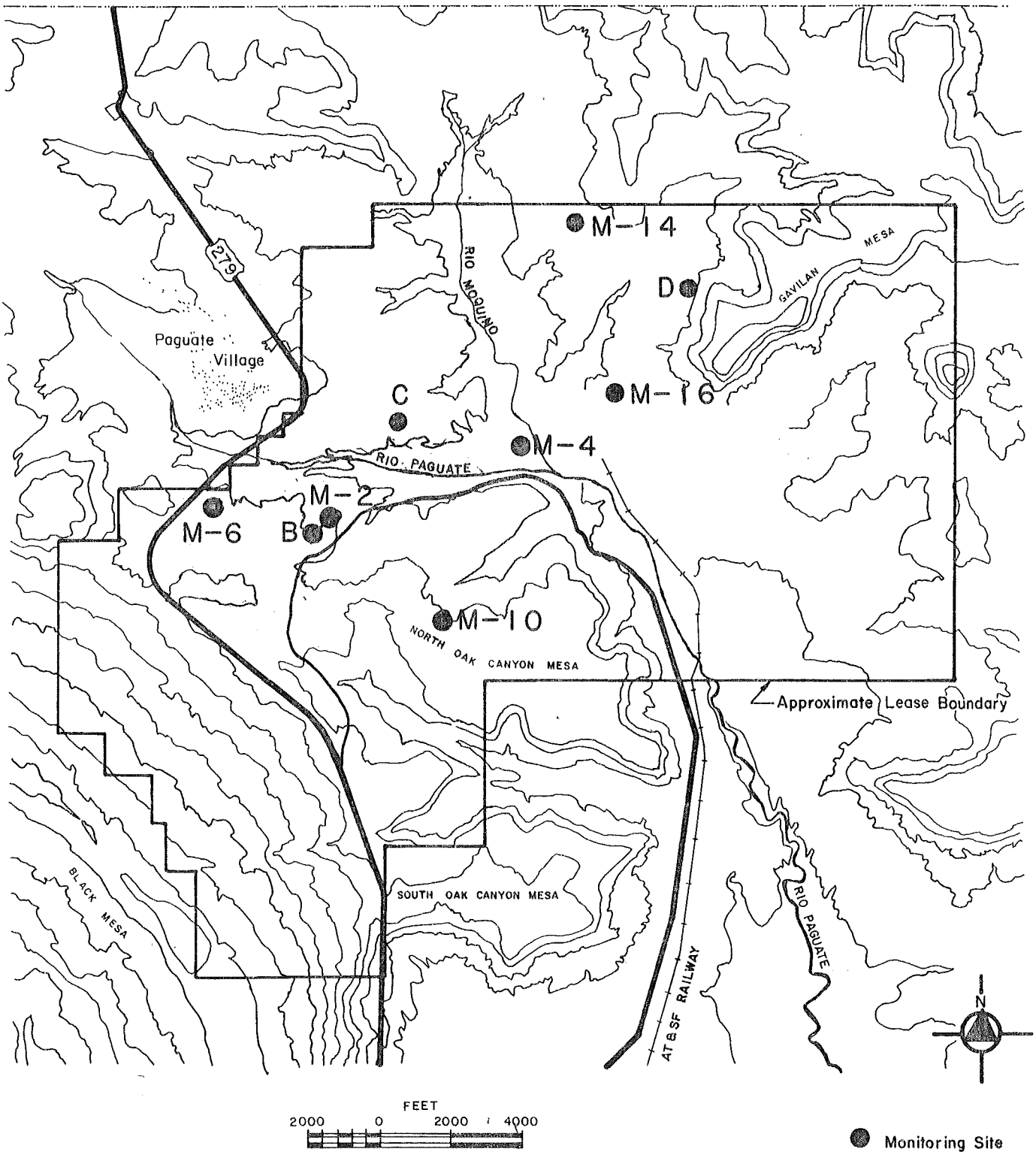
LOCATION OF GROUND WATER MONITORING STATIONS



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JACKPILE GROUNDWATER

ANACONDA MINERALS COMPANY
NEW MEXICO OPERATION

FOR THE 1st Quarter, 1984

DESCRIPTION	DATE	WATER LEVEL	pH	TEMP °C	ELEC. COND.	TDS	SO_4	U-Nat. mg/l	Ra-226 pCi/L
M-2	03-13-84	5971.23	8.28	18.5	1070	816	321	<0.003	0.09
M-4	03-20-84	5897.07	7.22	19.5	1280	884	393	0.010	0.17
M-6	03-13-84	5983.65	8.17	18	1050	1044	362	<0.003	0.47
M-10	03-13-84	5959.26	7.69	18.5	1190	1228	706	0.050	4.4
M-14	02-14-84	5934.83	8.67	19	700	412	46.1	0.010	0.30
M-16	02-14-84	5908.94	7.30	18.5	750	572	135	0.015	0.22
"B"	03-20-84	5979.45	6.34	19.2	8000	7540	5270	0.096	3.30
"C"	03-20-84	5930.18	6.46	18	3680	4000	2532	0.990	3.90
"D"	02-14-84	5842.14	7.82	15	3780	3988	2214	0.470	0.94

ANACONDA Minerals Co. ny
New Mexico Operations
P.O. Box 638
Grants, New Mexico 87020
Telephone 505 876 2211

January 24, 1984

FEB 8 A 8: 55

Minerals Staff
Rio Puerco Resource Area
Bureau of Land Management
3550 Pan American Freeway, N.E.
P. O. Box 6770
Albuquerque, N.M. 87107

Dear Sir:

The Fourth Quarter of 1983 sampling data for Anaconda's former Jackpile minesite leases is submitted as follows:

1. Radiological Analysis of Surface Water.
2. Chemical Analysis of Surface Water.
3. Map showing Surface Water Sampling Locations.
4. Results of the Air Monitoring Program.
5. Results of the Ambient Radon Monitoring Study.
6. Map showing location of Air and Radon Monitoring Stations.
7. Map of Groundwater Monitoring Locations.
8. Chemical Analysis of Groundwater Monitoring, 3rd and 4th Quarters.

Sincerely,

Meade A. Stirland
General Manager

mls

Enclosures - 8

MINERALS, RIO PUERCO RA
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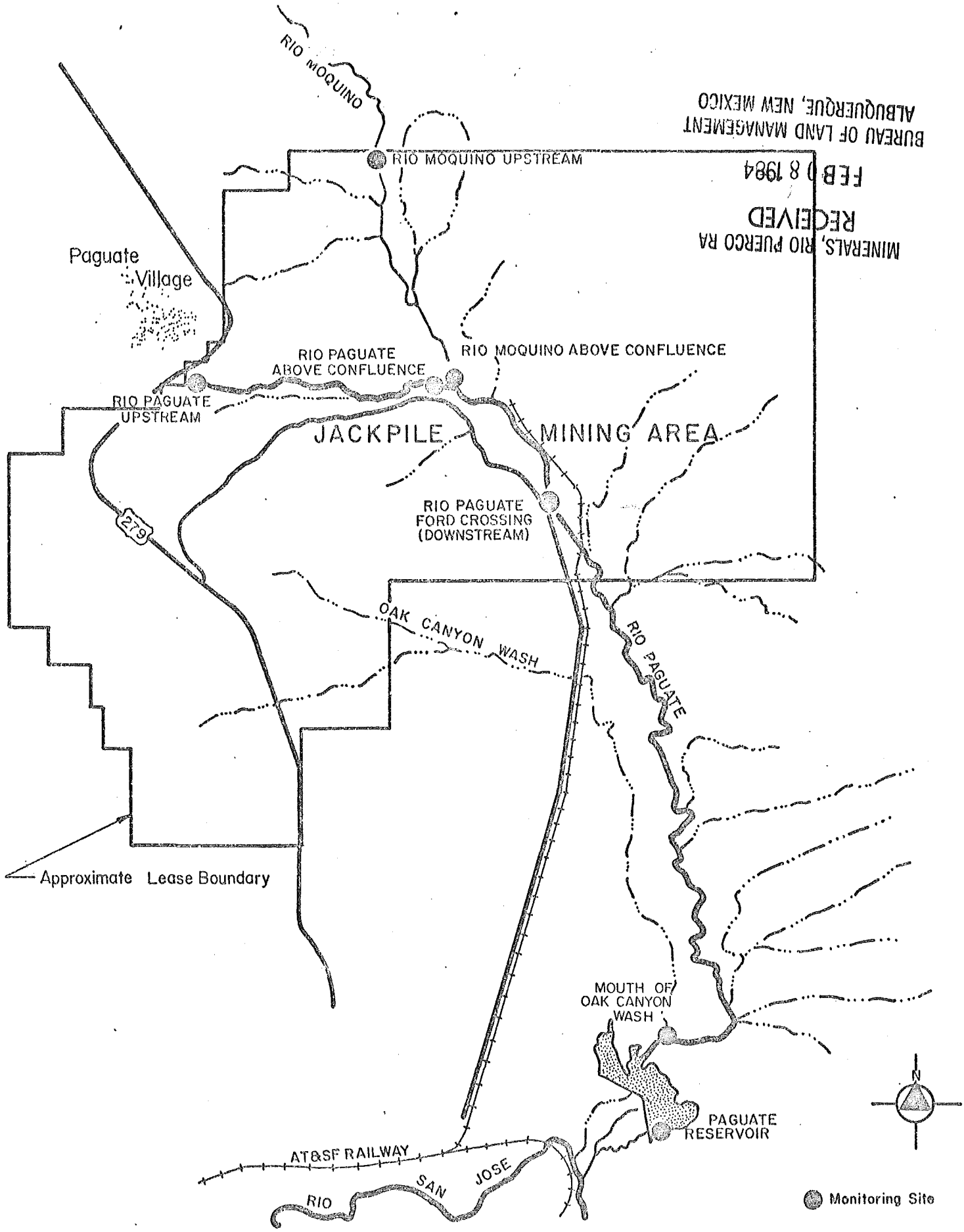

LOCATION OF
SURFACE WATER MONITORING STATIONS

JACKPILE - WATER RADIOLOGICAL ANALYSIS

(FOURTH QUARTER, 1983)

DESCRIPTIVE LOCATION	Radium-226 pCi/L			Uranium-Natural ppm		
	Jul.	Aug.	Sep.	Jul.	Aug	Sep.
Rio Paguate Upstream	0.24	0.37	1.41	0.001	0.0021	0.0004
Rio Moquino Upstream	0.33	0.92	0.66	0.0021	0.010	0.002
Rio Paguate Above the Confluence	0.26	0.80	<0.20	0.025	0.032	0.016
Rio Moquino Above the Confluence	0.37	1.17	<0.20	0.035	0.030	0.013
Rio Paguate Ford Crossing	1.33	1.97	0.57	0.103	0.110	0.061
Paguate Reservoir	0.94	2.10	0.38	0.391	0.539	0.619
Mouth of Oak Canyon Wash	*	*	*	*	*	*

* No sample because the Mouth of Oak Canyon Wash was dry.

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JACKPILE-AMBIENT RADON SURVEY

FOURTH QUARTER, 1983

LOCATION	DATE	Rn-222 pCi/L
1. P-10 Area	10/83	1.40
	11/83	1.33
	12/83	1.32
2. Well #4	10/83	0.83
	11/83	0.76
	12/83	0.84
3. Westgate	10/83	0.64
	11/83	0.69
	12/83	0.20

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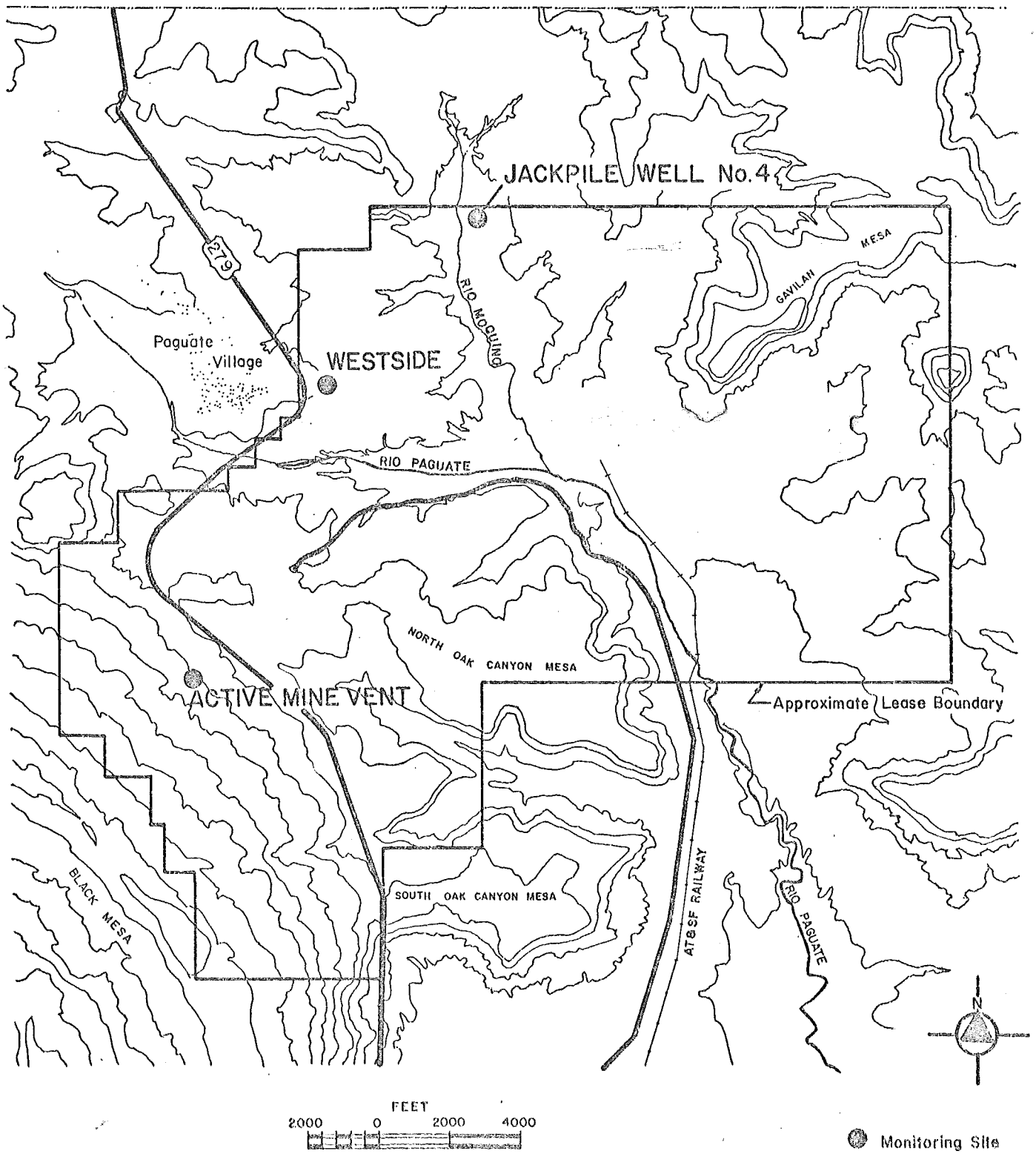
LOCATION OF AIR QUALITY MONITORING STATIONS



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JACKPILE - AIR SAMPLING SURVEY

FOURTH QUARTER, 1983

LOCATION	DATE	TOTAL PARTICULATE ugm/M^3	U-Nat. uCi/mlx10-15	Ra-226 uCi/mlx10-15	Th-230 uCi/mlx10-15	Pb-210 uCi/mlx10-15
1. P-10 Area	10-83	10.27	1.00	0.117	1.61	36.40
	11-83	12.07	0.85	0.78	3.54	57.34
	12-83	5.54	0.49	0.43	7.27	32.64
2. West Gate	10-83	13.77	0.98	0.190	1.58	21.89
	11-83	18.83	2.20	0.78	6.31	38.44
	12-83	13.15	2.15	0.48	5.58	23.91
3. Well #4	10-83	16.98	1.56	0.40	2.61	33.05
	11-83	13.78	1.04	0.37	1.01	40.43
	12-83	7.97	0.86	0.37	10.05	24.52

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NEW MEXICO OPERATIONS

FOR THE MONTH OF: October

DESCRIPTION	DATE	pH	TDS ppm	Cond umhos	HCO_3^- ppm	Cl^- ppm	$SO_4^=$ ppm	Na^+ ppm	K^+ ppm	Ca^{++} ppm	Mg^{++} ppm	NO_3^- ppm	F^- ppm	SiO_2 ppm	Mn^{++} ppm
Rio Paguate Upstream	10-4-83	7.31	508	500	232	8.8	132	25.6	4.8	73	28	3.0	0.33	38.1	0.057
Rio Moquino Upstream	10-4-83	8.38	1733	1500	298	17.2	945	186	8.4	164	111	2.9	0.58	21.1	0.012
Rio Paguate Above the Confluence	10-4-83	8.09	628	580	242	9.5	217	34.5	5.3	82	34.8	2.5	0.39	32.7	0.049
Rio Moquino Above the Confluence	10-4-83	8.01	2037	1790	293	18.5	1177	219	8.7	185	132	2.6	0.69	18.8	0.053
Rio Paguate Ford Crossing	10-4-83	8.13	1422	1120	281	15.2	746	135	7.2	142	92	2.9	0.56	24.6	0.076
Paguate Reservoir	10-4-83	7.20	3607	2630	146	36.4	2428	331	25.1	440	196	3.4	0.93	6.1	0.03

	DATE	As ppm	Ba ppm	Cd ppm	Cr ppm	Pb ppm	Hg ppm	Se ppm	Cu ppm	Fe ppm	Zn ppm	Mo ppm	Ni ppm	V ppm
Rio Paguate Upstream	10-4-83	<0.005	<0.05	<0.001	<0.005	<0.01	<0.0005	<0.005	0.004	0.013	0.010	<0.01	<0.005	<0.05
Rio Moquino Upstream	10-4-83	<0.005	0.05	<0.001	<0.005	<0.01	<0.0005	<0.005	0.005	0.013	0.001	<0.01	<0.005	<0.05
Rio Paguate Above the Confluence	10-4-83	<0.005	<0.05	<0.001	<0.005	<0.01	<0.0005	<0.005	0.004	0.012	0.006	<0.01	<0.005	<0.05
Rio Moquino Above the Confluence	10-4-83	<0.005	<0.05	<0.001	<0.005	<0.01	<0.0005	<0.005	0.007	0.006	0.001	<0.01	<0.005	<0.05
Rio Paguate Ford Crossing	10-4-83	<0.005	<0.05	<0.001	<0.005	<0.01	<0.0005	<0.005	0.003	0.014	0.001	<0.01	<0.005	<0.05
Paguate Reservoir	10-4-83	<0.005	<0.05	<0.001	<0.005	<0.01	<0.0005	<0.005	0.005	0.014	0.001	<0.01	<0.005	<0.05

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ANACONDA MINERALS COMPANY
NEW MEXICO OPERATIONS

FOR THE MONTH OF: November

DESCRIPTION	DATE	pH	TDS ppm	Cond umhos	HCO_3^- ppm	Cl^- ppm	$SO_4^=$ ppm	Na^+ ppm	K^+ ppm	Ca^{++} ppm	Mg^{++} ppm	NO_3^- ppm	F^- ppm	SiO_2 ppm	Mn^{++} ppm
Rio Paguate Upstream	11-1-83	8.19	646	600	285	9.0	184	41.7	5.6	78	37.8	4.3	0.34	47.3	0.050
Rio Moquino Upstream	11-1-83	8.33	1765	1760	271	16.6	986	213	8.7	166	101	2.0	0.61	23.1	0.006
Rio Paguate Above the Confluence	11-1-83	8.34	753	690	310	10.7	234	47.6	8.4	96	41.5	3.7	0.41	36.0	0.040
Rio Moquino Above the Confluence	11-1-83	8.32	2117	2030	298	19.1	1258	257	9.8	166	134	3.9	0.79	17.9	0.031
Rio Paguate Ford Crossing	11-1-83	8.29	1679	1750	305	17.4	900	220	8.2	124	100	3.8	0.68	27.9	0.037
Paguate Reservoir	11-1-83	7.68	3736	3600	181	44.8	2441	387	26.9	452	198	4.1	0.78	2.2	0.20

	DATE	As ppm	Ba ppm	Cd ppm	Cr ppm	Pb ppm	Hg ppm	Se ppm	Cu ppm	Fe ppm	Zn ppm	Mo ppm	Ni ppm	V ppm
Rio Paguate Upstream	11-1-83	<0.005	<0.05	<0.001	<0.005	<0.01	<0.0005	<0.005	0.090	0.021	0.025	<0.01	<0.005	<0.05
Rio Moquino Upstream	11-1-83	<0.005	<0.05	<0.001	<0.005	<0.01	<0.0005	<0.005	0.006	0.011	0.011	<0.01	<0.005	<0.05
Rio Paguate Above the Confluence	11-1-83	<0.005	0.07	<0.001	<0.005	<0.01	<0.0005	<0.005	0.002	0.014	0.005	<0.01	<0.005	<0.05
Rio Moquino Above the Confluence	11-1-83	<0.005	<0.05	<0.001	<0.005	<0.01	<0.0005	<0.005	0.001	0.012	0.008	<0.01	<0.005	<0.05
Rio Paguate Ford Crossing	11-1-83	<0.005	<0.05	<0.001	<0.005	<0.01	<0.0005	<0.005	0.001	0.020	0.001	<0.01	<0.005	<0.05
Paguate Reservoir	11-1-83	<0.005	0.05	<0.001	<0.005	<0.01	<0.0005	<0.005	0.006	0.010	0.009	<0.01	<0.006	<0.05

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ANACONDA MINERALS COMPANY
NEW MEXICO OPERATIONS

FOR THE MONTH OF: December

DESCRIPTION	DATE	pH	TDS ppm	Cond umhos	HCO_3^- ppm	Cl^- ppm	$SO_4^=$ ppm	Na^+ ppm	K^+ ppm	Ca^{++} ppm	Mg^{++} ppm	NO_3^- ppm	F^- ppm	SiO_2 ppm	Mn^{++} ppm
Rio Paguate Upstream	12-1-83	8.14	603	410	285	8.2	163	31.8	4.8	73	33.6	3.0	0.30	44.9	0.084
Rio Moquino Upstream	12-1-83	8.49	1602	1120	310	13.9	859	162	6.9	141	105	3.6	0.51	21.6	0.008
Rio Paguate Above the Confluence	12-1-83	8.62	684	425	293	8.7	206	38.8	5.0	87	40.2	4.4	0.35	37.4	0.072
Rio Moquino Above the Confluence	12-1-83	8.59	1991	1300	310	15.4	1144	208	6.9	163	139	3.6	0.63	18.6	0.056
Ri aguate Ford Crossing	12-1-83	8.48	1333	830	329	14.4	647	126	6.0	114	93	2.9	0.46	27.8	0.09
Paguate Reservoir	12-1-83	8.02	3144	2300	159	37.4	2074	298	19.2	396	156	5.1	0.98	3.0	0.17

	DATE	As ppm	Ba ppm	Cd ppm	Cr ppm	Pb ppm	Hg ppm	Se ppm	Cu ppm	Fe ppm	Zn ppm	Mo ppm	Ni ppm	V ppm
Rio Paguate Upstream	12-1-83	<0.005	0.05	<0.001	<0.005	<0.01	<0.0005	<0.005	0.007	0.047	0.027	<0.01	<0.005	<0.05
Ric oquino Upstream	12-1-83	<0.005	<0.05	<0.001	<0.005	<0.01	<0.0005	<0.005	0.048	0.016	0.024	<0.01	0.007	<0.05
Rio Paguate Above the Confluence	12-1-83	<0.005	<0.05	<0.001	<0.005	<0.01	<0.0005	<0.005	0.003	0.031	0.002	<0.01	<0.005	<0.05
Rio Moquino Above the Confluence	12-1-83	<0.005	<0.05	<0.001	<0.005	<0.01	<0.0005	<0.005	0.002	0.011	<0.001	<0.01	<0.005	<0.05
Rio Paguate Ford Crossing	12-1-83	<0.005	<0.05	<0.001	<0.005	<0.01	<0.0005	<0.005	0.003	0.014	0.001	<0.01	<0.005	<0.05
Paguate Reservoir	12-1-83	<0.005	<0.05	<0.001	<0.005	<0.01	<0.0005	<0.005	0.004	0.018	0.001	<0.01	<0.005	<0.05

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ALBUQUERQUE, NEW MEXICO

MINERALS, RIO PUERCO RA
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FEB 18 1984
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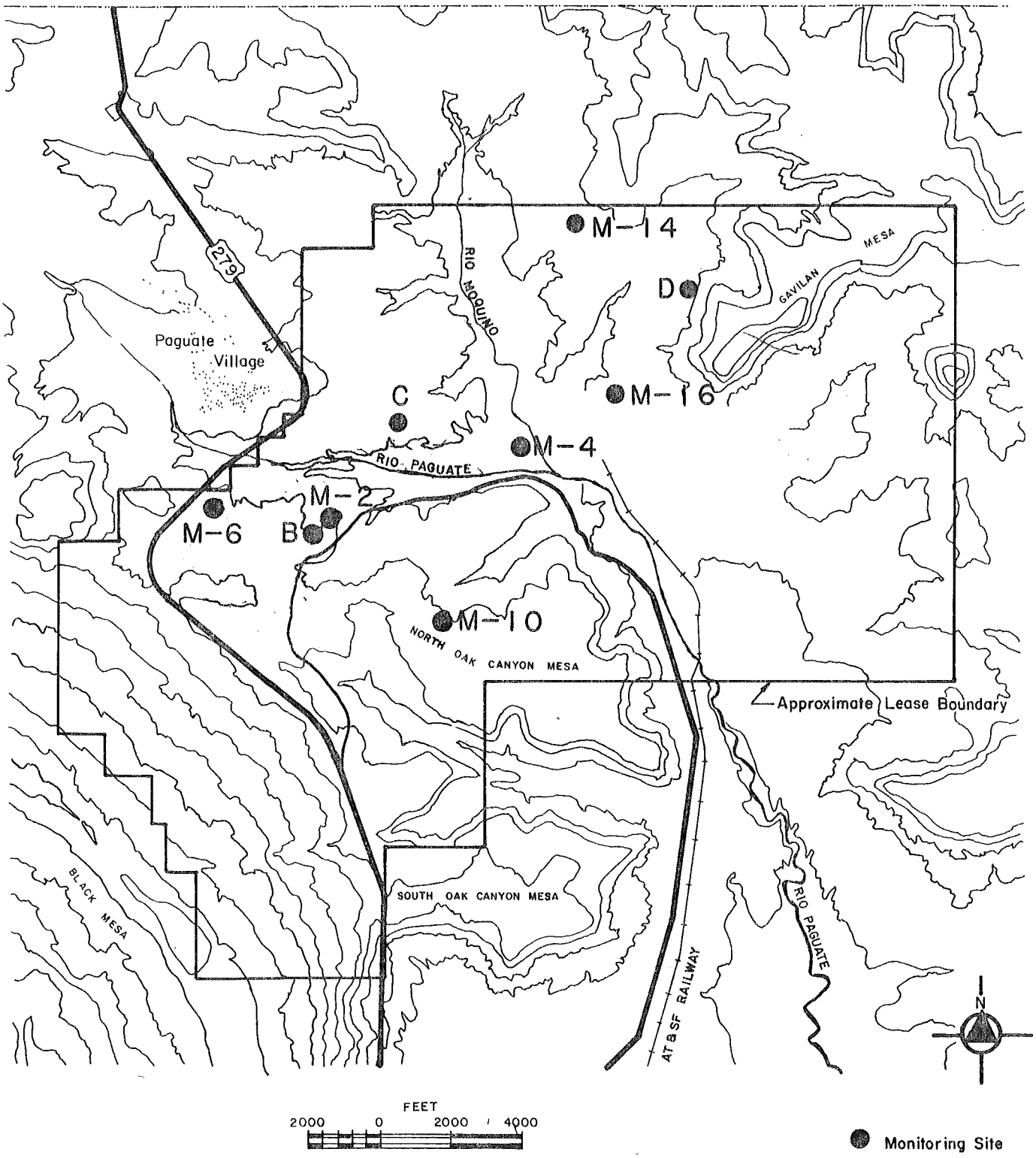
ALBUQUERQUE, NEW MEXICO

LOCATION OF GROUND WATER MONITORING STATIONS



350002237

JACKPILE GROUNDWATER

ANACONDA MINERALS COMPANY
NEW MEXICO OPERATION

FOR THE 3rd Quarter

DESCRIPTION	DATE	WATER LEVEL	pH	TEMP °C	ELEC. COND.	TDS	SO_4	U-Nat. mg/l	Ra-226 pCi/L
M-2	8-23-83	5971.67	8.31	16	1400	1285	467	0.006	0.29
M-4	7-28-83	5896.68	7.44	19	1150	1091	369	0.011	1.23
M-6	8-19-83	5981.71	8.44	17.5	1250	1149	364	0.008	0.38
M-10	8-23-83	5959.19	7.70	17	1700	1566	660	0.070	4.46
M-14	7-28-83	5936.89	8.47	18	560	42.8	593	0.003	0.46
M-16	8-23-83	5909.34	7.21	19	800	151	783	0.021	0.54
"B"	8-19-83	5979.45	6.15	20	7200	7889	5407	<0.001	1.38
"C"	7-28-83	5930.80	6.70	15	3340	4398	2713	1.414	5.06
"D"	8-23-83	5840.50	7.91	16	4280	4674	2197	0.246	2.01

MINERALS, RIO PUERCO RA
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BUREAU OF LAND MANAGEMENT
ALBUQUERQUE, NEW MEXICO

JACKPILE GROUNDWATER

ANACONDA MINERALS COMPANY
NEW MEXICO OPERATION

FOR THE Fourth Quarter

DESCRIPTION	DATE	WATER LEVEL	pH	TEMP °C	ELEC. COND.	TDS	SO_4	U-Nat. mg/l	Ra-226 pCi/L
M-2	10-26-83	5971.68	8.27	20	1500	1318	463	0.011	1.17
M-4	10-31-83	5896.73	7.43	21	1200	1058	346	0.015	3.52
M-6	10-31-83	5982.45	7.92	17.5	1225	1215	370	0.009	0.54
M-10	10-26-83	5959.34	7.68	17.5	1450	1620	685	0.109	5.56
M-14	10-19-83	5936.15	8.64	17.5	510	33.7	617	0.010	0.80
M-16	10-19-83	5909.22	7.66	18	720	812	143	0.035	0.69
"B"	10-26-83	5979.31	6.20	26	6500	7878	5234	0.004	2.18
"C"	10-31-83	5930.76	6.64	18	2500	4313	2720	1.697	2.18
"D"	10-31-83	5841.23	7.35	20	4300	4843	2247	0.414	2.43

MINERALS, RIO PUERCO RA
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FEB 08 1984
BUREAU OF LAND MANAGEMENT
ALBUQUERQUE, NEW MEXICO

ANACONDA Minerals Company
New Mexico Operations
P.O. Box 638
Grants, New Mexico 87020
Telephone 505 876 2211

October 25, 1983

NOV 7 A 9:22

ALBUQUERQUE, N.M.

Minerals Staff
Rio Puerco Resource Area
Bureau of Land Management
3550 Pan American Freeway, N.E.
P. O. Box 6770
Albuquerque, N.M. 87107

Dear Sir:

The Third Quarter of 1983 sampling data for Anaconda's former Jackpile minesite leases is submitted as follows:

1. Radiological Analysis of Ground and Surface Water.

2. Chemical Analysis of Ground and Surface Water.

3. Maps showing Ground and Surface Water Sampling Locations.

4. Results of the Air Monitoring Program.

5. Results of the Ambient Radon Monitoring Study.

6. Map showing location of Air and Radon Monitoring Stations.

Sincerely,

Meade A. Stirland, Manager
Environment, Health & Safety

mls

Enclosures

MINERALS, RIO PUERCO RA
RECEIVED
NOV 07 1983
BUREAU OF LAND MANAGEMENT
ALBUQUERQUE, NEW MEXICO

350002240

AIR QUALITY MONITORING PROGRAM

One 168-hour sample is taken each month at each of the four locations specified by Marc Nelson. They are collected about three meters above the ground on GF/A Glass Microfibre filter paper, using an RAC Heavy-duty Sampler.

AMBIENT RADON STUDY

Radon-222 is monitored continuously at each of the air sampling locations specified by Marc Nelson. The samples are monitored by the use of the Model RGM-2 Radon Gas Monitor. Normal data output is printed hourly and a 24-hour average is printed at the end of a 24-hour period.

JACKPILE - WATER RADIOLOGICAL ANALYSIS

(THIRD QUARTER, 1983)

DESCRIPTIVE LOCATION	Radium-226 pCi/L			Uranium-Natural ppm		
	Jul.	Aug.	Sep.	Jul.	Aug	Sep.
Rio Paguate Upstream	0.23	0.29	0.30	0.0031	0.0030	0.0010
Rio Moquino Upstream	<0.20	<0.20	0.33	0.0030	0.0038	0.0092
Rio Paguate Above the Confluence	1.04	1.20	2.75	0.155	0.150	0.292
Rio Moquino Above the Confluence	0.40	0.61	0.71	0.048	0.048	0.023
Rio Paguate Ford Crossing	0.52	4.61	1.23	0.232	0.401	0.211
Paguate Reservoir	0.38	3.21	3.77	0.022	0.024	0.154
Jackpile Well #4	0.32	*	*	0.0021	*	*
Jackpile New Shop	1.64	*	*	0.0021	*	*
Jackpile Old Shop	*	*	*	*	*	*
Mouth of Oak Canyon Wash	**	**	**	**	**	**

* Discontinued ,no sample
**No sample because the Mouth of Oak Canyon Wash was dry.

ANACONDA MINERALS COMPANY
NEW MEXICO OPERATIONS

FOR THE MONTH OF: July 83

DESCRIPTION	DATE	pH	TDS ppm	Cond umhos	HCO_3^- ppm	Cl^- ppm	$SO_4^=$ ppm	Na^+ ppm	K^+ ppm	Ca^{++} ppm	Mg^{++} ppm	NO_3^- ppm	F^- ppm	SiO_2 ppm	Mn^{++} ppm			
Rio Paguate Upstream	7/1/83	7.69	819	950	305	14	288	48	6.1	107	49	1.2	0.41	33.1	0.015			
Rio Moquino Upstream	7/1/83	8.06	1796	1800	251	18.5	1045	195	8.9	149	126	1.4	0.64	9.6	<0.005			
Rio Paguate Above the Confluence	7/1/83	7.80	1756	1950	403	20	884	135	10	162	140	1.1	0.72	20.2	0.081			
Rio Moquino Above the Confluence	7/1/83	8.03	2222	2200	268	21	1328	247	8.8	180	167	1.1	0.85	15.1	0.016			
Rio Paguate Ford Crossing	7/1/83	7.14	2229	2100	298	24.5	1300	248	9.1	177	170	1.4	0.84	15.9	0.007			
Paguate Reservoir	7/1/83	7.30	1392	1450	227	17.0	769	164	8.5	101	103	1.2	0.58	1.0	0.13			
Jackpile #4	7/1/83	8.33	791	830	378	11.0	174	222	0.7	2.4	0.4	1.4	1.0	10.1	0.01			
Jackpile New Shop	7/1/83	7.98	1584	1720	390	33.0	672	470	2.6	12	1.7	1.6	1.2	13.8	0.025			
Jackpile Old Shop			DISCONTINUED, NO SAMPLE															

	DATE	As ppm	Ba ppm	Cd ppm	Cr ppm	Pb ppm	Hg ppm	Se ppm	Cu ppm	Fe ppm	Zn ppm	Mo ppm	Ni ppm	V ppm			
Rio Paguate Upstream	7/1/83	<0.005	0.06	<0.001	<0.005	<0.01	<0.0005	<0.005	0.007	0.008	0.003	<0.01	<0.005	<0.05			
Rio Moquino Upstream	7/1/83	<0.005	<0.05	<0.001	<0.005	<0.01	<0.0005	<0.005	0.002	<0.005	0.001	<0.01	<0.005	<0.05			
Rio Paguate Above the Confluence	7/1/83	<0.005	<0.05	<0.001	<0.005	<0.01	<0.0005	<0.005	0.002	0.018	0.001	<0.01	<0.005	<0.05			
Rio Moquino Above the Confluence	7/1/83	<0.005	<0.05	<0.001	<0.005	<0.01	<0.0005	<0.005	0.001	<0.005	0.001	<0.01	<0.005	<0.05			
Rio Paguate Ford Crossing	7/1/83	<0.005	<0.05	<0.001	<0.005	<0.01	<0.0005	<0.005	0.001	0.040	0.001	<0.01	<0.005	<0.05			
Paguate Reservoir	7/1/83	<0.005	<0.05	<0.001	<0.005	<0.01	<0.0005	<0.005	0.002	0.082	0.001	<0.01	<0.005	<0.05			
Jackpile #4	7/1/83	<0.005	<0.05	<0.001	<0.005	<0.01	<0.0005	<0.005	0.002	0.041	0.035	<0.01	<0.005	<0.05			
Jackpile New Shop	7/1/83	<0.005	<0.05	<0.001	<0.005	<0.01	<0.0005	<0.005	0.003	0.021	0.003	<0.01	<0.005	<0.05			
Jackpile Old Shop				DISCONTINUED, NO SAMPLE													

350002243

ANACONDA MINERALS COMPANY
NEW MEXICO OPERATIONS

FOR THE MONTH OF: Aug 83

DESCRIPTION	DATE	pH	TDS ppm	Cond umhos	HCO_3^- ppm	Cl^- ppm	$SO_4^=$ ppm	Na^+ ppm	K^+ ppm	Ca^{++} ppm	Mg^{++} ppm	NO_3^- ppm	F^- ppm	SiO_2 ppm	Mn^{++} ppm
Rio Paguate Upstream	8/1/83	7.55	815	950	278	17.5	313	43.9	6.3	105	48.7	1.5	0.41	30.8	0.005
Rio Moquino Upstream	8/1/83	7.76	1953	2510	234	26.1	1169	227	10.3	139	145	1.5	0.68	19.3	<0.005
Rio Paguate Above the Confluence	8/1/83	7.86	1562	3320	361	24.9	774	131	9.7	126	133	1.3	0.78	20.1	0.011
Rio Moquino Above the Confluence	8/1/83	7.82	2606	3100	295	28.1	1588	300	10.2	187	195	1.1	0.95	16.7	<0.005
Rio Paguate Ford Crossing	8/1/83	7.75	2587	3000	317	30.3	1546	289	10.9	193	198	1.3	0.90	16.3	0.03
Paguate Reservoir	8/1/83	7.06	1662	1980	437	35.2	751	188	20.8	108	118	1.4	0.72	6.8	1.6
Jackpile #4			DISCONTINUED, NO SAMPLE												
Jackpile New Shop			DISCONTINUED, NO SAMPLE												
Jackpile Old Shop			DISCONTINUED, NO SAMPLE												

	DATE	As ppm	Ba ppm	Cd ppm	Cr ppm	Pb ppm	Hg ppm	Se ppm	Cu ppm	Fe ppm	Zn ppm	Mo ppm	Ni ppm	V ppm
Rio Paguate Upstream	8/1/83	<0.005	0.05	<0.001	<0.005	<0.01	<0.0005	0.005	0.006	0.016	0.009	<0.01	<0.005	<0.05
Rio Moquino Upstream	8/1/83	<0.005	<0.05	<0.001	<0.005	<0.01	<0.0005	<0.005	0.006	0.008	0.005	<0.01	<0.005	<0.05
Rio Paguate Above the Confluence	8/1/83	<0.005	<0.05	<0.001	<0.005	<0.01	<0.0005	<0.005	0.005	0.010	0.005	<0.01	<0.005	<0.05
Rio Moquino Above the Confluence	8/1/83	<0.005	0.05	<0.001	<0.005	<0.01	<0.0005	<0.005	0.001	<0.005	0.003	<0.01	<0.005	<0.05
Rio Paguate Ford Crossing	8/1/83	<0.005	0.05	<0.001	<0.005	<0.01	<0.0005	0.007	0.008	0.008	0.003	<0.01	0.005	<0.05
Paguate Reservoir	8/1/83	0.012	0.19	<0.001	<0.005	<0.01	<0.0005	<0.005	0.005	0.053	0.01	<0.01	0.007	<0.05
Jackpile #4			DISCONTINUED, NO SAMPLE											
Jackpile New Shop			DISCONTINUED, NO SAMPLE											
Jackpile Old Shop			DISCONTINUED, NO SAMPLE											

350002244

ANACONDA MINERALS COMPANY
NEW MEXICO OPERATIONS

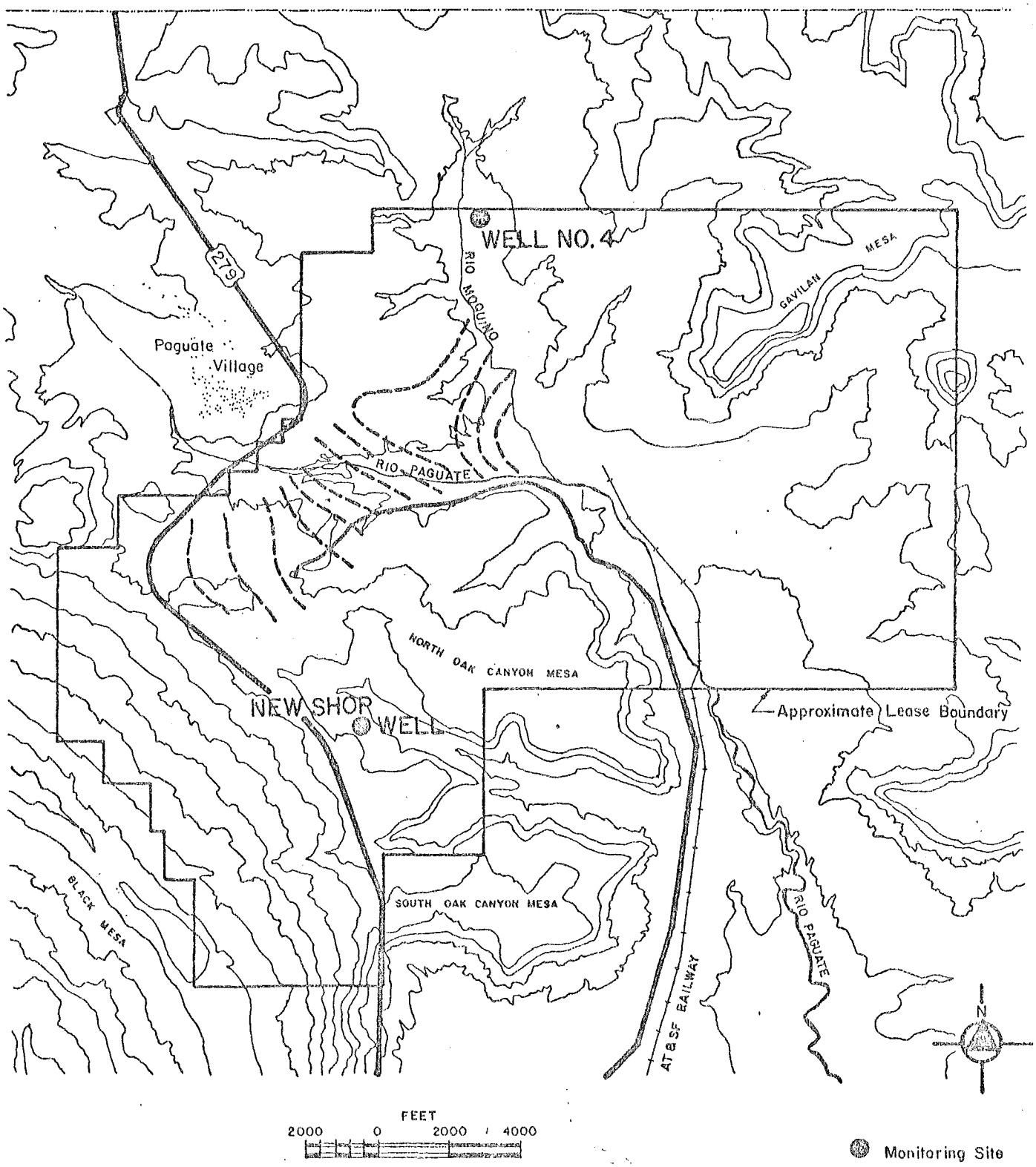
FOR THE MONTH OF: Sept. 83

DESCRIPTION	DATE	pH	TDS ppm	Cond umhos	HCO_3^- ppm	Cl^- ppm	$SO_4^=$ ppm	Na^+ ppm	K^+ ppm	Ca^{++} ppm	Mg^{++} ppm	NO_3^- ppm	F^- ppm	SiO_2 ppm	Mn^{++} ppm
Rio Paguate Upstream	9/1/83	7.91	896	1080	334	11.3	313	43.7	7.3	129	53	3.6	0.46	30.6	0.13
Rio Moquino Upstream	9/1/83	8.36	1453	1650	281	14.0	751	153	9.3	130	93	3.2	0.64	22.3	0.022
Rio Paguate Above the Confluence	9/1/83	7.53	1988	2100	451	20.3	1001	150	10.6	194	156	3.2	0.74	20.0	0.65
Rio Moquino Above the Confluence	9/1/83	8.39	1864	2020	281	16.9	1063	197	9.9	166	126	3.3	0.81	18.3	0.06
Rio Paguate Ford Crossing	9/1/83	8.32	2017	2080	305	19	1152	207	9.9	182	138	3.1	0.81	17.7	0.24
Paguate Reservoir	9/1/83	8.01	1786	1800	366	53.5	858	316	19.3	74	94	3.7	1.10	4.2	0.53
Jackpile #4			DISCONTINUED, NO SAMPLE												
Jackpile New Shop			DISCONTINUED, NO SAMPLE												
Jackpile Old Shop			DISCONTINUED, NO SAMPLE												

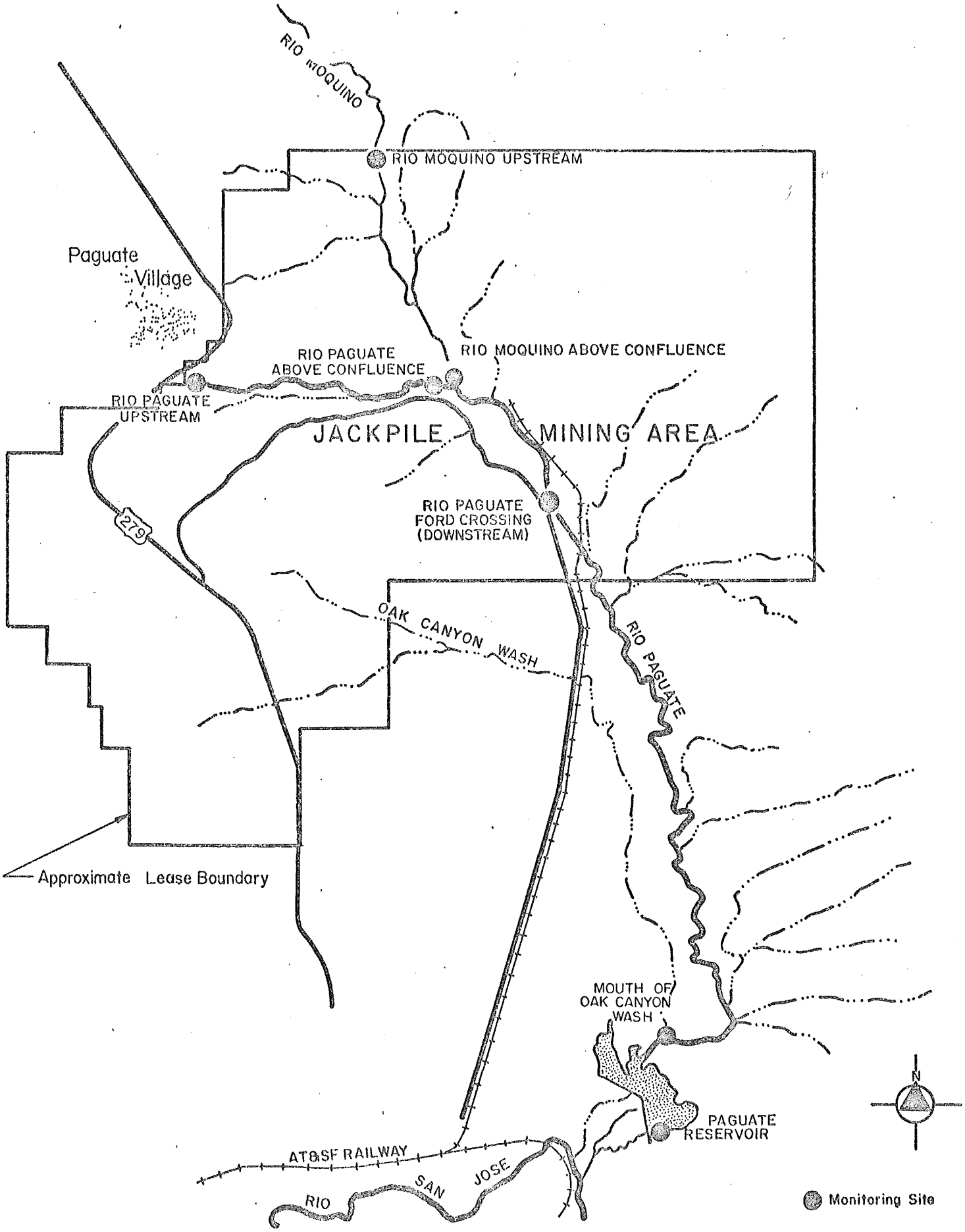
	DATE	As ppm	Ba ppm	Cd ppm	Cr ppm	Pb ppm	Hg ppm	Se ppm	Cu ppm	Fe ppm	Zn ppm	Mo ppm	Ni ppm	V ppm
Rio Paguate Upstream	9/1/83	<0.005	0.07	0.001	<0.005	<0.01	<0.0005	<0.005	0.003	0.015	0.006	<0.01	<0.005	<0.05
Rio Moquino Upstream	9/1/83	<0.005	0.08	0.001	<0.005	<0.01	<0.0005	<0.005	0.006	0.01	0.001	0.01	0.012	<0.05
Rio Paguate Above the Confluence	9/1/83	<0.005	0.07	0.001	<0.005	<0.01	<0.0005	<0.005	0.004	0.011	0.003	<0.01	<0.005	<0.05
Rio Moquino Above the Confluence	9/1/83	<0.005	0.08	<0.001	<0.005	<0.01	<0.0005	<0.005	0.005	0.011	0.003	<0.01	<0.005	<0.05
Rio Paguate Ford Crossing	9/1/83	<0.005	0.08	0.001	<0.005	<0.01	<0.0005	<0.005	0.004	0.026	0.002	<0.01	<0.005	<0.05
Paguate Reservoir	9/1/83	<0.005	0.27	<0.001	<0.005	<0.01	<0.0005	<0.005	0.004	0.006	0.006	0.01	0.006	<0.05
Jackpile #4			DISCONTINUED, NO SAMPLE											
Jackpile New Shop			DISCONTINUED, NO SAMPLE											
Jackpile Old Shop			DISCONTINUED, NO SAMPLE											

350002245

LOCATION OF GROUND WATER MONITORING STATIONS



350002246



LOCATION OF
SURFACE WATER MONITORING STATIONS

350002247

JACKPILE - AIR SAMPLING SURVEY

THIRD QUARTER, 1983

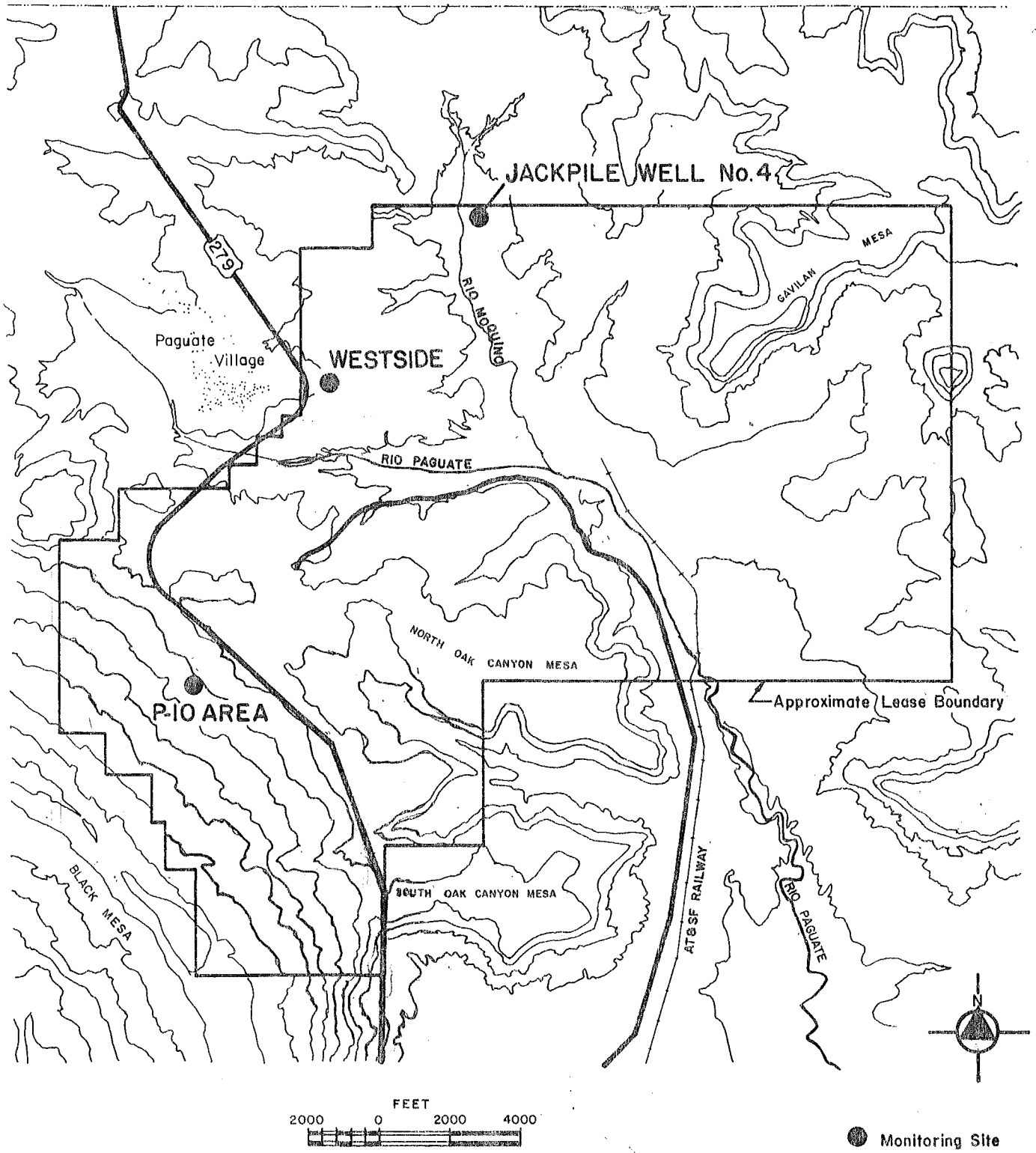
LOCATION	DATE	TOTAL PARTICULATE ugm/M^3	U-Nat. uCi/mlx10-15	Ra-226 uCi/mlx10-15	Th-230 uCi/mlx10-15	Pb-210 uCi/mlx10-15
1. Dump F		ELECTRICAL POWER DISCONTINUED, NO SAMPLE				
2. P-10 Area	7/83	28.13	0.947	0.356	1.06	17.35
	8/83	14.89	0.71	2.18	0.69	18.79
	9/83	20.49	0.77	0.17	1.31	18.21
3. West Gate	7/83	29.13	0.788	0.191	1.41	16.31
	8/83	17.95	0.48	0.23	0.92	20.59
	9/83	24.12	0.67	0.21	1.25	19.41
4. Well #4	7/83	27.42	1.01	0.184	1.09	19.44
	8/83	17.17	2.04	0.33	1.57	20.43
	9/83	23.48	0.91	1.09	1.09	18.72

JACKPILE-AMBIENT RADON SURVEY

THIRD QUARTER, 1983

LOCATION	DATE	Rn-222 pCi/L
1. Dump F	7/83	2.92
	8/83	Discontinued
	9/83	Discontinued
2. P-10 Area	7/83	1.34
	8/83	1.76
	9/83	2.05
3. Well #4	7/83	1.05
	8/83	1.18
	9/83	1.54
4. Westgate	7/83	2.45
	8/83	2.37
	9/83	2.43

LOCATION OF
AIR QUALITY MONITORING STATIONS



350002250

ANACONDA Minerals Co ny
New Mexico Operations
P.O. Box 638
Grants, New Mexico 87020
Telephone 505 876 2211

October 10, 1983

MINERALS, RIO PUERCO RA
RECEIVED
OCT 1 8 1983
BUREAU OF LAND MANAGEMENT
ALBUQUERQUE, NEW MEXICO

Minerals Staff
Rio Puerco Resource Area
Bureau of Land Management
500 Gold Avenue, SW
Federal Building, Room 116
Albuquerque, NM 87102

Dear Sir:

This letter is to provide additional data to the Second Quarter sampling data report for Anaconda's former Jackpile minesite leases. The following Pb-210 data should be added to the report we submitted on July 25, 1983:

Location	Date	Pb-210, uCi/ml x 10^{-15}
Dump F	6/83	16.51
Mine Vent	6/83	20.19
Westgate	6/83	16.94
Well #4	6/83	16.00

If you have any questions, please contact me.

Sincerely,

Meade A. Stirland
Environment, Health & Safety

cdw
pc: WCN
DLR
CES
LCL
CDW
File

ANACONDA Minerals Company is a Division of AtlanticRichfieldCompany

The Anaconda Company
Comprehensive Mine Plan
Environmental Monitoring Data

350002252

The Anaconda Company
Comprehensive Mine Plan
Environmental Monitoring Data

350002253

Laguna 1,4,&8
3570 (017)

FILE COPY
Surname

5-17-85

MAY 20 1985

Memorandum

To : Superintendent, Laguna Agency, BIA

From : Area Manager, Rio Puerco Resource Area

Subject: Modification of the Environmental Monitoring Program for Anaconda's Jackpile-Paguate Mine Pueblo of Laguna Leases 1, 4, and 8

Your May 9, 1985, letter raised concerns over the deletion of the air quality monitor station at F dump. Sampling at F dump was discontinued in June 1983. The March 14, 1985, approval deleted nine (9) minor water quality parameters which have never been found in excess of the detection limits for those parameters and changed the sampling frequency of six (6) other minor elements from monthly to quarterly. No other changes were made.

Since we have several years of background data and since there is no activity at the minesite, we feel thaepresent monitoring program is more than adequate. Upon completion of the Environmental Impact Statement and approval of a reclamation plan, both the air quality and water quality monitoring programs will be modified as necessary to fully monitor the impacts of the reclamation activities.

(ORIG. SGD.) HERRICIK E. HANKS

cc: Anaconda Comprehensive Mine Plan File
Anaconda Environmental Data File
Chron

017:JAndrews:pg:5/17/85

350002254

ANACONDA Minerals Co
New Mexico Operations
P.O. Box 638
Grants, New Mexico 87020
Telephone 505 876 2211

October 15, 1986

Minerals Staff
Rio Puerco Resource Area
Bureau of Land Management
435 Montano Rd., N.E.
Albuquerque, N.M. 87107

Dear Sir:

Because of an error in water level for Jackpile Well "B", attached is a corrected copy for the report dated 10-13-86 sent to you recently.

If you have questions, please call me.

Sincerely,

Natver Patel
Staff Chemist

mls

Enclosures

pc: MAS
CDW
CES

ANACONDA MINERALS COMPANY
NEW MEXICO OPERATION

FOR THE MONTH OF: _____

DESCRIPTION	DATE	Water Level Feet	pH Field	pH Lab	EC Field	EC Lab	SO_4 mg/l	TDS mg/l	U-Nat mg/l	Ra-226 pCi/l
M-2	7-15-86	5971.30	8.58	8.16	1500	1600	436	986	.0024	<.20
M-4	7-15-86	5896.74	8.35	7.79	1025	1000	276	665	.0005	.24±.18
M-6	7-15-86	5989.07	8.36	7.82	1425	1450	357	916	.0010	.39±.22
M-10	7-15-86	5959.17	7.86	7.74	1825	2025	670	1346	.0541	8.75±2.1
M [illegible]	7-15-86	5936.38	8.98	8.43	620	630	37	392	.0006	.24±.15
M-16	7-15-86	5907.77	7.56	7.49	860	870	155	610	.0437	.49±.24
JP "B"	7-15-86	5977.32	6.33	6.26	6800	8000	5040	7491	.0072	1.04±.78
JP "C"	7-15-86	5930.42	6.68	6.64	3350	3900	2263	3793	1.352	1.93±.95
JP "D"	7-15-86	5849.06	9.35	9.20	5350	6025	2419	4599	.1283	.47±.22

350002256

ANACONDA Minerals Company
New Mexico Operations
P.O. Box 638
Grants, New Mexico 87020
Telephone 505 876 2211

October 13, 1986

Minerals Staff
Rio Puerco Resource Area
Bureau of Land Management
435 Montano Rd., N.E.
Albuquerque, N.M. 87107

Dear Sir:

Following are the sampling data of the Third Quarter (July-September) 1986 for Anaconda's former Jackpile Minesite leases.

1. Chemical and Radiological Analysis for Surface Water.
2. Maps Showing Surface Water Sampling Locations.
3. Chemical and Radiological Analysis of Groundwater.
4. Map of Groundwater Monitoring Locations.
5. Results of the Air Monitoring Program Including Radon Concentrations.
6. Maps Showing Locations of Air and Radon Monitoring Stations.

Sincerely,

Natver Patel

Natver Patel
Staff Chemist

mls

Enclosures

pc: MAS
CDW
CES

Anaconda Comprehensive Mine Plan File
Env. Monitoring Data

ANACONDA Minerals Company is a Division of AtlanticRichfieldCompany
AMCO-6187-A (8-83)

ANACONDA MINERALS COMPANY
NEW MEXICO OPERATION

Description	Date	Field pH	Lab pH	Field E.C.	Lab E.C.	HCO_3 mg/l	Cl mg/l	SO_4 mg/l	Na mg/l	K mg/l	Ca mg/l	Mg mg/l	NO_3 mg/l	SiO_2 mg/l	Mn mg/l	U-Nat mg/l	Ra-226 pCi/l
Rio Paguate Upstream	7-1-86	8.37	7.89	765	760	253	9	230	32	5	100	36	< 1.0	26	< .10	.0031	0.14±.12
Rio Moquino Upstream	7-1-86	8.62	8.17	1900	2000	250	17	926	195	16	131	91	< 1.0	15	< .10	.0085	0.35±.14
Rio Paguate above Confluence	7-1-86	8.18	7.95	820	780	251	9	270	37	6	96	38	< 1.0	22	< .10	.0392	0.46±.27
Rio Moquino above confluence	7-1-86	8.29	8.13	2450	2620	250	19	1375	264	17	174	139	< 1.0	21	< .10	.0505	1.13±.38
Ri aguate @ Ford Crossing	7-1-86	8.35	8.14	1950	1990	272	17	889	171	12	151	100	< 1.0	20	< .10	.1428	1.75±.61
Paguate Reservoir	7-1-86	7.78	7.96	2300	2500	378	32	1111	236	27	168	126	< 1.0	4	0.40	.0389	0.42±.20

	Date	zn mg/l	Pb mg/l	Ni mg/l	Se mg/l	Cu mg/l	Ba mg/l	Fe mg/l		TDS mg/l
Rio Paguate Upstream										587
Rio Moquino Upstream										1577
Rio Paguate above confluence										622
Ri Moquino abo e confluence										2215
Rio Paguate @ Ford crossing										1579
Paguate Reservoir										2027

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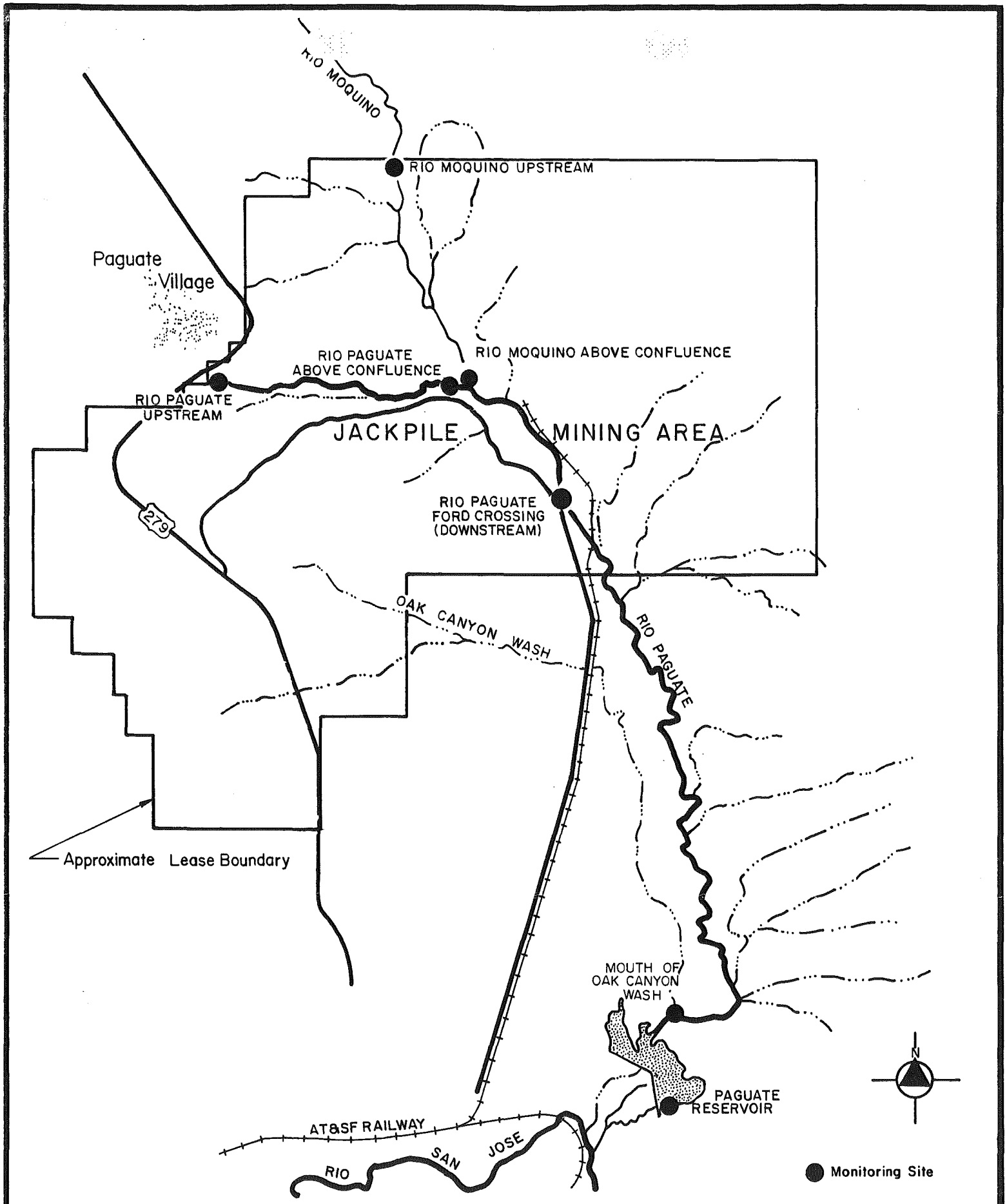

LOCATION OF
SURFACE WATER MONITORING STATIONS

350002259

ANACONDA MINERALS COMPANY
NEW MEXICO OPERATION

FOR THE MONTH OF: _____

DESCRIPTION	DATE	Water Level Feet	pH Field	pH Lab	EC Field	EC Lab	SO_4 mg/l	TDS mg/l	U-Nat mg/l	Ra-226 pCi/l
M-2	7-15-86	5971.30	8.58	8.16	1500	1600	436	986	.0024	<.20
M-4	7-15-86	5896.74	8.35	7.79	1025	1000	276	665	.0005	.24±.18
M-6	7-15-86	5989.07	8.36	7.82	1425	1450	357	916	.0010	.39±.22
M-10	7-15-86	5959.17	7.86	7.74	1825	2025	670	1346	.0541	8.75±2.1
M-14	7-15-86	5936.38	8.98	8.43	620	630	37	392	.0006	.24±.15
M-16	7-15-86	5907.77	7.56	7.49	860	870	155	610	.0437	.49±.24
JP "B"	7-15-86	5844.75	6.33	6.26	6800	8000	5040	7491	.0072	1.04±.78
JP "C"	7-15-86	5930.42	6.68	6.64	3350	3900	2263	3793	1.352	1.93±.95
JP "D"	7-15-86	5849.06	9.35	9.20	5350	6025	2419	4599	.1283	.47±.22

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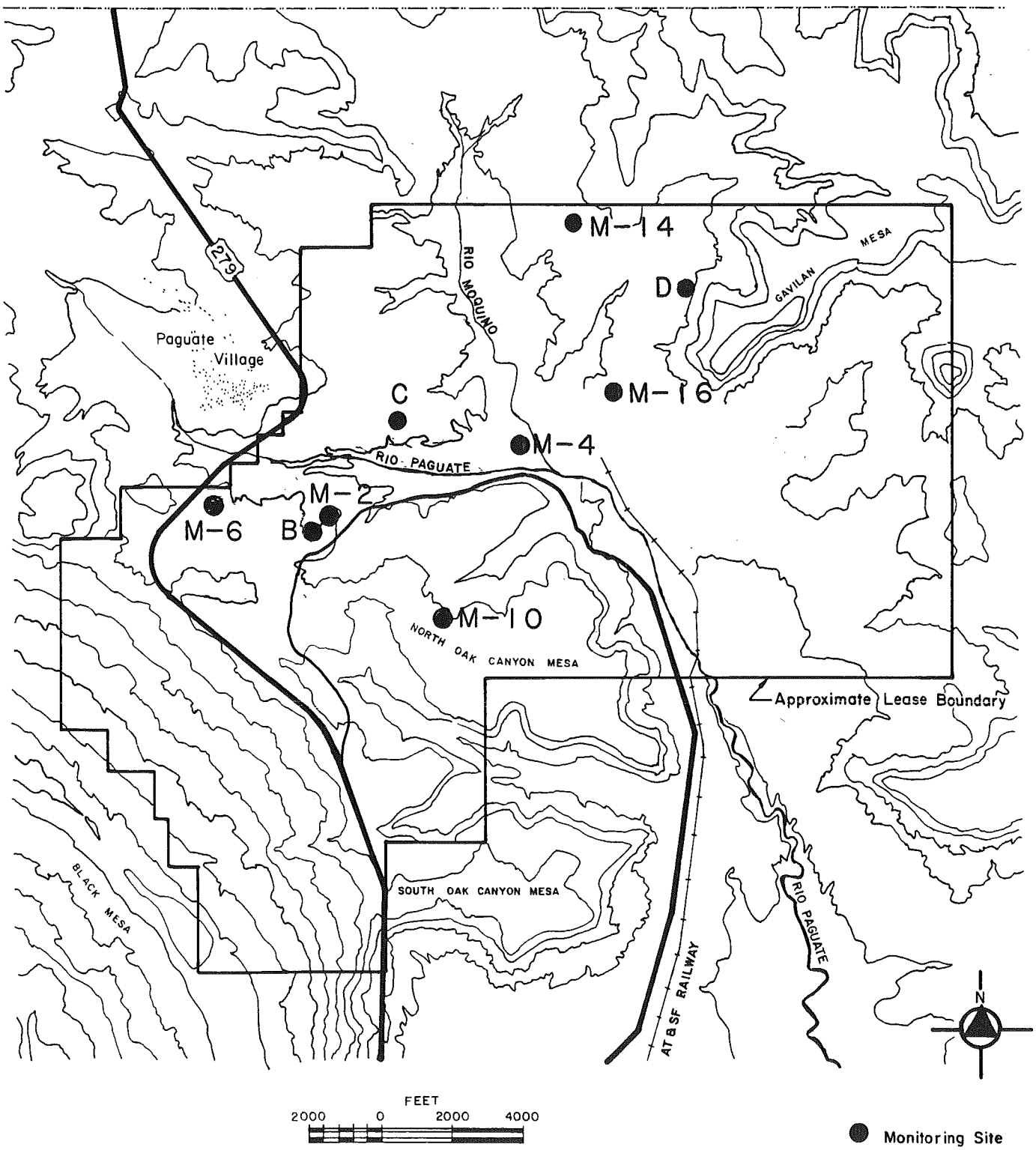
LOCATION OF GROUND WATER MONITORING STATIONS



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JACKPILE - AIR SAMPLING

THIRD QUARTER, 1986

LOCATION	DATE	TOTAL PARTICULATE ugm/M^3	U-Nat. uCi/mlx10-15	Ra-226 uci/mlx10-15	Th-230 uCi/mlx10-15	Pb-210 uCi/mlx10-15
P-10 Area	7/86	14.22	0.423 ± .026	0.250 ± .090	1.22 ± .45	30.75 ± 1.28
West Gate	7/86	17.09	0.578 ± .031	0.371 ± .132	1.21 ± .45	21.37 ± 1.26
Well #4	7/86	16.20*	0.532 ± .032	0.432 ± .160	1.72 ± .52	24.34 ± 1.28

*This value may include a contribution from a landfill burning adjacent to this station, installed and operated by the Laguna Reservation and Tribe, respectively.

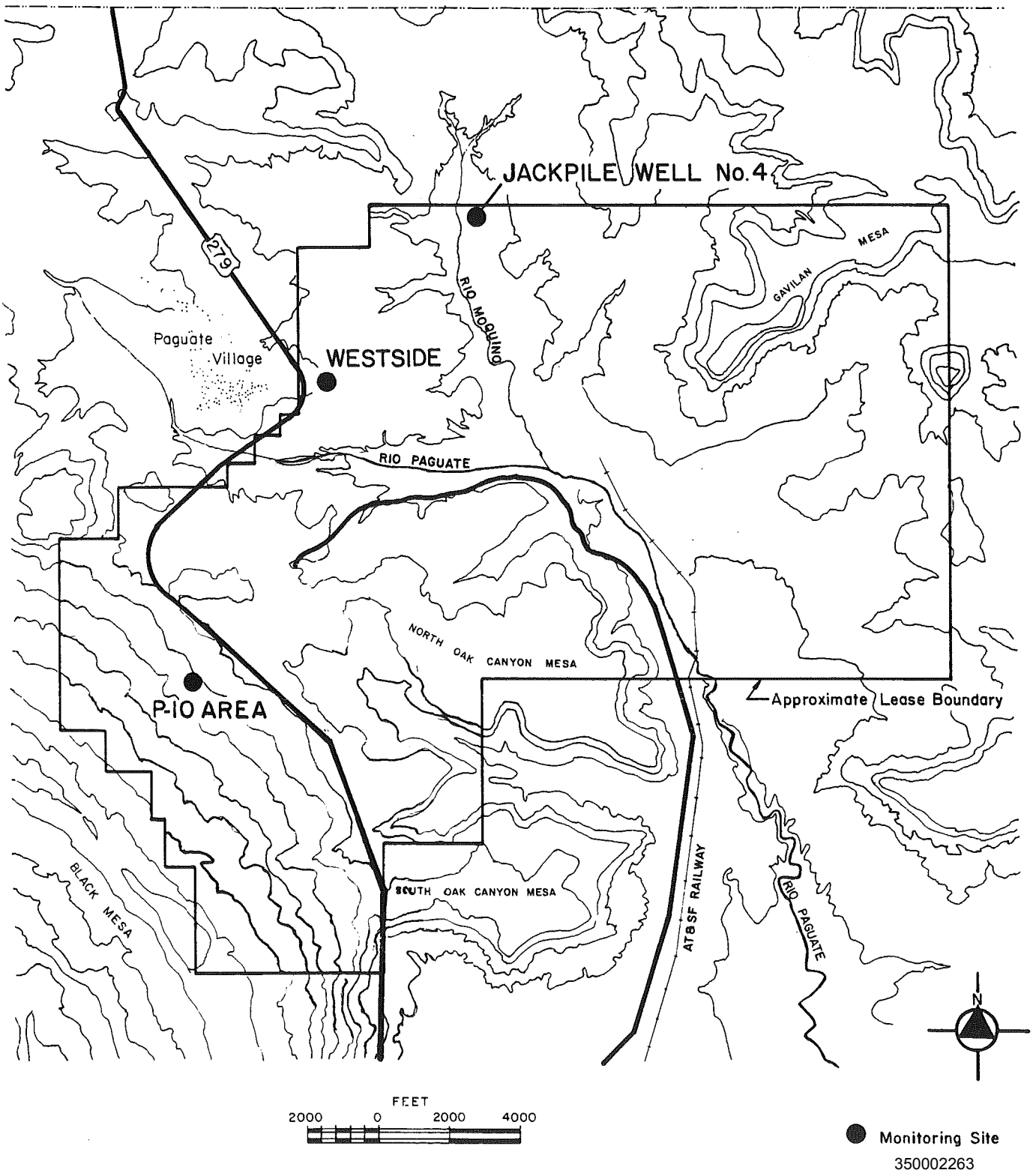
JACKPILE - AMBIENT RADON CONCENTRATION

THIRD QUARTER, 1986

LOCATION	DATE	Rn-222 pCi/L ± Sd**
P-10 Area	7/86	1.32±.76
	8/86	1.45±1.10
	9/86	2.68±1.34
West Gate	7/86	.43±.11
	8/86	.54±.13
	9/86	.62±.10
Well #4	7/86	0.90±.28
	8/86	0.74±.23
	9/86	1.24±.32

**Standard deviation is determined from daily results.

LOCATION OF
AIR QUALITY MONITORING STATIONS



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ANACONDA Minerals Co. ıy
New Mexico Operations
P.O. Box 638
Grants, New Mexico 87020
Telephone 505 876 2211

October 10, 1985

Minerals Staff
Rio Puerco Resource Area
Bureau of Land Management
3550 Pan American Freeway, N.E.
P. O. Box 6770
Albuquerque, N.M. 87107

Dear Sir:

Following are the sampling data of the Third Quarter (July-September) 1985 for Anaconda's former Jackpile Minesite leases.

1. Chemical and Radiological Analysis for Surface Water.
2. Maps Showing Surface Water Sampling Locations.
3. Chemical and Radiological Analysis of Groundwater.
4. Map of Groundwater Monitoring Locations.
5. Results of the Air Monitoring Program including radon concentrations.
6. Maps Showing Locations of Air and Radon Monitoring Stations.

