U. S. NUCLEAR REGULATORY COMMISSION
REGION I

Report No. 99990001/89-001

Docket No. 99990001

License No. none Priority ___ Category ____ Program Code _____

Licensee: Heritage Minerals, Inc.
P. O. Box 12
Lakehurst, New Jersey 08733

Facility Name: Heritage Minerals, Inc.

Inspection At: Route 70, Mile Marker 41, Lakehurst, N. J.

Inspection Conducted: January 12, 1989

Inspector: Laurence F. Friedman 2/17/89
Laurence F. Friedman, Ph.D., C.H.P. date
Senior Health Physicist

Approved by: John D. Kinneman 2/17/89
John D. Kinneman, Chief date
Nuclear Materials Safety Section B

Inspection Summary: Special Safety Inspection Conducted January 12, 1989 (Report No. 99990001/89-001)

Areas Inspected: Location, geology and hydrology of site; history of site; current process; tour of plant; collection and analysis of samples.

Results: One violation was identified: Possession of source material without an NRC license.

DETAILS

1. Persons Contacted

Heritage Minerals, Inc.

*John F. Lord, P.E., Plant Manager
Tony V. Cuculic, Chief Engineer

State of New Jersey, Department of Environmental Protection

*Peter C. Taylor, Central Bureau of Field Operation, Division of Hazardous Waste Management
*Karl W. Muessig, Ph.D., Geologist, N. J. Geological Survey, Division of Water Resources

*indicates those present at Exit Interview

2. Location, Geology and Hydrology of the Site

The Heritage Mineral, Inc., site is located in Manchester Township, Ocean County, New Jersey. A map showing the general location of the site is included as Attachment 1. A more detailed map showing the location of the settling pond and dredge pond (see below) is included as Attachment 2. Maps showing the layout of the plant are included as Attachments 3 and 4.

The Plant Manager stated that the entire site has an area of 7000 acres. He estimated that 1000-1200 acres had been involved in the mining operation. He stated that the balance of the site had not been disturbed. The plant itself, including the feed pile, settling pond and tailings piles occupies, an area estimated by the Plant Manager at 450-500 acres.

According to the New Jersey Geological Survey, the site is located on the Atlantic Coastal Plain. The formations are sandy and permeable to at least 1500 feet, where some clay is encountered, and bedrock is not encountered until at least 3000 feet.

The uppermost aquifer at the site is the Cohansey. Depth below grade to seasonal high water of this aquifer is approximately six feet.

3. History of Site

The following information was obtained from the New Jersey Department of Environmental Protection, and was confirmed by the Plant Manager. In 1957, ASARCO Incorporated purchased the previously undeveloped site, and initiated studies to delineate an ilmenite ore body. The New Jersey Geologist estimated that this ore contained 70% quartz (SiO_2), 29% ilmenite (TiO_2), and the remaining 1% zirconium, monazite, etc.,

including rare earths and uranium and thorium. Development of the site began in 1971, and active mining operations began in 1973.

Mining consisted of a hydraulic dredge operating on the exposed surface of the Cohansey aquifer which extracted a sand slurry for transfer to a dewatering barge. Water and gravel was separated and returned to the dredge pond, and the sand slurry was pumped to the wet mill. At the wet mill, the heavier minerals were separated from the lighter fraction by physical methods. This lighter fraction, comprising approximately 96% of the original mass, was returned to the dredge pond.

The heavier ore fraction, containing titanium dioxide, zircon, quartz, kyanite, sillimanite, and other trace minerals, was stockpiled to allow for dewatering. This material was fed to a rotary kiln for drying, and was then screened to remove coarse material, more than 99% quartz, which was deposited in a pile behind the dry mill.

The electrically conductive titanium dioxide-bearing minerals were separated from the non-conductive materials electrically, and the product was further refined magnetically to produce the final ilmenite product. This product represented approximately 2.5% of the original mass. The dry-mill tailings were stockpiled for future processing, and comprise the present "New Feed" pile to the east of the dry mill.

ASARCO halted operations in March 1982. The hydraulic dredging operations stopped, but the processing plant was used for experimental purposes under a lease to Humphreys Engineering until September 1982. Humphreys evaluated the possibility of producing a zircon product from the stockpiled dry-mill tailings.

In 1984-85, Kerr-Magee considered buying the property, and brought in Hazen Research, Inc., to perform studies of the process. Attachment 5 is a table from the Hazen report showing source material concentrations at various points in the process. The table was furnished to the inspector by the licensee during the inspection.

The property was purchased by the present owner, the Houson Corporation, which is owned by the Hovnanian family, in 1986. The facilities were leased to Mineral Recovery, Inc., and operated by them until August 1987. From August 1987 to the present, operations have been conducted by Heritage Minerals, Inc., which is owned by Houson.

4. Current Process

The current operation, which the Plant Manager stated is identical with the process studied by Kerr-Magee, processes the dry-mill tailings from the ASARCO operation to extract zircon and leucoxene (titanium dioxide). A flow chart of the process is included as Attachment 6. The "New Feed" on the chart is the dry-mill tailings from ASARCO. The material is

physically processed using water spirals and tables to separate light material, which is sent to a hopper where it is combined with the tailings from the dry mill.

