for Tomchuk

Summary Report on Lock 4 Dredging Monitoring

by

T. J. Tofflemire

February 1979

NEW YORK STATE
DEPARTMENT OF ENVIRONMENTAL CONSERVATION

SAN-P21 (4/79)

11.0721

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Bureau of Water Research
New York State Department of Environmental Conservation
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11.0722

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SUMMARY OF LOCK 4 DREDGING OBSERVATIONS*

Introduction

Hydraulic dredging was conducted by New York State Department of Transportation (DOT) below Lock 4 near Stillwater from August 31 through September 13 and September 27 through October 11, 1977. Figures 1 and 2 provide aerial photographs of the area. The dredging was south of Lock 4 and, for the most part, north of the junction with the Hoosic River. DOT generally dredged five days per week on two eight-hour shifts (8-4 PM and 4-12 PM). The dredged slurry was pumped to the upland spoil area on the southwest of the Lock 4 as indicated in Figure 3. The dredging was monitored daily by New York State Department of Environmental Conservation (DEC) staff (Dr. Tofflemire, Mr. Murdock and Mr. Rafferty). Two types of studies were involved and discussed. The first dealt with monitoring the spoils lagoon and return flow, and improvement of these operations by feeding polymer or increasing retention time. The second study dealt with in-river monitoring of losses at the hydraulic dredge head and near a derric boat (1/3 yd^3 clamshell) used on a trial basis.

Methods

The detailed observations are contained in memos dated 8/22, 9/13, 9/16, 10/5 and 10/18, 1977. Turbidity was measured by a Hach Laboratory Kit (nephlometer).# Suspended solids and volatile suspended solids were determined by filtering known volumes of effluent through Gelman glass fiber filters and then weighing the filters after drying 100°C or ashing at 500°C. The filters remove particles above .4 μm. A hydrometer calibrated in .001 specific gravity units was used to make approximate measurements of the influent percent solids. An 80 pound bag of road salt ($CaCl_2$) and styrofoam chips were periodically dumped at the influent pipe and conductivity measured at various points with time with a Beckman model MG conductivity meter. Many aerial and ground photographs were taken. Transit surveys of the site were made to obtain distances and elevations. A cationic polymer, Calgon Cat Floc B, was fed by two different modes at different times. A cole palmer masterflex feed pump was used when feeding polymer on the dredge. The polymer received roughly a 10 to 1 tap water dilution and then mixed with the dredged slurry in the suction pipe leading to the dredge pump. A gravity diffuser and valve was used when polymer was fed at box 1. The diffuser was a 3/4" diameter hose with many small holes punctured in it. In both cases the polymer was fed from 50 gallon drums. Water samples for PCB were taken in 2 liter hexane washed glass bottles and delivered to O'Brien and Gere in Syracuse for analysis.

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* T.J. Tofflemire, February 1979. # Measures Formazin Turbidity Units, FTU.

Very turbid water samples were filtered and PCB reported on both the filtrated and particulate fractions. Aroclors 1016, 1221 and 1254 were always measured. In this report these three aroclors were totalized and generally only the totals are discussed.

In the dredge head loss study, Mr. Reed and Mr. Thomas of Malcolm Pirnie and Mr. Forester of DEC were also involved. A Beckman transmissometer was used to measure light transmittance under water. A 3/8" diameter cooper sampling pipe was terminating 2 feet behind the dredge head and also used as noted in Figure 4.

Water samples were also taken from the river at various depths and at various distances above and below the dredges by a copper pipe attached to a vacuum flask. Some of the boats and equipment are shown in Figure 5. The samples were analyzed for suspended solids, turbidity and PCB. At three transects across the Lock 4 river section, the depths, widths and velocities were measured. The flow in the Lock 4 river section could be controlled by opening Lock 4 valves a desired amount. With the valves shut, the velocity in the canal section was almost zero.

Spoils Lagoon and Return Flow Study

Figure 6 is a section of the Normandeau map Lock 4 canal section. As one travels south from Lock 4, in the canal section of the river, he encounters the spoil site and Hoosic river entrance (.4 miles). Bottom sounding surveys (DOT sweep reports) in the spring of 1977 indicated that there was 15,000 cubic yards of sediment to be dredged in this river section and that it was deepest on the west side of the channel. The DOT dredge and pipeline can be seen in Figure 2. Transit surveys of the spoils lagoon were made before and after dredging, as noted in Figure 3. The large southern area of the lagoon is over 30 feet above river level, while the long narrow lagoon section at the north is only 16 feet above river level. It is very unlikely the site will ever be flooded because a river stage increase of more than 10 feet is extremely unlikely. The bottom of the lagoon appeared to be fractured shale, but sand from previous dredging was present over much of the site. The long narrow lagoon section contained small trees, brush and tall weeds which proved effective in dispersing the flow.

Table 1 gives daily dredge delay times and summarized turbidity values at spillway Box 0, Box 1 and Box 2. Box 0 was not installed and used until 9/26. During start ups after long shut downs, most of the flow seeped into the lagoon bottom. Over the entire project it is estimated that about 1/2 of the total flow pumped went to seepage. Small seepage springs to the river were sampled several times and had turbidities of less than 20 JTU. Boards ten inches high were added to the boxes at various times to maintain retention times as the lagoon filled up with sediment. Typically the retention time to the center of the salt peak was 25 minutes in the basins above B1 and 30 minutes in the basin below. On 9/9 and 9/13 the retention time became very short above B1 and some flushing of fine sediment over B1 was noted upon dredge start up. On several evenings the center baffle dike broke through. This shortened the retention time above Box 1 to two to eight minutes. The next morning this was repaired by DOT, however. On 9/14 DOT was asked to shut down to improve the retention in the lagoon system. By 9/26 the lagoon was dug out and new Box 0 installed. This digging again boosted the seepage rate in the bottom of the lagoon above Box 0.

