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OUTDOOR AIRBORNE ASBESTOS CONCENTRATIONS AT THE UNION CARBIDE ASBESTOS MINING AND MILLING OPERATIONS IN CALIFORNIA

Prepared at the request of:

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INTRODUCTION

Science Applications, Incorporated, under contract with the Environmental Protection Agency, is conducting a study of the impact of various asbestos sources in California on the surrounding population. Union Carbide Corporation was asked, and agreed to provide, certain historical information on airborne asbestos at its mine and mill. Particular emphasis was placed on property line measurements in order to estimate general population exposures.

BACKGROUND

The Union Carbide asbestos mill near King City, California started up in 1963 and has been in essentially regular operation since that time. The mill uses a unique wet process which greatly facilitates control of both worker exposure and environmental asbestos release.

Ore is mined by a cut-and-bench procedure in the Diablo Mountains about 55 road miles from King City. Mining takes place for about a two-month period every two years and the ore is stockpiled at the mine-site. Ore is hauled to the mill by truck for about six months each summer. Sufficient material is stored at the mill to last through the winter when weather conditions inhibit mining operations and hauling.

A comprehensive industrial hygiene program has been carried out at this location since 1963. The program includes worker exposure monitoring, regular medical surveillance, and worker safety and health training. Extensive efforts have been made to reduce both exposure and emissions.

ASBESTOS CONCENTRATION MEASUREMENTS

The main emphasis of the industrial hygiene program is on worker protection so the great majority of the airborne measurements are made in the direct proximity to the workers and are generally within the mill. Rather limited sampling has been included, however, at the fence lines and occasionally at various places closer to the mill building. These external data are provided.

Seven sets of area samples have been collected over the years at the mine. With one exception, these were all in the immediate vicinity of active mining and milling operations. They are provided with the understanding that they are not property line measurements.

From 1963 through early 1969 concentrations were measured with the midget impinger. The NIOSH phase contrast method was adopted in mid-1969 and is still in use. No measurements have been made with electron microscopy procedures.

When the change from midget impinger to phase contrast microscopy was made in 1969, a rather crudely documented conversion factor of 2 fibers/cc >5μ per million particles per cubic foot was developed from comparative measurements. It is both well known and obvious that the conversion from particles to fibers is not a universal factor but will be considerably influenced by the characteristics of the dust cloud being sampled. A wide range of factors have been proposed for this conversion. Since the value of 2 falls within this range and since there is no basis to adjust it to any other value, it has been used in reporting the present data.

RESULTS AND DISCUSSION

The airborne concentrations measured from 1963 through the present in the vicinity around the mill are summarized in Table I and are shown graphically in Figure 1. A layout of the mill property is provided in Figure 2.

Figure 1 gives the airborne concentrations, expressed as fibers/cc >5μ, as a function of the month and year in which they were measured. The place where the measurement procedure was changed from midget impinger to optical phase contrast is also indicated. Most of the data were taken at the property boundary with that from the north fenceline indicated by an open circle and that from the south fenceline by a triangle. For several of the later years a substantial number of samples were collected in close proximity to the mill and these results are shown by the solid circles.

A very approximate trend line has been included on the Figure. It is immediately evident that a reduction in concentration of about three orders of magnitude has been made since the plant started up in the early 1960's. The fenceline levels are now generally below 0.1 fiber/cc which NIOSH has designated as the detection limit for the method[1]. As might be expected, the levels directly around the mill tend to be higher than the fenceline but are still quite low.

The data for the concentrations during the mining and hauling of asbestos ore are shown in Table II and Figure 3. It should be reiterated that these are not property line concentrations but were measured during active operations. Here there has been a reduction in concentration of approximately two orders of magnitude. The levels are now well below the current occupational standard of 2 fibers/cc >5μ.

[1] These data are included even though there are serious technical reservations regarding the reliability of the measurement method at this apparent concentration level. This is not the place to address this critically important issue.