Sincerely,

Natver Patel

Natver Patel
Staff Chemist

mls

Enclosures

pc: MAS
CDW
CES

ANACONDA MINERALS COMPANY
NEW MEXICO OPERATIONS

Third Quarter, 1985

Description	Date	Field pH	Field Cond. umhos	Lab Cond. umhos	HCO4 ppm	Cl ppm	SO4 ppm	Na ppm	K ppm	Ca ppm	Mg ppm	NO3 ppm	F ppm	SiO2 ppm	Mn ppm	Fe ppm	TDS ppm	Lab pH
Rio Paguate Upstream	7-1-85	8.17	1000	984	254	12	254	48	8	126	46	<1.0	0.56	31	.02	<.01	678	8.23
Rio Moquino Upstream	7-1-85	8.49	2300	2290	234	19	1090	250	14	166	126	<1.0	1.00	18	<.01	<.01	1930	8.29
Rio Paguate Above Confluence	7-1-85	7.96	1750	1716	302	19	570	130	12	152	108	<1.0	0.90	21	0.20	<.01	1330	8.29
Rio Moquino Above Confluence	7-1-85	8.00	2900	2860	242	21	1650	340	14	211	173	<1.0	1.40	18	<.01	<.01	2580	8.19
Rio Paguate @ Ford Crossing	7-1-85	8.20	2700	2860	257	28	1310	300	17	188	164	<1.0	1.30	16	.01	<.01	2370	8.1[illegible]
Paguate Res.	7-1-85	7.27	1750	1650	300	13	661	170	15	145	77	<1.0	0.98	2	1.0	.14	1270	7.93

	Date	U-Nat mg/l	Ra-226 pCi/l
Rio Paguate Upstream	7-1-85	.0020	.26± .16
Rio Moquino Upstream	7-1-85	.0039	.16± .12
Rio Paguate Above Confluence	7-1-85	.1099	2.29± .61
Rio Moquino Above Confluence	7-1-85	.0500	1.51± .47
Rio Paguate @ Ford Crossing	7-1-85	.2650	2.11± .66
Paguate Reservoir	7-1-85	.0236	1.13± .36

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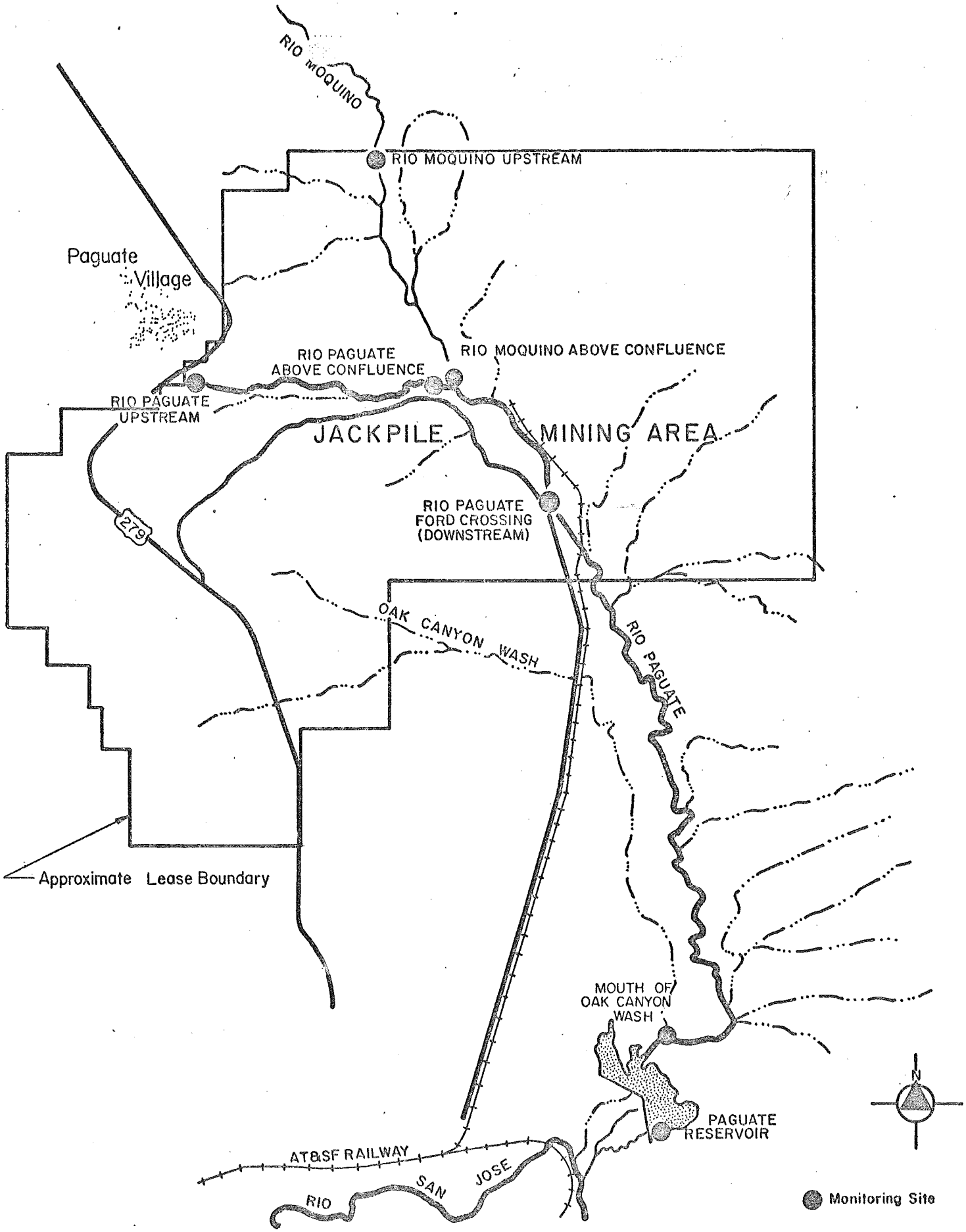

LOCATION OF
SURFACE WATER MONITORING STATIONS

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ANACONDA MINERALS COMPANY
NEW MEXICO OPERATIONS

Third Quarter, 1985

Description	Date	Water Level	Field pH	Field Temp. °C	Field Elect. Cond.	TDS	S04	U-Nat mg/l	Ra-226 pCi/L	Lab pH	Lab EC	
M-2	7-8-85	5970.55	8.26	16.5	1600	958	468	.0016	0.19 ± .23	8.20	1980	
M-4	7-8-85	5896.14	7.96	16.0	1150	712	289	.0010	0.68 ± .24	7.95	1050	
M-6	7-8-85	5986.99	8.44	17.0	1550	922	370	.0022	0.33 ± .20	8.11	1500	
M-10	7-8-85	5858.78	7.77	16.5	2000	1220	727	.0718	5.58 ± 1.5	7.89	1950	
M-14	7-8-85	5939.02	8.85	17.0	645	417	33	.0004	0.31 ± .17	8.46	690	
M-16	7-8-85	5907.91	7.61	18.0	915	564	157	.0445	0.50 ± .21	7.93	932	
"B"	7-8-85	5975.95	6.16	18.5	7850	7550	4600	.0100	1.27 ± .64	6.59	7920	
"C"	7-8-85	5929.72	6.76	15.0	3800	4260	2540	1.024	3.09 ± .90	7.19	3840	
"D"	7-8-85	5845.69	8.87	15.0	5800	4250	2540	.0829	1.10 ± .29	8.84	6060	

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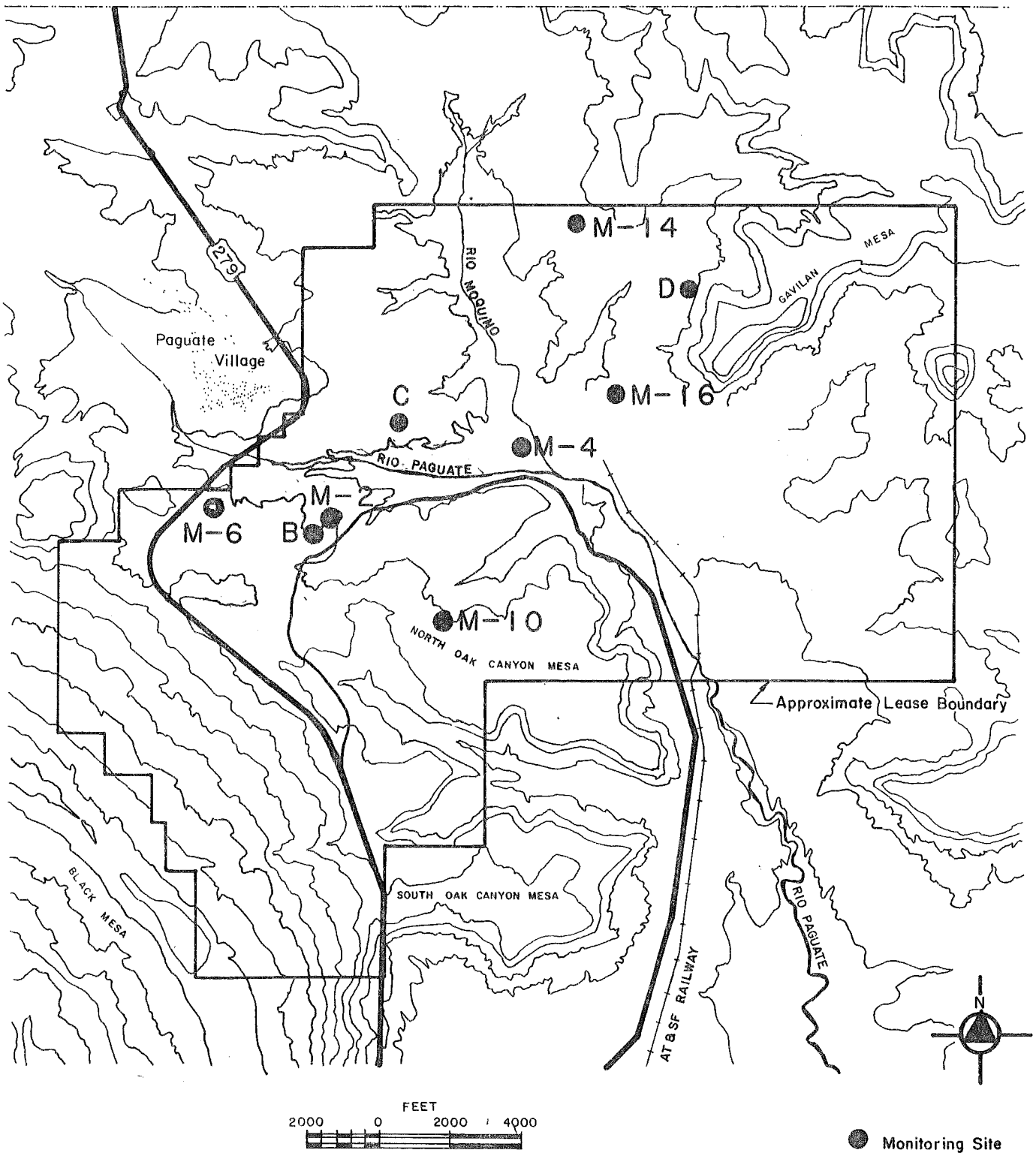
LOCATION OF GROUND WATER MONITORING STATIONS



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JACKPILE - AIR SAMPLING

THIRD QUARTER, 1985

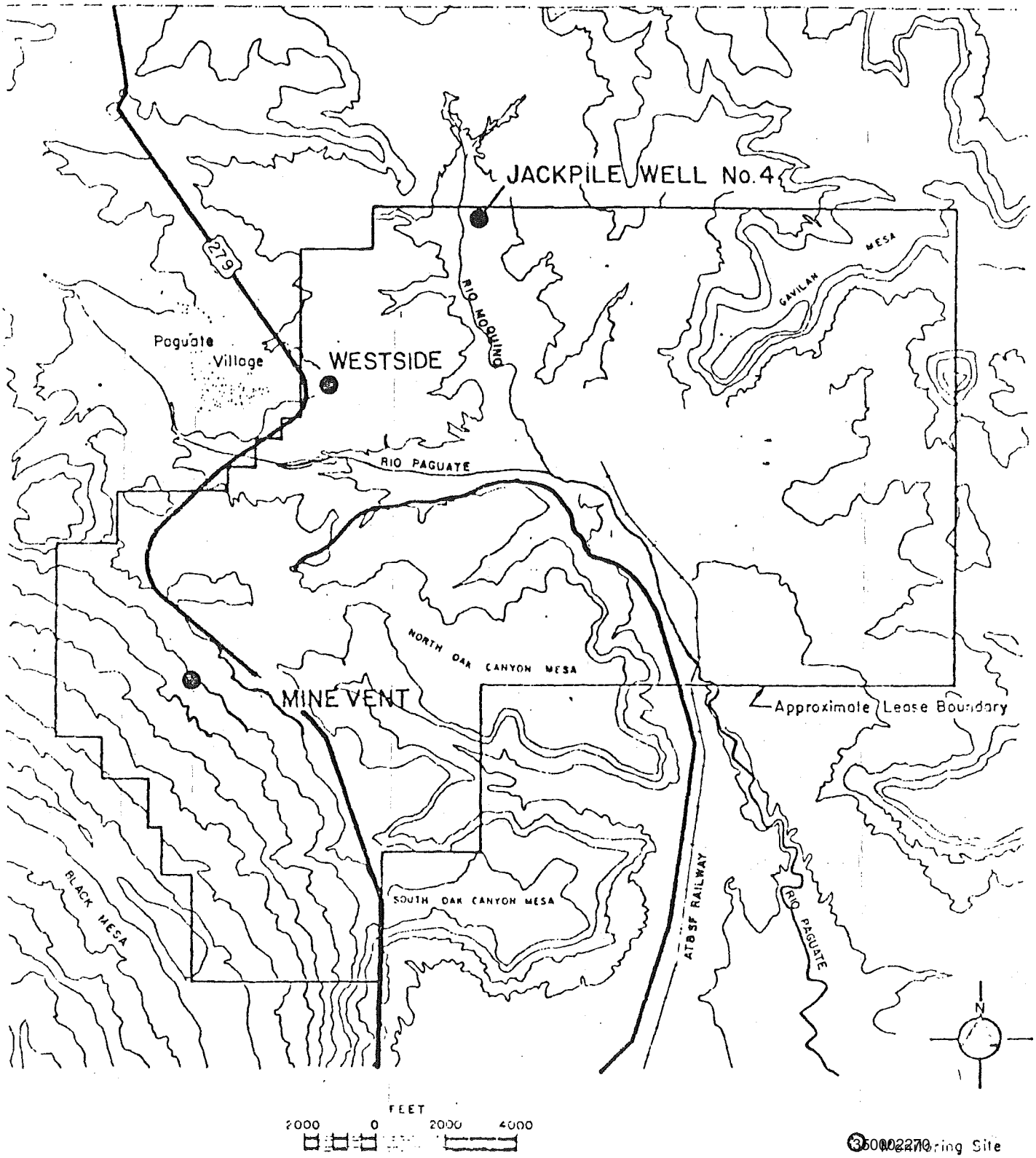
LOCATION	DATE	TOTAL PARTICULATE ugm/M^3	U-Nat. uCi/mlx10-15	Ra-226 uCi/mlx10-15	Th-230 uCi/mlx10-15	Pb-210 uCi/mlx10-15
1. P-10 Area	07/85	31.78	0.44	.510 ± .179	1.297 ± .360	37.72 ± 1.99
2. West Gate	07/85	33.59	0.59	.469 ± .210	0.740 ± .330	30.09 ± 1.40
3. Well #4	07/85	33.20	0.44	0.247 ± .130	0.960 ± .330	30.60 ± 1.30

JACKPILE-AMBIENT RADON CONCENTRATION

THIRD QUARTER, 1985

LOCATION	DATE	Rn-222 pCi/L
1. P-10 Area	7/85	0.225
	8/85	0.49
	9/85	1.57
2. Westgate	7/85	< 0.20
	8/85	0.42
	9/85	0.20
3. Well #4	7/85	0.78
	8/85	1.02
	9/85	1.07

LOCATION OF
AIR QUALITY MONITORING STATIONS



ANACONDA Minerals Co. ..y
New Mexico Operations
P.O. Box 638
Grants, New Mexico 87020
Telephone 505 876 2211

July 10, 1985

Minerals Staff
Rio Puerco Resource Area
Bureau of Land Management
3550 Pan American Freeway, N.E.
P. O. Box 6770
Albuquerque, N.M. 87107

Dear Sir:

Following are the sampling data of the second quarter (April-June) and annual 1985 for Anaconda's former Jackpile Minesite leases. Please note that this is the first report being submitted under the new sampling program approved by you in your letter dated March 14, 1985.

1. Chemical and Radiological Analysis for Surface Water.
2. Maps Showing Surface Water Sampling Locations.
3. Chemical and Radiological Analysis of Groundwater.
4. Map of Groundwater Monitoring Locations.
5. Results of the Air Monitoring Program.
6. Results of the Ambient Radon Monitoring Study.
7. Maps Showing Locations of Air and Radon Monitoring Stations.

Sincerely,

Natver Patel

Natver Patel
Staff Chemist

mls

Enclosures

pc: MAS
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LAND MANAGEMENT

85 JUL 12 A 9: 07

ALBUQUERQUE DISTRICT
ALBUQUERQUE, N.M.

ANACONDA MINERALS COMPANY
NEW MEXICO OPERATION

FOR THE MONTH OF: 2nd quarter 1985

DESCRIPTION	DATE	Field pH	Field Cond. umhos	Lab Cond umhos	HCO_3 ppm	Cl ppm	SO_4 ppm	Na ppm	K ppm	Ca ppm	Mg ppm	NO_3 ppm	F ppm	SiO_2 ppm	Mn ppm	Fe ppm	TDS ppm	Lab pH
Rio Paguate Upstream	4-17-85	8.39	840	941	235	11	214	43	5	95	47	<1.0	0.37	33	0.15	.06	684	8.24
Rio Moquino Upstream	4-17-85	8.31	1500	1730	239	11	750	136	7	129	86	<1.0	0.44	20	.05	.02	1400	8.27
Rio Paguate above Confluence	4-17-85	8.37	910	984	267	12	262	53	6	90	53	<1.0	0.41	31	.06	.08	736	8.33
Rio Moquino above Confluence	4-17-85	8.19	1700	1890	223	13	900	154	8	132	102	<1.0	0.52	20	.05	.02	1610	8.22
Rio Paguate @ Ford Crossing	4-17-85	8.26	1600	1730	239	15	800	158	8	120	97	<1.0	0.51	23	.07	.02	1500	3.30
Paguate Reservoir	4-17-85	7.48	1150	1300	216	13	530	100	8	91	54	<1.0	0.44	17	.09	.07	972	8.03

	DATE	Zn ppm	Pb ppm	Ni ppm	Se ppm	Ba ppm	Cu ppm		U-Nat mg/l	Ra-226 pCi/l
Rio Paguate Upstream	4-17-85	<.10	<.01	<.10	<.01	.10	.06		.001	<0.10
Rio Moquino Upstream	4-17-85	<.10	<.01	<.10	<.01	<.10	<.01		.003	0.14
Rio Paguate above Confluence	4-17-85	<.10	<.01	<.10	<.01	.10	<.01		.022	0.50
Rio Moquino above Confluence	4-17-85	<.10	<.01	<.10	<.01	<.10	<.01		.009	0.25
Rio Paguate @ Ford Crossing	4-17-85	<.10	<.01	<.10	<.01	<.10	<.01		.048	0.54
Paguate Reservoir	4-17-85	<.10	<.01	<.10	<.01	<.10	<.01		.042	0.34

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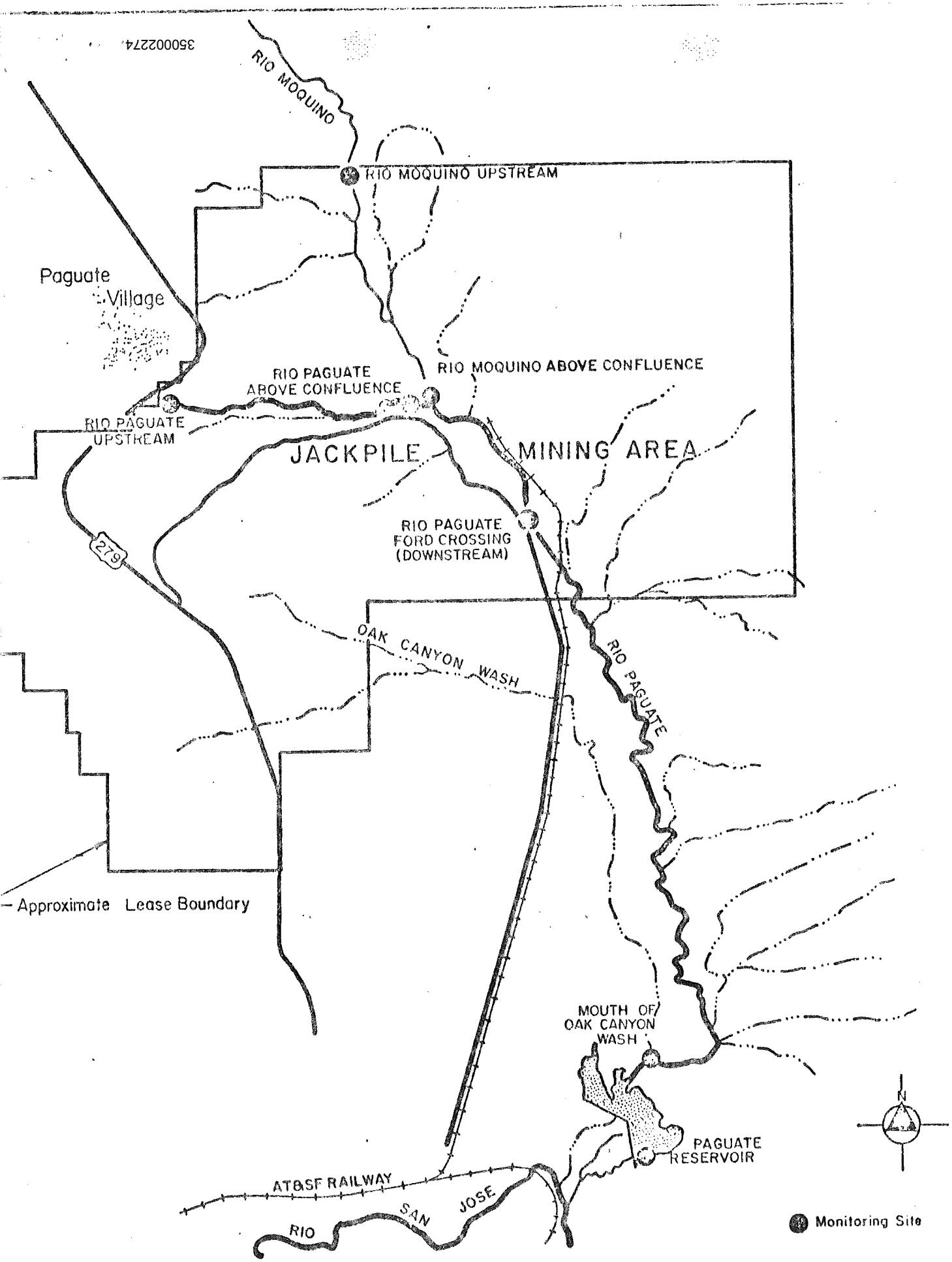

LOCATION OF
SURFACE WATER MONITORING STATIONS

Anaconda Minerals Company
New Mexico Operations

JACKPILE GROUNDWATER--ANNUALLY & 2nd Qtr 1985

DESCRIPTION	DATE	WATER LEVEL	pH	ELECT. COND.	HCO_3 ppm	CO_3 ppm	Cl ppm	SO_4 ppm	Na ppm	K ppm	Ca ppm	Mg ppm	Mn ppm	NO_3 ppm	SiO_2 ppm	TDS ppm	U-Nat mg/L	Ra-226 pCi/L	Temp. °C	Lab pH	Lab Cond
M-2	4-18-85	5970.77	8.32	1400	375	0	18	384	384	3	6	2	.09	<1.0	7	1020	.001	0.14	15.0	8.23	1610
M-4	4-18-85	5896.41	7.41	1200	375	0	22	324	181	6	121	49	.14	<1.0	13	848	.003	1.82	15.0	7.82	1280
M-6	4-18-85	5987.29	8.24	1325	391	0	15	328	354	3	4	2	.04	<1.0	11	912	.001	0.41	16.0	8.26	1450
M-10	4-18-85	5959.06	7.71	1800	373	0	16	705	360	6	48	30	.17	<1.0	10	1250	.067	7.40	16.5	7.98	1950
M-14	4-18-85	5940.12	8.74	620	297	23	2	38	180	1	2	1.0	<.01	<1.0	11	412	<.001	<0.20	16.0	8.78	689
M-16	4-18-85	5908.16	7.51	860	350	0	6	157	215	2	21	8	.16	<1.0	10	572	.045	0.39	17.5	8.08	952
"B"	4-18-85	5976.42	6.10	6625	214	0	27	4260	1680	21	439	203	3.83	<1.0	18	7560	.003	1.23	18.0	6.55	8110
"C"	4-18-85	5929.78	6.52	3300	340	0	36	2460	220	11	576	330	1.87	<1.0	8	4330	1.486	3.82	14.0	7.09	4330
"D"	4-18-85	5845.75	8.62	5150	1072	9	11	2660	1524	15	57	44	.09	<1.0	6	4460	.634	1.14	14.0	8.34	6490

DESCRIPTION	DATE	As ppm	Ba ppm	Cd ppm	Cr ppm	F ppm	Pb ppm	Hg ppm	Se ppm	Ag ppm	Cu ppm	Fe ppm	Zn ppm	Al ppm	B ppm	Co ppm	Mo ppm	Ni ppm	V ppm	PO_4 ppm
M-2	4-18-85	<.01	<.10	<.001	<.01	1.03	<.01	.0005	<.01	<.01	<.01	.01	<.01	<.10	.60	<.01	<.01	<.10	<.01	<1.0
M-4	4-18-85	<.01	<.10	<.001	<.01	.053	<.01	.0006	<.01	<.01	<.01	.22	<.10	<.10	.20	<.01	<.01	<.10	<.01	<1.0
M-6	4-18-85	<.01	<.10	<.001	<.01	1.04	<.01	.0006	<.01	<.01	<.01	.26	<.10	<.10	.60	<.01	<.01	<.10	<.01	<1.0
M-10	4-18-85	<.01	<.10	<.001	<.01	0.93	<.01	<.0004	<.01	<.01	<.01	<.01	<.10	<.10	.50	<.01	<.01	<.10	<.01	<1.0
M-14	4-18-85	<.01	<.10	<.001	<.01	0.89	<.01	<.0004	<.01	<.01	<.01	.10	<.10	<.10	.20	<.01	<.01	<.10	<.01	<1.0
M-16	4-18-85	<.01	<.10	<.001	<.01	.87	<.01	.0005	<.01	<.01	<.01	<.01	<.10	<.10	.30	<.01	<.01	<.10	<.01	<1.0
"B"	4-18-85	<.01	<.10	.003	<.01	.13	<.01	.0006	<.01	<.01	<.01	48	.30	<.10	1.5	.13	<.01	<.10	<.01	<1.0
"C"	4-18-85	<.01	<.10	<.001	<.01	.22	<.01	<.0004	.02	<.01	<.01	5.5	<.10	<.10	.50	<.01	<.01	<.10	<.01	<1.0
"D"	4-18-85	<.01	<.10	.004	<.01	.18	<.01	<.0004	<.01	<.01	<.01	.03	<.10	<.10	.50	<.01	<.01	<.10	<.01	<1.0

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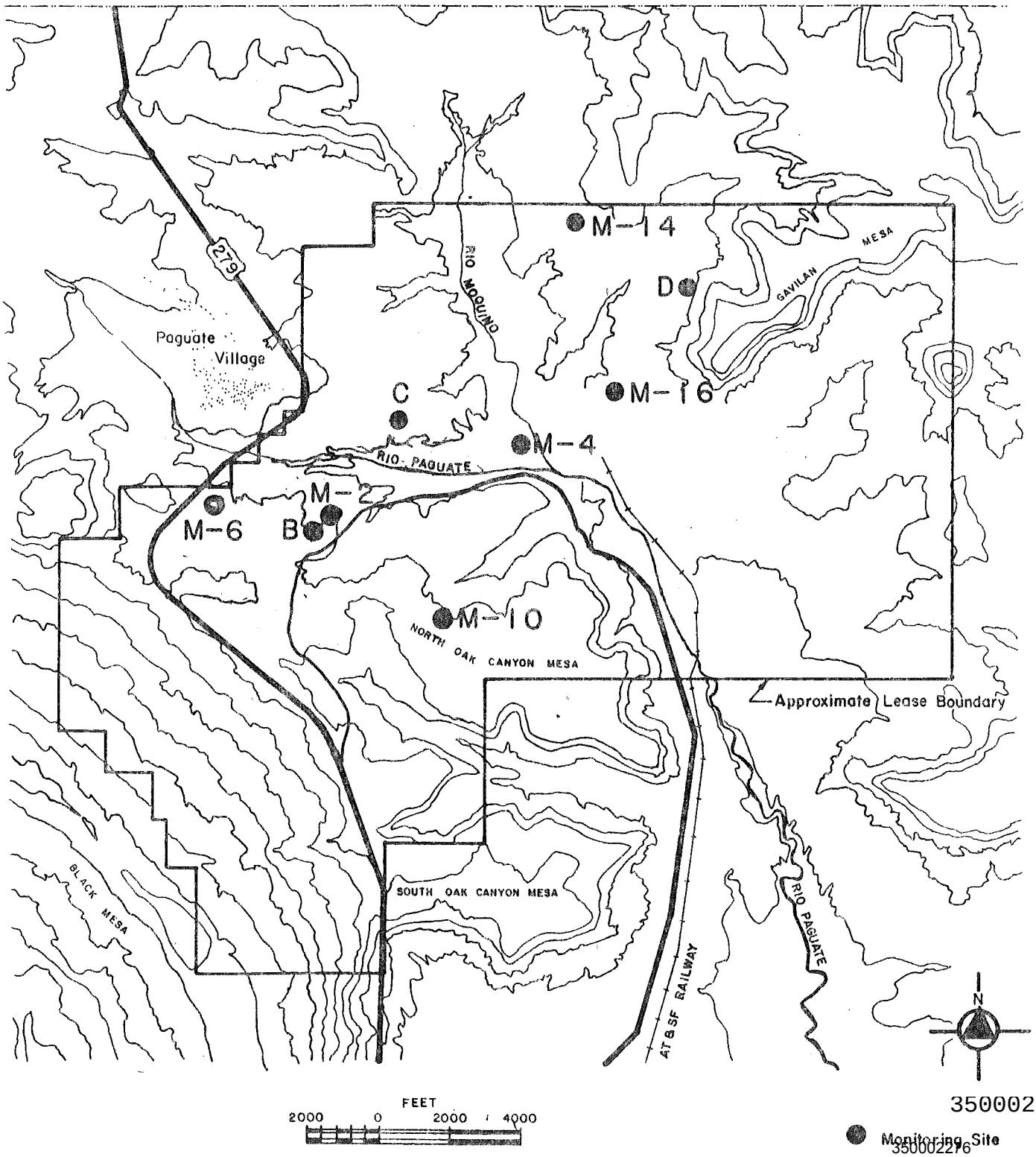
LOCATION OF GROUND WATER MONITORING STATIONS



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JACKPILE - AIR SAMPLING SURVEY

SECOND QUARTER, 1985

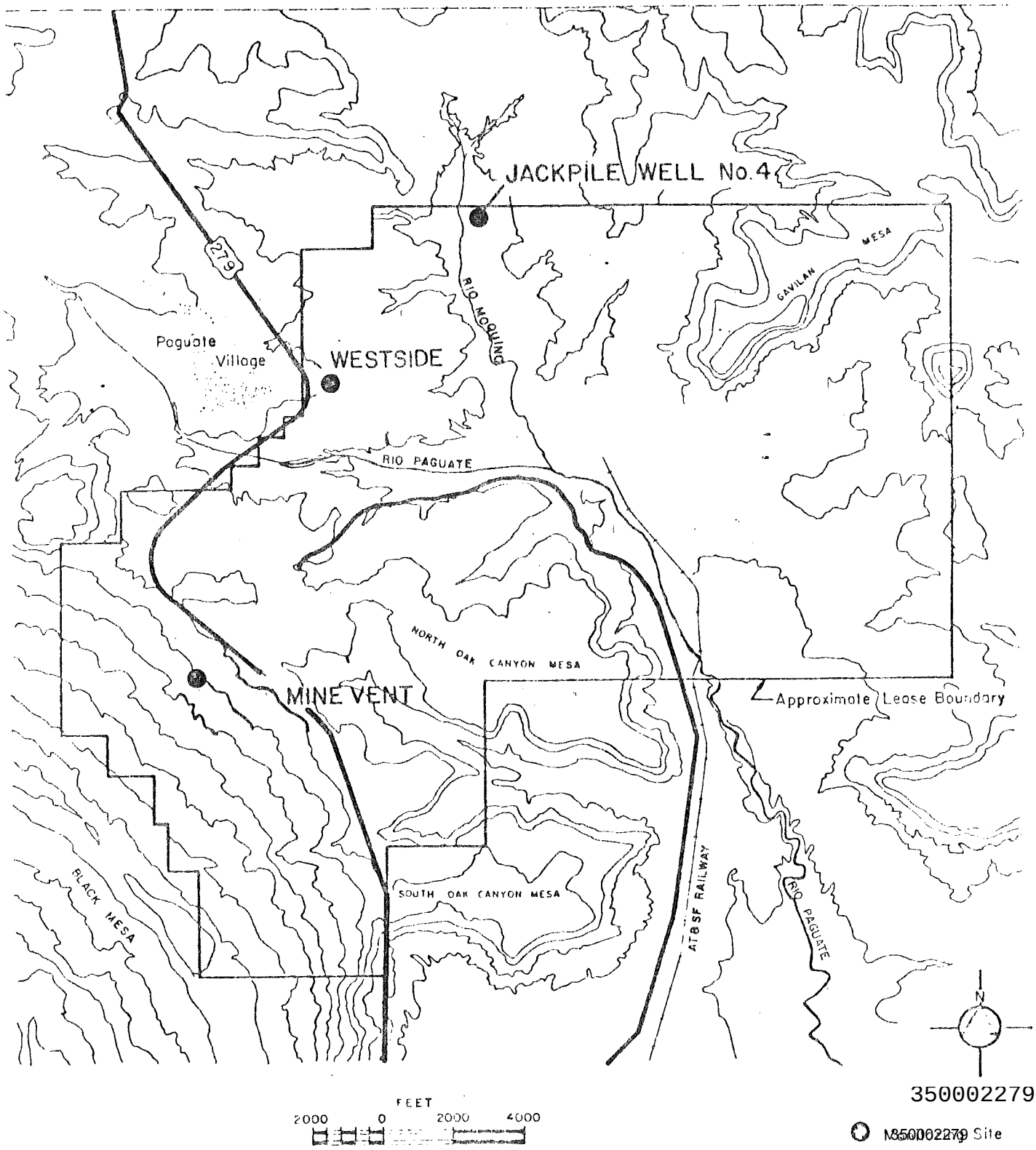
LOCATION	DATE	TOTAL PARTICULATE ugm/M^3	U-Nat. uCi/mlx10-15	Ra-226 uCi/mlx10-15	Th-230 uCi/mlx10-15	Pb-210 uCi/mlx10-15
1. P-10 Area	04/85	22.32	0.20	0.38	0.87	24.80
2. West Gate	04/85	27.83	0.32	0.26	1.16	18.82
3. Well #4	04/85	24.61	0.22	0.45	0.51	25.62

JACKPILE-AMBIENT RADON SURVEY

SECOND QUARTER, 1985

LOCATION	DATE	Rn-222 pCi/L
1. P-10 Area	4/85	1.12
	5/85	1.48
	6/85	1.18
2. Westgate	4/85	<0.20
	5/85	<0.20
	6/85	<0.20
3. Well #4	4/85	1.13
	5/85	0.93
	6/85	1.22

LOCATION OF
AIR QUALITY MONITORING STATIONS



ANACONDA Minerals Co[illegible]y
New Mexico Operations
P.O. Box 638
Grants, New Mexico 87020
Telephone 505 876 2211

April 9, 1985

Mxa
4/18/85

BLM
ALBUQUERQUE
APR 15 1985

Minerals Staff
Rio Puerco Resource Area
Bureau of Land Management
3550 Pan American Freeway, N.E.
P. O. Box 6770
Albuquerque, N.M. 87107

Dear Sir:

Following are the sampling data of the first quarter 1985 for Anaconda's former Jackpile Minesite leases:

1. Chemical and Radiological Analysis for Surface Water.
2. Maps Showing Surface Water Sampling Locations.
3. Results of the Air Monitoring Program.
4. Results of the Ambient Radon Monitoring Study.
5. Maps Showing Locations of Air and Radon Monitoring Stations.
6. Map of Groundwater Monitoring Locations.
7. Chemical and Radiological Analysis of Groundwater Monitoring for the First Quarter 1985.

Sincerely,

Natver Patel by CDW

Natver Patel
Staff Chemist

mls

Enclosures

pc: MAS
CDW
CES

ANACONDA MINERALS COMPANY
NEW MEXICO OPERATION

FOR THE MONTH OF: 1/85

DESCRIPTION	DATE	Field pH	Calc. TDS ppm	Field Cond umhos	HCO_3^- ppm	Cl^- ppm	$SO_4^=$ ppm	Na^+ ppm	K^+ ppm	Ca^{++} ppm	Mg^{++} ppm	NO_3^- ppm	F^- ppm	SiO_2 ppm	Mn^{++} ppm	Lab pH	Lab Cond uohms
Rio Paguate Upstream	1-7-85	8.17	592	620	285	10	146	34	5	79	32	<1.0	0.33	43	.061	7.59	724
Rio Moquino Upstream	1-7-85	8.40	1387	1700	317	13	679	136	7	155	79	<1.0	0.47	26	0.055	7.81	1780
Rio Paguate above Confluence	1-7-85	8.61	636	700	283	10	180	41	5	80	36	<1.0	0.36	38	.037	7.56	791
Rio Moquino above Confluence	1-7-85	8.65	1510	1800	325	14	763	152	7	161	87	<1.0	0.50	24	.047	7.76	1910
Rio Paguate @ Ford Crossing	1-7-85	8.32	1357	1700	310	13	666	134	7	143	82	<1.0	0.49	27	.047	7.81	1720
Paguate Reservoir	1-7-85	7.27	1446	1800	305	24	712	154	12	165	73	<1.0	0.56	20	0.12	7.20	1820

	DATE	As ppm	Ba ppm	Cd ppm	Cr ppm	Pb ppm	Hg ppm	Se ppm	Cu ppm	Fe ppm	Zn ppm	Mo ppm	Ni ppm	V ppm	U-nat mg/L	Ra-226 pCi/L
Rio Paguate Upstream	1-7-85	<.005	<.05	<.001	<.005	<.01	<.0005	<.005	.015	.015	.005	<.01	<.005	<.05	.0010	0.18
Rio Moquino Upstream	1-7-85	<.005	<.05	<.001	<.005	<.01	<.0005	<.005	.004	<.005	.002	<.01	<.005	<.05	.0041	0.17
Rio Paguate above Confluence	1-7-85	<.005	<.05	<.001	<.005	<.01	<.0005	<.005	.011	.005	.007	<.01	<.005	<.05	.0125	0.44
Rio Moquino above Confluence	1-7-85	<.005	<.05	<.001	<.005	<.01	<.0005	<.005	.008	<.005	.002	<.01	<.005	<.05	.0109	0.35
Rio Paguate @ Ford Crossing	1-7-85	<.005	<.05	<.001	<.005	<.01	<.0005	<.005	.008	<.005	.008	<.01	<.005	<.05	.0346	0.44
Paguate Reservoir	1-7-85	<.005	<.05	<.001	<.005	<.01	<.0005	<.005	.005	.023	.004	<.01	<.005	<.05	.1082	0.38

350002281

ANACONDA MINERALS COMPANY
NEW MEXICO OPERATION

FOR THE MONTH OF: 2/85

DESCRIPTION	DATE	Field pH	Calc. TDS ppm	Field Cond umhos	HCO_3^- ppm	Cl^- ppm	$SO_4^=$ ppm	Na^+ ppm	K^+ ppm	Ca^{++} ppm	Mg^{++} ppm	NO_3^- ppm	F^- ppm	SiO_2 ppm	Mn^{++} ppm	Lab pH	Lab Cond uohms
Rio Paguate Upstream	2-4-85	8.15	535	540	264	11	124	31	6	72	26	<1.0	0.33	44	.062	7.59	668
Rio Moquino Upstream	2-4-85	8.03	1344	1380	359	14	610	128	9	148	73	2	0.52	28	.039	7.74	1590
Rio Paguate above Confluence	2-4-85	8.28	600	570	281	12	153	36	6	78	32	<1.0	0.35	42	.034	7.79	719
Rio Moquino above Confluence	2-4-85	7.94	1398	1300	329	14	681	143	9	144	76	1.6	0.53	28	.031	7.81	1640
Rio Paguate @ Ford Crossing	2-4-85	8.07	1120	1100	312	14	497	105	8	121	61	<1.0	0.48	33	.041	7.81	1360
Paguate Reservoir	2-4-85	7.25	1365	1400	288	23	684	142	12	137	77	<1.0	0.54	23	.017	7.38	1640

	DATE	As ppm	Ba ppm	Cd ppm	Cr ppm	Pb ppm	Hg ppm	Se ppm	Cu ppm	Fe ppm	Zn ppm	Mo ppm	Ni ppm	V ppm	U-nat mg/L	Ra-226 pCi/L
Rio Paguate Upstream	2-4-85	<.005	<.05	<.001	<.005	<.01	<.0005	<.005	.007	.013	.006	<.01	<.005	<.05	.0018	0.16
Rio Moquino Upstream	2-4-85	<.005	<.05	<.001	<.005	<.01	<.0005	<.005	.006	.005	.004	<.01	<.005	<.05	.0043	0.20
Rio Paguate above Confluence	2-4-85	<.005	<.05	<.001	<.005	<.01	<.0005	<.005	.006	.006	.004	<.01	<.005	<.05	.0120	0.34
Rio Moquino above Confluence	2-4-85	<.005	<.05	<.001	<.005	<.01	<.0005	<.005	.006	<.005	.003	<.01	<.005	<.05	.0072	0.29
Rio Paguate @ Ford Crossing	2-4-85	<.005	<.05	<.001	<.005	<.01	<.0005	<.005	.006	.006	.003	<.01	<.005	<.05	.0349	0.69
Paguate Reservoir	2-4-85	<.005	<.05	<.001	<.05	<.01	<.0005	<.005	.007	.016	.003	<.01	<.005	<.05	.0647	0.53

350002282

ANACONDA MINERALS COMPANY
NEW MEXICO OPERATION

FOR THE MONTH OF: March 1985

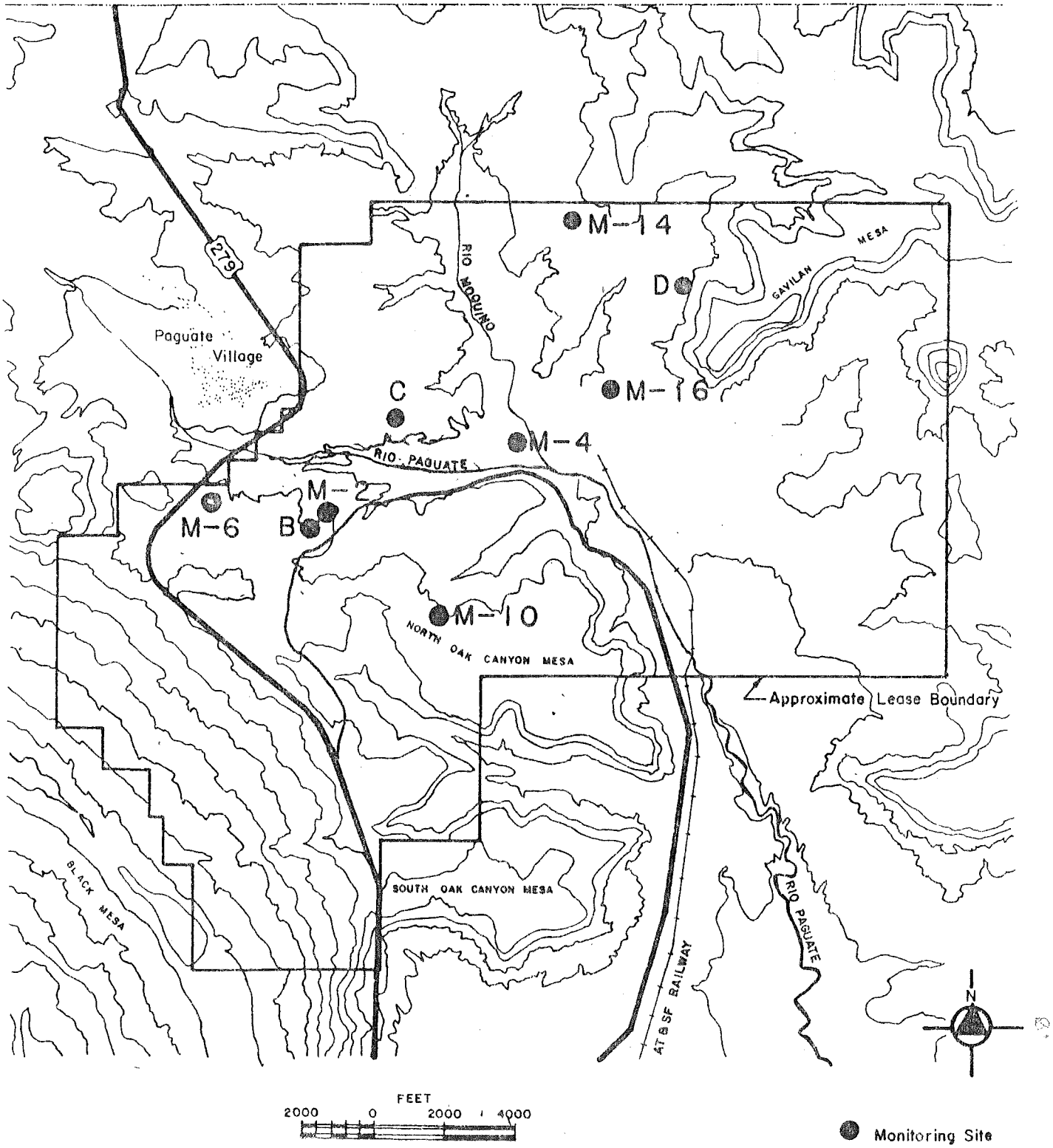
DESCRIPTION	DATE	Field pH	TDS ppm	Field Cond umhos	HCO_3^- ppm	Cl^- ppm	$SO_4^=$ ppm	Na^+ ppm	K^+ ppm	Ca^{++} ppm	Mg^{++} ppm	NO_3^- ppm	F^- ppm	SiO_2 ppm	Mn^{++} ppm	Lab pH	Lab Cond uohms
Rio Paguate Upstream	03-04-85	8.04	431	410	203	8	107	23	5	63	21	<1.0	0.26	36	.045	7.46	527
Rio Moquino Upstream	03-04-85	8.20	657	675	220	8	250	61	5	80	32	<1.0	0.34	28	.049	7.48	811
Rio Paguate above Confluence	03-04-85	8.34	371	370	171	7	96	21	4	52	18	<1.0	0.26	30	.031	7.10	463
Rio Moquino above Confluence	03-04-85	8.34	693	690	207	8	294	65	5	77	36	<1.0	0.35	26	.035	7.16	854
Rio Paguate @ Ford Crossing	03-04-85	7.87	586	590	183	7	238	51	5	69	31	<1.0	0.31	26	.030	7.25	733
Paguate Reservoir	03-04-85	7.62	363	400	129	9	130	29	4	44	17	<1.0	0.34	17	.020	7.06	463

	DATE	As ppm	Ba ppm	Cd ppm	Cr ppm	Pb ppm	Hg ppm	Se ppm	Cu ppm	Fe ppm	Zn ppm	Mo ppm	Ni ppm	V ppm	U-nat mg/L	Ra-226 pCi/L
Rio Paguate Upstream	03-04-85	<.005	<.05	<.001	<.005	<.01	<.0005	<.005	.008	.031	.010	<.01	.010	<.05	.0012	0.20
Rio Moquino Upstream	03-04-85	<.005	<.05	<.001	<.005	<.01	<.0005	<.005	.009	.016	.005	<.01	<.005	<.05	.0013	0.28
Rio Paguate above Confluence	03-04-85	<.005	<.05	<.001	<.005	<.01	<.0005	<.005	.010	.060	.007	<.01	.006	<.05	.0087	0.64
Rio Moquino above Confluence	03-04-85	<.005	<.05	<.001	<.005	<.01	<.0005	<.005	.008	.016	.005	<.01	<.005	<.05	.0031	0.49
Rio Paguate @ Ford Crossing	03-04-85	<.005	<.05	<.001	<.005	<.01	<.0005	<.005	.009	.020	.006	<.01	.005	<.05	.0148	0.69
Paguate Reservoir	03-04-85	<.005	<.05	<.001	<.005	<.01	<.0005	<.005	.010	.039	.007	<.01	.006	<.05	.0150	0.34

350002283

35000228 4

LOCATION OF GROUND WATER MONITORING STATIONS

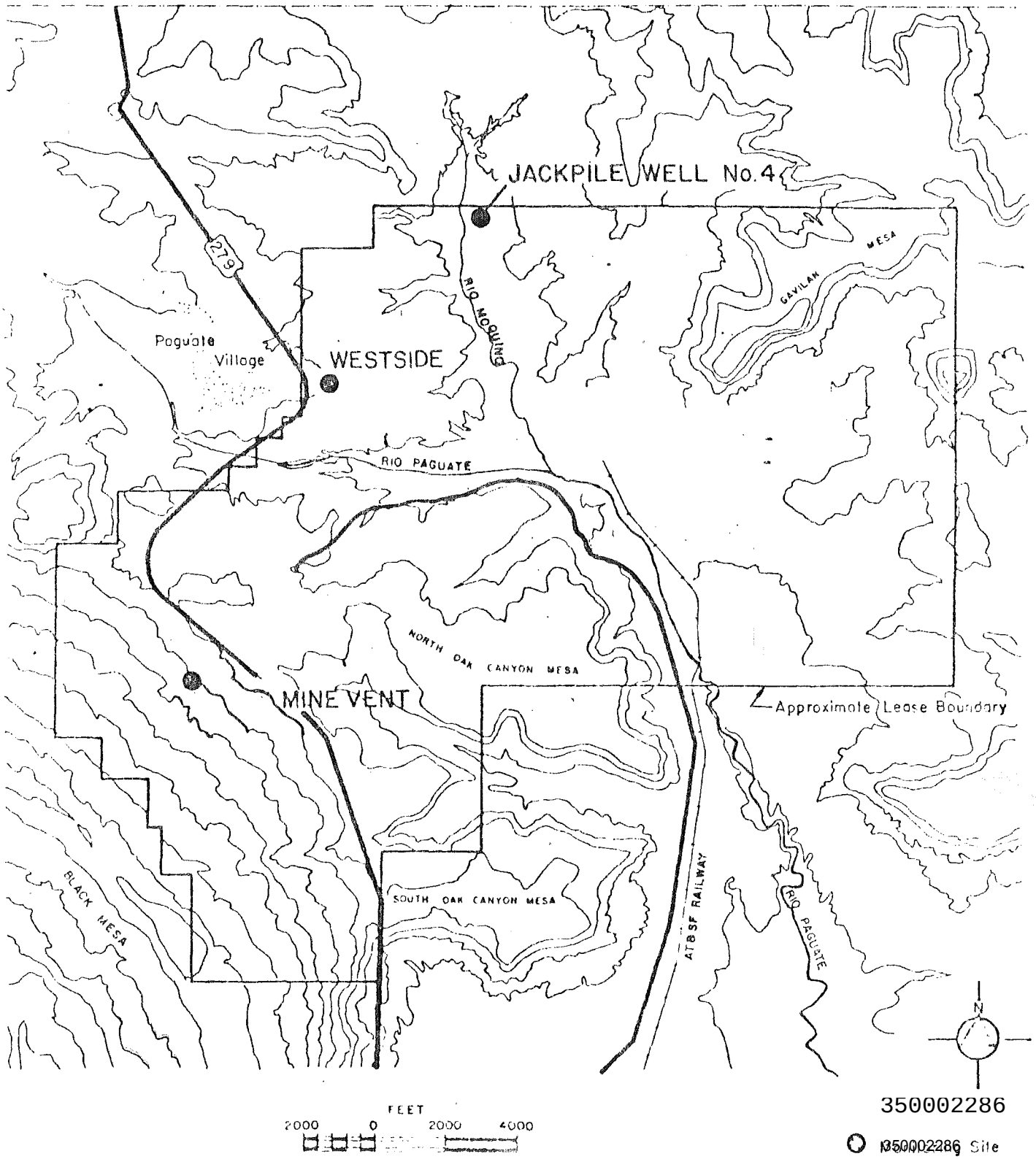


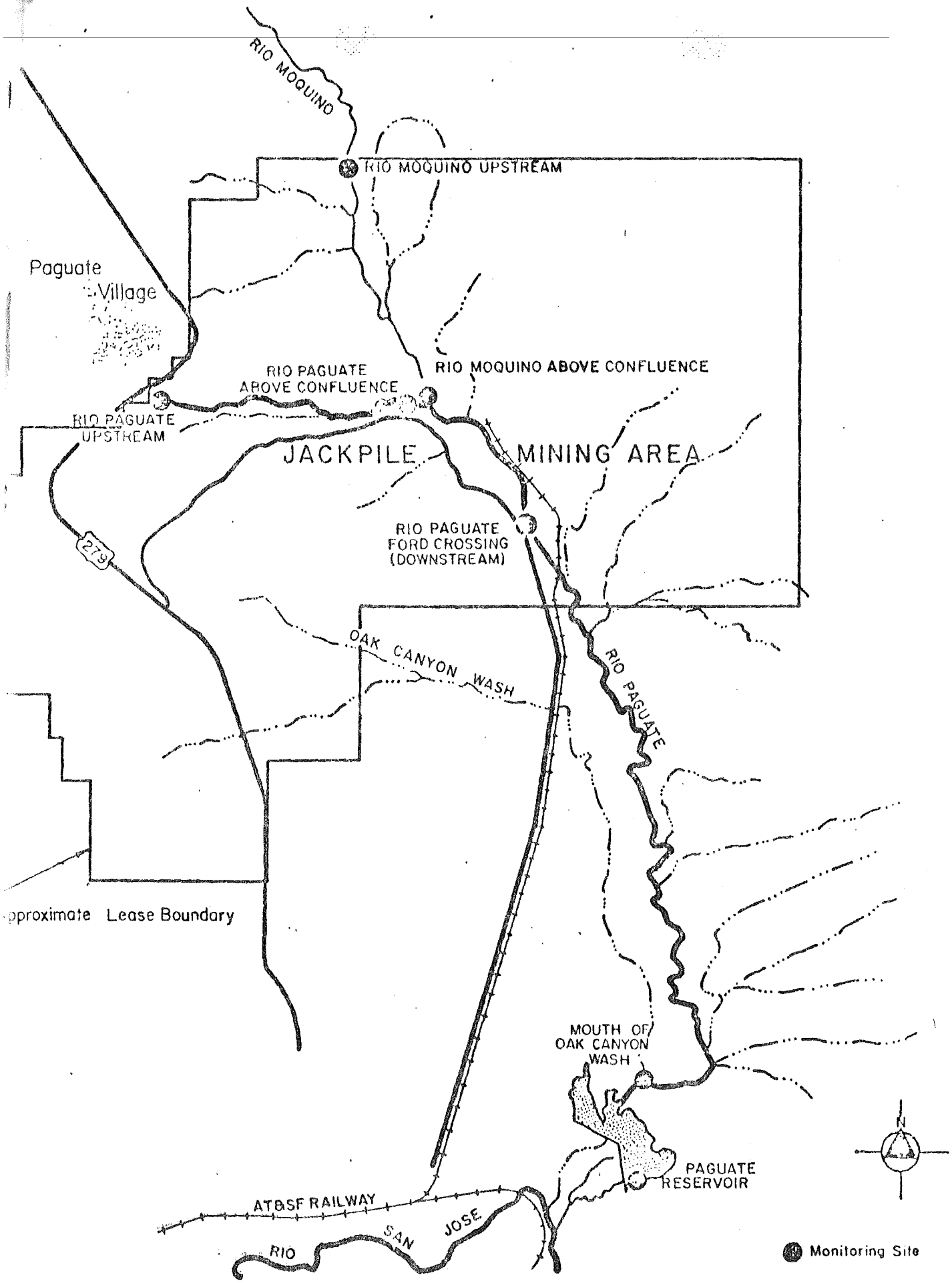
ANACONDA MINERALS COMPANY
NEW MEXICO OPERATION

FOR THE MONTH OF First Quarter 1985

DESCRIPTION	DATE	WATER LEVEL (Feet)	FIELD pH	FIELD TEMP °C	FIELD ELEC CPMD	mg/l TDS DRIED	SO_4 mg/l	U-Nat mg/l	Ra-226 pCi/L	LAB pH	LAB E.C.
M-2	1-17-85	5971.10	8.06	15	1600	984	453	.0032	0.23	8.10	1670
M-4	1-21-85	5896.55	7.65	14	1200	824	356	.0046	1.58	7.79	1340
M-6	1-21-85	5985.87	8.14	15.5	1300	840	345	.0012	0.43	8.16	1460
M-10	1-17-85	5959.30	7.85	16	2000	1280	684	.0640	5.53	8.15	2030
M-14	1-18-85	5941.17	8.73	16	615	344	40	.0002	0.38	8.36	675
M-16	1-18-85	5908.26	7.39	17.5	880	532	151	.1017	0.42	8.07	961
"B"	1-17-85	5977.31	6.00	18	7500	7284	5029	.0072	2.04	7.57	8160
"C"	1-21-85	5929.97	6.45	13	3500	3864	2506	1.887	3.41	7.37	4050
"D"	1-21-85	5844.99	7.21	14	5300	4864	2658	1.166	2.34	8.01	6390

LOCATION OF
AIR QUALITY MONITORING STATIONS





LOCATION OF
SURFACE WATER MONITORING STATIONS

350002287

JACKPILE - AIR SAMPLING SURVEY

FIRST QUARTER, 1985

LOCATION	DATE	TOTAL PARTICULATE µgm/M^3	U-Nat. µCi/mlx10-15	Ra-226 µCi/mlx10-15	Th-230 µCi/mlx10-15	Pb-210 µCi/mlx10-15
1. P-10 Area	01/85	7.84	0.346	0.196	1.293	38.33
	02/85	6.41	0.353	0.373	1.052	23.53
	03/85	49.86	0.113	0.310	0.828	*
2. West Gate	01/85	17.48	0.227	0.175	0.906	31.06
	02/85	12.30	0.460	0.518	0.330	20.07
	03/85	45.38	0.331	0.276	0.487	*
3. Well #4	01/85	10.34	0.334	0.202	1.191	29.62
	02/85	6.61	0.673	0.340	1.070	18.88
	03/85	36.02	0.214	0.270	0.265	*

* These results will be forwarded to you as soon as we receive them.

JACKPILE-AMBIENT RADON SURVEY

FIRST QUARTER, 1985

LOCATION	DATE	Rn-222 pCi/L
1. P-10 Area	1/85	<.20
	2/85	0.53
	3/85	0.43
2. Westgate	1/85	0.389
	2/85	0.143
	3/85	0.22
3. Well #4	1/85	<.20
	2/85	0.204
	3/85	0.99

ANACONDA Minerals Company
New Mexico Operations
P.O. Box 638
Grants, New Mexico 87020
Telephone 505 876 2211

April 22, 1985

Mineral Staff
Rio Puerco Resource Area
Bureau of Land Management
3556 Pan American Freeway NE
P. O. Box 6770
Albuquerque, New Mexico 87107

Gentlemen:

Following are the Pb-210 results of Air Sampling Survey for Anaconda's former Jackpile Minesite Leases for the frst quarter, 1985.

Location	Date	Pb-210 uCi/ml x 10-15
P-10 Area	03/85	33.11
West Gate	03/85	24.68
J.P. Well #4	03/85	26.50

This completes the first quarter report for 1985.

Sincerely,

Natver Patel

Natver Patel
Staff Chemist

jn

pc: MAS
CDW
CES

ANACONDA Minerals Company is a Division of AtlanticRichfieldCompany
AMCO-6187-A (8-83)

File: Anaconda
Env. Monitoring data

ANACONDA Minerals Company
New Mexico Operations
P.O. Box 638
Grants, New Mexico 87020
Telephone 505 876 2211

RECEIVED
BUREAU OF
LAND MANAGEMENT

85 FEB 28 A 9: 02

ALBUQUERQUE DISTRICT
ALBUQUERQUE, N.M.

~~HT~~
2/28/85

February 25, 1985

Minerals Staff
Rio Puerco Resource Area
Bureau of Land Management
3550 Pan American Freeway, N.E.
P.O. Box 6770
Albuquerque, NM 87107

Dear Sir:

This letter includes the Pb-210 data not available at the time we submitted our Fourth Quarter of 1984 report to you for Anaconda's former Jackpile minesite leases. The data are as follows:

Location	Date	Pb-210 uCi/ml x 10^{-15}
P-10 Area	12/84	63.04
Westgate	12/84	64.33
Well #4	12/84	76.26

If you have any questions concerning this data, please call me.

Sincerely,

Carl D. Woolfolk

Carl D. Woolfolk,
Environmental Engineer

cdw
pc: MAS
CES
NP

Laguna 1,4&8
3570 (017)

MAR 14 1985

Mr. Meade A. Stirland
General Manager
Anaconda Minerals Company
New Mexico Operation
Grants, New Mexico 87020

Dear Mr. Stirland:

We have reviewed your requests of January 24 and 29, 1985, to modify the environmental monitoring program at the Jackpile-Paguate Mine (Laguna Tribal Leases 1, 4, and 8). Your proposals are satisfactory and the monitoring plan is hereby approved.

This office will continue to review all monitoring data and we may require future changes in the plan if necessary. If you have any questions, please contact John Andrews of my staff at (505) 766-3114.

Sincerely yours,

(Orig. Sgd.) GEORGE LASKAR

Acting Herrick E. Hanks
Rio Puerco Resource Area
Manager

cc;
Area Director, AAO, BIA w/enclosures
Superintendent, Laguna Agency, BIA w/enclosures
Governor, Pueblo of Laguna, BIA w/enclosures
Anaconda Comprehensive Mine Plan File
Anaconda Environmental Data File

017:JAndrews:pg:3/14/85

350002292

ANACONDA Minerals Company
New Mexico Operations
P.O. Box 638
Grants, New Mexico 87020
Telephone 505 876 2211

FEB 1 A10: 1985

2/1/85

January 29, 1985

Herrick E. Hanks, Manager
Rio Puerco Resource Area
Bureau of Land Management
3550 Pan American Freeway, NE
P.O. Box 6770
Albuquerque, NM 87107

Dear Mr. Hanks:

Since my request of 24 January 1985, I have reviewed the results of our sampling and monitoring for the past several years at our former Jackpile Minesite leases and find that the data indicates further modification would be beneficial to us without jeopardizing environmental protection at the Minesite.

By this letter, we are requesting that the attached environmental sampling and monitoring plan be approved for our former Jackpile Minesite lease area(includes request of January 24, 1985).

We would appreciate your consideration of this matter. This plan, if approved, would provide a substantial time and cost savings to Anaconda.

Sincerely,

Meade A. Stirland

Meade A. Stirland
General Manager

pc: CES
NP
CDW

ANACONDA Minerals Company is a Division of AtlanticRichfieldCompany
AMCO-6187-A (8-83)

GROUNDWATER MONITORING PLAN FOR FORMER JACKPILE MINESITE

AIR

Locations

Westgate Area
Mine Vent Area
J. P. Well #4

Frequency & Parameter

Monthly	Radon-222
Quarterly	Total Particulate Uranium-Natural Radium-226 Thorium-230 Lead-210

SURFACE WATER

Locations

Moquino Upstream
Paguate Upstream
Paguate Above the Confluence with Moquino
Moquino Above the Confluence with Paguate
Paguate at Ford Crossing
Paguate Reservoir

Frequency & Parameter

Quarterly	Field pH & Conductivity	Cl
	Lab pH & Conductivity	Fe
	Mg	Mn
	Na	NO_3
	K	Total Dissolved Solids
	HCO_3	Radium-226
	SiO_2	Uranium-Natural
	SO_4	F
Annually	Zn	Se
	Pb	Ba
	Ni	Cu

GROUNDWATER

No change in the existing program will be requested per the BLM approval on June 16, 1983.

Reports will be submitted on a quarterly basis as has been done in the past.

ANACONDA Minerals Co[illegible]any
New Mexic[illegible]erations
P.O. Box 638
Grants, New Mexico 87020
Telephone 505 876 2211

January 24, 1985

85 JAN 28 A 9:01

HH 1/28/85

Herrick E. Hanks, Manager
Rio Puerco Resource Area
Bureau of Land Management
3550 Pan American Freeway, NE
P. O. Box 6770
Albuquerque, New Mexico 87107

Dear Mr. Hanks:

The chemical and radiological analysis for Anaconda's former Jackpile Minesite leases are reported to the Bureau of Land Management on a quarterly basis. The six Surface Water locations are sampled monthly for analysis of 36 different chemical & radiolgical parameters. A review of the results for the last four years in relation to the concentration for which we monitor and report, indicates that a significant number, nine, of these chemical constituents have never occurred in excess of the limit of detection. This would indicate that these chemical parameters are not a significant portion of the surface water that we monitor and do not pose a hazard to the environment or the health and welfare of plants or animals in the vicinity of the minesite.

We respectfully request that the nine parameters: Arsenic, Cadmium, Chromium, Mercury, Silver, Cobalt, Molybdenum, Vanadium and Phosphate; be excluded from our monitoring requirements.

We appreciate your consideration of this matter. This change, if approved, will allow a significant cost savings to Anaconda.

Sincerely,

Meade A. Stirland
General Manager

jmn

pc: CDW
NP
CES

Hold - another letter coming, per telephone conversation w/ Meade Stirland on 1/28/85 (11:55am).
HH

350002295
AMCO-6187-A (8-83)

ANACONDA Minerals Co[illegible]ny
New Mexico Operations
P.O. Box 638
Grants, New Mexico 87020
Telephone 505 876 2211

JAKJ
1-17-85

1/24/85

Anaconda
Comprehensive
mine plan -
Env. monit. data
file

January 14, 1985

BLM
ALBUQUERQUE
JAN 16 1985

Minerals Staff
Rio Puerco Resource Area
Bureau of Land Management
3550 Pan American Freeway, N.E.
P. O. Box 6770
Albuquerque, N.M. 87107

Dear Sir:

The Fourth Quarter of 1984 sampling data for Anaconda's former Jackpile minesite leases is submitted as follows:

1. Radiological Analysis of Surface Water;
2. Chemical Analysis of Surface Water;
3. Maps Showing Surface Water Sampling Locations;
4. Results of the Air Monitoring Program;
5. Results of the Ambient Radon Monitoring Study;
6. Map showing location of Air and Radon Monitoring Stations;
7. Map of Groundwater Monitoring Locations; and,
8. Chemical Analysis of Groundwater Monitoring, Fourth Quarter.

Sincerely,

Carl D. Woolfolk

Carl D. Woolfolk

mls

Enclosures

pc: MAS, CES

JACKPILE - WATER RADIOLOGICAL ANALYSIS

(FOURTH QUARTER, 1984)

DESCRIPTIVE LOCATION	Radium-226 pCi/L			Uranium-Natural ppm		
	Oct.	Nov.	Dec.	Oct.	Nov.	Dec.
Rio Paguate Upstream	0.32	<0.20	<0.20	0.002	0.002	0.003
Rio Moquino Upstream	1.33	<0.20	<0.20	0.005	0.003	0.001
Rio Paguate Above the Confluence	2.40	1.03	1.22	0.313	0.206	0.045
Rio Moquino Above the Confluence	1.26	0.24	0.22	0.138	0.027	0.011
Rio Paguate Ford Crossing	1.90	0.66	0.54	0.325	0.109	0.067
Paguate Reservoir	0.24	0.57	0.15	0.065	0.047	0.079
Mouth of Oak Canyon Wash	*	*	*	*	*	*

* No sample because the Mouth of Oak Canyon Wash was dry.

ANACONDA MINERALS COMPANY
NEW MEXICO OPERATIONS

FOR THE MONTH OF: October

DESCRIPTION	DATE	Field pH	TDS ppm	Field Cond umhos	HCO_3^- ppm	Cl^- ppm	$SO_4^=$ ppm	Na^+ ppm	K^+ ppm	Ca^{++} ppm	Mg^{++} ppm	NO_3^- ppm	F^- ppm	SiO_2 ppm	Mn^{++} ppm	Lab pH	Lab EC @ 25°C
Rio Paguate Upstream	10-1-84	7.98	840	863	317	10.2	291	37	7.1	134	42	<1.0	0.39	31.7	0.046	7.74	1030
Rio Moquino Upstream	10-1-84	8.29	1868	1921	276	16.5	1065	215	10.3	169	114	1.2	0.57	21.8	0.008	7.99	2220
Rio Paguate Above the Confluence	10-1-84	7.72	1818	1851	407	18.5	912	142	9.9	206	120	1.2	0.71	19.7	0.20	7.79	2100
Rio Moquino Above the Confluence	10-1-84	8.34	1987	2061	268	17	1165	225	9.6	171	129	<1.0	0.79	16.7	0.11	8.05	2370
Rio Paguate Ford Crossing	10-1-84	8.24	2256	2304	317	20.8	1312	236	10.5	209	149	<1.0	0.77	17.3	0.12	8.03	2640
Paguate Reservoir	10-1-84	7.25	827	972	146	15	433	60	12.6	125	33	<1.0	0.57	12.5	0.12	7.36	1080

	DATE	As ppm	Ba ppm	Cd ppm	Cr ppm	Pb ppm	Hg ppm	Se ppm	Cu ppm	Fe ppm	Zn ppm	Mo ppm	Ni ppm	V ppm
Rio Paguate Upstream	10-1-84	<0.005	0.06	<0.001	<0.005	<0.01	<0.0005	<0.005	0.005	0.033	0.010	<0.01	<0.005	<0.05
Rio Moquino Upstream	10-1-84	<0.005	<0.05	<0.001	<0.005	<0.01	<0.0005	<0.005	0.006	0.046	0.010	<0.01	<0.005	<0.05
Rio Paguate Above the Confluence	10-1-84	<0.005	<0.05	<0.001	<0.005	<0.01	<0.0005	<0.005	0.004	0.039	0.006	<0.01	<0.005	<0.05
Rio Moquino Above the Confluence	10-1-84	<0.005	<0.05	<0.001	<0.005	<0.01	<0.0005	0.006	0.003	0.022	0.006	<0.01	<0.005	<0.05
Rio Paguate Ford Crossing	10-1-84	<0.005	<0.05	<0.001	<0.005	<0.01	<0.0005	0.009	0.005	0.020	0.003	<0.01	<0.005	<0.05
Paguate Reservoir	10-1-84	<0.005	<0.05	<0.001	<0.005	<0.01	<0.0005	<0.005	0.003	0.067	0.008	<0.01	<0.005	<0.05

350002298

ANACONDA MINERALS COMPANY
NEW MEXICO OPERATIONS

FOR THE MONTH OF: November

DESCRIPTION	DATE	Field pH	TDS ppm	Field Cond umhos	HCO_3^- ppm	Cl^- ppm	$SO_4^=$ ppm	Na^+ ppm	K^+ ppm	Ca^{++} ppm	Mg^{++} ppm	NO_3^- ppm	F^- ppm	SiO_2 ppm	Mn^{++} ppm	Lab pH	Lab EC @ 25°C
Rio Paguate Upstream	11-01-84	8.24	984	987	366	11.5	360	49	6.0	141	49	<1.0	0.38	31.2	0.062	7.88	1110
Rio Moquino Upstream	11-01-84	8.43	1396	1501	300	12.5	711	142	7.0	143	79	<1.0	0.47	27.0	0.031	8.04	1640
Rio Paguate Above the Confluence	11-01-84	7.83	1478	1629	381	16.0	703	112	7.5	166	91	<1.0	0.63	21.2	0.17	7.84	1690
Rio Moquino Above the Confluence	11-01-84	8.38	1664	1729	293	14.0	910	190	7.5	145	103	<1.0	0.58	24.4	0.034	8.05	1930
Rio Paguate Ford Crossing	11-01-84	8.14	1873	2021	317	17.2	1050	199	7.9	164	116	<1.0	0.63	22.4	0.063	7.93	2140
Paguate Reservoir	11-01-84	6.78	812	903	143	10.5	435	58	7.2	124	32	<1.0	0.50	9.4	0.18	7.44	1000

	DATE	As ppm	Ba ppm	Cd ppm	Cr ppm	Pb ppm	Hg ppm	Se ppm	Cu ppm	Fe ppm	Zn ppm	Mo ppm	Ni ppm	V ppm
Rio Paguate Upstream	11-01-84	<0.005	0.07	<0.001	<0.005	<0.01	<0.0005	<0.005	0.006	0.009	0.011	<0.01	<0.005	<0.05
Rio Moquino Upstream	11-01-84	<0.005	<0.05	<0.001	<0.005	<0.01	<0.0005	<0.005	0.003	0.007	0.007	<0.01	<0.005	<0.05
Rio Paguate Above the Confluence	11-01-84	<0.005	<0.05	<0.001	<0.005	<0.01	<0.0005	<0.005	0.005	0.005	0.004	<0.01	<0.005	<0.05
Rio Moquino Above the Confluence	11-01-84	<0.005	<0.05	<0.001	<0.005	<0.01	<0.0005	<0.005	0.004	0.005	0.001	<0.01	<0.005	<0.05
Rio Paguate Ford Crossing	11-01-84	<0.005	<0.05	<0.001	<0.005	<0.01	<0.0005	<0.005	0.007	0.006	0.003	<0.01	<0.005	<0.05
Paguate Reservoir	11-01-84	<0.005	<0.05	<0.001	<0.005	<0.01	<0.0005	<0.005	0.007	0.024	0.003	<0.01	<0.005	<0.05

350002299

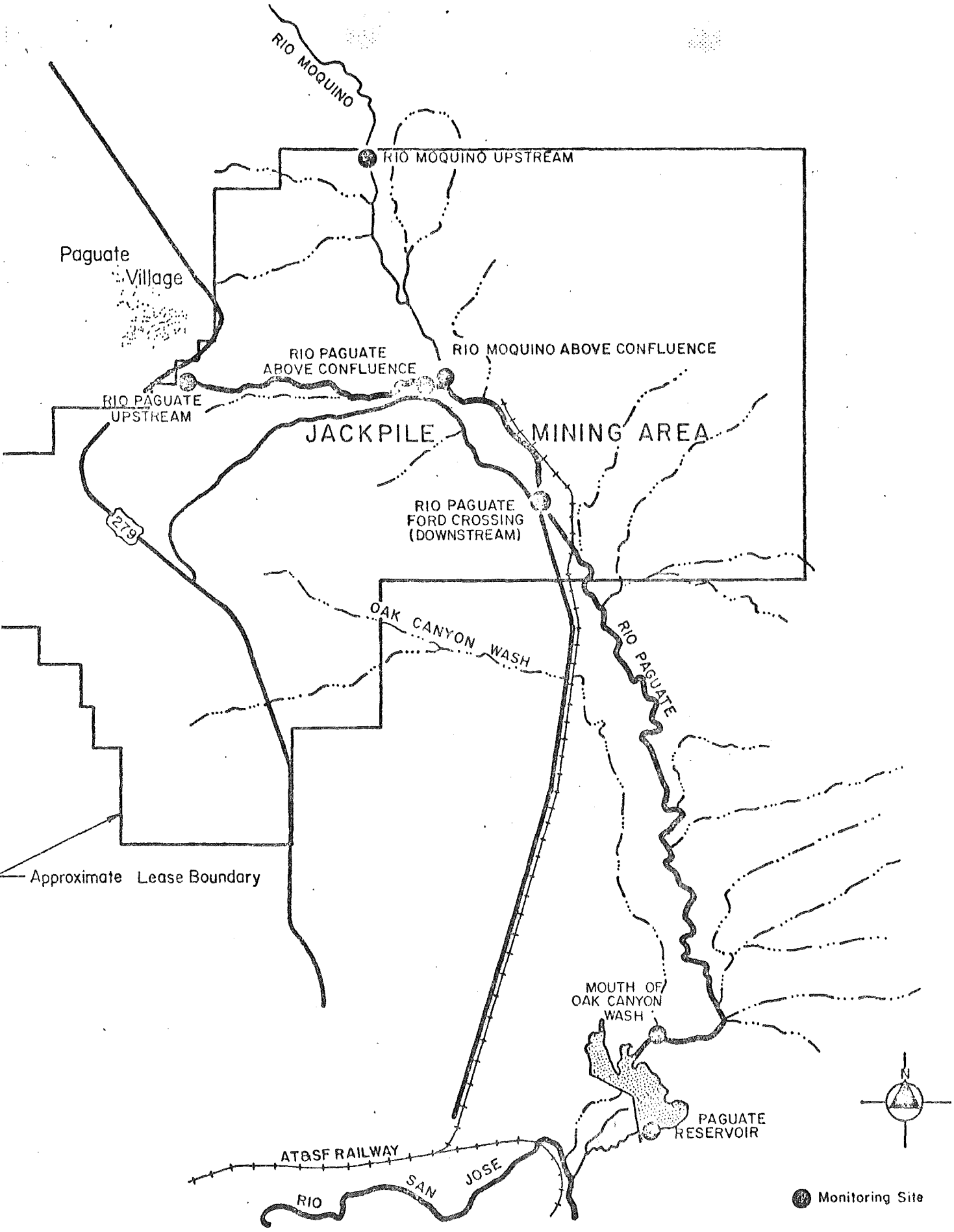
ANACONDA MINERALS COMPANY
NEW MEXICO OPERATIONS

FOR THE MONTH OF: December

DESCRIPTION	DATE	Field pH	TDS ppm	Field Cond umhos	HCO_3^- ppm	Cl^- ppm	$SO_4^=$ ppm	Na^+ ppm	K^+ ppm	Ca^{++} ppm	Mg^{++} ppm	NO_3^- ppm	F^- ppm	SiO_2 ppm	Mn^{++} ppm	Lab pH	Lab EC @ 25°C
Rio Paguate Upstream	12-4-84	8.05	729	766	300	9.5	232	38	5.2	105	38	<1.0	0.33	38.9	0.075	7.62	868
Rio Moquino Upstream	12-4-84	8.28	1297	1349	295	10.5	641	124	6.5	145	73	<1.0	0.41	25.5	0.020	7.80	1510
Rio Paguate Above the Confluence	12-4-84	8.25	881	935	310	10.8	331	57	5.7	113	52	<1.0	0.42	27.3	0.058	7.76	1060
Rio Moquino Above the Confluence	12-4-84	8.23	1394	1557	281	12.2	734	141	6.4	137	81	<1.0	0.48	20.8	0.030	7.85	1710
Rio Paguate Ford Crossing	12-4-84	8.37	1428	1520	298	13.0	736	145	6.5	140	88	<1.0	0.51	23.3	0.051	7.86	1720
Paguate Reservoir	12-4-84	7.08	1060	1392	227	21.6	518	84	10.9	154	42	<1.0	0.50	10.6	0.29	7.06	1290

	DATE	As ppm	Ba ppm	Cd ppm	Cr ppm	Pb ppm	Hg ppm	Se ppm	Cu ppm	Fe ppm	Zn ppm	Mo ppm	Ni ppm	V ppm
Rio Paguate Upstream	12-4-84	<0.005	<0.05	<0.001	<0.005	<0.01	<0.0005	<0.005	0.007	0.008	0.012	<0.01	<0.005	<0.05
Rio Moquino Upstream	12-4-84	<0.005	<0.05	<0.001	<0.005	<0.01	<0.0005	<0.005	0.008	<0.005	<0.001	<0.01	<0.005	<0.05
Rio Paguate Above the Confluence	12-4-84	<0.005	<0.05	<0.001	<0.005	<0.01	<0.0005	<0.005	0.006	<0.005	0.003	<0.01	<0.005	<0.05
Rio Moquino Above the Confluence	12-4-84	<0.005	<0.05	<0.001	<0.005	<0.01	<0.0005	<0.005	0.005	<0.005	<0.001	<0.01	<0.005	<0.05
Rio Paguate Ford Crossing	12-4-84	<0.005	<0.05	<0.001	<0.005	<0.01	<0.0005	<0.005	0.004	<0.005	<0.001	<0.01	<0.005	<0.05
Paguate Reservoir	12-4-84	<0.005	<0.05	<0.001	<0.005	<0.01	<0.0005	<0.005	0.007	0.041	0.003	<0.01	<0.005	<0.05

350002300



LOCATION OF
SURFACE WATER MONITORING STATIONS

350002301

JACKPILE - AIR SAMPLING SURVEY

FOURTH QUARTER, 1984

LOCATION	DATE	TOTAL PARTICULATE $\mu gm/M^3$	U-Nat. $\mu Ci/ml x10^{-15}$	Ra-226 $\mu Ci/ml x10^{-15}$	Th-230 $\mu Ci/ml x10^{-15}$	Pb-210 $\mu Ci/ml x10^{-15}$
1. P-10 Area	10/84	9.48	0.08	0.78	0.60	42.51
	11/84	14.54	0.165	0.177	1.662	58.03
	12/84	7.88	0.12	0.139	1.15	-
2. West Gate	10/84	12.67	0.20	0.39	0.66	30.92
	11/84	23.77	0.121	0.161	1.071	45.54
	12/84	15.95	0.13	0.214	0.67	-
3. Well #4	10/84	12.00	0.15	0.37	0.86	28.83
	11/84	21.03	0.226	0.289	1.457	40.18
	12/84	9.69	0.14	0.306	1.44	-

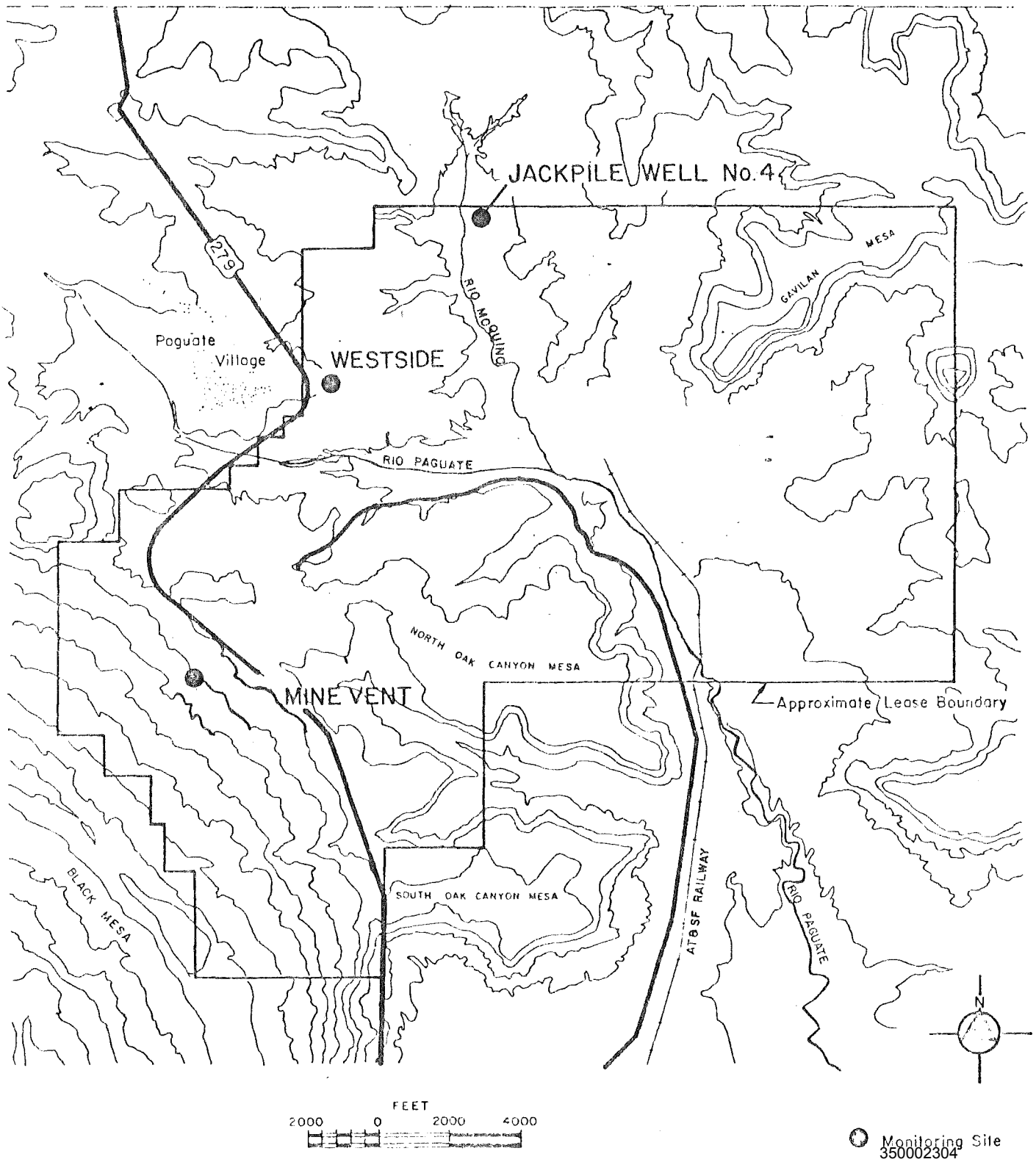
- These results will be forwarded to you as soon as we receive them.