For several different times polymer was fed on the dredge. This generally cut the turbidity in half at B1. When polymer was fed at B1 through a gravity diffuser, the turbidity was dramatically reduced from 500 to less than 20 JTU at B2. The brush in the long narrow channel seemed to aid the flocculation and settling process. The cationic polymer, Calgon Cat Floc B, was fed at approximately 20 mg/l. The gravity feed system was difficult to maintain, and in the future a positive pumping system is recommended.

An oil boom was placed across the pool above B1 and also across B0 to trap the scum which at previous dredging sites had been shown to be very high in PCB. On several occasions the scum was pulled to the side of the basin 1 and shoveled into a small land depression. For future systems, a gravity scum draw off pipe and collection pit is recommended.

Based on hydrometer readings, the influent percent solids was typically 3 percent although it varied drastically with swings across the river and with the dredge operator. On the average, the dredge was off about 7 1/2 hours out of the 16 hour day and this left 8 1/2 hours of pumping time. Pumping at 20 cfs for 18 to 19 days at 3 percent solids would yield about 10,000 cubic yards of sediment which is less than the original DOT sweep report amount of 15,000 dubic yards and the final DOT sweep report amount of about 24,000 cubic yards removed. A problem occurred in the final transit survey; and at this point, the correct yardage in the site is not known.

Table 2 provides a summary of the sediment analyses. Although there was considerable variation in the percent silt plus clay, it typically ranged from 20 to 30 percent. The sediment PCB was typically 20 ppm. The sediment in the first basin contains sand and some wood chips while the second basin has a much more silty sediment. The metals data are given in Table 3. Relative to other dredging sites on the upper Hudson, the metals appear low and below return water standards.

Table 4 gives the return flow and river water suspended solids and volatile suspended solids values. Each individual filter was not tarred although representative ones were. There was typically a variation of 1.5 mg in the filter weight, while the solids weight was usually 30 mg before filter clogging. This procedure resulted in some loss of accuracy. For later projects, the filters were tarred and stored. Volatile suspended solids weights were more precise since each filter, with solids dried at 100°C, represented a tare weight. The volatile suspended solids were typically 15 percent of the total solids. Figure 7 indicated that there was a fairly direct relationship between turbidity and suspended solids for the Lock 4 water samples.

Table 5 gives the water sample PCB data. Type II samples were separated into a water fraction and a solids fraction for analysis, while Type I samples were analyzed as water only. The samples with the dredge head or derric boat ID will be discussed later and dealt with the river monitoring study. The samples with the Box ID were of the spoils area return flow. Calculations were made relating turbidity, suspended solids and PCB. The following data summary was made from these samples.

Parameter	Lagoon Influent	Box 1 Effluent	Box 2 Effluent
% solids	3	<.02	---
PCB on solids µg/g	20	4-15	---
PCB:			
No polymer - µg/l	600	3.0	3.0
With polymer - µg/l	600	<1.5	<1.5
Suspended solids:			
No polymer - mg/l	30,000	500+	450
With polymer - mg/l	30,000	220	200, <20*

* The <20 values occurred with the polymer feed at Box 1, as opposed to on the dredge.

In this section the following measurement tasks were performed and will be discussed in order:

A. Measurement of river cross sections and velocities and sampling of sediments.

B. Water sampling at the hydraulic dredge head.

C. River water sampling above and below the hydraulic dredge and the derrick boat (clamshell dredge).

D. Monitoring of the scow dump.

On and before 9/28 and 9/29 the hydraulic dredge was dredging in a northerly direction, opposite the shale flats south of transect B. The sampling was done primarily while standing at various locations on the dredge. On 9/30 the hydraulic dredge was turned around so that is was facing south (down current near transect C). During this period, sampling was done from boats both upstream and downstream of the dredge while the sampling pipe attached to the dredge head was not used. Later on 9/30, the hydraulic dredge was shut off and the derrick boat brought along side, facing south, where it was monitored while dredging. Here, the thought was to try to compare the derrick boat to the previously monitored hydraulic dredge where all variables were equal (dredge position, type of sediment, river cross section, etc.). After this monitoring was completed, the scow which had been receiving the clamshell bites was turned crosswise in the river and dumped. This dump was also monitored. Fortunately, there was not much identifiable spoils lagoon return flow during the 9/28 to 9/30 period because most of the return flow seeped into the ground.

<u>River Cross Sections, and Sediment Sampling</u>

Figure 8 shows the three river cross sections measured to a vertical accuracy of .1 ft and a horizontal accuracy of 1 ft. The location of the cross sections and of the in river sediment samples is noted in Figures 6 & 9. Sieve analyses for the sediment samples are listed in Table 6.