The remaining, heavy material is kiln dried and passed to the dry mill where it is screened and separated electrically and magnetically. The non-conductors zircon and monazite are separated from the conductors, leucoxene (65% titanium dioxide) and rutile (92+% titanium dioxide).

Both streams are then further refined magnetically. The zircon product is separated from the monazite in the dry mill. The monazite goes into a hopper where it is combined with the tailings from the wet mill. The contents of the hopper are mixed with water and piped out to the combined tailings pile, located behind (to the north of) the wet mill. Some of the leucoxene is separated as product, and some is further refined into rutile by magnetic separation from residual zircon, which is recycled. Both the rutile and leucoxene are sold as product.

The Plant Manager stated that the stock of New Feed at the start of operations in November 1986 was approximately 1.2-1.6 x 10^6 short tons, of which an estimated 250,000-300,000 tons remain. Except for product shipped, an estimated 50,000-60,000 tons reported as TiO_2, the balance, approximately 1.0 x 10^6 tons, is in the combined plant tailings pile. Approximately 2600 tons of zirconium product and 800 tons of titanium product are produced each month. Approximately 25,000 tons of wet-mill tailings and 300 tons of dry-mill tailings are produced each month. Twenty per cent of the dry-mill tailings is monazite, a sand which contains source material. The Plant Manager estimated that present supplies of feed stocks (the "New Feed") would last approximately eight more months. Current plans are to reprocess the combined plant tailings, using the current process, to recover the same products. This process is expected to take another three years. No decision has been made as to whether to continue operations beyond that time.

The inspectors also discussed a housing and recreational development proposed for the site by the present owner. The development is planned around the lakes left by the dredging operation and is currently awaiting various state and local permits. The Plant Manager stated that development would start at the east end of the site and that the present plant location would be developed last. The entire project is expected to take 20 years.

5. Tour of Plant

The inspectors from the NRC and the State of New Jersey toured the plant. The plant operates 24 hours a day, seven days a week, and employs a total of 50 workers. The plant consists of the wet mill, a 200 by 100 foot building, half of which is used, and the dry mill, a 100 by 100 foot

building, all of which is used. There are also a service and office building and various small out buildings

Background radiation levels were measured at the turn-off from Route 70 with a Ludlum Model 19 micro-R meter, and observed to be 7 uR/hr. Ambient radiation levels in the wet mill building and the dry mill building were approximately 50 uR/hr, except in the area of the dryer product discharge (dry mill feed) where levels of 300 uR/hr were measured. Levels of 240 uR/hr were measured in the vicinity of the dry-mill tailing discharge.

Workers were observed to be wearing single use, disposable dust masks while working in the dry mill. Little dust was actually observed, as virtually all fines are removed in the wet mill.

The inspectors noted that there was no health physics program, and the Plant Manager stated that no surveys for radiation or radioactive material were performed.

The inspectors also toured the combined plant tailings pile. Radiation levels over the pile were approximately 30 uR/hr.

6. Collection and Analysis of Samples

Six samples of plant feed stock, in-process material, and tailings were collected. The position of each sample in the process stream is indicated on Attachment 6. The samples ranged in mass from 786 to 1544 grams. Each sample was analyzed by gamma spectroscopy using an intrinsic germanium detector calibrated for the geometry of the samples (Marinelli beaker) with NBS-traceable standards. No attempt was made to dry the samples, which makes the reported weight-per cent values low. The activity of lead-212 was taken as the activity of thorium in the sample, and the activity of protactinium-234m was taken as the activity of uranium. These nuclides were assumed to be in equilibrium with the thorium-232 and uranium-238 parents, respectively. Activities were converted to masses using specific activities of 1.09E-1 uCi/g for thorium-232 and 3.33E-1 uCi/g for uranium-238. The weight-per cent of thorium, uranium, and total source material in each sample is reported in Table 1. Based on the analysis of the sample of combined plant tailings and the estimate of the total mass of these tailings, there appears to be approximately 62 tons each of uranium and thorium in the combined plant tailings pile.

The table concentrate had a source material concentration of 0.074% and the monazite waste has a source material concentration of 0.585%.

"Source material" is defined [10 CFR 40.4(h)] as (1) uranium or thorium, or any combination thereof, in any physical or chemical form, or (2) ores which contain by weight one-twentieth of one percent (0.05%) or more of

(i) uranium, (ii) thorium, or (iii) any combination thereof. 10 CFR 40.13, "Unimportant quantities of source material," provides an exemption from the requirements for an NRC license for any person who receives, possesses, uses, transfers, or delivers source material in any chemical mixture, compound, solution, or alloy in which the source material is by weight less than one-twentieth of one percent (0.05%) of the mixture, compound, solution, or alloy. Except for this exemption, 10 CFR 40.3 provides "that no person . . . shall receive title to, own, receive, possess, use, transfer, or deliver . . . any source material after removal from its place of deposit in nature, except as authorized in a specific or general license issued by the Commission pursuant to the regulations in [10 CFR Part 40]."