JACKPILE-AMBIENT RADON SURVEY

FOURTH QUARTER, 1984

LOCATION	DATE	Rn-222 pCi/L
1. P-10 Area	10/84	0.33
	11/84	1.00
	12/84	0.39
2. Well #4	10/84	<0.20
	11/84	<0.20
	12/84	<0.20
3. Westgate	10/84	0.37
	11/84	0.52
	12/84	0.48

LOCATION OF
AIR QUALITY MONITORING STATIONS



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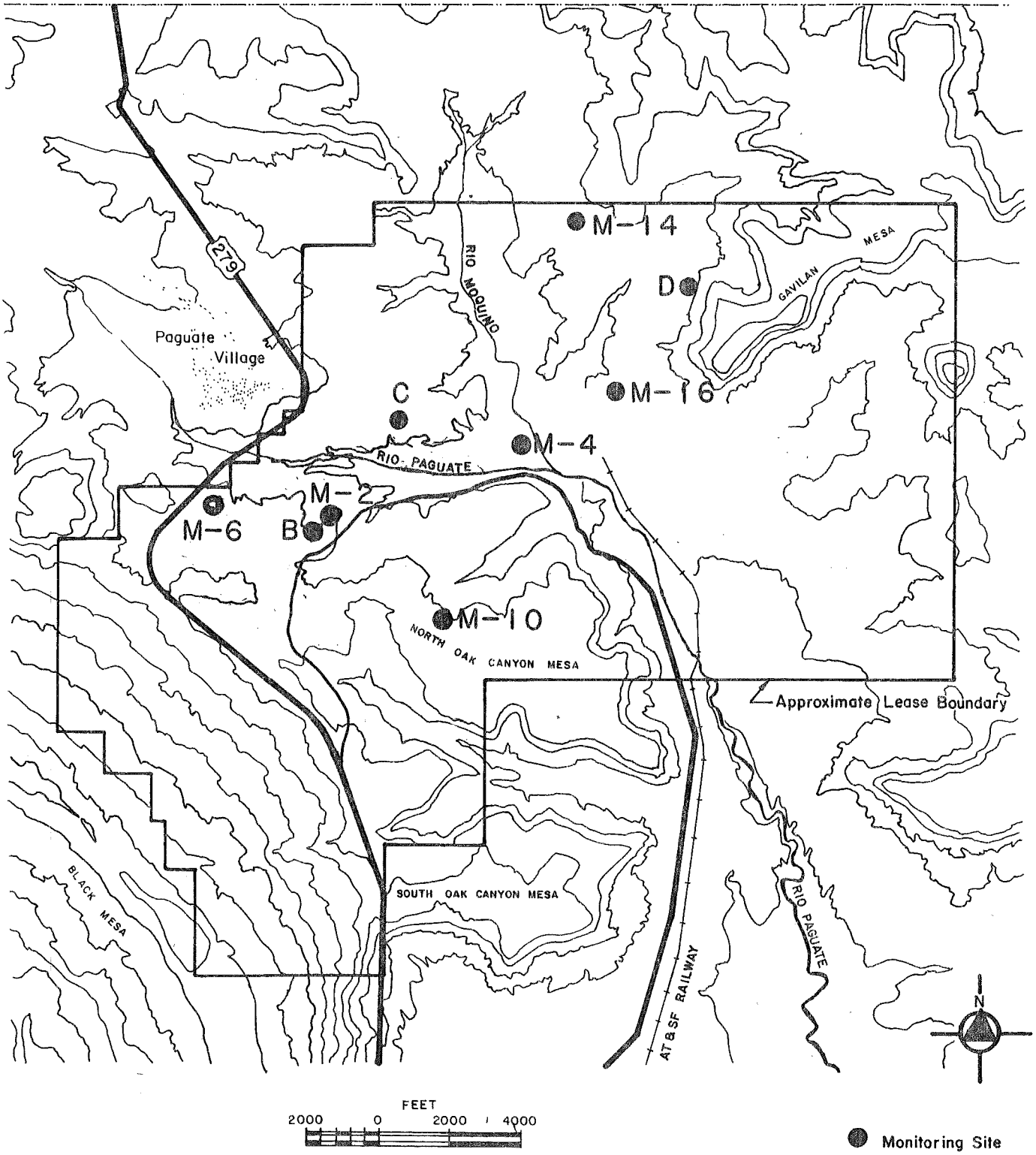
LOCATION OF GROUND WATER MONITORING STATIONS



350002305

JACKPILE GROUNDWATER

ANACONDA MINERALS COMPANY
NEW MEXICO OPERATION

FOR THE FOURTH QUARTER

DESCRIPTION	DATE	WATER LEVEL	Field pH	Field TEMP °C	Field ELEC. COND.	TDS	SO_4	U-Nat. mg/l	Ra-226 pCi/L	Lab pH	Lab Elec Cond							
M-2	10-29-84	5970.79	8.40	17.5	1562	1036	477	0.002	1.02	7.85	1740							
M-4	10-29-84	5896.86	7.61	18.0	1260	708	370	0.011	1.25	7.77	1250							
M-6	10-30-84	5984.90	8.15	17.5	1521	988	423	0.003	1.20	7.94	1560							
M-10	10-30-84	5958.96	7.85	19.5	1946	1364	721	0.055	7.00	7.88	2000							
M-14	11-1-84	5936.31	8.59	20.0	671	368	84	0.006	0.49	7.75	723							
M-16	10-29-84	5908.34	7.48	21.0	984	636	244	0.100	0.40	7.83	1040							
"B"	10-29-84	5978.17	6.01	20.0	6303	7612	5580	0.007	1.40	6.25	8440							
"C"	10-29-84	5930.21	6.50	17.0	3978	4084	2736	1.478	4.65	7.09	4200							
"D"	10-29-84	5847.30	7.26	21.0	5940	4668	2609	1.535	2.90	7.81	6270							

Anaconda Comprehensive Plan Env. File

ANACONDA Minerals Company
New Mexico Operations
P.O. Box 638
Grants, New Mexico 87020
Telephone 505 876 2211

RECEIVED
BUREAU OF
LAND MANAGEMENT

84 NOV 15 A 9: 05

ALBUQUERQUE DISTRICT
ALBUQUERQUE, N.M.

BKG 11/15/84
11/15/84

November 9, 1984

Minerals Staff
Rio Puerco Resource Area
Bureau of Land Management
3550 Pan American Freeway, NE
P. O. Box 6770
Albuquerque, N.M. 87107

Dear Sir:

The third quarter of 1984 sampling data for Anaconda's former Jackpile Minesite leases was submitted on October 10, 1984. However, the Pb-210 data for the air sampling surveys was omitted for August and Septmber, 1984. The Pb-210 data has been received and is being reported within this correspondence. The data is as follows:

Location	Date	Pb-210 $uCi/ml x 10^{-15}$
P-10 Area	8/84	21.68
	9/84	34.84
Westgate	8/84	21.63
	9/84	37.23
Well #4	8/84	24.07
	9/84	33.99

If you have any questions regarding this data, please call me.

Sincerely,

Carl D. Woolfolk
Senior Env. Engineer

mls

cc: MAS, CES, DLR

Anaconda Comprehensive mine plan Env. file

ANACONDA Minerals Company
New Mexico Operations
P.O. Box 638
Grants, New Mexico 87020
Telephone 505 876 2211

RECEIVED
BUREAU OF
LAND MANAGEMENT

84 OCT 17 A 9: 02

ALBUQUERQUE, N.M.

Amd 10/17/84

October 10, 1984

Minerals Staff
Rio Puerco Resource Area
Bureau of Land Management
3550 Pan American Freeway, N.E.
P. O. Box 6770
Albuquerque, N.M. 87107

Dear Sir:

The Third Quarter of 1984 sampling data for Anaconda's former Jackpile minesite leases is submitted as follows:

1. Radiological Analysis of Surface Water;
2. Chemical Analysis of Surface Water;
3. Maps Showing Surface Water Sampling Locations;
4. Results of the Air Monitoring Program;
5. Results of the Ambient Radon Monitoring Study;
6. Map showing location of Air and Radon Monitoring Stations;
7. Map of Groundwater Monitoring Locations; and,
8. Chemical Analysis of Groundwater Monitoring, Third Quarter.

Please note that the Pb-210 results for air monitoring will be forwarded upon our receipt of those results.

Sincerely,

Dean L. Roberts

Dean L. Roberts
Chief Environmental Engineer

mls

Enclosures

pc: CES, CDW, MAS

JACKPILE - WATER RADIOLOGICAL ANALYSIS

(THIRD QUARTER, 1984)

DESCRIPTIVE LOCATION	Radium-226 pCi/L			Uranium-Natural ppm		
	Jul.	Aug.	Sep.	Jul.	Aug	Sep.
Rio Paguate Upstream	0.29	0.28	0.39	0.003	0.003	0.003
Rio Moquino Upstream	0.17	0.24	0.23	0.012	0.002	0.013
Rio Paguate Above the Confluence	0.67	1.91	4.40	0.170	0.344	0.306
Rio Moquino Above the Confluence	5.20	4.13	1.99	0.406	0.164	0.210
Rio Paguate Ford Crossing	2.00	1.53	1.91	0.251	0.325	0.340
Paguate Reservoir	2.00	0.67	0.58	0.136	0.617	0.203
Mouth of Oak Canyon Wash	*	*	*	*	*	*

* No sample because the Mouth of Oak Canyon Wash was dry.

JACKPILE-AMBIENT RADON SURVEY

THIRD QUARTER, 1984

LOCATION	DATE	Rn-222 pCi/L
1. P-10 Area	7/84	<0.20
	8/84	<0.20
	9/84	<0.20
2. Well #4	7/84	<0.20
	8/84	0.66
	9/84	1.02
3. Westgate	7/84	<0.20
	8/84	<0.20
	9/84	<0.20

JACKPILE - AIR SAMPLING SURVEY

THIRD QUARTER, 1984

LOCATION	DATE	TOTAL PARTICULATE µgm/M^3	U-Nat. µCi/ml×10-15	Ra-226 µCi/ml×10-15	Th-230 µCi/ml×10-15	Pb-210 µCi/ml×10-15
1. P-10 Area	7/84	23.18	0.19	0.17	0.85	22.06
	8/84	14.60	0.66	0.20	0.24	*
	9/84	18.98	0.05	0.24	0.97	*
2. West Gate	7/84	22.98	0.43	0.07	1.51	19.04
	8/84	18.54	0.56	0.49	0.35	*
	9/84	25.76	0.11	0.49	0.73	*
3. Well #4	7/84	28.07	0.66	0.14	1.87	20.72
	8/84	15.94	0.11	0.17	0.40	*
	9/84	24.20	0.14	0.23	1.24	*

*August and September Pb-210 results will be forwarded to you upon our receipt of the results.

ANACONDA MINERALS COMPANY
NEW MEXICO OPERATIONS

FOR THE MONTH OF: July

DESCRIPTION	DATE	Field pH	TDS ppm	Field Cond umhos	HCO_3^- ppm	Cl^- ppm	$SO_4^=$ ppm	Na^+ ppm	K^+ ppm	Ca^{++} ppm	Mg^{++} ppm	NO_3^- ppm	F^- ppm	SiO_2 ppm	Mn^{++} ppm	Lab pH	umhos 25°C Cond.
Rio Paguate Upstream	7-2-84	7.60	714	700	210	10.2	300	34	7.9	112	34	5.1	0.48	20.9	0.049	7.60	838
Rio Moquino Upstream	7-2-84	8.42	2.081	2600	227	22.5	1264	271	10.9	143	139	2.5	0.74	18.1	0.006	8.04	2310
Rio Paguate Above the Confluence	6-2-84	7.66	1359	1400	237	14	744	103	9.9	170	75	4.7	0.72	14.1	0.12	7.78	1500
Rio Moquino Above the Confluence	7-2-84	8.19	2203	2360	259	17.3	1332	248	11.5	203	128	3.1	0.84	14.1	0.068	7.82	2370
Rio Paguate Ford Crossing	7-2-84	8.10	1463	1770	207	15	833	138	10	171	84	3.7	0.75	13.3	0.064	7.63	1660
Paguate Reservoir	7-2-84	7.63	3289	3800	573	52	1786	368	31.5	291	184	2.6	0.80	16.8	0.35	7.81	3340

	DATE	As ppm	Ba ppm	Cd ppm	Cr ppm	Pb ppm	Hg ppm	Se ppm	Cu ppm	Fe ppm	Zn ppm	Mo ppm	Ni ppm	V ppm
Rio Paguate Upstream	7-2-84	<0.005	0.05	<0.001	<0.005	<0.01	<0.0005	<0.005	0.005	0.039	0.015	<0.01	<0.005	<0.05
Rio Moquino Upstream	7-2-84	<0.005	<0.05	<0.001	<0.005	<0.01	<0.0005	<0.005	0.008	0.034	0.007	<0.01	0.007	<0.05
Rio Paguate Above the Confluence	7-2-84	<0.005	<0.05	<0.001	<0.005	<0.01	<0.0005	<0.005	0.011	0.038	0.021	<0.01	0.010	<0.05
Rio Moquino Above the Confluence	7-2-84	<0.005	0.07	<0.001	<0.005	<0.01	<0.0005	0.072	0.004	0.028	0.004	<0.01	<0.005	<0.05
Rio Paguate Ford Crossing	7-2-84	<0.005	0.05	<0.001	<0.005	<0.01	<0.0005	0.010	0.008	0.045	0.010	<0.01	0.007	<0.05
Paguate Reservoir	7-2-84	0.007	<0.05	<0.001	<0.005	<0.01	<0.0005	<0.005	0.008	0.055	0.013	<0.01	0.005	<0.05

350002312

ANACONDA MINERALS COMPANY
NEW MEXICO OPERATIONS

FOR THE MONTH OF: August

DESCRIPTION	DATE	Field pH	TDS ppm	Field Cond umhos	HCO_3^- ppm	Cl^- ppm	$SO_4^=$ ppm	Na^+ ppm	K^+ ppm	Ca^{++} ppm	Mg^{++} ppm	NO_3^- ppm	F^- ppm	SiO_2 ppm	Mn^{++} ppm	Lab pH	umhos 25°C Cond.
Rio Paguate Upstream	8-1-84	8.08	769	800	325	10.8	240	38.8	7.3	101	43.4	2.2	0.44	32.2	0.035	7.85	857
Rio Moquino Upstream	8-8-84	8.27	942	1200	162	10.5	510	98	9.0	101	48	2.9	0.74	12.7	0.018	7.47	1160
Rio Paguate Above the Confluence	8-1-84	7.48	2567	2610	503	23	1383	204	13.3	239	198	2.3	0.81	22.4	0.71	7.71	2620
Rio Moquino Above the Confluence	8-1-84	8.08	2708	2800	310	21	1651	325	11.3	199	187	2.5	1.0	16.1	0.026	8.08	2920
Rio Paguate Ford Crossing	8-1-84	8.21	2417	2920	317	26.5	1424	288	10.7	171	176	2.2	0.95	20.5	0.043	7.90	2660
Paguate Reservoir	8-8-84	7.62	1141	1350	73.2	21.0	716	111	17.2	147	51	3.5	0.60	8.2	0.072	6.83	1390

	DATE	As ppm	Ba ppm	Cd ppm	Cr ppm	Pb ppm	Hg ppm	Se ppm	Cu ppm	Fe ppm	Zn ppm	Mo ppm	Ni ppm	V ppm
Rio Paguate Upstream	8-1-84	<0.005	0.07	<0.001	<0.005	<0.01	<0.0005	<0.005	0.006	0.018	0.031	<0.01	0.005	<0.05
Rio Moquino Upstream	8-8-84	<0.005	<0.05	<0.001	<0.005	<0.01	<0.0005	<0.005	0.006	0.008	0.008	<0.01	<0.005	<0.05
Rio Paguate Above the Confluence	8-1-84	<0.005	0.05	<0.001	<0.005	<0.01	<0.0005	<0.005	0.009	0.032	0.019	<0.01	<0.005	<0.05
Rio Moquino Above the Confluence	8-1-84	<0.005	<0.05	<0.001	<0.005	<0.01	<0.0005	0.014	0.008	0.062	0.011	<0.01	<0.005	<0.05
Rio Paguate Ford Crossing	8-1-84	<0.005	<0.05	<0.001	<0.005	<0.01	<0.0005	<0.005	0.006	0.048	0.023	<0.01	<0.005	<0.05
Paguate Reservoir	8-8-84	<0.005	0.08	<0.001	<0.005	<0.01	0.0006	<0.005	0.011	0.029	0.010	<0.01	0.006	<0.05

350002313

ANACONDA MINERALS COMPANY
NEW MEXICO OPERATIONS

FOR THE MONTH OF: September

DESCRIPTION	DATE	Field pH	TDS ppm	Field Cond umhos	HCO_3^- ppm	Cl^- ppm	$SO_4^=$ ppm	Na^+ ppm	K^+ ppm	Ca^{++} ppm	Mg^{++} ppm	NO_3^- ppm	F^- ppm	SiO_2 ppm	Mn^{++} ppm	Lab pH	umhos 25°C Cond
Rio Paguate Upstream	9-4-84	8.10	812	800	329	11.0	262	42	6.6	117	41	3.1	0.38	34.4	0.11	8.06	908
Rio Moquino Upstream	9-4-84	8.31	2218	2540	268	23.3	1332	272	11.3	152	155	3.0	0.72	23.6	0.007	8.12	2530
Rio Paguate Above the Confluence	9-4-84	7.88	2149	2350	451	22.0	1114	178	11.3	200	168	3.1	0.76	21.9	0.42	7.99	2330
Rio Moquino Above the Confluence	9-4-84	8.39	2325	2450	281	21.3	1397	277	9.9	177	157	3.2	0.94	17.9	0.047	8.16	2610
Rio Paguate Ford Crossing	9-4-84	8.31	2467	2860	322	25.3	1465	275	10.8	189	176	3.1	0.85	19.3	0.060	8.15	2730
Paguate Reservoir	9-4-84	7.74	1723	1800	183	21.6	1040	141	20.1	230	83	3.1	0.97	16.2	0.21	7.68	1960

	DATE	As ppm	Ba ppm	Cd ppm	Cr ppm	Pb ppm	Hg ppm	Se ppm	Cu ppm	Fe ppm	Zn ppm	Mo ppm	Ni ppm	V ppm
Rio Paguate Upstream	9-4-84	<0.005	0.07	<0.001	<0.005	<0.01	<0.0005	<0.005	0.004	0.014	0.011	<0.01	<0.005	<0.05
Rio Moquino Upstream	9-4-84	<0.005	0.05	<0.001	<0.005	<0.01	<0.0005	<0.005	0.008	0.008	0.082	<0.01	<0.005	<0.05
Rio Paguate Above the Confluence	9-4-84	<0.005	0.05	0.001	<0.005	<0.01	<0.0005	<0.005	0.007	0.011	0.035	<0.01	<0.005	<0.05
Rio Moquino Above the Confluence	9-4-84	<0.005	<0.05	<0.001	<0.005	<0.01	<0.0005	0.027	0.008	0.007	0.020	<0.01	<0.005	<0.05
Rio Paguate Ford Crossing	9-4-84	<0.005	0.05	0.001	<0.005	<0.01	<0.0005	0.013	0.007	0.011	0.037	<0.01	<0.005	<0.05
Paguate Reservoir	9-4-84	<0.005	<0.05	<0.001	<0.005	0.01	<0.0005	<0.005	0.007	0.047	0.012	<0.01	<0.005	<0.05

350002314

JACKPILE GROUNDWATER

ANACONDA MINERALS COMPANY
NEW MEXICO OPERATION

FOR THE Third Quarter

DESCRIPTION	DATE	WATER LEVEL	Field pH	Field TEMP °C	Field ELEC. COND.	TDS	SO_4	U-Nat. mg/l	Ra-226 pCi/L	LAB pH	LAB EC							
M-2	7-16-84	5972.62	8.16	20.5	1380	1020	451	0.009	0.36	7.91	1590							
M-4	7-17-84	5896.68	7.50	20.5	1130	896	352	0.003	0.94	7.61	1320							
M-6	9-7-84	5984.31	8.16	20.0	1270	908	336	0.002	0.59	8.20	1440							
M-10	9-7-84	5959.08	7.69	22.0	1750	1368	680	0.066	6.76	7.99	2010							
M-14	9-7-84	5934.48	8.58	21.0	600	416	42	0.001	0.43	8.26	659							
M-16	7-17-84	5908.59	7.51	23.5	880	576	150	0.032	0.69	7.79	910							
"B"	7-16-84	5976.73	6.34	22.5	5900	7724	5185	0.008	2.20	6.53	7950							
"C"	7-17-84	5930.07	6.62	18.5	3120	4112	2550	1.950	2.80	6.95	4200							
"D"	7-17-84	5842.20	8.18	20.0	4510	4208	2239	0.400	2.40	8.26	5540							

The Anaconda Company
Environmental Monitoring Data
Correspondence

3500023316

The Anaconda Company
Environmental Monitoring Data
Correspondence

ANACONDA Minerals Co y
New Mexico Operations
P.O. Box 638
Grants, New Mexico 87020
Telephone 505 876 2211

July 25, 1983

ALBUQUERQUE DISTRICT MINING
RECEIVED
JUL 29 1983
MINERALS MANAGEMENT SERVICE
ALBUQUERQUE, NEW MEXICO

Minerals Staff
Rio Puerco Resource Area
Bureau of Land Management
500 Gold Avenue, S.W.
Federal Building, Room 116
Albuquerque, N.M. 87102

Dear Sir:

The Second Quarter of 1983 sampling data for Anaconda's former Jackpile minesite leases is submitted as follows:

1. Radiological Analysis of Ground and Surface Water.

2. Chemical Analysis of Ground and Surface Water.

3. Maps showing Ground and Surface Water Sampling Locations.

4. Results of the Air Monitoring Program.

5. Results of the Ambient Radon Monitoring Study.

6. Map showing location of Air and Radon Monitoring Stations.

Sincerely,

Meade A. Stirland, Manager
Environment, Health & Safety

mls

Enclosures

cc: W. C. Norem
D. L. Roberts
C. E. Sanchez
L. C. Leyba
File

ANACONDA Minerals Company is a Division of AtlanticRichfieldCompany

ALBUQUERQUE DISTRICT MINING
RECEIVED
JUL 29 1983
MINERALS MANAGEMENT SERVICE
ALBUQUERQUE, NEW MEXICO

AIR QUALITY MONITORING PROGRAM

One 168-hour sample is taken each month at each of the four locations specified by Marc Nelson. They are collected about three meters above the ground on GF/A Glass Microfibre filter paper, using an RAC Heavy-duty Sampler.

AMBIENT RADON STUDY

Radon-222 is monitored continuously at each of the air sampling locations specified by Marc Nelson. The samples are monitored by the use of the Model RGM-2 Radon Gas Monitor. Normal data output is printed hourly and a 24-hour average is printed at the end of a 24-hour period.

ALBUQUERQUE DISTRICT MINING
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JUL 29 1983
MINERALS MANAGEMENT SERVICE
ALBUQUERQUE, NEW MEXICO

JACKPILE - WATER RADIOLOGICAL ANALYSIS

(SECOND QUARTER, 1983)

DESCRIPTIVE LOCATION	Radium-226 pCi/L			Uranium-Natural ppm		
	Apr.	May	Jun.	Apr.	May	Jun.
Rio Paguate Upstream	<0.20	<0.20	<0.20	0.0034	0.001	0.0021
Rio Moquino Upstream	<0.20	<0.20	<0.20	0.0044	0.001	0.0041
Rio Paguate Above the Confluence	0.77	0.27	1.23	0.023	0.010	0.025
Rio Moquino Above the Confluence	0.48	0.53	0.33	0.0095	0.0071	0.021
Rio Paguate Ford Crossing	1.14	0.21	1.41	0.019	0.018	0.064
Paguate Reservoir	1.17	0.31	0.87	0.052	0.021	0.037
Jackpile Well #4	0.51	<0.20	0.46	0.003	0.004	0.001
Jackpile New Shop	2.29	1.48	1.61	0.005	0.005	0.004
Jackpile Old Shop	3.42	*	*	0.32	*	*
Mouth of Oak Canyon Wash	**	**	**	**	**	**

* No sample collected because power was discontinued.
**No sample because the Mouth of Oak Canyon Wash was dry.

NACONDA MINERALS COMPANY
NEW MEXICO OPERATIONS

FOR THE MONTH OF: April 1983

$SO_4^{=}$ ppm	Na^{+} ppm	K^{+} ppm	Ca^{++} ppm	Mg^{++} ppm	NO_3^{-} ppm	F^{-} ppm	SiO_2 ppm	Mn^{++} ppm
280	48.1	6.1	122	49.5	2.6	0.41	33.6	0.012
504	112	6.8	129	66	6.6	0.42	20.3	0.007
329	54	6.6	119	54	2.0	0.40	32.3	0.023
575	127	7.0	142	81	5.0	0.45	23.1	0.010
214	44	3.9	60	32.1	5.1	0.27	23.5	0.012
461	121	8.9	109	59	4.4	0.48	18.4	0.020
165	229	1.0	2.5	0.4	5.2	1.2	10.5	0.013
525	461	2.9	12.3	1.6	5.1	1.3	15.0	0.021
2428	540	10.4	328	223	72	0.65	14.8	0.009

Hg ppm	Se ppm	Cu ppm	Fe ppm	Zn ppm	Mo ppm	Ni ppm	V ppm
.0005	<0.005	0.016	0.008	0.011	<0.01	<0.005	<0.05
.0005	<0.005	0.011	0.006	0.003	<0.01	<0.005	<0.05
.0005	<0.005	0.008	0.005	0.002	<0.01	<0.005	<0.05
.0005	<0.005	0.008	0.005	0.002	<0.01	<0.005	<0.05
.0005	<0.005	0.013	0.029	0.023	<0.01	0.009	<0.05
.0005	<0.005	0.014	0.18	0.012	<0.01	0.013	<0.05
.0005	<0.005	0.007	0.067	0.027	<0.01	<0.005	<0.05
.0005	<0.005	0.010	0.065	0.004	<0.01	<0.005	<0.05
.0005	<0.005	0.003	0.005	0.52	<0.01	0.011	<0.05

ALBUQUERQUE DISTRICT MINING
RECEIVED
JUL 29 1983
MINERALS MANAGEMENT SERVICE
ALBUQUERQUE, NEW MEXICO

ONDA MINERALS COMPANY
V MEXICO OPERATIONS

FOR THE MONTH OF: May, 1983

	Na^+ ppm	K^+ ppm	Ca^{++} ppm	Mg^{++} ppm	NO_3^- ppm	F^- ppm	SiO_2 ppm	Mn^{++} ppm			
	31.3	4.6	76	27.8	0.36	0.35	42.6	0.075			
	82	4.9	104	47.4	0.60	0.41	28.4	0.047			
	32.5	4.9	75	31	0.26	0.37	39.3	0.026			
	130	6.4	146	74	0.70	0.50	23.8	0.038			
	77	4.9	102	48.6	0.33	0.41	30.2	0.035			
	57	5.0	74	32.5	0.33	0.40	21.4	0.036			
	232	0.9	2.6	0.3	0.45	0.98	12.2	0.008			
	473	2.5	11.5	1.7	0.73	1.00	13.5	0.030			
	Se ppm	Cu ppm	Fe ppm	Zn ppm	Mo ppm	Ni ppm	V ppm				
5	<0.005	0.004	0.021	0.006	<0.01	<0.005	<0.05				
5	<0.005	0.006	0.025	0.002	<0.01	<0.005	<0.05				
5	<0.005	0.009	0.036	0.003	<0.01	<0.005	<0.05				
5	<0.005	0.006	0.022	0.001	<0.01	<0.005	<0.05				
5	<0.005	0.005	0.011	0.004	<0.01	<0.005	<0.05				
5	<0.005	0.009	0.024	0.006	<0.01	<0.005	<0.05				
5	<0.005	0.005	0.051	0.007	<0.01	<0.005	<0.05				
5	<0.005	0.033	0.008	0.008	<0.001	<0.005	<0.05				

350002322

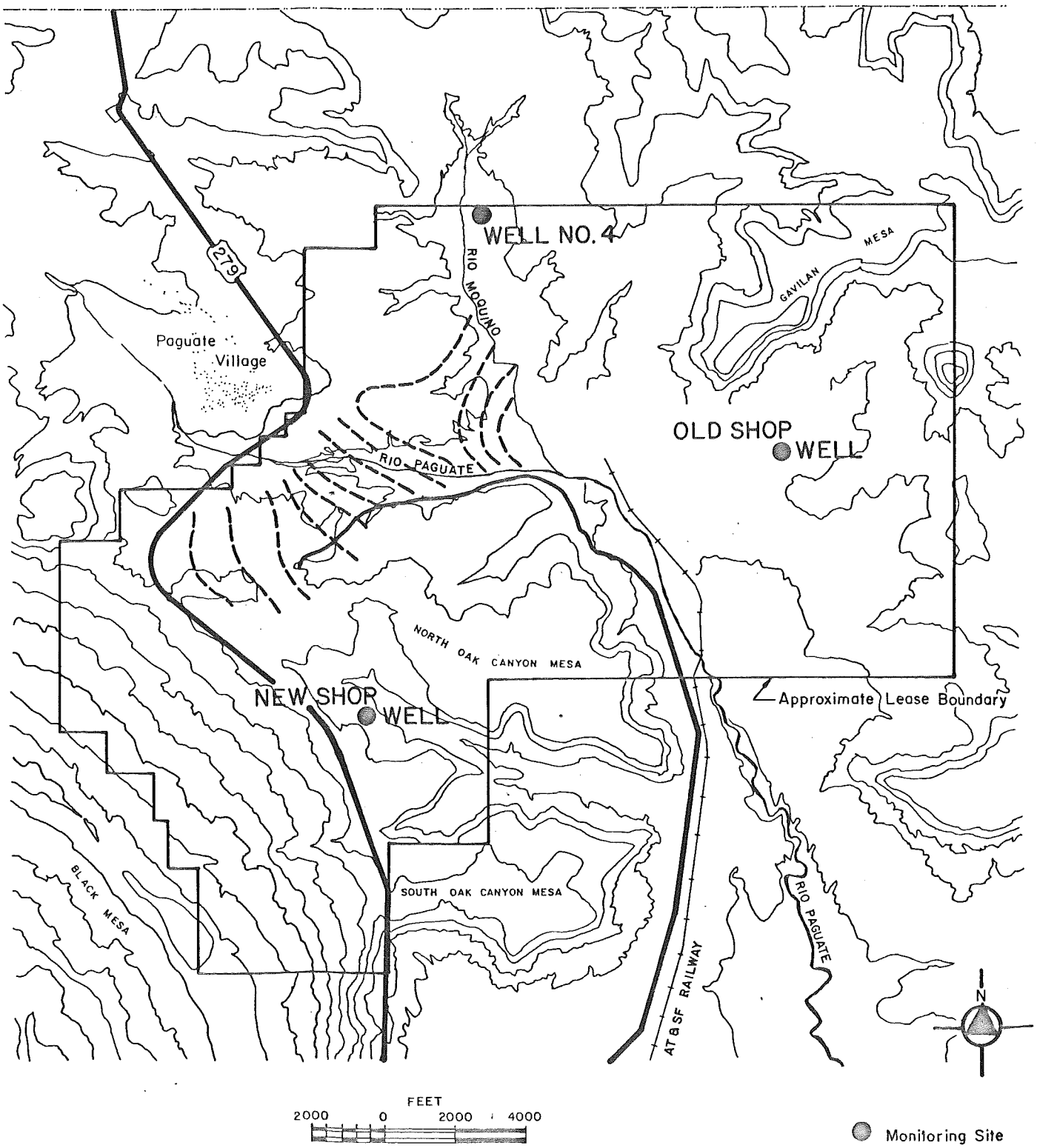
ONDA MINERALS COMPANY
MEXICO OPERATIONS

FOR THE MONTH OF: June, 1983

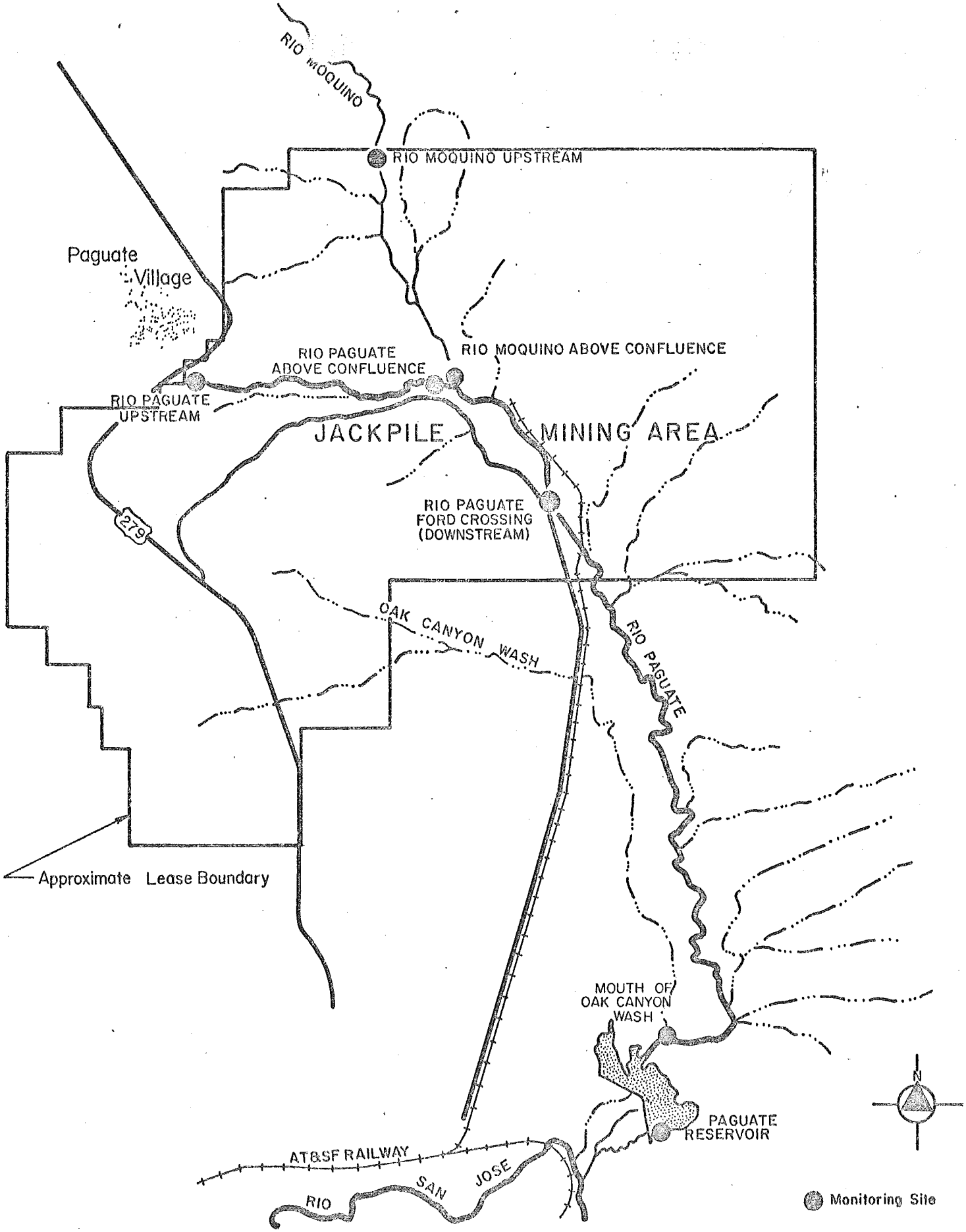
	Na^+ ppm	K^+ ppm	Ca^{++} ppm	Mg^{++} ppm	NO_3^- ppm	F^- ppm	SiO_2 ppm	Mn^{++} ppm			
	43.9	5.3	115	50	1.1	0.40	34.7	0.047			
	153	7.0	152	105	1.3	0.53	12.9	0.005			
	55	5.9	98	59	1.6	0.44	30.2	0.028			
	198	8.5	165	139	1.6	0.67	11.6	0.022			
	159	7.0	142	121	1.4	0.59	19.2	0.012			
	117	7.1	97	76	1.1	0.45	7.3	0.16			
	215	0.9	4.4	0.6	2.2	0.93	7.8	0.021			
	450	2.4	8.5	1.6	2.2	1.10	8.8	0.018			
	Se ppm	Cu ppm	Fe ppm	Zn ppm	Mo ppm	Ni ppm	V ppm				
5	<0.005	0.011	0.013	0.009	<0.01	<0.005	<0.05				
5	<0.005	0.006	0.012	0.003	<0.01	<0.005	<0.05				
5	<0.005	0.009	0.022	0.007	<0.01	<0.005	<0.05				
5	<0.005	0.010	0.013	0.007	<0.01	<0.005	<0.05				
5	<0.005	0.005	0.020	0.003	<0.01	<0.005	<0.05				
5	<0.005	0.007	0.061	0.006	<0.01	<0.005	<0.05				
5	<0.005	0.010	0.022	0.073	<0.01	<0.005	<0.05				
5	<0.005	0.004	0.014	0.002	<0.01	<0.005	<0.05				

350002323

LOCATION OF GROUND WATER MONITORING STATIONS



350002324



LOCATION OF
SURFACE WATER MONITORING STATIONS

350002325

JACKPILE - AIR SAMPLING SURVEY

SECOND QUARTER, 1983

LOCATION	DATE	TOTAL PARTICULATE µgm/M^3	U-Nat. µCi/mlx10-15	Ra-226 µCi/mlx10-15	Th-230 µCi/mlx10-15	Pb-210 µCi/mlx10-15
1. Dump F	4/83	8.54	0.71	0.12	1.41	13.33
	5/83	21.33	2.83	0.54	1.02	14.37
	6/83	21.44	0.99	0.55	0.27	*
2. Mine Vent	4/83	9.61	0.48	0.14	1.39	19.22
	5/83	19.22	0.66	0.51	0.91	22.51
	6/83	20.19	1.59	0.51	0.86	*
3. West Gate	4/83	14.10	0.39	0.13	1.05	19.36
	5/83	17.58	0.72	0.34	1.00	14.99
	6/83	23.05	1.13	0.31	1.73	*
4. Well #4	4/83	5.92	0.67	0.15	0.97	11.84
	5/83	18.36	0.69	0.49	1.17	13.40
	6/83	22.48	1.35	0.49	0.54	*

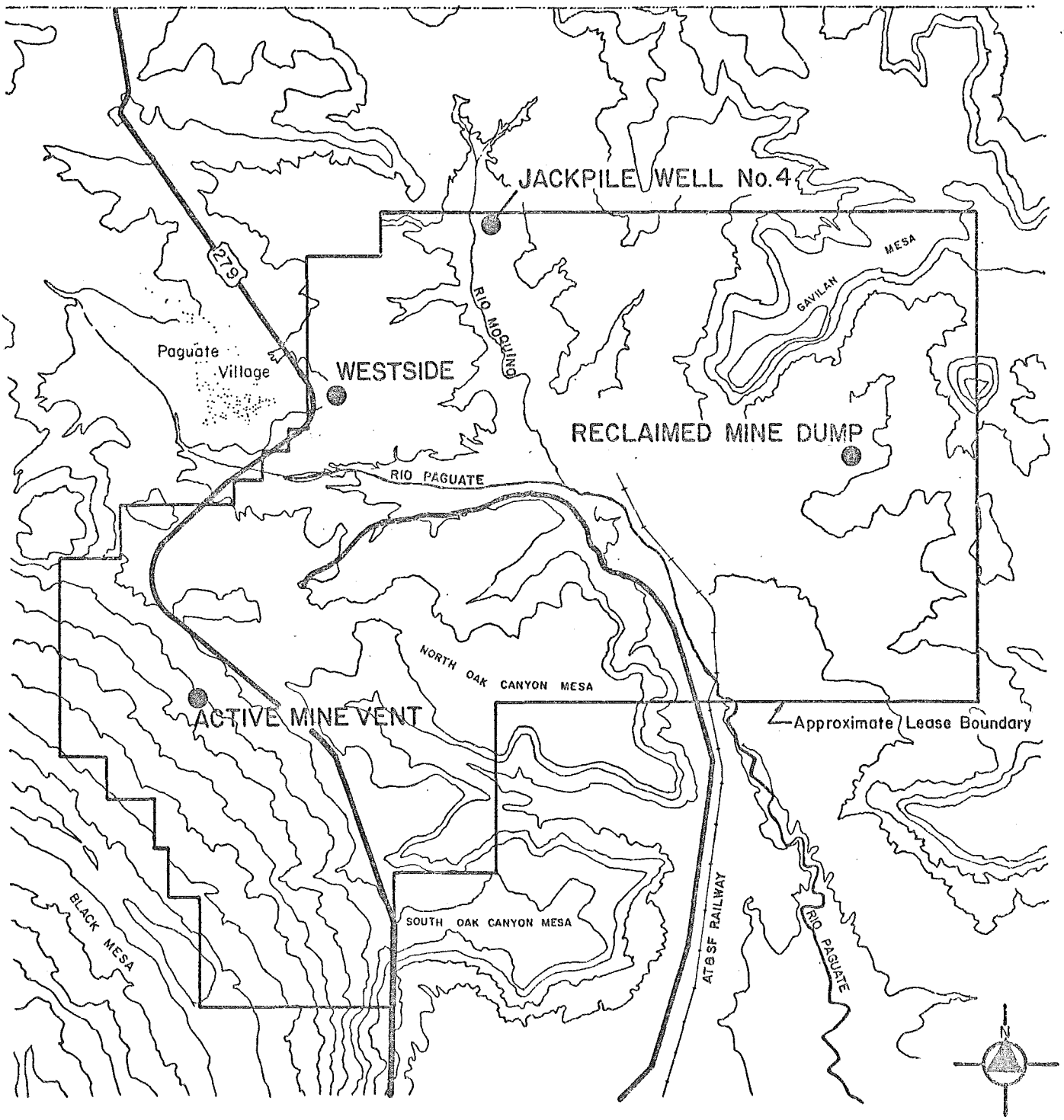
* - Indicates that Pb-210 analysis are not complete. Results will be forwarded upon completion.

JACKPILE-AMBIENT RADON SURVEY

SECOND QUARTER, 1983

LOCATION	DATE	Rn-222 pCi/L
1. Dump F	4/83	2.51
	5/83	2.91
	6/83	2.90
2. Mine Vent	4/83	1.99
	5/83	2.26
	6/83	1.95
3. Well #4	4/83	1.16
	5/83	1.41
	6/83	1.54
4. Westgate	4/83	1.05
	5/83	0.71
	6/83	1.44

LOCATION OF AIR QUALITY MONITORING STATIONS



FEET
2000 0 2000 4000

Monitoring Site

350002328

ANACONDA Minerals Co · any
New Mexico Operations
P.O. Box 638
Grants, New Mexico 87020
Telephone 505 876 2211

April 27, 1983

Mr. Dale C. Jones
District Mining Supervisor
Bureau of Land Management
500 Gold Avenue, S.W.
Federal Building, Room 116
Albuquerque, N.M. 87102

Dear Mr. Jones:

The following information is being submitted in accordance with the Jackpile-Paguate Minesite Sampling Program for the First Quarter of 1983.

1. Radiological Analysis of Ground and Surface Water.

2. Chemical Analysis of Ground and Surface Water.

3. Maps showing Ground and Surface Water Sampling Locations.

4. Results of the Air Monitoring Program.

5. Results of the Ambient Radon Monitoring Study.

6. Map showing location of Air and Radon Monitoring Stations.

Sincerely,

Meade A. Stirland, Manager
Environment, Health & Safety

mls

Enclosures

cc: W. C. Norem
D. L. Roberts
C. E. Sanchez
L. C. Leyba
File

ALBUQUERQUE DISTRICT MINING
RECEIVED
MAY 10 1983
MINERALS MANAGEMENT SERVICE
ALBUQUERQUE, NEW MEXICO

ANACONDA Minerals Company is a Division of AtlanticRichfieldCompany

AIR QUALITY MONITORING PROGRAM

One 168-hour sample is taken each month at each of the four locations specified by Marc Nelson. They are collected about three meters above the ground on GF/A Glass Microfibre filter paper, using an RAC Heavy-duty Sampler.

AMBIENT RADON STUDY

Radon-222 is monitored continuously at each of the air sampling locations specified by Marc Nelson. The samples are monitored by the use of the Model RGM-2 Radon Gas Monitor. Normal data output is printed hourly and a 24-hour average is printed at the end of a 24-hour period.

ALBUQUERQUE DISTRICT MINING
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MAY 1 0 1983
MINERALS MANAGEMENT SERVICE
ALBUQUERQUE, NEW MEXICO

JACKPILE - WATER RADIOLOGICAL ANALYSIS

(FIRST QUARTER, 1983)

DESCRIPTIVE LOCATION	Radium-226 pCi/L			Uranium-Natural ppm		
	Jan.	Feb.	Mar.	Jan.	Feb.	Mar.
Rio Paguate Upstream	0.60	<0.20	<0.20	0.001	0.005	0.001
Rio Moquino Upstream	0.32	<0.20	<0.20	0.005	0.005	0.004
Rio Paguate Above the Confluence	0.86	0.31	0.54	0.036	0.036	0.020
Rio Moquino Above the Confluence	0.23	0.27	0.62	0.015	0.014	0.013
Rio Paguate Ford Crossing	0.72	0.87	1.57	0.065	0.049	0.040
Paguate Reservoir	0.14	0.75	0.09	1.330	0.370	0.640
Jackpile Well #4	<0.20	0.24	0.24	0.002	0.001	0.0004
Jackpile New Shop	1.50	1.99	0.46	0.002	0.001	0.0004
Jackpile Old Shop	2.56	3.12	2.68	0.260	0.350	0.310
Mouth of Oak Canyon Wash	*	*	*	*	*	*

* No sample because the Mouth of Oak Canyon Wash was dry.

ALBUQUERQUE DISTRICT MINING
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MAY 1 0 1983
MINERALS MANAGEMENT SERVICE
ALBUQUERQUE, NEW MEXICO

ALBUQUERQUE DISTRICT MINING
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MAY 1 0 1983
MINERALS MANAGEMENT SERVICE
ALBUQUERQUE, NEW MEXICO

ANACONDA MINERALS COMPANY
NEW MEXICO OPERATION

FOR THE MONTH OF: Jan. 1983

DESCRIPTION	DATE	pH	TDS ppm	Cond. umhos	HCO_3^- ppm	Cl^- ppm	$SO_4^=$ ppm	Na^+ ppm	K^+ ppm	Ca^{++} ppm	Mg^{++} ppm	NO_3^- ppm	F^- ppm	SiO_2 ppm	Mn^{++} ppm
Rio Paguate Upstream	1/3/83	7.70	771	500	329	10.7	232	45	4.9	89.0	49.0	11	0.50	33.0	0.065
Rio Moquino Upstream	1/3/83	8.02	1424	1100	329	11.4	705	146	6.6	115.0	95.0	16	0.50	24.8	0.008
Rio Paguate Above Conflu.'	1/3/83	8.01	913	700	342	10.9	328	57	5.5	98.0	61.0	10	0.48	28.2	0.037
Rio Moquino Above Conflu.'	1/3/83	8.10	1564	1050	312	13.0	821	162	6.7	128.0	108.0	12	0.61	22.3	0.022
Rio Paguate Ford Crossing	1/3/83	7.80	1563	950	342	14.4	787	150	6.9	140.0	110.0	12	0.60	24.8	0.031
Paguate Reserv.	1/3/83	7.44	1996	1350	345	24.7	1090	210	14.0	175.0	125.0	11	0.58	17.1	0.13
Jackpile #4	1/3/83	8.43	1024	1100	359	18.5	318	310	1.4	3.8	0.6	11	1.00	11.8	0.01
Jackpile New Shop	1/3/83	8.52	1566	1720	376	29.2	660	473	2.9	8.6	1.6	13	1.10	10.5	0.015
Jackpile Old Shop	1/3/83	7.73	3978	3150	254	107.0	2440	550	10.1	309.0	221.0	83	0.88	10.3	0.012

		As ppm	Ba ppm	Cd ppm	Cr ppm	Pb ppm	Hg ppm	Se ppm	Cu ppm	Fe ppm	Zn ppm	Mo ppm	Ni ppm	V ppm
Rio Paguate Upstream	1/3/83	<0.005	<0.05	<0.001	<0.005	<0.01	<0.0005	<0.005	0.015	0.029	0.013	<0.01	0.006	<0.05
Rio Moquino Upstream	1/3/83	<0.005	<0.05	0.001	<0.005	<0.01	<0.0005	<0.005	0.009	0.010	0.002	<0.01	<0.005	<0.05
Rio Paguate Above Conflu.'	1/3/83	<0.005	<0.05	<0.001	<0.005	<0.01	<0.0005	<0.005	0.014	0.010	0.006	<0.01	0.006	<0.05
Rio Moquino Above Conflu.'	1/3/83	<0.005	<0.05	<0.001	<0.005	<0.01	<0.0005	<0.005	0.009	0.009	0.001	<0.01	<0.005	<0.05
Rio Paguate Ford Crossing	1/3/83	<0.005	<0.05	<0.001	<0.005	<0.01	<0.0005	<0.005	0.011	0.010	0.003	<0.01	<0.005	<0.05
Paguate Reserv.	1/3/83	<0.005	<0.05	<0.001	<0.005	<0.01	<0.0005	<0.005	0.012	0.030	0.006	<0.01	0.008	<0.05
Jackpile #4	1/3/83	<0.005	<0.05	<0.001	<0.005	<0.01	<0.0005	<0.005	0.009	0.070	0.004	<0.01	0.006	<0.05
Jackpile New Shop	1/3/83	<0.005	<0.05	<0.001	<0.005	<0.01	<0.0005	<0.005	0.001	0.030	0.001	<0.01	0.008	<0.05
Jackpile Old Shop	1/3/83	<0.005	<0.05	<0.001	<0.005	<0.01	<0.0005	<0.005	0.010	0.013	2.5	<0.01	0.006	<0.05

350002332

ALBUQUERQUE DISTRICT MINING
RECEIVED
MAY 1 0 1983
MINERALS MANAGEMENT SERVICE
ALBUQUERQUE, NEW MEXICO

ANACONDA MINERALS COMPANY
NEW MEXICO OPERATION

FOR THE MONTH OF: February 1983

DESCRIPTION	DATE	pH	TDS ppm	Cond. umhos	HCO_3^- ppm	Cl^- ppm	$SO_4^=$ ppm	Na^+ ppm	K^+ ppm	Ca^{++} ppm	Mg^{++} ppm	NO_3^- ppm	F^- ppm	SiO_2 ppm	Mn^{++} ppm
Rio Paguate Upstream	2/1/83	8.19	897	630	334	13.1	318	54	7.5	108.0	59.0	3.0	0.49	26.5	0.074
Rio Moquino Upstream	2/1/83	8.19	1236	900	295	11.5	590	123	7.5	132.0	73.0	3.3	0.58	18.8	0.019
Rio Paguate Above Conflu.'	2/1/83	8.03	906	700	310	13.0	346	60	7.4	103.0	63.0	2.5	0.48	24.0	0.030
Rio Moquino Above Conflu.'	2/1/83	8.23	1351	1200	305	12.0	668	144	8.0	122.0	88.0	3.3	0.60	20.1	0.023
Rio Paguate Ford Crossing	2/1/83	8.06	1404	1100	307	13.0	717	135	8.2	130.0	91.0	1.7	0.48	19.9	0.020
Paguate Reserv.	2/1/83	7.71	1262	980	244	15.5	656	130	9.6	123.0	81.0	2.2	0.58	15.8	0.031
Jackpile #4	3/1/83	8.39	833	890	388	11.3	173	251	1.4	2.7	0.7	13.0	1.20	11.6	0.011
Jackpile New Shop	2/1/83	8.18	1575	1600	390	27.2	662	471	3.7	11.7	1.5	6.7	1.20	12.4	0.023
Jackpile Old Shop	3/1/83	7.53	4021	3300	251	107.0	2470	560	12.5	316.0	216	80.0	0.86	12.0	0.013

		As ppm	Ba ppm	Cd ppm	Cr ppm	Pb ppm	Hg ppm	Se ppm	Cu ppm	Fe ppm	Zn ppm	Mo ppm	Ni ppm	V ppm
Rio Paguate Upstream	2/1/83	<0.005	0.06	<0.001	<0.005	<0.01	<0.0005	<0.005	0.014	0.029	0.013	<0.01	0.006	<0.05
Rio Moquino Upstream	2/1/83	<0.005	<0.05	<0.001	<0.005	<0.01	<0.0005	<0.005	0.014	0.012	0.01	<0.01	<0.005	<0.05
Rio Paguate Above Conflu.'	2/1/83	<0.005	<0.05	<0.001	<0.005	<0.01	<0.0005	<0.005	0.006	0.013	0.014	<0.01	<0.005	<0.05
Rio Moquino Above Conflu.'	2/1/83	<0.005	<0.05	<0.001	<0.005	<0.01	<0.0005	<0.005	0.019	0.049	0.045	<0.01	<0.005	<0.05
Rio Paguate Ford Crossing	2/1/83	<0.005	<0.05	<0.001	<0.005	<0.01	<0.0005	<0.005	0.009	0.009	0.004	<0.01	<0.005	<0.05
Paguate Reserv.	2/1/83	<0.005	<0.05	<0.001	<0.005	<0.01	<0.0005	<0.005	0.011	0.017	0.007	<0.01	<0.005	<0.05
Jackpile #4	2/1/83	<0.005	<0.05	<0.001	<0.005	<0.01	<0.0005	<0.005	0.011	0.062	0.011	<0.01	<0.005	<0.05
Jackpile New Shop	2/1/83	<0.005	<0.05	<0.001	<0.005	<0.01	<0.0005	<0.005	0.009	0.039	0.003	<0.01	<0.005	<0.05
Jackpile Old Shop	2/1/83	<0.005	<0.05	<0.001	<0.005	<0.01	<0.0005	0.014	0.011	0.012	0.50	<0.01	0.007	<0.05

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ALBUQUERQUE DISTRICT MINING
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MAY 1 0 1983
MINERALS MANAGEMENT SERVICE
ALBUQUERQUE, NEW MEXICO

ANACONDA MINERALS COMPANY
NEW MEXICO OPERATION

FOR THE MONTH OF: March 1983

DESCRIPTION	DATE	pH	TDS ppm	Cond. umhos	HCO_3^- ppm	Cl^- ppm	$SO_4^=$ ppm	Na^+ ppm	K^+ ppm	Ca^{++} ppm	Mg^{++} ppm	NO_3^- ppm	F^- ppm	SiO_2 ppm	Mn^{++} ppm
Rio Paguate Upstream	3/1/83	8.24	6 92	530	295	10.0	212	39.6	5.8	92.0	35.8	1.50	0.50	33.2	0.070
Rio Moquino Upstream	3/1/83	8.25	1204	1100	268	10.9	595	123.0	6.7	122.0	76.0	1.50	0.49	22.9	0.011
Rio Paguate Above Conflu.'	3/1/83	8.42	739	650	285	10.5	255	45.5	6.0	97.0	38.4	0.63	0.28	30.8	0.018
Rio Moquino Above Conflu.'	3/1/83	8.35	1388	1300	281	12.4	720	145.0	7.0	130.0	91.0	0.70	0.31	19.9	0.013
Rio Paguate Ford Crossing	3/1/83	8.37	1240	1200	293	12.5	602	115.0	7.1	121.0	81.0	8.20	0.49	23.5	0.010
Paguate Reserv.	3/1/83	7.60	1295	980	240	16.4	679	138.0	9.5	130.0	80.0	1.20	0.51	13.1	0.010
Jackpile #4	3/1/83	8.75	1051	1050	366	11.4	349	315.0	1.3	4.5	0.9	1.30	1.50	8.8	0.012
Jackpile New Shop	3/1/83	8.91	1572	1600	381	28.4	682	466.0	2.7	7.9	1.4	1.00	1.40	9.4	0.015
Jackpile Old Shop	3/1/83	7.74	4080	3540	254	111.0	2515	580.0	11.0	318	228.0	62.00	0.76	11.8	0.009

		As ppm	Ba ppm	Cd ppm	Cr ppm	Pb ppm	Hg ppm	Se ppm	Cu ppm	Fe ppm	Zn ppm	Mo ppm	Ni ppm	V ppm
Rio Paguate Upstream	3/1/83	<0.005	<0.05	<0.001	<0.005	<0.01	<0.0005	<0.005	0.016	0.008	0.013	<0.01	<0.005	<0.05
Rio Moquino Upstream	3/1/83	<0.005	<0.05	<0.001	<0.005	<0.01	<0.0005	<0.005	0.013	0.008	0.003	<0.01	0.007	<0.05
Rio Paguate Above Conflu.'	3/1/83	<0.005	<0.05	<0.001	<0.005	<0.01	<0.0005	<0.005	0.014	0.005	0.004	<0.01	<0.005	<0.05
Rio Moquino Above Conflu.'	3/1/83	<0.005	<0.05	<0.001	<0.005	<0.01	<0.0005	<0.005	0.011	0.017	0.002	<0.01	<0.005	<0.05
Rio Paguate Ford Crossing	3/1/83	<0.005	<0.05	<0.001	<0.005	<0.01	<0.0005	<0.005	0.015	0.006	0.003	<0.01	<0.005	<0.05
Paguate Reserv.	3/1/83	<0.005	<0.05	<0.001	<0.005	<0.01	<0.0005	<0.005	0.013	0.013	0.009	<0.01	<0.005	<0.05
Jackpile #4	3/1/83	<0.005	<0.05	<0.001	<0.005	<0.01	<0.0005	<0.005	0.013	0.010	0.11	<0.01	<0.005	<0.05
Jackpile New Shop	3/1/83	<0.005	<0.05	<0.001	<0.005	<0.01	<0.0005	<0.005	0.014	0.013	0.003	<0.01	<0.005	<0.05
Jackpile Old Shop	3/1/83	<0.005	<0.05	<0.001	<0.005	<0.01	<0.0005	<0.005	0.004	0.010	0.51	<0.01	0.006	<0.05

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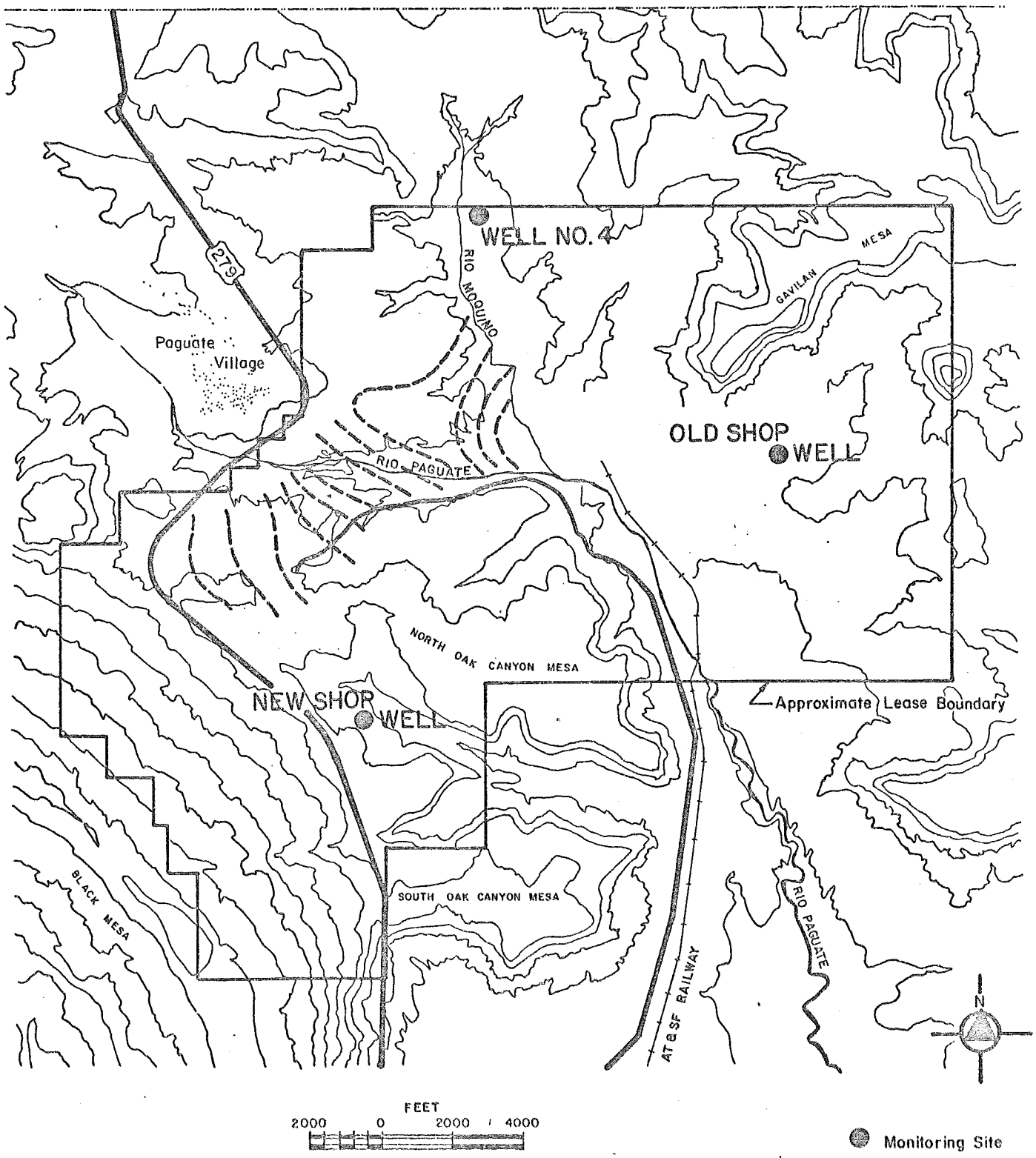
MINERALS MANAGEMENT SERVICE
ALBUQUERQUE, NEW MEXICO

LOCATION OF GROUND WATER MONITORING STATIONS



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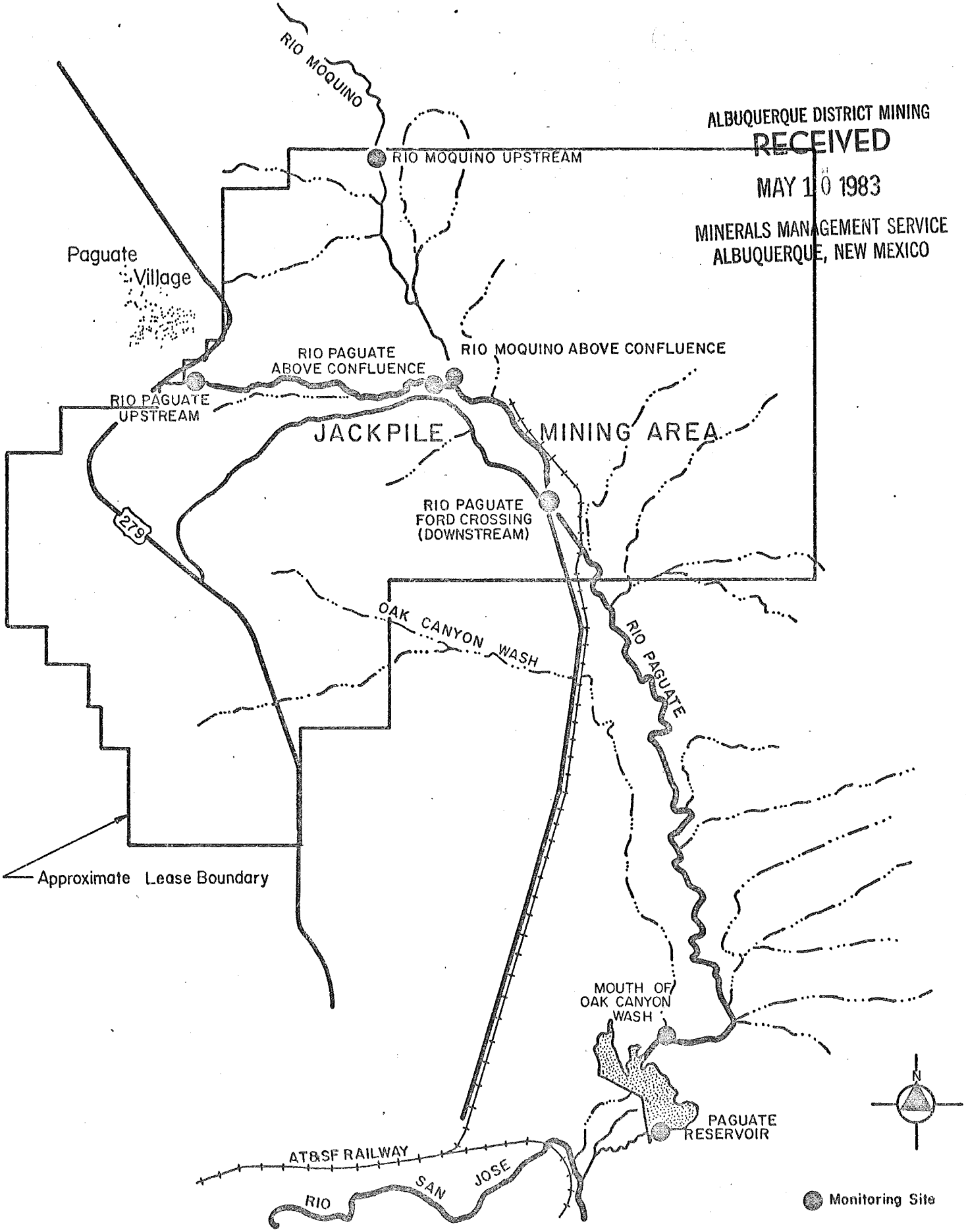

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ALBUQUERQUE, NEW MEXICO

LOCATION OF
SURFACE WATER MONITORING STATIONS

350002336

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MINERALS MANAGEMENT SERVICE
ALBUQUERQUE, NEW MEXICO

JACKPILE - AIR SAMPLING SURVEY

FIRST QUARTER, 1983

LOCATION	DATE	TOTAL PARTICULATE µgm/M^3	U-Nat. µCi/mlx10-15	Ra-226 µCi/mlx10-15	Th-230 µCi/mlx10-15	Pb-210 µCi/mlx10-15
1. Dump F	1/83	6.70	0.58	0.56	0.45	36.61
	2/83	4.18	0.62	0.20	1.54	18.94
	3/83	9.10	0.04	0.17	1.44	11.42
2. Mine Vent	1/83	7.81	0.95	0.31	0.43	49.76
	2/83	4.72	0.33	0.20	1.09	23.61
	3/83	10.20	0.06	0.09	1.66	20.39
3. West Gate	1/83	11.67	1.11	0.19	0.37	28.24
	2/83	8.64	0.52	0.20	1.83	19.90
	3/83	12.92	0.06	0.28	1.74	13.48
4. Well #4	1/83	7.40	0.36	0.95	0.15	31.63
	2/83	4.39	0.72	0.13	2.01	16.51
	3/83	6.91	0.04	0.08	1.26	7.89

ALBUQUERQUE DISTRICT MINING
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MAY 1 0 1983
MINERALS MANAGEMENT SERVICE
ALBUQUERQUE, NEW MEXICO

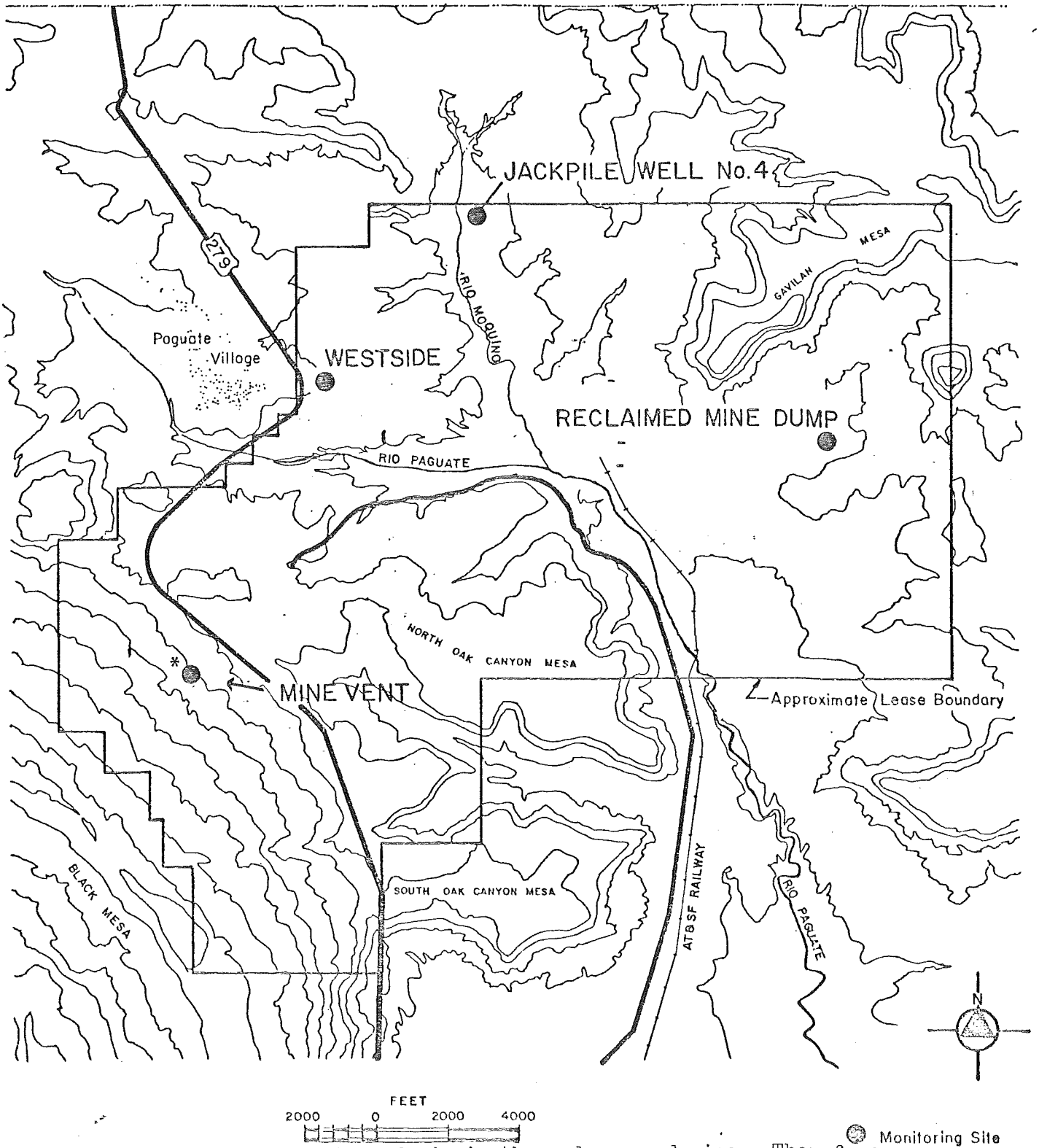
JACKPILE-AMBIENT RADON SURVEY

FIRST QUARTER, 1983

LOCATION	DATE	Rn-222 pCi/L
1. Dump F	1/83	3.26
	2/83	2.57
	3/83	2.60
2. Mine Vent	1/83	2.87
	2/83	2.44
	3/83	2.19
3. Well #4	1/83	2.06
	2/83	1.03
	3/83	1.37
4. Westgate	1/83	1.21
	2/83	1.05
	3/83	0.85

ALBUQUERQUE DISTRICT MINING
RECEIVED
MAY 10 1983
MINERALS MANAGEMENT SERVICE
ALBUQUERQUE, NEW MEXICO

LOCATION OF AIR QUALITY MONITORING STATIONS



*There is no longer any circulation of air in the underground mine. Therefore the Mine Vent is not considered active.

350002339

ANACONDA Minerals Co. any
New Mexico Operations
P.O. Box 638
Grants, New Mexico 87020
Telephone 505 876 2211

February 14, 1983

ALBUQUERQUE DISTRICT MINING
RECEIVED
FEB 22 1983
MINERALS MANAGEMENT SERVICE
ALBUQUERQUE, NEW MEXICO

Mr. Dale C. Jones
District Mining Supervisor
Bureau of Land Management
500 Gold Avenue, S.W.
Federal Building, Room 116
Albuquerque, N.M. 87102

Dear Mr. Jones:

The following information is being submitted in accordance with the Jackpile-Paguate Minesite Sampling Program for the Fourth Quarter of 1982.

1. Radiological Analysis of Ground and Surface Water.

2. Chemical Analysis of Ground and Surface Water.

3. Maps showing Ground and Surface Water Sampling Locations.

4. Results of the Air Monitoring Program.

5. Results of the Ambient Radon Monitoring Study.

6. Map showing location of Air and Radon Monitoring Stations.

Sincerely,

Meade A. Stirland, Manager
Environment, Health & Safety

mls

Enclosures

cc: W. C. Norem
D. L. Roberts
C. E. Sanchez
File

350002340

AIR QUALITY MONITORING PROGRAM

One 168-hour sample is taken each month at each of the four locations specified by Marc Nelson. They are collected about three meters above the ground on GF/A Glass Microfibre filter paper, using an RAC Heavy-duty Sampler.

AMBIENT RADON STUDY

Radon-222 is monitored continuously at each of the air sampling locations specified by Marc Nelson. The samples are monitored by the use of the Model RGM-2 Radon Gas Monitor. Normal data output is printed hourly and a 24-hour average is printed at the end of a 24-hour period.

JACKPILE - WATER RADIOLOGICAL ANALYSIS

(FOURTH QUARTER, 1982)

DESCRIPTIVE LOCATION	Radium-226 pCi/L			Uranium-Natural ppm		
	Oct.	Nov.	Dec.	Oct.	Nov.	Dec.
Rio Paguate Upstream	0.20	0.23	2.05	0.003	0.001	0.001
Rio Moquino Upstream	0.20	0.20	0.76	0.006	0.004	0.009
Rio Paguate Above the Confluence	1.02	1.11	1.94	0.253	0.097	0.062
Rio Moquino Above the Confluence	0.60	0.37	1.39	0.068	0.046	0.023
Rio Paguate Ford Crossing	1.38	0.88	0.56	0.188	0.161	0.097
Paguate Reservoir	1.28	0.23	0.39	0.065	0.102	0.159
Jackpile Well #4	0.34	0.22	0.45	0.001	0.003	0.003
Jackpile New Shop	0.74	1.54	1.08	0.003	0.001	0.001
Jackpile Old Shop	3.48	2.42	2.31	0.248	0.320	0.287
Mouth of Oak Canyon Wash	*	*	*	*	*	*

* No sample because the Mouth of Oak Canyon Wash was dry.