TABLE 6. SUMMARY SIEVE ANALYSES

Sample Description	% finer than			
	2 mm	1 mm	.5 mm	.074 mm
9/28 Inf. 4462	89.2	82.3	55.5	1.3
10/4 Inf.	89.4	73.7	43.7	2.6
9/6 Inf. 4450	93.0	84.0	55.0	19.0

Sample Description	25 mm	2 mm	.83 mm	.42 mm	.25 mm	.074 mm	Sp Gr.
9/11 2nd Basin, B2	100	80.9	69.2	54.5	49.6	40.9	2.58
9/29 River 4460	100	93.6	92.5	90.4	84.6	52.2	2.64
9/29 River 4461	100	99.8	99.4	98.0	94.0	81.3	2.26
9/30 River 4471	100	99.9	99.8	99.4	98.1	73.6	2.48
9/20 1st Basin, B1	100	90.8	77.6	61.3	55.8	47.1	2.47

During the dredging period, the pool below Lock 4 was typically at DOT elevation 70.8 (USGS 69.6), while the pool above was about 16 feet higher. The Lock water conduits between the pools are 6 feet by 4 feet and have a total cross sectional area of 24 x 2 ft^2. The formula $V = \sqrt{2gh}$ gives a total possible flow of 1530 cfs. Considering head losses and restrictions due to only partially opening the valves, a lower flow of about 1000 cfs is estimated for the study periods. Based on velocity measurements across transects A and B a flow of about 1000 cfs was also obtained during the study.

Water Sampling at the Hydraulic Dredge Head

Figure 10 gives the turbidity values collected primarily by the dredge head sampling pipe. Samples collected on the right side of the dredge (points B & C) are sometimes higher in turbidity since the engine cooling water return flow affects them. The average or composite dredge head turbidities on the four dates were as follows: 9/8, 120; 9/14, 114; 9/28, 70; and 9/29, 85. On 9/28 and 29 the dredge was cutting a thin layer of sand while on the earlier dates the dredge was probably taking a bigger cut of silt and sand. The earlier dates were probably more representative of the Lock 4 dredging. The two dredge head PCB samples (DEC 4458 and 4454) given in Table 5 and Figure 10 had an average PCB of 20 μg/l and turbidity of 78 FTU while the background values averaged .5 μg/l and 10 FTU respectively. From the earlier tests the turbidity averaged 117 FTU. The corresponding suspended solids value from Figure 7 was 120 mg/l. From other 9/29 flow background water tests by DOT and DEC, the suspended solids appears slightly higher than 10 mg/l and the PCB lower than .5 μg/l.

Figure 11 summarizes the dredge head sampling estimates. The loss of PCB and suspended solids were calculated to be less than 0.2 percent of the solids pumped by the dredge.

River Water Sampling Above and Below the Hydraulic Dredge and the Derrick Boat

Calibration data for the transmissometer is given in the top of Figure 12. The percent transmittance decreased with increased depth (reduced light) or with increased turbidity. There was considerable scatter in the percent transmittance versus suspended solids plot. The plots on the lower half of the figure gave the averages of the transmissometer readings for various water depths. The 9/28 readings were taken off the four corners of the hydraulic dredge when it was facing upstream. The 9/30 readings were taken 50-200 feet downstream of the dredges in a small boat. There is some concern about the transmissometer calibration changing from day to day. It is suggested that the 9/28 hydraulic dredging data be compared with the calibration curve above. The two 9/30 dredges (hydraulic versus clamshell) can be compared with each other. The derrick boat (clamshell) appeared to lower transmittance values and give more turbidity disturbance than the hydraulic dredge in a side by side comparison with all other conditions equal.

From the water samples collected 50-100 feet downstream of the hydraulic dredge or derrick boat on 9/30, the following analyses were obtained as given in Table 5.

Sample 9/30			Turb.	Susp. Solids	PCB μg/l			
No.	Dredge	Depth	FTU	mg/l	1016	1221	1254	Total
4466	Hyd.	5	35	36	.20	<.01	<.03	.24
4463	Hyd.	14	40	59	.52	<.02	<.04	.58
4464	Hyd.	14	40	59	.40	<.25	<.25	<.90-.58*
	Ave.		38.3	51.3	.37			.467
4468	Clam	1	26	66	.30	<.03	<.04	.37
4467	Clam	14	40	62	.35	<.25	<.25	<.85-.58*
4469	Clam	14	30	42	.10	<.02	.2	.32
	Ave.		32	56.7	.25			.423

* Note: Preferred value used in average.

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From the water analyses, it was difficult to tell any significant difference in loss of solids or PCB between the two types of dredges. Fine sand grains were observed in the bottom of the 2 ℓ glass water bottles. The clamshell water samples seemed to have more sand grains from a visual comparison than the hydraulic water samples. Additional comments and figures on the river monitoring by John Reed are given in the appendix.

Monitoring of the Scow Dump 9/30

The following measurements were taken within 50 feet downstream of the scow immediately after it wet dumped the sediment dredged by the derrick boat:

Depth-ft.	1	3	5	7	10	12	14
% Trans.	49	25	15	9	24	19	15

Water Sample:	Turb.	Susp. Solids	PCB-μg/1			
			1016	1221	1254	Total
DEC 4470 at 0-1 feet	30	---	3.4	<.25	2.9	6.55

The 1 to 7 foot transmissometer readings were definitely lower than the dredge monitoring averages. After the scow dump, considerable scum was observed to come to the surface. A 0-1 foot water sample of this gave a significantly higher PCB value than any other water sample in the entire Lock 4 study.

Summary and Conclusions

1. A considerable portion of the dredging water pumped seeped into the ground and the seepage return water, where it could be observed, was always clear.