The finding that Heritage Minerals, Inc., possessed and used table concentrate and monazite waste in which the concentrations of source material were greater than 0.05% by weight without being authorized to do so by an NRC license is an apparent violation of 10 CFR 40.3.

7. Exit Interview

The results of the inspection were discussed with the individuals indicated in Section 1. The inspector explained the provisions of 10 CFR Part 40, and that whether Heritage Minerals, Inc., would have to apply for an NRC license depended on the results of the analysis of the samples.

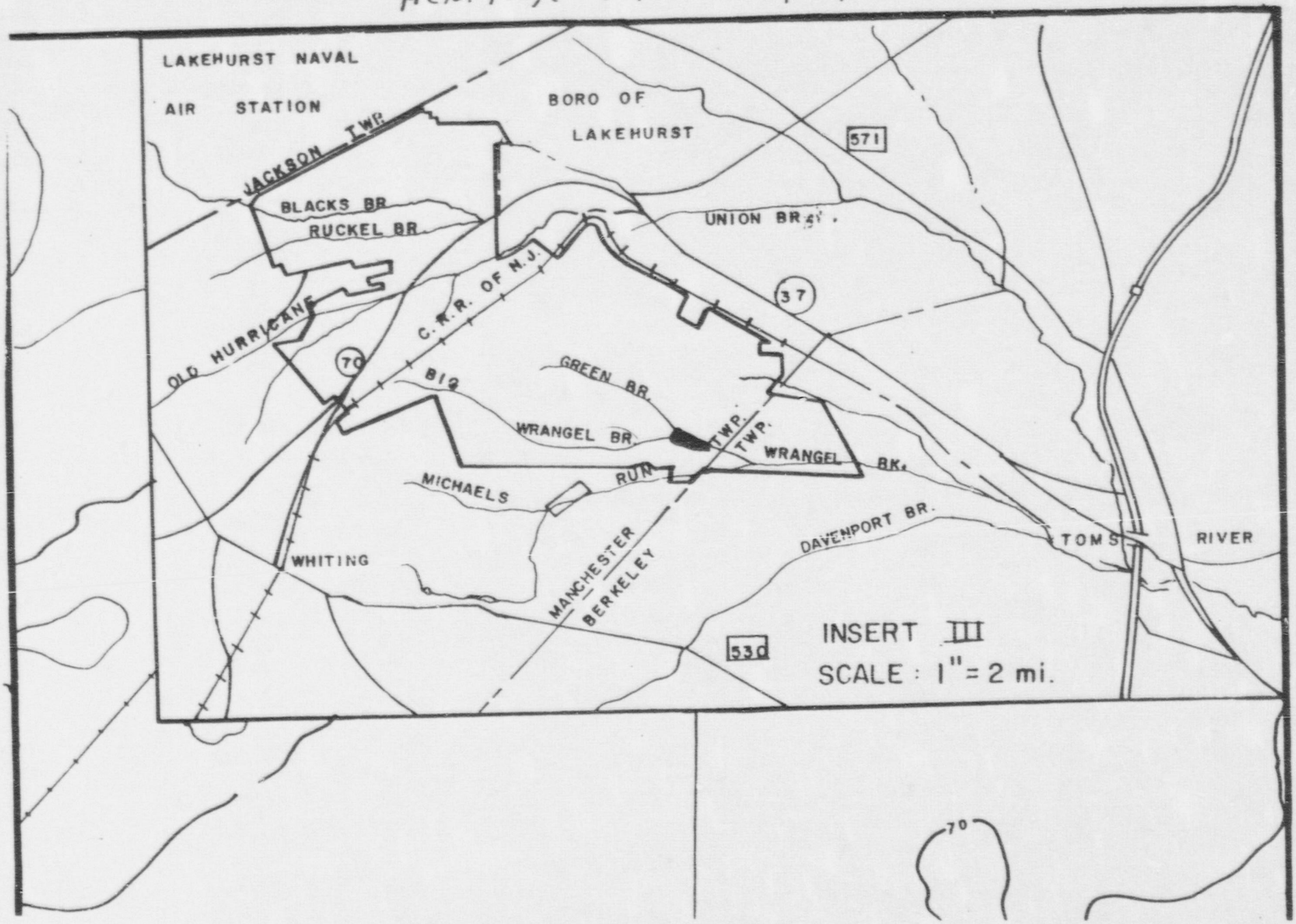
The Plant Manager showed the inspectors a memorandum of a meeting in August 1986 between the then Plant Manager and a consultant, and a representative of the NRC, at which the NRC representative stated that, since the intermediate process streams were combined with other material before discharge to the tailings pile, the process could be viewed as a "black box," and that an NRC license was not required. The Plant Manager stated that he would cooperate in applying for a license if one was now deemed to be required.