THE ANACONDA MINERALS COMPANY
New Mexico Operations

FOR THE MONTH OF: October 1982

DESCRIPTION	DATE	pH	TDS ppm	Cond umhos	HCO_3^- ppm	Cl^- ppm	$SO_4^=$ ppm	Na^+ ppm	K^+ ppm	Ca^{++} ppm	Mg^{++} ppm	NO_3^- ppm	F^- ppm	SiO_2 ppm	Mn^{++} ppm
Rio Paguate Upstream	10/1/82	7.77	811	890	295	11.5	301	46	7.5	98	51	0.23	0.50	38.7	0.053
Rio Moquino Upstream	10/1/82	8.08	1603	1500	246	14.1	927	160	10.0	138	107	0.30	0.60	23.8	0.005
Rio Paguate Above the Confluence	10/1/82	8.02	1538	1500	349	14.6	791	118	10.5	137	117	0.27	0.69	22.9	0.055
Rio Moquino Above the Confluence	10/1/82	8.05	1908	1790	244	16.7	1144	196	10.4	157	137	1.50	0.66	17.8	0.082
Rio Paguate Ford Crossing	10/1/82	8.06	2175	1800	244	20.0	1338	209	10.9	196	156	0.28	0.41	16.5	0.078
Paguate Reservoir	10/1/82	7.16	1063	1500	154	14.7	601	87	10.9	144	51	0.17	0.52	19.0	<0.005
Jackpile #4	10/1/82	8.45	781	900	373	12.5	159	231	1.2	2.3	0.3	0.44	1.10	10.9	0.006
Jackpile New Shop	10/1/82	8.46	1530	1700	356	29.0	682	438	3.7	17.5	1.8	0.30	1.20	9.6	0.022
Jackpile Old Shop	10/1/82	7.68	3904	3450	259	102	2422	530	12.1	257	252	68	0.65	14.6	0.012
		As ppm	Ba ppm	Cd ppm	Cr ppm	Pb ppm	Hg ppm	Se ppm	Cu ppm	Fe ppm	Zn ppm	Mo ppm	Ni ppm	V ppm	
Rio Paguate Upstream	10/1/82	<0.005	0.05	<0.001	<0.005	<0.01	<0.0005	<0.005	0.003	0.008	0.025	<0.01	<0.005	<0.05	
Rio Moquino Upstream	10/1/82	<0.005	<0.05	<0.001	<0.005	<0.01	<0.0005	<0.005	0.003	<0.005	0.007	<0.01	<0.005	<0.05	
Rio Paguate Above the Confluence	10/1/82	<0.005	0.05	<0.001	<0.005	<0.01	<0.0005	<0.005	0.016	0.006	0.009	0.01	0.005	<0.05	
Rio Moquino Above the Confluence	10/1/82	<0.005	<0.05	<0.001	<0.005	<0.01	<0.0005	<0.005	0.006	0.005	0.010	<0.01	0.010	<0.05	
Rio Paguate Ford Crossing	10/1/82	<0.005	<0.05	<0.001	<0.005	<0.01	<0.0005	<0.005	0.008	0.005	0.008	<0.01	0.007	<0.05	
Paguate Reservoir	10/1/82	<0.005	<0.05	<0.001	<0.005	<0.01	<0.0005	<0.005	0.008	0.008	0.009	<0.01	<0.005	<0.05	
Jackpile #4	10/1/82	<0.005	<0.05	<0.001	<0.005	<0.01	<0.0005	<0.005	0.008	0.056	0.023	<0.01	<0.005	<0.05	
Jackpile New Shop	10/1/82	<0.005	<0.05	<0.001	<0.005	<0.01	<0.0005	<0.005	0.006	0.028	0.010	<0.01	<0.005	<0.05	
Jackpile Old Shop	10/1/82	<0.005	<0.05	<0.001	<0.005	<0.01	<0.0005	0.038	0.015	<0.005	0.780	<0.01	0.006	<0.05	

350002343

THE ANACONDA MINERALS COMPANY.
New Mexico Operations

FOR THE MONTH OF: November 1982

DESCRIPTION	DATE	pH	TDS ppm	Cond umhos	HCO_3^- ppm	Cl^- ppm	$SO_4^=$ ppm	Na^+ ppm	K^+ ppm	Ca^{++} ppm	Mg^{++} ppm	NO_3^- ppm	F^- ppm	SiO_2 ppm	Mn^{++} ppm			
R 'aguate Upstream	11/2/82	8.37	807	850	300	10.4	300	50	7.3	82	56	0.68	0.40	29.5	0.059			
Rio Moquino Upstream	11/8/82	8.42	1427	1320	281	13.2	765	153	10.0	103	100	1.10	0.52	26.1	0.007			
Rio Paguate Above the Confluence	11/2/82	8.38	1078	1100	317	12.9	476	84	8.4	93	85	1.00	0.50	27.0	0.058			
Rio Moquino Above the Confluence	11/2/82	8.42	1789	1700	207	15.3	1096	192	10.4	131	135	1.10	0.64	15.4	0.033			
Rio Paguate Ford Crossing	11/2/82	8.30	1901	1700	285	16.9	1111	196	10.2	136	144	0.68	0.64	20.5	0.063			
Paguate Reservoir	11/2/82	7.39	1149	1100	139	17.1	681	109	12.9	133	56	0.61	0.58	20.5	0.035			
Jackpile #4	11/9/82	8.26	783	900	373	10.4	169	224	1.1	2.3	0.5	0.87	1.10	11.3	0.008			
Jackpile New Shop	11/2/82	8.86	1484	1720	348	27.0	654	438	3.6	8.8	1.5	1.30	1.20	10.3	0.014			
Jackpile Old Shop	11/2/82	7.79	3810	3850	264	107	2334	530	13.3	263	231	66	0.64	16.3	0.011			
		As ppm	Ba ppm	Cd ppm	Cr ppm	Pb ppm	Hg ppm	Se ppm	Cu ppm	Fe ppm	Zn ppm	Mo ppm	Ni ppm	V ppm				
Rio Paguate Upstream	11/2/82	<0.005	0.06	<0.001	<0.005	<0.01	<0.0005	<0.005	0.014	0.015	0.019	<0.01	<0.005	<0.05				
Rio Moquino Upstream	11/2/82	<0.005	<0.05	<0.001	<0.005	<0.01	<0.0005	<0.005	0.011	0.011	0.003	<0.01	<0.005	<0.05				
Rio Paguate Above the Confluence	11/2/82	<0.005	<0.05	<0.001	<0.005	<0.01	<0.0005	<0.005	0.011	0.015	0.004	<0.01	<0.005	<0.05				
Rio Moquino Above the Confluence	11/2/82	<0.005	<0.05	<0.001	<0.005	<0.01	<0.0005	<0.005	0.014	0.011	0.004	<0.01	<0.005	<0.05				
Rio Paguate Ford Crossing	11/2/82	<0.005	<0.05	<0.001	<0.005	<0.01	<0.0005	<0.005	0.007	0.007	0.002	<0.01	<0.005	<0.05				
ate Reservoir	11/2/82	<0.005	<0.05	<0.001	<0.005	<0.01	<0.0005	<0.005	0.013	0.030	0.004	<0.01	<0.005	<0.05				
pile #4	11/9/82	<0.005	<0.05	<0.001	<0.005	<0.01	<0.0005	<0.005	0.008	0.064	0.006	<0.01	<0.005	<0.05				
pile New Shop	11/2/82	<0.005	<0.05	<0.001	<0.005	<0.01	<0.0005	<0.005	0.009	0.020	0.001	<0.01	<0.005	<0.05				
Jackpile Old Shop	11/2/82	<0.005	<0.05	<0.001	<0.005	<0.01	<0.0005	0.021	0.016	0.012	0.610	<0.01	0.006	<0.005				

350002344

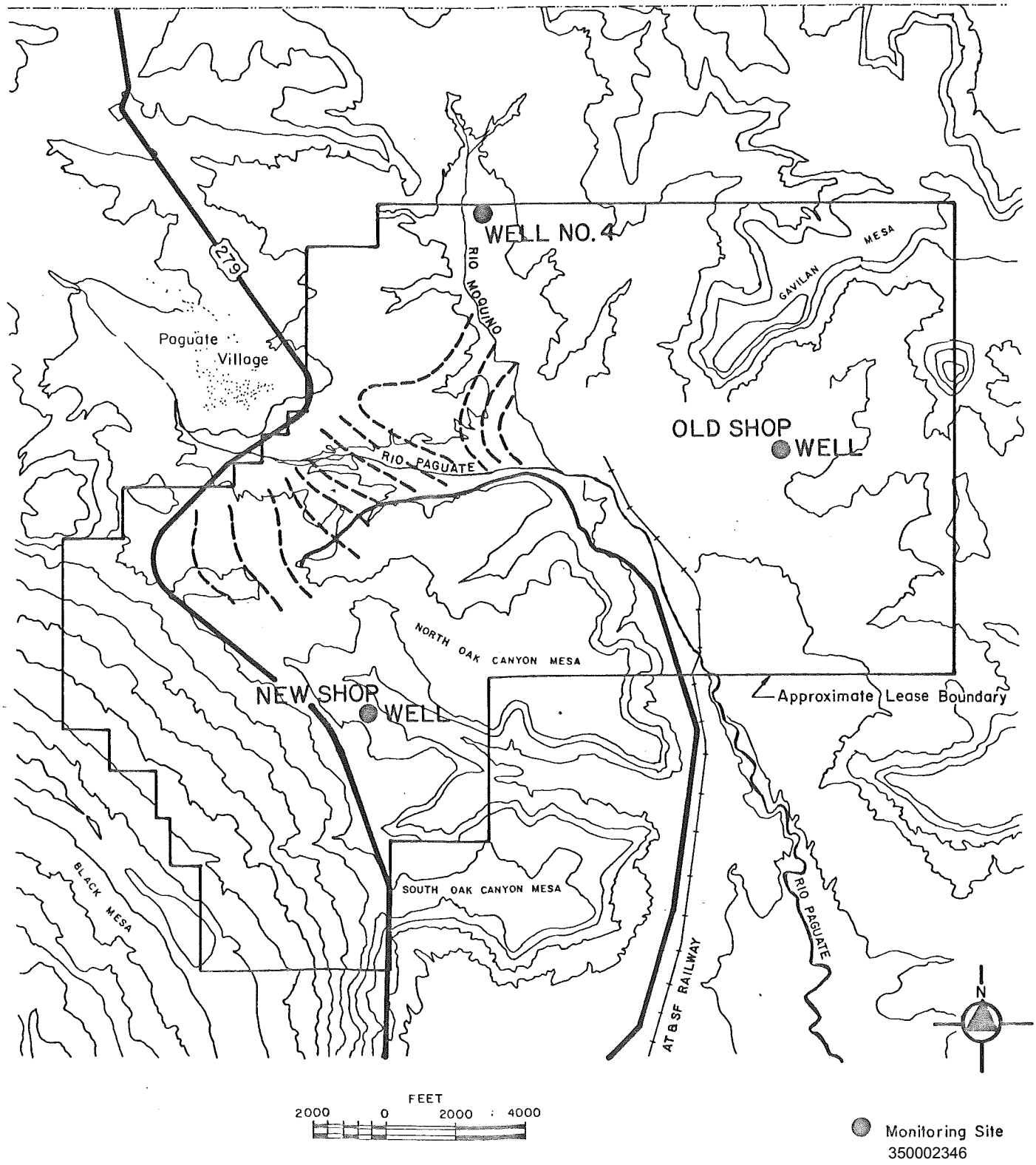
THE ANACONDA MINERALS COMPANY
New Mexico Operations

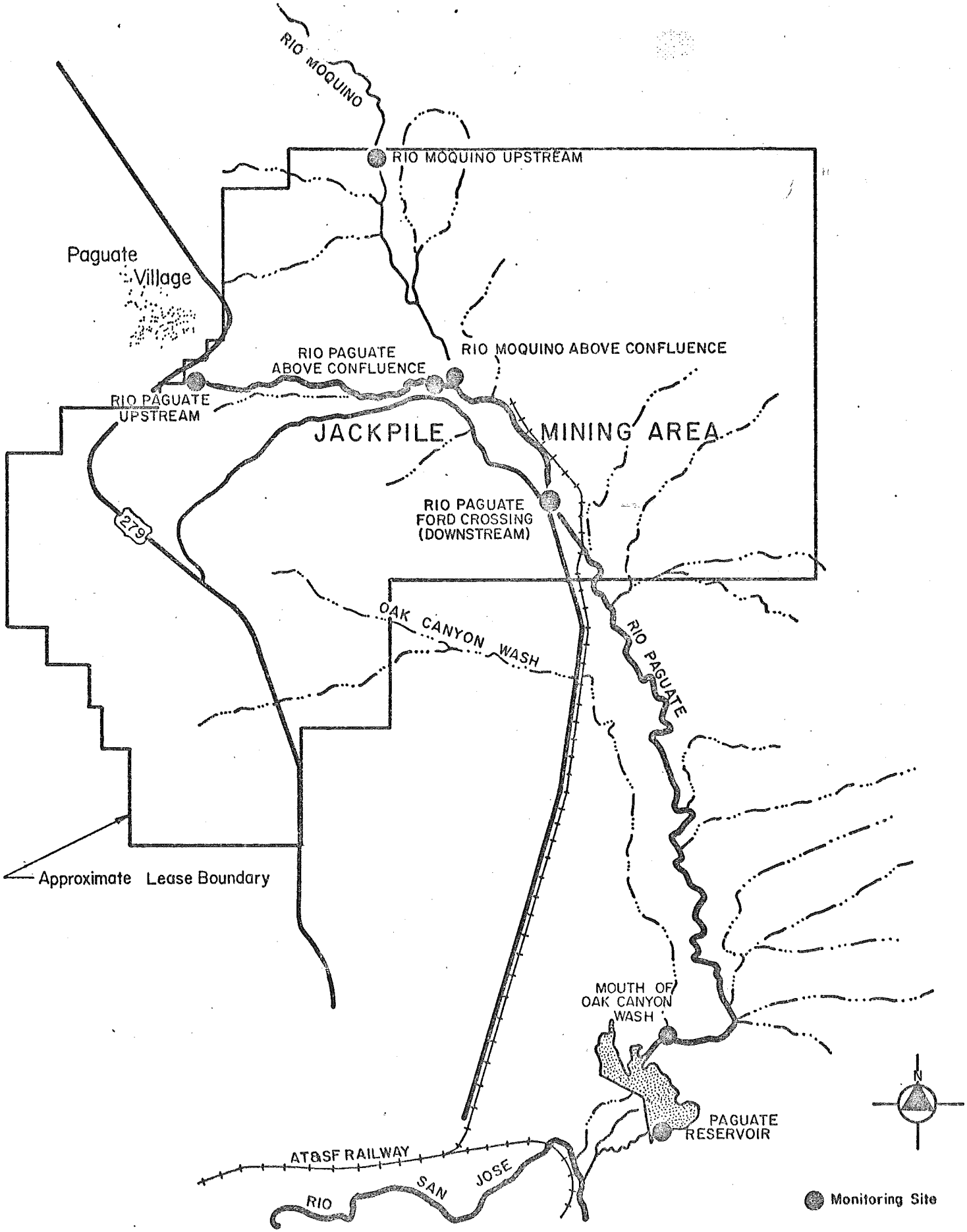
FOR THE MONTH OF: December 1982

DESCRIPTION	DATE	pH	TDS ppm	Cond umhos	HCO_3^- ppm	Cl^- ppm	$SO_4^=$ ppm	Na^+ ppm	K^+ ppm	Ca^{++} ppm	Mg^{++} ppm	NO_3^- ppm	F^- ppm	SiO_2 ppm	Mn^{++} ppm
Paguate Upstream	12/2/82	8.27	861	650	337	11.0	302	50	5.9	89	60	5.9	0.44	28.9	0.056
Rio Moquino Upstream	12/2/82	8.40	1435	900	285	12.5	760	159	7.6	113	91	6.3	0.53	24.2	0.008
Rio Paguate Above the Confluence	12/2/82	8.37	1016	750	300	13.1	441	87	6.6	87	75	5.3	0.50	23.1	0.057
Rio Moquino Above the Confluence	12/2/82	8.36	1700	1090	281	14.4	958	185	7.6	125	123	5.0	0.62	18.0	0.025
Rio Paguate Ford Crossing	12/2/82	8.31	1692	1250	288	11.5	951	173	7.4	129	126	5.2	0.61	17.1	0.035
Paguate Reservoir	12/2/82	8.00	1721	1120	246	27.6	986	173	15.3	163	104	5.0	0.56	8.8	0.013
Jackpile #4	12/2/82	8.94	1001	1100	361	18.6	322	287	1.2	3.6	0.8	5.1	1.20	11.3	0.010
Jackpile New Shop	12/2/82	8.66	1499	1600	354	28.0	657	438	2.7	8.9	1.5	7.0	1.40	13.2	0.015
Jackpile Old Shop	12/2/82	7.87	3854	3400	259	106	2376	540	10.4	274	226	61	0.72	13.3	0.033
		As ppm	Ba ppm	Cd ppm	Cr ppm	Pb ppm	Hg ppm	Se ppm	Cu ppm	Fe ppm	Zn ppm	Mo ppm	Ni ppm	V ppm	
Rio Paguate Upstream	12/2/82	<0.005	0.07	<0.001	<0.005	<0.01	<0.0005	<0.005	0.010	0.011	0.015	<0.01	0.005	<0.05	
Rio Moquino Upstream	12/2/82	<0.005	<0.05	<0.001	<0.005	<0.01	<0.0005	<0.005	0.007	0.074	0.008	<0.01	0.006	<0.05	
Rio Paguate Above the Confluence	12/2/82	<0.005	<0.05	<0.001	<0.005	<0.01	<0.0005	<0.005	0.012	0.009	0.003	0.02	0.005	<0.05	
Rio Moquino Above the Confluence	12/2/82	<0.005	<0.05	<0.001	<0.005	<0.01	<0.0005	<0.005	0.009	0.008	0.002	<0.01	0.006	<0.05	
Rio Paguate Ford Crossing	12/2/82	<0.005	<0.05	<0.001	<0.005	<0.01	<0.0005	<0.005	0.008	0.008	0.003	<0.01	0.005	<0.05	
Paguate Reservoir	12/2/82	<0.005	<0.05	<0.001	<0.005	<0.01	<0.0005	<0.005	0.009	0.010	0.008	<0.01	0.006	<0.05	
Jackpile #4	12/2/82	<0.004	<0.05	<0.001	<0.005	<0.01	<0.0005	<0.005	0.007	0.099	0.005	<0.01	<0.005	<0.05	
Jackpile New Shop	12/2/82	<0.005	0.06	<0.001	<0.005	<0.01	<0.0005	<0.005	0.008	0.021	0.001	<0.01	<0.005	<0.05	
Jackpile Old Shop	12/2/82	<0.005	<0.05	<0.001	<0.005	0.02	<0.0005	0.018	0.010	0.010	0.590	<0.01	0.011	<0.05	

3500002345

LOCATION OF GROUND WATER MONITORING STATIONS





LOCATION OF
SURFACE WATER MONITORING STATIONS

350002347

JACKPILE - AIR SAMPLING SURVEY

FOURTH QUARTER, 1982

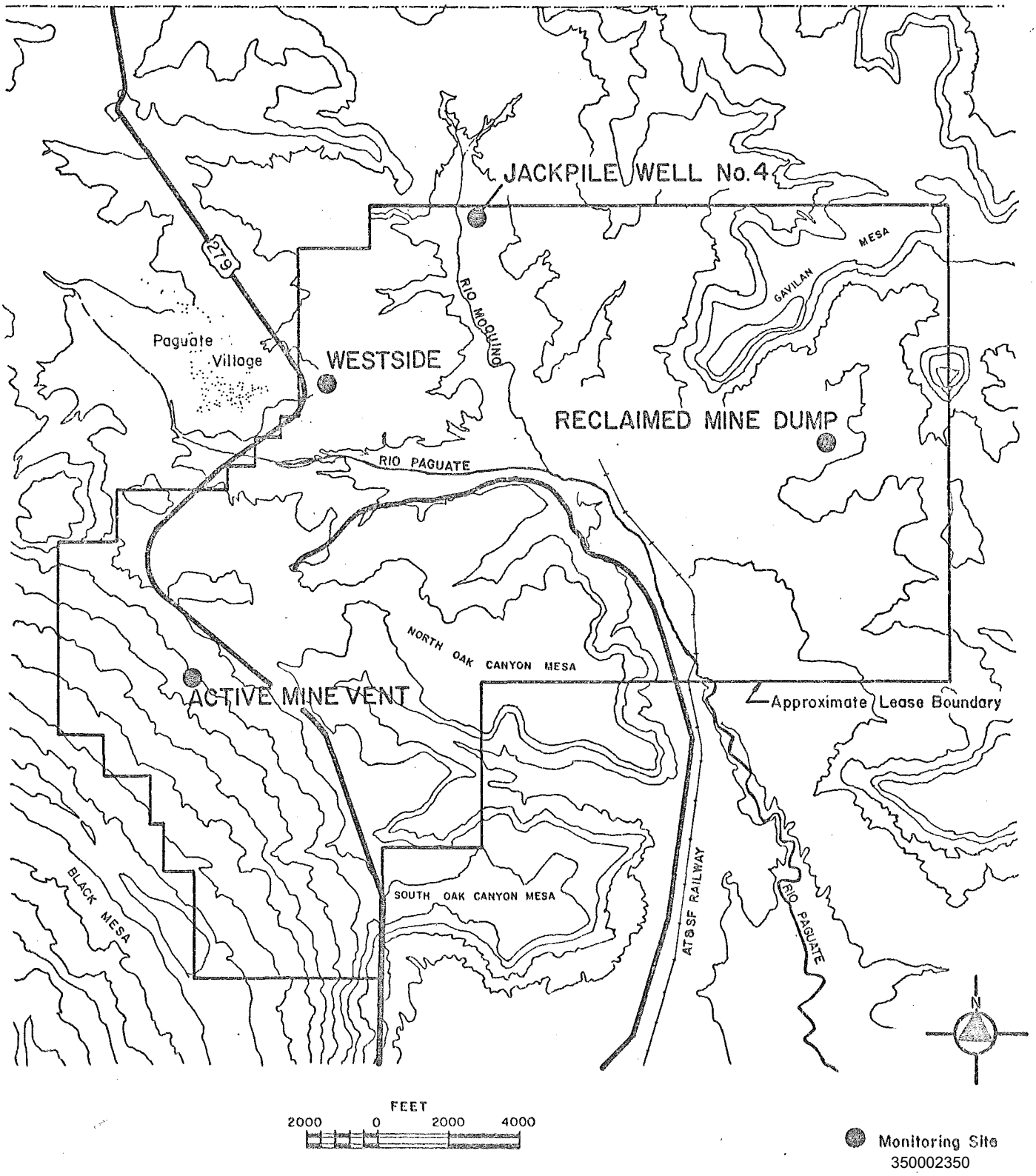
LOCATION	DATE	TOTAL PARTICULATE µgm/M^3	U-Nat. µCi/mlx10-15	Ra-226 µCi/mlx10-15	Th-230 µCi/mlx10-15	Pb-210 µCi/mlx10-15
1. Dump F	10/82	15.24	0.82	1.43	0.34	26.09
	11/82	15.31	1.38	0.20	0.27	37.33
	12/82	6.87	0.75	1.24	0.13	28.32
2. Mine Vent	10/82	15.20	0.05	0.27	0.25	49.75
	11/82	16.73	1.34	0.27	0.14	70.81
	12/82	8.10	1.33	0.75	0.19	40.95
3. West Gate	10/82	19.78	0.10	1.86	0.36	20.83
	11/82	29.35	0.86	0.18	0.15	31.31
	12/82	16.17	0.65	0.69	0.23	22.22
4. Well #4	10/82	22.74	0.55	0.87	0.22	21.98
	11/82	25.35	1.23	0.58	0.36	33.33
	12/82	8.12	0.86	1.43	0.15	25.38

JACKPILE-AMBIENT RADON SURVEY

FOURTH QUARTER, 1982

LOCATION	DATE	Rn-222 pCi/L
1. Dump F	10/82	2.07
	11/82	2.61
	12/82	2.47
2. Mine Vent	10/82	3.25
	11/82	3.31
	12/82	2.35
3. Well #4	10/82	2.39
	11/82	2.42
	12/82	2.02
4. Westgate	10/82	1.11
	11/82	1.13
	12/82	1.02

LOCATION OF
AIR QUALITY MONITORING STATIONS



350002350

ANACONDA Minerals Company
New Mexico Operations
P.O. Box 638
Grants, New Mexico 87020
Telephone 505 876 2211

ALBUQUERQUE DISTRICT MINING
RECEIVED
NOV 22 1982
MINERALS MANAGEMENT SERVICE
ALBUQUERQUE, NEW MEXICO

November 15, 1982

ROUTE
Date Surname
11/22 Dist. Supv.
Mining Eng.
11/22 Mining Eng.
Mining Eng.
11/22 Env. Scien.
Geologist
11/22 Secretary
Note:

Mr. Dale C. Jones
District Mining Supervisor
Minerals Management Service
500 Gold Avenue, S.W.
Federal Building, Room 116
Albuquerque, N.M. 87102

Dear Mr. Jones:

The following information is being submitted in accordance with the Jackpile-Paguate Minesite Sampling Program for the Third Quarter of 1982.

1. Radiological Analysis of Ground and Surface Water.

2. Chemical Analysis of Ground and Surface Water.

3. Maps showing Ground and Surface Water Sampling Locations.

4. Results of the Air Monitoring Program.

5. Results of the Ambient Radon Monitoring Study.

6. Map showing location of Air and Radon Monitoring Stations.

Sincerely,

Meade A. Stirland

Meade A. Stirland, Manager
Environment, Health & Safety

mls
Enclosures
cc: R. D. Lynn/W. C. Norem
D. L. Roberts
C. E. Sanchez
File

350002351

AIR QUALITY MONITORING PROGRAM

One 168-hour sample is taken each month at each of the four locations specified by Marc Nelson. They are collected about three meters above the ground on GF/A Glass Microfibre filter paper, using an RAC Heavy-duty Sampler.

AMBIENT RADON STUDY

Radon-222 is monitored continuously at each of the air sampling locations specified by Marc Nelson. The samples are monitored by the use of the Model RGM-2 Radon Gas Monitor. Normal data output is printed hourly and a 24-hour average is printed at the end of a 24-hour period.

JACKPILE - WATER RADIOLOGICAL ANALYSIS

(THIRD QUARTER, 1982)

DESCRIPTIVE LOCATION	Radium-226 pCi/L			Uranium-Natural ppm		
	July	Aug.	Sept.	July	Aug.	Sept.
Rio Paguate Upstream	0.20	0.37	0.46	0.003	0.003	0.006
Rio Moquino Upstream	0.20	0.20	0.36	0.011	0.006	0.006
Rio Paguate Above the Confluence	0.42	1.77	0.82	0.016	0.176	0.085
Rio Moquino Above the Confluence	0.76	3.84	1.74	0.030	0.179	0.130
Rio Paguate Ford Crossing	0.38	1.43	1.93	0.150	0.330	0.261
Paguate Reservoir	1.27	1.16	1.15	0.058	0.254	0.056
Jackpile Well #4	0.65	1.08	0.84	0.003	0.001	0.006
Jackpile New Shop	1.49	0.80	1.86	0.003	0.001	0.001
Jackpile Old Shop	3.29	1.97	2.16	0.234	0.202	0.242
Mouth of Oak Canyon Wash	*	*	*	*	*	*

* No sample because the Mouth of Oak Canyon Wash was dry.

ANACONDA MINERALS COMPANY
NEW MEXICO OPERATIONS

FOR THE MONTH OF: July 1982

DESCRIPTION	DATE	pH	TDS ppm	Cond umhos	HCO_3^- ppm	Cl^- ppm	$SO_4^=$ ppm	Na^+ ppm	K^+ ppm	Ca^{++} ppm	Mg^{++} ppm	NO_3^- ppm	F^- ppm	SiO_2 ppm	Mn^{++} ppm
Rio Paguate Upstream	7-1-82	8.4	655	800	305	8.7	180	35	5.5	84.8	35	0.75	0.21	27	0.029
Rio Moquino Upstream	7-1-82	8.3	2075	2600	264	19	1236	241	10.5	151	152	0.90	0.13	11.6	<0.005
Rio Paguate Above the Confluence	7-1-82	8.4	686	890	256	10	251	48	6.6	69	44	0.75	0.19	23.5	<0.005
Rio Moquino Above the Confluence	7-1-82	8.2	2523	2600	268	20	1554	277	9.3	186	207	1.10	0.50	13.5	0.008
Rio Paguate Ford Crossing	7-1-82	8.2	1670	2000	268	18	942	182	8.3	126	124	0.82	0.35	16.9	0.011
Paguate Reservoir	7-1-82	7.3	2614	3000	183	37	1675	299	20.2	199	199	1.20	0.35	2.4	0.410
Jackpile #4	7-1-82	8.5	1022	900	393	16	321	292	1.3	5.6	0.5	1.10	0.82	8.8	0.007
Jackpile New Shop	7-1-82	8.2	1582	1800	403	36	662	459	2.7	15.8	1.4	1.10	0.82	11.1	0.026
Jackpile Old Shop	7-1-82	7.7	3854	4100	266	95	2378	512	9.2	302	235	55	0.35	9.6	0.014

		As ppm	Ba ppm	Cd ppm	Cr ppm	Pb ppm	Hg ppm	Se ppm	Cu ppm	Fe ppm	Zn ppm	Mo ppm	Ni ppm	V ppm
Rio Paguate Upstream	7-1-82	<0.005	<0.05	<0.001	<0.005	<0.01	<0.0005	<0.005	0.003	0.042	0.001	<0.01	<0.005	<0.05
Rio Moquino Upstream	7-1-82	<0.005	<0.05	<0.001	<0.005	<0.01	<0.0005	<0.005	0.003	<0.005	0.003	<0.01	<0.005	<0.05
Rio Paguate Above the Confluence	7-1-82	<0.005	<0.05	<0.001	<0.005	<0.01	<0.0005	<0.005	0.004	0.024	0.001	<0.01	<0.005	<0.05
Rio Moquino Above the Confluence	7-1-82	<0.005	<0.05	<0.001	<0.005	<0.01	<0.0005	<0.005	0.003	0.006	<0.001	<0.01	<0.005	<0.05
Rio Paguate Ford Crossing	7-1-82	<0.005	<0.05	<0.001	<0.005	<0.01	<0.0005	<0.005	0.004	0.008	0.005	<0.01	<0.005	<0.05
Paguate Reservoir	7-1-82	<0.005	<0.05	<0.001	<0.005	<0.01	<0.0005	<0.005	0.007	0.057	0.006	<0.01	<0.005	<0.05
Jackpile #4	7-1-82	<0.005	<0.05	<0.001	<0.005	<0.01	<0.0005	<0.005	0.002	0.044	<0.001	0.01	<0.005	<0.05
Jackpile New Shop	7-1-82	<0.005	<0.05	<0.001	<0.005	<0.01	<0.0005	<0.005	0.002	0.044	0.001	<0.01	<0.005	<0.05
Jackpile Old Shop	7-1-82	<0.005	<0.05	<0.001	<0.005	<0.01	<0.0005	0.036	0.004	0.007	0.80	<0.01	<0.005	<0.05

350002354

ANACONDA MINERALS COMPANY
NEW MEXICO OPERATIONS

FOR THE MONTH OF: August 1982

DESCRIPTION	DATE	pH	TDS ppm	Cond umhos	HCO_3^- ppm	Cl^- ppm	$SO_4^=$ ppm	Na^+ ppm	K^+ ppm	Ca^{++} ppm	Mg^{++} ppm	NO_3^- ppm	F^- ppm	SiO_2 ppm	Mn^{++} ppm
Rio Paguate Upstream	8-2-82	8.1	785	1000	349	11.7	237	42.9	7.6	83	52	0.74	0.52	31.7	0.15
Rio Moquino Upstream	8-2-82	8.3	2127	2500	244	20.5	1306	225	12.3	158	159	0.94	0.78	20.1	0.007
Rio Paguate Above the Confluence	8-2-82	7.9	1164	1400	315	16.0	541	84	9.0	108	89	0.68	0.68	26.3	0.045
Rio Moquino Above the Confluence	8-2-82	8.1	1814	2250	222	20.0	1089	204	11.2	144	122	0.66	0.82	13.7	0.035
Rio Paguate Ford Crossing	8-2-82	8.1	1901	2280	251	20.3	1126	205	10.9	148	138	0.92	0.82	19.3	0.025
Paguate Reservoir	8-2-82	8.4	1762	2150	12.2	21.0	1241	181	17.8	172	115	1.10	0.92	9.8	0.270
Jackpile #4	8-2-82	8.4	1012	1800	378	18.2	319	289	1.3	3.9	0.6	0.80	1.20	10.7	0.008
Jackpile New Shop	8-2-82	8.3	1531	1800	368	27.1	657	448	2.7	10.2	1.5	0.94	1.30	11.6	0.026
Jackpile Old Shop	8-2-82	7.6	3900	3500	261	107	2417	560	9.4	2.44	251	47	0.70	10.9	0.013

		As ppm	Ba ppm	Cd ppm	Cr ppm	Pb ppm	Hg ppm	Se ppm	Cu ppm	Fe ppm	Zn ppm	Mo ppm	Ni ppm	V ppm
Rio Paguate Upstream	8-2-82	<0.005	<0.05	<0.001	<0.005	<0.01	<0.0005	<0.005	0.009	0.008	0.014	<0.01	<0.005	<0.05
Rio Moquino Upstream	8-2-82	<0.005	<0.05	<0.001	<0.005	<0.01	<0.0005	<0.005	0.006	<0.005	0.003	<0.01	<0.005	<0.05
Rio Paguate Above the Confluence	8-2-82	<0.005	<0.05	<0.001	<0.005	<0.01	0.0005	<0.005	0.004	0.009	0.002	<0.01	<0.005	<0.05
Rio Moquino Above the Confluence	8-2-82	<0.005	<0.05	<0.001	<0.005	<0.01	<0.0005	<0.005	0.006	0.007	0.002	<0.01	<0.005	<0.05
Rio Paguate Ford Crossing	8-2-82	<0.005	<0.05	0.004	<0.005	<0.01	<0.0005	<0.005	0.003	0.008	0.010	<0.01	<0.005	<0.05
Paguate Reservoir	8-2-82	<0.005	<0.05	0.001	<0.005	<0.01	<0.0005	0.019	0.005	0.009	0.021	<0.01	<0.005	<0.05
Jackpile #4	8-2-82	<0.005	<0.05	<0.001	<0.005	<0.01	<0.0005	<0.005	0.014	0.041	0.005	0.01	<0.005	<0.05
Jackpile New Shop	8-2-82	<0.005	<0.05	<0.001	<0.005	<0.01	<0.0005	<0.005	0.022	0.065	0.004	<0.01	<0.005	<0.05
Jackpile Old Shop	8-2-82	<0.005	<0.05	0.002	<0.005	<0.01	<0.0005	0.37	0.018	0.013	2.90	<0.01	<0.005	<0.05

350002355

ANACONDA MINERALS COMPANY
NEW MEXICO OPERATIONS

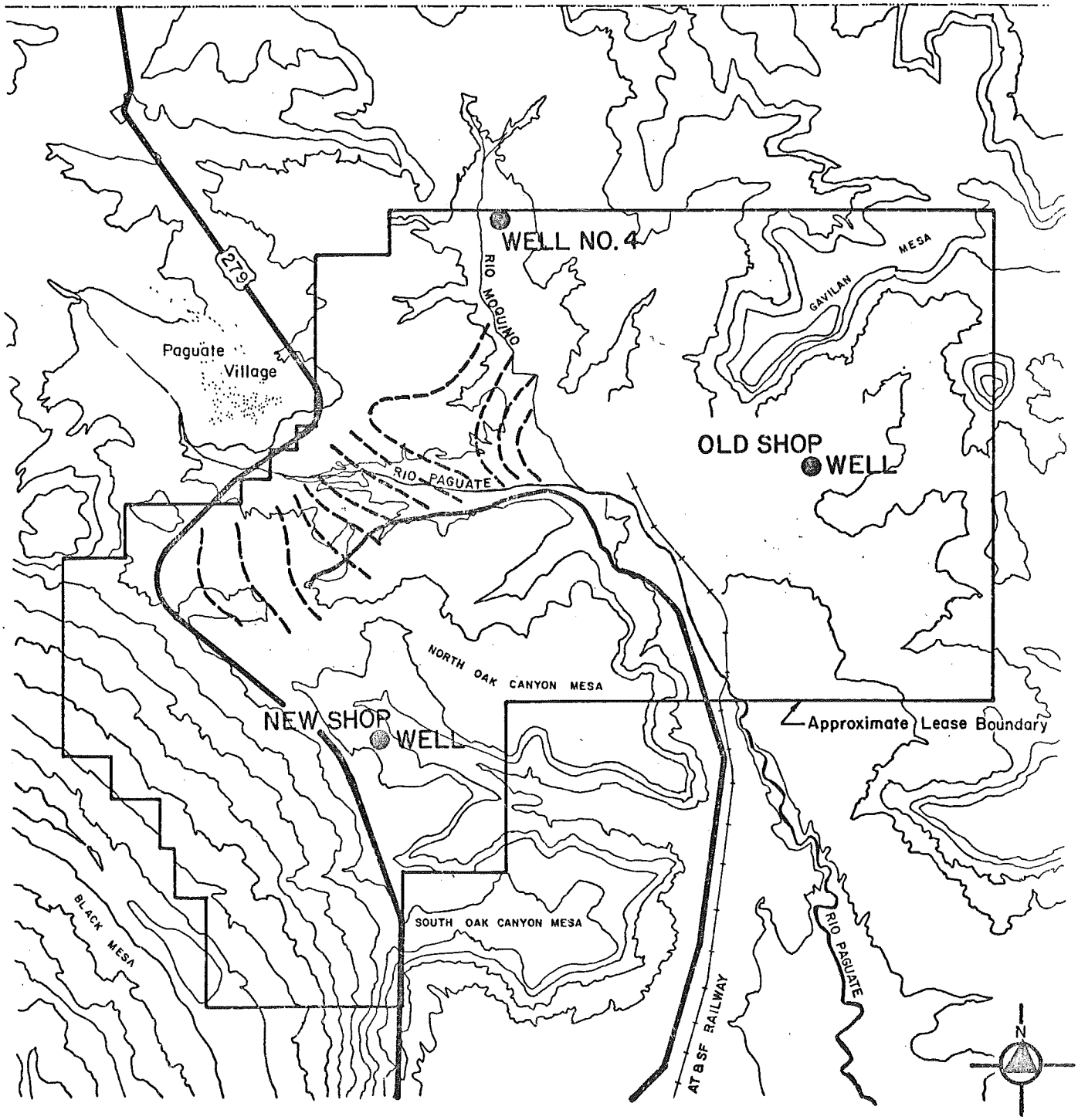
FOR THE MONTH OF: September 1982

DESCRIPTION	DATE	pH	TDS ppm	Cond umhos	HCO_3^- ppm	Cl^- ppm	$SO_4^=$ ppm	Na^+ ppm	K^+ ppm	Ca^{++} ppm	Mg^{++} ppm	NO_3^- ppm	F^- ppm	SiO_2 ppm	Mn^{++} ppm
Rio Paguate Up eam	9-1-82	7.9	843	1000	329	9.9	288	43.2	8.0	119	45	0.31	0.49	30.8	0.082
Rio Moquino Upstream	9-1-82	8.2	2340	2550	256	20	1428	224	14.2	270	127	0.37	0.78	17.9	<0.005
Rio Paguate Above the Confluence	9-1-82	7.9	1260	1400	246	11.3	655	74	10.4	201	61	0.37	0.70	16.7	0.051
Rio Moquino Above the Confluence	9-1-82	7.9	2389	2550	268	18.3	1442	235	12.8	271	140	0.94	0.94	15.0	0.210
Rio Paguate Ford Crossing	9-1-82	7.9	2181	2100	281	18.4	1286	190	12.4	274	118	0.43	0.80	12.4	0.038
Paguate Reservoir	9-1-82	6.9	719	750	130	7.8	368	49	7.8	120	25.7	0.23	0.80	4.7	0.024
Jackpile #4	9-1-82	8.3	1007	1100	373	16	321	285	2.2	7.1	1.1	0.43	1.20	11.6	0.008
Jackpile New Shop	9-1-82	7.8	1526	1750	370	25.4	662	442	4.4	18.2	1.6	0.62	1.30	15.4	0.016
Jackpile Old Shop	9-3-82	7.5	3858	3620	220	97.5	2412	538	11.9	251	245	64	0.70	12.4	0.016

		As ppm	Ba ppm	Cd ppm	Cr ppm	Pb ppm	Hg ppm	Se ppm	Cu ppm	Fe ppm	Zn ppm	Mo ppm	Ni ppm	V ppm
Paguate Upstream	9-1-82	<0.005	0.06	<0.001	<0.005	<0.01	<0.0005	<0.005	0.042	0.005	0.026	0.01	<0.005	0.05
Rio Moquino Upstream	9-1-82	<0.005	0.06	<0.001	<0.005	<0.01	<0.0005	<0.005	0.033	0.006	0.005	0.01	0.006	<0.05
Rio Paguate Above the Confluence	9-1-82	<0.005	<0.05	<0.001	<0.005	<0.01	<0.0005	<0.005	0.034	<0.005	0.009	<0.01	0.006	<0.05
Rio Moquino Above the Confluence	9-1-82	<0.005	0.06	<0.001	<0.005	<0.01	<0.0005	0.020	0.038	0.006	0.028	0.01	0.017	<0.05
Rio Paguate Ford Crossing	9-1-82	<0.005	0.07	<0.001	<0.005	<0.01	<0.0005	0.009	0.022	0.007	0.005	0.01	0.008	<0.05
te Reservoir	9-1-82	<0.005	<0.05	<0.001	<0.005	<0.01	<0.0005	<0.005	0.028	0.015	0.005	<0.01	<0.005	<0.05
pile #4	9-1-82	<0.005	<0.05	<0.001	<0.005	<0.01	<0.0005	<0.005	0.021	0.018	0.005	<0.01	<0.005	<0.05
pile New Shop	9-1-82	<0.005	<0.05	<0.001	<0.005	<0.01	<0.0005	<0.005	0.012	0.019	0.011	<0.01	<0.005	<0.05
pile Old Shop	9-3-82	<0.005	<0.05	0.001	<0.005	<0.01	<0.0005	0.033	0.020	0.011	0.870	<0.01	0.013	<0.05

350002356

LOCATION OF GROUND WATER MONITORING STATIONS



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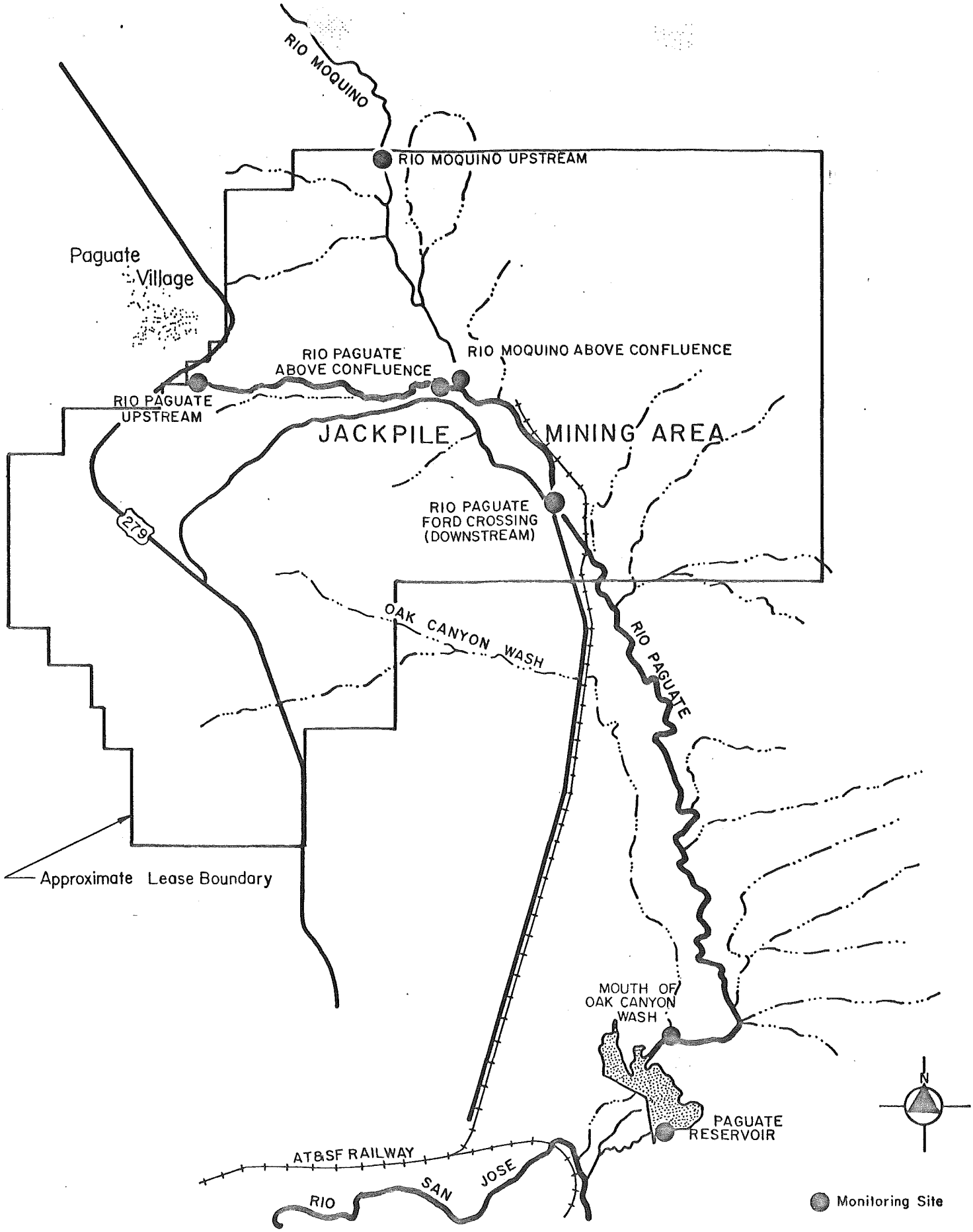


LOCATION OF
SURFACE WATER MONITORING STATIONS

350002358

JACKPILE - AIR SAMPLING SURVEY

THIRD QUARTER, 1982

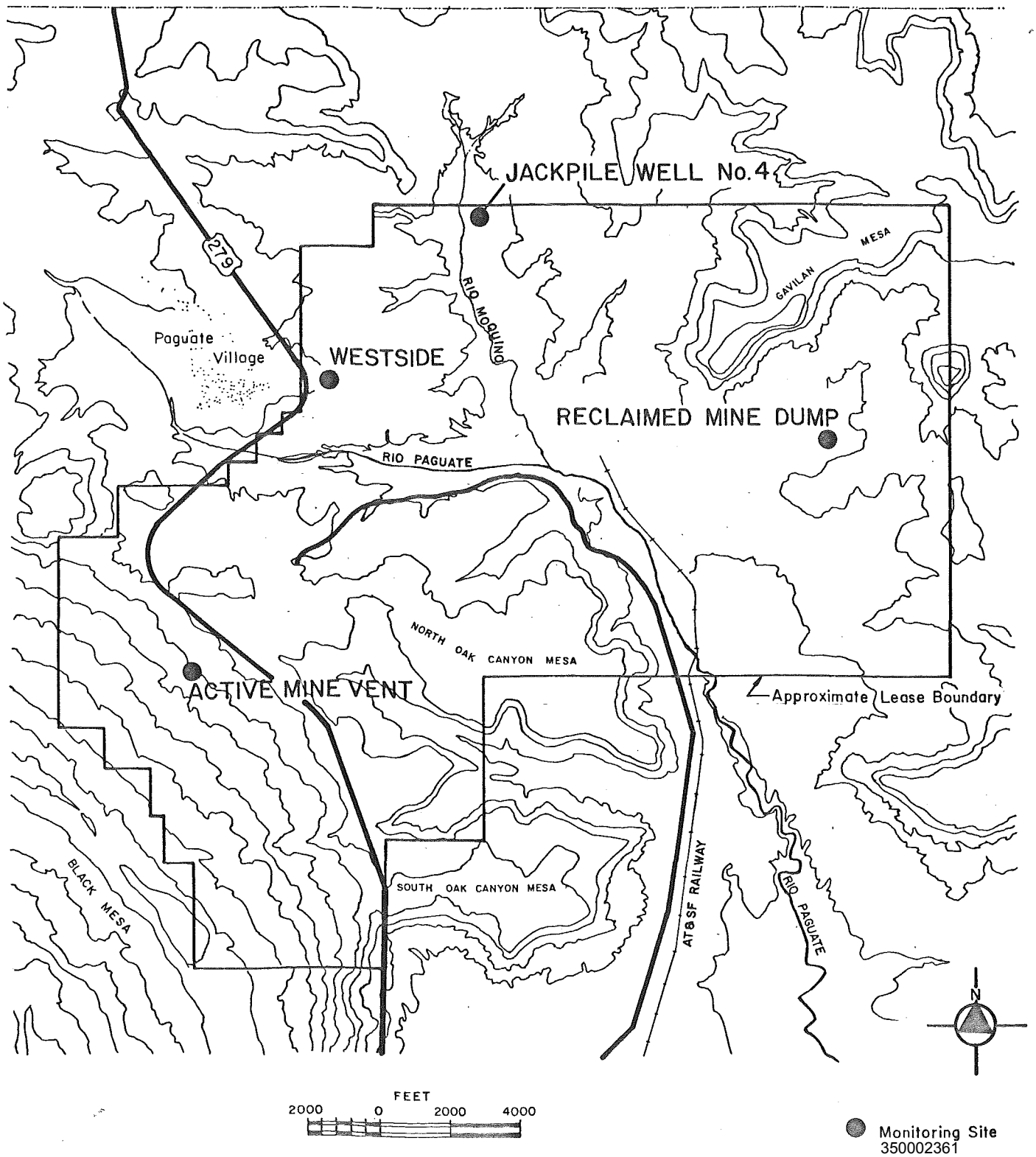
LOCATION	DATE	TOTAL PARTICULATE µgm/M^3	U-Nat. µCi/mlx10-15	Ra-226 µCi/mlx10-15	Th-230 µCi/mlx10-15	Pb-210 µCi/mlx10-15
1. Dump F	7/82	15.46	4.06	0.20	0.53	16.91
	8/82	11.44	5.67	0.44	2.93	30.35
	9/82	17.96	0.73	0.20	2.43	26.21
2. Mine Vent	7/82	16.83	1.56	0.10	0.30	26.63
	8/82	13.89	3.84	0.28	2.12	28.79
	9/82	17.59	1.31	0.19	3.01	27.64
3. West Gate	7/82	25.00	13.68	0.32	0.31	16.84
	8/82	20.05	1.98	0.22	1.04	22.40
	9/82	24.49	0.77	0.12	3.06	29.59
4. Well #4	7/82	21.86	4.15	0.14	0.44	15.84
	8/82	15.73	2.19	0.13	2.36	24.16
	9/82	19.78	2.09	0.38	2.75	35.16

JACKPILE-AMBIENT RADON SURVEY

THIRD QUARTER, 1982

LOCATION	DATE	Rn-222 pCi/L
1. Dump F	7/82	1.41
	8/82	1.52
	9/82	1.44
2. Mine Vent	7/82	1.62
	8/82	1.62
	9/82	1.66
3. Well #4	7/82	1.83
	8/82	1.83
	9/82	1.89
4. Westgate	7/82	0.26
	8/82	0.86
	9/82	0.65

LOCATION OF
AIR QUALITY MONITORING STATIONS



ANACONDA Minerals Company
New Mexico Operations
P.O. Box 638
Grants, New Mexico 87020
Telephone 505 876 2211

ROUTE SLIP
8/30 Dist. Supv.
Mining Eng.
Mining Eng.
8/30 Mining Eng.
8/30 Env. Scien.
Geologist
8/30 Secretary
Note:

ALBUQUERQUE DISTRICT MINING
RECEIVED
AUG 30 1982
MINERALS MANAGEMENT SERVICE
ALBUQUERQUE, NEW MEXICO

August 20, 1982

Mr. Dale C. Jones
District Mining Supervisor
Minerals Management Service
500 Gold Avenue, S.W.
Federal Building, Room 116
Albuquerque, N.M. 87102

Dear Mr. Jones:

The following information is being submitted in accordance with the Jackpile-Paguate Minesite Sampling Program for the Second Quarter of 1982.

1. Radiological Analysis of Ground and Surface Water.

2. Chemical Analysis of Ground and Surface Water.

3. Maps showing Ground and Surface Water Sampling Locations.

4. Results of the Air Monitoring Program.

5. Results of the Ambient Radon Monitoring Study.

6. Map showing location of Air and Radon Monitoring Stations.

Sincerely,

Meade A. Stirland

Meade A. Stirland, Manager
Environment, Health & Safety

mls
Enclosures
cc: R. D. Lynn
D. L. Roberts
C. E. Sanchez
File

350002362

AIR QUALITY MONITORING PROGRAM

One 168-hour sample is taken each month at each of the four locations specified by Marc Nelson. They are collected about three meters above the ground on GF/A Glass Microfibre filter paper, using an RAC Heavy-duty Sampler.

AMBIENT RADON STUDY

Radon-222 is monitored continuously at each of the air sampling locations specified by Marc Nelson. The samples are monitored by the use of the Model RGM-2 Radon Gas Monitor. Normal data output is printed hourly and a 24-hour average is printed at the end of a 24-hour period.

JACKPILE - WATER RADIOLOGICAL ANALYSIS

(SECOND QUARTER, 1982)

DESCRIPTIVE LOCATION	Radium-226 pCi/L			Uranium-Natural ppm		
	April	May	June	April	May	June
Rio Paguate Upstream	0.20	0.20	0.66	0.005	0.005	0.003
Rio Moquino Upstream	0.20	0.20	0.52	0.011	0.011	0.011
Rio Paguate Above the Confluence	0.23	2.06	0.20	0.011	0.023	0.028
Rio Moquino Above the Confluence	0.51	0.86	0.58	0.027	0.017	0.017
Rio Paguate Ford Crossing	0.98	0.45	0.48	0.049	0.074	0.062
Paguate Reservoir	0.20	1.25	0.63	0.210	0.153	0.141
Jackpile Well #4	0.20	0.42	0.37	0.006	0.003	0.011
Jackpile New Shop	1.60	1.79	2.02	0.006	0.003	0.006
Jackpile Old Shop	2.10	3.04	1.92	0.330	0.187	0.247
Mouth of Oak Canyon Wash	*	*	*	*	*	*

* No sample because the Mouth of Oak Canyon Wash was dry.

FOR THE MONTH OF: April, 1982

DESCRIPTION	DATE	pH	TDS ppm	Cond umhos	HCO_3^- ppm	Cl^- ppm	$SO_4^=$ ppm	Na^+ ppm	K^+ ppm	Ca^{++} ppm	Mg^{++} ppm	NO_3^- ppm	F^- ppm	SiO_2 ppm	Mn^{++} ppm
Rio Paguate Upstream	4-1-82	7.9	564	600	285	8	125	27.9	4.3	86	26	0.7	0.50	58.4	0.055
Rio Moquino Upstream	4-1-82	8.1	1609	1600	305	13.2	863	152	7.9	173	92	1.1	0.76	30	0.011
Rio Paguate Above the Confluence	4-1-82	8.1	599	1600	275	8.5	162	33.8	5.1	82	30.3	0.5	0.43	58.2	0.008
Rio Moquino Above the Confluence	4-1-82	8.0	1784	1900	292	15	995	185	8.6	187	98	0.7	0.64	26.5	0.018
Rio Paguate Ford Crossing	4-1-82	8.3	1345	1300	317	13	666	123	7.1	137	79	0.9	0.64	39	0.013
Paguate Reservoir	4-1-81	8.1	1826	1600	274	24.2	1028	209	12.9	185	90	1.0	0.68	15.8	0.011
Jackpile #4	4-1-82	8.3	996	1200	373	14.9	307	290	1.1	5.1	0.6	1.1	1.6	18.4	0.006
Jackpile New Shop	4-1-82	8.2	1653	1250	402	25.1	724	476	3.3	18	1.5	1.0	1.3	16	0.018
Jackpile Old Shop	4-1-82	7.5	3995	3575	251	99	2468	499	9.3	373	228	66	0.9	22.7	0.009

	DATE	As ppm	Ba ppm	Cd ppm	Cr ppm	Pb ppm	Hg ppm	Se ppm	Cu ppm	Fe ppm	Zn ppm	Mo ppm	Ni ppm	V ppm
Rio Paguate Upstream	4-1-82	<0.005	<0.05	<0.001	<0.005	<0.01	<.0005	<0.005	0.004	0.06	0.005	<0.01	<0.005	<0.05
Rio Moquino Upstream	4-1-82	<0.005	<0.05	<0.001	<0.005	<0.01	<.0005	<0.005	0.002	0.02	0.003	<0.01	<0.005	<0.05
Rio Paguate Above the Confluence	4-1-82	<0.005	<0.05	<0.001	<0.005	<0.01	<.0005	<0.005	0.003	0.03	0.003	<0.01	<0.005	<0.05
Rio Moquino Above the Confluence	4-1-82	<0.005	<0.05	<0.001	<0.005	<0.01	<.0005	<0.005	0.004	0.02	0.004	<0.01	<0.005	<0.05
Rio Paguate Ford Crossing	4-1-82	<0.005	<0.05	<0.001	<0.005	<0.01	<.0005	<0.005	0.003	0.04	0.006	<0.01	<0.005	<0.05
Paguate Reservoir	4-1-82	<0.005	<0.05	<0.001	<0.005	<0.01	<.0005	<0.005	0.003	0.04	0.005	<0.01	<0.005	<0.05
Jackpile #4	4-1-82	<0.005	<0.05	<0.001	<0.005	<0.01	<.0005	<0.005	0.003	0.10	0.003	<0.01	<0.005	<0.05
Jackpile New Shop	4-1-82	<0.005	<0.05	<0.001	<0.005	<0.01	<.0005	<0.005	0.006	0.05	0.002	<0.01	<0.005	<0.05
Jackpile Old Shop	4-1-82	<0.005	<0.05	<0.001	<0.005	<0.01	<.0005	0.041	0.002	0.02	0.06	<0.01	<0.005	<0.05

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FOR THE MONTH OF: May, 1982

DESCRIPTION	DATE	pH	TDS ppm	Cond umhos	HCO_3^- ppm	Cl^- ppm	$SO_4^=$ ppm	Na^+ ppm	K^+ ppm	Ca^{++} ppm	Mg^{++} ppm	NO_3^- ppm	F^- ppm	SiO_2 ppm	Mn^{++} ppm
Rio Paguate Upstream	5-4-82	8.2	814	780	366	11.5	218	43.	8.8	112	46	7.2	0.60	35	0.04
Rio Moquino Upstream	5-3-82	8.4	1909	2000	341	15.7	1031	189	11.1	187	131	1.1	0.77	20	0.006
Rio Paguate Above the Confluence	5-3-82	8.4	742	700	280	10.2	268	46	6.4	82	47	0.59	0.52	36	<.005
Rio Moquino Above the Confluence	5-3-82	8.4	2040	1950	305	17	1156	213	11.3	205	130	0.95	0.75	20	0.017
Rio Paguate Ford Crossing	5-3-82	7.7	1595	3400	368	15	788	142	9.3	163	107	0.82	0.70	26	0.012
Paguate Reservoir	5-4-82	7.5	2050	1920	225	24.6	1230	230	14.5	201	121	0.82	0.69	5.1	0.10
Jackpile #4	5-4-82	8.6	992	1100	378	16.7	292	294	1.6	5.7	0.7	0.82	1.3	11	0.006
Jackpile New Shop	5-4-82	8.2	1653	1250	402	25.1	724	476	3.3	18	1.5	1.0	1.3	16	0.018
Jackpile Old Shop	5-3-82	7.7	4008	3400	280	100	2439	532	11.1	367	222	54	0.76	18	0.014

	DATE	As ppm	Ba ppm	Cd ppm	Cr ppm	Pb ppm	Hg ppm	Se ppm	Cu ppm	Fe ppm	Zn ppm	Mo ppm	Ni ppm	V ppm
Rio Paguate Upstream	5-4-82	<0.005	<0.05	<0.001	<0.005	0.04	<0.0005	<0.005	0.005	0.24	0.03	<0.01	<0.005	<0.05
Rio Moquino Upstream	5-3-82	<0.005	<0.05	<0.001	<0.005	<0.01	<0.0005	<0.005	0.007	0.02	0.003	<0.01	<0.005	<0.05
Rio Paguate Above the Confluence	5-3-82	<0.005	<0.05	<0.001	<0.005	<0.01	<0.0005	<0.005	0.014	0.03	0.007	<0.01	<0.005	<0.05
Rio Moquino Above the Confluence	5-3-82	<0.005	<0.05	<0.001	<0.005	<0.01	<0.0005	<0.005	0.007	0.02	0.002	<0.01	<0.005	<0.05
Rio Paguate Ford Crossing	5-3-82	<0.005	<0.05	<0.001	<0.005	0.05	<0.0005	<0.005	0.006	0.15	0.033	<0.01	<0.005	<0.05
Paguate Reservoir	5-4-82	<0.005	<0.05	<0.001	<0.005	0.04	<0.0005	<0.005	0.007	0.37	0.038	<0.01	<0.005	<0.05
Jackpile #4	5-4-82	<0.005	<0.05	<0.001	<0.005	<0.01	<0.0005	<0.005	0.005	0.06	0.001	<0.01	<0.005	<0.05
Jackpile New Shop	5-4-82	<0.005	<0.05	<0.001	<0.005	<0.01	<0.0005	<0.005	0.006	0.05	0.001	<0.01	<0.005	<0.05
Jackpile Old Shop	5-3-82	<0.005	<0.05	<0.001	<0.005	<0.01	<0.0005	0.035	0.005	0.01	0.46	<0.01	<0.005	<0.05

350002366

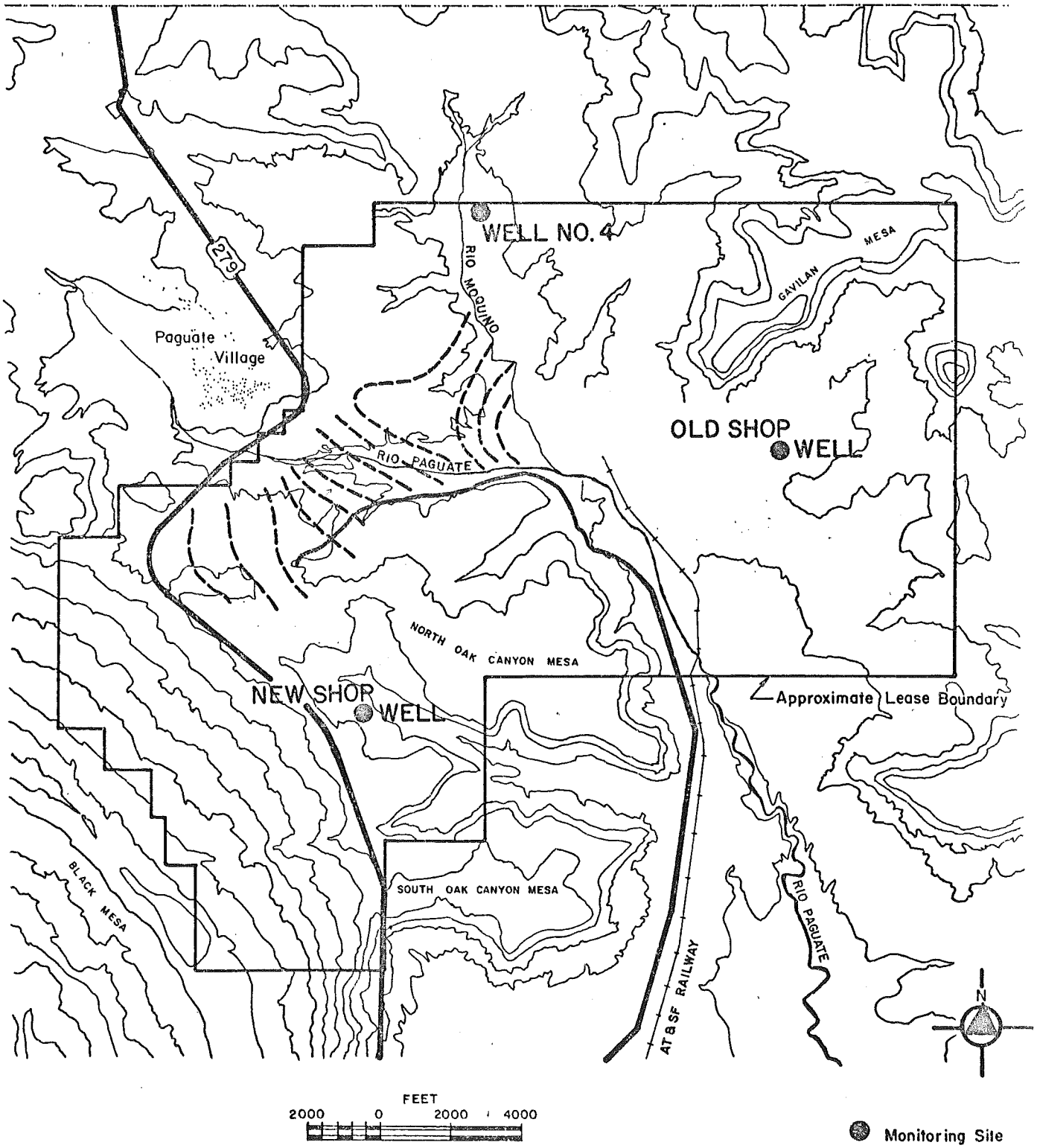
FOR THE MONTH OF: June, 1982

DESCRIPTION	DATE	pH	TDS ppm	Cond umhos	HCO_3^- ppm	Cl^- ppm	$SO_4^=$ ppm	Na^+ ppm	K^+ ppm	Ca^{++} ppm	Mg^{++} ppm	NO_3^- ppm	F^- ppm	SiO_2 ppm	Mn^{++} ppm
Rio Paguate Upstream	6-1-82	8.3	675	700	327	9.5	173	39	5.4	84	35	1.5	0.53	49	0.02
Rio Moquino Upstream	6-1-82	8.3	1706	1820	329	14	900	171	8.1	168	113	2.4	0.73	26	<0.005
Rio Paguate Above the Confluence	6-1-82	8.3	1865	2030	254	16.1	1092	190	9.2	176	125	1.9	0.78	43	0.005
Rio Moquino Above the Confluence	6-1-82	8.3	633	800	251	10	209	52	5.9	64	39	1.6	0.44	45	<0.005
Rio Paguate Ford Crossing	6-1-82	8.4	1636	2030	285	16.7	889	169	8.0	149	117	1.70	0.71	31	0.010
Paguate Reservoir	6-1-82	7.8	2242	2200	261	30	1326	242	16.5	225	138	2.10	0.70	0.94	0.02
Jackpile #4	6-8-82	8.6	1024	1060	359	18	341	297	1.6	3.9	0.6	1.5	1.1	11	<0.05
Jackpile New Shop	6-1-82	8.3	1616	1700	415	26.1	688	460	2.7	20	1.3	1.7	1.4	20	0.031
Jackpile Old Shop	6-1-82	7.7	3973	2650	264	102	2422	580	9.7	325	221	48	0.8	18	0.017

	DATE	As ppm	Ba ppm	Cd ppm	Cr ppm	Pb ppm	Hg ppm	Se ppm	Cu ppm	Fe ppm	Zn ppm	Mo ppm	Ni ppm	V ppm
Rio Paguate Upstream	6-1-82	<0.005	<0.05	<0.001	<0.005	<0.01	<0.0005	<0.05	0.004	0.01	0.006	<0.01	<0.005	<0.05
Rio Moquino Upstream	6-1-82	<0.005	<0.05	<0.001	<0.005	<0.01	<0.0005	<0.005	0.008	0.014	0.004	<0.01	0.005	<0.05
Rio Paguate Above the Confluence	6-1-82	<0.005	<0.05	<0.001	<0.005	<0.01	<0.0005	<0.005	0.004	0.03	0.010	<0.01	<0.005	<0.05
Rio Moquino Above the Confluence	6-1-82	<0.005	<0.05	<0.001	<0.005	<0.01	<0.0005	<0.005	0.003	0.02	0.006	<0.01	<0.005	<0.05
Rio Paguate Ford Crossing	6-1-82	<0.005	<0.05	<0.001	<0.005	<0.01	<0.0005	<0.005	0.004	0.02	0.004	<0.01	<0.005	<0.05
Paguate Reservoir	6-1-82	<0.005	0.06	<0.001	<0.005	<0.01	<0.0005	<0.005	0.009	0.05	0.006	<0.01	<0.005	<0.05
Jackpile #4	6-8-82	<0.005	<0.05	<0.001	<0.005	<0.01	<0.0005	<0.005	0.006	0.05	0.005	<0.01	<0.005	<0.05
Jackpile New Shop	6-1-82	<0.005	<0.05	<0.001	<0.005	<0.01	0.0006	<0.005	0.002	0.027	0.006	<0.01	<0.005	<0.05
Jackpile Old Shop	6-1-82	<0.005	<0.05	<0.001	<0.005	<0.01	<0.0005	0.014	0.005	0.01	0.49	<0.01	<0.005	<0.05

35002367

LOCATION OF GROUND WATER MONITORING STATIONS



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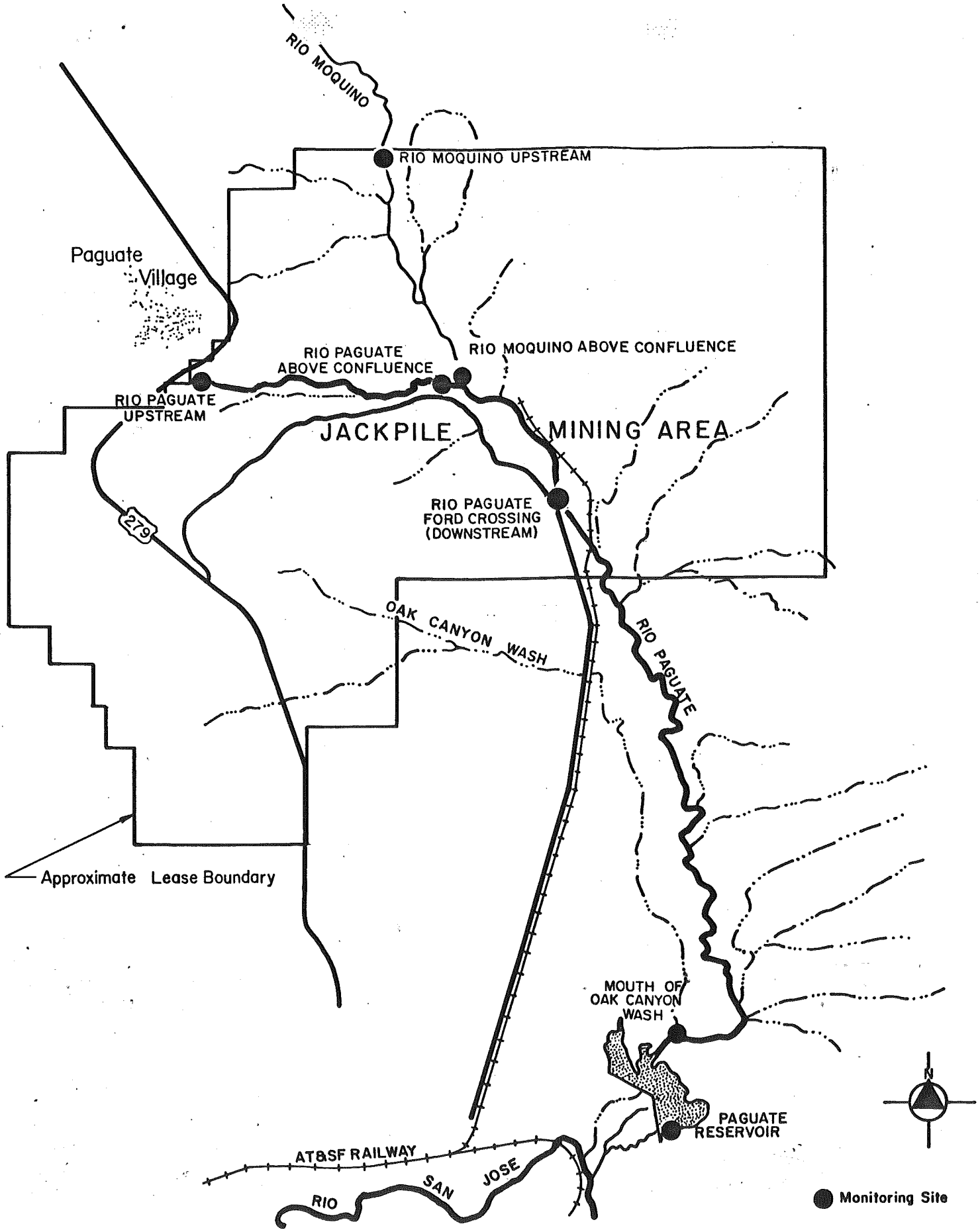


LOCATION OF
SURFACE WATER MONITORING STATIONS

350002369

JACKPILE - AIR SAMPLING SURVEY

SECOND QUARTER, 1982

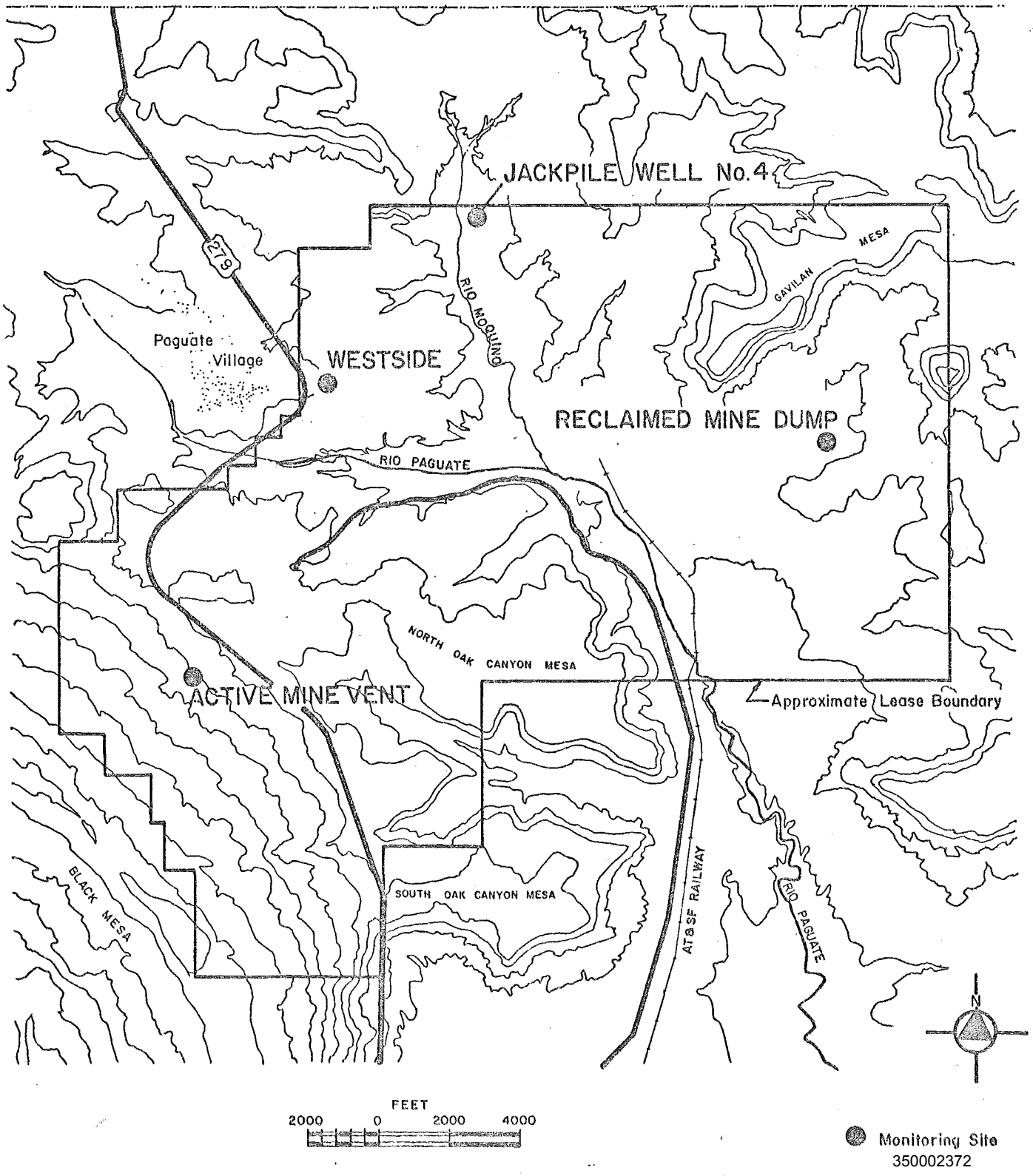
LOCATION	DATE	TOTAL PARTICULATE $\mu gm/M^3$	U-Nat. $\mu Ci/ml x10^{-15}$	Ra-226 $\mu Ci/ml x10^{-15}$	Th-230 $\mu Ci/ml x10^{-15}$	Pb-210 $\mu Ci/ml x10^{-15}$
1. Dump F	4/82	15.71	4.50	0.52	0.63	13.61
	5/82	16.58	0.79	1.16	0.53	7.36
	6/82	27.00	6.20	0.45	1.07	26.20
2. Mine Vent	4/82	13.46	2.07	0.10	0.34	36.54
	5/82	17.23	2.52	1.70	1.36	52.42
	6/82	24.64	3.72	0.10	0.97	39.61
3. West Gate	4/82	16.19	0.48	0.29	0.38	12.38
	5/82	17.80	1.07	1.15	0.34	43.90
	6/82	31.22	3.75	0.22	0.97	25.36
4. Well #4	4/82	15.38	2.07	0.10	0.24	9.13
	5/82	10.34	1.82	0.89	1.33	56.65
	6/82	21.20	4.03	0.17	0.52	23.56

JACKPILE-AMBIENT RADON SURVEY

SECOND QUARTER, 1982

LOCATION	DATE	Rn-222 pCi/L
1. Dump F	4/82	1.50
	5/82	1.56
	6/82	1.56
2. Mine Vent	4/82	1.77
	5/82	1.84
	6/82	1.81
3. Well #4	4/82	2.07
	5/82	2.04
	6/82	1.97
4. Westgate	4/82	0.95
	5/82	0.80
	6/82	0.32

LOCATION OF AIR QUALITY MONITORING STATIONS



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ANACONDA Minerals Company
New Mexico Operations
P.O. Box 638
Grants, New Mexico 87020
Telephone 505 876 2211

MP file
Environmental Monitoring

ALBUQUERQUE DISTRICT MINING
RECEIVED
MAY 12 1982
MINERALS MANAGEMENT SERVICE
ALBUQUERQUE, NEW MEXICO

May 5, 1982

Mr. Dale C. Jones
District Mining Supervisor
Minerals Management Service
500 Gold Avenue, S.W.
Federal Building, Room 116
Albuquerque, N.M. 87102

Dear Mr. Jones:

The following information is being submitted in accordance with the Jackpile-Paguate Minesite Sampling Program for the First Quarter of 1982.

1. Radiological Analysis of Ground and Surface Water.

2. Chemical Analysis of Ground and Surface Water.

3. Maps showing Ground and Surface Water Sampling Locations.

4. Results of the Air Monitoring Program.

5. Results of the Ambient Radon Monitoring Study.

6. Map showing location of Air and Radon Monitoring Stations.

Sincerely,

Meade A. Stirland

Meade A. Stirland, Manager
Environment, Health & Safety

mls
Enclosures
cc: R. D. Lynn
D. L. Roberts
C. E. Sanchez
File

350002373

AIR QUALITY MONITORING PROGRAM

One 168-hour sample is taken each month at each of the four locations specified by Marc Nelson. They are collected about three meters above the ground on GF/A Glass Microfibre filter paper, using an RAC Heavy-duty Sampler.

AMBIENT RADON STUDY

Radon-222 is monitored continuously at each of the air sampling locations specified by Marc Nelson. The samples are monitored by the use of the Model RGM-2 Radon Gas Monitor. Normal data output is printed hourly and a 24-hour average is printed at the end of a 24-hour period.

JACKPILE- WATER RADIOLOGICAL ANALYSIS

(FIRST QUARTER, 1982)

DESCRIPTIVE LOCATION	Radium-226 pCi/L			Uranium-Natural ppm		
	January	February	March	January	February	March
Rio Paguate Upstream	0.32	0.17	0.58	0.011	0.004	0.010
Rio Moquino Upstream	0.02	0.06	0.02	0.008	0.007	0.020
Rio Paguate Above the Confluence	2.09	0.68	1.71	0.046	0.065	0.017
Rio Moquino Above the Confluence	2.29	0.38	1.29	0.073	0.044	0.017
Rio Paguate Ford Crossing	2.75	0.77	1.16	0.135	0.118	0.074
Paguate Reservoir	0.63	1.89	0.76	0.250	0.265	0.217
Jackpile Well #4	0.56	0.76	0.93	0.010	0.005	0.030
Jackpile New Shop	1.99	1.96	3.61	0.003	0.011	0.010
Jackpile Old Shop	4.68	2.14	2.62	0.314	0.266	0.277
Mouth of Oak Canyon Wash	*	*	*	*	*	*

* No sample because the Mouth of Oak Canyon Wash was dry.