2. The long, narrow channel (Box 1 to Box 2) with brush, proved very effective in clarifying the water when polymer (approximately 20 mg/l Cat Floc B) was fed. Turbidity reductions from over 500 at Box 1 to less than 10 at Box 2 were achieved. The long, narrow channel was only moderately effective when no polymer was fed. However, the gravity polymer feed system required daily maintenance and cleaning, which was difficult.

3. Feeding polymer on the dredge reduced the turbidity at Box 1 from over 500 to less than 220.

4. The importance of maintaining at least 1 hour detention time in the lagoon and using an oil boom to trap the scum was again noted. In the future, a controlled scum removal system should be designed into the lagoon system. For future systems, a two storage lagoon system with polymer feed in between is recommended.

5. Based on transmissometer and turbidity readings the clamshell appeared to suspend more turbidity than the hydraulic dredge head.

6. The difficulty of detecting a measurable increase in turbidity suspended solids or PCB in the river downstream of a dredging operation was again noted. The suspended turbidity so quicly disperses or settles, so that very sensitive instruments and hundreds of measurements are often needed to detect a significant increase above background concentrations.

7. Wet dumping of Hudson River sediment at Lock 4 caused a scum to come to the surface which was high in PCB, as occurred for the wet dumping near Rogers Island in 1977.

TABLE 1. LOCK 4 SPOIL SITE OCCURRENCES

Date	Shut Down Time Hrs:Min Shift 1	Shift 2	Total	Retention B0 & 1	B2	Turbidity-JTU B1	B2	Comments
	N*	D*						
9/1	2:10	2:40	4:50	40 min		1000		2-3% solids#
	D	N						
9/6	2:00	2:20	4:20	17-20	30-50	700	600	Boards added to B1, 2
9/7	1:40	:50	2:30	17		700-1200	500	2% solids Seepage = 5 cfs B1; 4cfs B2
9/8	2:20	1:20	3:40		32	440	300-400	2-3% solids, new board B1
	N	D				200+		Poly 5-7 PM
9/9	3:00	1:40	4:40	15		1000	500	Baffle bike broke
9/12	2:20	3:10	5:30			800	400	New board at B1
						400	200	Poly 6 PM - 12 PM
9/13	2:00	1:50	3:50			850	500	AM no poly
				10-12		200-425	200-100	Poly PM, dike broke
9/14	1:00	2:20	3:20			1000	500	5-7% solids
						500	220	Poly PM
	N	D						
9/26	1:30	1:50	3:20					
								9/26, 27 all water to infiltration in B0, 1
9/27	1:10	1:50	3:30					
9/28	1:40	1:40	3:20			500-1000	500-200	Box 1 flow started at 4 PM; .5% solids
9/29	1:20	3:18	4:40			600	500-400	Box 2 flow began at noon
30	2:00	2:10	4:10	35	25	800-900	500-600	Seepage=B2, 3 cfs; B1, 4 cfs
	D	N						
10/3	1:50	1:40	3:30					No Box 2 flow until 4 PM
						800	500	
10/4	1:50	1:15	3:05					Little Box 2 flow, most to infiltration
10/5	1:50	1:05	2:55			700-500	450	
							75	Poly Box 1
10/6	1:50	1:55	3:45			600	10-20	Poly Box 1
10/7	2:00	1:45	3:45			500-300	10-20	Poly Box 1
	N	P						
10/11	2:10	2:00	4:10	25	22		20-40	Poly Box 1
Typical flow weighted value			3:40	25	30	700	460	No poly, 3% solids
						350	230	With poly on dredge
							20	With poly at Box 1

* N = Night 4 PM - 12 midnight
D = Day 8 AM - 4 PM

\# % solids always refers to influent

TABLE 2

SUMMARY SEDIMENT DATA LOCK 4

Sample I.D.	DEC No.	%S+C	% Vol. Solids	Texture Code	PCB - µg/g 1016	1221	1254	Total
May 1977 DOT comp. of 4-5 samples	12775	33	3.4	1,7	9	16.6	.84	26.4
4-128-G1, NAI, No.	4-135-1*	1.1	1.5	8	22	<1	9.3	<32.3
4-128-G2, NAI, So.	4-135-2*	24	69.7	8,1	<1	<1	<1	<3
4-128-C2, 0-2"	-	-	2.6	8	2.6	.2	<.5	<3.3
(NAI core) 2-7"	412832	-	2.4	8	3.6	10.0	.35	14.
7-9"		-	3.6	6,2	52	.39	36.	88.4
4-128-C1 0-1"		-	3.3	6	<1.4	<1.4	<1.4	<5.2
(So of Hoosic) 1-5.5"	412831	-	1.9	8	<1	<1	<1	<3
(NAI Core) 5.5-7.5		-	4.4	2,0	<1	<1	<1	<3
7.5-9.0		-	2.9	6,2	<1	<1	<1	<3
9.0-10.5		-	2.6	8	<1	<1	<1	<3
DEC - 9/6 Influent	4450	19	6.6		21.0	1.6	1.4	24.0
9/11 1st Basin comp.	4445	(20)	9.9	1,7	35	<1	<1	37
9/11 2nd Basin comp.	4444	41	12.8	1	58	<1	7	66
9/15 1st Basin comp.	4455	12.1		7	9.2	<1	<1	<11.2
9/23 Influent	no PCB	2	-	9,7	-	-	-	-
10/4 Influent	no PCB	3	-	6	-	-	-	-
9/28 Influent	4462	1.3	1.7	8	6.9	<1	<1	<8.9
9/29 No of Hoosic	4460	52	6.1	1,7	6.9	<1	<1	<8.9
9/29 So of Lock 4	4461	81	15.8	1,7	17.	<1.2	<1.	<19.2
9/30 No of Hoosic	4471	74	7.7	1	9.8	<1	<1	<11.8