TABLE 1

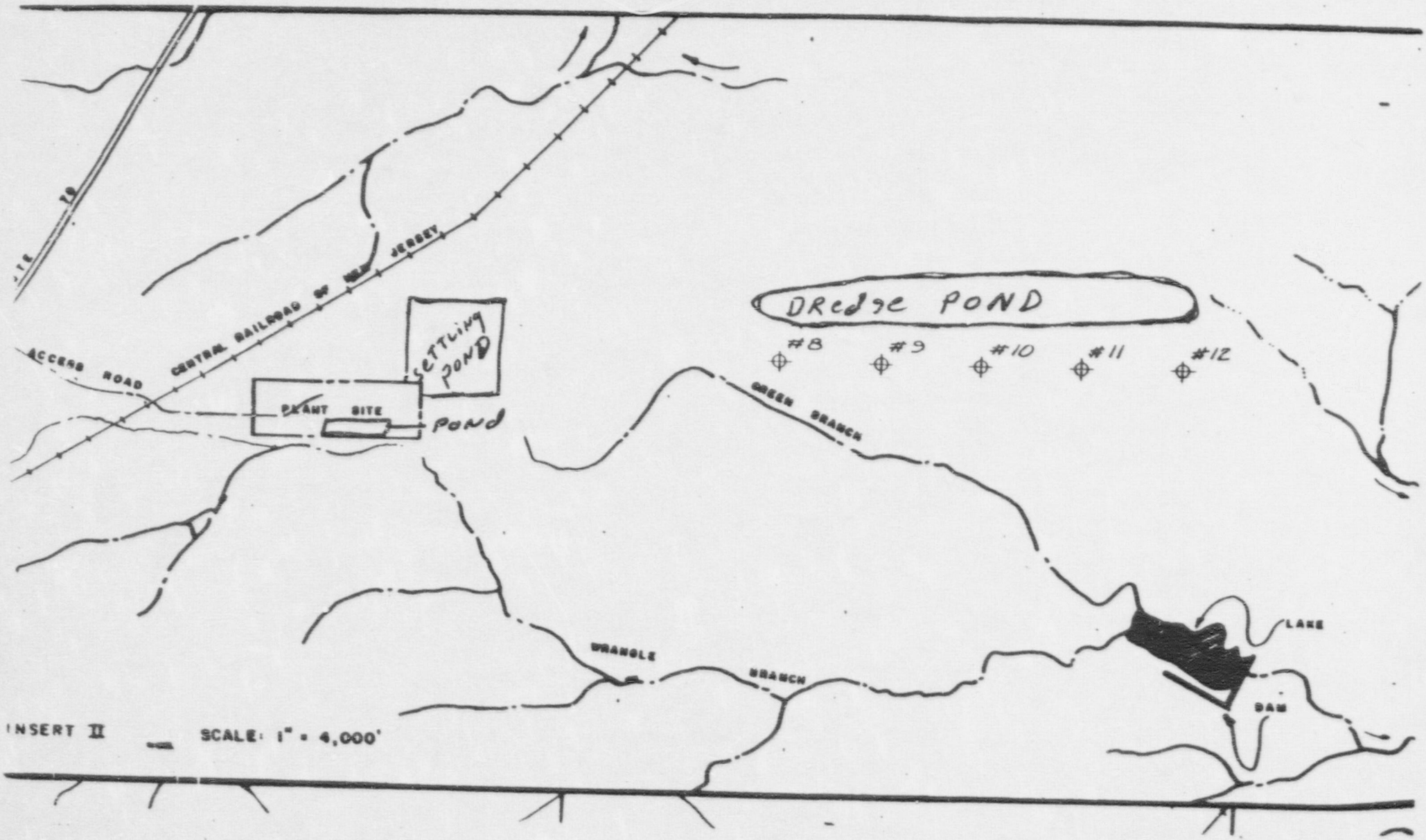
SOURCE MATERIAL CONCENTRATION IN SAMPLES (WET BASIS)

Sample No.	Sample Identity	% Th	% U	% Source Mat.
1	table concentrate	0.048	0.026	0.074
2	new feed	0.009	0.009	0.018
3	combined plant tailings	0.006	0.006	0.012
4	monazite waste	0.539	0.047	0.585
5	zircon product	0.007	0.029	0.035
6	leucoxene product	0.010	0.004	0.014