PROPERTY LINE AIRBORNE ASBESTOS

CONCENTRATIONS - UNION CARBIDE CORPORATION

KING CITY ASBESTOS MILL

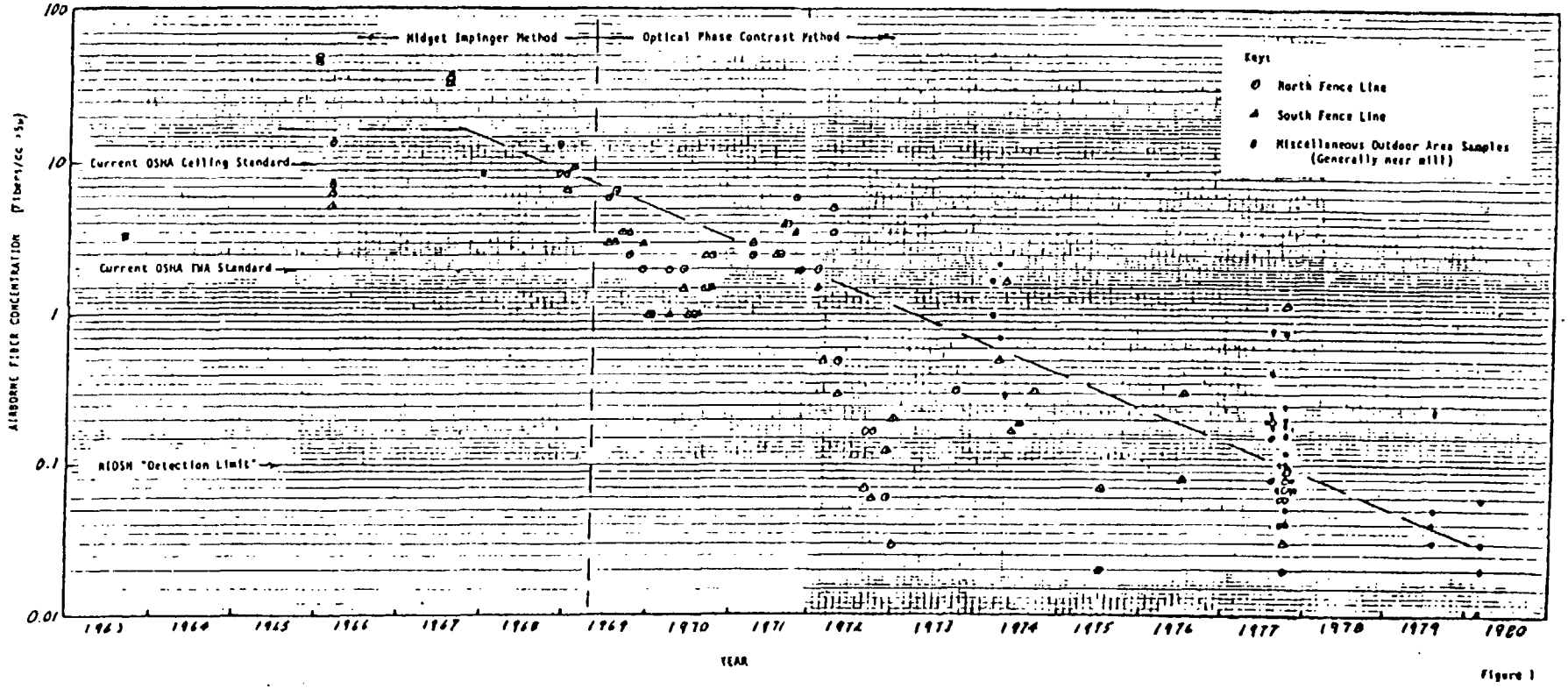

Figure 1

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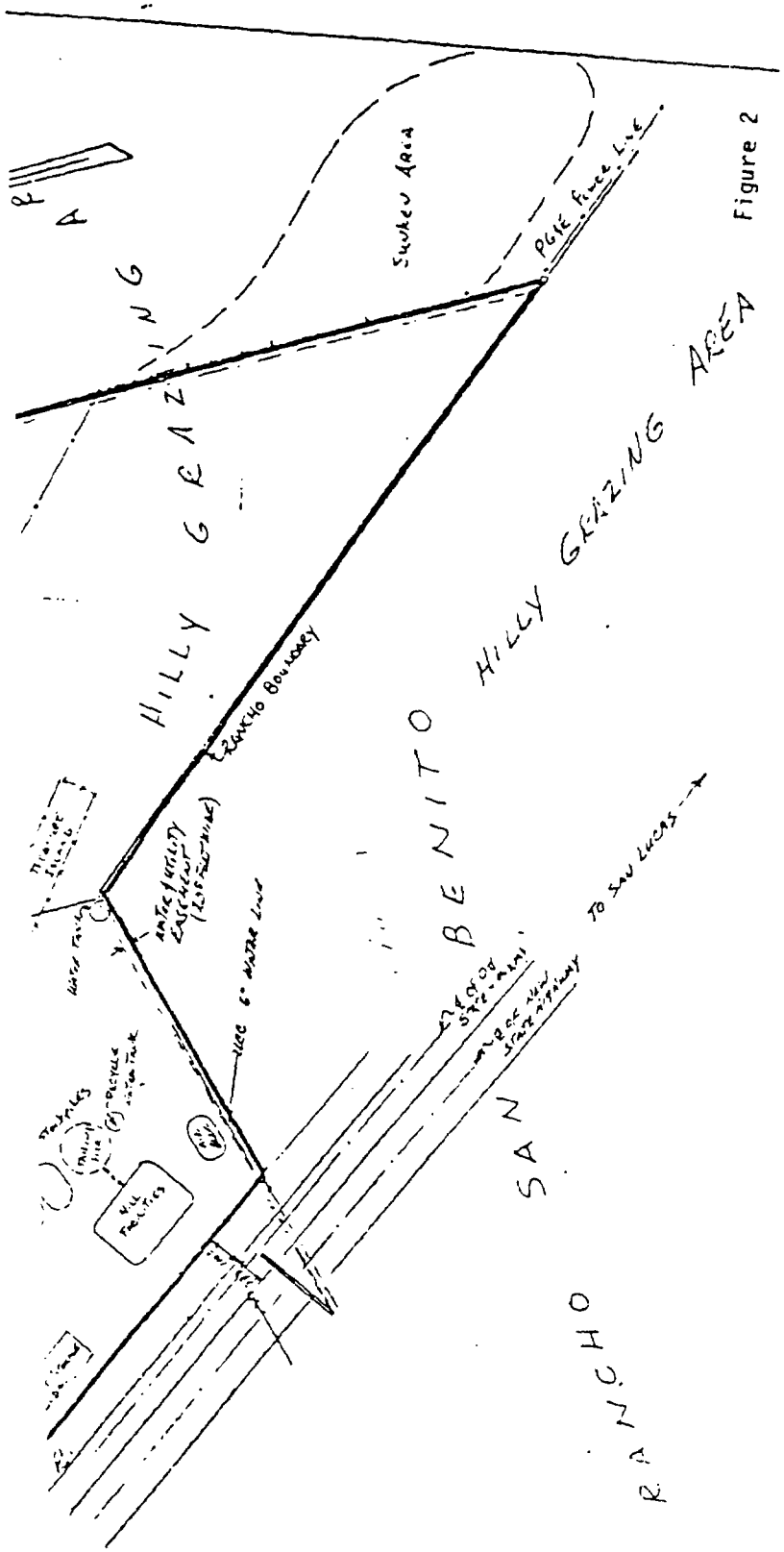