FOR THE MONTH OF: January 1982

DESCRIPTION	DATE	pH	TDS ppm	Cond umhos	HCO_3^- ppm	Cl^- ppm	$SO_4^=$ ppm	Na^+ ppm	K^+ ppm	Ca^{++} ppm	Mg^{++} ppm	NO_3^- ppm	F^- ppm	SiO_2 ppm	Mn^{++} ppm
Paguate Upstream	1-02-82	8.30	788	550	361	10.5	218	44.4	6.5	100	45.2	1.0	0.50	14.0	0.10
Rio Moquino Upstream	1-07-82	8.45	1606	1080	317	15.0	833	159	11.9	178	88	2.7	0.69	16.0	0.01
Rio Paguate Above the Confluence	1-14-82	8.04	917	630	353	12.7	315	61	7.8	109	55.1	0.93	0.54	23.0	0.05
Rio Moquino Above the Confluence	1-14-82	8.43	2297	1350	317	19.1	1324	253	12.6	223	145	1.2	0.82	16.0	0.08
Rio Paguate Ford Crossing	1-14-82	8.28	1557	1150	302	16.2	809	156	10.0	170	91	1.0	0.68	14.0	0.04
Paguate Reservoir	1-07-82	8.06	1316	800	195	19.3	732	95	17.5	205	50.2	1.0	0.62	8.8	0.02
Jackpile #4	1-07-82	8.68	1019	900	366	15.6	329	294	2.4	6.4	0.67	2.7	1.4	12.0	0.01
Jackpile New Shop	1-07-82	8.09	1541	1500	380	26.1	659	445	5.1	18.8	1.45	2.4	1.5	13.0	0.02
Jackpile Old Shop	1-14-82	7.91	3850	3350	244	99.0	2369	504	15.0	336	224	56.0	0.79	18.0	0.01

		As ppm	Ba ppm	Cd ppm	Cr ppm	Pb ppm	Hg ppm	Se ppm	Cu ppm	Fe ppm	Zn ppm	Mo ppm	Ni ppm	V ppm
Rio Paguate Upstream	1-07-82	<0.005	<0.05	<0.001	<0.005	0.01	<0.0005	<0.005	0.004	0.02	0.004	<0.01	<0.005	<0.05
Rio Moquino Upstream	1-02-82	<0.005	<0.05	<0.001	<0.005	0.01	<0.0005	<0.005	0.004	0.01	0.005	<0.01	<0.005	<0.05
Rio Paguate Above the Confluence	1-14-82	<0.005	<0.05	<0.001	<0.005	0.01	<0.0005	<0.005	0.003	0.01	0.004	<0.01	<0.005	<0.05
Rio Moquino Above the Confluence	1-14-82	<0.005	<0.05	<0.001	<0.005	0.02	<0.0005	<0.005	0.004	0.01	0.002	<0.01	<0.005	<0.05
Rio Paguate Ford Crossing	1-14-82	<0.005	<0.05	<0.001	<0.005	0.01	<0.0005	<0.005	0.004	0.01	0.005	<0.01	<0.005	<0.05
Paguate Reservoir	1-07-82	<0.005	<0.05	<0.001	<0.005	0.01	<0.0005	<0.005	0.004	0.03	0.004	<0.01	<0.005	<0.05
Jackpile #4	1-07-82	<0.005	<0.05	<0.001	<0.005	0.02	<0.0005	<0.005	0.003	0.05	0.003	<0.01	<0.005	<0.05
Jackpile New Shop	1-07-82	<0.005	<0.05	0.009	<0.005	0.01	<0.0005	<0.005	0.003	0.04	0.010	<0.01	<0.005	<0.05
Jackpile Old Shop	1-14-82	<0.005	<0.05	<0.001	<0.005	0.02	<0.0005	0.20	0.006	0.01	1.59	<0.01	<0.005	<0.05

35000237
35000237

FOR THE MONTH OF: February, 1982

DESCRIPTION	DATE	pH	TDS ppm	Cond umhos	HCO_3^- ppm	Cl^- ppm	$SO_4^=$ ppm	Na^+ ppm	K^+ ppm	Ca^{++} ppm	Mg^{++} ppm	NO_3^- ppm	F^- ppm	SiO_2 ppm	Mn^{++} ppm			
Paguate Upstream	2-04-82	8.21	706	420	309	9.0	207	33.6	5.1	96	42.7	1.0	0.40	35.0	0.099			
Rio Moquino Upstream	2-04-82	8.34	1806	1150	326	16.2	981	170	9.1	183	117	0.80	0.59	18.0	0.012			
Rio Paguate Above the Confluence	2-04-82	8.55	2111	1310	280	17.9	1249	210	8.4	193	151	0.50	0.70	13.0	0.14			
Rio Moquino Above the Confluence	2-11-82	8.24	692	520	280	10.0	227	42	5.2	80	45.8	0.40	0.40	30.0	0.029			
Rio Paguate Ford Crossing	2-11-82	8.02	1395	1050	268	14.0	755	124	5.4	135	93	0.51	0.49	18.0	0.042			
Paguate Reservoir	2-04-82	8.38	1752	1200	259	20.0	1000	163	11.3	195	0.013	0.54	0.55	12.0	0.013			
Jackpile #4	2-04-82	8.64	998	900	378	14.5	304	291	1.9	5.4	0.53	0.50	1.2	12.0	0.008			
Jackpile New Shop	2-04-82	8.02	1629	1500	400	25.5	687	484	4.2	19.1	1.5	0.54	1.3	15.0	0.020			
Jackpile Old Shop	2-04-82	7.81	3918	3300	248	105	2447	485	11.5	347	232	10.0	0.65	8.1	0.024			
		As ppm	Ba ppm	Cd ppm	Cr ppm	Pb ppm	Hg ppm	Se ppm	Cu ppm	Fe ppm	Zn ppm	Mo ppm	Ni ppm	V ppm				
Rio Paguate Upstream	2-04-82	<0.005	<0.05	<0.001	<0.005	<0.01	<0.0005	<0.005	0.002	0.02	0.016	<0.01	<0.005	<0.05				
Rio Moquino Upstream	2-04-82	<0.005	<0.05	<0.001	<0.005	<0.01	<0.0005	<0.005	0.001	0.01	0.011	<0.01	<0.005	<0.05				
Rio Paguate Above the Confluence	2-04-82	<0.005	<0.05	<0.001	<0.005	<0.01	<0.0005	<0.005	0.004	0.01	0.010	<0.01	<0.005	<0.05				
Rio Moquino Above the Confluence	2-11-82	<0.005	<0.05	<0.001	<0.005	<0.01	<0.0005	<0.005	<0.001	0.02	0.008	<0.01	<0.005	<0.05				
Rio Paguate Ford Crossing	2-11-82	<0.005	<0.05	<0.001	<0.005	<0.01	<0.0005	<0.005	0.006	0.01	0.008	<0.01	<0.005	<0.05				
Paguate Reservoir	2-04-82	<0.005	<0.05	<0.001	<0.005	<0.01	<0.0005	<0.005	<0.001	0.03	0.011	<0.01	<0.005	<0.05				
Jackpile #4	2-04-82	<0.005	<0.05	<0.001	<0.005	<0.01	<0.0005	<0.005	<0.001	0.09	0.018	<0.01	<0.005	<0.05				
Jackpile New Shop	2-04-82	<0.005	<0.05	<0.001	<0.005	<0.01	<0.0005	<0.005	0.001	0.04	0.010	<0.01	<0.005	<0.05				
Jackpile Old Shop	2-04-82	<0.005	<0.05	<0.001	<0.005	<0.01	<0.0005	0.36	0.004	0.02	0.17	<0.01	<0.005	<0.05				

350002377

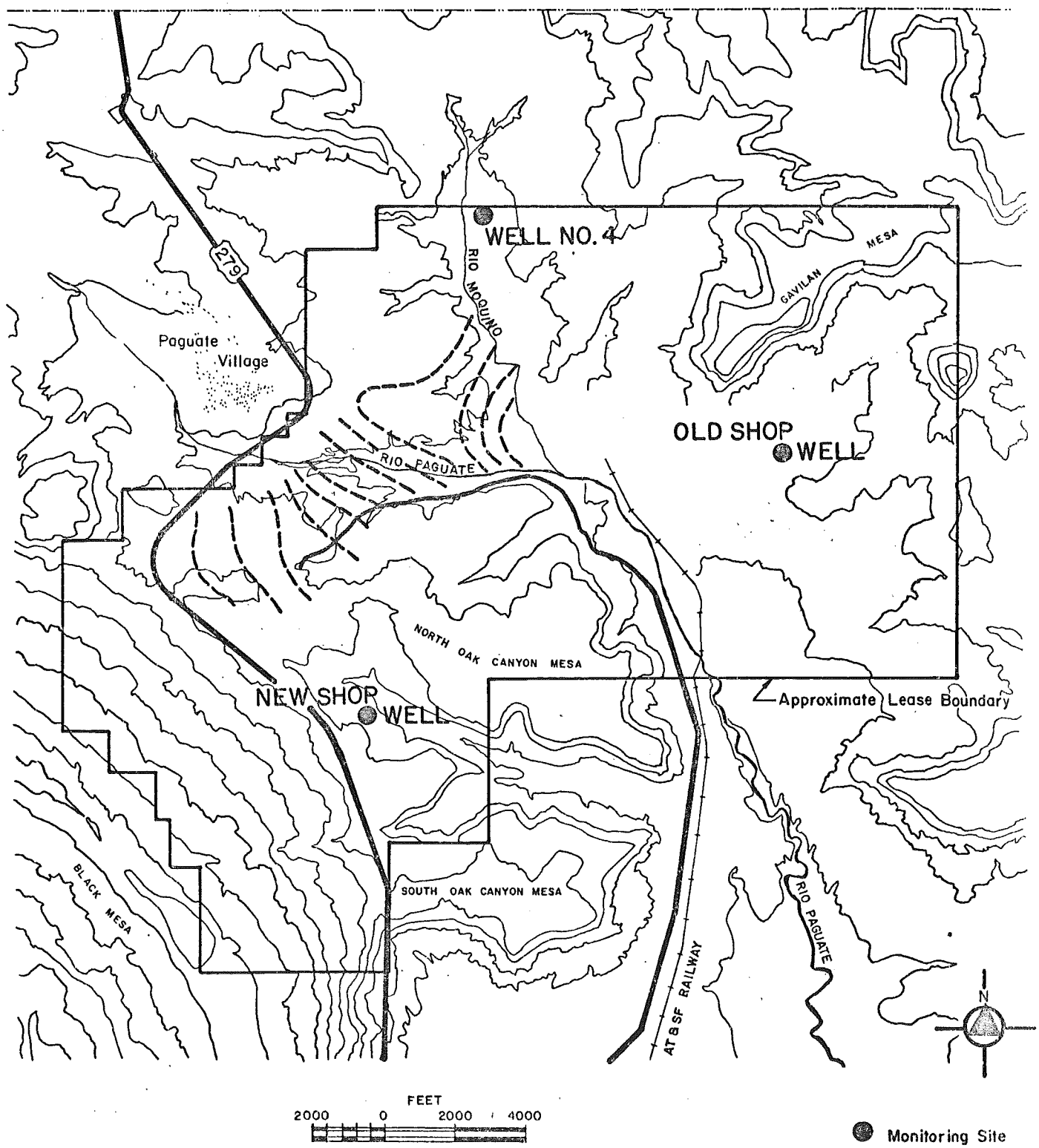
FOR THE MONTH OF: March, 1982

DESCRIPTION	DATE	pH	TDS ppm	Cond umhos	HCO_3^- ppm	Cl^- ppm	$SO_4^=$ ppm	Na^+ ppm	K^+ ppm	Ca^{++} ppm	Mg^{++} ppm	NO_3^- ppm	F^- ppm	SiO_2 ppm	Mn^{++} ppm
Paguate Upstream	3-08-82	8.13	667	800	329	9.9	159	33.0	4.9	93	34.5	1.4	0.81	36.0	0.074
Rio Moquino Upstream	3-01-82	8.30	1722	1200	309	15.0	932	155	7.8	201	97	2.8	0.62	30.0	0.006
Rio Paguate Above the Confluence	3-01-82	8.42	1740	1350	253	20.5	987	156	7.9	202	110	1.9	0.62	24.0	0.015
Rio Moquino Above the Confluence	3-04-82	8.31	737	1000	317	11.0	227	41.6	5.3	90	41.5	1.4	1.6	36.0	0.019
Rio Paguate Ford Crossing	3-01-82	8.10	1629	1100	312	16.5	868	140	7.7	180	101	1.5	0.81	25.0	0.011
Paguate Reservoir	3-04-82	8.02	1732	1400	276	23.5	961	162	11.2	196	99	1.5	0.81	17.0	0.060
Jackpile #4	3-01-82	8.50	1026	950	378	25.5	315	294	1.4	6.1	1.30	1.9	1.6	13.0	0.009
Jackpile New Shop	3-01-82	8.00	1566	1450	390	26.5	677	444	3.1	18.0	2.70	2.0	0.90	16.0	0.016
Jackpile Old Shop	3-04-82	8.07	4005	3300	251	112	2472	490	10.4	370.0	238.0	58.0	0.77	13.0	0.010

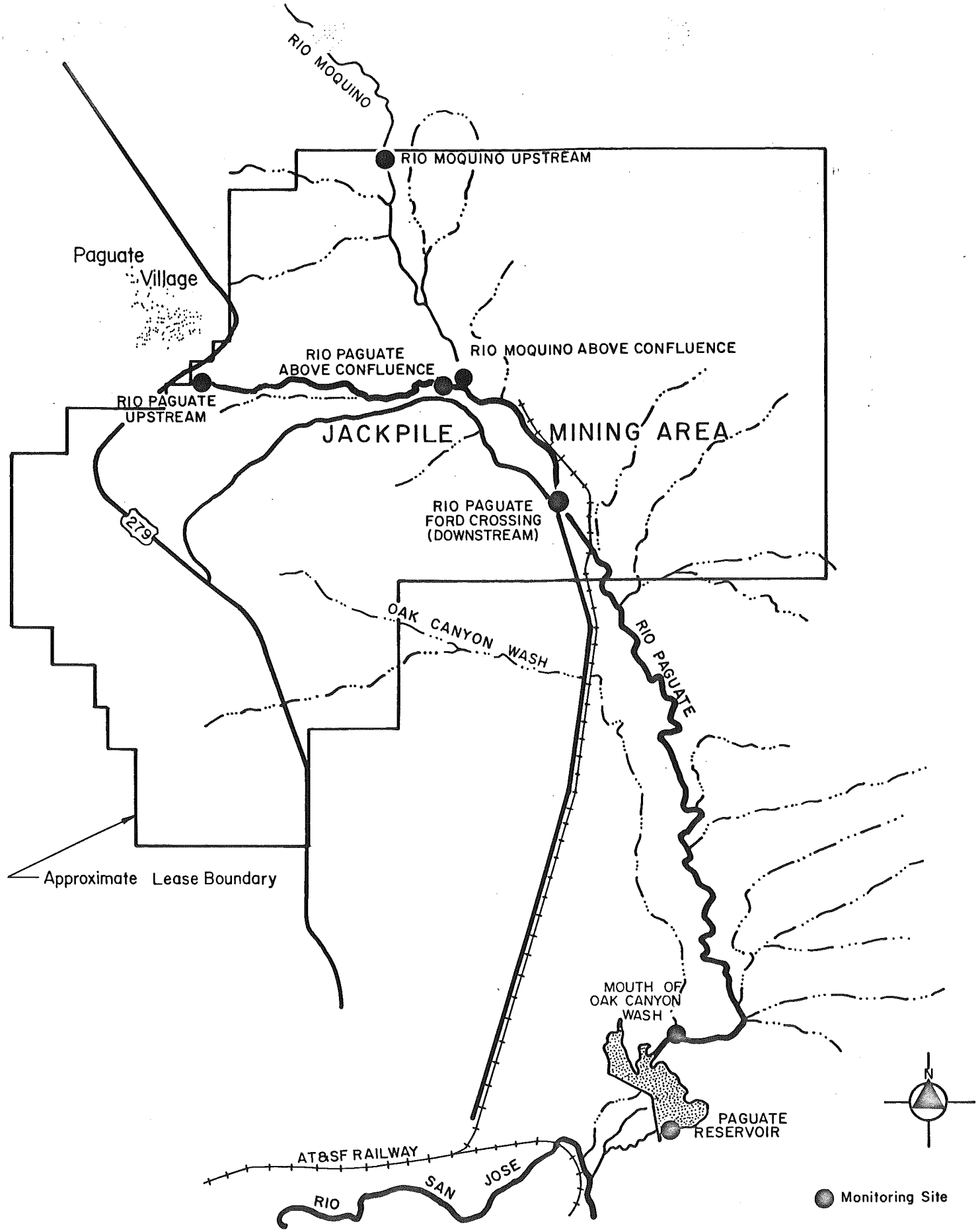
		As ppm	Ba ppm	Cd ppm	Cr ppm	Pb ppm	Hg ppm	Se ppm	Cu ppm	Fe ppm	Zn ppm	Mo ppm	Ni ppm	V ppm
Rio Paguate Upstream	3-08-82	<0.005	0.06	<0.001	<0.005	<0.01	<0.0005	<0.005	0.006	0.03	0.009	<0.01	<0.005	<0.05
Rio Moquino Upstream	3-01-82	<0.005	<0.05	<0.001	<0.005	<0.01	<0.0005	<0.005	0.004	0.02	0.003	<0.01	<0.005	<0.05
Rio Paguate Above the Confluence	3-01-82	<0.005	<0.05	<0.001	<0.005	<0.01	<0.0005	<0.005	0.003	0.01	0.003	<0.01	<0.005	<0.05
Rio Moquino Above the Confluence	3-04-82	<0.005	<0.05	<0.001	<0.005	<0.01	<0.0005	<0.005	0.002	0.02	0.004	<0.01	<0.005	<0.05
Rio Paguate Ford Crossing	3-01-82	<0.005	<0.05	<0.001	<0.005	<0.01	<0.0005	<0.005	0.005	0.02	0.002	0.02	<0.005	<0.05
Paguate Reservoir	3-04-82	<0.005	0.22	<0.001	<0.005	0.01	<0.0005	<0.005	0.003	0.03	0.013	<0.01	<0.005	<0.05
Jackpile #4	3-01-82	<0.005	0.14	<0.001	<0.005	<0.01	<0.0005	<0.005	0.006	0.08	0.009	0.02	<0.005	<0.05
Jackpile New Shop	3-01-82	<0.005	0.07	<0.001	<0.005	<0.01	<0.0005	<0.005	0.004	0.09	0.008	<0.01	<0.005	<0.05
Jackpile Old Shop	3-04-82	<0.005	0.15	<0.001	<0.005	<0.01	<0.0005	0.23	0.003	0.01	1.08	0.02	<0.005	<0.05

35002378

LOCATION OF GROUND WATER MONITORING STATIONS



350002379



LOCATION OF
SURFACE WATER MONITORING STATIONS

350002380

JACKPILE - AIR SAMPLING SURVEY

FIRST QUARTER, 1982

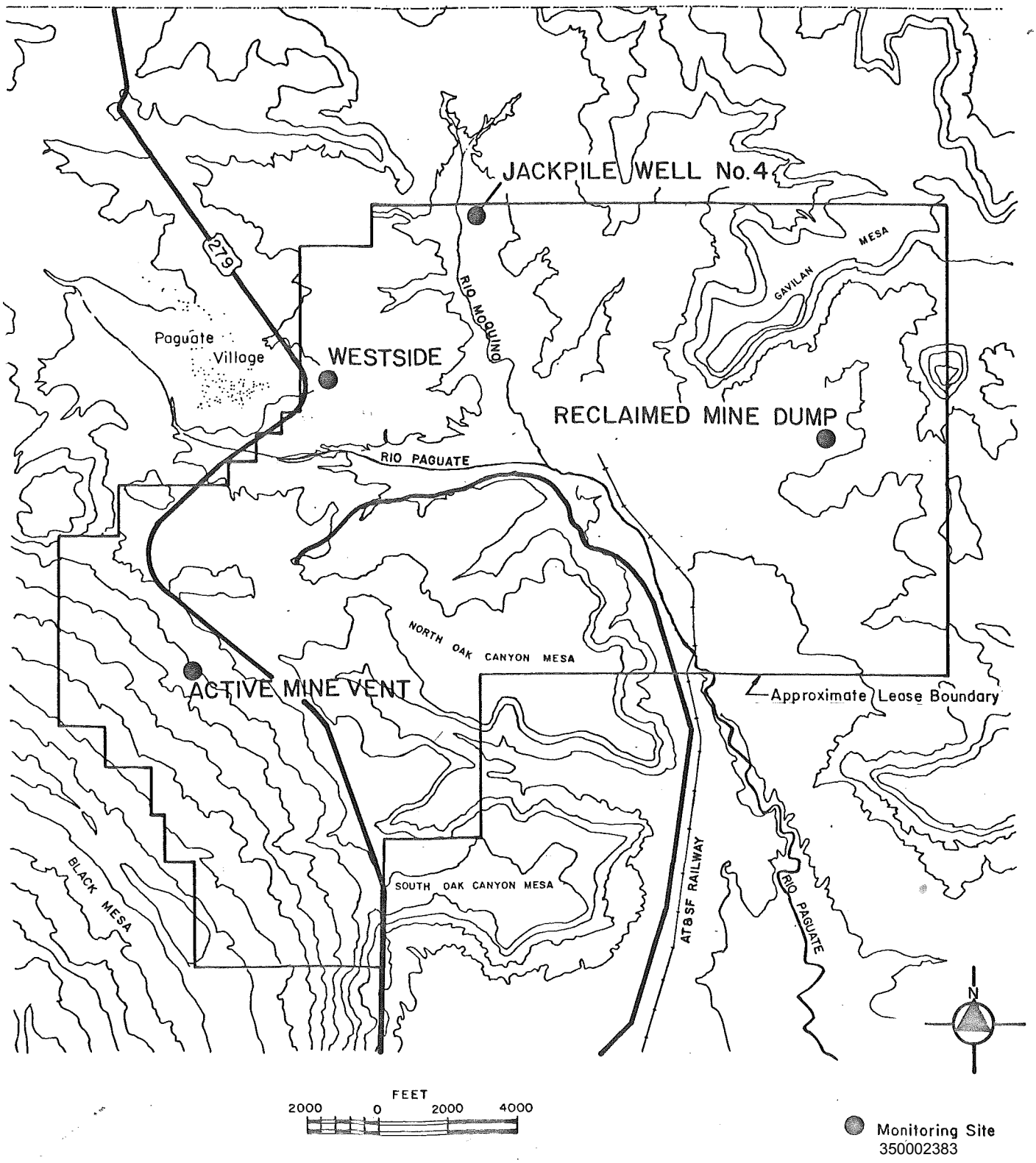
LOCATION	DATE	TOTAL PARTICULATE µgm/M^3	U-Nat. µCi/mlx10-15	Ra-226 µCi/mlx10-15	Th-230 µCi/mlx10-15	Pb-210 µCi/mlx10-15
1. Dump F	1/82	22.50	6.73	4.28	0.67	34.44
	2/82	23.37	8.34	1.10	1.32	31.49
	3/82	22.50	0.83	1.06	2.56	10.93
2. Mine Vent	1/82	10.30	4.39	0.48	0.84	24.10
	2/82	2.92	3.66	0.28	0.60	12.96
	3/82	10.30	5.54	0.30	0.12	38.38
3. West Gate	1/82	19.30	10.13	1.20	1.60	33.00
	2/82	19.81	9.68	0.45	2.56	39.74
	3/82	19.30	2.70	0.10	1.10	21.57
4. Well #4	1/82	19.40	7.13	1.59	1.59	31.84
	2/82	17.89	5.37	1.09	0.82	28.57
	3/82	19.40	6.77	0.35	0.10	18.30

JACKPILE-AMBIENT RADON SURVEY

FIRST QUARTER, 1982

LOCATION	DATE	Rn-222 pCi/L
1. Dump F	1/82	2.09
	2/82	2.21
	3/82	1.79
2. Mine Vent	1/82	1.46
	2/82	1.46
	3/82	1.44
3. Well #4	1/82	2.52
	2/82	2.40
	3/82	2.24
4. Westgate	1/82	1.15
	2/82	1.17
	3/82	1.01

LOCATION OF AIR QUALITY MONITORING STATIONS



Environmental Monitoring File: Anaconda Jackpile/Paguate Mine, Comprehensive

MINERALS
ANACONDA Copper Company
New Mexico Operations
P.O. Box 638
Grants, New Mexico 87020
505/876-2211

February 12, 1982

ALBUQUERQUE DISTRICT MINING
RECEIVED
FEB 25 1982
U.S. GEOLOGICAL SURVEY
ALBUQUERQUE, NEW MEXICO

Mr. Dale Jones
District Mining Supervisor
UNITED STATES DEPARTMENT OF INTERIOR
GEOLOGICAL SURVEY
P.O. Box 26124
Albuquerque, New Mexico 87125

Dear Sir:

The following information is being submitted in accordance with the Jackpile-Paguate Minesite Reclamation Sampling Program for the Fourth Quarter of 1981.

1. Radiological Analysis of Ground and Surface Water.
2. Chemical Analysis of Ground and Surface Water.
3. Maps showing Ground and Surface Water Sampling Locations.
4. Results of the Air Monitoring Program.
5. Results of the Ambient Radon Monitoring Study.
6. Map showing location of Air and Radon Monitoring Stations.

Sincerely,

Dean L. Robert for

Meade A. Stirland, Manager
ENVIRONMENT, HEALTH & SAFETY

Enclosures

350002384

AIR QUALITY MONITORING PROGRAM

One 168-hour sample is taken each month at each of the four locations specified by Marc Nelson. They are collected about three meters above the ground on GF/A Glass Microfibre filter paper, using an RAC Heavy-duty Sampler.

AMBIENT RADON STUDY

Radon-222 is monitored continuously at each of the air sampling locations specified by Marc Nelson. The samples are monitored by the use of the Model RGM-2 Radon Gas Monitor. Normal data output is printed hourly and a 24 hour average is printed at the end of a 24 hour period.

JACKPILE - WATER RADIOLOGICAL ANALYSIS

(FOURTH QUARTER, 1981)

DESCRIPTIVE LOCATION	Radium-226 pCi/L			Uranium-Natural ppm		
	October	November	December	October	November	December
Rio Paguate Upstream	0.06	0.16	0.28	0.015	0.004	0.007
Rio Moquino Upstream	0.36	0.04	0.20	0.013	0.007	0.006
Rio Paguate Above the Confluence	0.51	0.46	0.32	0.115	0.084	0.056
Rio Moquino Above the Confluence	0.36	0.48	0.65	0.049	0.041	0.056
Rio Paguate Ford Crossing	0.88	1.52	0.50	0.230	0.183	0.164
Paguate Reservoir	0.55	0.58	0.05	0.120	0.119	0.141
Jackpile Well #4	0.12	0.80	0.54	0.003	0.013	0.006
Jackpile New Shop	1.95	3.03	1.50	0.004	0.005	0.010
Jackpile Old Shop	4.02	4.22	2.75	0.214	0.195	0.246
Mouth of Oak Canyon Wash	*	*	*	*	*	*

* No sample because the Mouth of Oak Canyon Wash was dry.

THE ANACONDA MINERALS COMPANY
New Mexico Operations

FOR THE MONTH OF: OCTOBER 1981

DESCRIPTION	DATE	pH	TDS ppm	Cond umhos	HCO_3^- ppm	Cl^- ppm	$SO_4^=$ ppm	Na^+ ppm	K^+ ppm	Ca^{++} ppm	Mg^{++} ppm	NO_3^- ppm	F^- ppm	SiO_2 ppm	Mn^{++} ppm		
Rio Paguate Upstream	10-8-81	8.2	811	890	353	13.1	248	42	6.5	97	49.0	0.45	0.47	27	<.005		
Rio Moquino Upstream	10-8-81	8.3	1919	2030	268	17.0	1105	186	11.0	214	116.0	0.55	0.76	16	<.005		
Rio Paguate Above the Confluence	10-8-81	8.2	1066	1140	305	16.0	460	73	7.6	139	64.0	0.31	0.58	27	<.005		
Rio Moquino Above the Confluence	10-8-81	8.3	2054	2150	290	18.2	1153	216	10.3	230	120.0	0.34	0.76	12	0.010		
Rio Paguate Ford Crossing	10-8-81	8.2	2148	2230	280	30.0	1235	218	10.2	247	125.0	0.48	0.76	14	0.012		
Paguate Reservoir	10-8-81	7.9	934	1020	130	20.7	511	63	7.8	164	35.3	0.26	0.57	6	<.005		
Jackpile #4	10-8-81	8.4	1037	1220	373	18.0	324	297	1.4	5	0.5	0.51	1.30	10	0.011		
Jackpile New Shop	10-8-81	8.2	1583	1930	414	28.0	654	461	2.9	18	1.4	0.59	1.30	12	0.017		
Jackpile Old Shop	10-8-81	8.1	3932	4000	268	107.0	2439	496	10.6	356	214.0	37.00	0.73	7	0.022		
		As ppm	Ba ppm	Cd ppm	Cr ppm	Pb ppm	Hg ppm	Se ppm	Cu ppm	Fe ppm	Zn ppm	Mo ppm	Ni ppm	V ppm			
Rio Paguate Upstream	10-8-81	<.005	<.05	< .001	< .005	< .01	<0.0005	<0.005	0.004	0.017	0.002	<0.01	<0.005	<0.05			
Rio Moquino Upstream	10-8-81	<.005	<.05	< .001	< .005	< .01	<0.0005	<0.005	0.005	0.031	0.005	<0.01	<0.005	<0.05			
Rio Paguate Above the Confluence	10-8-81	<.005	<.05	< .001	< .005	< .01	<0.0005	<0.005	0.009	0.043	0.006	<0.01	<0.005	<0.05			
Rio Moquino Above the Confluence	10-8-81	<.005	<.05	< .001	< .005	< .01	<0.0005	0.006	0.004	0.013	0.003	<0.01	<0.005	<0.05			
Rio Paguate Ford Crossing	10-8-81	<.005	<.05	< .001	< .005	< .01	<0.0005	0.10	0.003	0.023	0.005	<0.01	<0.005	<0.05			
Paguate Reservoir	10-8-81	<.005	<.05	< .001	< .005	< .01	<0.0005	<0.005	0.005	0.019	0.006	<0.01	<0.005	<0.05			
Jackpile #4	10-8-81	<.005	<.05	< .001	< .005	< .01	<0.0005	<0.005	0.004	0.064	0.004	<0.01	<0.005	<0.05			
Jackpile New Shop	10-8-81	<.005	<.05	< .001	< .005	< .01	<0.0005	<0.005	0.003	0.018	0.027	<0.01	<0.005	<0.05			
Jackpile Old Shop	10-8-81	<.005	<.05	< .001	< .005	< .01	<0.0005	0.28	0.004	0.031	1.47	<0.01	<0.005	<0.05			

350002387

THE ANACONDA MINERALS COMPANY
New Mexico Operations

FOR THE MONTH OF: NOVEMBER 1981

DESCRIPTION	DATE	pH	TDS ppm	Cond umhos	HCO_3^- ppm	Cl^- ppm	$SO_4^=$ ppm	Na^+ ppm	K^+ ppm	Ca^{++} ppm	Mg^{++} ppm	NO_3^- ppm	F^- ppm	SiO_2 ppm	Mn^{++} ppm		
Rio Paguate Upstream	11-4-8	8.2	725	790	331	10.0	195	39	7.3	96	42.7	0.58	0.37	32.0	<.005		
Rio Moquino Upstream	11-4-81	8.1	1902	1900	290	15.5	1077	200	13.1	193	111.0	0.74	0.62	15.0	<.005		
Rio Paguate Above the Confluence	11-4-81	8.2	874	910	341	11.5	289	60	7.3	115	48.0	0.47	0.48	27.0	<.005		
Rio Moquino Above the Confluence	11-4-81	8.1	2173	2200	292	18.1	1258	225	11.6	230	135.0	0.50	0.76	13.0	0.04		
Rio Paguate Ford Crossing	11-4-81	8.1	1978	2000	324	20.2	1097	210	11.2	203	107.0	0.94	0.63	17.0	0.03		
Paguate Reservoir	11-4-81	8.1	957	1020	138	10.3	531	65	9.7	165	35.8	0.52	0.60	3.4	<.005		
Jackpile #4	11-1-81	8.3	1048	1800	353	17.7	365	300	1.6	6	0.6	0.79	1.10	7.3	0.01		
Jackpile New Shop	11-4-81	8.2	1588	1790	390	26.7	687	453	3.1	21	1.6	0.81	1.20	12.0	0.02		
Jackpile Old Shop	11-4-81	8.0	3990	3890	256	105.0	2439	516	12.6	386	205.0	53.00	0.57	8.1	0.02		
		As ppm	Ba ppm	Cd ppm	Cr ppm	Pb ppm	Hg ppm	Se ppm	Cu ppm	Fe ppm	Zn ppm	Mo ppm	Ni ppm	V ppm			
Rio Paguate Upstream	11-4-81	<0.005	<0.05	<0.001	<0.005	<.01	<0.0005	<0.005	0.004	0.23	0.003	<0.05	<0.005	<0.05			
Rio Moquino Upstream	11-4-81	<0.005	<0.05	<0.001	<0.005	< .01	<0.0005	<0.005	0.005	0.03	0.005	<0.05	0.011	<0.05			
Rio Paguate Above the Confluence	11-4-81	<0.005	<0.05	<0.001	<0.005	< .01	<0.0005	<0.005	0.003	0.04	0.003	<0.05	<0.005	<0.05			
Rio Moquino Above the Confluence	11-4-81	<0.005	<0.05	<0.001	<0.005	< .01	0.0007	<0.005	0.002	0.04	0.005	<0.05	<0.005	<0.05			
Rio Paguate Ford Crossing	11-4-81	<0.005	<0.05	<0.001	<0.005	< .01	<0.0005	<0.005	0.003	3.12	0.003	<0.05	<0.005	<0.05			
uate Reservoir	11-4-81	<0.005	<0.05	<0.001	<0.005	0.02	<0.0005	<0.005	0.005	0.08	0.010	<0.05	0.013	<0.05			
kpile #4	11-1-81	<0.005	<0.05	<0.001	<0.005	< .01	0.0011	<0.005	0.002	0.02	0.004	<0.05	<0.005	<0.05			
kpile New Shop	11-4-81	<0.005	<0.05	<0.001	<0.005	< .01	<0.0005	<0.005	0.003	0.16	0.030	<0.05	<0.005	<0.05			
kpile Old Shop	11-4-81	<0.005	<0.05	<0.001	<0.005	< .01	<0.0005	0.14	0.003	0.05	1.500	<0.05	<0.005	<0.05			

350002388

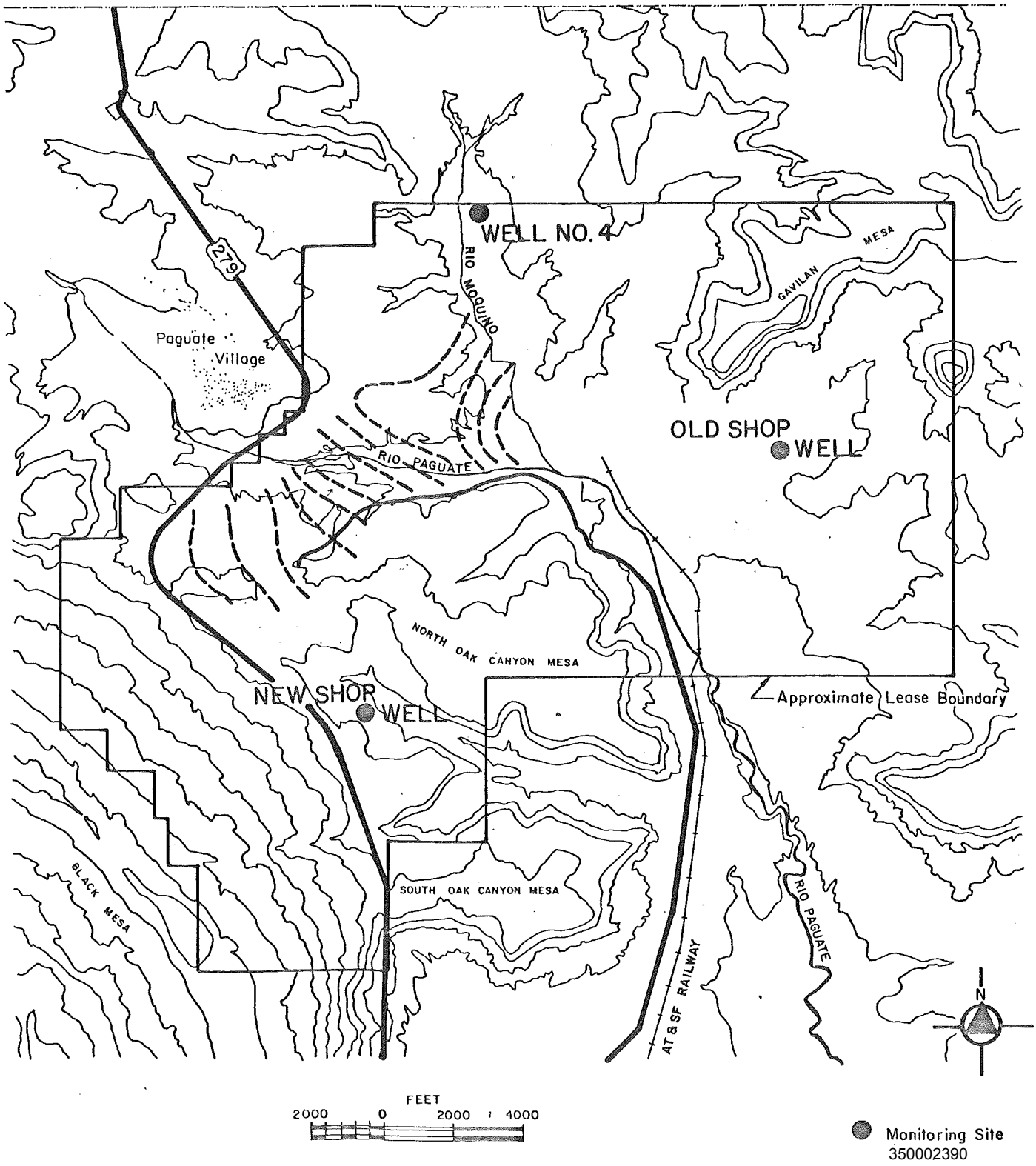
THE ANACONDA MINERALS COMPANY
New Mexico Operations

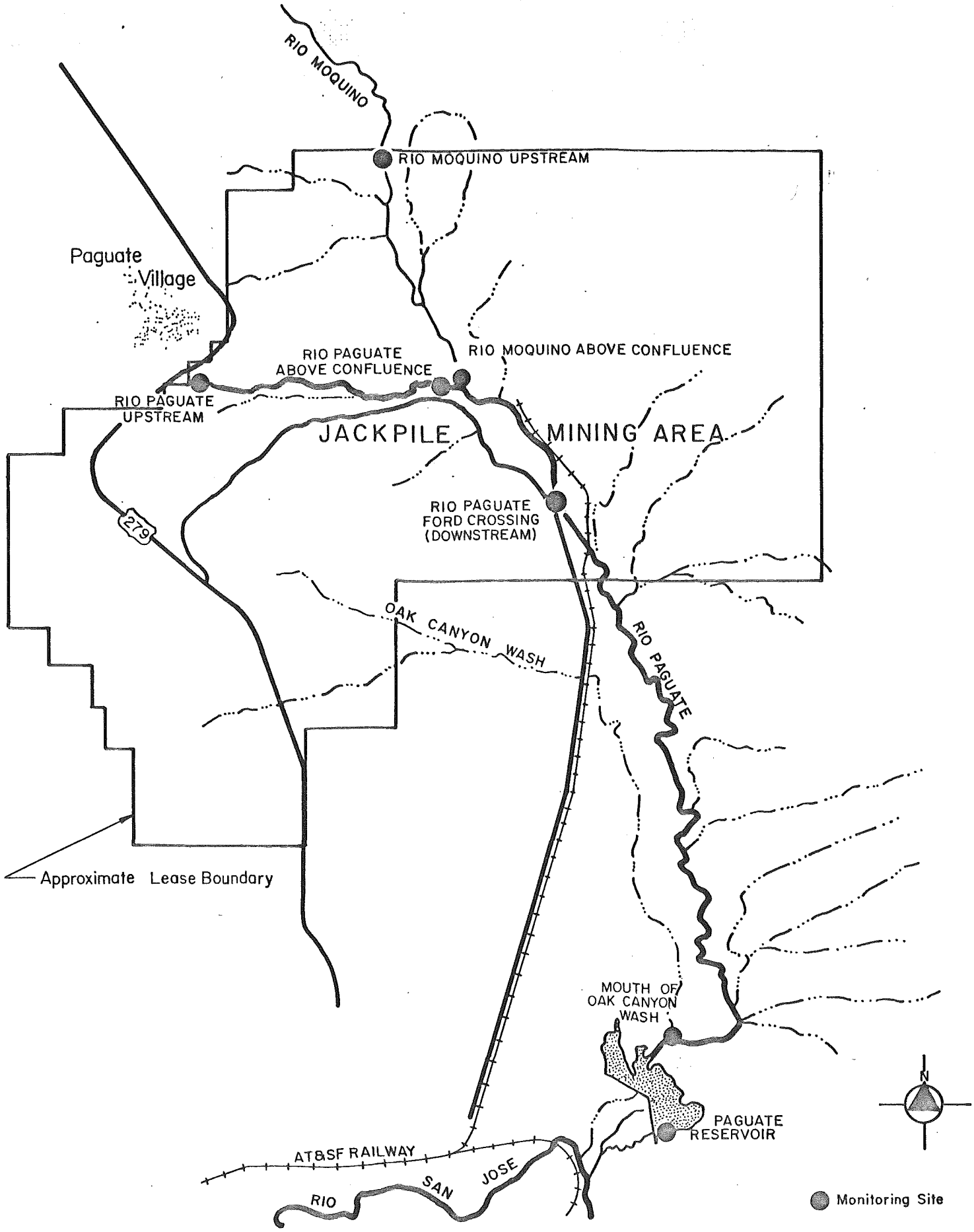
FOR THE MONTH OF: DECEMBER 1981

DESCRIPTION	DATE	pH	TDS ppm	Cond umhos	HCO_3^- ppm	Cl^- ppm	$SO_4^=$ ppm	Na^+ ppm	K^+ ppm	Ca^{++} ppm	Mg^{++} ppm	NO_3^- ppm	F^- ppm	SiO_2 ppm	Mn^{++} ppm		
Rio Paguate Upstream	12-9-81	8.0	822	865	351	11.5	255	45	5.9	99	53.5	0.33	0.40	29.2	.055		
Rio Moquino Upstream	12-9-81	8.1	1614	1690	326	13.8	841	143	9.3	174	104.0	0.52	0.58	16.9	.006		
Rio Paguate Above the Confluence	12-9-81	8.2	1017	1070	361	12.8	385	69	5.4	115	68.0	0.33	0.43	22.5	.076		
Rio Moquino Above the Confluence	12-9-81	8.1	2455	2430	409	18.5	1369	255	9.4	240	152.0	0.33	0.74	12.4	.130		
Rio Paguate Ford Crossing	12-9-81	8.0	2123	2190	351	19.5	1178	226	9.3	196	141.0	0.52	0.64	14.7	.113		
Paguate Reservoir	12-9-81	8.0	1008	1100	146	12.1	562	68	12.3	167	38.7	0.33	0.50	2.7	.007		
Jackpile #4	12-9-81	8.3	1021	1320	366	16.2	338	290	1.7	5	55.0	0.52	1.10	10.1	.009		
Jackpile New Shop	12-9-81	8.3	1567	1870	348	25.5	681	458	3.8	17	1.3	2.10	1.20	12.3	.027		
Jackpile Old Shop	12-9-81	8.1	3998	3990	251	100.0	2480	510	11.1	364	236.0	43.00	0.64	11.3	.016		
		As ppm	Ba ppm	Cd ppm	Cr ppm	Pb ppm	Hg ppm	Se ppm	Cu ppm	Fe ppm	Zn ppm	Mo ppm	Ni ppm	V ppm			
Rio Paguate Upstream	12-9-81	<.005	<.05	<.001	<.005	<.01	<.0005	<.005	<.001	.03	0.002	<.01	<.005	<.05			
Rio Moquino Upstream	12-9-81	<.005	<.05	<.001	<.005	<.01	<.0005	<.005	<.001	.02	0.003	<.01	<.005	<.05			
Rio Paguate Above the Confluence	12-9-81	<.005	<.05	<.001	<.005	<.01	<.0005	<.005	0.004	.02	0.003	<.01	<.005	<.05			
Rio Moquino Above the Confluence	12-9-81	<.005	<.05	<.001	<.005	<.01	<.0005	<.005	0.002	.03	0.004	<.01	<.005	<.05			
Rio Paguate Ford Crossing	12-9-81	<.005	<.05	<.001	<.005	<.01	<.0005	<.005	<.001	.02	0.003	<.01	<.005	<.05			
uate Reservoir	12-9-81	<.005	<.05	<.001	<.005	<.01	<.0005	<.005	<.001	.03	0.003	<.01	<.005	<.05			
kpile #4	12-9-81	<.005	<.05	<.001	<.005	<.01	<.0005	<.005	<.001	.06	0.005	<.01	<.005	<.05			
kpile New Shop	12-9-81	<.005	<.05	<.001	<.005	<.01	<.0005	<.005	0.003	.05	0.014	<.01	<.005	<.05			
Jackpile Old Shop	12-9-81	<.005	<.05	<.001	<.005	<.01	<.0005	0.21	<.001	.02	.77	<.01	<.005	<.05			

350002389

LOCATION OF GROUND WATER MONITORING STATIONS





LOCATION OF
SURFACE WATER MONITORING STATIONS

350002391

JACKPILE - AIR SAMPLING SURVEY

FOURTH QUARTER, 1981

LOCATION	DATE	TOTAL PARTICULATE µgm/M^3	U-Nat. µCi/mlx10-15	Ra-226 µCi/mlx10-15	Th-230 µCi/mlx10-15	Pb-210 µCi/mlx10-15
1. Dump F	10/81	16.9	2.48	1.58	1.70	17.54
	11/81	19.7	0.75	1.26	1.26	33.96
	12/81	15.0	2.38	0.81	0.92	34.59
2. Mine Vent	10/81	10.8	0.09	0.33	0.85	14.22
	11/81	19.3	0.06	0.06	0.15	34.59
	12/81	11.3	2.17	0.18	0.81	28.05
3. West Gate	10/81	19.0	0.62	0.26	1.24	36.08
	11/81	23.7	1.64	0.31	0.61	29.74
	12/81	25.3	2.14	0.35	0.90	37.50
4. Well #4	10/81	24.2	1.89	0.79	1.69	13.76
	11/81	39.9	1.93	0.83	1.00	31.49
	12/81	29.2	0.71	0.43	1.38	29.05

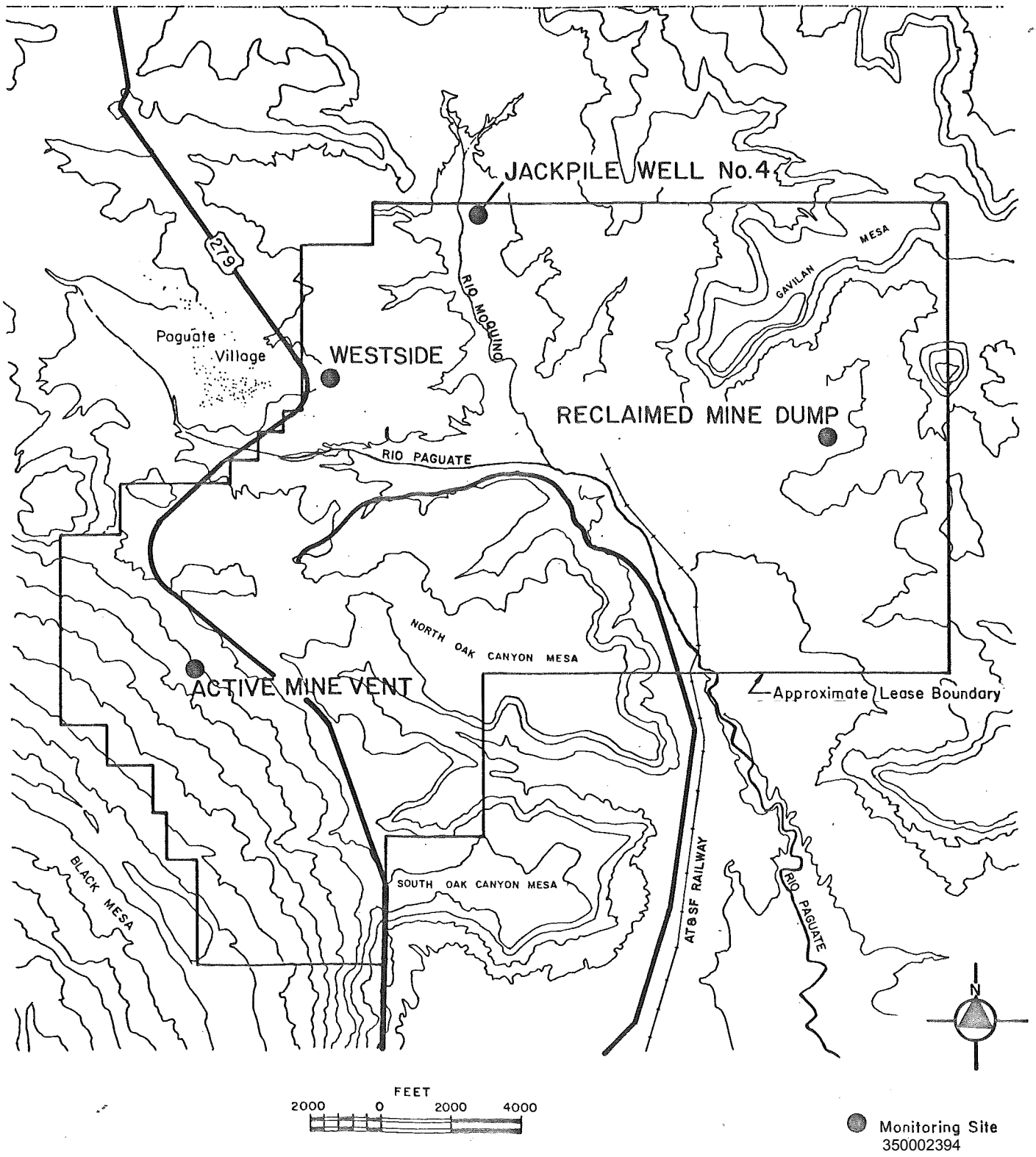
350002392

JACKPILE-AMBIENT RADON SURVEY

FOURTH QUARTER, 1981

LOCATION	DATE	Rn-222 pCi/l
1. Dump F	10/81	2.11
	11/81	2.70
	12/81	2.70
2. Mine Vent	10/81	1.94
	11/81	2.19
	12/81	2.22
3. Well #4	10/81	2.41
	11/81	2.78
	12/81	2.72
4. Westgate	10/81	1.13
	11/81	1.25
	12/81	1.24

LOCATION OF
AIR QUALITY MONITORING STATIONS



ANACONDA Copper Company
555 Seventeenth Street
Denver, Colorado 80217
Telephone 303 575 4000

ALBUQUERQUE DISTRICT MINING
RECEIVED
JAN 13 1982
U.S. GEOLOGICAL SURVEY
ALBUQUERQUE, NEW MEXICO

November 13, 1981

Mr. John Andrews
United States Department of the Interior
Geological Survey
P.O. Box 26124
Albuquerque, New Mexico 87125

Dear Mr. Andrews:

Pursuant to your request, attached please find an evaluation of air particulate samples taken at the four permanent stations at the Jackpile-Paguate mine site.

If additional information or clarification is required, please advise.

Sincerely,

W. E. Gray, Chairman
Anaconda EIS Team

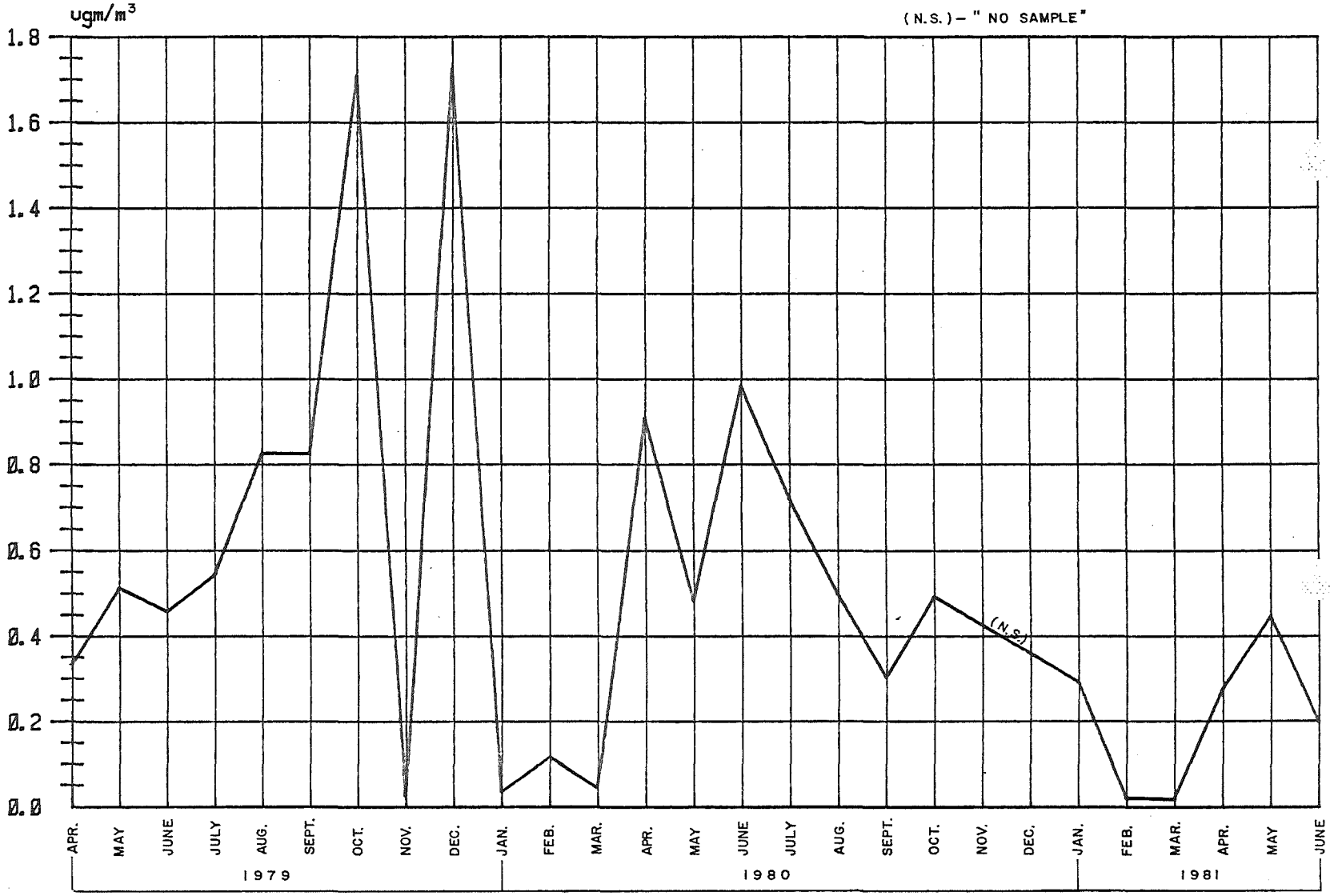
WEG/cc
Attach.

ANACONDA Copper Company is a Division of The ANACONDA Company
A.R.CO.-6178

JACKPILE - AIR SAMPLING SURVEY

TOTAL PARTICULATE

DUMP F

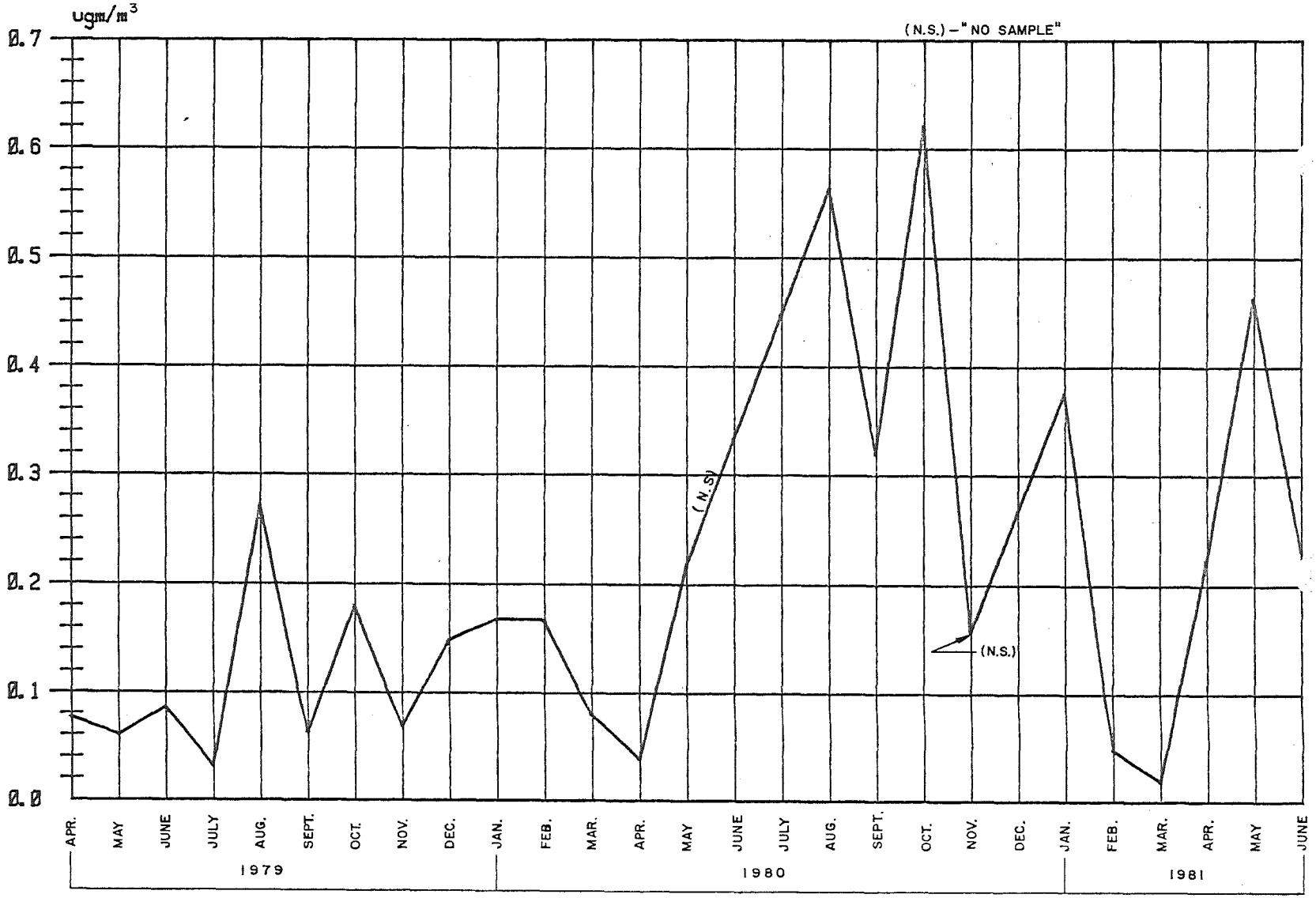


350002396

JACKPILE - AIR SAMPLING SURVEY

TOTAL PARTICULATE

MINE VENT



3500023 97

JACKPILE - AIR SAMPLING SURVEY

TOTAL PARTICULATE

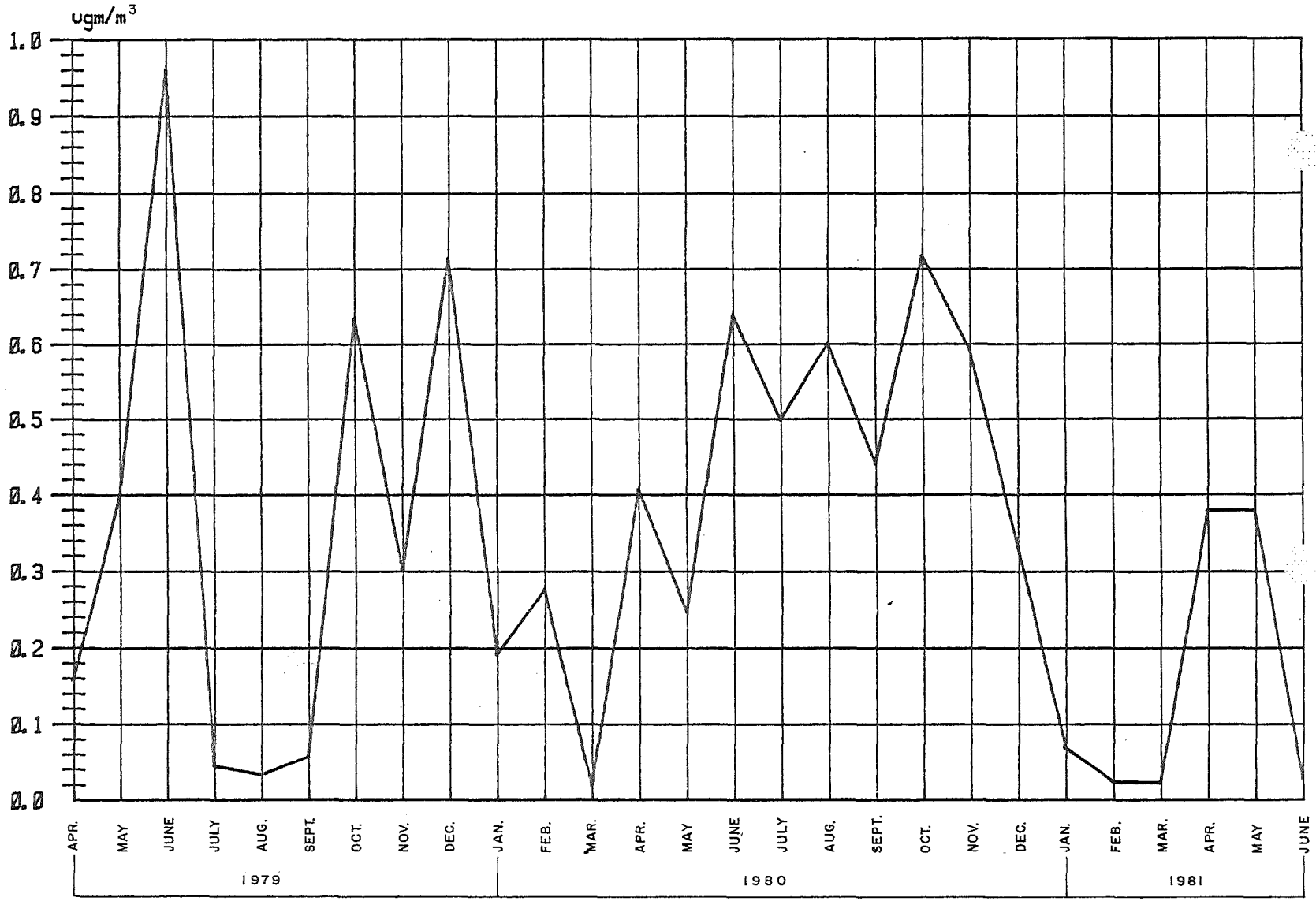
WEST GATE

35000239 8

JACKPILE - AIR SAMPLING SURVEY

TOTAL PARTICULATE

WELL #4



3500023 99

JACKPILE - AIR SAMPLING SURVEY

TOTAL PARTICULATE IN ugm/m^3

DATE	DUMP F	MINE VENT	WEST GATE	WELL #4
4-79	0.333	0.076	0.823	0.158
5-79	0.513	0.060	0.540	0.397
6-79	0.487	0.086	0.932	0.961
7-79	0.544	0.031	0.066	0.044
8-79	0.826	0.272	0.640	0.033
9-79	0.825	0.062	0.119	0.057
10-79	1.710	0.180	0.947	0.635
11-79	0.023	0.068	NS	0.300
12-79	1.725	0.149	0.104	0.715
1-80	0.033	0.168	0.085	0.191
2-80	0.116	0.167	0.032	0.276
3-80	0.042	0.079	0.020	0.020
4-80	0.909	0.038	0.357	0.407
5-80	0.482	0.217	0.321	0.246
6-80	0.983	NS	1.012	0.639
7-80	0.719	NS	0.790	0.498
8-80	0.497	0.564	0.571	0.601
9-80	0.302	0.319	0.554	0.440
10-80	0.492	0.621	0.722	0.718
11-80	NS	0.157	0.360	0.591
12-80	NS	NS	0.537	0.330
1-81	0.291	0.376	0.820	0.069
2-81	0.020	0.047	0.147	0.024
3-81	0.017	0.018	0.021	0.023
4-81	0.276	0.223	0.489	0.379
5-81	0.477	0.464	0.490	0.380
6-81	0.197	0.231	0.537	0.028

These values are wrong! Misplaced decimal point

NS - indicates No Sample

350002400

RECEIVED
1979 DEC -7 PM 2:56
STATE COMMISSION OF
PUBLIC RECORDS & ARCHIVES

State of New Mexico
Environmental Improvement Board
Crown Building, P. O. Box 968
Santa Fe, New Mexico 87503

EIB/AQCR 201
(Supercedes EIB/AQC Regulation
201 dated April 19, 1974)

AIR QUALITY CONTROL REGULATION 201

201. AMBIENT AIR QUALITY STANDARDS --

A. The maximum allowable concentrations of total suspended particulate in the ambient air are as follows:

	MAXIMUM CONCENTRATION
1. 24 - hour average	150 $\mu g/m^3$
2. 7 - day average	110 $\mu g/m^3$
3. 30 - day average	90 $\mu g/m^3$
4. Annual geometric mean	60 $\mu g/m^3$

B. When one or more of the following elements are present in the total suspended particulate, the maximum allowable concentrations of the elements involved, based on a thirty-day average, are as follows:

	MAXIMUM CONCENTRATION
1. Beryllium	0.01 $\mu g/m^3$
2. Asbestos	0.01 $\mu g/m^3$
3. Heavy metals (total combined)	10 $\mu g/m^3$

C. The maximum allowable concentrations of the following air contaminants in the ambient air are as follows:

	MAXIMUM CONCENTRATION
1. Sulfur dioxide	
(a) 24 - hour average	0.10 ppm
(b) Annual arithmetic average	0.02 ppm
2. Hydrogen sulfide	

(a) For the state, except the Pecos-Permian Basin Intra-state Air Quality Control Region (1-hour average, not to be exceeded more than once per year) 0.010 ppm

350002401

ANACONDA Copper Company
555 Seventeenth Street
Denver, Colorado 80217
Telephone 303 575 4000

December 8, 1981

Mr. John Andrews
UNITED STATES DEPARTMENT OF THE INTERIOR
Geological Survey
P.O. Box 26124
Albuquerque, New Mexico 87125

Dear Mr. Andrews

Anaconda correspondence dated November 13, 1981 to your office incorrectly reported results of the Jackpile-Paguate air sampling survey data due to a decimal point error. Attached please find a summary of the corrected data.

If additional clarification is required, please advise.

Sincerely,

W. E. Gray, Chairman
Anaconda EIS Team

WEG/cc

ALBUQUERQUE DISTRICT MINING
RECEIVED
DEC 10 1981
U.S. GEOLOGICAL SURVEY
ALBUQUERQUE, NEW MEXICO

JACKPILE - AIR SAMPLING SURVEY
TOTAL PARTICULATE IN $\mu gm/m^3$

DATE	DUMP F	MINE VENT	WEST GATE	WELL #4
4-79	33.3	7.6	82.3	15.8
5-79	51.3	6.0	54.0	39.7
6-79	48.7	8.6	93.2	96.1
7-79	54.4	3.1	6.6	4.4
8-79	82.6	27.2	64.0	3.3
9-79	82.5	6.2	11.9	5.7
10-79	171.0	18.0	94.7	63.6
11-79	2.3	6.8	NS	30.0
12-79	172.5	14.9	10.4	71.5
1-80	3.3	16.8	8.5	19.1
2-80	11.6	16.7	3.2	27.6
3-80	4.2	7.9	2.0	2.0
4-80	90.9	3.8	35.7	40.7
5-80	48.2	21.7	32.1	24.6
6-80	98.3	NS	101.2	63.9
7-80	71.9	NS	79.0	49.8
8-80	49.7	56.4	57.1	60.1
9-80	30.2	31.9	55.4	44.0
10-80	49.2	62.1	72.2	71.8
11-80	NS	15.7	36.0	59.1
12-80	NS	NS	53.7	33.0
1-81	29.1	37.6	82.0	6.9
2-81	2.0	4.7	14.7	2.4
3-81	1.7	1.8	2.1	2.3
4-81	27.6	22.3	48.9	37.9
5-81	47.7	46.4	49.0	38.0
6-81	19.7	23.1	53.7	2.8

NS- Indicates No Sample
7 Day Average - Maximum Concentration 110 $\mu g/m^3$

JACKPILE - AIR SAMPLING SURVEY
TOTAL PARTICULATE IN $\mu gm/m^3$

DATE	DUMP F	MINE VENT	WEST GATE	WELL #4
4-79	33.3	7.6	82.3	15.8
5-79	51.3	6.0	54.0	39.7
6-79	48.7	8.6	93.2	96.1
7-79	54.4	3.1	6.6	4.4
8-79	82.6	27.2	64.0	3.3
9-79	82.5	6.2	11.9	5.7
10-79	171.0	18.0	94.7	63.6
11-79	2.3	6.8	NS	30.0
12-79	172.5	14.9	10.4	71.5
1-80	3.3	16.8	8.5	19.1
2-80	11.6	16.7	3.2	27.6
3-80	4.2	7.9	2.0	2.0
4-80	90.9	3.8	35.7	40.7
5-80	48.2	21.7	32.1	24.6
6-80	98.3	NS	101.2	63.9
7-80	71.9	NS	79.0	49.8
8-80	49.7	56.4	57.1	60.1
9-80	30.2	31.9	55.4	44.0
10-80	49.2	62.1	72.2	71.8
11-80	NS	15.7	36.0	59.1
12-80	NS	NS	53.7	33.0
1-81	29.1	37.6	82.0	6.9
2-81	2.0	4.7	14.7	2.4
3-81	1.7	1.8	2.1	2.3
4-81	27.6	22.3	48.9	37.9
5-81	47.7	46.4	49.0	38.0
6-81	19.7	23.1	53.7	2.8

NS- Indicates No Sample
7 Day Average - Maximum Concentration 110 $\mu g/m^3$

JACKPILE - AIR SAMPLING SURVEY
TOTAL PARTICULATE IN $\mu gm/m^3$

DATE	DUMP F	MINE VENT	WEST GATE	WELL #4
4-79	33.3	7.6	82.3	15.8
5-79	51.3	6.0	54.0	39.7
6-79	48.7	8.6	93.2	96.1
7-79	54.4	3.1	6.6	4.4
8-79	82.6	27.2	64.0	3.3
9-79	82.5	6.2	11.9	5.7
10-79	171.0	18.0	94.7	63.6
11-79	2.3	6.8	NS	30.0
12-79	172.5	14.9	10.4	71.5
1-80	3.3	16.8	8.5	19.1
2-80	11.6	16.7	3.2	27.6
3-80	4.2	7.9	2.0	2.0
4-80	90.9	3.8	35.7	40.7
5-80	48.2	21.7	32.1	24.6
6-80	98.3	NS	101.2	63.9
7-80	71.9	NS	79.0	49.8
8-80	49.7	56.4	57.1	60.1
9-80	30.2	31.9	55.4	44.0
10-80	49.2	62.1	72.2	71.8
11-80	NS	15.7	36.0	59.1
12-80	NS	NS	53.7	33.0
1-81	29.1	37.6	82.0	6.9
2-81	2.0	4.7	14.7	2.4
3-81	1.7	1.8	2.1	2.3
4-81	27.6	22.3	48.9	37.9
5-81	47.7	46.4	49.0	38.0
6-81	19.7	23.1	53.7	2.8

NS- Indicates No Sample
7 Day Average - Maximum Concentration 110 $\mu g/m^3$

ANACONDA Copper Company
New Mexico Operations
P.O. Box 638
Grants, New Mexico 87020
505/876-2211

December 2, 1981

ALBUQUERQUE DISTRICT MINING
RECEIVED
DEC 09 1981
U.S. GEOLOGICAL SURVEY
ALBUQUERQUE, NEW MEXICO

Mr. Dale Jones
District Mining Supervisor
UNITED STATES DEPARTMENT OF INTERIOR
GEOLOGICAL SURVEY
P.O. Box 26124
Albuquerque, New Mexico 87125

Dear Sir:

The following information is being submitted in accordance with the Jackpile-Paguate Minesite Reclamation Sampling Program for the Third Quarter of 1981.

1. Radiological Analysis of Ground and Surface Water.
2. Chemical Analysis of Ground and Surface Water.
3. Maps showing Ground and Surface Water Sampling Locations.
4. Results of the Air Monitoring Program.
5. Results of the Ambient Radon Monitoring Study.
6. Map showing location of Air and Radon Monitoring Stations.

Sincerely,

Meade A. Stirland, Manager
ENVIRONMENT, HEALTH & SAFETY

jls

Enclosures

350002406

AIR QUALITY MONITORING PROGRAM

One 168-hour sample is taken each month at each of the four locations specified by Marc Nelson. They are collected about three meters above the ground on GF/A Glass Microfibre filter paper, using an RAC Heavy-duty Sampler.

AMBIENT RADON STUDY

Radon-222 is monitored continuously at each of the air sampling locations specified by Marc Nelson. The samples are monitored by the use of the Model RGM-2 Radon Gas Monitor. Normal data output is printed hourly and a 24 hour average is printed at the end of a 24 hour period.

JACKPILE - WATER RADIOLOGICAL ANALYSIS

(THIRD QUARTER, 1981)

DESCRIPTIVE LOCATION	Radium-226 pCi/L			Uranium-Natural ppm		
	July	August	September	July	August	September
Rio Paguate Upstream	0.32	0.23	0.27	0.013	0.003	0.002
Rio Moquino Upstream	0.60	0.40	0.29	0.012	0.014	0.009
Rio Paguate Above the Confluence	0.72	1.87	1.79	0.140	0.138	0.050
Rio Moquino Above the Confluence	1.15	1.05	2.34	0.073	0.053	0.138
Rio Paguate Ford Crossing	1.36	1.28	1.18	0.285	0.318	0.292
Paguate Reservoir	1.99	0.71	0.81	0.196	0.110	0.061
Jackpile Well #4	0.18	0.19	0.06	0.004	0.002	0.001
Jackpile New Shop	2.45	1.50	2.80	0.005	0.003	0.001
Jackpile Old Shop	3.35	4.93	2.20	0.293	0.228	0.215
Mouth of Oak Canyon Wash	*	*	*	*	*	*

* No sample because the Mouth of Oak Canyon Wash was dry.

ANACONDA COPPER COMPANY
NEW MEXICO OPERATION

FOR THE MONTH OF: July, 1981

DESCRIPTION	DATE	pH	TDS ppm	Cond umhos	HCO_3^- ppm	Cl^- ppm	$SO_4^=$ ppm	Na^+ ppm	K^+ ppm	Ca^{++} ppm	Mg^{++} ppm	NO_3^- ppm	P^- ppm	SiO_2 ppm	Mn^{++} ppm			
Rio Paguate Upstream	7-14-81	7.9	888	890	341	14	306	47.3	7	120	51	0.8	<0.1	33	<.005			
Rio Moquino Upstream	7-14-81	8.1	2062	1960	244	16	1235	190	12	232	131	0.7	<0.1	21	<.005			
Rio Paguate Above the Confluence	7-14-81	8.1	1032	1040	280	16	462	71	8	128	64	0.9	<0.1	22	<.005			
Rio Moquino Above the Confluence	7-14-81	7.9	1685	1700	195	16	1016	167	10	184	93	1.7	<0.1	8	<.005			
Rio Paguate Ford Crossing	7-14-81	8.1	1805	1730	244	18	1056	166	10	208	101	0.9	<0.1	9	<.005			
Paguate Reservoir	7-14-81	7.7	1655	1580	103	11	1069	97	12	289	68	4.0	<0.1	8	<.005			
Jackpile #4	7-14-81	8.4	1011	1160	353	18	325	294	1	4	0.2	0.7	<0.1	9	0.006			
Jackpile New Shop	7-14-81	8.4	1580	1770	378	26	674	468	2.69	11	3	3	<0.1	15	0.016			
Jackpile Old Shop	7-14-81	8.2	3893	3350	256	120	2402	548	9	281	246	28	<0.1	8.1	0.014			
		As ppm	Ba ppm	Cd ppm	Cr ppm	Pb ppm	Hg ppm	Se ppm	Cu ppm	Fe ppm	Zn ppm	Mo ppm	Ni ppm	V ppm				
Rio Paguate Upstream	7-14-81	<.005	<0.05	<.001	<.005	0.02	<.0005	<.005	0.003	0.007	0.002	<0.01	<.005	<0.05				
Rio Moquino Upstream	7-14-81	<.005	<0.05	<.001	<.005	0.02	<.0005	<.005	0.003	0.013	0.017	<0.01	<.005	<0.05				
Rio Paguate Above the Confluence	7-14-81	<.005	<0.05	<.001	<.005	0.02	<.0005	<.005	0.002	0.010	0.004	<0.01	<.005	<0.05				
Rio Moquino Above the Confluence	7-14-81	<.005	<0.05	<.001	<.005	0.02	<.0005	<.005	0.003	0.011	0.002	<0.01	<.005	<0.05				
Rio Paguate Ford Crossing	7-14-81	<.005	<0.05	<.001	<.005	0.02	<.0005	<.005	0.004	0.018	0.007	<0.01	<.005	<0.05				
Paguate Reservoir	7-14-81	<.005	<0.05	<.001	<.005	0.02	<.0005	<.005	0.004	0.006	0.011	<0.01	<.005	<0.05				
Jackpile #4	7-14-81	<.005	<0.05	<.001	<.005	0.02	<.0005	<.005	0.003	0.025	0.003	<0.01	<.005	<0.05				
Jackpile New Shop	7-14-81	<.005	<0.05	<.001	<.005	0.02	<.0005	<.005	0.003	0.014	0.055	<0.01	<.005	<0.05				
Jackpile Old Shop	7-14-81	<.005	<0.05	<.001	<.005	0.03	<.0005	0.22	0.006	0.010	1.310	<0.01	<.005	<0.05				

350002409

ANACONDA COPPER COMPANY
NEW MEXICO OPERATION

FOR THE MONTH OF: August, 1981

DESCRIPTION	DATE	pH	TDS ppm	Cond umhos	HCO_3^- ppm	Cl^- ppm	$SO_4^=$ ppm	Na^+ ppm	K^+ ppm	Ca^{++} ppm	Mg^{++} ppm	NO_3^- ppm	P^- ppm	SiO_2 ppm	Mn^{++} ppm
Rio Paguate Upstream	8-03-81	8.2	900	1030	336	14	312	47	8	128	53	0.7	<0.1	28	<.005
Rio Moquino Upstream	8-03-81	8.2	1984	2150	200	17	1234	191	11	204	125	0.7	<0.1	18	<.005
Rio Paguate Above the Confluence	8-03-81	8.3	1200	1280	285	17	585	91	6	130	83	1.0	<0.1	25	<.005
Rio Moquino Above the Confluence	8-03-81	8.3	2258	2360	231	19	1408	227	11	214	145	0.9	<0.1	24	<.005
Rio Paguate Ford Crossing	8-03-81	8.3	2098	2250	295	21	1217	211	10	204	132	.6	<0.1	23	<.005
Paguate Reservoir	8-13-81	8.1	909	1630	122	9	529	68	7	136	35	2	<0.1	7	<.005
Jackpile #4	8-03-81	8.4	991	1200	353	17	312	287	1	4	0.5	0.7	<0.1	8	.009
Jackpile New Shop	8-03-81	8.4	1564	1940	346	26	664	483	3	13	1.4	0.7	<0.1	12	.025
Jackpile Old Shop	8-03-81	8.3	3875	3950	256	105	2414	501	1	291	255	49	<0.1	6	.014

		As ppm	Ba ppm	Cd ppm	Cr ppm	Pb ppm	Hg ppm	Se ppm	Cu ppm	Fe ppm	Zn ppm	Mo ppm	Ni ppm	V ppm
Rio Paguate Upstream	8-03-81	<.005	<0.05	<.001	<.005	<.01	<.0005	<.005	0.032	0.16	0.006	0.02	<.005	<0.05
Rio Moquino Upstream	8-03-81	<.005	0.06	<.001	<.005	<.01	<.0005	<.005	0.007	0.05	0.004	<0.01	<.005	<0.05
Rio Paguate Above the Confluence	8-03-81	<.005	<0.05	<.001	<.005	<.01	<.0005	<.005	0.008	0.05	0.004	0.02	<.005	<0.05
Rio Moquino Above the Confluence	8-03-81	<.005	<0.05	<.001	<.005	<.01	<.0005	<.005	0.010	0.04	0.004	<0.01	<.005	<0.05
Rio Paguate Ford Crossing	8-13-81	<.005	<0.05	<.001	<.005	<.01	<.0005	<.005	0.006	0.03	0.007	<0.01	<.005	<0.05
Paguate Reservoir	8-03-81	<.005	<0.05	<.001	<.005	<.01	<.0005	<.005	0.007	0.06	0.010	<0.01	<.005	<0.05
Jackpile #4	8-03-81	<.005	<0.05	<.001	<.005	<.01	<.0005	<.005	0.007	0.05	0.010	<0.01	<.005	<0.05
Jackpile New Shop	8-03-81	<.005	0.06	<.001	<.005	<.01	<.0005	<.005	0.021	0.12	0.150	0.01	<.005	<0.05
Jackpile Old Shop	8-03-81	<.005	<0.05	<.001	<.005	<.01	<.0005	0.33	0.005	0.03	1.580	0.01	<.005	<0.05

350002410

ANACONDA COPPER COMPANY
NEW MEXICO OPERATION

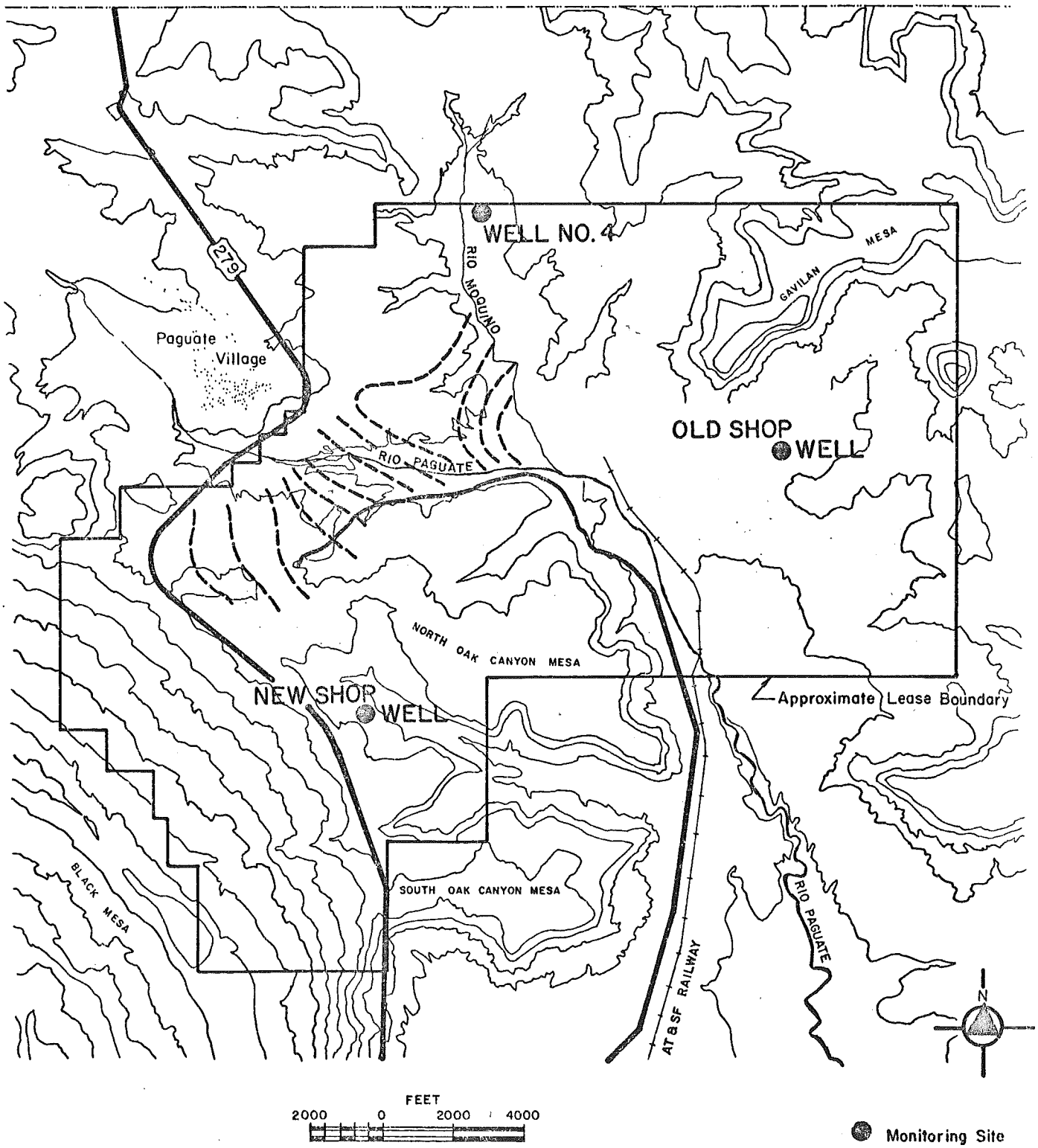
FOR THE MONTH OF: September, 1981

DESCRIPTION	DATE	pH	TDS ppm	Cond umhos	HCO_3^- ppm	Cl^- ppm	$SO_4^=$ ppm	Na^+ ppm	K^+ ppm	Ca^{++} ppm	Mg^{++} ppm	NO_3^- ppm	P^- ppm	SiO_2 ppm	Mn^{++} ppm
Rio Paguate Upstream	9-09-81	8.1	818	925	331	12	260	46	6	112	49	0.4	<0.1	23	<.005
Rio Moquino Upstream	9-09-81	8.0	2597	2700	224	18	1650	214	12	350	127	0.5	<0.1	24	<.005
Rio Paguate Above the Confluence	9-09-81	8.1	932	1080	287	15	388	67	7	108	58	0.5	<0.1	23	<.005
Rio Moquino Above the Confluence	9-09-81	8.0	2877	3000	283	21	1795	294	11	313	158	0.5	<0.1	14	0.019
Rio Paguate Ford Crossing	9-09-81	8.0	2347	2550	302	22	1395	200	10	274	142	0.6	<0.1	14	0.017
Paguate Reservoir	9-09-81	7.7	1426	1910	139	9	886	79	8	248	55	0.5	<0.1	2.4	<.005
Jackpile #4	9-09-81	8.2	1053	1250	375	17	334	316	2	6	0.67	0.6	<0.1	12	0.023
Jackpile New Shop	9-09-81	8.1	1611	2000	400	26	689	470	3	18	2	0.8	<0.1	11	0.016
Jackpile Old Shop	9-09-81	8.0	3933	4100	265	100	2433	522	10	352	201	47	<0.1	9	0.016

		As ppm	Ba ppm	Cd ppm	Cr ppm	Pb ppm	Hg ppm	Se ppm	Cu ppm	Fe ppm	Zn ppm	Mo ppm	Ni ppm	V ppm
Rio Paguate Upstream	9-09-81	<.005	<0.05	<.001	<.005	<0.01	<.0005	<.005	0.003	0.010	0.004	<0.01	<.005	<0.05
Rio Moquino Upstream	9-09-81	<.005	<0.05	<.001	<.005	<0.01	<.0005	<.005	0.004	0.012	0.003	<0.01	<.005	<0.05
Rio Paguate Above the Confluence	9-09-81	<.005	<0.05	<.001	<.005	<0.01	<.0005	<.005	0.002	0.007	0.011	<0.01	<.005	<0.05
Rio Moquino Above the Confluence	9-09-81	<.005	<0.05	<.001	<.005	<0.01	<.0005	<.005	0.004	0.012	0.003	<0.01	<.005	<0.05
Rio Paguate Ford Crossing	9-09-81	<.005	<0.05	<.001	<.005	<0.01	<.0005	<.005	0.017	0.027	0.010	<0.01	<.005	<0.05
Paguate Reservoir	9-09-81	<.005	<0.05	<.001	<.005	<0.01	<.0005	<.005	0.004	0.012	0.006	<0.01	<.005	<0.05
Jackpile #4	9-09-81	<.005	<0.05	<.001	<.005	<0.01	<.0005	<.005	0.006	0.023	0.005	<0.01	<.005	<0.05
Jackpile New Shop	9-09-81	<.005	<0.05	<.001	<.005	<0.01	<.0005	<.005	0.002	0.043	0.022	<0.01	<.005	<0.05
Jackpile Old Shop	9-09-81	<.005	<0.05	<.001	<.005	<0.01	<.0005	<.005	0.002	0.017	0.820	<0.01	<.005	<0.05

350002411

LOCATION OF GROUND WATER MONITORING STATIONS



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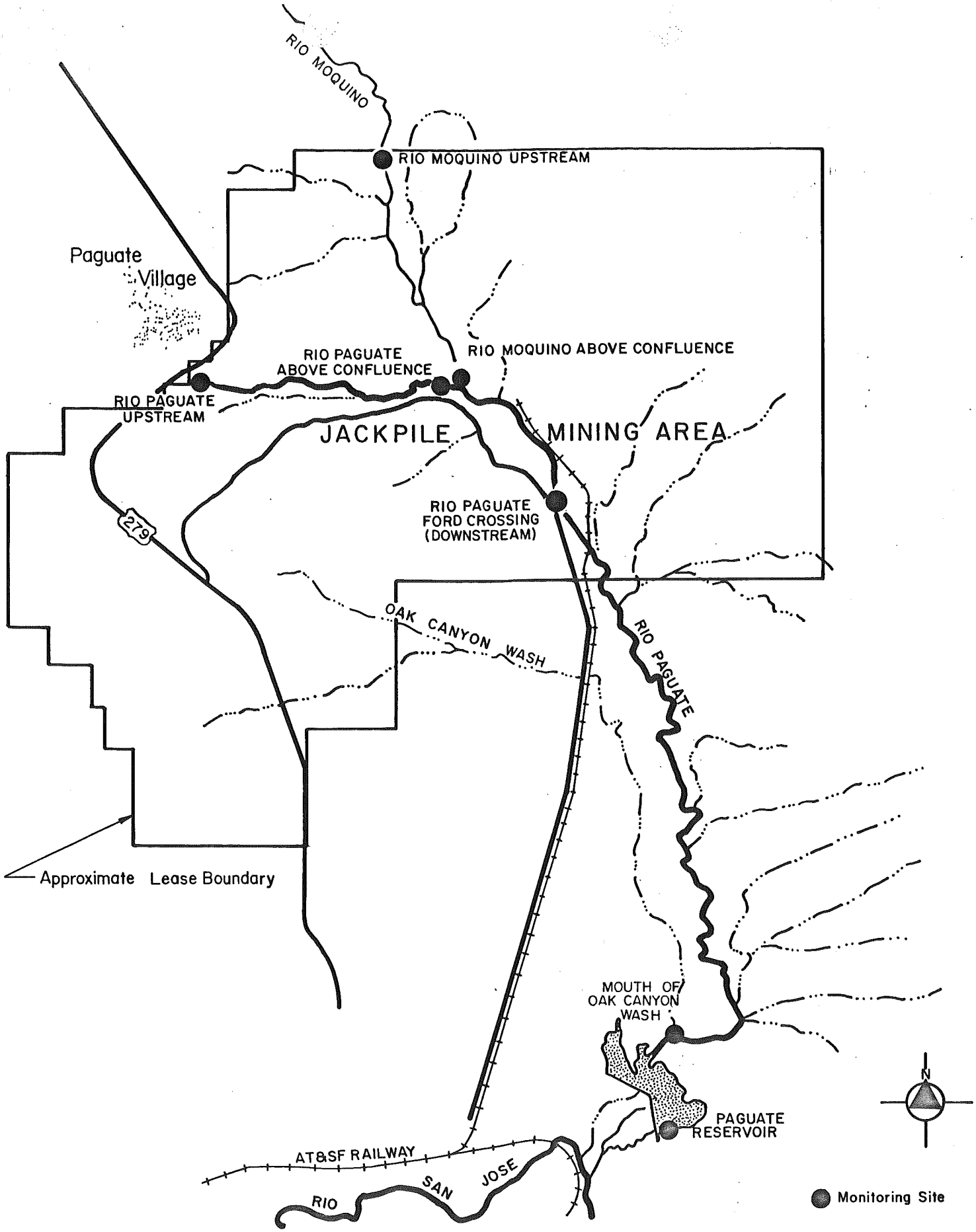


LOCATION OF
SURFACE WATER MONITORING STATIONS

350002413

ALBUQUERQUE DISTRICT MINING
RECEIVED
JAN 24 1983
MINERALS MANAGEMENT SERVICE
ALBUQUERQUE, NEW MEXICO

JACKPILE - AIR SAMPLING SURVEY

THIRD QUARTER, 1981

LOCATION	DATE	TOTAL PARTICULATE µgm/M^3	U-Nat. µCi/mlx10-15	Ra-226 µCi/mlx10-15	Th-230 µCi/mlx10-15	Pb-210 µCi/mlx10-15
1. Dump F	7/81	30.0	5.36	1.36	3.12	31.20
	8/81	20.0	2.89	0.07	3.22	35.17
	9/81	17.0	1.63	0.85	2.20	37.59
2. Mine Vent	7/81	20.0	2.87	0.40	1.26	21.26
	8/81	20.0	0.58	1.55	2.06	3.22
	9/81	17.0	1.00	0.57	0.63	33.96
3. West Gate	7/81	8.0	2.76	0.59	2.76	5.92
	8/81	23.0	1.45	0.25	1.77	26.58
	9/81	18.0	1.91	0.44	3.12	32.48
4. Well #4	7/81	29.0	2.84	0.20	1.82	25.00
	8/81	26.0	1.61	1.68	2.21	36.91
	9/81	19.0	0.53	0.60	2.71	22.52

350002414

JACKPILE-AMBIENT RADON SURVEY

THIRD QUARTER, 1981

LOCATION	DATE	Rn-222 pCi/l
1. Dump F	7/81	1.30
	8/81	1.89
	9/81	1.66
2. Mine Vent	7/81	0.72
	8/81	1.80
	9/81	2.07
3. Well #4	7/81	NS
	8/81	2.67
	9/81	2.30
4. Westgate	7/81	1.54
	8/81	1.55
	9/81	1.43

ANACONDA Copper Company
New Mexico Operations
P.O. Box 638
Grants, New Mexico 87020
505/876-2211

September 8, 1981

Mr. Ed Sandell
Deputy Conservation Manager
UNITED STATES DEPARTMENT OF INTERIOR
GEOLOGICAL SURVEY
P.O. Box 26124
Albuquerque, New Mexico 87125

Dear Sir:

The following information is being submitted in accordance with the Jackpile-Paguate Minesite Sampling Program for the Second Quarter of 1981.