Heritage mineral property



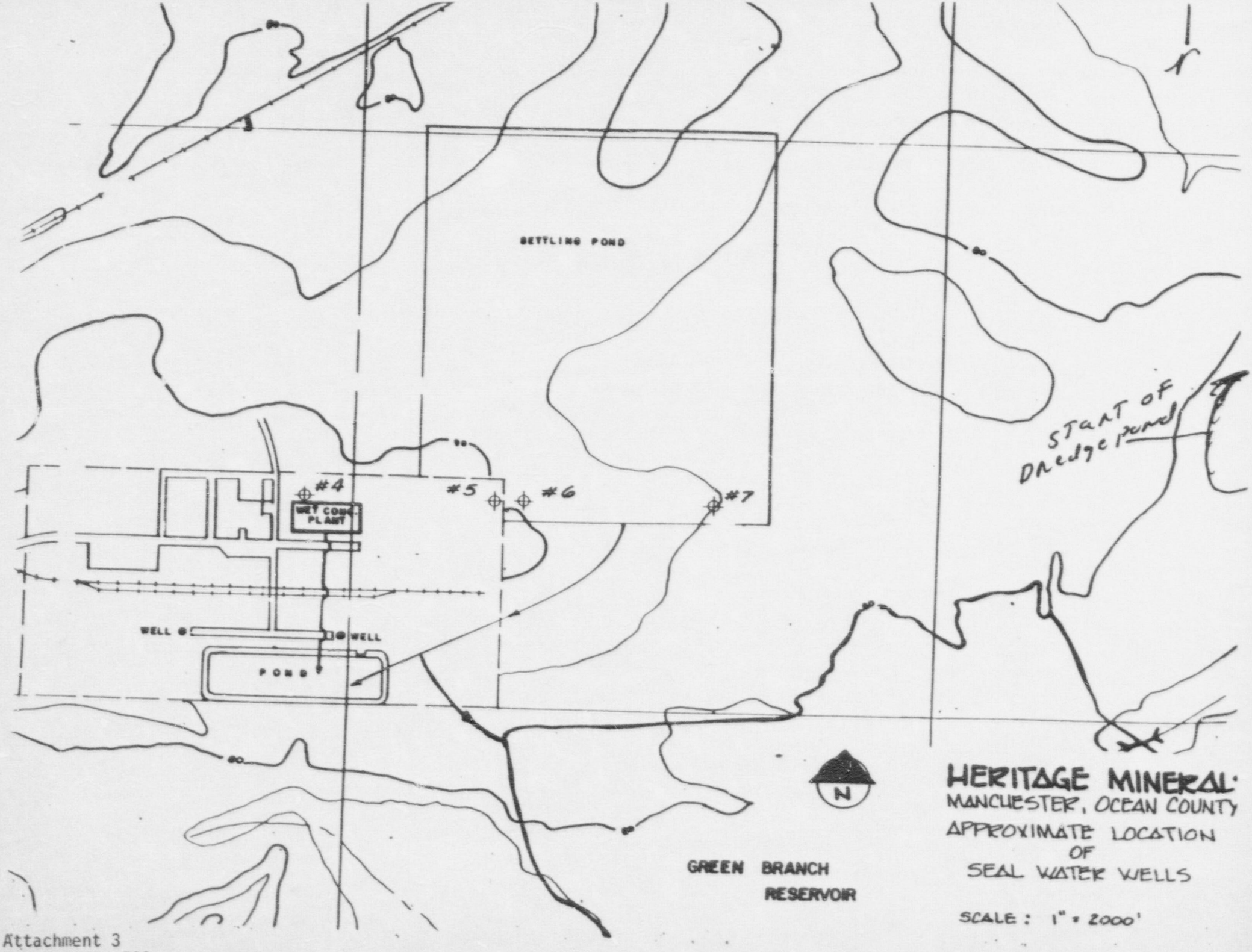
ATTACHMENT 1
99990001/89-001



HERITAGE MINERAL
MANCHESTER, OCEAN COUNTY
APPROXIMATE LOCATION
OF
SEAL WATER WELLS

SCALE: 1" = 2000'

Attachment 2
99990001/89-001



Attachment 3
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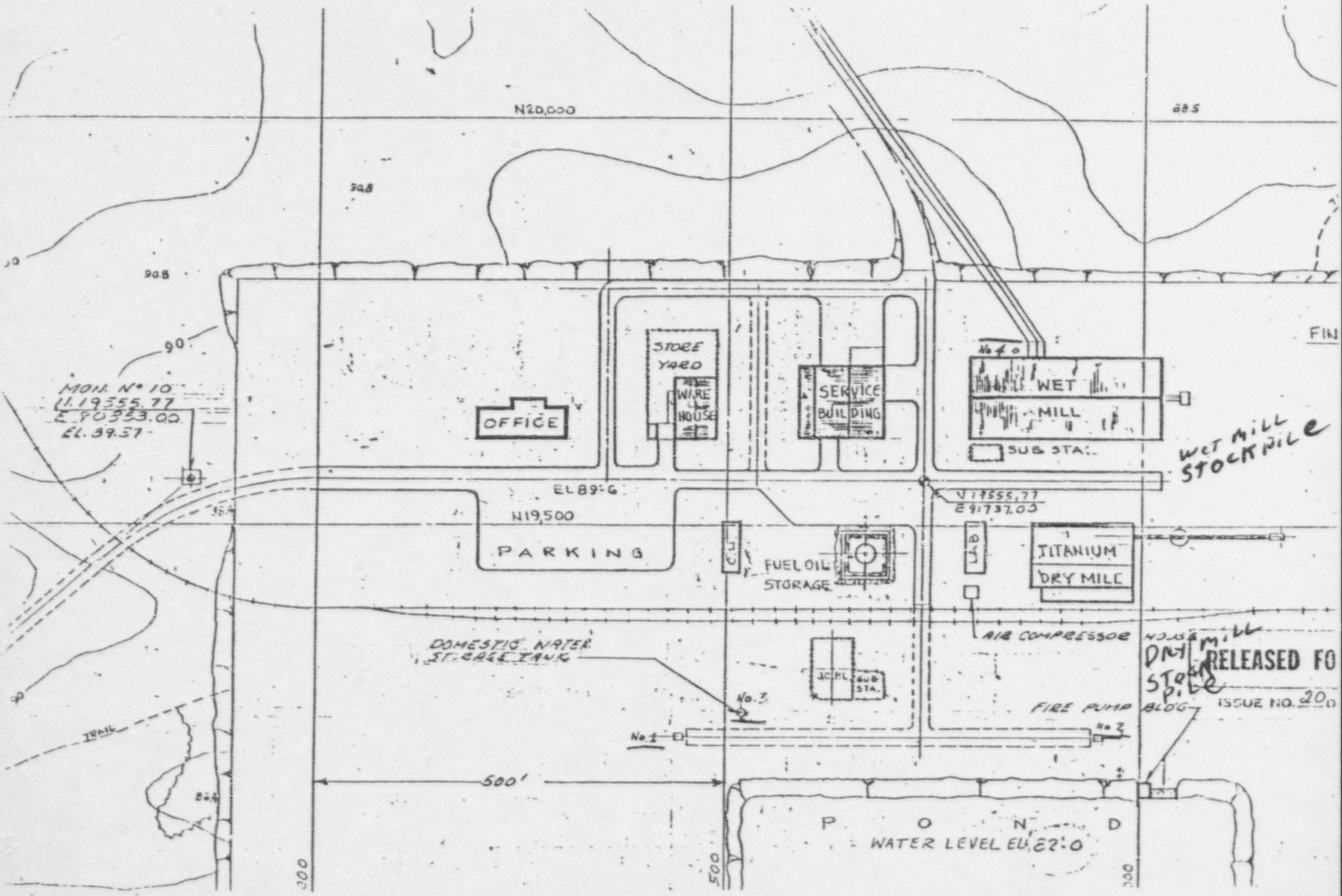