* Sample No. for 1 and 2 for PCB may be confused

( ) estimated

TABLE 3

LOCK 4 DREDGING METALS DATA - WATER: mg/l, SEDIMENT µg/g

DEC NO.	I.D., LOCATION	Pb	Fe	Cr	Cd	Zn	Na	Ca
4441	9/1 2 PM Box 2	.4	5.9	.1	.02	.29		
	9/7 Seepage, G. W.						3.7	110
4448	9/13 3 PM Box 1	.3	4.4	<.1	.02	.22		
4449*	9/13 5:10 PM Box 1	.1	1.1	<.1	<.02	.05		
	9/30 5 PM Box 2	<.1	.56	<.1	<.02	.05		
*	10/6 7 PM Box 2	<.1	.1	<.1	<.02	.05		
	9/11 Sediment	29	16,000	20	<.9	110		
	10/6 Sediment	65	8,900	49	4.	140		
	Ave. of 5 river water samples by DOT			<.01		.03		
	DOT Samples 9/12 Return Flow			<.01		.09		
	9/13 Return Flow			<.01		.09		
	9/15 Return Flow			<.01		.45		

*With Polymer

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TABLE 4
S.S. & V.S.S. Samples
Lock 4 Dredging Samples

1977

DATE	TIME	ml FILTERED	BOX	ID	TURBIDITY	V.S.S. mg/l	Susp. Solids mg/l	% Vol.
9/1	3 PM	100	2	DEC 4441	770	92	1025*	9
9/8 #	6:30 PM	100	1	DEC 4442	220	61	499*	12
9/7	4 PM	100	2		550	48	355*	13.5
9/8	8:25	100	1		220	31	247*	12.5
9/8	1930	100	1		440	38	284*	13.3
9/8	1900	100	2		250	46	334*	14
9/13#	1710	200	1	DEC 4449	120-145	19.5	112*	17.4
9/13#	7 PM	300	2		90	11	88*	12.5
9/14#	5:17 PM	270	2		200	15	142*	10.5
9/12		100 ml	1	DOT 1-2.77A		50	606	8
9/13		100 ml	1	DOT Comp. 1-2.77B		56	464*	12
9/13	2:15 PM	100 ml	1	DEC 4448	800	46	595*	7.8
9/29		200 ml		DEC 4454 Dredge Head Comp.	85	23	156	15
9/30		500 ml		DEC 4466 D.H. 4	35	5.8	36	16
9/30		500 ml		DEC 4468 D.H. 7	26	6.0	66	9
9/30	4:50 PM	95 ml	2		740	59	659	9
9/30		300 ml		DEC 4469 D.H. 7	30	8.0	42	19
9/30		500 ml		DEC 4463 D.H. 2	40	9.8	59	17

TA[illegible] 4 (cont.)
S.S. & V.S.S. Samples
Lock 4 Dredging Samples

1977

DATE	TIME	ml FILTERED	BOX	ID	TURBIDITY	V.S.S. mg/l	Susp. Solids mg/l	% Vol.
9/30		500 ml		DEC 4464 D.H. 1	40	6.8	59	12
9/29	7 PM	100 ml	2	DEC 4459	550	51	426	12
9/29	7 PM	100 ml	1		660	58	684	8
9/28	7 PM	150 ml	2		170	13	188	7
9/29		1000 ml		MP 3		2.2	12.2	2
9/29		500 ml		10' Deep, Left DEC 4457 Side of Dredge	5	1.2	1.8	67
9/30		500 ml		DEC 4465 D.H. 5	35	6.2	50	12
9/30	7 PM	100	2	#4		51	426	12
9/30		500		DEC 4467 D.H. 6	40	6.0	62	10
10/5#	1600	400	2	Poly at Box 1	40	6.3	41*	15.3
10/6#	11:30 AM	400	2	With Poly		12	110*	11
10/6#	7 PM	450	2		7.5	0.22	2.0	11
10/6	1430	150	2		5	11	62*	18
10/7	3:30	250	1		17.5	15	207	2
10/7#	7 PM	1800	2	DEC 4476	12-38	4.0		
10/5#	1700	325	2	DEC 4473 With Poly	5	4.0	5.0*	80
10/11#	1530	425	2		10	0.94	10.8	9
10/7#	3:45 PM	425	2	DEC 4477	5	1.6	6.1	26

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TABLE 4 (cont.)
S.S. & V.S.S. Samples
Lock 4 Dredging Samples

1977

DATE	TIME	ml FILTERED	BOX	ID	TURBIDITY	V.S.S. mg/l	Susp. Solids mg/l	% Vol.
10/5		100	1	DOT Comp. 1-2-77H Before Poly		46	376	12
9/14		100	1	1200 JTU		77	614	12.5
9/14	1-2-77C	100	1	DEC 4472 700 JTU DOT Comp.	700	81	692	40
10/5#	1900	480	2	DEC 75356		3.5	1.5-3.5	

*Blank filter weights averaged .120 gm; while for unstarred samples, the filter weight averaged .1374 gm. Gelman 47 mm glass fiber filters were used, and the average weight loss on ignition at 550° C was .0004 gm.