1. Radiological Analysis of Ground and Surface Water.

2. Chemical Analysis of Ground and Surface Water.

3. Maps Showing Ground and Surface Water Sampling Locations.

4. Results of the Air Monitoring Program.

5. Results of the Ambient Radon Monitoring Program.

6. Map Showing location of Air and Radon Monitoring Stations.

Sincerely,

Meade A. Stirland, Manager
ENVIRONMENT, HEALTH & SAFETY

jls

Enclosures

RECEIVED
SEP 14 1981
U.S. GEOLOGICAL SURVEY
ALBUQUERQUE, NEW MEXICO

AIR QUALITY MONITORING PROGRAM

One 168-hour sample is taken each month at each of the four locations specified by Marc Nelson. They are collected about three meters above the ground on GF/A Glass Microfibre filter paper, using an RAC Heavy-duty Sampler.

AMBIENT RADON STUDY

Radon-222 is monitored continuously at each of the air sampling locations specified by Marc Nelson. The samples are monitored by the use of the Model RGM-2 Radon Gas Monitor. Normal data output is printed hourly and a 24-hour average is printed at the end of a 24-hour period.

JACKPILE - WATER RADIOLOGICAL ANALYSIS

(SECOND QUARTER, 1981)

DESCRIPTIVE LOCATION	Radium-226 pCi/L			Uranium-Natural ppm		
	April	May	June	April	May	June
Rio Paguate Upstream	0.57	0.59	0.46	0.011	0.006	0.013
Rio Moquino Upstream	0.27	0.22	0.24	0.010	0.008	0.012
Rio Paguate Above the Confluence	3.46	2.46	12.17	0.032	0.023	0.063
Rio Moquino Above the Confluence	1.55	0.68	2.87	0.027	0.017	0.041
Rio Paguate Ford Crossing	3.13	3.81	2.90	0.053	0.058	0.219
Paguate Reservoir	1.00	1.32	3.01	1.214	0.508	0.396
Jackpile Well #4	0.50	0.51	1.32	0.015	0.005	0.008
Jackpile New Shop	3.38	1.94	4.64	0.011	0.007	0.012
Jackpile Old Shop	4.04	3.19	2.37	0.145	0.272	0.301

ANACONDA COPPER COMPANY
NEW MEXICO OPERATION

FOR THE MONTH OF: APRIL 1981

DESCRIPTION	DATE	pH	TDS ppm	Cond umhos	HCO_3^- ppm	Cl^- ppm	$SO_4^=$ ppm	Na^+ ppm	K^+ ppm	Ca^{++} ppm	Mg^{++} ppm	NO_3^- ppm	F^- ppm	SiO_2 ppm	Mn^{++} ppm			
Rio Paguate Upstream	4-07-81	8.3	462	545	244	7	80	27	4	62	22	1.4	0.35	18.0	<0.005			
Rio Moquino Upstream	4-07-81	8.0	1417	1650	256	11	775	154	7	124	86	2.2	0.54	9.3	<0.005			
Rio Paguate Above the Confluence	4-07-81	8.2	499	570	258	7	108	32	5	63	23	1.2	0.37	17.0	<0.005			
Rio Moquino Above the Confluence	4-07-81	8.0	1686	1890	251	13	966	213	8	124	106	1.2	0.64	8.4	<0.005			
Rio Paguate Ford Crossing	4-07-81	8.1	1126	1300	275	11	544	119	6	101	66	1.5	0.52	12.0	<0.005			
Paguate Reservoir	4-07-81	7.7	2591	2790	122	44	1699	319	2	245	135	1.6	0.35	2.9	<0.005			
Jackpile #4	4-07-81	8.3	1021	1240	353	15	315	313	1	4	< 1	2.0	1.15	7.0	0.007			
Jackpile New Shop	4-07-81	8.4	1546	1890	380	26	653	452	2	13	2	2.7	1.25	7.4	0.017			
Jackpile Old Shop	4-07-81	8.3	1987	2340	283	48	1057	405	5	92	68	11.0	1.05	5.1	0.007			

	DATE	As ppm	Ba ppm	Cd ppm	Cr ppm	Pb ppm	Hg ppm	Se ppm	Cu ppm	Fe ppm	Zn ppm	Mo ppm	Ni ppm	V ppm				
Rio Paguate Upstream	4-07-81	<0.005	0.09	<0.001	<0.005	<0.005	<.0005	0.005	0.006	0.310	0.007	<0.01	<0.005	<0.05				
Rio Moquino Upstream	4-07-81	<0.005	0.10	<0.001	<0.005	<0.005	<.0005	<0.005	0.004	0.012	0.013	<0.01	<0.005	<0.05				
Rio Paguate Above the Confluence	4-07-81	<0.005	0.10	<0.001	<0.005	<0.005	<.0005	<0.005	0.008	0.013	0.010	<0.01	<0.005	<0.05				
Rio Moquino Above the Confluence	4-07-81	<0.005	0.10	<0.001	<0.005	<0.005	<.0005	<0.005	0.004	0.012	0.180	<0.01	<0.005	<0.05				
Rio Paguate Ford Crossing	4-07-81	<0.005	0.10	<0.001	<0.005	<0.005	<.0005	<0.005	0.003	0.007	0.006	<0.01	<0.005	<0.05				
Paguate Reservoir	4-07-81	<0.005	0.09	<0.001	<0.005	<0.005	<.0005	0.005	0.006	0.018	0.007	<0.01	<0.005	<0.05				
Jackpile #4	4-07-81	<0.005	<0.05	<0.001	<0.005	<0.005	<.0005	<0.005	0.004	0.028	0.006	<0.01	<0.005	<0.05				
Jackpile New Shop	4-07-81	<0.005	<0.05	<0.001	<0.005	<0.005	<.0005	<0.005	0.004	0.041	0.037	<0.01	<0.005	<0.05				
Jackpile Old Shop	4-07-81	<0.005	0.06	<0.001	<0.005	<0.005	<.0005	0.007	0.007	0.006	0.120	<0.01	<0.005	<0.05				

35002419

ANACONDA COPPER COMPANY
NEW MEXICO OPERATION

FOR THE MONTH OF: MAY 1981

DESCRIPTION	DATE	pH	TDS ppm	Cond umhos	HCO_3^- ppm	Cl^- ppm	$SO_4^=$ ppm	Na^+ ppm	K^+ ppm	Ca^{++} ppm	Mg^{++} ppm	NO_3^- ppm	F^- ppm	SiO_2 ppm	Mn^{++} ppm
Rio Paguate Upstream	5-07-81	8.1	656	800	292	6	192	37	6	88	32	<0.1	0.41	33.4	<0.005
Rio Moquino Upstream	5-07-81	8.1	1564	1790	258	9	875	180	8	144	88	0.6	0.54	18.8	<0.005
Rio Paguate Above the Confluence	5-07-81	8.2	638	790	263	8	210	44	6	66	38	<0.1	0.44	34.7	<0.005
Rio Moquino Above the Confluence	5-07-81	8.2	1814	2010	256	12	1049	228	8	158	101	0.4	0.60	22.7	<0.005
Rio Paguate Ford Crossing	5-07-81	8.1	1546	1750	273	11	835	192	8	138	86	0.6	0.62	23.1	<0.005
Paguate Reservoir	5-07-81	7.6	2469	2950	106	37	1619	360	21	184	139	0.4	0.80	1.8	<0.005
Jackpile #4	5-07-81	8.3	1032	1290	370	13	324	306	1	4	1	0.4	1.20	9.4	0.007
Jackpile New Shop	5-07-81	8.3	1597	2050	358	23	679	485	3	13	2	0.6	1.20	13.3	0.015
Jackpile Old Shop	5-07-81	8.2	3784	4190	263	89	2349	550	10	282	198	40.0	0.68	8.1	0.013

	DATE	As ppm	Ba ppm	Cd ppm	Cr ppm	Pb ppm	Hg ppm	Se ppm	Cu ppm	Fe ppm	Zn ppm	Mo ppm	Ni ppm	V ppm
Rio Paguate Upstream	5-07-81	<0.005	<0.05	<0.001	<0.005	0.011	<.0005	<0.005	0.002	0.006	0.003	<0.01	<0.005	<0.05
Rio Moquino Upstream	5-07-81	<0.005	<0.05	<0.001	<0.005	0.017	<.0005	<0.005	0.002	0.005	0.033	<0.01	<0.005	<0.05
Rio Paguate Above the Confluence	5-07-81	<0.005	<0.05	<0.001	<0.005	0.008	<.0005	<0.005	0.003	0.021	0.002	<0.01	<0.005	<0.05
Rio Moquino Above the Confluence	5-07-81	<0.005	<0.05	<0.001	<0.005	0.019	<.0005	<0.005	0.002	0.008	0.007	<0.01	<0.005	<0.05
Rio Paguate Ford Crossing	5-07-81	<0.005	<0.05	<0.001	<0.005	0.015	<.0005	<0.005	0.003	0.017	0.005	<0.01	<0.005	<0.05
Paguate Reservoir	5-07-81	<0.005	<0.05	<0.001	<0.005	0.020	<.0005	<0.005	0.004	0.008	0.010	<0.01	<0.005	<0.05
Jackpile #4	5-07-81	<0.005	<0.05	<0.001	<0.005	0.006	<.0005	<0.005	0.004	0.018	0.012	<0.01	<0.005	<0.05
Jackpile New Shop	5-07-81	<0.005	<0.05	<0.001	<0.005	0.012	<.0005	<0.005	0.002	0.011	0.018	<0.01	<0.005	<0.05
Jackpile Old Shop	5-07-81	<0.005	<0.05	<0.001	<0.005	0.026	<.0005	0.160	0.002	0.008	1.200	<0.01	<0.005	<0.05

350002420

ANACONDA COPPER COMPANY
NEW MEXICO OPERATION

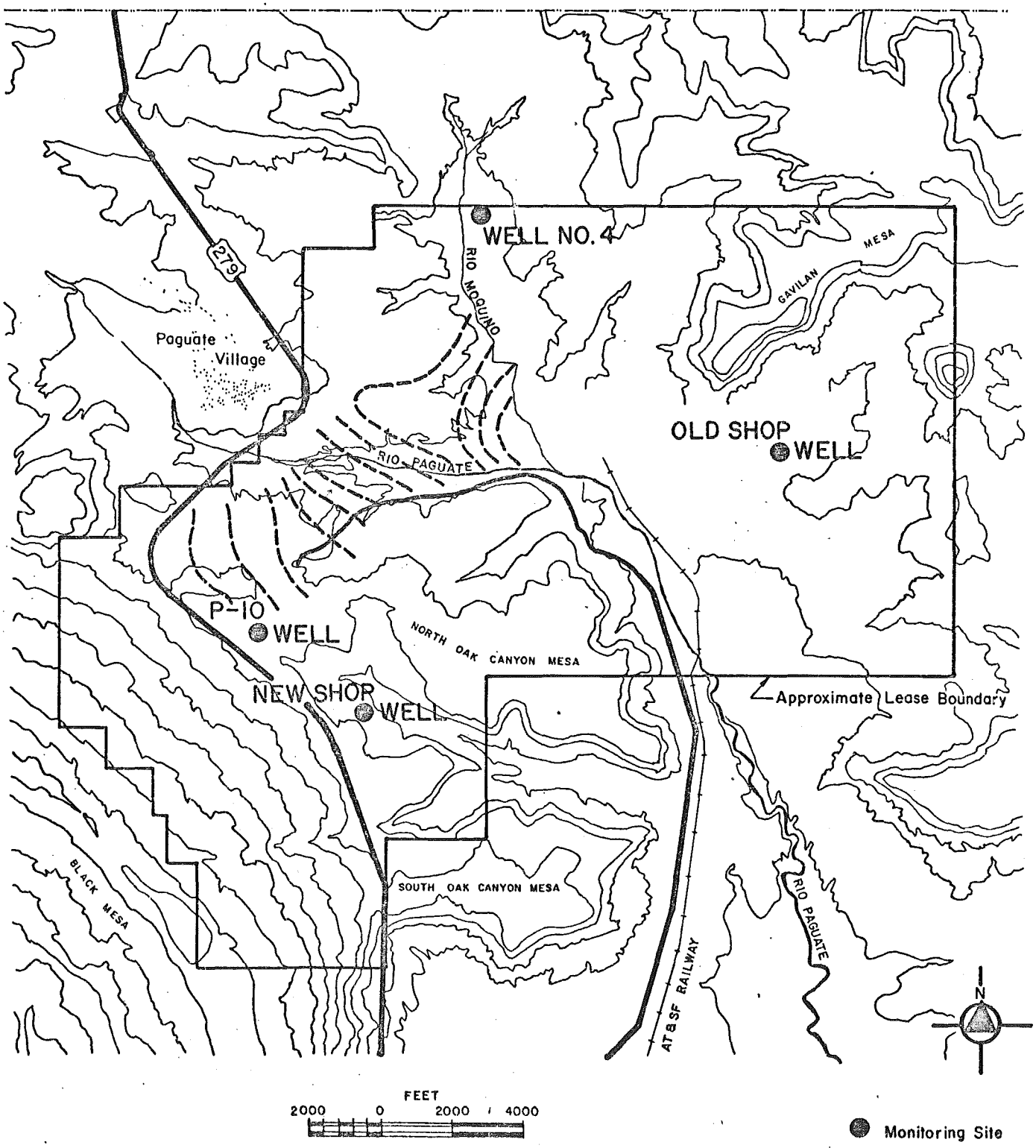
FOR THE MONTH OF: JUNE 1981

DESCRIPTION	DATE	pH	TDS ppm	Cond umhos	HCO_3^- ppm	Cl^- ppm	$SO_4^=$ ppm	Na^+ ppm	K^+ ppm	Ca^{++} ppm	Mg^{++} ppm	NO_3^- ppm	P^- ppm	SiO_2 ppm	Mn^{++} ppm
Paguate Upstream	6-15-81	7.9	1316	1550	292	24	653	97	8.8	160	78	1.1	0.47	25.3	<.005
Rio Moquino Upstream	6-15-81	8.2	2538	2850	248	22	1592	320	9.6	160	180	2.9	0.90	12.4	0.005
Rio Paguate Above the Confluence	6-15-81	7.9	1324	1570	268	25	677	110	8.8	144	87	1.9	0.50	20.5	<.005
Rio Moquino Above the Confluence	6-15-81	8.2	2505	2800	292	19	1522	312	9.1	192	155	1.9	0.96	13.7	<.005
Rio Paguate Ford Crossing	6-15-81	8.2	2140	2360	305	26	1244	243	10.2	156	153	1.9	0.74	15.8	<.005
Paguate Reservoir	6-15-81	7.8	4547	4800	89	105	3090	625	45.8	309	279	2.5	1.00	0.2	<.005
Jackpile #4	6-15-81	8.1	1001	1250	380	15	301	287	8.2	4	1	2.3	1.10	5.6	0.007
Jackpile New Shop	6-15-81	8.2	1585	1980	402	25	671	465	2.7	12	2	2.4	1.30	8.8	0.016
Jackpile Old Shop	6-15-81	8.1	3774	3700	246	109	2323	560	9.3	301	182	41	0.74	4.3	0.012

	DATE	As ppm	Ba ppm	Cd ppm	Cr ppm	Pb ppm	Hg ppm	Se ppm	Cu ppm	Fe ppm	Zn ppm	Mo ppm	Ni ppm	V ppm
Rio Paguate Upstream	6-15-81	<.005	<0.05	<.001	<.005	0.02	<.0005	<.005	0.003	0.01	0.004	<0.01	<.005	<0.05
Rio Moquino Upstream	6-15-81	<.005	<0.05	<.001	<.005	0.02	<.0005	<.005	0.004	0.05	0.006	<0.01	.005	<0.05
Rio Paguate Above the Confluence	6-15-81	<.005	<0.05	<.001	<.005	0.02	<.0005	<.005	0.003	0.01	0.003	<0.01	<.005	<0.05
Rio Moquino Above the Confluence	6-15-81	<.005	<0.05	<.001	<.005	0.02	<.0005	<.005	0.005	0.05	<.001	<0.01	<.005	<0.05
Rio Paguate Ford Crossing	6-15-81	<.005	<0.05	<.001	<.005	0.05	<.0005	<.005	0.016	0.08	0.038	<0.01	<.005	<0.05
Paguate Reservoir	6-15-81	<.005	<0.05	<.001	<.005	0.02	<.0005	<.005	0.003	0.01	0.004	<0.01	<.005	<0.05
Jackpile #4	6-15-81	<.005	<0.05	<.001	<.005	0.02	<.0005	<.005	0.004	0.01	0.004	<0.01	<.005	<0.05
Jackpile New Shop	6-15-81	<.005	<0.05	<.001	<.005	0.02	<.0005	<.005	0.004	0.08	0.062	0.02	<.005	<0.05
Jackpile Old Shop	6-15-81	<.005	<0.05	<.001	<.005	0.02	<.0005	0.11	0.008	0.03	1.10	<0.01	<.005	<0.05

350002421

LOCATION OF GROUND WATER MONITORING STATIONS



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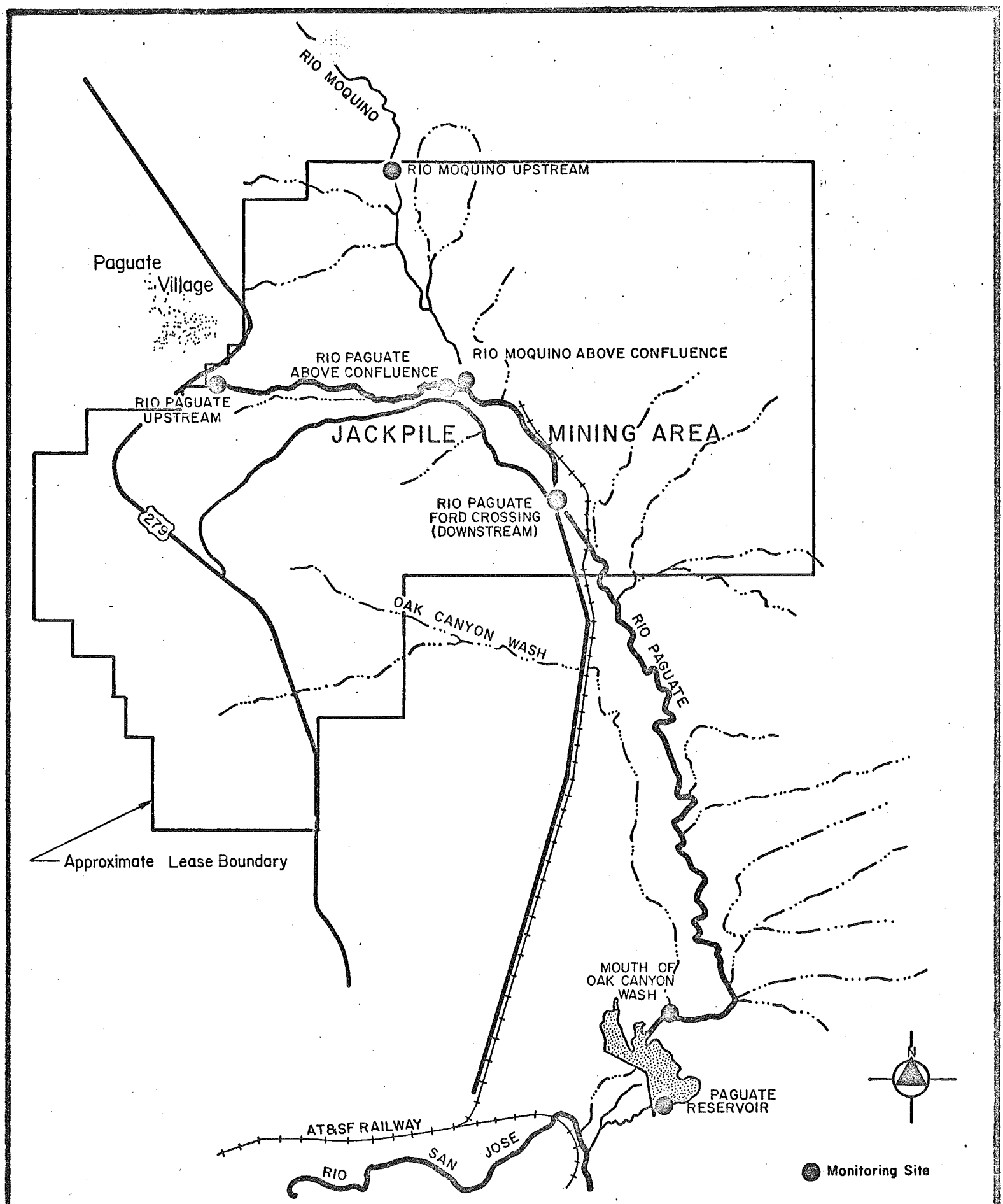


LOCATION OF
SURFACE WATER MONITORING STATIONS

350002423

JACKPILE - AIR SAMPLING SURVEY

SECOND QUARTER, 1981

LOCATION	DATE	Total Particulate $mg/M^3 x10^{-8}$	U-Nat. $\mu ci/ml x10^{-15}$	Ra-226 $\mu ci/ml x10^{-15}$	Th-230 $\mu ci/ml x10^{-15}$	Pb-210 $\mu ci/ml x10^{-15}$
1. Dump F	4/81	2.76	20.08	2.56	2.02	28.30
	5/81	4.77	3.73	2.11	2.96	29.58
	6/81	1.97	9.70	0.46	2.51	27.40
2. Mine Vent	4/81	2.23	30.40	1.46	3.12	33.33
	5/81	4.64	2.96	1.48	1.74	53.54
	6/81	2.31	0.85	3.02	2.38	34.76
3. West Gate	4/81	4.89	10.70	0.84	2.13	20.00
	5/81	4.90	6.67	0.65	0.85	28.10
	6/81	5.37	4.25	1.14	2.57	31.14
4. Well #4	4/81	3.79	9.39	0.54	0.81	18.24
	5/81	3.80	1.70	0.68	2.72	20.41
	6/81	0.28	7.05	0.90	1.28	26.92

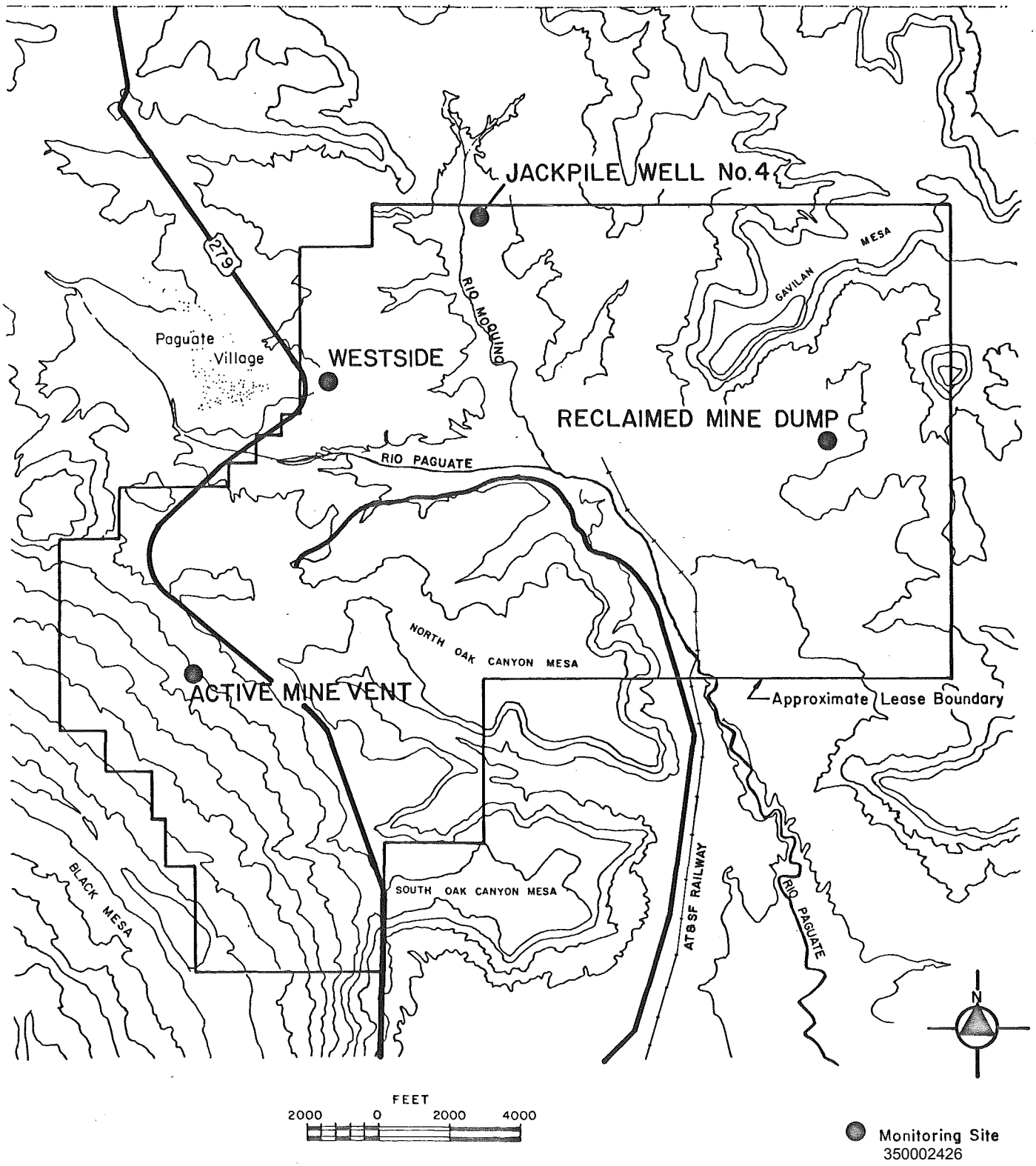
350002424

JACKPILE - AMBIENT RADON SURVEY

SECOND QUARTER, 1981

LOCATION	DATE	Rn-222 pCi/l
1. Dump F	4/81	1.67
	5/81	1.65
	6/81	1.42
2. Mine Vent	4/81	1.52
	5/81	1.19
	6/81	0.82
3. Well #4	4/81	1.75
	5/81	1.33
	6/81	1.61
4. Westgate	4/81	1.69
	5/81	1.63
	6/81	1.59

LOCATION OF
AIR QUALITY MONITORING STATIONS



350002426

ANACONDA Copper Company
New Mexico Operations
P.O. Box 638
Grants, New Mexico 87020
505/876-2211

DCM, MINING
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JUN 29 1981
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U.S. GEOLOGICAL SURVEY
ALBUQUERQUE, NEW MEXICO

June 19, 1981

Mr. Ed Sandell
Deputy Conservation Manager
United States Department of Interior
Geological Survey
P.O. Box 26124
Albuquerque, New Mexico 87125

Dear Sir:

The following information is being submitted in accordance with the Jackpile-Paguate Minesite Reclamation Sampling Program for the period between January 1980 and June 1981.

1. Surface gamma survey from reclaimed sites
2. Radiological analysis of reclaimed site soils and vegetation
3. Chemical analysis of reclaimed site soils and vegetation
4. Radon exhalation values from reclaimed sites
5. Map showing radon exhalation sampling stations

Sincerely,

Meade A. Stirland

Meade A. Stirland, Manager
ENVIRONMENT, HEALTH & SAFETY

jls

Enclosure

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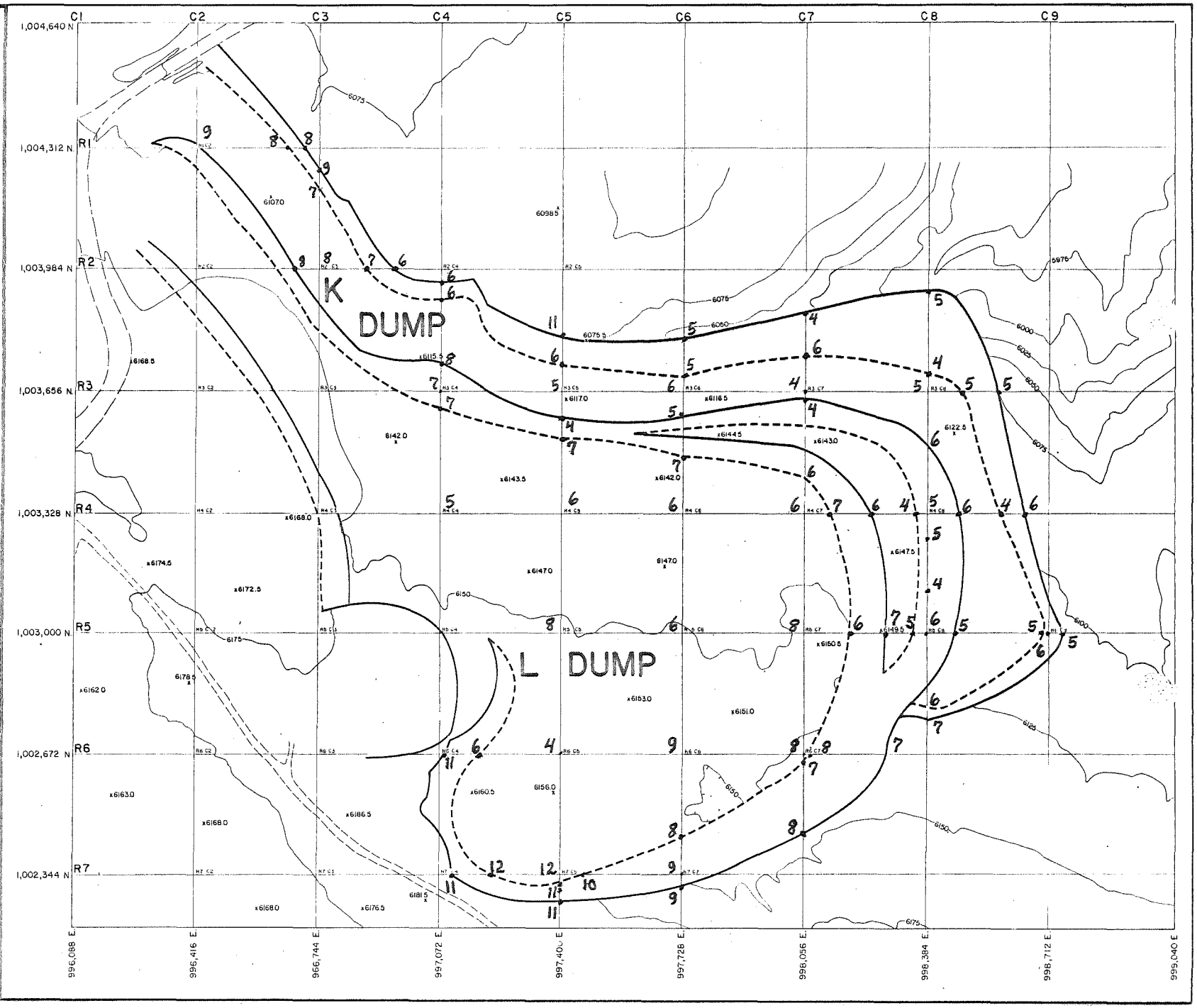
JUL 02 1981
U.S. GEOLOGICAL SURVEY
ALBUQUERQUE, NEW MEXICO

Gamma Radilogical Survey

Readings in μ per hr.
100 Meter Grid



350002428

STATISTICAL ANALYSIS

DUMPS K & L

All surveyed points from the gamma survey map are used for statistical analysis. A population is considered uniform provided the standard deviation is less than thirty-five (35) percent of that population. A uniform gamma survey dictates, according to our Minesite reclamation Sampling Plan, that the area can be sampled for soil and vegetation on $10M^2$ station per 90,000 M^2 area. However, should an area be smaller than 90,000 M^2, it will receive the same sampling density.

Readings in uR/hr

11 + 11 + 9 + 9 + 11 + 12 + 12 + 10 + 8 + 5

7 + 8 + 11 + 6 + 4 + 9 + 8 + 8 + 7 + 6 +

7 + 8 + 6 + 8 + 6 + 7 + 5 + 5 + 4 + 6 +

5 + 5 + 6 + 5 + 7 + 5 + 4 + 7 + 6 + 5 +

7 + 6 + 4 + 6 + 7 + 6 + 6 + 4 + 6 + 6 +

4 + 6 + 6 + 6 + 8 + 7 + 11 + 6 + 5 + 5 +

5 + 6 + 4 + 6 + 4 + 5 + 4 + 5 + 5 + 5 +

8 + 9 + 7 + 8 + 7 + 6 + 9 + 8 + 8

$$\bar{x} = \frac{\sum xi}{N} = \frac{530}{79} = 6.71$$

$$\sigma = \sqrt{\frac{\sum (xi - \bar{x})^2}{N-1}} = 2.0$$

$$\text{Uniformity} = \frac{\sigma}{\bar{x}} = \frac{2.0}{6.76} = .2981 = 29.81\%$$

GAMMA SURVEY

Routine 100 meter measurements in uR/hr.

Location: Dumps L and K **Date:** Oct 1980

	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10					
R1		9													
R2			8	6											
R3				7	5	6	4	5							
R4				5	6	6	6	5							
R5					8	6	8	6	6						
R6					4	9	8								
R7				11	12	9									

FORM 1006

350002430

THE ANACONDA COPPER COMPANY
RECLAIMED SITE SOIL
ANALYSIS

RADIOLOGICAL

Sample	DATE TAKEN	THORIUM-230 pCi/gm	RADIUM-226 pCi/gm	LEAD-210 pCi/gm	URANIUM ug/gm
Dump F (C4)	09-24-80	2.86	1.66	3.1	2.41
Dump F (C3)	09-24-80	2.17	2.17	3.4	5.65
Dump G (C4)	09-24-80	3.55	0.94	3.0	5.82

THE ANACONDA COPPER COMPANY
RECLAIMED SITE SOIL
ANALYSIS

CHEMICAL

SAMPLE SITE	DATE TAKEN	As ppm	Se ppm	Mo ppm	Pb ppm	V ppm	Cd ppm	Zn ppm
Dump C (R 9)	01-21-80	<0.10	<0.40	<0.5	<0.5	<0.5	<0.1	0.60
Dump D (R 8)	01-17-80	<0.10	<0.40	<0.5	<0.5	<0.5	<0.1	<0.30
Dump E (R 8)	01-17-80	<0.10	<0.40	<0.5	<0.5	<0.5	<0.1	0.70
Dump F (C 4)	09-24-80	<0.10	<0.05	<0.1	<0.5	0.6	<0.1	<0.50
Dump F (C 3)	09-24-80	0.20	<0.05	<0.1	<0.5	<0.5	<0.1	<0.50
Dump G (C 4)	09-24-80	<0.10	<0.05	0.2	<0.5	<0.5	<0.1	0.70

THE ANACONDA COPPER COMPANY
RECLAIMED SITE VEGETATION
ANALYSIS

RADIOLOGICAL - Dumps C,D,E,G

SAMPLE	DATE TAKEN	THORIUM-230 pCi/gm	RADIUM-226 pCi/gm	LEAD-210 pCi/gm	URANIUM ug/gm
Dump C (R 9)	09-24-80	1.17	1.15	3.2	7.13
Dump D (R 8)	09-24-80	0.56	0.39	2.0	4.71
Dump E (R 8)	09-24-80	2.56	1.14	3.2	5.37
Dump G (C 4)	09-24-80	0.84	1.02	3.2	2.89

THE ANACONDA COPPER COMPANY
RECLAIMED SITE VEGETATION
ANALYSIS

RADIOLOGICAL - DUMP F - This Dump was selected for individual species analysis.

SAMPLE	DATE TAKEN	THORIUM-230 pCi/gm	RADIUM-226 pCi/gm	LEAD-210 pCi/gm	URANIUM ugm/gm
Stickleaf	09-24-80	2.52	1.26	4.7	4.52
Fourwing saltbush	09-24-80	0.72	0.30	1.4	2.70
Red Three Awn	09-24-80	0.50	0.56	3.4	9.79
Alkali Sacaton	09-24-80	1.84	1.32	5.0	4.82
Annual Forbs	09-24-80	0.85	0.79	2.0	2.98
Blue Grama	09-24-80	1.75	1.70	3.5	3.41
Weeping Lovegrass	09-24-80	0.28	0.58	4.0	10.21
Crested Wheatgrass	09-24-80	1.73	0.94	3.7	4.03

THE ANACONDA COPPER COMPANY
RECLAIMED SITE VEGETATION
ANALYSIS

CHEMICAL - Dump C,D,E,G

SAMPLE SITE	DATE TAKEN	As ppm	Se ppm	Mo ppm	Pb ppm	V ppm	Cd ppm	Zn ppm
Dump C (R 9)	9-24-80	0.3	0.07	0.7	<0.5	0.9	<0.1	32.0
Dump D (R 8)	9-24-80	0.6	<0.05	1.1	<0.5	0.7	<0.1	36.0
Dump E (R 8)	9-24-80	0.7	3.00	0.7	<0.5	0.8	<0.1	57.0
Dump G (C 4)	9-24-80	0.4	0.49	<0.1	<0.5	<0.5	<0.1	43.0

THE ANACONDA COPPER COMPANY
RECLAIMED SITE VEGETATION
ANALYSIS

CHEMICAL - F DUMP - This Dump was selected for individual species analysis.

SAMPLE SITE	DATE TAKEN	As ppm	Cd ppm	Mo ppm	Pb ppm	Se ppm	V ppm	Zn ppm
Stickleaf	09-24-80	0.7	<0.1	0.4	<0.5	0.07	<0.5	110
Fourwing Saltbush	09-24-80	0.4	<0.1	<0.1	<0.5	0.17	<0.5	19
Red Three Awn	09-24-80	0.7	<0.1	0.2	<0.5	0.07	<0.5	40
Alkali Sacaton	09-24-80	0.4	<0.1	0.1	<0.5	0.12	<0.5	19
Annual Forb	09-24-80	0.4	<0.1	0.2	<0.5	0.05	<0.5	16
Blue Grama	09-24-80	0.4	<0.1	0.1	<0.5	0.09	1.1	26
Weeping Lovegrass	09-24-80	<0.3	<0.1	<0.1	<0.5	0.39	0.8	44
Crested Wheatgrass	09-24-80	0.8	<0.1	<0.1	<0.5	0.16	1.1	40

THE ANACONDA COPPER COMPANY
RADON EXHALATION ANALYSIS

SITE	DATE	RADON EXHALATION fci/cm^2 - sec
Dump D	09-25-80	0.060
Dump E	09-30-80	0.468
Dump F	10-01-80	0.131
Dump F	06-11-81	0.110
Dump G	09-02-80	1.646
Dump G	06-08-81	0.415
Dump L	06-09-81	0.257
Dump K	06-10-81	0.270

ANACONDA Minerals Company
New Mexico Operations
P.O. Box 638
Grants, New Mexico 87020
Telephone 505 876 2211

MP

May 26, 1982

ALBUQUERQUE DISTRICT MINING
RECEIVED
MAY 27 1982
MINERALS MANAGEMENT SERVICE
ALBUQUERQUE, NEW MEXICO

Mr. Dale Jones
District Mining Supervisor
Minerals Management Service
500 Gold Avenue, S.W.
Federal Building, Room 116
Albuquerque, New Mexico 87102

Dear Mr. Jones:

Attached please find corrected pages for substitution in Anaconda's correspondence submitted to your office dated June 16, 1981.

This information has been forwarded to Mr. Gene Yang who is with Argonne National Laboratory. The data is being used for purposes of the Environmental Impact Study (EIS).

If additional information or clarification is required, please advise.

Sincerely,

Meade A. Stirland, Manager
Environment, Health & Safety

mls

Enclosure

350002438

FOR THE MONTH OF: January, 1981

DESCRIPTION	DATE	pH	TDS ppm	Cond umhos	HCO_3^- ppm	Cl^- ppm	$SO_4^=$ ppm	Na^+ ppm	K^+ ppm	Ca^{++} ppm	Mg^{++} ppm	NO_3^- ppm	F^- ppm	SiO_2 ppm	Mn^{++} ppm			
Paguate Upstream	1-08-81	8.3	546	690	341	13	179	35	4	85	33	<1	0.36	28	<0.10			
Rio Moquino Upstream	1-08-81	8.2	1527	1800	396	18	888	172	11	129	99	<1	0.50	14	<0.10			
Rio Paguate Above the Confluence	1-08-81	8.4	601	768	305	13	244	48	4	76	41	<1	0.41	24	<0.10			
Rio Moquino Above the Confluence	1-08-81	8.4	869	1200	420	20	323	284	6	13	2	<1	0.63	12	<0.10	← Inserted	Data	
Rio Paguate Ford Crossing	1-08-81	8.2	1593	2000	300	21	966	180	11	131	118	<1	0.60	18	<0.10			
Paguate Reservoir	1-08-81	8.4	1644	1900	34	38	1133	157	22	182	88	<1	0.54	6	<0.10			
Jackpile #4	1-12-81	8.6	635	1200	NIL	20	321	273	3	5	1	<1	1.04	10	<0.10			
Jackpile New Shop	1-08-81	8.4	1359	2000	391	30	681	418	6	15	2	2	1.15	13	0.10			
Jackpile Old Shop	1-12-81	8.3	3140	3790	214	96	2051	480	14	219	167	<1	0.68	6	<0.10			
		As ppm	Ba ppm	Cd ppm	Cr ppm	Pb ppm	Hg ppm	Se ppm	Cu ppm	Fe ppm	Zn ppm	Mo ppm	Ni ppm	V ppm				
Rio Paguate Upstream	1-08-81	<0.005	<0.05	<0.001	<0.005	0.01	<0.0005	<0.005	0.003	<0.10	0.052	<0.01	<0.005	<0.05				
Rio Moquino Upstream	1-08-81	<0.005	<0.05	<0.001	<0.005	<.01	<0.0005	<0.005	0.003	<0.10	0.011	<0.01	<0.005	<0.05				
Rio Paguate Above the Confluence	1-08-81	<0.005	<0.05	<0.001	<0.005	<.01	<0.0005	<0.005	0.002	<0.10	0.007	<0.01	<0.005	<0.05				
Rio Moquino Above the Confluence	1-08-81	<0.005	<0.05	<0.001	<0.005	<0.01	<0.005	<0.005	0.002	<0.10	0.003	<0.01	<0.005	<0.05	← Inserted	Data		
Rio Paguate Ford Crossing	1-08-81	<0.005	0.12	<0.001	<0.005	<0.01	<0.0005	<0.005	0.002	<0.10	0.020	<0.01	<0.005	<0.05				
Paguate Reservoir	1-08-81	<0.005	0.09	<0.001	<0.005	<0.01	<0.0005	<0.005	0.003	<0.10	0.013	<0.01	<0.005	<0.05				
Jackpile #4	1-12-81	<0.005	<0.05	<0.001	<0.005	<0.01	<0.0005	<0.005	0.003	<0.10	0.010	<0.01	<0.005	<0.05				
Jackpile New Shop	1-08-81	<0.005	<0.05	<0.001	<0.005	0.01	<0.0005	<0.005	0.004	0.20	0.063	<0.01	<0.005	<0.05				
Jackpile Old Shop	1-12-81	<0.005	<0.05	<0.001	<0.005	0.01	<0.0005	0.02	0.003	<0.10	3.70	<0.01	<0.005	<0.05				

350002439

FOR THE MONTH OF: February 1981

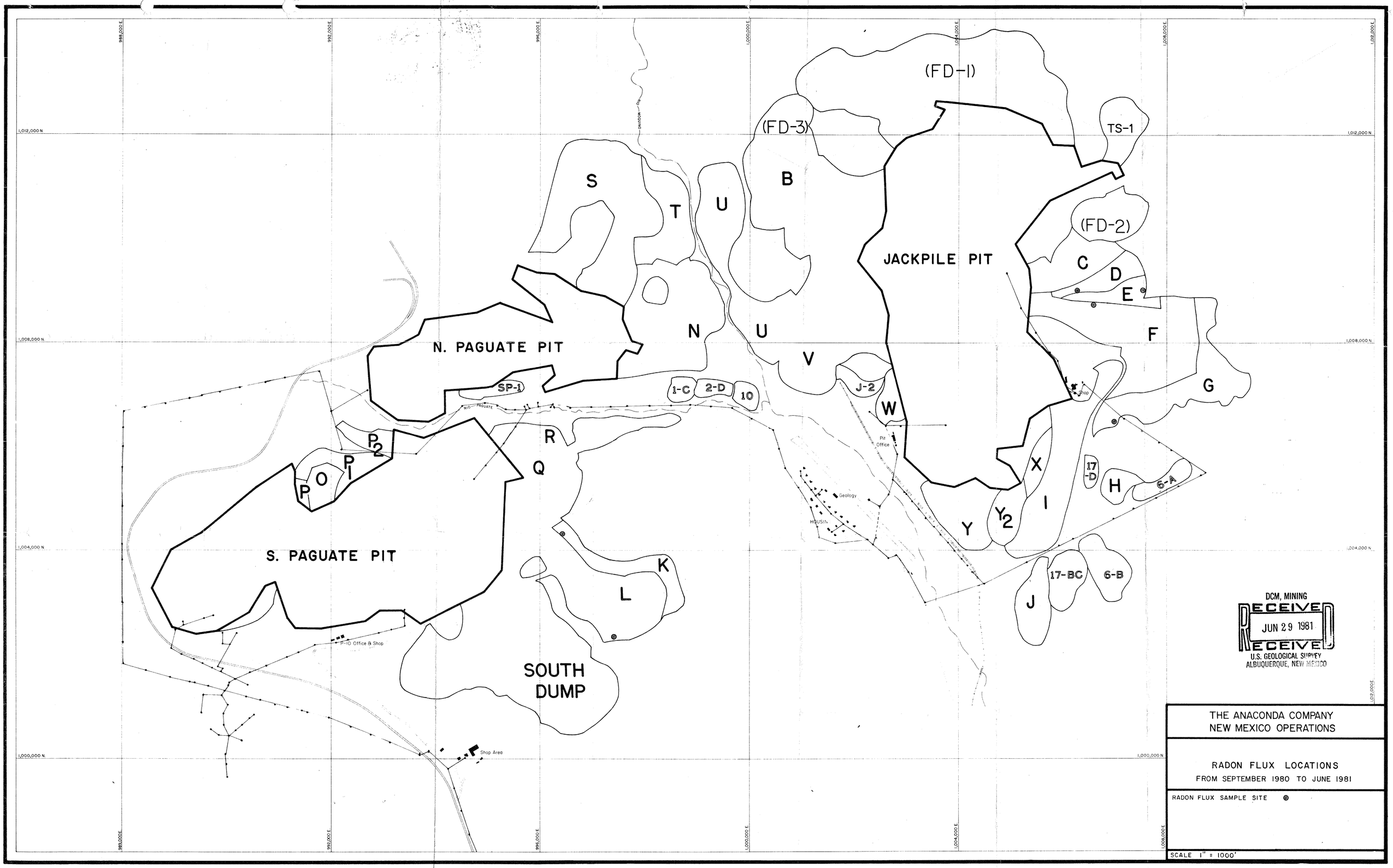
DESCRIPTION	DATE	pH	TDS ppm	Cond umhos	HCO_3^- ppm	Cl^- ppm	$SO_4^=$ ppm	Na^+ ppm	K^+ ppm	Ca^{++} ppm	Mg^{++} ppm	NO_3^- ppm	F^- ppm	SiO_2 ppm	Mn^{++} ppm			
Paguate Upstream	2-11-81	8.3	486	697	302	11	149	31	3	74	20	<1	.33	30	<0.10			
Rio Moquino Upstream	2-11-81	8.2	1634	2200	312	20	992	214	11	154	73	<1	.53	15	<0.10			
Rio Paguate Above the Confluence	2-11-81	8.4	450	638	271	11	147	31	3	74	20	<1	.34	30	<0.10			
Rio Moquino Above the Confluence	2-11-81	8.3	1834	2250	235	19	1225	228	9	150	73	<1	.63	12	<0.10	← Inserted	Data	
Rio Paguate Ford Crossing	2-11-81	8.3	1502	2190	294	22	924	182	10	134	64	<1	.52	20	<0.10			
Paguate Reservoir	2-11-81	7.3	1898	2410	30	46	1314	205	24	224	66	<1	.58	3	<0.10			
Jackpile #4	2-11-81	8.8	841	1200	366	18	332	290	2	5	1	<1	1.1	12	<0.10			
Jackpile New Shop	2-11-81	8.4	1368	2200	393	30	668	437	5	18	1	1	1.3	15	<0.10			
Jackpile Old Shop	2-11-81	8.0	3570	4200	248	1	2359	557	18	319	133	48	.60	13	<0.10			
		As ppm	Ba ppm	Cd ppm	Cr ppm	Pb ppm	Hg ppm	Se ppm	Cu ppm	Fe ppm	Zn ppm	Mo ppm	Ni ppm	V ppm				
Rio Paguate Upstream	2-11-81	<0.005	<0.05	<0.001	<0.005	.007	<0.0005	<0.005	.002	<0.10	.005	<0.01	<0.005	<0.05				
Rio Moquino Upstream	2-11-81	<0.005	<0.05	<0.001	<0.005	.011	<0.0005	<0.005	.003	<0.10	.017	<0.01	<0.005	<0.05				
Rio Paguate Above the Confluence	2-11-81	<0.005	<0.05	<0.001	<0.005	.006	<0.0005	<0.005	.003	<0.10	.010	<0.01	<0.005	<0.05				
Rio Moquino Above the Confluence	2-11-81	<0.005	<0.05	<0.001	<0.005	.014	<0.0005	<0.005	.002	<0.10	.017	<0.01	<0.005	<0.05	← Inserted	Data		
Rio Paguate Ford Crossing	2-11-81	<0.005	<0.05	<0.001	<0.005	.014	<0.0005	<0.005	.003	<0.10	.017	<0.01	<0.005	<0.05				
uate Reservoir	2-11-81	<0.005	<0.05	<0.001	<0.005	.014	<0.0005	<0.005	.004	<0.10	.010	<0.01	<0.005	<0.05				
kpile #4	2-11-81	<0.005	<0.05	<0.001	<0.005	<0.005	<0.0005	<0.005	.003	<0.10	.010	<0.01	<0.005	<0.05				
kpile New Shop	2-11-81	<0.005	<0.05	<0.001	<0.005	.010	<0.0005	<0.005	.002	0.10	.035	<0.01	<0.005	<0.05				
kpile Old Shop	2-11-81	<0.005	<0.05	<0.001	<0.005	.016	<0.0005	.14	.003	<0.10	1.5	<0.01	<0.005	<0.05				

350002440

FOR THE MONTH OF: MARCH, 1981

DESCRIPTION	DATE	pH	TDS ppm	Cond umhos	HCO_3^- ppm	Cl^- ppm	$SO_4^=$ ppm	Na^+ ppm	K^+ ppm	Ca^{++} ppm	Mg^{++} ppm	NO_3^- ppm	F^- ppm	SiO_2 ppm	Mn^{++} ppm			
o Paguate Upstream	3-12-81	8.2	525	786	332	12	169	40	3	87	22	<1	0.42	29	<0.10			
Rio Moquino Upstream	3-12-81	8.2	1513	2200	270	19	945	178	11	154	58	<1	0.62	14	<0.10			
Rio Paguate Above the Confluence	3-12-81	8.2	592	835	305	12	235	52	4	84	28	<1	0.51	27	<0.10			
Rio Moquino Above the Confluence	3-12-81	8.3	1886	2690	296	23	1185	245	13	164	95	<1	0.74	15	0.10	← INSerted	Data	
Rio Paguate Ford Crossing	3-12-81	7.6	1913	2780	183	14	1303	255	18	174	44	7	0.70	8	0.10			
Paguate Reservoir	3-12-81	8.0	2186	2780	88	43	1522	223	28	260	54	5	0.86	8	<0.10			
Jackpile #4	3-12-81	8.7	823	1550	354	19	332	278	2	5	1	<1	1.11	11	<0.10			
Jackpile New Shop	3-12-81	8.3	1385	2300	399	31	686	437	5	15	1	<1	1.20	13	<0.10			
Jackpile Old Shop	3-12-81	7.9	3764	4600	249	115	2460	543	18	314	137	44	0.68	11	0.10			
		As ppm	Ba ppm	Cd ppm	Cr ppm	Pb ppm	Hg ppm	Se ppm	Cu ppm	Fe ppm	Zn ppm	Mo ppm	Ni ppm	V ppm				
Rio Paguate Upstream	3-12-81	<0.005	0.12	<0.001	<0.005	<0.005	<0.0005	<0.005	.002	<0.10	.031	<0.01	<0.005	<0.05				
Rio Moquino Upstream	3-12-81	<0.005	0.10	<0.001	<0.005	<0.005	<0.0005	<0.005	.002	<0.10	.021	<0.01	<0.005	<0.05				
Rio Paguate Above the Confluence	3-12-81	<0.005	0.08	<0.001	<0.005	<0.005	<0.0005	<0.005	.001	0.10	.006	<0.01	<0.005	<0.05				
Rio Moquino Above the Confluence	3-12-81	<0.005	0.11	<0.001	<0.005	<0.005	<0.0005	<0.005	<.001	0.30	.030	<0.01	<0.005	<0.05	← INSerted	Data		
Rio Paguate Ford Crossing	3-12-81	<0.005	0.12	<0.001	<0.005	0.01	<0.0005	<0.005	.002	0.10	.022	<0.01	<0.005	<0.05				
guate Reservoir	3-12-81	<0.005	0.06	<0.001	<0.005	0.01	<0.0005	<0.005	.005	0.10	.018	<0.01	<0.005	<0.05				
ckpile #4	3-12-81	<0.005	<0.05	<0.001	<0.005	0.01	<0.0005	<0.005	.002	<0.10	.029	<0.01	<0.005	<0.05				
ckpile New Shop	3-12-81	<0.005	<0.05	<0.001	<0.005	<0.005	<0.0005	<0.005	<.001	0.10	.037	<0.01	<0.005	<0.05				
Jackpile Old Shop	3-12-81	<0.005	<0.05	<0.001	<0.005	0.01	<0.0005	.026	.002	<0.10	.58	<0.01	<0.005	<0.05				

350002441



DCM, MINING
RECEIVED
JUN 29 1981
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U.S. GEOLOGICAL SURVEY
ALBUQUERQUE, NEW MEXICO

THE ANACONDA COMPANY
NEW MEXICO OPERATIONS

RADON FLUX LOCATIONS
FROM SEPTEMBER 1980 TO JUNE 1981

RADON FLUX SAMPLE SITE ◎

SCALE 1" = 1000'

350002442

ANACONDA Copper Company
New Mexico Operations
P.O. Box 638
Grants, New Mexico 87020
505/876-2211

DCM, MINING
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JUN 18 1981
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U.S. GEOLOGICAL SURVEY
ALBUQUERQUE, NEW MEXICO

June 16, 1981

Mr. Ed Sandell
Deputy Conservation Manager
UNITED STATES DEPARTMENT OF INTERIOR
GEOLOGICAL SURVEY
P.O. Box 26124
Albuquerque, New Mexico 87125

Dear Sir:

The following information is being submitted in accordance with the Jackpile-Paguate Minesite Sampling Program for the First Quarter of 1981.

1. Radiological Analysis of Ground and Surface Water.

2. Chemical Analysis of Ground and Surface Water.

3. Maps Showing Ground and Surface Water Sampling Locations.

4. Results of the Air Monitoring Program.

5. Results of the Ambient Radon Monitoring Program.

6. Map Showing location of Air and Radon Monitoring Stations.

Sincerely,

Meade A. Stirland

Meade A. Stirland, Manager
ENVIRONMENT, HEALTH & SAFETY

jls

Enclosures

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JUN 22 1981
U.S. GEOLOGICAL SURVEY
ALBUQUERQUE, NEW MEXICO

AIR QUALITY MONITORING PROGRAM

One 168-hour sample is taken each month at each of the four locations specified by Marc Nelson. They are collected about three meters above the ground on GF/A Glass Microfibre filter paper, using an RAC Heavy-duty Sampler.

AMBIENT RADON STUDY

Radon-222 is monitored continuously at each of the air sampling locations specified by Marc Nelson. The samples are monitored by the use of the Model RGM-2 Radon Gas Monitor. Normal data output is printed hourly and a 24-hour average is printed at the end of a 24-hour period.

JACKPILE - WATER RADIOLOGICAL ANALYSIS

(FIRST QUARTER, 1981)

DESCRIPTIVE LOCATION	Radium-226 pCi/L			Uranium-Natural ppm		
	January	February	March	January	February	March
Rio Paguate Upstream	0.34	0.54	0.41	0.012	0.002	0.012
Rio Moquino Upstream	0.07	0.14	0.29	0.003	0.001	0.008
Rio Paguate Above the Confluence	0.66	0.78	3.68	0.024	0.007	0.075
Rio Moquino Above the Confluence	0.24	1.26	1.93	0.026	0.014	0.086
Rio Paguate Ford Crossing	1.64	2.22	5.70	0.025	0.177	2.147
Paguate Reservoir	0.83	0.71	2.69	0.076	0.167	0.806
Jackpile Well #4	0.43	0.85	0.52	0.003	0.007	0.008
Jackpile New Shop	1.47	3.47	2.88	0.003	0.003	0.021
Jackpile Old Shop	3.32	3.93	3.37	0.330	0.335	0.285

ANACONDA COPPER COMPANY
NEW MEXICO OPERATION

FOR THE MONTH OF: January, 1981

DESCRIPTION	DATE	pH	TDS ppm	Cond umhos	HCO_3^- ppm	Cl^- ppm	$SO_4^=$ ppm	Na^+ ppm	K^+ ppm	Ca^{++} ppm	Mg^{++} ppm	NO_3^- ppm	F^- ppm	SiO_2 ppm	Mn^{++} ppm
Rio Paguate (Upstream)	1-08-81	8.3	546	690	341	13	179	35	4	85	33	<1	0.36	28	<0.10
Rio Moquino (Upstream)	1-08-81	8.2	1527	1800	396	18	888	172	11	129	99	<1	0.50	14	<0.10
Rio Paguate Above Confl.	1-08-81	8.4	601	768	305	13	244	48	4	76	41	<1	0.41	24	<0.10
Rio Paguate (Ford Crossing)	1-08-81	8.2	1593	2000	300	21	966	180	11	131	118	<1	0.60	18	<0.10
Paguate Reservoir	1-08-81	8.4	1644	1900	34	38	1133	157	22	182	88	<1	0.54	6	<0.10
Jackpile #4	1-12-81	8.6	635	1200	NIL	20	321	273	3	5	1	<1	1.04	10	<0.10
Jackpile New Shop	1-08-81	8.4	1359	2000	391	30	681	418	6	15	2	2	1.15	13	0.10
Jackpile Old Shop	1-12-81	8.3	3140	3790	214	96	2051	480	15	219	167	<1	0.68	6	<0.10

	DATE	As ppm	Ba ppm	Cd ppm	Cr ppm	Pb ppm	Hg ppm	Se ppm	Cu ppm	Fe ppm	Zn ppm	Mo ppm	Ni ppm	V ppm
Rio Paguate (Upstream)	1-08-81	<0.005	<0.05	<0.001	<0.005	0.01	<0.0005	<0.005	0.003	<0.10	0.052	<0.01	<0.005	<0.05
Rio Moquino (Upstream)	1-08-81	<0.005	<0.05	<0.001	<0.005	< .01	<0.0005	<0.005	0.003	<0.10	0.011	<0.01	<0.005	<0.05
Rio Paguate Above Confl.	1-08-81	<0.005	<0.05	<0.001	<0.005	< .01	<0.0005	<0.005	0.002	<0.10	0.007	<0.01	<0.005	<0.05
Rio Paguate (Ford Crossing)	1-08-81	<0.005	0.12	<0.001	<0.005	<0.01	<0.0005	<0.005	0.002	<0.10	0.020	<0.01	<0.005	<0.05
Paguate Reservoir	1-08-81	<0.005	0.09	<0.001	<0.005	<0.01	<0.0005	<0.005	0.003	<0.10	0.013	<0.01	<0.005	<0.05
Jackpile #4	1-12-81	<0.005	<0.05	<0.001	<0.005	<0.01	<0.0005	<0.005	0.003	<0.10	0.010	<0.01	<0.005	<0.05
Jackpile New Shop	1-08-81	<0.005	<0.05	<0.001	<0.005	0.01	<0.0005	<0.005	0.004	0.20	0.063	<0.01	<0.005	<0.05
Jackpile Old Shop	1-12-81	<0.005	<0.05	<0.001	<0.005	0.01	<0.0005	0.02	0.003	<0.10	3.70	<0.01	<0.005	<0.05

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ANACONDA COPPER COMPANY
NEW MEXICO OPERATION

FOR THE MONTH OF: February, 1981

DESCRIPTION	DATE	pH	TDS ppm	Cond umhos	HCO_3^- ppm	Cl^- ppm	$SO_4^=$ ppm	Na^+ ppm	K^+ ppm	Ca^{++} ppm	Mg^{++} ppm	NO_3^- ppm	F^- ppm	SiO_2 ppm	Mn^{++} ppm
Rio Paguate (Upstream)	2-11-81	8.3	486	697	302	11	149	31	3	74	20	< 1	.33	30	<0.10
Rio Moquino (Upstream)	2-11-81	8.2	1634	2200	312	20	992	214	11	154	73	< 1	.53	15	<0.10
Rio Paguate Above Confl.	2-11-81	8.4	450	638	271	11	147	31	3	74	20	< 1	.34	30	<0.10
Rio Paguate (Ford Crossing)	2-11-81	8.3	1502	2190	294	22	924	182	10	134	64	< 1	.52	20	<0.10
Paguate Reservoir	2-11-81	7.39	1898	2410	30	46	1314	205	24	224	66	< 1	.58	3	<0.10
Jackpile #4	2-11-81	8.8	841	1200	366	18	332	290	2	5	1	< 1	1.1	12	<0.10
Jackpile New Shop	2-11-81	8.4	1368	2200	393	30	668	437	5	18	1	1	1.3	15	<0.10
Jackpile Old Shop	2-11-81	8.0	3570	4200	248	1	2359	557	18	319	133	48	0.60	13	<0.10

	DATE	As ppm	Ba ppm	Cd ppm	Cr ppm	Pb ppm	Hg ppm	Se ppm	Cu ppm	Fe ppm	Zn ppm	Mo ppm	Ni ppm	V ppm
Rio Paguate (Upstream)	2-11-81	<0.005	<0.05	<0.001	<0.005	.007	<0.0005	<0.005	.002	<0.10	.005	<0.01	<0.005	<0.05
Rio Moquino (Upstream)	2-11-81	<0.005	<0.05	<0.001	<0.005	.011	<0.0005	<0.005	.003	<0.10	.017	<0.01	<0.005	<0.05
Rio Paguate Above Confl.	2-11-81	<0.005	<0.05	<0.001	<0.005	.006	<0.0005	<0.005	.003	<0.10	.010	<0.01	<0.005	<0.05
Rio Paguate (Ford Crossing)	2-11-81	<0.005	<0.05	<0.001	<0.005	.014	<0.0005	<0.005	.003	<0.10	.017	<0.01	<0.005	<0.05
Paguate Reservoir	2-11-81	<0.005	<0.05	<0.001	<0.005	.014	<0.0005	<0.005	.004	<0.10	.010	<0.01	<0.005	<0.05
Jackpile #4	2-11-81	<0.005	<0.05	<0.001	<0.005	<0.005	<0.0005	<0.005	.003	<0.10	.010	<0.01	<0.005	<0.05
Jackpile New Shop	2-11-81	<0.005	<0.05	<0.001	<0.005	.010	<0.0005	<0.005	.002	0.10	.035	<0.01	<0.005	<0.05
Jackpile Old Shop	2-11-81	<0.005	<0.05	<0.001	<0.005	.016	<0.0005	.14	.003	<0.10	1.5	<0.01	<0.005	<0.05

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ANACONDA COPPER COMPANY
NEW MEXICO OPERATION

FOR THE MONTH OF: March, 1981

DESCRIPTION	DATE	pH	TDS ppm	Cond umhos	HCO_3^- ppm	Cl^- ppm	$SO_4^=$ ppm	Na^+ ppm	K^+ ppm	Ca^{++} ppm	Mg^{++} ppm	NO_3^- ppm	F^- ppm	SiO_2 ppm	Mn^{++} ppm
Rio Paguate (Upstream)	3-12-81	8.2	525	786	332	12	169	40	3	87	22	<1	0.42	29	<0.10
Rio Moquino (Upstream)	3-12-81	8.2	1513	2200	270	19	945	178	11	154	58	<1	0.62	14	<0.10
Rio Paguate Above Confl.	3-12-81	8.2	592	835	305	12	235	52	4	84	28	<1	0.51	27	<0.10
Rio Paguate (Ford Crossing)	3-12-81	7.6	1913	2780	183	14	1303	255	18	174	44	7	0.70	8	0.10
Paguate Reservoir	3-12-81	8.0	2186	2780	88	43	1522	223	28	260	54	5	0.86	8	<0.10
Jackpile #4	3-12-81	8.7	823	1550	354	19	332	278	2	5	1	<1	1.11	11	<0.10
Jackpile New Shop	3-12-81	8.3	1385	2300	399	31	686	437	5	15	1	<1	1.20	13	<0.10
Jackpile Old Shop	3-12-81	7.9	3764	4600	249	115	2460	543	18	314	137	44	0.68	11	0.10

	DATE	As ppm	Ba ppm	Cd ppm	Cr ppm	Pb ppm	Hg ppm	Se ppm	Cu ppm	Fe ppm	Zn ppm	Mo ppm	Ni ppm	V ppm
Rio Paguate (Upstream)	3-12-81	<0.005	0.12	0.001	<0.005	<0.005	<0.0005	<0.005	.002	<0.10	.031	<0.01	<0.005	<0.05
Rio Moquino (Upstream)	3-12-81	<0.005	0.10	<0.001	<0.005	<0.005	<0.0005	<0.005	.002	<0.10	.021	<0.01	<0.005	<0.05
Rio Paguate Above Confl.	3-12-81	<0.005	0.08	<0.001	<0.005	<0.005	<0.0005	<0.005	.001	0.10	.006	<0.01	<0.005	<0.05
Rio Paguate (Ford Crossing)	3-12-81	<0.005	0.12	<0.001	<0.005	0.01	<0.0005	<0.005	.002	0.10	.022	<0.01	<0.005	<0.05
Paguate Reservoir	3-12-81	<0.005	0.06	<0.001	<0.005	0.01	<0.0005	<0.005	.005	0.10	.018	<0.01	<0.005	<0.05
Jackpile #4	3-12-81	<0.005	<0.05	<0.001	<0.005	0.01	<0.0005	<0.005	.002	<0.10	.029	<0.01	<0.005	<0.05
Jackpile New Shop	3-12-81	<0.005	<0.05	<0.001	<0.005	<0.005	<0.0005	<0.005	<0.001	0.10	.037	<0.01	<0.005	<0.05
Jackpile Old Shop	3-12-81	<0.005	<0.05	<0.001	<0.005	0.01	<0.0005	.026	.002	<0.10	0.58	<0.01	<0.005	<0.05

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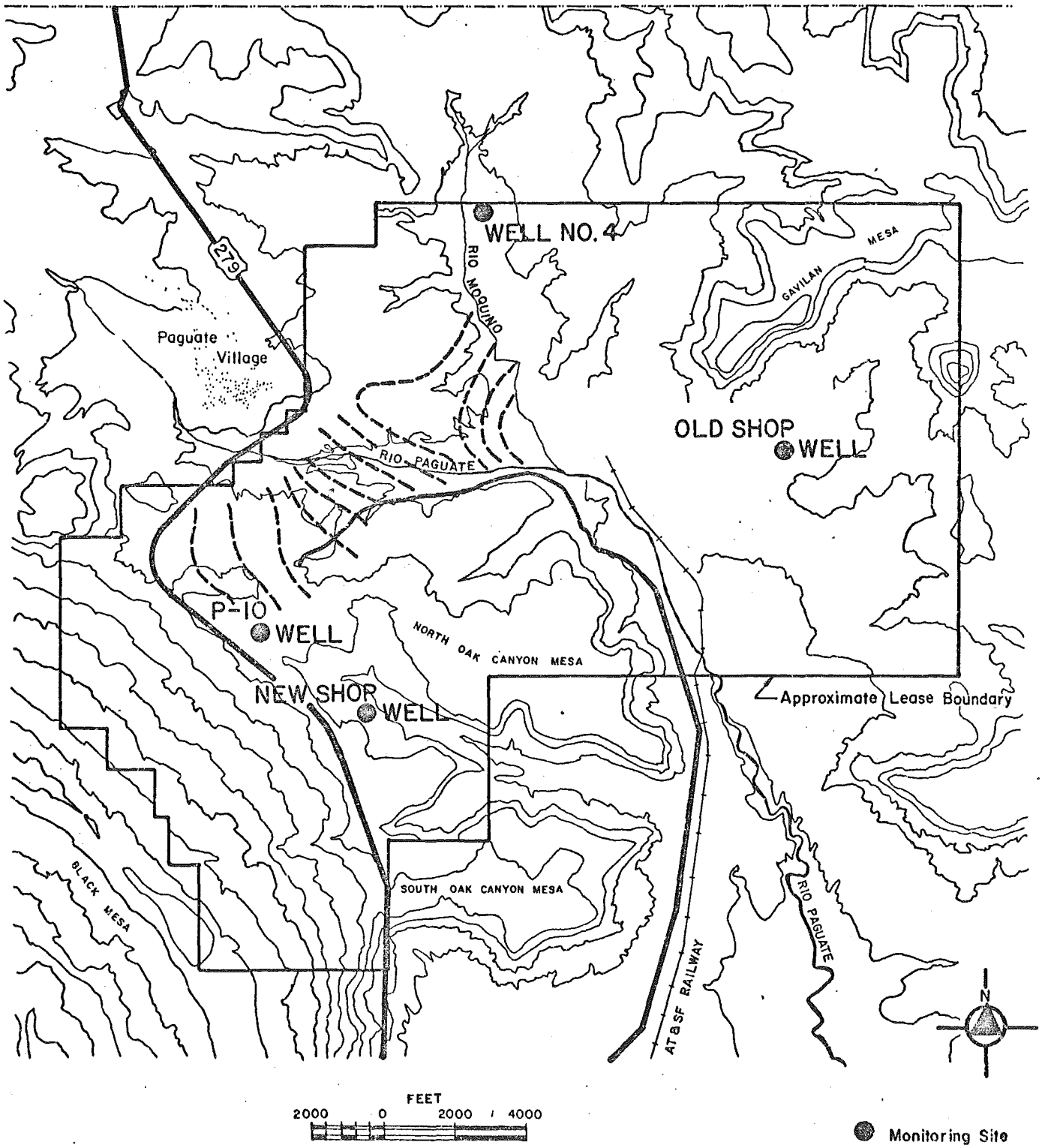
LOCATION OF GROUND WATER MONITORING STATIONS



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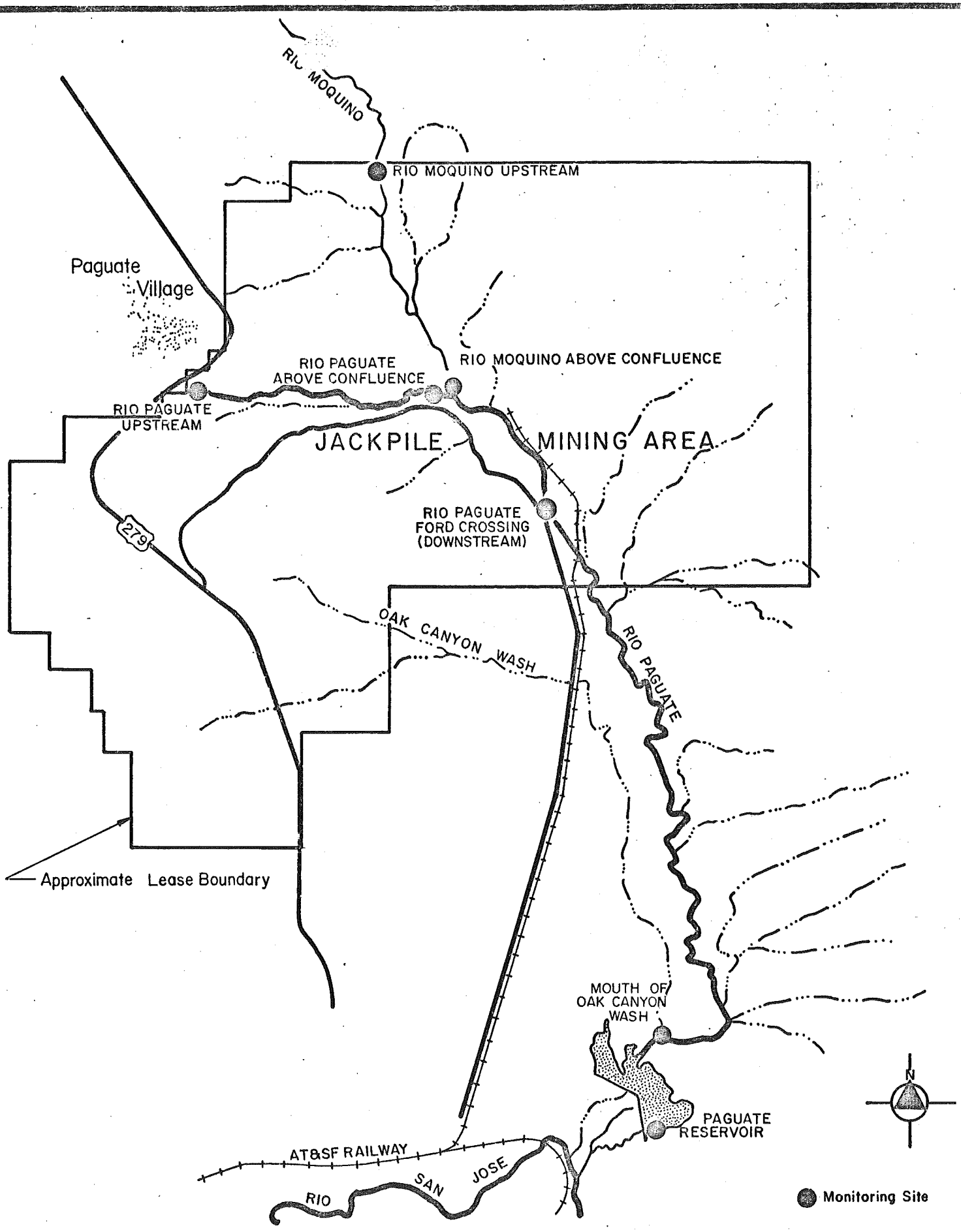

LOCATION OF
SURFACE WATER MONITORING STATIONS

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JACKPILE - AIR SAMPLING SURVEY

FIRST QUARTER, 1981

LOCATION	DATE	Total Particulate $mg/M^3 x10^{-8}$	U-Nat. $uci/ml x10^{-15}$	Ra-226 $uci/ml x10^{-15}$	Th-230 $uci/ml x10^{-15}$	Pb-210 $uci/ml x10^{-15}$
1. Dump F	1/81	2.91	15.26	0.96	2.81	85.18
	2/81	0.20	4.58	1.03	2.39	38.06
	3/81	0.17	5.59	2.59	1.54	23.21
2. Mine Vent	1/81	3.76	3.98	0.87	2.13	54.64
	2/81	0.47	2.49	1.10	0.83	29.83
	3/81	0.18	2.02	1.67	2.62	26.14
3. West Gate	1/81	8.20	5.06	2.50	0.64	73.08
	2/81	1.47	9.50	2.50	5.31	38.12
	3/81	0.21	2.68	1.58	1.44	18.88
4. Well #4	1/81	0.69	6.98	2.60	2.88	92.46
	2/81	0.24	3.50	0.40	1.09	33.33
	3/81	0.23	4.61	2.96	2.78	22.48

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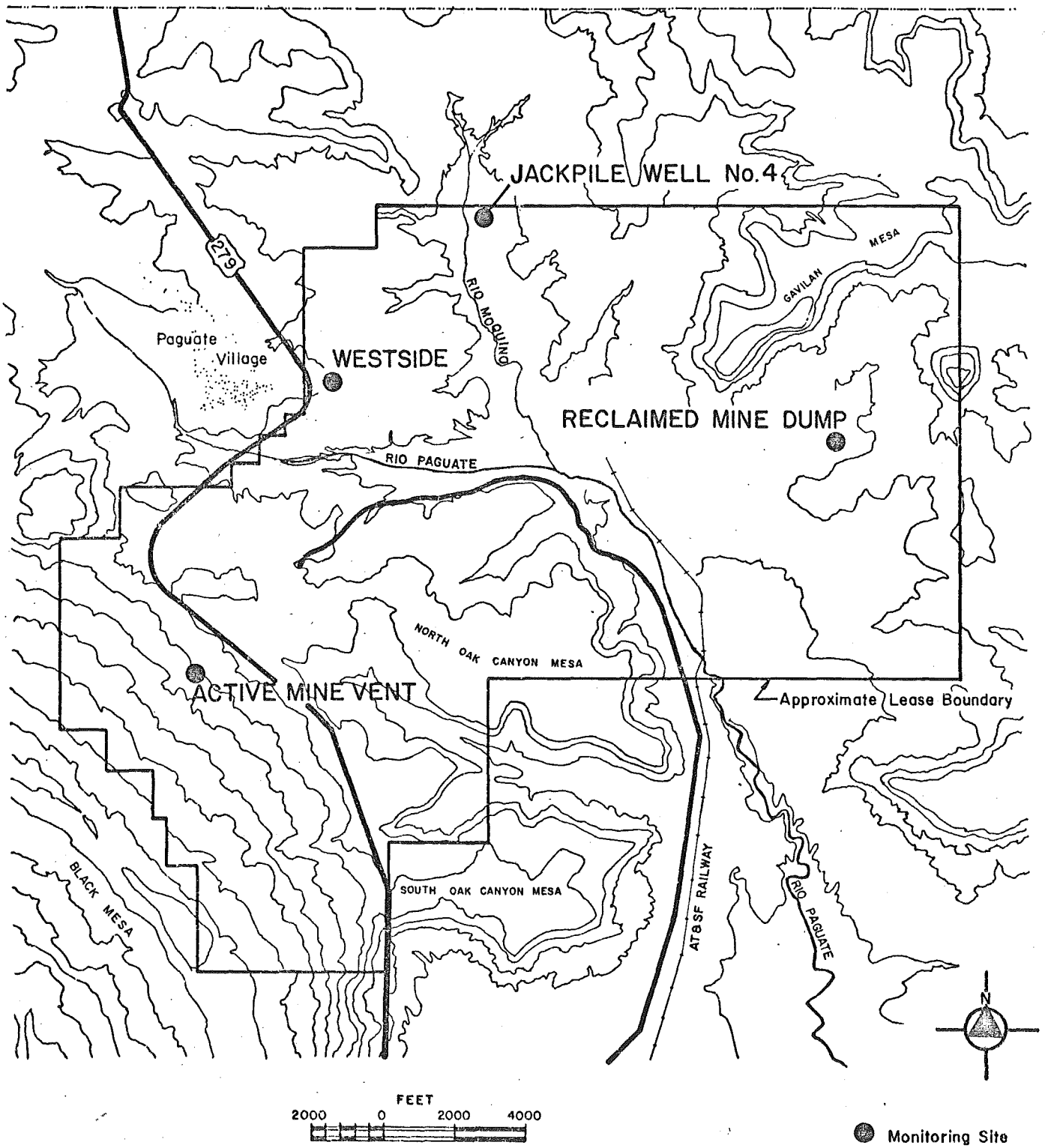
JACKPILE - AMBIENT RADON SURVEY

FIRST QUARTER, 1981

LOCATION	DATE	Rn-222 pCi/l
1. Dump F	1/81	3.14
	2/81	2.72
	3/81	2.26
2. Mine Vent	1/81	3.68
	2/81	2.46
	3/81	2.36
3. Well #4	1/81	2.17
	2/81	1.72
	3/81	1.56
4. Westgate	1/81	2.56
	2/81	NS
	3/81	0.90

LOCATION OF
AIR QUALITY MONITORING STATIONS



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ANACONDA Copper Company
New Mexico Operations
P.O. Box 638
Grants, New Mexico 87020
505/876-2211

DCM, MINING
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U.S. GEOLOGICAL SURVEY
ALBUQUERQUE, NEW MEXICO

April 8, 1981

Mr. Ed Sandell,
Deputy Conservation Manager
UNITED STATES DEPARTMENT OF INTERIOR
GEOLOGICAL SURVEY
P.O. Box 26124
Albuquerque, New Mexico 87125

Dear Sir:

The following information is being submitted in accordance with the Jackpile-Paguate Minesite Reclamation Sampling Program for the Fourth Quarter of 1980.

1. Radiological Analysis of Ground and Surface Water.

2. Chemical Analysis of Ground and Surface Water.

3. Maps showing Ground and Surface Water Sampling Locations.

4. Results of the Air Monitoring Program.

5. Results of the Ambient Radon Study.

6. Map showing location of Air and Radon Monitoring Stations.

Sincerely,

Meade A. Stirland

Meade A. Stirland, Manager
ENVIRONMENT, HEALTH & SAFETY

jls

Enclosures

AIR QUALITY MONITORING PROGRAM

One 168-hour sample is taken each month at each of the four locations specified by Marc Nelson. They are collected about three meters above the ground on GF/A Glass Microfibre filter paper, using an RAC Heavy-duty Sampler.

AMBIENT RADON STUDY

Radon-222 is monitored continuously at each of the air sampling locations specified by Marc Nelson. The samples are monitored by the use of the Model RGM-2 Radon Gas Monitor. Normal data output is printed hourly and a 24 hour average is printed at the end of a 24 hour period.