Attachment 4
99990001/89-001

Final Zircon Conc	% Fe_2O_3
Unscrubbed	0.17
10 min scrub	0.066
4 min scrub	0.070

Screen Analyses of Various Products

Screen analyses were made on various products during the course of testing, mainly to determine if certain sized particles were being retained or lost preferentially. These screen analyses are contained in Appendix C-1.

Table 5 gives the screen analyses for the bulk zircon concentrate. Table 6 contains the screen analyses for the three TiO_2 products. As mentioned previously, all of the valuable minerals are in the 60- x 200-mesh size range.

Thorium and Uranium Assays and Distribution throughout the Flowsheet

Radiometric assays on the as-received sand showed 130 ppm ThO_2 and 55 ppm U_3O_8. Radiometric analyses throughout the flowsheet are summarized in Table 7. The thorium and uranium are enriched in the induced roll magnetic product from the table concentrate which is where the monazite concentrates. This product assays 20791 ppm ThO_2 (approx 2.08% ThO_2), and 1120 ppm U_3O_8.

The spiral plant tailings assay 0.7 ppm ThO_2 and 3 ppm U_3O_8. If the monazite-rich products are added to these tailings, the calculated assays increase to around 140 ppm ThO_2 and 11 ppm U_3O_8.

Rare Earth Content of Monazite-rich Product

The total rare earth plus thorium and P_2O_5 content of the monazite-rich product (induced roll magnetic from table concentrate) was determined by wet chemical methods.