Figure 2

MS

967		1968			
ıun.		Jan.		Dec.	
:f	f/cc	Mppcf	f/cc	Mppcf	f/cc
	-	-	-	6.6	13.2
				4.4	8.8
.7	33.4	-	-	-	-
.2	36.4				
-	-	-	-	-	-
-	-	-	-	-	-

			1970						
Sept.	Oct.	Dec.	Jan.	Apr.	June	July	Aug.	Sept.	Oct.
f/cc	f/cc	f/cc	f/cc	f/cc	f/cc	f/cc	f/cc	f/cc	f/cc
-	2.5	2	1	2	2	1	0	1.5	2.5
3.5	3.5	3	1	1	1.5	:	1	2.5	2

1973			1974							
Dec.	Jan.	Oct.	Feb.	Mar.	Apr.	Ma:	f/c:	July	Sept.	Oct.
f/cc	f/cc	f/cc	f/cc	f/cc	f/cc	f/cc		f/cc	f/cc	f/cc
0.06	0.03	0.32	-	-	-	-	-	-	-	-
0.24	0.21		-	-	0.5	1.7	0.17	0.19	0.31	-
-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	1.0	2.2	0.3	-	-	-	-
-	-	-	-	1.7	0.7	-	-	-	-	-

ɔber			1978	1979 Aug.	1980 Mar.
f/cc	f/cc	f/cc	f/cc	f/cc	f/cc
0.02	0.06	0.06	-	-	-
1.17	-	0.08	-	-	-
0.08	-	0.10	-	-	-
0.25	-	0.06	-	-	-
0.07	-	-	-	-	-
-	0.12	-	-	-	-
-	0.10	-	-	-	-
-	-	-	-	0.31	0.02
-	-	-	-	0.04	0.03
-	-	-	-	0.05	0.06
-	-	-	-	0.03	0.01

nger than 5 microns per cubic

3. All counts after July 1969 are by the membrane filter method.

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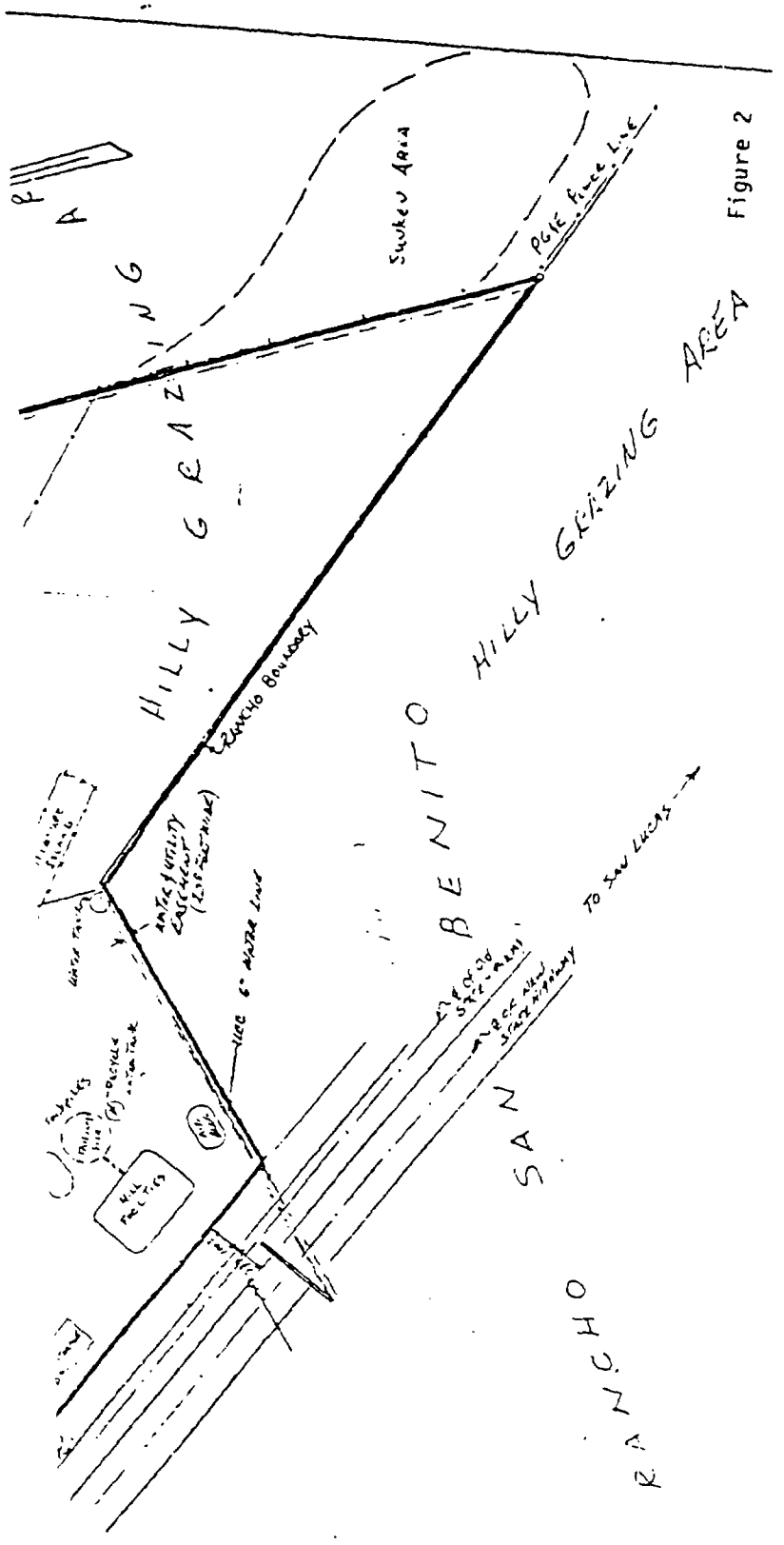