#Polymer was feed and resulted in lower solids values for these samples.

TABLE 5

SUMMARY OF LOCK DREDGING WATER SAMPLES FOR PCB

TYPE	DEC#	O'BRIEN & GERE	ID	TURB	SS	VOL. SS	TOC	PCB-ppb-water 1016	1221	1254	TOTAL	DOT Tot.
	4441		9/1 Box 2, 2 PM	770		92	30					
II	4442	74608	*9/8 Box 1, 6:30 PM	220	499	69	6.4	.41	<.05	<.05	<1.25#	
II	4446	74820	9/12 Scum			5.8						
II	4448	74821	9/13 Box 1, 2:15 PM	800	595	46	7.8	.05	<.05	<.05	< .84#	
II	4449	74822	*9/13 Box 1, 5 PM	120-145	112	19.5	6.2	.30	<.03	<.03	< 1.20	
II	4472	75096	9/14 DOT 1-2-77C	1200	692	81		1.7	<.10	<.10	< 4.34#	1.65
I	4454	75089	9/29 Dredge Head Composite	85	156	23		1.3	<.1	.3	< 1.70	
I	4456	75087	9/29 Above Dredge Background	5-10				.56	.05	.05	< .66	
I	4457	75088	9/29 Left Side Dredge	5	1.8	1.2		.1	<.1	<.1	< .3	
I	4458	75086	9/28 Dredge Head Composite	70				1.6	<.25	<.45	< 2.30	
II	4459	75091	9/29 Box 2, 7 PM	550	426	51		2.4	<.25	<.25	<4.65#	
I	4463	75165	9/30 Dredge Head Composite-14'	40	59	9.8		.52	<.02	.04	< .58	
I	4464	75083	9/30 Dredge Head Composite-14'	40	59	6.8		.4	<.25	< .25	< .90	
I	4465	75081	9/30 Background Above Dredge	35	50	6.2		<.02	<.02	> .02	< .06	
I	4466	75082	9/30 Dredge Head Composite-5'	35	36	5.8		.2	<.01	< .03	< .24	
I	4467	75084	9/30 Derrick Boat Composite-14'	40	62	6.0	9.0	.35	<.25	< .25	< .85	
I	4468	75086	9/30 Derrick Boat Composite-1'	26	66	6.0		.30	<.03	< .04	< .37	
I	4469	75163	9/30 Derrick Boat Composite-14'	30	42	8.0		.1	<.02	.2	< .32	
I	4470	75092	9/30 Derrick Boat Dump-0'	25-30				3.4	<.25	2.9	< 6.55	

11.0740

TABLE 5 (cont.)
SUMMARY OF LOCK 4 DREDGING WATER SAMPLES FOR PCB

TYPE	DEC#	O'BRIEN & GERE	ID	TURB	SS	VOL. SS	TOC	PCB-ppb 1016	1221	1254	TOTAL	DOT Tot.
I	4473	75353	*10/5 Box 2, 5 PM	5	5	4	16	.42	< .08	< .08	< .58	
II	4475	75356	10/5 Box 1, DOT Composite	(375)	376	46		1.00	<.25	.63	<1.88	.44
I	4476	75354	*10/5 Box 2, 7 PM	12-38	(20)	4		.1	< .02	.07	< .19	1.23
I	4477	75355	*10/7 Box 2, 3:45 PM	5	6.1	1.6	7.4	.5	< .03	< .03	<.56	
I	4478		10/11 Box 2, 3:30 PM	10	10.8	.9		.2	<.02	<.02	<.24	

*Indicates with Polymer addition.
( )Indicates estimated values, or where 2 values appear the (value) is the solids from the PCB separation.
Type II samples contained enough solids, so that the solids fraction had to be analysed separately and listed below. The solids PCB were expressed on a water basis in ug/l and the total in the Table above is the sum of the solids plus water.

DEC #	PCB-ug/1-Solids 1016	1221	1254	Sub-total
4442	.31	<1.34	.29	.73
4446				
4448	.37	.16	.15	.68
4449	.52	.12	.19	.83
4472	.21	.21	2.03	2.45
4459	1.14	.25	.36	1.75
4475				