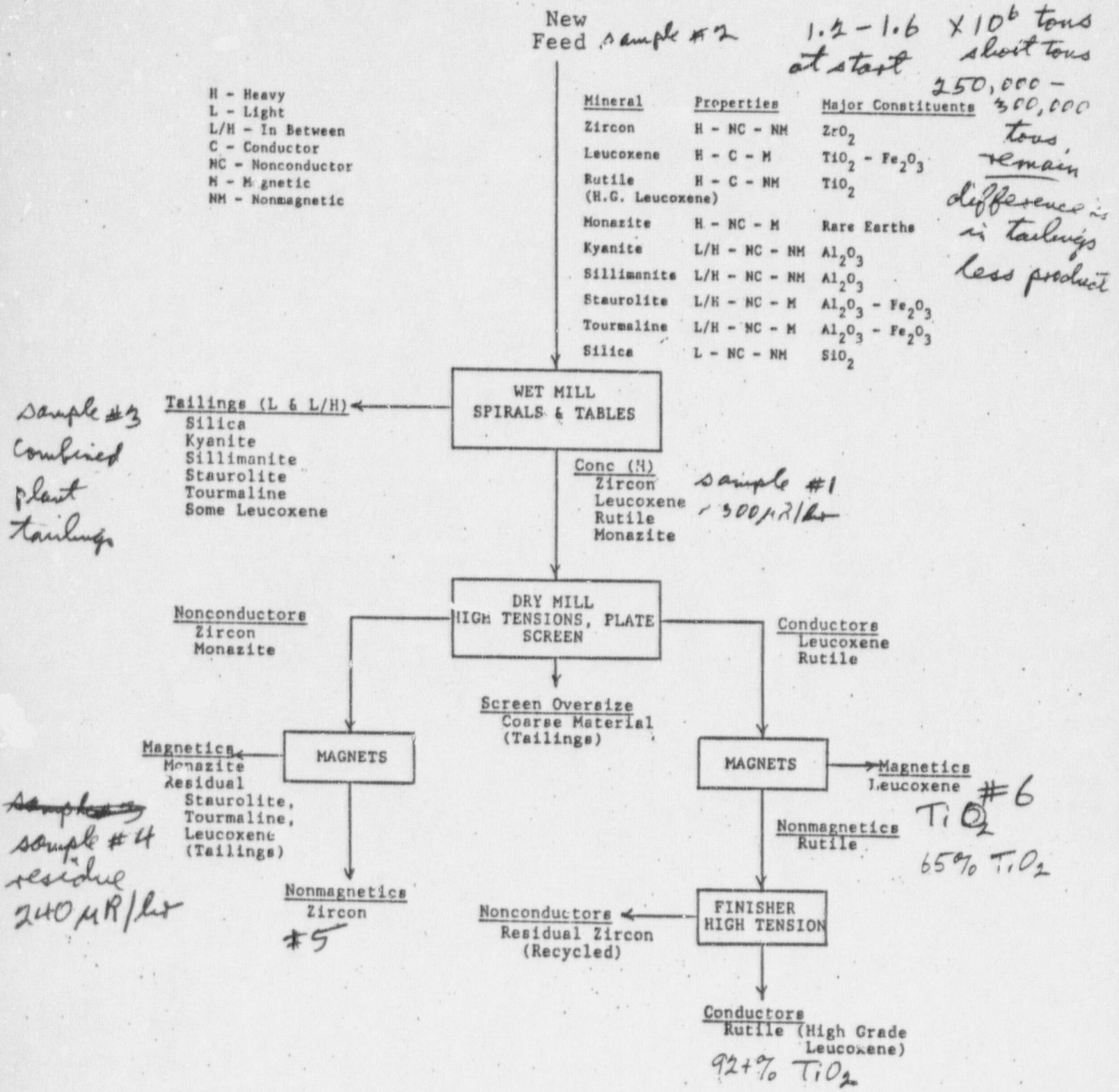
Table 7

U_3O_8 and ThO_2 Distribution in Current Flowsheet

	ThO_2			U_3O_8	
	Wt %	ppm	Distr %	ppm	Distr %
Feed to spiral plant (calc)	(100.00)	(130)	(100.0)	(55)	(100.0)
Spiral plant tail (calc)	(67.93)	(0.7)	(0.4)	(3)	(4.1)
Scavenger tail	59.8	0.5	0.2	3	3.5
Recleaner scavenger tail -65 mesh	8.13	3	0.2	4	0.6
Spiral plant concentrate	(32.07)	(407)	(99.6)	(152)	(95.9)
TiO_2 conc (calc)	(6.26)	(55)	(2.8)	(27)	(3.3)
Lower TiO_2	4.36	52	1.8	25	2.1
70% TiO_2	1.06	78	0.6	30	0.6
+90% TiO_2	0.84	55	0.4	30	0.6
TiO_2 plant tailing (calc)	(25.16)	(500)	(96.6)	(188)	(92.5)
Table conc (calc)	(10.88)	(965)	(85.8)	(300)	(64.1)
Mag	0.46	20791	73.3	1120	10.2
Nonmag (zircon)	10.42	156	12.5	264	53.9
Table mid	7.73	163	9.7	178	27.0
Table tail	6.55	23	1.1	11	1.4
Miscellaneous mids	0.65	NA	-	NA	-

1/ Based on data from Deister Co. Test and Flowsheet D-4 through D-6.

Attachment 6
99990001/89-001



MINERALOGICAL FLOWSHEET

February 26, 88

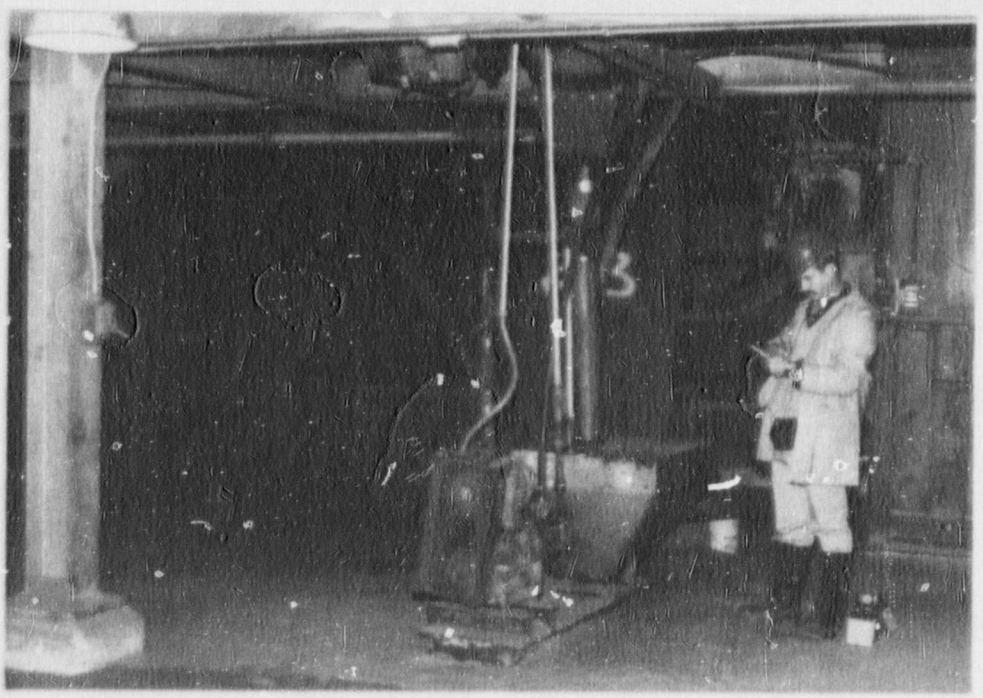
over last 2 years 50,000 - 60,000 tons product shipped.