Figure 2

MS

967		1968			
un.		Jan.		Dec.	
:f	f/cc	Mppcf	f/cc	Mppcf	f/cc
	-	-	-	6.6	13.2
				4.4	8.8
.7	33.4	-	-	-	-
.2	36.4				
-	-	-	-	-	-
-	-	-	-	-	-

			1970						
ept.	Oct.	Dec.	Jan.	Apr.	June	July	Aug.	Sept.	Oct.
f/cc	f/cc	f/cc	f/cc	f/cc	f/cc	f/cc	f/cc	f/cc	f/cc
-	2.5	2	1	2	2	1	0	1.5	2.5
3.5	3.5	3	1	1	1.5	1	1	2.5	2

	1973		1974							
Dec.	Jan.	Oct.	Feb.	Mar.	Apr.	Ma.	-	July	Sept	Oct.
f/cc	f/cc	f/cc	f/cc	f/cc	f/cc	f/cc	f/cc	f/cc	f/cc	f/cc
0.06	0.03	0.32	-	-	-	-	-	-	-	-
0.24	0.21		-	-	0.5	1.7	0.17	0.19	0.31	-
-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	1.0	2.2	0.3	-	-	-	-
-	-	-	-	1.7	0.7	-	-	-	-	-

			1978	1979	1980
ober				Aug.	Mar.
f/cc	f/cc	f/cc	f/cc	f/cc	f/cc
0.02	0.06	0.06	-	-	-
1.17	-	0.08	-	-	-
0.08	-	0.10	-	-	-
0.25	-	0.06	-	-	-
0.07	-	-	-	-	-
-	0.12	-	-	-	-
-	0.10	-	-	-	-
-	-	-	-	0.31	0.02
-	-	-	-	0.04	0.03
-	-	-	-	0.05	0.06
-	-	-	-	0.03	0.01

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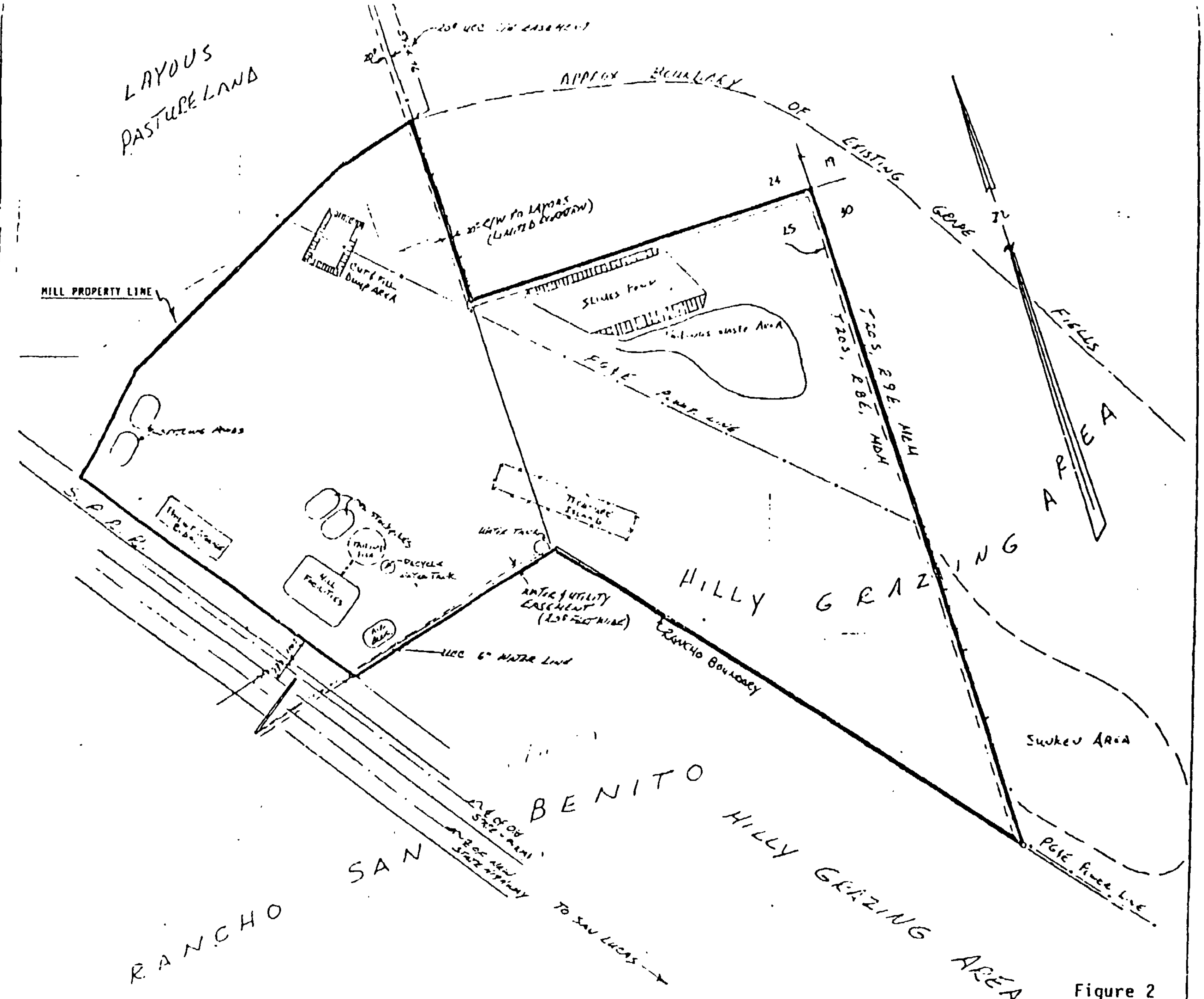