Additional Water PCB Analyses at Lock 4 by DOT

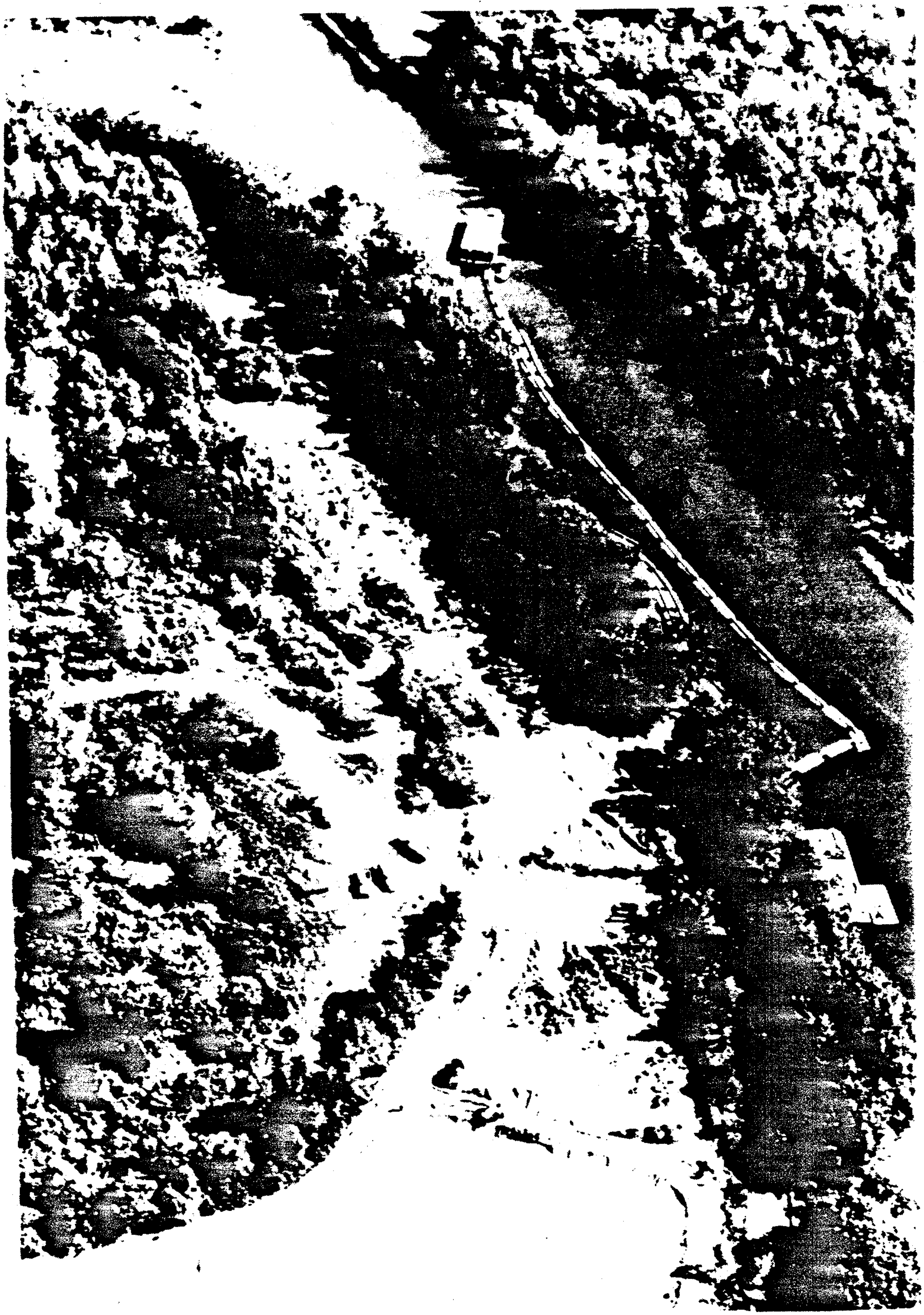
Return Flow

ID	Turb	SS	Total PCB
9/12/77		606	.85
9/13/77		464	1.20
9/15/77			.45

River Water

ID	Turb	SS	Total PCB
9/14 upst.	<10		.45
9/14 dwst.	<10		.35
10/5 upst.	<10		.11
10/5 dwst.	<10		.07
9/29 ave. of 6	10	17	