JACKPILE - WATER RADIOLOGICAL ANALYSIS

(FOURTH QUARTER, 1980)

DESCRIPTIVE LOCATION	Radium-226 pCi/L			Uranium-Natural ppm		
	October	November	December	October	November	December
Rio Paguate Upstream	0.33	0.02	0.13	0.002	0.010	0.008
Rio Moquino Upstream	0.36	0.23	0.48	0.001	0.001	0.006
Rio Paguate Above the Confluence	2.00	1.33	1.21	0.082	0.078	0.038
Rio Moquino Above the Confluence	0.71	1.33	0.81	0.077	0.022	0.007
Rio Paguate Ford Crossing	2.89	1.01	1.26	0.260	0.209	0.136
Paguate Reservoir	2.44	0.96	1.46	0.267	0.224	0.218
Jackpile Well #4	0.73	0.38	1.03	0.013	0.007	0.001
Jackpile New Shop	1.07	2.13	0.66	0.018	0.003	0.011
Jackpile Old Shop	1.02	2.14	NS	0.082	0.064	NS

ANACONDA COPPER COMPANY
NEW MEXICO OPERATION

FOR THE MONTH OF: October 1980

DESCRIPTION	DATE	pH	TDS ppm	Cond umhos	HCO_3^- ppm	Cl^- ppm	$SO_4^=$ ppm	Na^+ ppm	K^+ ppm	Ca^{++} ppm	Mg^{++} ppm	NO_3^- ppm	F^- ppm	SiO_2 ppm	Mn^{++} ppm
Rio Paguate (Upstream)	10-2-80	8.0	501	730	340	14	129	35	4	89	33	<1	0.44	29	<0.10
Rio Moquino (Upstream)	10-2-80	8.2	1781	2300	274	23	1108	218	14	148	118	<1	0.62	16	<0.10
Rio Paguate (Above Confluence	10-2-80	8.0	647	850	291	16	271	59	6	74	51	<1	0.52	26	<0.10
Rio Moquino (Above Confluence	10-2-80	8.0	2359	2800	269	25	1517	298	16	148	118	<1	0.88	16	<0.10
Rio Paguate (Ford Crossing)	10-2-80	8.0	1991	2570	302	29	1225	247	15	164	144	<1	0.74	18	<0.10
Paguate Reservoir	10-2-80	7.9	1329	1700	181	17	821	99	14	213	59	<1	0.74	16	<0.10
Jackpile #4	10-2-80	8.6	842	1300	388	20	322	290	2	4	<1	1	1.10	11	<0.10
Jackpile New Shop	10-2-80	8.4	1365	2100	395	32	655	448	6	14	1	<1	1.15	14	<0.10
Jackpile Old Shop	10-2-80	8.4	1431	2100	331	38	754	359	6	56	37	6	1.00	12	<0.10

	DATE	As ppm	Ba ppm	Cd ppm	Cr ppm	Pb ppm	Hg ppm	Se ppm	Cu ppm	Fe ppm	Zn ppm	Mo ppm	Ni ppm	V ppm
Rio Paguate (Upstream)	10-2-80	<.005	0.21	<.001	<.005	<.005	<.0005	<.005	0.005	<0.10	0.006	<.005	<.005	<0.01
Rio Moquino (Upstream)	10-2-80	<.005	0.17	<.001	<.005	<.005	<.0005	<.005	0.004	<0.10	0.011	0.008	<.005	0.012
Rio Paguate (Above Confluence	10-2-80	<.005	0.10	<.001	<.005	0.011	<.0005	<.005	0.003	<0.10	0.081	0.008	<.005	<0.01
Rio Moquino (Above Confluence	10-2-80	<.005	0.36	<.001	<.005	<.005	<.0005	<.005	0.010	<0.10	0.014	0.010	<.005	0.015
Rio Paguate (Ford Crossing)	10-2-80	<.005	0.16	<.001	<.005	<.005	<.0005	<.005	0.004	<0.10	0.003	0.009	<.005	0.014
Paguate Reservoir	10-2-80	<.005	0.24	<.001	<.005	<.005	<.0005	<.005	0.006	<0.10	0.007	0.008	<.005	0.014
Jackpile #4	10-2-80	<.005	<0.05	<0.001	<.005	0.006	<.0005	<.005	0.006	<0.10	0.011	<0.005	0.012	<0.01
Jackpile New Shop	10-2-80	<.005	0.10	<0.001	<.005	<.005	<.0005	<.005	0.006	0.20	0.033	<0.005	<.005	<0.01
Jackpile Old Shop	10-2-80	<.005	0.14	<0.001	<.005	<.005	<.0005	0.15	0.007	<0.10	0.106	<0.005	<.005	<0.01

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ANACONDA COPPER COMPANY
NEW MEXICO OPERATION

FOR THE MONTH OF: November 1980

DESCRIPTION	DATE	pH	TDS ppm	Cond umhos	HCO_3^- ppm	Cl^- ppm	$SO_4^=$ ppm	Na^+ ppm	K^+ ppm	Ca^{++} ppm	Mg^{++} ppm	NO_3^- ppm	F^- ppm	SiO_2 ppm	Mn^{++} ppm
Rio Paguate (Upstream)	11-7-80	8.2	571	720	368	12	178	34	4	92	39	<1	0.38	30	<0.10
Rio Moquino (Upstream)	11-7-80	8.2	1411	1800	234	23	869	154	11	127	99	<1		17	<0.10
Rio Paguate (Above Confluence)	11-7-80	8.2	614	740	295	14	265	45	5	64	50	<1	0.41	25	<0.10
Rio Moquino (Above Confluence)	11-7-80	8.1	1901	2350	251	21	1218	216	13	158	133	<1	0.70	17	<0.10
Rio Paguate (Ford Crossing)	11-7-80	8.2	1680	2100	288	22	1027	186	12	141	128	<1	0.56	20	<0.10
Paguate Reservoir	11-7-80	8.6	1441	1700	84	20	975	114	17	187	77	<1	0.64	9	<0.10
Jackpile #4	11-7-80	8.7	786	1200	353	17	316	257	2	4	1	1	1.08	13	<0.10
Jackpile New Shop	11-7-80	8.6	1325	2000	386	28	672	397	6	13	1	1	1.18	17	<0.10
Jackpile Old Shop	11-7-80	8.4	1396	1900	332	59	745	319	6	53	36	3	1.05	12	<0.10

	DATE	As ppm	Ba ppm	Cd ppm	Cr ppm	Pb ppm	Hg ppm	Se ppm	Cu ppm	Fe ppm	Zn ppm	Mo ppm	Ni ppm	V ppm
Rio Paguate (Upstream)	11-7-80	<.005	0.06	<.001	<.005	0.055	<.0005	<.005	0.005	<.10	0.006	<0.01	<.005	<0.05
Rio Moquino (Upstream)	11-7-80	<.005	0.17	<.001	<.005	<.005	<.0005	<.005	0.004	<.10	0.011	<0.01	<.005	0.012
Rio Paguate (Above Confluence	11-7-80	<.005	0.10	<.001	<.005	0.010	<.0005	<.005	0.001	<.10	0.009	<0.01	<.005	<0.05
Rio Moquino (Above Confluence	11-7-80	<.005	<0.05	<.001	<.005	0.017	<.0005	<.005	0.002	<.10	0.021	<0.01	<.005	<0.05
Rio Paguate (Ford Crossing)	11-7-80	<.005	<0.05	<.001	<.005	0.012	<.0005	<.005	0.002	<.10	0.017	<0.01	<.005	<0.05
ate Reservoir	11-7-80	<.005	<0.05	<.001	<.005	0.014	<.0005	<.005	0.002	<.10	0.038	<0.01	<.005	<0.05
pile #4	11-7-80	<.005	0.06	<.001	<.005	0.055	<.0005	<.005	0.003	<.10	0.011	<0.01	<.005	<0.05
pile New Shop	11-7-80	<.005	0.10	<.001	<.005	0.012	<.0005	<.005	0.001	0.14	0.039	<0.01	<.005	<0.05
Jackpile Old Shop	11-7-80	<.005	0.07	<.001	<.005	0.012	<.0005	0.083	0.002	<.10	0.201	<0.01	<.005	<0.05

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ANACONDA COPPER COMPANY
NEW MEXICO OPERATION

FOR THE MONTH OF: December 1980

DESCRIPTION	DATE	pH	TDS ppm	Cond umhos	HCO_3^- ppm	Cl^- ppm	$SO_4^=$ ppm	Na^+ ppm	K^+ ppm	Ca^{++} ppm	Mg^{++} ppm	NO_3^- ppm	F^- ppm	SiO_2 ppm	Mn^{++} ppm
Rio Paguate (Upstream)	12-4-80	8.1	575	755	349	12	185	37	4	94	40	<1	0.38	29	<0.10
Rio Moquino (Upstream)	12-4-80	8.0	1132	1500	249	14	656	130	7	112	75	<1	0.47	15	<0.10
Rio Paguate (Above Confluence)	12-4-80	8.0	654	825	320	15	263	51	5	81	52	<1	0.45	29	<0.10
Rio Moquino (Above Confluence)	12-4-80	8.0	1577	2050	256	19	969	196	9	131	108	<1	0.63	17	<0.10
Rio Paguate (Ford Crossing)	12-4-80	8.0	1496	2000	308	21	876	172	9	137	110	<1	0.59	18	<0.10
Paguate Reservoir	12-4-80	7.6	1480	1850	55	32	1008	138	19	172	77	<1	0.59	6	<0.10
Jackpile #4	12-4-80	8.4	659	1200	356	20	337	281	2	5	1	<1	1.20	12	<0.10
Jackpile New Shop	12-4-80	8.2	1353	2000	388	20	667	437	5	15	2	1	1.33	15	<0.10
Jackpile Old Shop	NS														

	DATE	As ppm	Ba ppm	Cd ppm	Cr ppm	Pb ppm	Hg ppm	Se ppm	Cu ppm	Fe ppm	Zn ppm	Mo ppm	Ni ppm	V ppm
Rio Paguate (Upstream)	12-4-80	<0.005	<0.05	<.001	<.005	0.008	<.0005	<.005	0.003	<.10	0.007	<0.01	<.005	<0.05
Rio Moquino (Upstream)	12-4-80	<0.005	0.07	<.001	<.005	0.010	<.0005	<.005	0.001	<.10	0.046	<0.01	<.005	<0.05
Rio Paguate (Above Confluence)	12-4-80	<0.005	<0.05	<.001	<.005	0.006	<.0005	<.005	0.003	<.10	0.003	<0.01	<.005	<0.05
Rio Moquino (Above Confluence)	12-4-80	<0.005	0.12	<.001	<.005	0.017	<.0005	<.005	0.004	<.10	0.020	<0.01	<.005	<0.05
Rio Paguate (Ford Crossing)	12-4-80	<0.005	0.10	<.001	<.005	0.011	<.0005	<.005	0.002	<.10	0.003	<0.01	<.005	<0.05
Paguate Reservoir	12-4-80	<0.005	0.10	<.001	<.005	0.011	<.0005	<.005	0.004	<.10	0.008	<0.01	<.005	<0.05
Jackpile #4	12-4-80	<0.005	0.12	<.001	<.005	0.007	<.0005	<.005	0.005	<.10	0.041	<0.01	<.005	<0.05
Jackpile New Shop	12-4-80	<0.005	0.22	<.001	<.005	0.010	<.0005	<.005	0.008	<.10	0.052	<0.01	<.005	<0.05
Jackpile Old Shop	NS													

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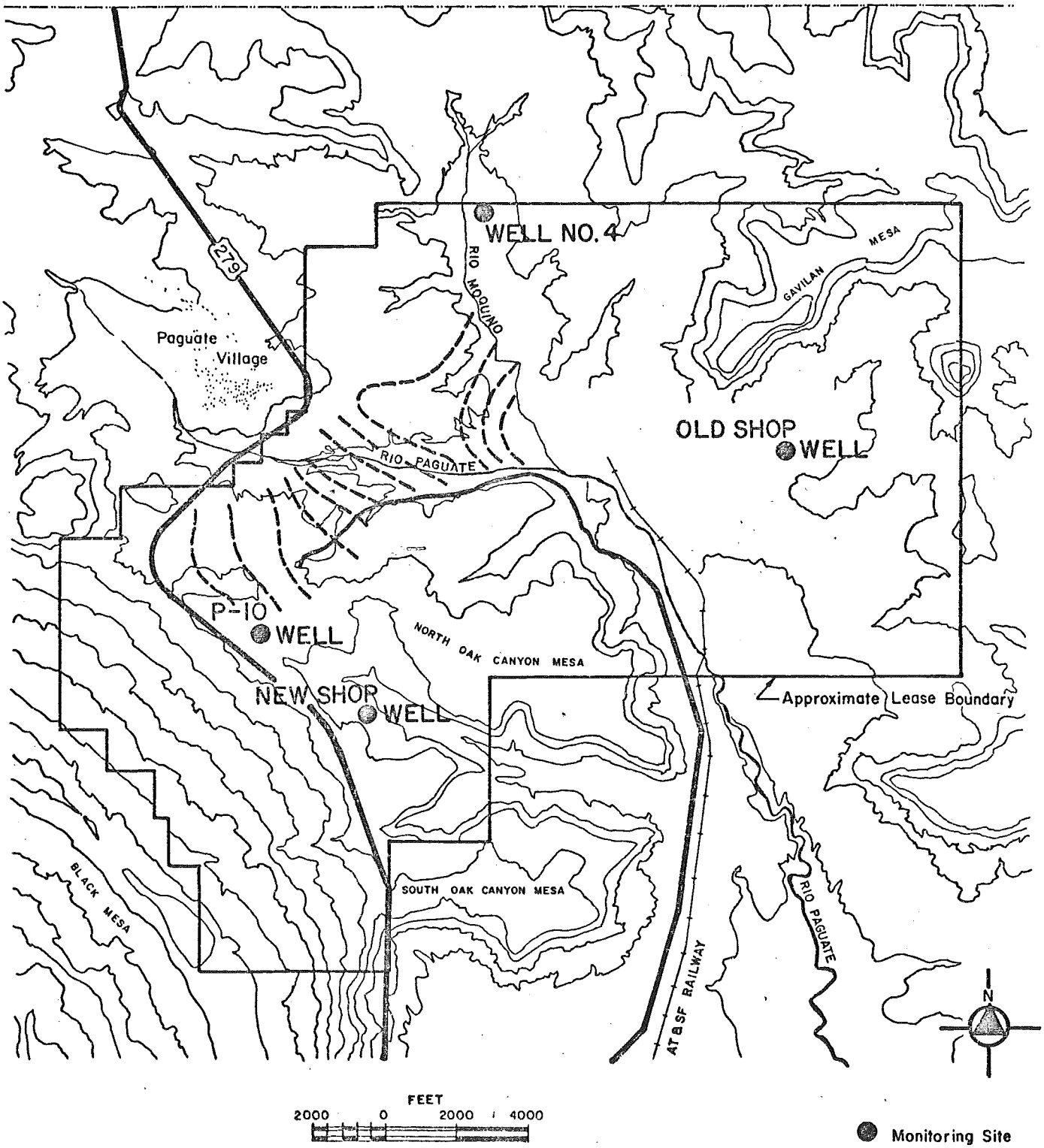
LOCATION OF GROUND WATER MONITORING STATIONS



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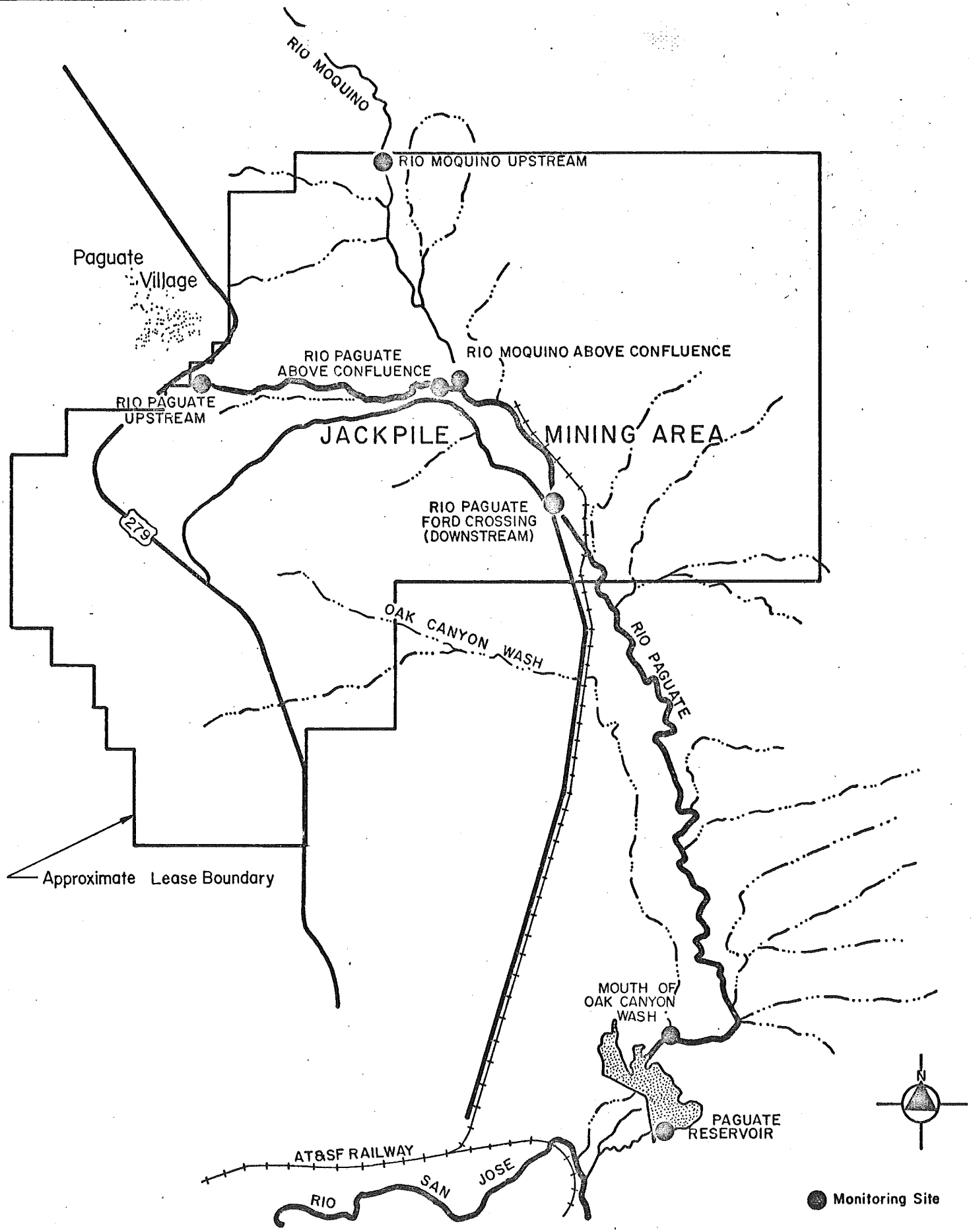

LOCATION OF
SURFACE WATER MONITORING STATIONS

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JACKPILE - AIR SAMPLING SURVEY

FOURTH QUARTER, 1980

LOCATION	DATE	Total Particulate $mg/M^3 x10^{-8}$	U-Nat. $uci/ml x10^{-15}$	Ra-226 $uci/ml x10^{-15}$	Th-230 $uci/ml x10^{-15}$	Pb-210 $uci/ml x10^{-15}$
1. Dump F	10/80	4.92	25.55	1.92	4.59	42.22
	11/80	NS	NS	NS	NS	NS
	12/80	NS	NS	NS	NS	NS
2. Mine Vent	10/80	6.21	78.02	1.45	12.32	53.14
	11/80	1.57	1.84	0.21	0.86	27.11
	12/80	NS	NS	NS	NS	NS
3. West Gate	10/80	7.22	14.31	2.62	6.93	35.00
	11/80	3.60	0.83	0.75	0.75	14.96
	12/80	5.37	1.35	3.40	3.40	*
4. Well #4	10/80	7.18	33.16	2.67	8.14	37.89
	11/80	5.91	2.71	1.26	1.46	28.48
	12/80	3.30	28.21	1.97	4.50	*

NS - indicates no samples

* - indicates that Pb-210 analysis are not complete. Results will be forwarded upon completion.

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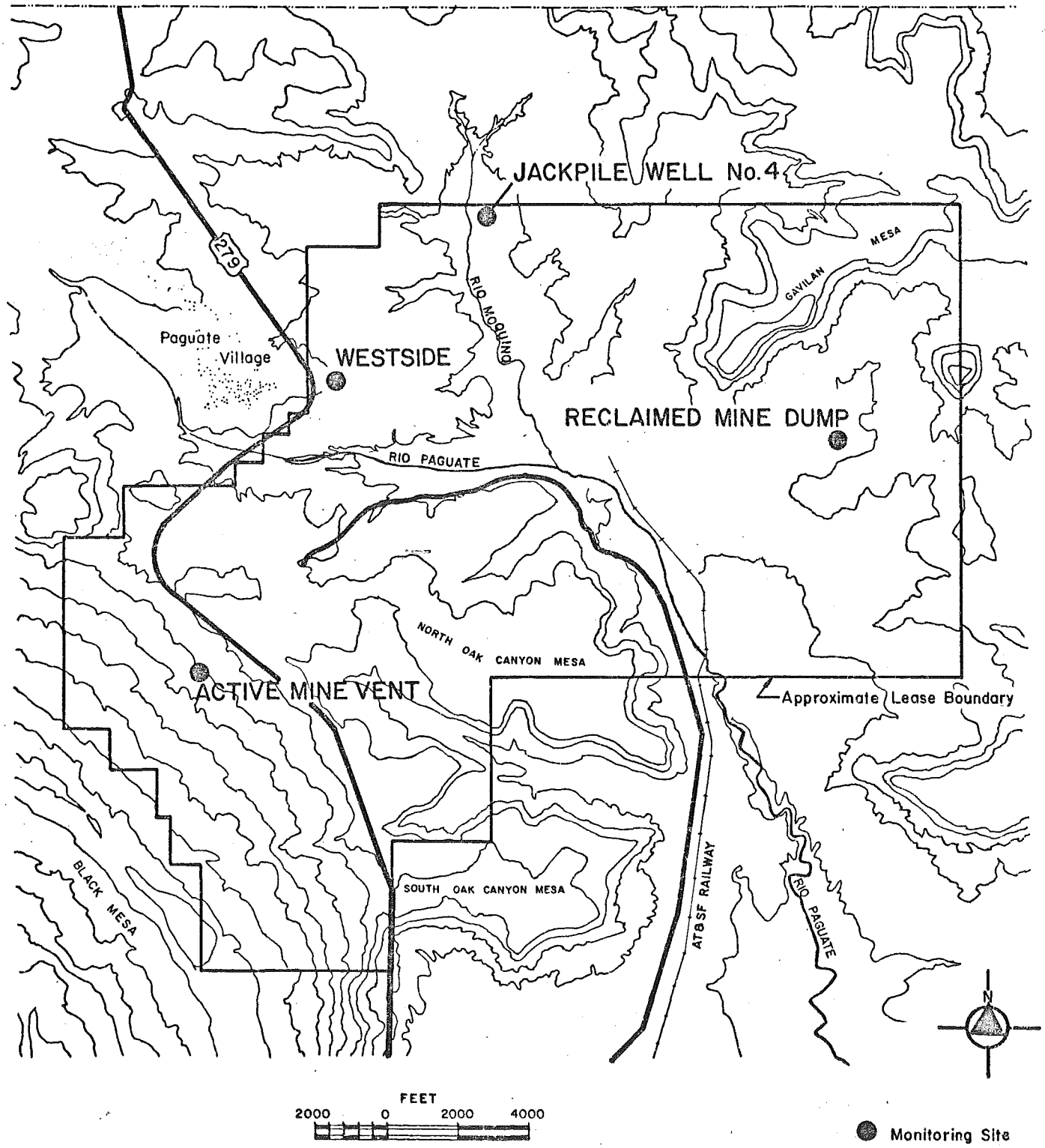
JACKPILE - AMBIENT RADON STUDY

FOURTH QUARTER, 1980

LOCATION	DATE	Rn-222 pCi/l
1. Dump F	10/80	1.70
	11/80	NS
	12/80	NS
2. Mine Vent	10/80	2.17
	11/80	2.84
	12/80	3.51
3. Well #4	10/80	0.97
	11/80	1.21
	12/80	2.29
4. Westgate	10/80	1.15
	11/80	1.28
	12/80	NS

LOCATION OF
AIR QUALITY MONITORING STATIONS



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ANACONDA Copper Company
New Mexico Operations
P.O. Box 638
Grants, New Mexico 87020
505/876-2211

April 7, 1981

DCM, MINING
RECEIVED
APR 8 1981
NOTED SANDELL
RECEIVED
U.S. GEOLOGICAL SURVEY
ALBUQUERQUE, NEW MEXICO

Mr. Ed Sandell,
Deputy Conservation Manager
United States Department of Interior
Geological Survey
P.O. Box 26124
Albuquerque, New Mexico 87125

Dear Sir:

The following information is being submitted in accordance with the Jackpile-Paguate Minesite Reclamation Sampling Program for the Third Quarter of 1980.

Results of the Air Monitoring Program - Pb-210 for September 1980.

Sincerely,

Meade A. Stirland, Manager
ENVIRONMENT, HEALTH & SAFETY

jls

cc: RDL
ECL
CES
File

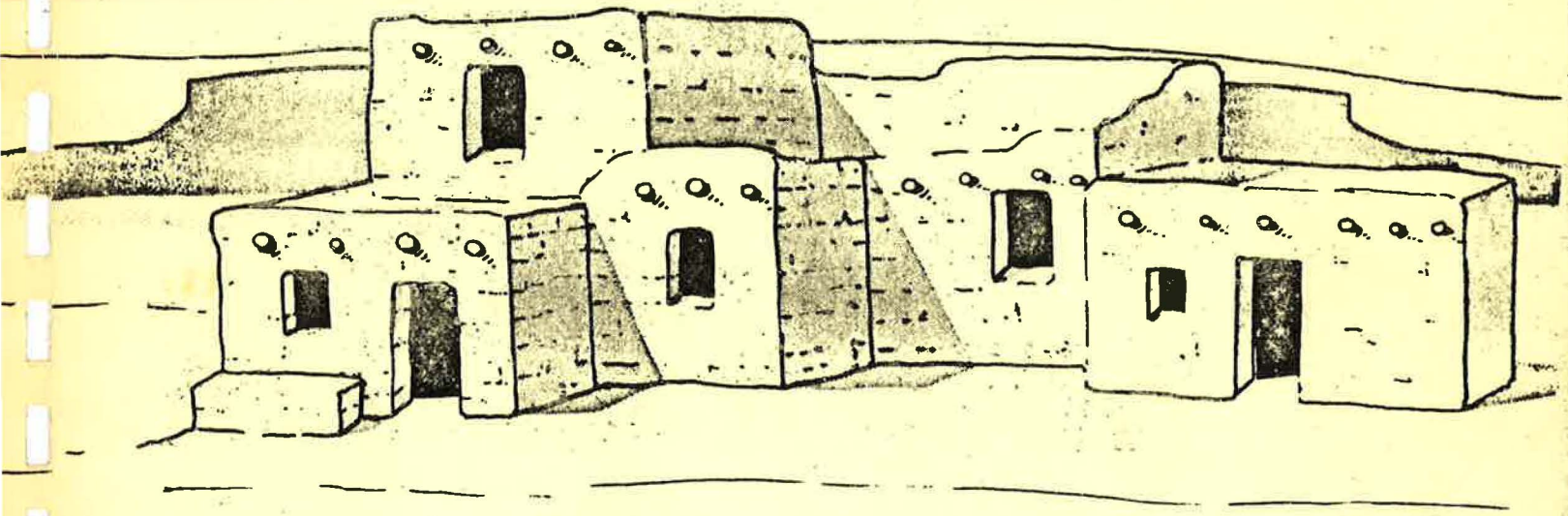
JACKPILE-AIR SAMPLING SURVEY

THIRD QUARTER, 1980

LOCATION	DATE	Pb-210 uCi/mlx10^{-15}
1. DUMP F	9/80	9.48
2. MINE VENT	9/80	152.84
3. WESTGATE	9/80	34.61
4. WELL #4	9/80	26.19

Effects of Uranium Mine Dewatering on the Water Resources of the Pueblo of Laguna, New Mexico

Final Report



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EFFECTS OF URANIUM MINE DEWATERING ON THE WATER RESOURCES OF THE PUEBLO OF LAGUNA, NEW MEXICO

by

John J. Ward
Gary R. Walter
Sophie J. Alweis
Gary J. Axen
Harold W. Bentley
Shlomo P. Neuman, Modeling Consultant

Final Report

ALBUQUERQUE DISTRICT MINING
RECEIVED
MAR 26 1982
U.S. GEOLOGICAL SURVEY
ALBUQUERQUE, NEW MEXICO

Contract #MOOC-14202943

Prepared for

Pueblo of Laguna
Laguna, New Mexico

DCM, MINING
RECEIVED
MAR 24 1982
U.S. GEOLOGICAL SURVEY
ALBUQUERQUE

Hydro Geo Chem, Inc.
744 North Country Club Road
Tucson, Arizona 85716

March 15, 1982

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Summary and Principle Conclusions

Groundwater

1. The Pueblo of Laguna is underlain by Jurassic and Cretaceous rocks within the Acoma Sag and Rio Puerco Fault Belt structural elements of the San Juan Basin. At least four water-bearing units comprise this rock sequence and one, the Westwater Canyon Member of the Morrison Formation, is a principle aquifer in the San Juan Basin. The other three are, in ascending order, the Entrada Sandstone-Todilto Limestone, the Bluff Sandstone, and the basal Dakota Sandstone-Jackpile Sandstone. The four water-bearing units are separated by layers of low permeability and, as a group, are bounded by the Chinle Formation on the bottom and the Mancos Shale above. These two units are considered to be impermeable confining beds in this study.

2. Water movement within the water-bearing beds is basinward from recharge areas in the Chuska Mountains, Zuni Uplift and San Juan Mountains. Water exits the basin primarily through the northwest (4-Corners) area, with smaller amounts exiting through the Gallup Sag and Acoma Sag/Rio Puerco Fault Belt areas. Within the study area, defined as the southeastern part of the basin, groundwater moves southeasterly in all the water-bearing units. The hydraulic head generally decreases with increasing depth except in the Rio Puerco Fault Zone where the opposite occurs.

3. The groundwater shows a chemical evolution from a calcium sulfate to a sodium sulfate type. The predominant reaction

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along the flow paths from the Zuni Uplift to the Pueblo area is cation exchange. As water enters the Rio Puerco Fault Zone it mixes with saline waters upwelling from the Permian rocks. The amount of upward leakage ranges from about 4 percent to 30 percent of the total water in the Westwater Canyon aquifer within the Fault Zone.

Specific conductance contour mapping in the Westwater Canyon shows an apparent freshening of water along flow paths underneath Mt. Taylor. A carbon-14 age date of water on the Bernabe Montano Grant, corrected for mixing, is about 21,000 years. This suggests that the flow paths for the Westwater Canyon originate in the Zuni Uplift area and that little recharge is added along the flow paths.

4. A 3-dimensional steady-state model of the groundwater in the southeastern third of the basin was calibrated to quantify the water movement in each of the four water-bearing units. It was found that the most sensitive model parameter was the vertical hydraulic conductivity of the confining beds. Successful duplication of the potentiometric surface resulted from an assignment of 10^{-5} ft/day to this parameter, and by assigning recharge of 2 cubic feet per second (cfs) to the Dakota Sandstone in the San Mateo/Mt. Taylor areas. The total flux through the model was 4.42 cfs, in agreement with preliminary estimates.

Transient Simulations

5. An expanded numerical model was developed to simulate the

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effects of water withdrawal from the Westwater Canyon aquifer. The conditions in the smaller model were used in calibration of the larger one. Mine withdrawal scenarios were run with this model. It was found that Church Rock Mining District, the proposed PNM Bisti power plant, and the Crownpoint and Noserock developments did not draw down the potentiometric surface of the Westwater Canyon on the Pueblo during their expected operational period to the year 2030.

6. Dewatering simulations from five mining developments did affect the water levels on the Pueblo. In order of increasing affects, these are the Ambrosia Lake Mining District, Kerr-McGee Rio Puerco Mine, Conoco Bernabe Montano mine, Gulf Mt. Taylor, and Bokum Marquez. The latter two mines cause an average draw-down of 32 and 23 feet, respectively, on the Pueblo and a maximum drawdown of 200 and 130 feet, respectively, at the closest point of the Pueblo to the mine.

Because the Westwater Canyon is at higher elevations at the basin boundaries, dewatering depths at mines are smaller there. The mines simulated in these areas, the Ambrosia Lake and Rio Puerco mines, caused little drawdown at the Pueblo. Conoco Bernabe Montano mine will dewater from down-thrown blocks of the Westwater causing about 1400 feet of drawdown on the Montano Grant. The increased vertical leakage caused by this drawdown will restrict the extent of the cone of depression from this mine.

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7. The area most likely to impact the water levels on the Pueblo extends in a north and northwest direction to a distance of about 60 miles from the northern boundary of the Pueblo. The drawdown on the Pueblo caused by a mine in this region after 30 years of dewatering can be estimated by the relation: drawdown in feet $\approx 285 - 160 \cdot \log_{10}$(distance in miles).

Water Quality

8. Uranium mining and milling in the Church Rock and Crownpoint areas should not affect the quality of the Pueblo's water resources. High concentrations of heavy metals that have been found in suspended and bedload sediment of the Rio San Jose may be related to mining activities in the Ambrosia Lake area.

9. Water in the lower Rio Paguate and Rio Moquino is thought to be contaminated by activities at the Jackpile mine; leakage from the Sohio millpond may, in the future, contaminate the Rio Moquino. The Gulf Mt. Taylor, Bokum Marquez, and Kerr-McGee Rio Puerco mines all have the potential to pollute surface water of the Rio Puerco drainage.

10. A water quality monitoring program has been designed to monitor contaminant migration from existing pollutant sources and to collect baseline data where mining development is proposed. The monitoring program requires installation of staff/crest gages and bi-monthly sediment and water sampling at 7 stream sites. Water-level monitoring in the Westwater Canyon aquifer is suggested

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at Conoco well WW-102 on the Bernabe Montano Grant. To monitor water levels in the Westwater Canyon and Dakota aquifers, completion of well 79-1 near Mt. Taylor is proposed.

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LIST OF PLATES--Continued

19. Potentiometric Surface of Layer 3 in 2030 from Mining Activities in Ambrosia Lake, Church Rock, and Mt. Taylor Areas, and the PNM Bisti Power Plant.

20. Potentiometric Surface of Layer 3 with Maximum Drawdown Expected from Mining Activities.

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EFFECTS OF URANIUM MINE DEWATERING ON THE WATER RESOURCES OF THE PUEBLO OF LAGUNA, NEW MEXICO

CHAPTER 1

INTRODUCTION

Since the discovery of uranium in the San Juan Basin in about 1950, mining has increased until today some 38 mines annually produce 20,000 tons of ore. Water use due to uranium mining now exceeds 24,000 acre-feet per year. Projections to the year 2000 indicate that 72 mines may use more than 58,000 acre-feet of water per year (U.S. Dept. Interior, 1980).

Most of this water is pumped for dewatering purposes from the Westwater Canyon Member of the Morrison Formation. Dewatering due to mining activities also occurs in the Jackpile sandstone of the Brushy Basin Member. Approximately one third of the lands of the Laguna Pueblo are underlain by these two geologic units (about 220 square miles).

Purpose and Scope of Investigation

The present study was made to quantify the present and possible future effects of uranium mine activities on the water resources of the Pueblo of Laguna. The work has been divided into three parts. Part 1 is a compilation and analysis of existing data. Part 2 is a computer based groundwater flow model of the Jurassic Formations. Part 3 incorporates the results obtained in parts 1 and 2 into a surface- and groundwater

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monitoring program to verify projected effects. This report is a compilation of all three parts. Not included in this report is the final aspect of this study: an evaluation of a tracer test to be conducted in the Ambrosia Lake area. That evaluation will follow in a separate report.

The area delineated for intensive study includes the Pueblo of Laguna, and extends 60 miles north and west of the Reservation into the San Juan Basin. Most of our data collection effort was devoted to this area. Because previous modeling efforts (U.S. Geological Survey, 1978; Guyton, 1978; U.S. Dept. Interior, 1980) have predicted that the effects of uranium mine dewatering will extend throughout the San Juan Basin, our groundwater model includes areas from outside the 60 mile study area. Data used beyond this area, however, came from the previous modeling efforts.

Location of Study Area

The Pueblo of Laguna occupies five separate parcels of land in Cibola, Valencia, Bernalillo, and Sandoval Counties, New Mexico. These parcels lie on the southeastern edge of the San Juan Basin, a structural groundwater basin which occupies northwestern New Mexico and parts of Arizona, Colorado, and Utah. There is not complete coincidence between the San Juan River Basin and the San Juan groundwater basin. In this report, the San Juan Basin will refer only to the latter.

Figure 1 shows the Pueblo of Laguna, its position

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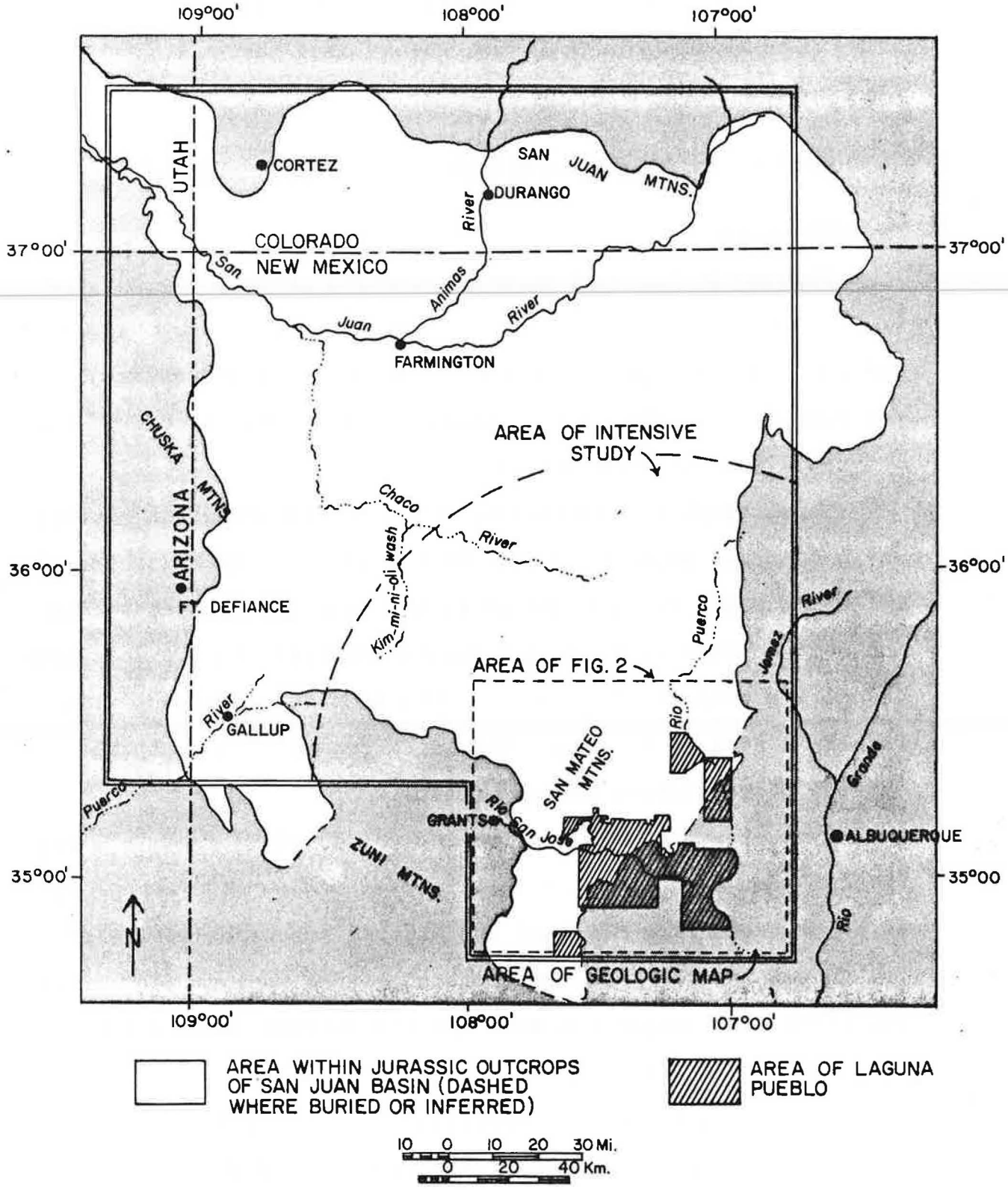

Figure 1. Location map of study area

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within the San Juan Basin, and the 60 mile study area. Figure 2 shows place-names in the Laguna Pueblo area that are used in this report.

Sources of Geologic, Hydrologic, and Chemical Data

Geologic Data

Because of the vast mineral reserves beneath the surface of the San Juan Basin, especially those of gas, oil, coal, and uranium, the geology of the Basin has been intensively studied for many years. The bulk of Chapter 2 was summarized from the many published sources available.

Stratigraphic information, shown on the structure contour and isopachous maps, came from many sources. The State Engineer's Office in Santa Fe provided us with a number of site-specific geologic reports from uranium mining applications. The Environmental Improvement Division in Santa Fe provided many similar reports. Most of this information is generally unavailable outside of regulatory agency offices.

Much stratigraphic information was obtained from drilling records kept at New Mexico Institute of Mining and Technology at Socorro and from the Land and Mineral Resources Office of the Laguna Pueblo. The construction of the various geologic, structure, and isopachous maps and the sources of data are given in Appendix A.

Detailed lithologic descriptions are given only for the Laguna Pueblo area. Regional variations in lithology are dis-

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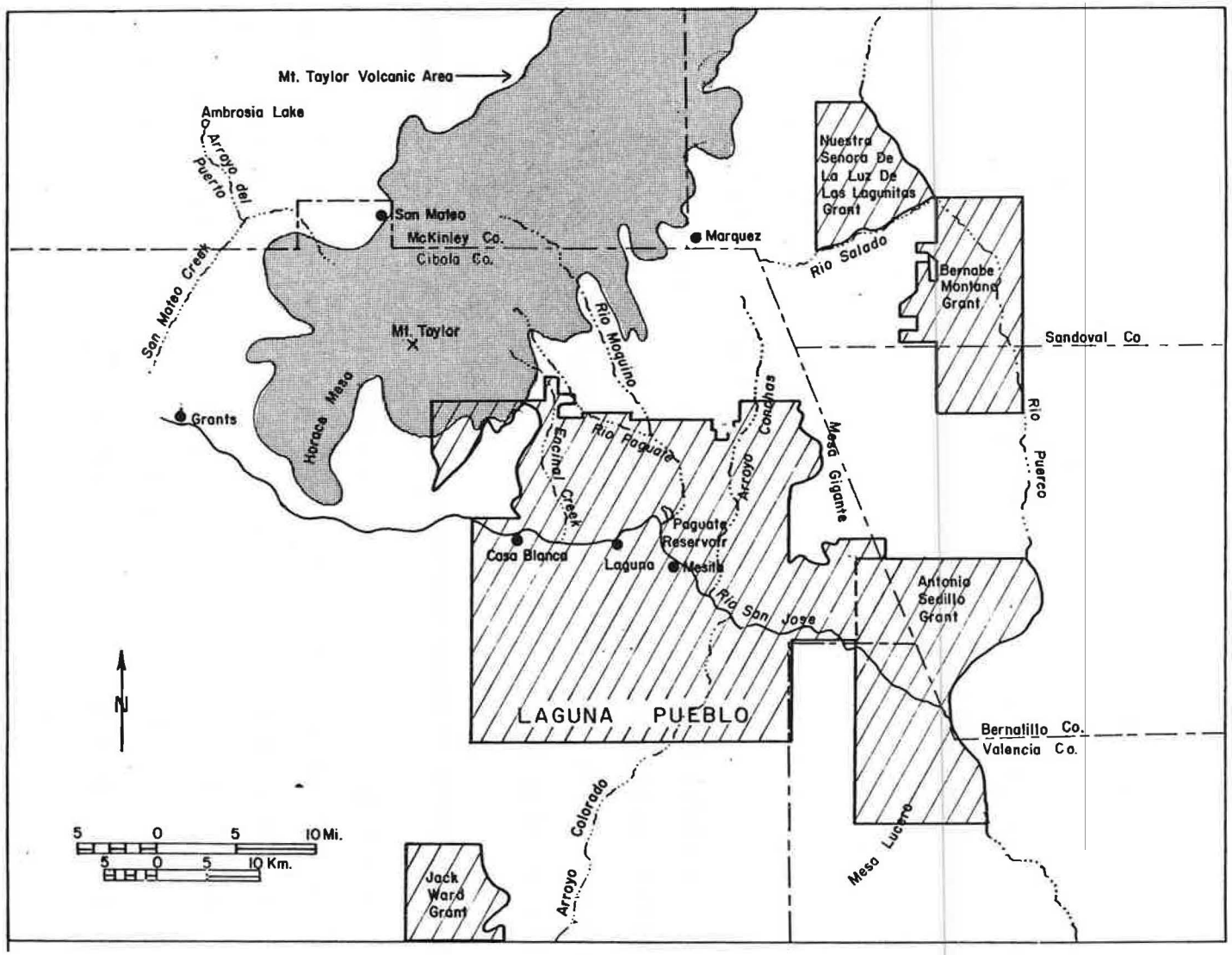

Figure 2. Place names in Laguna Pueblo area

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cussed in general terms. Special emphasis is placed on the Morrison Formation (Jurassic) which contains most of the uranium ore. In the Laguna Pueblo area, rock descriptions are taken primarily from Moench and Schlee (1967), Landis, and others (1973) and Kelley and Wood (1946). Descriptions of Tertiary and Quaternary units are taken from Lyford (1977).

Stratigraphic nomenclature in the southern San Juan Basin has been in a state of flux, and many articles have been written in an effort to resolve some of the problems. To a large degree the nomenclature for the stratigraphic interval which crops out on the Laguna Pueblo has been clarified. Fortunately, the water bearing units in the Laguna area usually correspond to stratigraphic units which have been discussed and mapped by various authors. With few exceptions, the subsurface extent of these units is also well known.

Little has been written concerning the water bearing properties of the rocks which underlie the Laguna Pueblo. Lyford (1977) authored a summary of groundwater investigations in the area of the Laguna Reservation and Dinwiddie and Motts (1964) summarized the availability of groundwater on parts of the Acoma and Laguna Reservations. Both reports dealt with the water bearing properties of the stratigraphic units in the area. Gordon (1961) and Cooper and John (1968) authored reports on the geology and groundwater in the Grants-Bluewater and Southeast McKinley County areas, respectively.

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Hydrologic Data

Water level data are generally of three types: static water levels measured in water wells open to the formation of interest, shut-in pressures from drill-stem tests, and elevations of springs and streams in outcrop areas.

Static water levels measured in wells are generally the most accurate of the three. The largest sources of inaccuracy are probably due to nearby pumping wells or incomplete recovery in the measured well or to measurements in wells open to several hydrogeologic units. Data were used for drawing potentiometric surface maps only when the stratigraphic interval to which the well was open was known. The effect that non-static conditions may have had on the water-level data caused considerable difficulty when contouring steady-state potentiometric surfaces. Locally, there may be some error in our estimate of pre-mining water levels. This is particularly evident in the Ambrosia Lake area.

Water-level data came mainly from the USGS WATSTOR program in Albuquerque, uranium mine engineering and consulting reports, and the published literature.

Shut-in pressures from drill-stem tests are generally the only water-level data available inward from the Basin margins. The Jurassic formations are too deep and the water is too saline there for human use. The scatter of the data attests to its general unreliability for use in constructing potentiometric surface maps. Contouring in the center of the Basin was done

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using some of these data and ignoring others. Where conflicting data existed, contouring was done using our interpretation of the groundwater system, sometimes sacrificing the best fit of the data. Guyton's (1978) report for Phillips Petroleum Co. was the main source of drill-stem test data.

The surface elevation of a spring is generally assumed to be equal to or slightly lower than the level of the water in the aquifer feeding it. In this report the assumption is made that spring elevations represent water levels in the formation from which they emerge. A small error may result from this assumption. The various geologic maps shown in Figure A-1 were used to pick the aquifers associated with these springs.

Most of the water-level data have been published recently by the USGS (Frenzel, Craigg, and Padgett, 1981), therefore these data have not been tabulated separately in this report. All data used, however, are shown on the appropriate potentiometric surface maps.

Information on the hydraulic characteristics of the various geologic units came from a variety of sources, which are tabulated in this report. In several cases we re-analyzed drawdown or recovery portions of aquifer tests when we felt that the original analysis could be improved. In these cases, we analyzed those portions of the data that reflected the long-term transmissivity of the test area.

Chemical Data

Chemical analyses of water samples came from many sources. Most analyses were from the USGS WATSTOR program. Other analyses

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were taken from various engineering reports of the uranium companies and from records at the Environmental Improvement Division.

The quality of the data is quite variable, and a substantial number of analyses are questionable. Cation-anion balances were recalculated in this study for all analyses. Although a good balance does not quarantee that the analyses are correct, such balances commonly pinpoint inaccurate or incomplete analyses. Only those data sets where the sums of cations and anions (as meq/l) agree within 5 percent were used in our geochemical interpretations. All analyses, however, are tabulated in this report. They are compiled as Appendix B.

Acknowledgements

A number of agencies and individuals contributed substantially to the data collection portions of this study. We would especially like to thank Ms. Ann Mariano and Mr. Ron Solimon of the Laguna Office of Mineral Resources for providing us with guidance on site visits and for unpublished geologic data. Appreciation is also expressed to Mr. Robert Borton of the New Mexico State Engineer's Office and Messrs. Peter Frenzel and Dennis Risser of the U.S. Geological Survey, Albuquerque, for contributing much data, and for assistance in the hydrology and numerical simulation aspects of the project.

We would also like to thank Mr. Peter Balleau and Ms. Greta Dickerson of the Bureau of Indian Affairs, Albuquerque, for their technical assistance and thoughtful review of preliminary manuscripts.

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Organization of Report

This report consists of one volume and a series of maps bound separately. The three appendices in the back of this volume contain geologic information, chemical data, and particulars on the construction of the steady-state and transient models, respectively.

For the reader's ease, we have called illustrations Figures if they appear in the text, and Plates if they are in the accompanying binder.

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CHAPTER 2

GEOLOGY

The San Juan Basin is a Laramide structural basin, bounded by monoclinal folds on the north, northeast, and west. Faults bound the basin on the east and southeast. The Laguna Pueblo lies in the southeasternmost corner of the Basin in what is known as the Acoma Sag (Figure 3). To the east is the Lucero Uplift and the Rio Puerco Fault Zone, both north-south trending fault zones. To the west of the Pueblo are the Zuni Mountains, an anticlinal upwarp. Northwest of the Pueblo is Mount Taylor and Mesa Chivato, both Tertiary volcanics.

The purpose of the geologic portion of this study is to support development of a computer model of the groundwater flow system near the Laguna Pueblo; hence it is detailed in the Laguna Pueblo area and more generalized elsewhere. Geologic, isopach and structure contour maps have been constructed following these guidelines.

Structure

The major structural elements of the San Juan Basin are shown in Figure 3 (Kelley, 1957). The San Juan Basin is a Laramide (Late Cretaceous--Early Tertiary) structural basin (Woodward and Callender, 1977) and is composed of the central Basin and the Chaco Slope. It is bounded on the west by the

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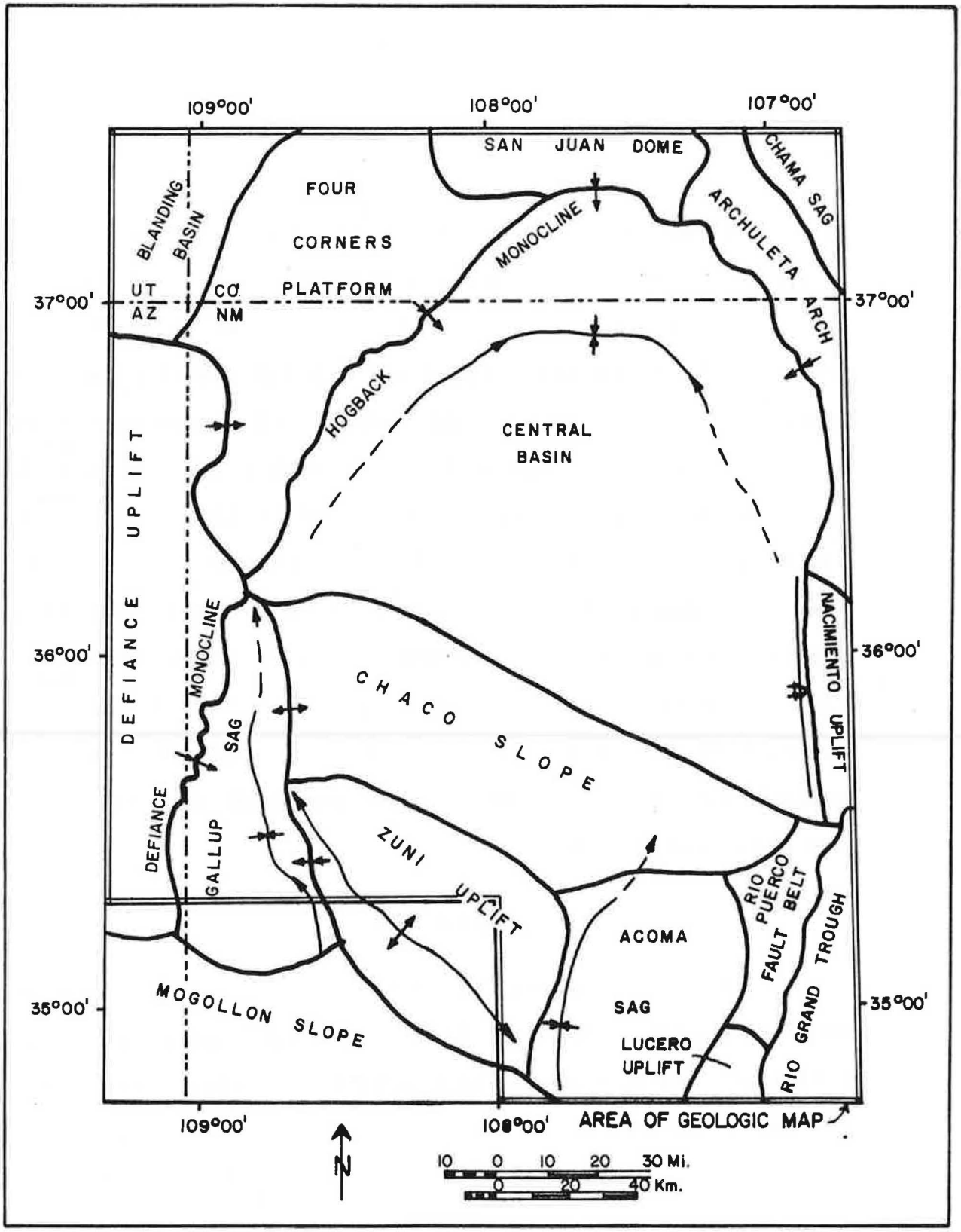

Figure 3. Structural elements of the San Juan Basin and surrounding area

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Defiance Uplift, which is roughly continuous with the Hogback Monocline on the northwest and north. The Gallina-Archuleta Arch forms the boundary on the northeast between the San Juan and Chama Basins. On the east the basin is bounded by the Nacimiento Uplift, the Rio Puerco Fault Zone and the Lucero Uplift. On the south are the Acoma Sag, Zuni Uplift and Gallup Sag. North of the Zuni Uplift and Acoma Sag is the gently north-dipping Chaco Slope.

The Defiance Uplift is an elongate, north-trending arch with a steep eastern limb called the Defiance Monocline with approximately 7000 feet of structural relief (Woodward and Callender, 1977).

The Four Corners Platform lies in the northwest corner of the Basin, and is separated from it by the Hogback Monocline. As much as 8000 feet of structural relief exists across the Hogback Monocline in New Mexico with a maximum dip of 60° (Woodward and Callender, 1977). North of the Hogback Monocline is the San Juan Dome, a complex uplift covered with silicic volcanics of the San Juan Mountains volcanic field. Kelly (1957) postulated up to 20,000 feet of structural relief across the Hogback Monocline in this area, where the stratigraphic sequence is constructed above the 14,000 foot Precambrian, Needle Mountain Dome.

Northeast of the central basin is the Gallina-Archuleta Arch, which separates the San Juan Basin from the Chama Basin (Chama Sag of Figure 3). This arch is strongly asymetric, having a steep west limb with up to 13,000 feet of structural

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relief, and a more gentle east limb with only about 1500 feet of structural relief. The west limb of the arch is steeper at its southern end (Woodward and Callender, 1977).

The Nacimiento Uplift bounds the Basin on the east. This uplift consists of an east-tilted block, bounded on the west by a north-trending thrust or a high-angle reverse fault. At depth the fault dips steeply along its entire length, but flattens near the surface at its northern end. Paralleling the fault to the west is a long north-trending syncline, which has a steep, locally overturned, east limb and a west limb sloping gently into the basin (Woodward and Callender, 1977). Farther south the Nacimiento Uplift blends into, or is truncated by, the Rio Puerco Fault Zone.

The Rio Puerco Fault Zone consists of northwest-trending folds, monoclinal folds, and northeast-trending en-echelon normal faults. Total structural relief is about 3000 feet. Various episodes of deformation occurred during the entire Cenozoic (Woodward and Callender, 1977).

The Lucero Uplift is a complex fault zone along the eastern side of Mesa Lucero south of the Rio Puerco fault zone. Laramide, west-dipping thrusts and Late Cenozoic normal faults are found in the uplift (Kelley and Wood, 1946).

The Acoma Sag, on which the Pueblo of Laguna is located, is a broad, north-plunging syncline with a moderately steeply dipping west limb (adjacent to the Zuni Uplift) and a gently dipping (from Mesa Lucero) east limb.

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The Zuni Uplift is a doubly-plunging anticlinorium trending northwest. The northeastern limb blends into the Chaco Slope. On the west the uplift is bounded by the Nutria Monocline, which drops into the Gallup Sag.

Stratigraphy

Permian System

The oldest rocks which crop out on the Pueblo of Laguna are Permian in age. In ascending order, these are the Yeso Formation, Glorieta Sandstone, and the San Andres Limestone. Prior to deposition of the Yeso Formation, rocks of the Magdalena Group (Pennsylvanian Age) were deposited in marine waters (Moench and Schlee, 1967). This was followed by a brief period of continental deposition (Abo Formation of Permian Age). Marine conditions returned, and the Yeso Formation, Glorieta Sandstone, and San Andres Limestone were deposited.

Subsequently, a long period of erosion occurred, during which time solution porosity developed in the San Andres Limestone in the Grants-Bluewater area (Gordon, 1961) and probably in the Prewitt-Thoreau areas. This type of porosity apparently does not exist in the Laguna area (Lyford, 1977).

The Yeso Formation consists of two members, the lower Mesita Blanca Sandstone member and the upper Los Vallos member. The Mesita Blanca Member is the same as the De Chelly Sandstone in the Four-Corners Region (Baars and Stevenson, 1977). The

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Mesita Blanca member consists of sandstone about 250 feet thick at the Carrizo Arroyo section (just south of Mesa Lucero) of Kelley and Wood (1946). The lower part of the Los Vallos member is about 1000 feet thick and consists of clastic sandstones with thin persistant limestone beds. The upper one-half to two-thirds of the unit consists of up to 50% gypsum or anhydrite interbedded with sandstone, shale, siltstone and minor limestone.

The Glorieta Sandstone conformably overlies the Yeso Formation. It consists of about 200 feet of sandstone with a persistant evaporite bed about 20 feet thick in the middle of the unit.

The Glorieta Sandstone is conformably overlain by the San Andres Limestone; it can be divided into two portions--a lower evaporite and an upper limestone. The evaporite unit is about 350 feet thick in the Carrizo Arroyo section and contains interbedded shale and limestone. The upper limestone unit is about 100 feet thick.

The upper contact of the San Andres Limestone is an erosional unconformity of low relief beneath the Late Triassic Chinle Formation.

The Abo, Yeso and Glorieta Formations do not extend across the entire San Juan Basin. Baars and Stevenson (1977) have indicated the extent of the Permian rocks in the basin.

Triassic and Early Jurassic(?) Rocks

The Triassic rocks in the study area consist of the Chinle Formation and the Glen Canyon Group. Over most of the Basin

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only the Chinle is present; the Glen Canyon Group is truncated beneath the unconformity at the base of the Carmel Formation or Entrada Sandstone and exists only in the far west and northwest corners of the Basin. The approximate extent of the various units of importance in the Glen Canyon Group (after O'Sullivan and Green, 1973) is shown on the isopach map of the San Rafael Group (Plate 7). Thickness of the Glen Canyon Group rocks is also included with the San Rafael Group on that plate.

Overall, Triassic rocks are thickest along the west edge of the Basin (greater than 1500 feet) and thin in a northeast direction to about 300 feet in the northeast corner of the Basin (O'Sullivan, 1977).

Chinle Formation

In the area of the Laguna Reservation the Chinle Formation crops out in broad, scattered exposures. It also occurs in the near subsurface beneath Quaternary alluvium and basalt in an east-northeast trending band seven to eight miles wide which runs between El Rito and Mesa Lucero.

Two incompletely exposed members of the Chinle can be mapped in the Laguna area (Moench and Schlee, 1967). These are the lower Petrified Forest Member and the upper Correo Sandstone Member.

The upper 200 plus feet of the Petrified Forest Member are described as gray-red calcareous mudstone and siltstone. The Correo Sandstone Member is up to 100 feet thick and composed of well-cemented arkosic to subarkosic sandstone with

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conglomeratic lenses at the bottom and siltstone lenses in the upper part. In the Mesita deep test-hole (Lyford, 1977) located in T.9N., R.5W., section 12, no sandstone or conglomerate was described in the upper part of the 990 feet of rocks assigned to the Chinle Formation. Moench and Schlee (1967) mapped the outcrops at El Rito as Correo Sandstone. Consequently, part or all of the rocks assigned to the Jurassic Entrada Sandstone in the Mesita test hole may belong to the Correo Sandstone Member of the Chinle Formation.

The Petrified Forest Member is thought to be composed of flood plain deposits, with episodic volcanic input (bentonite layers), while the Correo Sandstone is described as fluvial in origin (Moench and Schlee, 1967). Diabase (holocrystalline and aphanitic) intervals up to 37 feet thick are common in the upper half of the Mesita test hole. Although these are likely to be Quaternary or Tertiary dikes or sills, no metamorphic effects are described in the adjacent sediments.

Glen Canyon Group

The Glen Canyon Group overlies the Chinle Formation in the western and northwestern parts of the Basin. It includes (in ascending order) the Rock Point and Lukachukai Members of the Wingate Sandstone (Triassic), the Kayenta Formation (Triassic) and the Navajo Sandstone (Triassic and Early Jurassic).

Both members of the Wingate Sandstone pinch out along NNE-trending lines (see San Rafael isopach map, Plate 7).

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The Lukachukai Member was thought by various authors to extend as far east as the northern Zuni Mountains (Smith, 1954; Harshbarger and others, 1957). More recent work by Green (1976) has shown that these beds belong to the Entrada Sandstone.

The Kayenta Formation consists of fine- to coarse-grained sandstone with minor interbedded siltstone and shale. Where its entire thickness is present, it is about 100-150 feet thick (O'Sullivan and Green, 1973). It is present only in the far northwest corner of the Basin.

The Navajo Sandstone is composed of fine- to very fine-grained, well-sorted quartz grains. The Navajo Sandstone is more than 700 feet thick west of the geologic map area (Plate 2), but probably never reaches this maximum in the map area, thinning to a feather edge at the line shown on the San Rafael Group isopach map (Plate 7).

Jurassic Formations

Rocks of Jurassic age in the area of the Laguna Pueblo form the major bedrock aquifers. Also, uranium mining activity is concentrated in the Jurassic Morrison Formation.

In ascending order, the stratigraphic units of the Jurassic system are the Carmel Formation, Entrada Sandstone, Todilto Limestone, Summerville Formation (or Wanakah Formation in Colorado), Bluff Sandstone (or Junction Creek Sandstone in Colorado) of the San Rafael Group, and the Morrison Formation. To the west and south of the Pueblo the Cow Springs Sandstone and Zuni Sandstone (respectively) are mapped. These units are

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equivalent, in part or whole, to the Bluff Sandstone and Morrison Formation. With the exceptions of the Cow Springs and Zuni Sandstones and the Carmel Formation, all of these units are regionally extensive.

San Rafael Group

The San Rafael Group includes the Carmel, Entrada, Todilto, Summerville and Bluff rock units. On Plate 7 it also includes the Cow Springs, Zuni, Junction Creek and Wanakah units. Figure 4 schematically shows the lithologies of the San Rafael Group in the Laguna Pueblo.

Carmel Formation. The Carmel Formation is restricted to the western edge of the Basin. The San Rafael Group isopach map shows the pinchout line of the Carmel Formation. O'Sullivan and Craig (1973) placed rocks that crop out along the north side of the Zuni Mountains in the Carmel Formation. Other authors placed these rocks with the Wingate Sandstone, as discussed above. In this study and other recent works these rocks are considered to belong to the Entrada Sandstone.

The Carmel Formation consists of shale, in beds up to 20 feet thick, with minor sandstone interbeds. The shale is locally sandy or silty.

Entrada Sandstone. The Entrada Sandstone crops out in a thin band of cliffs southwest and east of Mesita and south of Mesa Gigante. Across much of the southern San Juan Basin the Entrada can be broken into three units consisting of upper and

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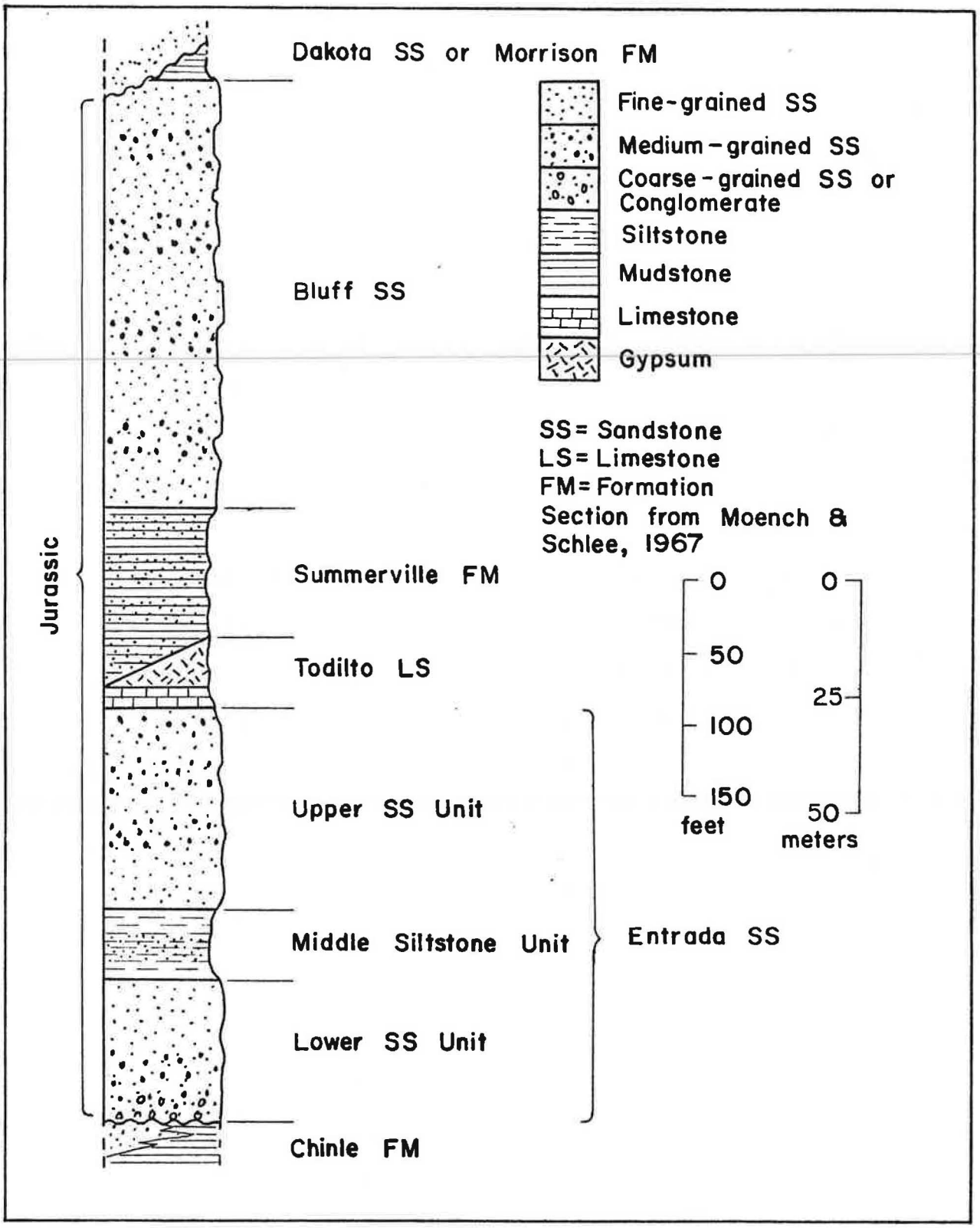

Figure 4. Stratigraphic section of the San Rafael Group in the Laguna area

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lower sandstone units and a middle siltstone unit. The Entrada rests conformably on the Carmel Formation in the westernmost part of the Basin, but lies unconformably on the Chinle over most of the area.

The contact between the lower and middle units is even and shows no sign of erosion. The upper sandstone unit and the middle siltstone unit interfinger with one another, one thickening at the expense of the other while the combined thickness remains about constant.

The lower sandstone unit is a well-cemented (calcite and/or quartz), cliff-forming sandstone up to 30 feet thick. It is a light-brown, fine- to coarse-grained sandstone that fines upward and to the northeast. Conglomerate lenses are present locally in scours at the base.

The middle siltstone unit is 35-40 feet thick at Petoch Butte and 75-80 feet thick at Mesa Gigante. It is light reddish-brown and forms slopes in outcrop. It is friable, well-cemented, contains minor fine-grained sandstones, and is sandier toward the top. The unit appears to thicken northwestward of the reservation.

The upper sandstone unit of the Entrada is 80-200 feet thick with thickest sections in the southeast part of the Basin. It is planar or trough cross-bedded with sets up to 10 feet thick. Grain size generally decreases upward and northward and varies from coarse to very fine.

The Entrada Sandstone was apparently derived from the Mogollon Highland to the south (Harshbarger and others, 1957).

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The lower sandstone unit is fluvial in origin; the middle siltstone represents deposition in shallow water or a tidal flat; the upper sandstone was probably fluvial in origin and reworked by winds.

Todilto Limestone. The Todilto Limestone crops out in a pattern similar to that of the underlying Entrada Sandstone. The contact between these units is generally sharp, with some local intertonguing. In the Laguna district the Todilto consists of two sub-units, a lower limestone unit and an upper gypsum-anhydrite unit (Moench and Schlee, 1967). The lower limestone is 2-36 feet thick, but laterally quite extensive. It is laminated in its lower part and massive above. The unit is very-fine to coarse-grained and locally brecciated.

The upper evaporite unit is present in lenses up to 75 feet thick. A leached breccia often exists at the contact zone between the evaporite and limestone units. The upper contact is poorly exposed.

The Todilto was deposited in shallow, enclosed lucustrine conditions or in a marine embayment with a high dissolved salt content.

Summerville and Wanakah Formations. The Summerville Formation crops out in narrow bands south and southwest of Laguna and north and east of Mesita. It is apparently conformable with the underlying Todilto Limestone.

The Summerville consists of interstratified mudstones and sandstones averaging about 130 feet thick. Sandstone layers

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are fine- to very fine-grained orthoquartzites or subarkoses. Sand content increases upward. The Summerville Formation is probably a near-shore, shallow-marine deposit.

The Wanakah Formation in Colorado is the lateral equivalent of the Summerville Formation. It is composed of limy, sandy siltstone, fine-grained sandstone and limestone. It is thin, varying from 25 to 100 feet thick (Haynes, Volgel and Wyant, 1972). Santos (1975) reported that the Summerville is absent north of lat 37°37'30" N.; Stone and Mizell (1978) have shown it to be present in the western portion of the basin.

Bluff Sandstone and Equivalent Units. The Bluff Sandstone crops out south of the Rio San Jose, west of Mesita, and around Mesa Gigante. In the Laguna area the Bluff Sandstone ranges from 200 to 400 feet thick, averaging about 300 feet (Moench and Schlee, 1967). Two parts are recognized. The lower part is reddish-brown to pale-orange quartzose sandstone with alternating horizontal beds and small- to medium-scale cross-bedded cosets. This part is well-cemented, very fine- to medium-grained and of fluviatile or near-shore, regressive origin. The upper part has large-scale cross-bedded cosets. It is a well-sorted, fine- to medium-grained, moderately cemented quartzose sandstone of eolian origin.

The Cow Springs Sandstone in the southwest San Juan Basin and the Zuni Sandstone in the Acoma Sag area are both laterally equivalent to, and intertongue with, the Bluff Sandstone. All three are eolian or intradune deposits.

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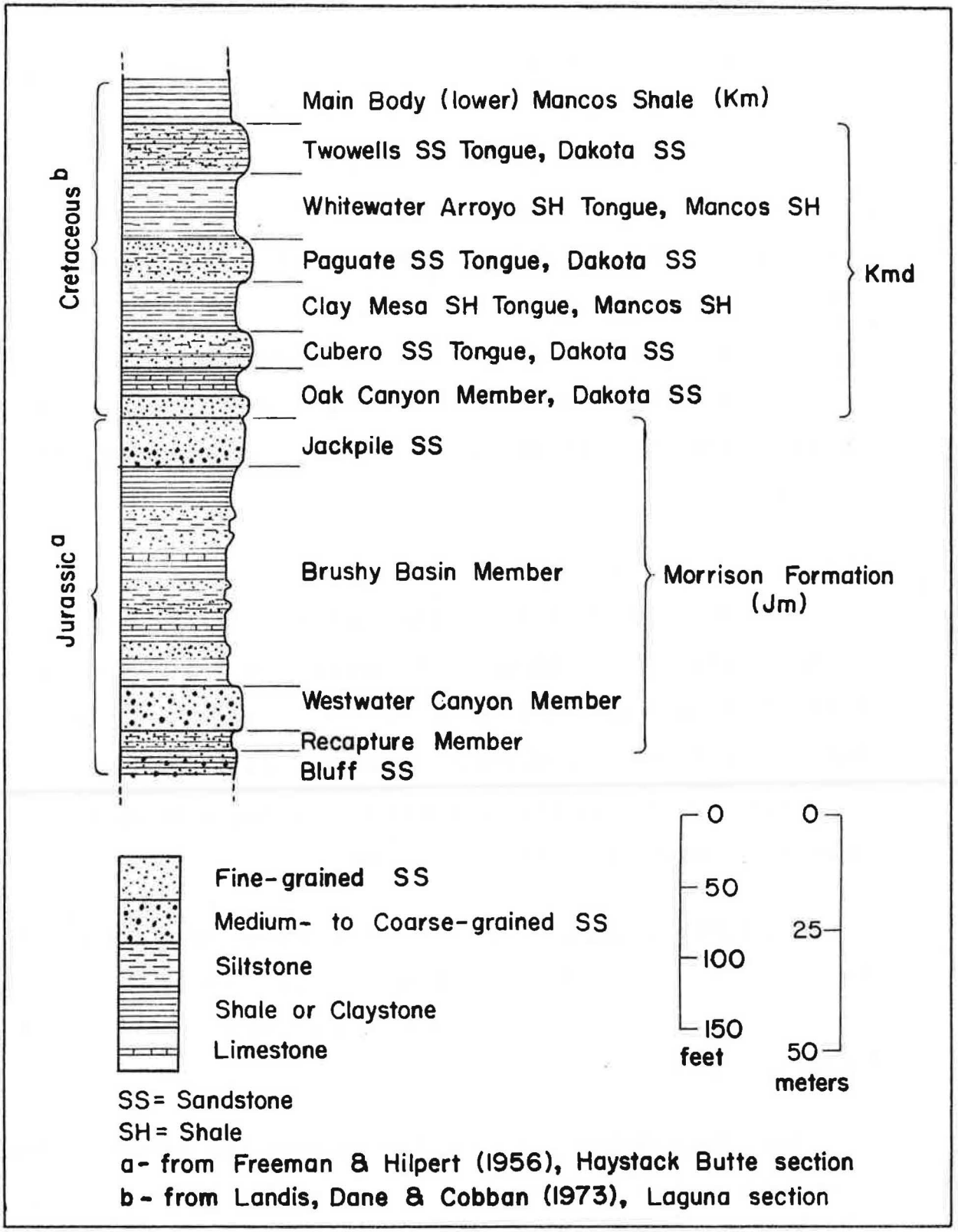

Figure 5. Stratigraphic section of the Morrison, Dakota and Lower Mancos formations

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extensively with the Cow Springs Sandstone (see San Rafael Group isopach, Plate 7). Plate 3 is a fence diagram (after Harshbarger and others, 1957) showing relationships of these Jarassic units in western New Mexico and eastern Arizona.

In the Laguna Pueblo area the Recapture Member is usually less than 50 feet thick and locally absent where streams of the Westwater Canyon Member have scoured it away. The Recapture consists of interstratified mudstone, siltstone, sandstone and limestone. The sandstone is typically fine-grained quartz and feldspar and is clay-cememted, averaging 16% clay (up to 30%) (Moench and Schlee, 1967).

Westwater Canyon Member. The Westwater Canyon Member is generally 10 to 60 feet thick in the Laguna area, but ranges up to 100 feet. It is locally absent on the south end of Mesa Gigante. The Westwater Canyon Member is a poorly sorted, fine- to coarse-grained, arkosic or subarkosic sandstone, averaging 51% quartz with abundant perthite, microcline, plagioclase, and sedimentary and igneous rock fragments. Grains are angular to rounded and vary from well-cemented (with clay and silica) to uncemented. Cross bedding is small- to medium-scale. A meandering or braided stream system deposited the sands that comprise this member.

Brushy Basin Member. The Brushy Basin Member is the thickest and most widely exposed unit in the Morrison Formation, ranging from 220 to 300 feet thick. The member is composed primarily

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If it is considered as one unit, this interval thickens to the south and west. The Cow Springs is very thick in the west, where it is laterally equivalent to the Morrison Formation (see the San Rafael isopach map, Plate 7), and interfingers extensively with the Recapture Member (Harshbarger and others, 1957).

In Colorado the lateral equivalent to the Bluff is named the Junction Creek Sandstone (Haynes, Vogel and Wyant, 1972). It is a fine- to coarse-grained eolian sandstone about 275 feet thick.

Morrison Formation

The Morrison Formation crops out extensively on the Mesa flanks west, north, and east of Laguna, and in the northern part of the Bernabe Montano Grant. It consists of four members: Salt Wash, Recapture, Westwater Canyon, and Brushy Basin.

Figure 5 schematically shows the lithologies of the Morrison Formation in the Pueblo area.

Salt Wash Member. The Salt Wash Member is composed of sandstone and claystone (Craig and others, 1955). It is present only in the northeast part of the Basin and is a maximum of about 300 feet thick.

Recapture Member. In the Laguna area the Recapture Member lies with a sharp, or locally intertonguing, contact on the Bluff Sandstone (Moench and Schlee, 1967). North and northwest of the Zuni Mountains the Recapture Member intertongues

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of greenish mudstones. Interlayered sandstone lenses up to 85 feet thick crop out in the Arch Mesa and La Gotera Quadrangles (Moench and Puffett, 1963; Moench and others, 1965). Sandstone beds up to 5 feet thick are fairly common throughout. Thin limestone beds are also common.

The Jackpile sandstone is the uppermost sandstone unit in the Brushy Basin Member. It is present in a north-northeast-trending band that extends from the Paraje area on the Rio San Jose to just west of the Nacimiento Mountains (Santos, 1975). It is locally discontinuous within this band. The width of the band perpendicular to the long axis is poorly known, but is probably between 10 and 20 miles. Moench and Schlee (1967) believe that the Jackpile sandstone was deposited in a contemporaneously forming synclinal basin, although evidence for this deformation is lacking elsewhere (Santos, 1970, 1975).

The Jackpile has a chalky white cast in its upper part from secondary kaolinization, and is grey to pale-orange in the lower part. The unit is friable, poorly to moderately well sorted quartzose with minor feldspar, clay galls, rock fragments and chert. The unit is generally fine- to medium-grained, but is coarser at its base (where it is calcite cemented) than at the top (where it is clay cemented). The rock is massive or has medium-scale cross-bedded cosets. Plant fragments (sometimes silicified) and other carbonaceous material are found locally, and are usually present with uranium ore deposits.

An isopach map of the Jackpile sandstone has been drawn

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by Moench and Schlee (1967) and Santos (1975). This map is reproduced on the isopach map of the intertonguing Dakota Sandstone/Mancos Shale interval, Plate 11.

Early Cretaceous Formations

The Burro Canyon Formation of early Cretaceous age, is present only in the northern parts of the San Juan Basin. According to Haynes, Vogel and Wyant (1972) it pinches out near the San Juan River. Harshbarger and others (1957) show it pinching out north of Bitlabito, about half way to the Colorado/ New Mexico border (Plate 3).

The Burro Canyon Formation is a fluvial deposit consisting of quartz sandstone, conglomerate, mudstone, shale, and siltstone. It averages about 150 feet thick, and thins southward beneath the Dakota Sandstone (Haynes, Vogel and Wyant, 1972). The Burro Canyon Formation is mapped with the Mancos Shale/ Dakota Sandstone interval of Figure 5 and in the isopach map, Plate 11.

Late Cretaceous Formations

Late Cretaceous Rocks of the San Juan Basin include the Dakota Sandstone, Mancos Shale, Gallup Sandstone, Crevasse Canyon Formation, Point Lookout Sandstone, Menefee Formation, Cliff House Sandstone, Lewis Shale, Pictured Cliffs Sandstone, Fruitland Formation, and Kirtland Shale (Molenaar, 1977).

These rocks have complex intertongueing relationships due to repeated transgressions and regressions of the Late Cretaceous shoreline. The shales generally represent open marine deposi-

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tion and are usually separated laterally and vertically from non-marine deposits by near-shore sandstone bodies. Figure 6 is a schematic stratigraphic section of Late Cretaceous Rocks that run from the Zuni Mountains on the south to about 40 miles east of Durango, Colorado on the north.

Dakota Sandstone and Lower Mancos Shale. The Dakota Sandstone is Late Cretaceous in age and has an unconformity at its base. Regionally this is an angular unconformity, with successively older formations truncated to the south. The sandstone represents the transgressive shoreline deposits of the Late Cretaceous Mancos Sea. Hence, the Dakota Sandstone becomes younger to the south and west. Three younger tongues of Dakota sandstone are present in the Lower Mancos Shale, and represent off shore sand bars (S. Hook, personal communication, 1981).

In ascending stratigraphic order the rock units in the Dakota Sandstone-Lower Mancos Shale interval are the Oak Canyon Member of the Dakota Sandstone, the Cubero Sandstone Tongue of the Dakota Sandstone, the Clay Mesa Shale Tongue of the Mancos Shale, the Paguate Sandstone Tongue of the Dakota Sandstone, the Whitewater Arroyo Shale Tongue of the Mancos Shale, and the Twowells Sandstone Tongue of the Dakota Sandstone. These units are shown in the composite stratigraphic section, Figure 5.