Figure 2

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AREA AIRBORNE ASBESTOS CONCENTRATIONS

DURING MINING AND HAULING - UNION

CARBIDE CORPORATION ASBESTOS MINE

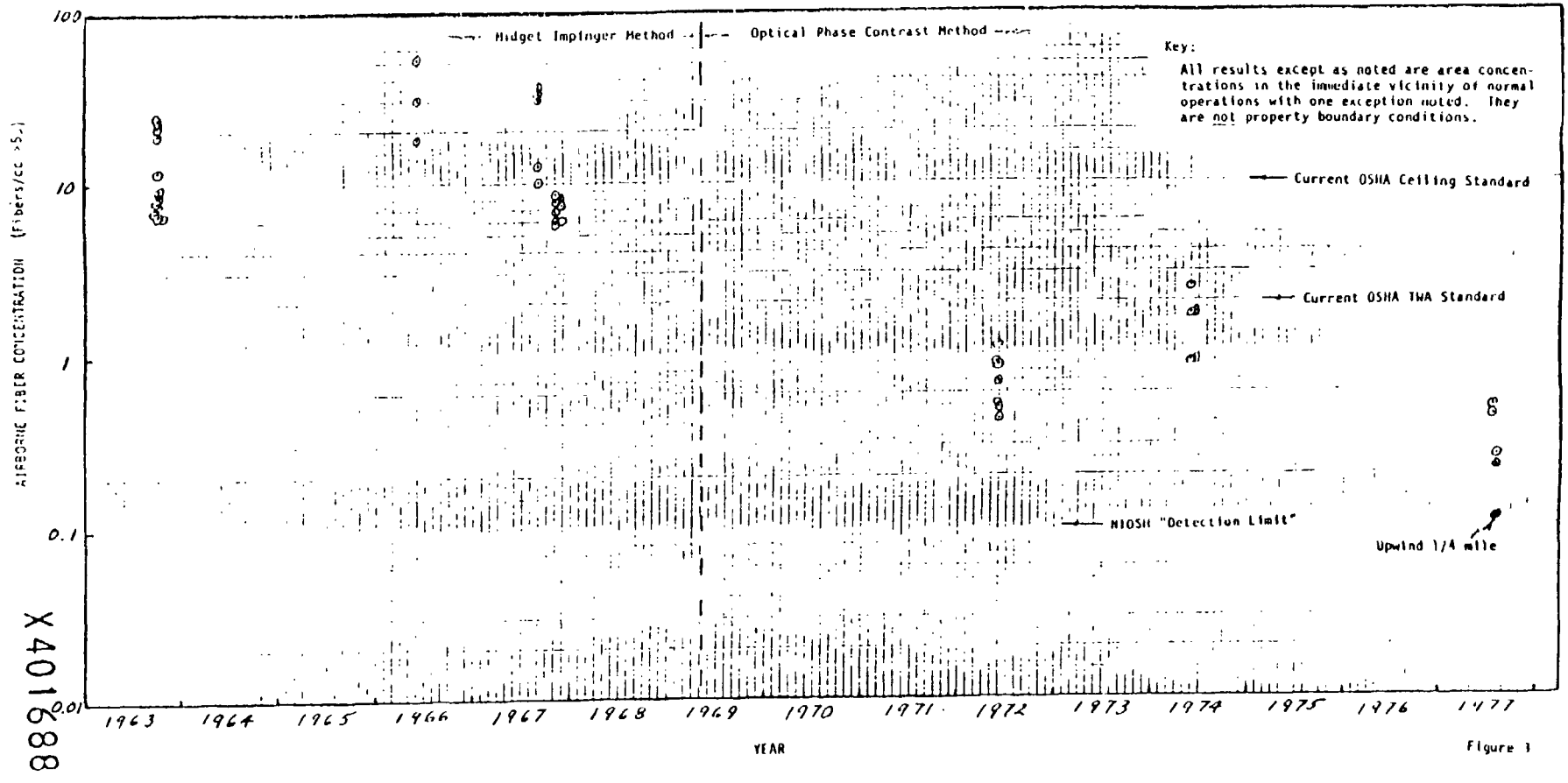


Figure 1

X401688

AIRBORNE CONCENTRATIONS

DURING MINING AND HAULING OPERATIONS

SEPTEMBER, 1963

Sampling Location and Operation	Remarks	Mppcf[1]
Alongside wobbler during loading trucks.	Variable wind direction and speed so that sampling location is upwind of dust part of time.	4.2 3.8 3.3 3.9
Riding caterpillars cleaning mine site.	Much large, nonrespirable material noted.	9.6 10.9 11.3 11.8
Walking across ore pile.	Light breeze (5 mph) from west and south.	3.2 3.4
Riding pick-up with windows open on road from mine.	Deep dust on portions of road.	4.7 6.0
	JUNE, 1966	
Beside operator of front loader (no cab) loading ore truck.	Contractor operator.	26.0
Area around truck during loading.	Visible dust.	15.4
General area around grizzly during truck loading.	Much loose, finely divided material on ground.	14.2
	AUGUST, 1967	
Beside operator on caterpillar while loosening ore pile.	Not visibly dusty nor very windy.	6.3 5.0
Beside operator on front loader while loading grizzly. Conveyor system operating.	Visibly dusty but not very windy.	18.0 15.1 16.7
	OCTOBER, 1967*	
Self-propelled.	Short section of haul road dry and dusty, no wind.	4.4
Scraper, mining and stockpiling ore 4350 level.	Road freshly watered, no wind.	2.9
Bulldozer) Push loading scrapers) Ore, 4350 level)	Freshly exposed ore, not watered, no wind.	3.0 3.4 3.9
Bulldozer clearing rocks from pit floor.	Pit floor, not watered, no wind.	4.0
Front end loader) Feeding screening plant)	Maneuvering area watered several hours earlier, very light breeze.	3.7 3.0

(1) Millions of particles per cubic foot.

(2) Fibers/cc >5μ. A conversion factor of 2 f/cc >5μ per Mppcf was used to convert midget impinger readings.

X4016

(October 1967 - Continued)

*The following description of dust control practices in effect was contained in the report of this survey:

"The sampling was conducted on the afternoon of October 25, 1967. All samples were collected adjacent to the operator of the particular equipment while performing normal operations. All haul roads and the front end loader maneuvering area adjacent to the mine stock pile had been watered in accordance with standard practice during the mining operations.

It has been practice to water down the front end loader maneuvering area on alternate days pending repair of the air conditioning system. During mining operations it is practice to have a water truck on duty continuously to water mine haul roads, dump areas and the loading area adjacent to the mine stock pile and screening plant. Scraper loading areas were not watered since the freshly exposed asbestos ore is damp. Watering overburden loading areas, however, was found at times to be necessary due to visible dust concentrations."