Two views of plant from entrance road

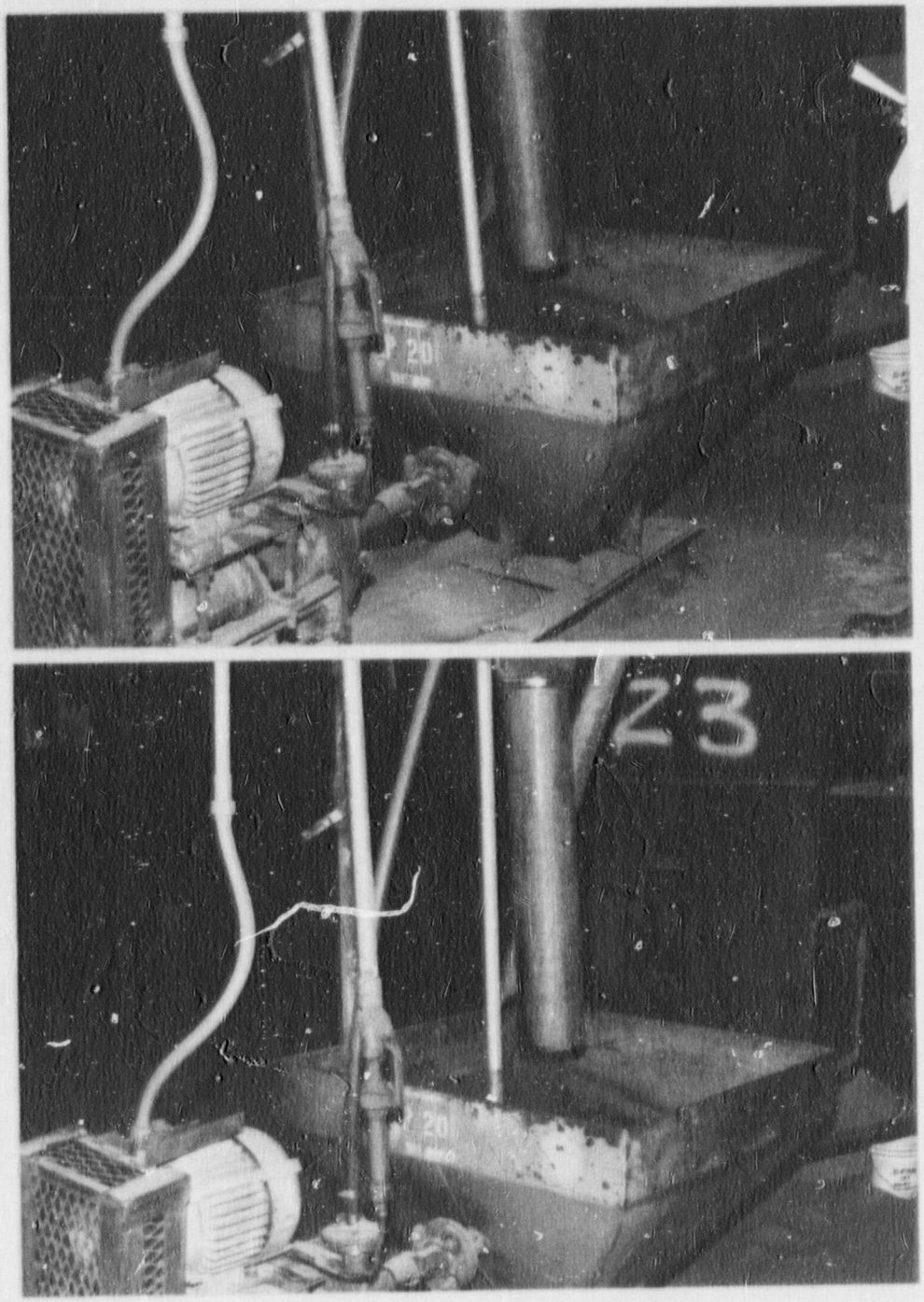
From wet mill, looking East to dryer and dry mill
(location of sample #1)

Combined plant tailings concentrate
From wet mill, looking NE

Looking SE towards New Feed pile
Settling pond contains process water which is recirculated



Sampling point for Monazite Waste
(Sample #4)



Sampling point for Monazite Waste
(Sample #4)