The Oak Canyon Member can be divided into upper and lower parts. The upper part is largely shale, and should probably

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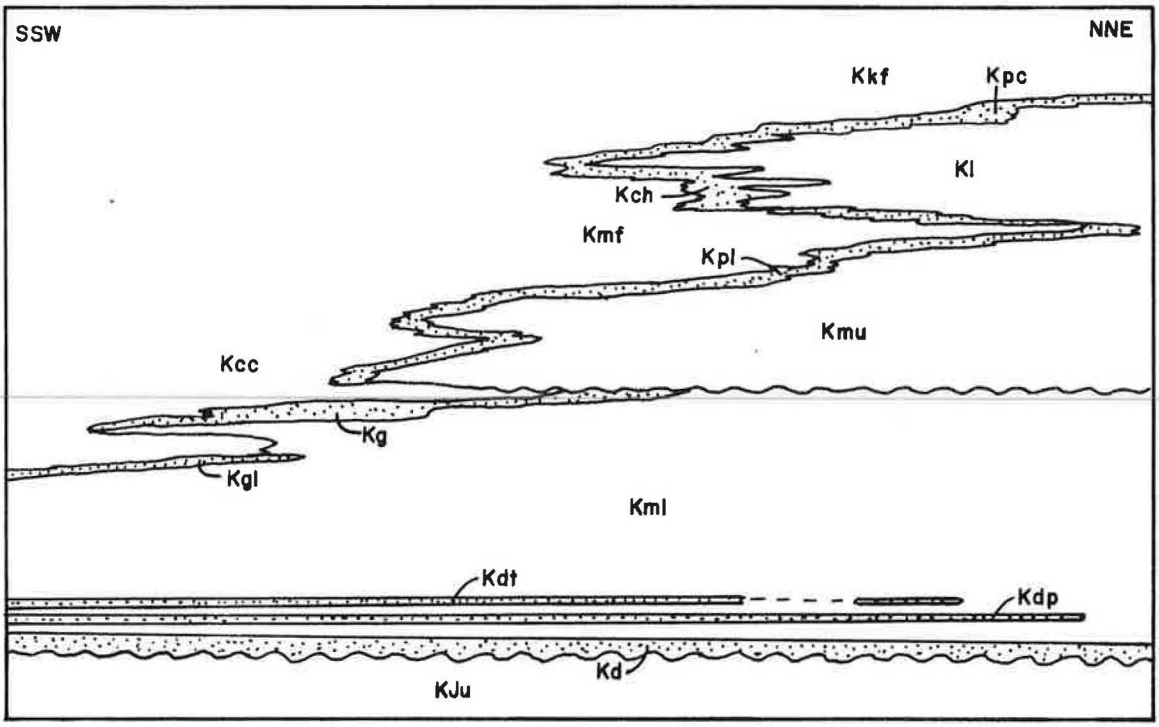

Kkf = Kirtland Shale and Fruitland Formation

Kpc = Pictured Cliffs Sandstone

Kl = Lewis Shale

Kch = Cliff House Sandstone

Kmf = Menefee Formation

Kpl = Point Lookout Sandstone

Kmu = Upper Mancos Shale

Kcc = Crevasse Canyon Formation

Kg = Gallup Sandstone

Kgl = Lower Gallup (Semilla equivalent) Sandstone

Kml = Lower Mancos Shale

Kdt = Twowells Tongue of Dakota Sandstone

Kdp = Paguate Tongue of Dakota Sandstone

Kd = main body of Dakota Sandstone

KJu = Early Cretaceous and Jurassic Formations

Figure 6. Stratigraphic section of Cretaceous formations from the Zuni Mountains to about 40 miles east of Durango, Colorado. (Molenaar, 1977)

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be considered a tongue of the Mancos Shale, which separates the lower part of the Oak Canyon Member from the overlying Cubero Sandstone Tongue.

The lower part of the Oak Canyon Member of the Dakota Sandstone is 33 feet thick in the section reported by Landis, Dane and Cobban (1973) near Laguna (in T.10N., R.5W, sections 20 and 21). It is composed of orange or brown, fine-grained or silty sandstone.

The upper part of the Oak Canyon Member is predominatly siltstone and shale with some limestone and bentonite. The unit is multicolored and is 40 feet thick.

The Cubero Sandstone Tongue of the Dakota Sandstone is 50 feet thick in the Laguna section of Landis, Dane and Cobban (1973) (Figure 5). It is composed of fine- to very-fine-grained, gray or orange-gray sandstone with some siltstone.

The Clay Mesa Shale Tongue of the Mancos Shale consists of 69 feet of shale and siltstone in the Laguna section.

The Paguate Tongue of the Dakota Sandstone is 61 feet thick in the section. It is formed of gray, very fine- to medium-grained sandstone with some silt.

The Whitewater Arroyo Shale Tongue of the Mancos Shale is 90 feet of shale, siltstone, and bentonite.

The Twowells Sandstone Tongue of the Dakota Sandstone is a silty, very fine- to fine-grained sandstone 73 feet thick.

The total Dakota Sandstone/Mancos Shale interval (Kmd of Figure 5) averages about 300 - 350 feet thick. In the northern part of the basin this thickness remains about constant, (see

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the isopach map of Kmd, Plate 11). Molenaar (1977) (Figure 6 of this report) showed the Paguate Tongue extending far north, into Colorado, and the Twowells as far north as Farmington, New Mexico. Although the exact extent of specific tongues could not be determined from the well logs studied, it appears that the generalized lithology of the interval, about half shale and half fine-grained, silty sandstone, remains true throughout the basin.

Upper Mancos Shale

The lower part of the Upper Mancos Shale is called the Graneros Shale Member. In the northern part of the basin the Graneros Shale is laterally equivalent to the Clay Mesa and Whitewater Arroyo Tongues of the Mancos discussed above (Molenaar, 1977), and also includes shales above the Twowells Sandstone Tongue of the Dakota Sandstone elsewhere. The Graneros Shale, composed of dark gray shale, is thickest on the southeast side of the San Juan Basin (350 feet) according to Molenaar (1977).

Above the Graneros Shale Member is the Greenhorn Limestone Member which is present over much of the San Juan Basin. It ranges in thickness from about 40 to 70 feet and consists of calcareous shale and argillaceous limestone.

The Greenhorn Limestone in the southeastern San Juan Basin is overlain by about 200 feet of Mancos Shale, which in turn is overlain by the Semilla Sandstone Member of the Mancos Shale (Dane and others, 1968). The Semilla Sandstone is the lateral

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equivalent of the lower Gallup or Atarque Member of the Gallup Sandstone of earlier authors (Hook, personal communication, 1981). The Semilla is a well-sorted, fine- to medium-grained sandstone, about 70 feet thick near La Ventana. Elsewhere it is comprised of thin, silty or sandy discontinuous lenses of off-shore bar sands, and is overlain over much of the San Juan Basin by the Juana Lopez Member of the Mancos Shale.

The Juana Lopez Member of the Mancos Shale is 107 feet thick at its type locality on the southeast side of the San Juan Basin. It is composed of thinly interbedded calcarenites, arenaceous sandstone and shale.

Overlying the Juana Lopez Member is more Mancos Shale. In the Gallup and Zuni areas this interval is called the Pescado and D-cross Tongue, respectively. This interval is 150 to 180 feet thick in the Zuni and Acoma areas (Molenaar, 1977).

Mesaverde Group

The Gallup Sandstone lies above the Mancos Shale, in the southern part of the basin and pinches out in the center of the Basin along a northwest-trending line (see the isopach map of the Mancos Shale, Plate 12). This pinching out causes a discontinuity in the isopach lines for the Mancos Shale. Above the Gallup Sandstone is the upper Mancos Shale, which is divided farther south into the Satan and Mulato Tongues of the Mancos Shale by the Dalton Sandstone and the Hosta Tongue of the Point Lookout Sandstone. The main body of the Point Lookout

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Sandstone lies above the Upper Mancos Shale everywhere in the basin. South of the Gallup pinchout the lower Mancos Shale is about 700 to 900 feet thick; north of the Gallup pinchout the Mancos Shale (upper and lower) is about 2000 feet thick.

Gallup Sandstone. The Gallup Sandstone represents the first major regression of the Late Cretaceous Mancos Sea. It is comprised mainly of marine sandstone but has other facies developed locally (Stone, 1981). The Gallup is conformable on the lower Mancos Shale. The upper contact is an unconformity along part of its reach where it is in contact with the upper Mancos Shale. Discontinuous offshore-sand-bar bodies such as the "Bisti Bar" and the basal Niobrara Sandstone exist north of the Gallup pinchout. These lie at approximately the same level as the Gallup main body, but are younger than the unconformity.

Younger Late Cretaceous Rocks. The Crevasse Canyon Formation lies conformably over the Gallup Sandstone, and represents continental deposits south and west of the Mulatto and Satan Tongues shore line (Figure 6).

The Point Lookout Sandstone is a regressive, marginal-marine sandstone which lies above the upper Mancos Shale.

The Menefee Formation overlies the Point Lookout Sandstone, and represents non-marine deposition. It is composed of flood-plain shales, fluvial sandstones, and several coal deposits.

The Cliff House Sandstone represents the next marine transgression, and is composed of marginal-marine sands.

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Following deposition of the Lewis Shale in marine waters, the regressive Pictured Cliffs Sandstone was deposited. This unit represents the final retreat of the sea from the San Juan Basin area.

Above the Pictured Cliffs Sandstone lies the non-marine Fruitland Formation consisting of coastal-plain deposits. This was followed by deposition of the Kirtland Shale, a coastal- or alluvial-plain deposit of shale and sandstone.

Quaternary-Tertiary Rock Units

Santa Fe Group

The Santa Fe Group crops out along the eastern margin of the Rio Puerco Fault Zone and the Lucero Uplift. It is composed primarily of unconsolidated gravel, sand and clay. The unit thickens rapidly eastward into the Albuquerque-Belen Basin.

Igneous Rocks

Dikes and plugs of Quaternary-Tertiary basalts are present in a band that trends north-northeastward from the southern Reservation boundary, and runs between Laguna and Mesita, and between Mesa Prieta and Cebolleta Mesa. Both of these mesas are capped by Quaternary-Tertiary basalt flows. The most extensive of these Quaternary-Tertiary volcanies is the Mt. Taylor series that is composed of basalt flows, alluvium and more silicic volcanics.

Quaternary basalt. Quaternary basalt crops out in several

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areas in the southeast part of the Basin. About 1150 square miles of basalt-covered valley south of Grants, called "The Malpais", may once have been connected to a similarly named flow north of Bluewater. This lava flowed down the Rio San Jose valley over older alluvium. In turn the lava flows were buried in places by more alluvium. There may be a connection between the flows near Grants in the Rio San Jose and the basalt outcrops in the Laguna area.

Alluvium

Quaternary alluvium in the southwest part of the basin lies primarily as thin mantles atop the mudstones, siltstones, and shales of the Chinle and upper Mancos formations, and the sandstone of the San Rafael Group. Less areally extensive but much thicker deposits occur in stream valleys.

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CHAPTER 3

GROUNDWATER

This chapter discusses groundwater in the Permian through Lower Cretaceous geologic sequence. After a description of the regional hydrologic setting, the hydrogeology of each of the major flow systems is presented, with particular emphasis on those parameters of importance in the numerical model. The latter part of the chapter describes the steady-state numerical simulation of the groundwater flow system, which was performed using a four-layer, three-dimensional finite difference model.

All measured water levels used to calibrate the numerical model are on steady-state potentiometric surface maps, Plates 13 14, 15, and 16. All aquifer test information used to construct each flow layer is tabulated as Table 1.

Regional Hydrologic Setting

Groundwater in the San Juan Basin may be viewed as one large, dynamic flow system. This is commonly the case in mature, compacted basins, such as the San Juan Basin. The system is characterized by recharge in outcrop areas, flow approximately down the dip of beds, and discharge that is mostly through upward leakage. Different patterns of water circulation are present. Shallow, more active sub-systems carry the majority of flow, while deeper circulation sub-systems show much longer flow paths, zones of stagnation, and longest travel times. Except in

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Table 1. Results of aquifer tests for wells penetrating Cretaceous, Jurassic, or alluvial aquifers in the southern San Juan Basin.

Test Site	Location	Date	Duration	Test Results*					Remarks	By	Source
				T ft^2/day	S	b ft	K ft/day	S_s ft^{-1}			
Rio San Jose Alluvium	9.6.2.123	1975	24 hrs.	265						USGS	Lyford, 1978
"	9.6.5.222	1975	24 hrs.	3150	.14	55	58	2.6×10^{-3}		USGS	Lyford, 1978
"	10.6.31.434	1960	45 min.	200		150	1.3			USGS	Lyford, 1977
"	10.6.31.443	1960	24 hrs.	3200		138	23			USGS	Dinwiddie & Motts, 1964
"	10.6.35.322	1960	12 hrs.	400		55	7.3			USGS	Dinwiddie & Motts, 1964
"	10.6.35.342	1960	12 hrs.	7900		68	117		cited report: T = 17000 ft^2/day	USGS	Dinwiddie & Motts, 1964
"	10.7.29.214	1960		414		89	4.7			USGS	Dinwiddie & Motts, 1964
"	10.7.35.21	1960	20 hrs.	590		112	5.3		cited report: T = 8000 ft^2/day	USGS	Dinwiddie & Motts, 1964
"	10.7.35.232	1960	20 hrs.	1060		122	8.7			USGS	Lyford, 1977
"	10.7.36.212	1970	40 hrs.	11500						USGS	Lyford, 1977
"	10.7.36.221	1970	20 hrs.	6400		150	43			USGS	Lyford, 1977
"	10.7.36.322	1975	6 hrs.	630						USGS	Lyford, 1978
"	10.7.36.424	1975	24 hrs.	7000		120	58			USGS	Lyford, 1978
"	10.8.28.314	1960		1410		110	13		cited report: T = 16000 ft^2/day	USGS	Dinwiddie & Motts, 1964
"	10.9.25.33	1960		27		49	.5			USGS	Dinwiddie & Motts, 1964

* T=Transmissivity, S=Storage Coef., b=Aquifer Thickness, K=Hydraulic Conductivity, S_s=Specific Storage

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Table 1--Continued

Test Site	Location	Date	Duration	Test Results* T ft^2/day	S	b ft	K ft/day	S_s ft^{-1}	Remarks	By	Source
Rio Paguate Alluvium	11.5.32.232	1974	3 hrs.	200						USGS	Lyford, 1977
"	11.5.32.234	1960	12 hrs.	75		60	1.3			USGS	Dinwiddie & Motts, 1964
Jurassic Westwater Canyon Aquifer	10.7.10.213	1979		18		200	.09			USGS	Risser, 1980
"	11.5.13			410							Guyton and Assoc., 1978
"	11.5.30.422			4					Well open Km to Jmw	USGS	Dinwiddie & Motts, 1964
"	12.1.30			490							Guyton and Assoc., 1978
"	12.2.36	1976	14 days	320	$2.6x10^{-4}$	304	1.05	$8.6x10^{-7}$	In Rio Puerco Fault Belt	Halpenny	Wright, & others, 1979
"	12.4.4			376	$2x10^{-4}$						Science Applications, Inc., 1980
"	12.4.14			285	$1.6x10^{-4}$						Science Applications, Inc., 1980
"	12.4.21			97	$1.2x10^{-4}$	60	1.6	$2x10^{-6}$	Porosity reported to be >20%		Science Applications, Inc., 1980
"	12.5.36			59					Includes Dakota		Guyton and Assoc., 1978
"	14.9.28.234			173	$7x10^{-3}$	190	.91	$3.7x10^{-5}$	cited report questions results	Phillips	Cooper, & John, 1968
"	Ambrosia Lk. area: 14.9 and 14.10						1.65				Mobil Oil Corp., 1980
"	15.11.29			270							Guyton and Assoc., 1978

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Table 1--Continued

Test Site	Location	Date	Duration	T ft^2/day	Test Results* S	b ft	K ft/day	S_s ft^{-1}	Remarks	By	Source
Jurassic Westwater Canyon Aquifer (continued)	16.11.33			289							Guyton & Assoc., 1978
	16.14.34			32							Guyton & Assoc., 1978
"	16.16.15			370							Guyton & Assoc., 1978
"	16.16.17			300							Guyton & Assoc., 1978
"	17.12.19			327							Guyton & Assoc., 1978
"	17.12.20.1			173	$1.5x10^{-4}$						Guyton & Assoc., 1978
"	17.12.20.3			290					Includes Cow Springs		Guyton & Assoc., 1978
"	17.12.28			100	$2.0x10^{-4}$						Guyton & Assoc., 1978
"	17.13.9.3	1978		187	$5.0x10^{-5}$	206	.91	$2.43x10^{-7}$		Harsh-barger	Harshbarger & Assoc., 1978
"	17.13.16			167	$3.0x10^{-4}$	290	.92	$1.00x10^{-6}$			Harshbarger & Assoc., 1977
"	18.14.15(est)			110							Frenzel, Craigg & Padgett, 1981
"	19.11.31			134						Phillips	Guyton & Assoc., 1978
"	19.12			95	$4.0x10^{-5}$	300	.32	$1.30x10^{-7}$	lab K ≈ .85 ft/day		Dames & Moore, 1977
"	20.6.32			35							Guyton & Assoc., 1978
"	21.9.16			130							Guyton & Assoc., 1978
"	23.13.9			330							Guyton & Assoc., 1978

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Table 1--Continued

Test Site	Location	Date	Duration	Test Results* T ft^2/day	S	b ft	K ft/day	S_s ft^{-1}	Remarks	By	Source
Jackpile Sandstone Aquifer	11.5.13			41					Lyford (1977) has T = 410	Sohio	Lyford, 1977
"	11.5.25 or 28			17	$1.8x10^{-3}$					Summers	Dames and Moore, 1976
"	11.5.25-28	1969		6	$4.5x10^{-4}$	45	.13	$1x10^{-5}$	lowest part of Jmj		New Mexico Research Foundation, 1969
"	11.5.25-28			3					results of several bail tests	Summers	New Mexico Research Foundation, 1969
San Rafael Group	8.7.14.223	1975		2					Je	USGS	Lyford, 1977
"	9.6.26.233	1974		1100					Jb	USGS	Lyford, 1977
"	9.5.13.233	1965		5.5					Je, Trc	USGS	Lyford, 1977
"	9.5.13.411	1963		110					Je, Trc	USGS	Lyford, 1977
Cretaceous System	11.5.30.422	1960		3.3					Kd, Km	USGS	Lyford, 1977
"	16.18.5-18	1980	2½ mon.	300	10^{-4}				Kg	USGS	USGS, 1980
"	18.11.18.1			60		75	.8		Kg (they erroneously calculated T = 200)	Phillips	Phillips Uranium Co., N.D.
"	19.12			57		122	.5		Kg	Dames & Moore	Dames and Moore, 1977
"	19.12			85	$4x10^{-5}$	234	.35	$1.7x10^{-7}$	Kd	Dames & Moore	Greenslade & Condrat 1979
"	13.4	1978					$7.7x10^{-2}$		Km (weathered)	Sohio	Woodward-Clyde, 1980
"	13.4						$9x10^{-3}$		Km	Sohio	Woodward-Clyde, 1980
"	14.8						$1.4x10^{-4}$		Km	Gulf	State Eng. Office, Santa Fe

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recharge areas, water migrates primarily from less active to more active areas (Kreitler, 1978). Hydraulic head in each subsystem depends on distance from and elevation of recharge areas; nature of aquifer materials, especially those of confining beds; and base levels of streams.

In the San Juan Basin, most water movement is toward the basin center from recharge areas along the southern, northeastern, and western basin margins. Most discharge occurs interformationally through upward leakage into the San Juan River. Smaller quantities of water discharge from the basin through the Gallup Sag in the southwest corner and through the Rio Puerco Fault Belt and Acoma Sag in the southeast corner (see Figure 3).

Figure 7, taken from Lyford and Frenzel's (1978) steady-state potentiometric surface map, is a sketch of groundwater levels in the Westwater Canyon aquifer, one of the flow layers modeled in this study. The three regions A, B, and C represent the natural recharge/discharge areas in the basin. For example, all groundwater in area A leaves the basin through the Rio Puerco or Rio San Jose areas; in area C all flow leaves the basin through the Gallup Sag; in area B all flow is into the San Juan River Drainage. Area A is that modeled in this study's steady-state simulations. Flow regions in each layer modeled in this study are assumed to be identical to those in Figure 7.

Two geologic units with very low hydraulic conductivity are treated as the lower and upper units of interest in this analysis. These are the Triassic Chinle Formation and the

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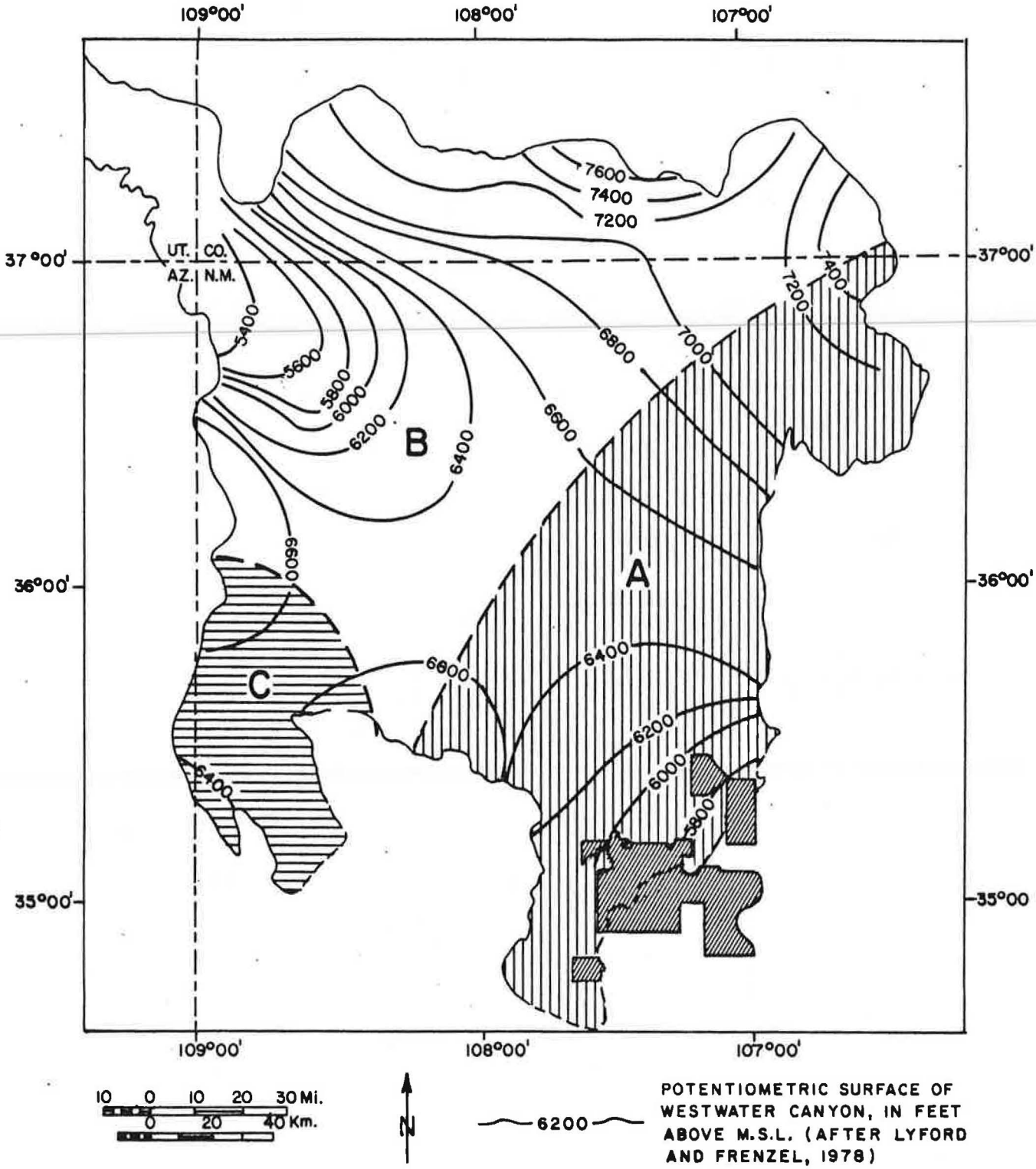

Figure 7. Major groundwater discharge regions within the Westwater Canyon Member

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Cretaceous lower Mancos Shale. Grouped on the basis of hydraulic continuity, the hydrogeologic units are, in ascending order: 1) Chinle Formation, 2) Entrada Sandstone-Todilto Limestone, 3) Summerville Formation-Bluff Sandstone, 4) Recapture Member of the Morrison Formation, 5) Westwater Canyon Member of the Morrison Formation, 6) Brushy Basin Member of the Morrison Formation (not including the Jackpile sandstone), 7) Dakota Sandstone-Jackpile sandstone, 8) Lower Mancos Shale.

Water from Permian rocks discharges on the Laguna Pueblo and is suspected to mix with overlying layers in the Rio Puerco Fault Zone. A discussion of the Permian system waters is therefore included.

Hydrogeology

Permian System

The Permian system consists of the Yeso Formation, Glorieta Sandstone, and San Andres Limestone. Permeability of these formations appears to be predominantly secondary and restricted to the vicinity of outcrop areas. Along the Rio San Jose several wells obtain water from these rocks (Lyford, 1977). Along and near the outcrops in the Zuni Uplift, solution permeability is very high (Cooper and John, 1968). Because of poor quality and generally low yields with distance from the outcrops, the Permian rocks are not considered a good aquifer and are not well understood. Although a few tests of specific capacity have been made, no transmissivity data are available.

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Water levels are above land surface in wells penetrating Permian rocks throughout much of the southeastern part of the basin. In the Sohio mine area the potentiometric surface in the Permian system is about 100-125 feet above that in overlying Jurassic aquifers (Lyford, 1977). In all places in the study area where data are available, potentiometric levels in Permian rocks are higher than those in overlying units. Thus, upward leakage is probable in areas where overlying confining beds are thin or extensively faulted.

Discharge from the Permian system is via springflow in the Mesa Lucero area and via the above mentioned leakage into younger units. Geochemical evidence, given later in this chapter, suggests that this leakage is minor except in the Rio Puerco Fault Zone.

Triassic System

In the study area the Chinle Formation is the only Triassic rock present. It is composed predominantly of mudstone, clay, and shale with smaller amounts of sandstone and siltstone. In the Laguna area it is about 1100 feet thick although the average thickness for the basin is about 1300 feet (O'Sullivan, 1977).

The Chinle is not considered an aquifer in the Crownpoint, Noserock, and Gallup areas (Guyton, 1978). Brod (1980) reported some water production from wells in sandstone lenses within the Chinle in the Ambrosia Lake area. Twenty-five wells penetrate the Chinle Formation on the Laguna Reservation. Most are within the broad valley of the Arroyo Colorado or along the Rio San Jose.

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Water quality is generally poor and yields are low. The Probable origin of the water is local recharge into discontinuous sand bodies within the Chinle Formation. The extreme variability of water quality noted by Lyford (1977), Brod (1980), and Cooper and John (1968), is good evidence that there is little horizontal hydraulic continuity within the Chinle study area.

The vertical hydraulic conductivity of the Chinle is generally very low due to the fine-grained, well-cemented, and clayey nature of the materials. Locally, however, post-depositional erosion, faulting, and increased thicknesses of sand layers could provide avenues for upward leakage from the Permian system. Because of the different chemistry of the Permian water, discussed in a later section in this chapter, any leakage through the Chinle would be noticeable by chemistry changes in water from higher units. This observation is only apparent in the Rio Puerco Fault Zone and Lucero Uplift areas. Based on the lithology and hydraulic conductivity tables provided by Davis and DeWeist (1966) and Kreitler (1978) the vertical hydraulic conductivity is probably about 10^{-6} ft/day. Because of the thickness of this unit, it can safely be considered a highly effective confining zone. For this reason we treat this as an impermeable lower boundary to the numerical model.

Lower San Rafael Group

Overlying the Chinle are two hydraulically connected formations of the Jurassic San Rafael Group: the Entrada Sandstone and Todilto Limestone. Neither unit is extensively exploited for water in the basin because of low yields and poor quality water.

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Because there is little exposure of the Entrada except as cliffs, recharge to the sandstone occurs predominantly through the overlying Todilto Limestone. Recharge to the Todilto is also primarily from downward leakage. Where data from both formations are available, measured water levels in the Entrada and Todilto (Plate 13) are similar.

The Summerville Formation separates the Entrada-Todilto unit from overlying water-bearing units. The Summerville consists of siltstone, shale, and sandstone with calcareous cement and varies from about 330 feet thick in the Ambrosia Lake area to 130 feet in the Laguna area. It probably thins northward toward the central basin. The Summerville Formation is generally considered to be a unit of low hydraulic conductivity (Brod, 1980) which separates the Entrada-Todilto from overlying aquifers. This separation is evidenced by the water-level differences between the Entrada and Bluff Sandstones in the Laguna area, shown on Plates 13 and 14.

The Bluff Sandstone and its lateral equivalent, the Zuni Sandstone, is the most extensive aquifer in the Laguna area. In most other areas of the basin the Bluff is not extensively used, so little information is available. The Bluff is represented by layer 2 in the model.

In the Laguna area, north of the Rio San Jose where the Bluff is overlain by the Morrison Formation, water flows toward the southeast. The potentiometric surface of the Bluff is 75-100 feet higher than the Entrada north of the river, but

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data are insufficient to compare the two units in other parts of the basin.

South of the Rio San Jose, in the Acoma Sag area, the groundwater in the Bluff Sandstone is derived from local recharge on benches, mesa tops, and knolls where the Bluff forms the caprock. Groundwater in the Sag is presumed to be isolated from water in the Jurassic aquifers north of the river.

Only one transmissivity value could be found for the Bluff, 1100 ft^2/day (Table 1). The test was conducted on Tribal lands south of the Rio San Jose. Because of the low yields reported elsewhere (Cooper and John, 1968) and the fine-grained, well-cemented nature of the aquifer matrix, this value is believed to be much higher than the average for the main sandstone layer north of the river.

The potentiometric surface of the Bluff could be contoured in the Laguna area only. Water levels and the model potentiometric surface results are shown on Plate 14.

Morrison Formation

The Westwater Canyon Member of the Morrison Formation is both the most productive bedrock aquifer and the primary uranium ore bearing unit in the southern part of the San Juan Basin. The aquifer is confined by the Brushy Basin Member above and the Recapture Member below.

Recapture Member. Plate 8 is an isopach map of the Recapture Member. It averages 150-200 feet thick in the basin center,

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thinning to less than 100 feet in most of the southern and southeastern parts of the basin. In some places it is absent because of erosion prior to deposition of the Westwater Canyon. The Recapture is predominantly coarse sand in the western part of the basin and about 50 percent medium-grained sand in the south and southeast portions of the basin. It is well-cemented and is generally considered a zone of low hydraulic conductivity.

Westwater Canyon Member. Plate 9 is an isopach map of the Westwater Canyon Member of the Morrison Formation. It is thickest (greater than 300 feet) in a north-south band on the west side of the basin. It thins eastward to less than 100 feet under the Laguna Reservation, but thickens within the Rio Puerco Fault Belt. It is represented by layer 3 in the model.

The transmissivity distribution of the Westwater Canyon is only partly related to the variations in thickness and grain size shown on the isopach map, Plate 9. Transmissivity trends seem to be related primarily to depth of burial of the aquifer and density of faulting and fracturing of the matrix. Figure C3 is a map of the transmissivity distribution of the Westwater Canyon overlain on the steady-state finite difference grid. Transmissivities used in the model were based on the aquifer test information given in Table 1, the isopach map, Plate 9, and were adjusted in the steady-state simulations to better fit the known head and flux distribution.

Recharge to the Westwater Canyon occurs primarily from leakage through overlying layers. There are insufficient exposures of

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sandstone to account for any direct recharge from rainfall. Within the study area and the area modeled in the steady-state simulations, water levels generally decrease with depth. Recharge to most units, therefore, occurs from overlying units. An exception is in the Rio Puerco Fault Zone, discussed later in this chapter. Limits on the volume of recharge were estimated using the three methods outlined below.

Method 1: Using Darcy's law and assumed values of aquifer head gradients, downward leakage into the Westwater from the Dakota can be estimated.

- Area of leakage (A) = area "A" on Figure 7, about 6000 mi^2.
- Average difference (Δh) between the Dakota Sandstone and Westwater is 50 ft.
- Vertical hydraulic conductivity (K_z) of the intervening Brushy Basin = 10^{-5} ft/day and its thickness (b) is 250 ft. (See Brushy Basin section immediately below.)
- Leakage = $K_z (\Delta h/b)A \approx 4$ cfs

Method 2: Using estimates of infiltration determined by a chloride balance (see geochemistry section, below), the area of Dakota outcrops, and estimates of recharge given by Kunkler (1979) in the San Mateo and San Lucas areas the volume of water entering the Dakota in the southern part of the basin can be estimated. Recharge to the Westwater is assumed to be less than this quantity.

- Infiltration rate (see geochemistry section) = 1 percent of 10 inches of precipitation per year = 0.009 ft/yr

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- Area of Dakota outcrops in Zuni Uplift area = 5.6×10^9 ft^2
- Recharge from Zuni Uplift = $(0.009) \cdot (5.6 \times 10^9)$ = 5×10^7 ft^3/yr = 1.6 cfs
- Recharge through faults in the Mt. Taylor, San Mateo, and San Lucas areas ≈ 4 cfs, estimated by streamflow losses (Kunkler, 1979). This is a higher than average rate because of recently increasing streamflows due to mining activities.
- Total recharge to rocks stratigraphically higher than the Westwater = 1.6 + 4.0 = 5.6 cfs

Method 3: During steady-state, or pre-mining conditions, discharge from an aquifer equals recharge to the aquifer. Unfortunately some of the flow from the Westwater discharges the basin unseen through the Rio Puerco Fault Zone. However, summing the observed discharges gives a lower limit of recharge. Estimated discharge rates are as follows:

- To Rio San Jose, between McCartys and Casa Blanca, about 1 cfs (Lyford, 1977)
- To Rio Salado (T.16N.,R.1W.) on the Zuni Indian Reservation: about 1-1.5 cfs (based on a single observation in May, 1981)
- Springs in Salado Canyon (T.13N.,R.3W.), less than 0.5 cfs
- To lower Rio Paguate and Arroyo Conchas, less than 0.5 cfs (Lyford 1977; Hydro-Search, 1979)

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- Total observable discharge: 3 - 3.5 cfs

Inability to make direct measurements of recharge cause large inaccuracies in all three methods. Method 2 is probably too large because it assumes all recharge goes into the Westwater through the San Mateo and other faults; recharge to higher stratigraphic units such as the Gallup Sandstone depletes this volume. A flow net drawn in this study's Phase 1 report showed less than 3 cfs flow in the Westwater in the Laguna area, a reasonable value in light of the other three estimates. This value was used to adjust parameters in the steady-state model of the Westwater Canyon. Water-level contours and model derived equipotentials for the Westwater are shown in Plate 15.

Brushy Basin Member. The Brushy Basin Member overlies the Westwater Canyon Member. Thickness and sand content of the Brushy Basin are shown on the isopach map, Plate 10. Thickness varies in an irregular manner that depends on the amount of pre-Dakota erosion. The Brushy Basin, not including the uppermost Jackpile sandstone unit, is considered to be a zone of low hydraulic conductivity due to its fine-grained, well-cemented matrix. Sandstone beds within the Brushy Basin yield some water, but there is probably little horizontal hydraulic continuity between beds. Large lateral lithologic changes within the Brushy Basin make the hydraulic characteristics difficult to predict.

Vertical hydraulic conductivity of the Brushy Basin probably averages between 10^{-4} and 10^{-6} ft/day, though in some areas it may be much larger.

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Cretaceous System

Above the Westwater Canyon aquifer lies the Dakota Sandstone. It is separated from the Westwater Canyon by the mudstones of the Brushy Basin and bounded above by the lower Mancos Shale.

Dakota Sandstone-Jackpile sandstone Aquifer. The basal Dakota Sandstone, consisting of the Oak Canyon Member, is regionally continuous. The member consists of silty, variably cemented sandstone, locally carbonaceous. In many areas the base of the Dakota has several feet of conglomerate or shale. A diabase sill marks the base of the Dakota in the Laguna area.

The decision to combine the Jackpile sandstone with the Dakota Sandstone as one hydrogeologic unit was based both on the similarity of water levels measured in the two formations and on lack of evidence of any substantial confining layer between them.

Hydraulic continuity among the various overlying tongues of the Dakota is more difficult to estimate. Although Brod (1980, quoting Berry, 1959) said they generally behave as one hydrologic unit, available water level data away from the outcrop areas show much scatter. This suggests that wells and test holes may have penetrated different tongues of Dakota, each with different hydraulic heads. This in turn suggests poor hydraulic continuity between the tongues. However, since most water level data for the Dakota comes from drill-stem tests, the scatter may be due to differing test procedures. The areal extent and thickness of both the Dakota Sandstone and the Jackpile sandstone

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are shown on Plate 11.

Water levels in wells tapping Jackpile sandstone are 50-130 feet higher than those in the Westwater Canyon between the Sohio and Marquez areas. Further south the potentiometric surfaces are about equal. Water levels in the Dakota Sandstone in the model area range from about 50 feet higher than those in the Westwater Canyon basinward of the Zuni Uplift to over 200 feet higher in the Zuni Uplift area and near the San Mateo Fault area on the western flanks of the Mt. Taylor volcanic field. Water levels in the Dakota are lower than those of the Westwater in the Rio Puerco Fault Belt, indicating upward groundwater movement in that area.

Recharge to the Dakota within the San Juan Basin is probably restricted to outcrops and to areas underneath Mt. Taylor. Little leakage is assumed to occur through the overlying Mancos basinward of the outcrops. Estimates of total recharge, as performed earlier in the Westwater Canyon section, are between 2 and 4 cfs. The Jackpile sandstone receives water from the Dakota Sandstone.

Water is discharged from the Dakota-Jackpile system into the Rio Puerco Fault Belt and to the surface as springs or seeps in several areas. The surface discharge areas are tabulated below.

Discharge area	Estimated discharge (cfs)
Rio Paguate-Rio Moquino confluence	0.1-0.2
Encinal Canyon	0.09

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Discharge area	Estimated discharge (cfs)
La Gotera Spring (T.13N.,R.3W.)	0.05
Springs in Cañon Piojo	seeps, almost dry
Seepage into Rio San Jose	unknown, probably less than 0.5
Ojito Springs, Salado Canyon area (T.16.N.,Rs.1 and 2W.)	unknown

Total discharge to the surface probably does not exceed 1 cfs.

Variations in transmissivity of the Dakota Sandstone are not predictable. Aquifer thickness, cementation, depth of burial, and fracture density all control transmissivity in an irregular fashion. Only one aquifer test of the Dakota is available (Table 1).

Trends in transmissivity are evident in the Jackpile sandstone. Close to the Jackpile-Paguate mine transmissivity is less than 10 ft^2/day, but increases northeastward to about 40 ft^2/day. The high dewatering rates encountered at the Bokum mine (about 140 gpm from the Jackpile sandstone) suggest that transmissivity there is large, perhaps as much as 150 ft^2/day.

Mancos Shale. The Mancos Shale is the uppermost bedrock unit considered in this study. The main body of the Mancos is about 900 feet thick (Brod, 1980). It contains numerous sandstone lenses though few with any regional continuity. Plate 12 is an isopach map of the Mancos Shale, minus the thicknesses of the various Dakota Sandstone tongues in the southern half of the basin.

Hydraulic characteristics of the Mancos have been measured

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in few places. Woodward-Clyde (1980) measured the hydraulic conductivity of the Mancos Shale in the vicinity of the Bokum millsite and Gulf measured this parameter near their San Mateo mine. At the Bokum site, values ranged from 7.7×10^{-2} ft/day for weathered Mancos to 9×10^{-3} ft/day for unweathered Mancos. At the San Mateo site, unweathered Mancos showed 1.4×10^{-4} ft/day.

Data from Sohio (1980) provide an order of magnitude estimate of vertical hydraulic conductivity in the area. The Sohio tailings pond is suspected to have leaked through about 50 feet of Mancos into the Tres Hermanos sandstone. Assuming a unit hydraulic gradient, an effective porosity of 10%, and three years for leachate to reach the Tres Hermanos Member, the vertical hydraulic conductivity is about 4.5×10^{-3} ft/day. This is higher than expected for shale and suggests that the Mancos there is extensively weathered or has been partially eroded and replaced by more permeable stream deposits.

Although testing procedures were variable and testing of unsaturated materials is subject to much inherent uncertainty, the shale is reasonably expected to have very low vertical hydraulic conductivity.

Storativity

Measurement of the artesian storage coefficient has been made in only a few places in the basin. Table 1 shows those values that are available. The average, around 2×10^{-4}, is a reasonable value for artesian aquifers. When divided by the average thickness of the Westwater Canyon, between 150-200 feet

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(see the isopach map, Plate 9), a specific storage of 1.33×10^{-6} to 1.0×10^{-6} is obtained. A value of 1×10^{-6} is generally considered an average specific storage for artesian aquifers (Lohman, 1972).

C.E. Jacob (1957) provided the only actual measurements of water-table storage available in the basin. In the Ambrosia Lake area, he calculated values between 0.024 and 0.044.

If a material is allowed to drain over a sufficiently long time, its storativity will approach its porosity. Values of porosity measured from cores taken from the Westwater Canyon range from 0.08 (Stone, 1979) to 0.22 (Guyton, 1978). Long term water-table storage therefore may approach these porosity values, although half the porosity value is probably reasonable.

Geochemistry

It is the intent in this section to obtain additional information on the groundwater flow system through interpretation of the groundwater chemistry.

Classification of water by geologic unit

Figures 8 through 12 (located in the pocket) are trilinear plots of 177 groundwater chemical analyses from the Permian through Cretaceous geologic units. Transparancies were used to facilitate comparison between geologic units. Locations of water analyses used in the figures are listed in Appendix B.

The water is classified mainly as sodium-sulfate or sodium-sulfate-bicarbonate. Several more subtle trends and facies can be discerned from the figures.

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On the cation (left side) triangle of each figure, the dominant ions are sodium and calcium, magnesium being a minor constituent in all but one analysis. Much of the data fit along line A-A'. Disregarding magnesium, the relation between sodium and calcium, as a fraction of total cations, is:

$$Na^{+} = 1 - (1.6 \cdot Ca^{++})$$

Sodium is shown to replace calcium approximately 2 for 1 along the line from A toward A', the approximate downgradient, or flow, direction.

Each anion triangle (to the right in the figures) shows the predominance of sulfate and bicarbonate. In approximately 80% of the samples the total anions are comprised of 10% or less chloride (line B-B' is the 10% isochlor). Samples to the right of line C-C' (the 50% isochlor) are from salt springs, the Nacemiento Uplift, or the Rio Puerco Fault Zone. Sulfate usually slightly exceeds bicarbonate.

Extending the points from the lower triangular fields characterizes water as a single point on the diamond shaped field. The four dominant water types are shown on the small diamond on the base.

This type of presentation does not indicate differences in total dissolved solids (TDS). If two water samples were to have the same ratios of constituents, but different concentrations, both would plot as the same point on a trilinear diagram. To show TDS increases, lines were drawn on the center diamonds in the direction of increasing concentration. These lines approximate the flow paths of water in each geologic unit. No arrows

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could be drawn for the Cretaceous or Triassic systems (Figures 8 and 11) because flow path directions are not obvious. In general, however, the geochemical trend is from calcium-bicarbonate or calcium-sulfate to sodium-sulfate water. TDS generally increases from left to right on all figures.

Sample analyses were averaged to derive a representative analysis for each hydrologic unit studied in the Zuni Uplift, or recharge area, and in the Laguna Reservation area. These average analyses are presented in Tables 2 and 3 and in Plate 4. They serve as the basis for the discussion in the rest of this section.

The predominant chemical reactions are:

(a) dissolution reactions:

$$CaSO_4 \cdot 2H_2O \rightleftarrows Ca^{++} + SO_4^{=} + 2H_2O \quad (1)$$

$$CaCO_3 + H^+ \rightleftarrows Ca^{++} + HCO_3^- \quad (2)$$

$$CaMg(CO_3)_2 \rightleftarrows Ca^{++} + Mg^{++} + 2CO_3^{=} \quad (3)$$

$$NaCl \rightleftarrows Na^+ + Cl^- \quad (4)$$

(b) cation exchange reactions:

$$Ca^{++} + Na_{2(EX)} \rightleftarrows Ca_{(EX)} + 2Na^+ \quad (5)$$

Reaction (4) occurs only in the discharge area of the Triassic and Permian rocks.

Reducing conditions may exist at depth and in the discharge areas and possible redox reactions are discussed later.

Reactions (1) and (5) plausibly account for the preponderance of sulfate and sodium in the groundwater. Other reactions that might explain the large concentrations of sodium and sulfate

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Table 2. Average analyses of water from Permian through Cretaceous aquifers in the Zuni Uplift area

Unit	Constituent	Concentration mg/l	meq/l	% react.
PERMIAN (Psg)	Ca	110	5.5	59
	Mg	23	1.9	20
	Na + K	45	2.0	21
	HCO_3	253	4.2	43
	CO_3	3.6	0.1	1
	SO_4	242	5.0	52
	Cl	14	0.4	4
	NO_3	.2	0.0	0
	TDS	568		
	pH 7.4			
	No. Samples 23			
TRIASSIC (Trc)	Ca	48	2.4	16
	Mg	15	1.2	8
	Na + K	265	11.5	76
	HCO_3	310	5.1	35
	CO_3	17	0.6	4
	SO_4	316	6.6	46
	Cl	74	2.1	14
	NO_3	8.4	0.1	1
	TDS	775		
	pH 8.1			
	No. Samples 14			
JURASSIC-SAN RAFAEL, ENTRADA (Je)	Ca	79	3.9	27
	Mg	4.5	0.4	3
	Na + K	232	10.1	70
	HCO_3	323	5.3	38
	CO_3	13	0.4	3
	SO_4	342	7.1	49
	Cl	41	1.2	8
	NO_3	11	0.2	1
	TDS	901		
	pH 7.9			
	No. Samples 7			
JURASSIC-MORRISON (Jm)	Ca	61	3.0	23
	Mg	20	1.7	12
	Na + K	200	8.7	65
	HCO_3	272	4.5	33
	CO_3	3	0.1	1
	SO_4	412	8.6	63
	Cl	19	0.5	3
	NO_3	1	0.0	0
	TDS	929		
	pH 7.7			
	No. Samples 32			
CRETACEOUS-DAKOTA (Kd)	Ca	42	2.1	15
	Mg	21	1.7	13
	Na + K	230	10.0	72
	HCO_3	312	5.1	41
	CO_3	13	0.4	3
	SO_4	296	6.2	50
	Cl	23	0.7	5
	NO_3	2.8	0.1	1
	TDS	750		
	pH 7.9			
	No. Samples 27			

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Table 3. Average analyses of water from Permian through Cretaceous aquifers in the Laguna Reservation area

Unit	Constituent	Concentration mg/l	Concentration meq/l	Concentration % react.
PERMIAN (Psg)	Ca	510	25.5	9
	Mg	300	24.7	8
	Na + K	5532	240.0	83
	HCO_3	1320	21.6	8
	CO_3	0	0.0	0
	SO_4	4800	100.0	35
	Cl	5800	164.0	57
	NO_3	0.2	0.0	0
	TDS	17,700		
	pH 7.3			
	No. Samples 1			
TRIASSIC (Trc)	Ca	174	8.7	30
	Mg	34	2.8	10
	Na + K	411	17.9	60
	HCO_3	250	4.1	14
	CO_3	2	0.1	1
	SO_4	980	20.4	69
	Cl	154	4.9	15
	NO_3	18	0.3	1
	TDS	2200		
	pH 7.3			
	No. Samples 5			
JURASSIC-SAN RAFAEL, ENTRADA (Je)	Ca	162	8.1	34
	Mg	46	3.8	16
	Na + K	272	11.8	50
	HCO_3	225	3.7	16
	CO_3	0	0.0	0
	SO_4	774	16.1	70
	Cl	110	3.1	13
	NO_3	10	0.2	1
	TDS	1410		
	pH 7.8			
	No. Samples 4			
JURASSIC-SAN RAFAEL, BLUFF (Jb)	Ca	89	4.4	21
	Mg	37	3.0	15
	Na + K	310	13.5	64
	HCO_3	328	5.4	25
	CO_3	8	0.3	1
	SO_4	649	13.5	64
	Cl	69	2.0	9
	NO_3	3.2	0.1	1
	TDS	1277		
	pH 8.2			
	No. Samples 16			
JURASSIC-MORRISON (Jm)	Ca	8	0.4	2
	Mg	5	0.4	2
	Na + K	400	17.4	96
	HCO_3	393	6.4	31
	CO_3	6	0.2	1
	SO_4	544	11.3	64
	Cl	27	0.8	4
	NO_3	0.7	0.0	0
	TDS	1167		
	pH 8.1			
	No. Samples 7			
CRETACEOUS-DAKOTA (Kd)	Ca	87	4.3	27
	Mg	38	3.1	19
	Na + K	202	8.8	54
	HCO_3	341	5.6	38
	CO_3	0	0.0	0
	SO_4	387	8.1	55
	Cl	31	0.9	6
	NO_3	2	0.0	1
	TDS	968		
	pH 7.4			
	No. Samples 7			

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are weathering of plagioclose and oxidation of sulfides. However, weathering of plagioclose would cause an addition of sodium above the 2 for 1 replacement with calcium, as reaction (5) and the trilinear diagrams indicate, and sulfide oxidation releases large amounts of acidity. Neither reaction effect is observed.

These five reaction mechanisms are further discussed in relation to the recharge area (Zuni Uplift), the Laguna area, and the discharge area (Rio Puerco).

Recharge area

Atmospheric input. The chloride ion in the recharge zone is ideally suited for estimation of recharge rates. Chloride in groundwater close to the recharge area can be assumed to come almost entirely from precipitation and dry fallout. Chloride groundwater concentrations are about 9 mg/l in those units that receive direct recharge; the Permian, Triassic, and Cretaceous rocks. Average chloride content of rain in the area is about 0.10 mg/l (Junge and Werbe, 1958). Average annual runoff from this area averages less than 3% of average annual rainfall (USGS surface water records, various years). Using assumptions of 10 inches of precipitation and a chloride enrichment of 90 times (9 mg/l ÷ 0.10 mg/l), about 0.11 inches of rainfall is calculated to recharge the groundwater, approximately 1 percent. Evapotranspiration, therefore, is 96%. This recharge calculation agrees with that of Geohydrology (1978). They determined recharge through water-budget calculations: runoff, 13%; evapotranspiration, 85%; and recharge, 2%.

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Junge and Werbe (1958) estimate that three milligrams per liter of sulfate are common in rainfall in the area. With an enrichment similar to chloride, sulfate may be greater than 200 mg/l in the recharge water. This would account for 50 percent of the observed sulfate concentrations in Table 2.

Bicarbonate concentration in recharge is, like chloride, assumed to be the average of the bicarbonate concentrations in water close to the recharge area, about 140 mg/l. This is not unreasonable given the likely bicarbonate enrichment in the soil zone.

Chemical reactions. The atmospheric input is probably large though not totally quantifiable. Reaction (1), and to a lesser extent, reaction (2) would add some dissolved constituents to the water. Assuming sodium rich clays, reaction (5) would cause addition of sodium and depletion of calcium in the water although it would not increase the TDS concentration. Reaction (5) might also control the chemistry through pH buffering. The assumed progression of cation exchange plotted against measured pH is shown on Figure 13. Even though the pH values listed in Appendix B are subject to much uncertainty, Figure 13a shows that a general relationship seems to hold: as sodium increases in solution by exchange with the alkaline earths, pH increases. Also shown in Figure 13a is the relationship of bicarbonate concentration to pH. Over a very narrow range increases in HCO_3 concentration correspond to increase in pH, suggesting that carbonate dissolution [reaction (2)] is an important reaction in the recharge area.

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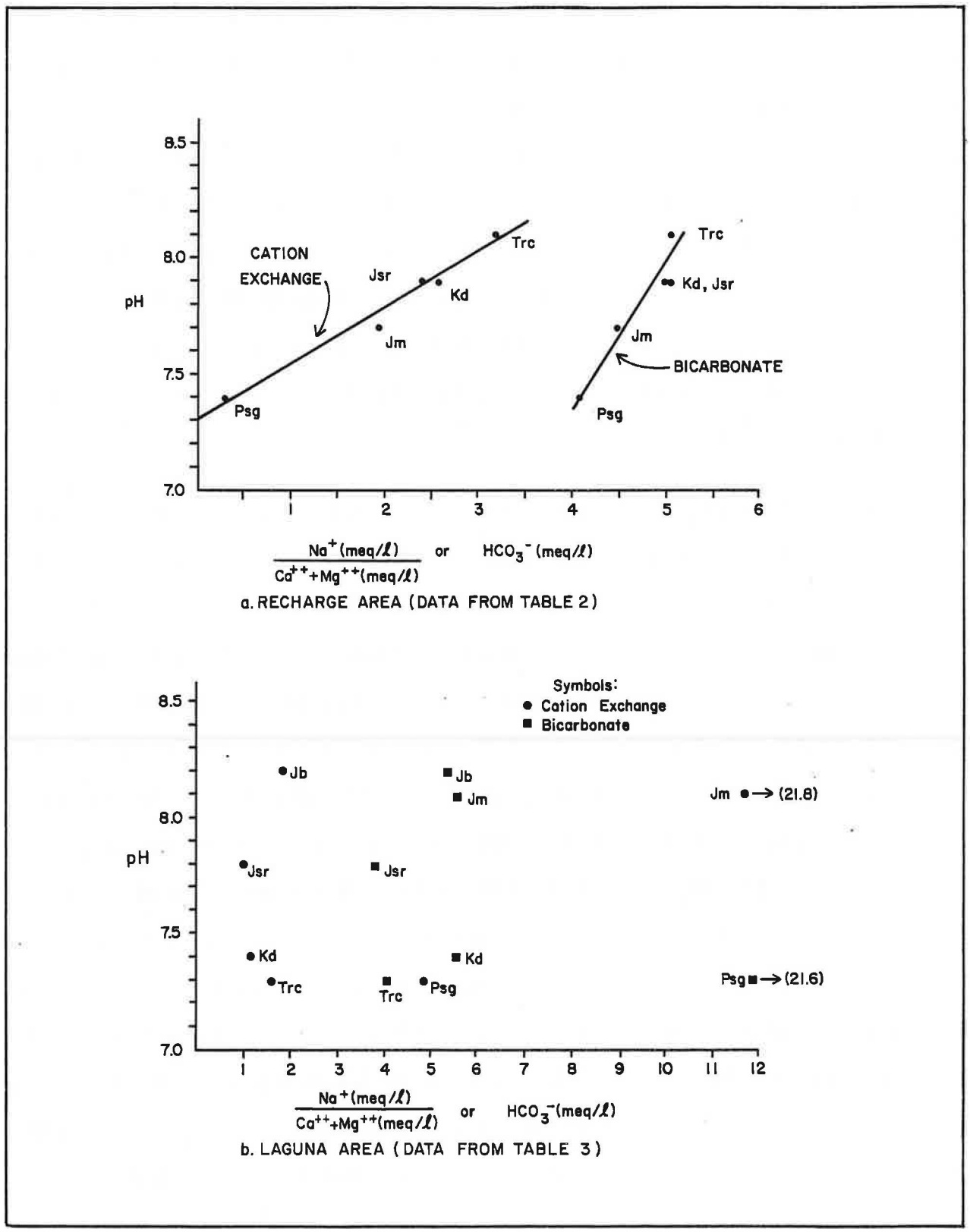

Figure 13. Relationships between pH, cation exchange, and bicarbonate concentrations

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TDS concentration of the five analyses in Table 2 support the topographic evidence that recharge occurs directly into the Permian, Triassic, and Cretaceous rocks, and through leakage into the Jurassic rocks. That is, TDS is low in units exposed to direct recharge and high in units not exposed. Recharge, as calculated from the chloride balance above, is about 0.11 inches per year, or 0.01 cfs/mi^2 of recharge area. Thus, the outcrop area of Cretaceous rocks (about 200 mi^2) accounts for approximately 2 cfs recharge. This estimate supports the suggestion that some additional recharge occurs further downdip, probably through fractures and faults in the Ambrosia Lake, San Mateo, and Mt. Taylor volcanic areas.

Laguna area

Chemical reactions. Table 3 shows average chemical analyses for six geologic units in the Laguna area, but does not include analyses from the Rio Puerco Fault Belt, the Lucero Uplift, or the lower Rio San Jose areas.

All units in Table 3 show increases in TDS, sodium, and sulfate over the corresponding analyses in Table 2. Calcium shows a small increase in some units; bicarbonate generally decreases as a percentage of anions. Water in all units except the Permian is classified as sodium-sulfate. The principle chemical reactions taking place between the recharge area and the Laguna area seem to be gypsum dissolution [reaction (1)], cation exchange [reaction (5)], and, in the Permian rocks, dissolution of sodium chloride [reaction (4)]. Oxidation of

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reduced sulfur species may account for some of the increase in sulfate by the redox reaction:

$$FeS_2 + 4O_2 + 2e^- \rightleftarrows 2SO_4^{=} + Fe^{++} \qquad (6)$$

Decrease in HCO_3 (suggested by comparison of Tables 2 and 3) and iron concentrations (not observed) as well as lowering of pH are accomplished by the reaction:

$$Fe^{++} + HCO_3^- \rightleftarrows FeCO_3\downarrow + H^+ \qquad (7)$$

Reactions (6) and (7) are speculative, as no evidence has been found supporting reducing or oxidizing conditions in Jurassic or Cretaceous rocks in this area.

Figure 13b shows the lack of correlation between cation exchange, bicarbonate, and pH in the Laguna area. Precipitation of calcite by reaction (1):

$$CaSO_4 \cdot 2H_2O \rightleftarrows Ca^{++} + SO_4^{=} + 2H_2O \qquad (1)$$

then

$$Ca^{++} + HCO_3^{=} \rightleftarrows CaCO_3\downarrow + H^+$$

causes both a reduction of pH and bicarbonate. Both occur in Table 3. Other reactions buffer the pH, and some reduction reactions tend to lower pH. The observed decreases in pH and bicarbonate concentration are small and may be the result only of measurement errors.

Rio Puerco area

Groundwater mixing. Table 4 lists analyses of groundwater from

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Table 4: Chemical analyses of Morrison Formation water from Conoco well WW-102 and from Rio Puerco Spring. (Major ions only; complete analysis in Appendix B)

	Conoco Sample (WW-102)	Rio Puerco Sample (spring)
Location:	12.1.31	12.1.7.24
Date sampled:	27 May '81	27 May '81
Field Data:		
Temp. (°C)	32.0	15.5
pH	8.54	7.37
S.C (µmhos)	11900	6400
Flow rate (gpm)	>100	>2

Concentration	mg/l	meq/l	% react.	mg/l	meq/l	% react.
Constituent						
Ca	42	2.1	2	430	21.5	25
Mg	9.8	.8	1	140	11.5	13
Na + K	2506	109	97	1205	52.4	62
HCO_3	280	4.0	4	460	7.5	8
CO_3	-	0	0	-	0	0
SO_4	2900	60.4	52	3500	72.9	83
Cl	1800	50.8	44	280	7.9	9
NO_3	<7.5	<0.1	0	<7.5	<0.1	0
TDS	8000			6800		
pH (lab)	8.5			7.8		

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the Morrison Formation on the Bernabe Montano Grant. The "Conoco" sample came from flowing well WW-102 (Conoco 65-A) and the "Rio Puerco" sample came from a spring on the bank of that river. Hydraulic head levels suggest that the Rio Puerco sample is downgradient from the Conoco sample. Both samples are downgradient from the average of Morrison samples shown in Table 3.

A comparison of the Conoco sample chemistry with that of both the Permian and Morrison samples of Table 3 suggests that the Conoco sample is a mixture of the other two. Upward leakage of sodium-chloride water is suspected due to the high hydraulic potential in the underlying Permian Formation. The amount of leakage can be estimated using a chloride balance and these assumptions:

1) average Cl^- concentration in Morrison Formation upgradient of Fault Belt = 27 mg/l (Table 2),
2) average Cl^- concentration in Permian Formation upgradient of Fault Belt = 5800 mg/l (Table 3),
3) mixture of these forms a solution of 1800 mg/l (Table 4).

If X_1 is the volume of water at concentration 27 mg/l, X_2 is the volume of water at concentration 5800 mg/l, and X_3 is a mixture of X_1 and X_2 at 1800 mg/l, then,

$$X_1 + X_2 = X_3$$
$$27X_1 + 5800X_2 = 1800X_3$$
$$X_1 \approx 2X_2$$

This chloride balance indicates that upward leakage accounts for about 30 percent of the total volume of water in the Morrison.

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If the chloride concentration in the Permian water is closer to that in the Lucero Uplift salt springs, about 9500 mg/l, upward leakage would contribute approximately 20 percent of the total water volume.

It should be noted that this mass balance does not hold for calcium or magnesium as the resultant waters, Table 4, contain less of these two constituents than either of the above ratios predict. Cation exchange within the fault area or in the Morrison is the most plausible explanation; low bicarbonates in the Fault area seem to preclude the possibility of recent recharge water.

The lower chlorinity of the Rio Puerco spring water indicates that upward leakage at that point is much less, nearly 1/7 of that at the Conoco site. The higher calcium, magnesium, and bicarbonate suggests that leakage into the Morrison occurs from higher units, as well as from below, or that some local recharge is occurring. It is also possible that water from the spring has mixed with southerly flowing Morrison water from the Nacemiento Uplift area. One analysis (19.1.14, see Appendix B) available from that area shows 1200 mg/l chloride. However, the model results indicate that flow in the Rio Puerco spring area originates in the Zuni Uplift area. Upward leakage of Permian water is, therefore, the probable source of the chloride.

Isotopic chemistry. It was the original intention of this study to obtain 3 or 4 groundwater samples in the Laguna and Rio Puerco areas for carbon-14 age dating. The purpose of the

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intended analyses was the verification of assumed flow paths of water in the Morrison Formation, as well as the gaining of additional insight into mixing of groundwater in the Rio Puerco Fault Belt.

For various reasons only one sample could be obtained, from well WW-102 (Conoco site) on the Montano Grant. A tenet of ^{14}C groundwater dating is that several samples of different ages should be collected and analyzed to demonstrate consistency of corrections based on geochemistry. Thus interpretation based on one sample is restricted. However some conclusions can be drawn from the WW-102 analytical results (listed in Appendix B).

A brief summary of carbon-14 water dating is useful at this point in the discussion. The element carbon (C) has three naturally occurring isotopes with masses of 12, 13, and 14. Carbon of mass 12 (^{12}C) and 13 (^{13}C) are stable isotopes, whereas ^{14}C is radioactive. In any chemical reaction such as the solution of CO_2 to form HCO_3^-, or the formation of carbohydrates from CO_2 by plants during photosynthesis, the light isotope (^{12}C) reacts at a different rate or amount than the heavier isotope (^{13}C). The isotope ratios of reactant and product species are therefore different, resulting in isotopic fractionation.

$\delta^{13}C$ values for samples from a single type of carbon-bearing material are relatively constant, but one material may have quite different $\delta^{13}C$ values from another. Marine limestones, such as the San Andres, have $\delta^{13}C$ values close to zero (because the marine carbonate PDB is used as the standard). Relative to the

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standard, atmospheric CO_2 and plants are depleted in ^{13}C. Atmospheric CO_2 has a $\delta^{13}C$ value of about -7‰; C-3 type plants, about -25‰; and C-4 type plants, about -15‰. These are large differences, thus $\delta^{13}C$ measurements have been shown to be valuable in determining sources of carbon (Pearson and Hanshaw, 1970).

Naturally occurring ^{14}C has a half-life of 5,730 years. Natural ^{14}C is formed by cosmic-ray reactions in the upper atmosphere and is found at virtually a constant concentration in atmospheric CO_2. ^{14}C concentrations are measured and reported as percentages relative to a standard whose ^{14}C concentration is that of an ideal plant, grown in 1950, in the absence of any atmospheric CO_2 of industrial origin.

^{14}C dating has been first and most extensively used in dating plant tissue. Plants using atmospheric CO_2 assimilate ^{14}C. When a plant dies, the amount of ^{14}C it contains decreases because of radioactive decay, and the amount remaining, relative to that of the ideal living plant, measures the time that has elapsed since its death.

The equation for radioactive decay is

$$\frac{A_{sm}}{A_{std}} = \exp\ (-\lambda t),$$

where $\frac{A_{sm}}{A_{std}}$ is the ratio of sample to standard activity, λ is the decay constant of the isotope (1.2×10^{-4}/yr for ^{14}C), and t is the age in years. For calculation, the decay equation is often written using natural logarithms as:

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$$t = -8266 \ln\left(\frac{A_{sm}}{A_{std}}\right)$$

As discussed above, the CO_2 in the soil air is a product of plant respiration and decay. Because of its plant origin, soil-air CO_2 has the same carbon-isotopic composition as plants. Soil CO_2 dissolved by groundwater will also inherit its plant isotopic character, and if soil CO_2 were the only source of carbonate dissolved in groundwater, its ^{14}C concentration would directly reflect the age of the groundwater--that is, the time elapsed since the water left the soil zone.

The rock through which groundwater flows generally contains mineral carbonate, which is commonly of marine origin and has a $\delta^{13}C$ value near zero. Because of its great age relative to the half-life of ^{14}C, mineral carbonate has no ^{14}C. Solution of ^{14}C-free carbonate lowers the measured ^{14}C concentration of carbonate dissolved in groundwater, ages derived from these ^{14}C values are falsely old. However, if the relative amounts of soil-derived and mineral carbonate are known, this effect can be corrected for.

For the WW-102 sample, the plant, or soil-air carbonate is taken to be the average of the very dilute bicarbonate concentration near the recharge area, approximately 140 mg/l (2.3 meq/l). The average bicarbonate in the Morrison in the Zuni Uplift area (Table 2) is about 272 mg/l (4.46 meq/l); therefore slightly more than half of the bicarbonate comes from atmospheric soil air sources. In the Laguna area there are 6.4 meq/l bicarbonate (Table 3). Assuming no more atmospheric input, about

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36 percent of the bicarbonate is from the atmosphere and soil-air (2.3 ÷ 6.4). This relative concentration can be explained by using the chemical reactions listed above.

Recalling reaction (5):

$$Ca^{++} + Na_{2(EX)} \rightleftarrows 2Na^{+} + Ca_{(EX)}$$

depletes the calcium (and the other alkaline earth) reservoir, driving reaction (2):

$$CaCO_3 + H^{+} \rightleftarrows Ca^{++} + HCO_3^{=}$$

further to the right. The H^{+} concentration limits how far this reaction can progress. Oxidation of sulfide minerals can supply the needed H^{+} ions.

The sample in question (Table 4) has 280 mg/l bicarbonate (4 meq/l). There are no completely satisfactory reasons for the lower bicarbonate at this well; a possible explanation is mixing with low bicarbonate water from the San Rafael Group and Chinle (see Table 3). The carbonate concentration in the sample is the sum of:

1.	atmospheric bicarbonate:	2.3 meq/l
2.	carbonate from reaction (2):	+ 1.7 meq/l
	Total	4.0 meq/l

Possible addition of calcium by gypsum dissolution and removel of calcium and magnesium by cation exchange makes equating the alkaline earths to bicarbonate too uncertain to utilize.

If it is assumed, by the chloride balance above, that between 20 and 30 percent (average 25 percent) of the sample

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water is from the Permian system, then the total carbon in the sample can be expressed as:

$$C_{sample} = 0.75(C_{ATM(m)} + C_{MIN(m)}) + 0.25(C_{ATM(p)} + C_{MIN(p)})$$

where the subscripts (m) and (p) stand for Morrison and Permian water, respectively, ATM is atmospheric carbon, and MIN is mineral carbon. Let $C_{ATM(m)} = C_{ATM(p)} = 2.3$ meq/l. If the only input of "live" carbon is from $C_{ATM(m)}$, then the proportion of live carbon to total carbon is (0.75)(2.3)/4.0, or 0.43.

$\delta^{13}C$, as discussed earlier, is also useful as a method to compute the proportion of atmospheric to total carbon in water. However, little is known about $\delta^{13}C$ values in the recharge area. If the $\delta^{13}C$ in the recharge water is -15‰ [a reasonable value for the area (K. Parada, private communication)], and if the $\delta^{13}C$ of the mineral carbonate is 0‰, then the $\delta^{13}C$ of the sample water would be $[(2.3)(4.0)]\cdot(-15‰) = -8.6‰$. The measured $\delta^{13}C = -7.7‰$. The agreement is close enough to give some support to the derived proportion.

The measured ^{14}C ratio is 3.43 ± 0.57% of modern. This, by the formula above, yields an age of 20,900 ± 600 years.

The average age of the water at the Montano Grant can also be estimated by using a form of Darcy's law:

$$t = \frac{Ln}{KI}$$

where t = time for water movement along a flow path

L = flow path length

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n = porosity

K = hydraulic conductivity

I = hydraulic gradient

Using values selected from the hydraulic conductivity map and from the preliminary flow net (Figure 25, Phase 1 report):

L = 55 miles = 290,400 ft.

n = 12-20% (Stone, 1979; Guyton, 1978)

K = 1.5 ft/day

I = 1100 ft/290,400 ft = 3.79×10^{-3} ft/ft

The Darcy age is calculated to be between 17,000 years and 28,000 years, depending on the porosity used. If the water were actually 20,900 years old, then the average porosity is about 15%. Thus the agreement between the ^{14}C and Darcy age is excellent.

Groundwater movement

The above discussion and data from Appendix B can be used to draw conclusions regarding groundwater flow patterns, the influence of Mt. Taylor on groundwater movement, and delineation of recharge and discharge areas.

Plate 5 is a map showing several water quality parameters of the Morrison Formation in the southern San Juan Basin. Conductivity contours were used instead of total dissolved solids contours because of the greater abundance of the conductivity data. Stiff diagrams were drawn using information from Tables 2, 3, and 4 and other data from Appendix B.

Four lobes of fresher water can be identified on the map.

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They are in the Chuska Mountain area (far western basin boundary), Zuni Uplift, Ambrosia Lake, and Mt. Taylor areas. The first three are known recharge areas to the basin while the latter one is a suspected although non-quantified recharge area.

Water levels in the Dakota indicate it receives recharge from the Mt. Taylor area. The decrease in specific conductivity in the Morrison suggests that this recharge also reaches the Westwater. The amount of recharge is very small, however, or the ^{14}C age of the sample discussed above would probably have been younger.

In most other respects the conductivity contours roughly parallel the water level contours showing, except under the Mt. Taylor area, regular increase in electrical conductance with distance from recharge areas.

The general evolution in water chemistry is shown in the Stiff diagrams. Three distinct geochemical facies are evident. The first is the low conductivity sodium-sulfate-bicarbonate water of the recharge areas. The second is high conductivity sodium-sulfate water typified by the Rio Puerco (eastern map area) and San Juan County (northern map area) samples. The Laguna sample (average of samples shown) is intermediate between low and high conductivity waters. The third facies, shown in the southwest map area, is typified by the brackish Bernabe Montano and the saline Mesa Lucero springs. These samples delineate the zone of upward migration of saline water.

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Steady-State Simulations

The numerical simulations of groundwater flow discussed in this section were performed using the three-dimensional, finite-difference computer program developed by Posson and others (1980). For brevity, we will refer to this program as FD3D. The numerical techniques used in this program are largely based on the programs developed by Trescott (1975), but FD3D includes numerous input/output and data processing enhancements which increase its efficiency and ease of use. FD3D is machine dependent and can only be run on either Cyber 6000 or 7000 mainframe computers using the NOS/BE operating system.

All simulations performed under this contract were run on a Cyber model 170-750 with extended memory operated by SUN Information Services of Dallas, Texas. Several slight modifications were required to run FD3D on this machine. These included changing some of the control statements and removing calls to METAPLOT, the general purpose plot routine. These modifications did not affect the computational parts of the program.

Model Structure and Boundary Conditions

As discussed previously, other models of the San Juan Basin (Lyford and Frenzel, 1978; Lyford and others, 1980) and our interpretation of the available water level data have indicated that under steady-state conditions, the Westwater Canyon aquifer can be divided into three active groundwater circulation zones. These zones are separated by limiting streamlines. Inasmuch as

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the head distribution in the other Jurassic and Cretaceous aquifers is similar to that in the Westwater, these units were also divided into the same circulation zones. This subdivision of the aquifer system allowed us to limit the steady-state model to the southeastern third of the basin (shown by zone A in Figure 7) and thus to maximize our efforts in the vicinity of the Laguna Pueblo area.

The use of hydraulic boundaries such as limiting streamlines in steady-state numerical simulations is a common hydrologic practice. We emphasize, however, that such boundaries are only valid for steady-state simulations.

The steady-state grid was constructed by dividing the hydrogeologic system between the Chinle Formation and the Mancos Shale into four layers. Figure 14 is a cross-section through the Pueblo area that shows the four layers and their relationship to the stratigraphic units. Each grid consists of 652 rectangular blocks. Boundary blocks for each layer differ slightly, corresponding to the location of each outcrop area and how each was treated in the simulations. The grid and boundary conditions used for each layer are shown on the formation constants maps, Figures C-1 through C-5 and on each steady-state result map, Plates 13 through 16.

The Chinle Formation and Mancos Shale are treated as impermeable confining beds except in the Rio Puerco Fault Zone. Layer 1 includes both the Entrada Sandstone and the Todilto Limestone and was assigned transmissivities representative of these units. These aquifers are separated from the overlying

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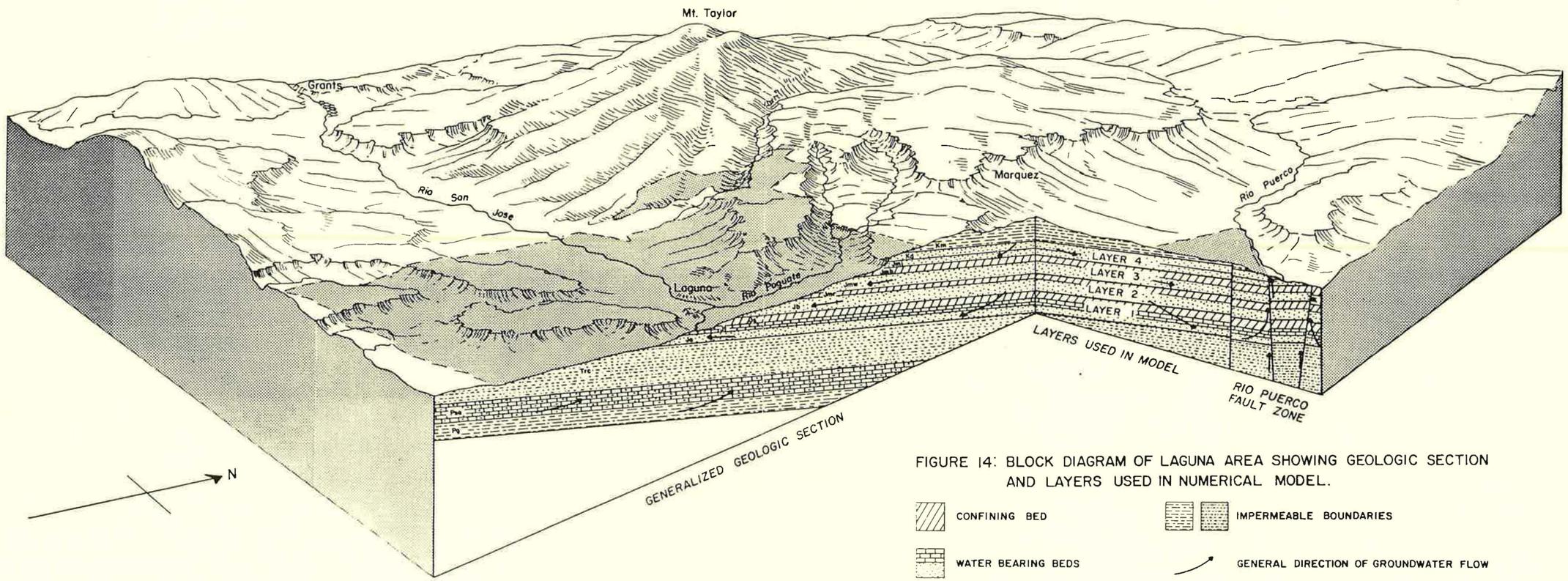

FIGURE 14: BLOCK DIAGRAM OF LAGUNA AREA SHOWING GEOLOGIC SECTION AND LAYERS USED IN NUMERICAL MODEL.

CONFINING BED

IMPERMEABLE BOUNDARIES

WATER BEARING BEDS

GENERAL DIRECTION OF GROUNDWATER FLOW

SEE PLATE I FOR EXPLANATION OF GEOLOGIC SYMBOLS.

NOTE: NOT TO SCALE.

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Bluff Sandstone by the Summerville Formation. The effect of this confining bed was incorporated into the model by assigning a low vertical hydraulic conductivity (K_z) to Layer 1. The distribution of transmissivity and vertical hydraulic conductivity is shown on Figure C-1 (Appendix C). Layer 2 represents the Bluff Sandstone and the Recapture Member of the Morrison Formation. This layer was assigned a transmissivity of 75 Ft^2/day. The distribution of vertical conductivities representing the Recapture is shown on Figure C-2. Layer 3 includes the Westwater Canyon and the Brushy Basin members of the Morrison Formation. The transmissivity distribution used for this layer is shown in Figure C-3. Figure C-4 shows the vertical hydraulic conductivity distribution of Layer 3, representing the Brushy Basin. The basal Dakota Sandstone and the Jackpile sandstone are represented in the model by Layer 4. Because the overlying Mancos Shale is treated as impervious, the vertical hydraulic conductivity of Layer 4 was set equal to the horizontal hydraulic conductivity. Its transmissivity distribution is shown in Figure C-5.

All values of hydraulic parameters were based on the available aquifer test data, lithologic interpretation, and the values necessary to obtain a reasonable match to the observed water levels in the various aquifers. We found, as did Lyford and Frenzel (1975), that the steady-state head distribution was relatively insensitive to changes in transmissivity values and very dependent on the values of K_z.

Because the head distribution was insensitive to changes in transmissivity, the hydraulic gradients were also insensitive

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to this parameter. For this reason, the computed boundary fluxes were simply linearly related to the transmissivities used in the model.

All of the confining beds in the model were initially assumed to have a vertical hydraulic conductivity of 1×10^{-5} ft/day except in the fault zone where a value of 1×10^{-4} ft/day was used. The values of the vertical hydraulic conductivity were specified by treating all the layers as if they were one meter thick and each K_z value was divided by the true thickness of the confining bed as estimated from the isopach maps. These values were further adjusted during steady-state calibration to match observed water-level data.

No-flow and constant-head boundary conditions were used in the steady-state simulations. Nodes containing outcrops of the various units which do not receive surface recharge or across which no groundwater movement occurs (based on potentiometric surface maps constructed from the existing water level data) were treated as no-flow boundaries. This condition was also applied to the limiting streamline which separates zone A (Figure 7) from the other circulation zones.

Recharge areas such as the northern flank of the Zuni Uplift and the Archuleta Arch were assigned constant head values based either on observed water levels or interpolations of the estimated potentiometric surface. Constant head conditions were also assigned to nodes in Layers 3 and 4 where these units outcrop under the Rio San Jose, equal to the elevation of the river. Nodes in areas of known springs or seeps were assigned

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constant head values equal to the average elevation of the outcrop in these nodes. All no-flow and constant-head nodes are shown on Plates 13 through 16.

The use of constant head boundary conditions in these areas is justified in the steady-state simulation because the appropriate head values in these zones can be estimated from the hydrologic data base more reliably than can recharge or spring discharges. The use of constant head conditions in these areas also allowed the model to compute the boundary flows to and from the aquifers. These computed flows were then compared to observed and estimated recharge values and spring discharges to assure that the model gave physically reasonable results.

In the Rio Puerco Fault Zone, the hydrologic and geochemical data suggest that 1) faulting has increased the vertical hydraulic conductivity by disrupting the confining beds, 2) considerable upward leakage occurs from underlying aquifers into the lower Dakota Sandstone, and 3) vertical leakage of saline water from the Paleozoic units in the Jurassic aquifers occurs. To simulate these conditions, a constant head value of 5900 feet was assigned to nodes in Layer 1 (Entrada-Todilto) in the fault zone and the transmissivity of these nodes was set to zero. Upward leakage from these nodes was then allowed by assigning them a low vertical hydraulic conductivity. In effect, these conditions introduced a constant head reservoir of saline water about 1000 feet below the Entrada and discharging to the overlying aquifers by vertical leakage along fault planes. Discharge of water through the Dakota into the Albuquerque Basin

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was simulated by specifying constant heads in Layer 4 in the fault zone. The vertical hydraulic conductivities of all the layers were also increased in the fault zone by a factor of 10.

Lastly, recharge was included in the steady-state model by specifying areal recharge to Layer 4 in nodes around Mt. Taylor. This was necessary to duplicate the head distribution in Layer 4 in the Laguna area, as well as water-level data in the area west of Mt. Taylor. Recharge was adjusted until agreement was reached; the final value used was 2.3 cfs. This recharge should be viewed as coming from several areas stretching from San Lucas Canyon westward and southward to Ambrosia Lake.

These adjustments and checks for reasonableness of both water-levels in all layers and fluxes at all boundary nodes constituted the calibration procedure for the steady-state simulations. Detailed calibration of the model could not be accomplished because of insufficient data on water-levels and hydraulic parameters over much of the basin. However, the reasonableness of the parameters used, and the results obtained, lend confidence in the calibration procedure.

Model Results

The resulting head distributions are shown in Plates 13, 14, 15, and 16. For comparison, water-level data and previously drawn water-level contours are included. The computed boundary flows are also shown for each layer. An exact match to the observed water-levels was not obtained. Given the scatter in the data, however, it is doubtful if the observed water-levels

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can be matched using a realistic hydraulic model. This is particularly true for the Dakota data which are largely based on drill stem tests. In addition, non-hydraulic processes affecting the head distribution in the Dakota sands in the interior of the basin have been postulated (e.g., Berry, 1959) which cannot be included in this model.

The principal areas of mismatch between the observed and simulated steady-state potentiometric surfaces are in the northeastern corner of the basin in Rio Arriba County and in Layer 1 near the outcrop area in the Zuni Uplift. Numerous attempts were made to improve the match in Rio Arriba County by changing constant head boundaries and transmissivities in the northern part of the model. These all resulted in a worsening of the fit in the principal area of interest near the Pueblo. Due to the limited hydrogeologic data in this area, we felt that further efforts to refine the model there were not justified given the closeness of the water-level matches nearer to the Pueblo.

As for the poor match between computed and observed water levels in Layer 1 near the Zuni Uplift, relatively little data are available for providing quidelines to improve the fit. Inasmuch as this mismatch in Layer 1 has little affect on heads and drawdowns in the Westwater Canyon Formation, extensive efforts to eliminate it were not justified.

The mass balance for the steady-state simulation is given in Table 5 in terms of the various recharge and discharge areas for each layer and for flow between layers. A number of significant features of the hydrologic system are revealed in the mass

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Table 5. Mass balance and distribution of flow in each layer in steady-state simulation

	Recharge (cfs)			Total Recharge
	Outcrops	Mt. Taylor/ San Mateo	Other Layers	
Layer 4 (Dakota/ Jackpile)	0.52	2.39		2.91
Layer 3 (Westwater)	1.01		0.06	1.07
Layer 2 (Bluff)	-		0.34	0.34
Layer 1 (Entrada/ Todilto)	0.07	-	0.04*	0.11
		Total Recharge		4.43

	Discharge (cfs)			Total Discharge
	Rio Jose, seeps, springs in Pueblo	Fault Zone	Other Layers	
Layer 4 (Dakota/ Jackpile)	0.39	2.47	0.06	2.92
Layer 3 (Westwater)	0.39	0.36	0.30	1.05
Layer 2 (Bluff)	0.35	-	-	0.35
Layer 1 (Entrada/ Todilto)	0.06	0.04	-	0.10
		Total Discharge		4.42
		Mass balance error 0.2%		

* Vertical flow from Paleozoic units

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