JUNE, 1972

Sample Location and Time	Conditions	f/cc
1. Front end loader screening ore - 10:10 a.m.	Slight overcast - wind 10-15 mph from north ground and ore damp - cab open on loader - operator wearing respirator - water truck working in area. 70°F - cat working on pile.	1.14
2. At picnic table - 10:19 a.m.	Same as #1. Filter stained by diesel smoke from loader.	0.42
3. Same as #1 - 10:48 a.m.	Same as #1.	0.86
4. Same as #2 - 10:55 a.m.	Same as #1. Filter stained by diesel smoke from loader.	0.68
5. On Cat pushing ore.	Same as #1.	0.86
6. By oil shed - 12:25 p.m.	Wind 10-15 mph fron north. No machinery operating - ground damp - 78°F.	0.48
7. Same as #6 - 12:25 p.m.	Same as #6.	0.50

MAY, 1974

Location, Time, Min. of Sampling, & Temp.	Conditions	f/cc
1. Mine pit area, east side, 11:05 a.m., 65°F, 30 min.	1. Clear day with east-west intermittent wind about 5-10 mph. 2. Full mining operation. 3. Sampler hand carried around the area.	1.70
2. Mine pit area, west side, 11:45 a.m., 65°F, 15 min.	1. Same as above. 2. Sample was taken for 15 min. because mining operation was stopped for lunch break.	2.46
3. Screening area, 12:35 p.m., 65°F, 30 min.	1. Full screening operation. 2. Clear day with intermittent wind, east-west, at about 5-10 mph. 3. Sampler was hand-carried around the area: 0-10 min. -- Loading section 11-20 min. -- Screening section 21-30 min. -- Stockpile section 4. Full loading operation in hauling trucks. Note: Visible dusts were observed during the loading and screening operations; but the dust could be too big and heavy for the sampler to collect with face down.	0.90
4. Top of ore stockpile, 1:10 p.m., 65°F, 30 min.	1. Clear day with intermittent wind of about 5-10 mph, directions changed to west-east. 2. Full mining operation.	0.90
5. Top of future stockpile, 1:55 p.m., 67°F, 30 min.	1. Same as above.	1.60

X401691

AUGUST 9, 1977

Subject: Area Samples
Location: Joe 5 Minesite (see sketch for Location).
Conditions:
1) Full screening operations.
2) Dozer operation on stockpile.
3) Ore truck loading.
4) Moving oversize material.
5) 2-10 mph intermittent wind (use wind meter).
6) Weather temperature of 92° F.

Remarks: The Joe 5 Mine area has been extremely dry since 8-1-77 because of the exhaustion of the "normal" year arround water supply. The Location of today's samples (see sketch) are such that maximum dust conditions exist whenever traffic passes.

Sample No:	Time	Remarks	f/cc
1-1	11:10 AM-12:10 PM	175A performing +1" rock removal; pick-up traffic. (none*)	0.23
1-2	12:10 PM- 1:10 PM	Four ore trucks and 2 loaders passed; dusty conditions. (none*)	0.65
1-3	1:10 PM- 2:10 PM	Two ore trucks passed; 125A loader performing +12" rock removal. (none*)	0.70
1-4	2:10 PM- 3:10 PM	125A performing +12" rock removal. (none*)	0.29
		Average:	0.47
2-1	11:15 AM-12:15 PM	175A performing +1" rock removal; pick-up traffic. (none*)	0.30
2-2	12:15 PM- 1:15 PM	5 ore trucks passed; 175A loader loading trucks; possible Diesel exhaust with sample. (lots*)	0.61
2-3	1:15 PM- 2:15 PM	1 ore truck passed; same as above. (little to lots*)	0.43
2-4	2:15 PM- 3:15 PM	Light traffic (Pick-up). (none*)	0.37
		Average:	0.43

(*) Filter discolored from diesel smoke.

X401692

SHEET NO. ..... JOB NO. .....

DATE ..... SUBJECT .....

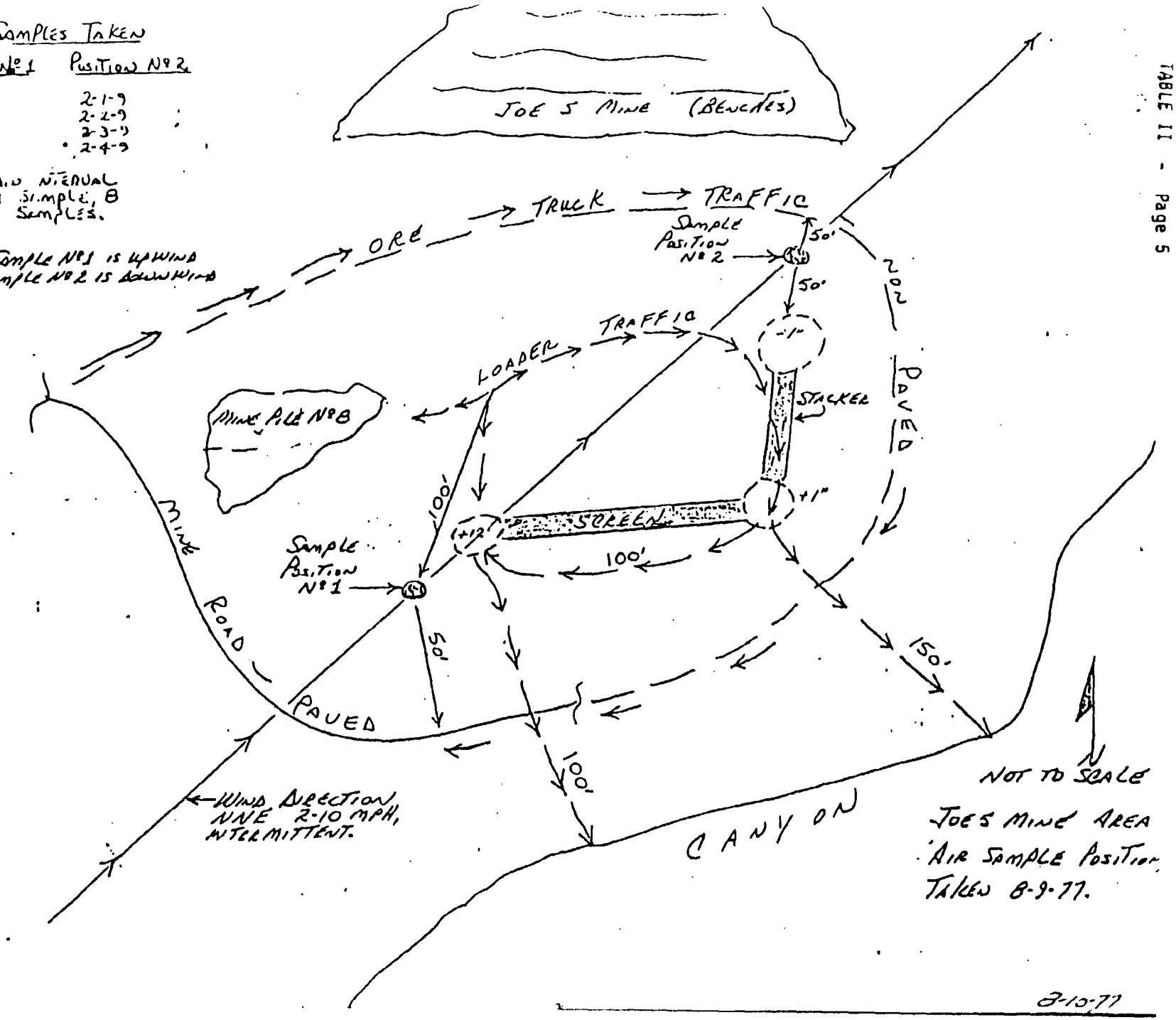
BY ..... DATE .....

Samples Taken

Position No 1	Position No 2
1-1-9	2-1-9
1-2-9	2-2-9
1-3-9	2-3-9
1-4-9	2-4-9

Go min intervals each sample, 8 total samples.

NOTE: Sample No 1 is upwind
Sample No 2 is downwind



X401693

8-10-77

AUGUST 19, 1977

Subject: Area (3) air samples
Location: Joe 5 Pit (see sketch)
Conditions: 1.) Full screening & Truckloading operation.
2.) Dozer operation on stockpile.
3.) Approximately 5 mph wind with gusty to 10 mph.
4.) Temperature 90° F.

Remarks: Sample No. 3, upwind, approximately $\frac{1}{4}$ mile southeast of Joe 5 Pit center. Approx. elevation 4400'.

Sample No.	Time	Remarks	f/cc
1-1	11:20 AM- 12:20 PM	No traffic.	0.27
1-2	12:20 PM- 13:20 PM	Light traffic within 50'.	0.38
1-3	13:20 PM- 14:20 PM	" " " "	0.20
1-4	14:20 PM- 15:20 PM	No traffic.	0.14
		Average:	0.25
2-1	11:25 AM- 12:25 PM	No traffic.	0.12
2-2	12:25 PM-13:25 PM	Light traffic within 100'.	0.13
2-3	13:25 PM- 14:25 PM	" " " "	0.34
2-4	14:25 PM- 15:25 PM	No traffic.	0.29
		Average:	0.22
3-1	11:40 AM- 12:40 PM	Dormant area, hill top.	0.16
3-2	12:40 PM- 13:40 PM	" " " "	0.10
3-3	13:40 PM- 14:40 PM	" " " "	0.12
3-4	14:40 PM- 15:40 PM	" " " "	0.05
		Average:	0.11

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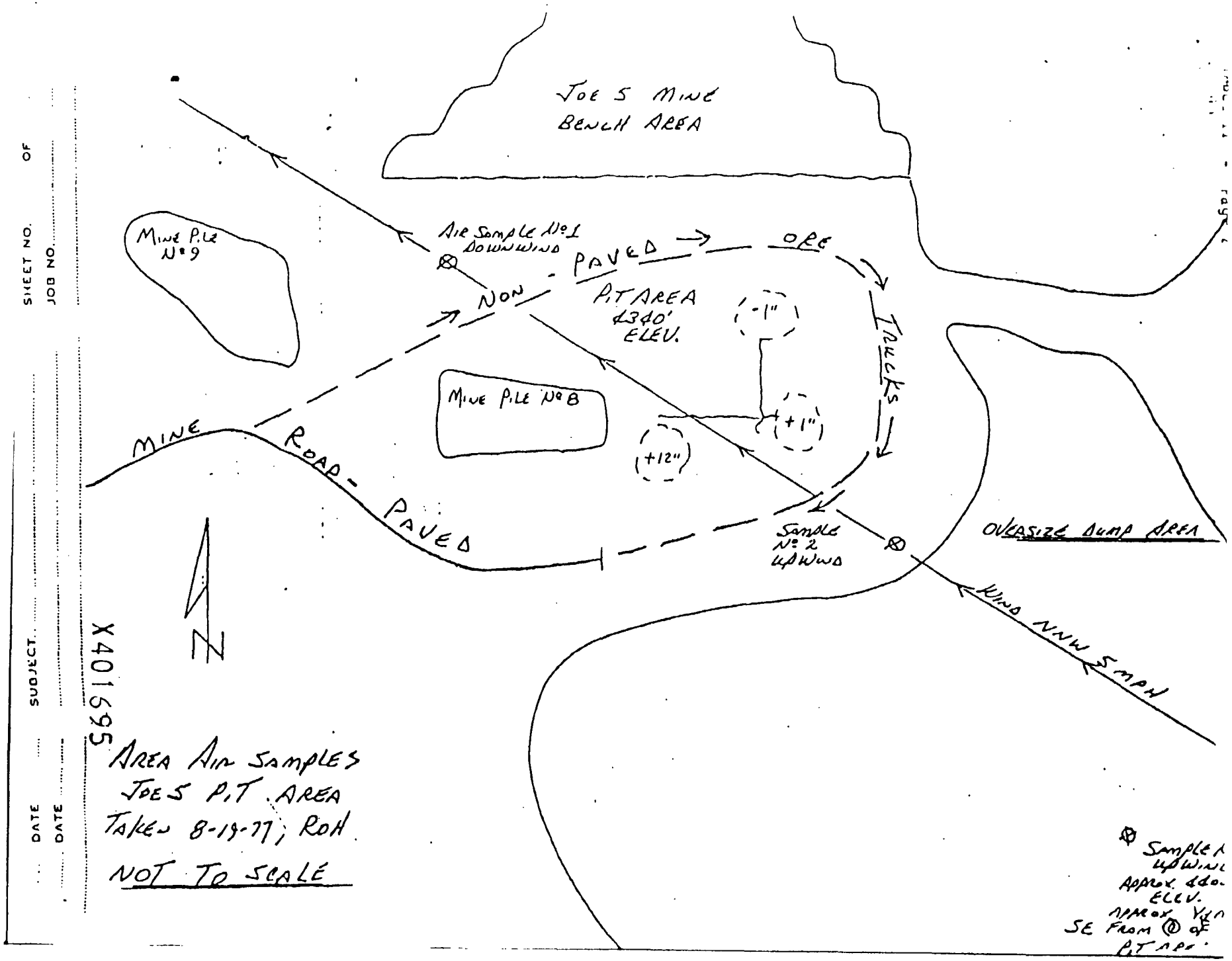

SHEET NO. ..... OF .....

JOB NO. .....

SUBJECT. .....

DATE .....

DATE .....

X4015695

AREA AIR SAMPLES
JOE 5 P.T. AREA
TAKEN 8-19-77; ROH

NOT TO SCALE