FIGURE 1



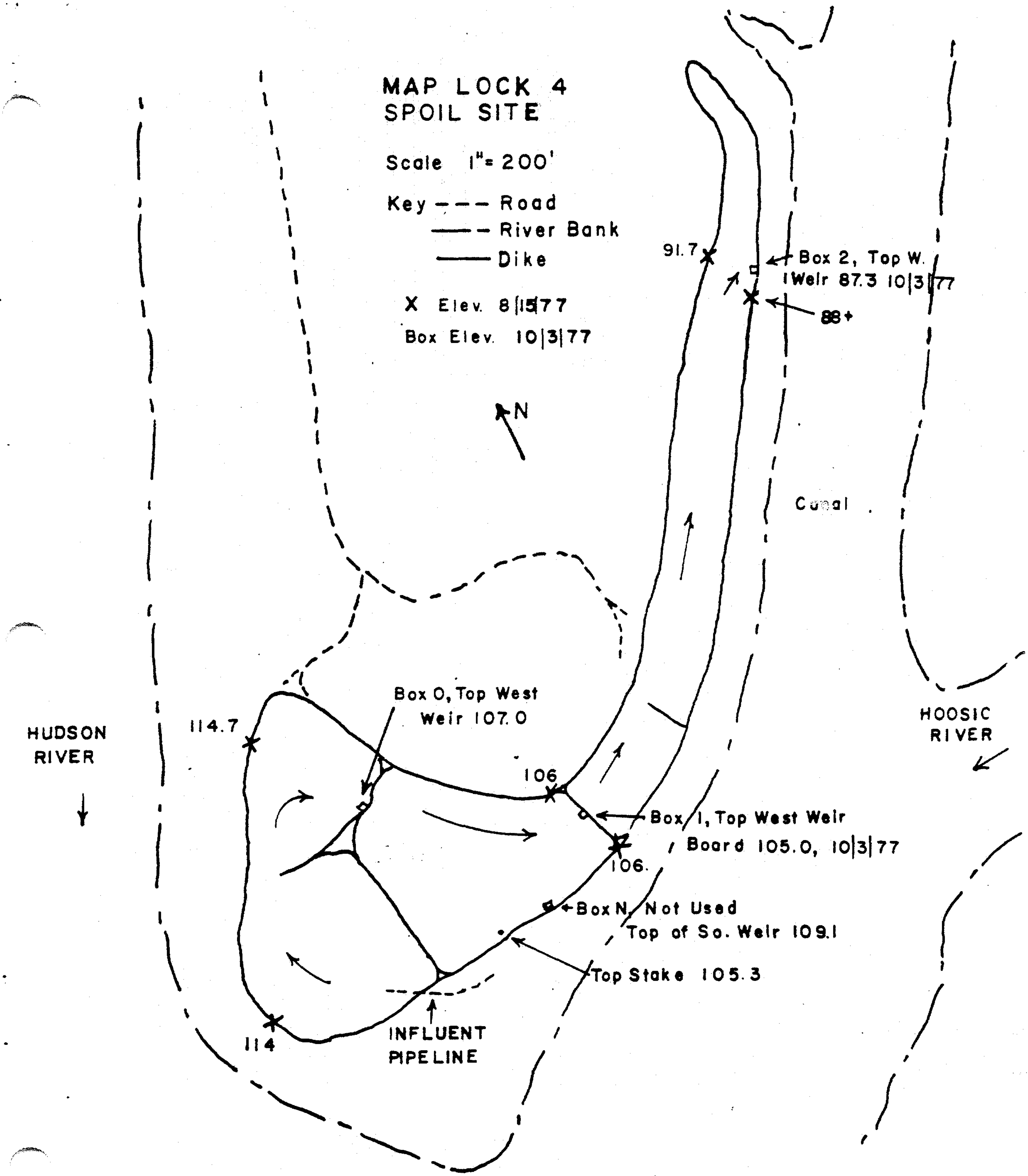
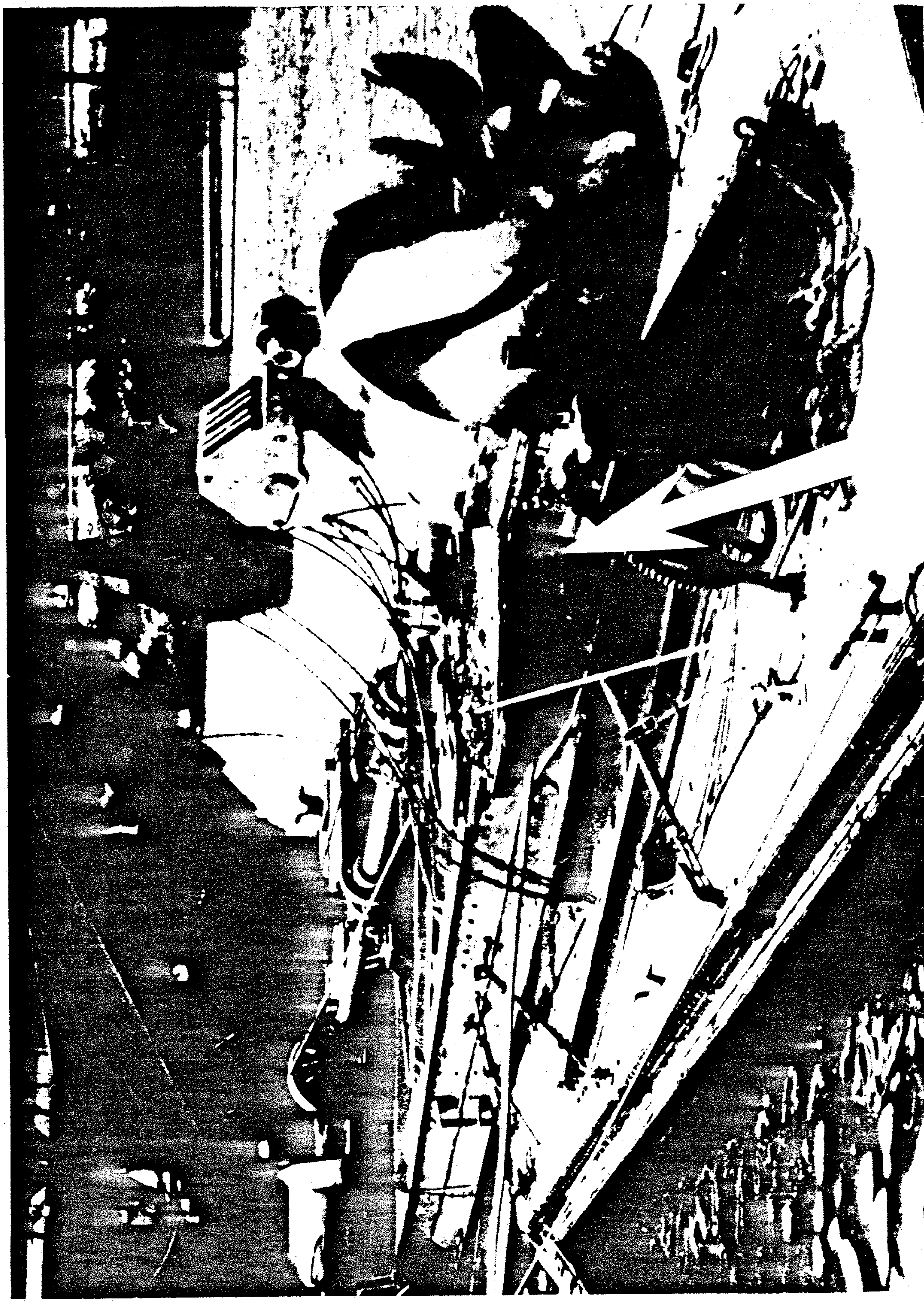
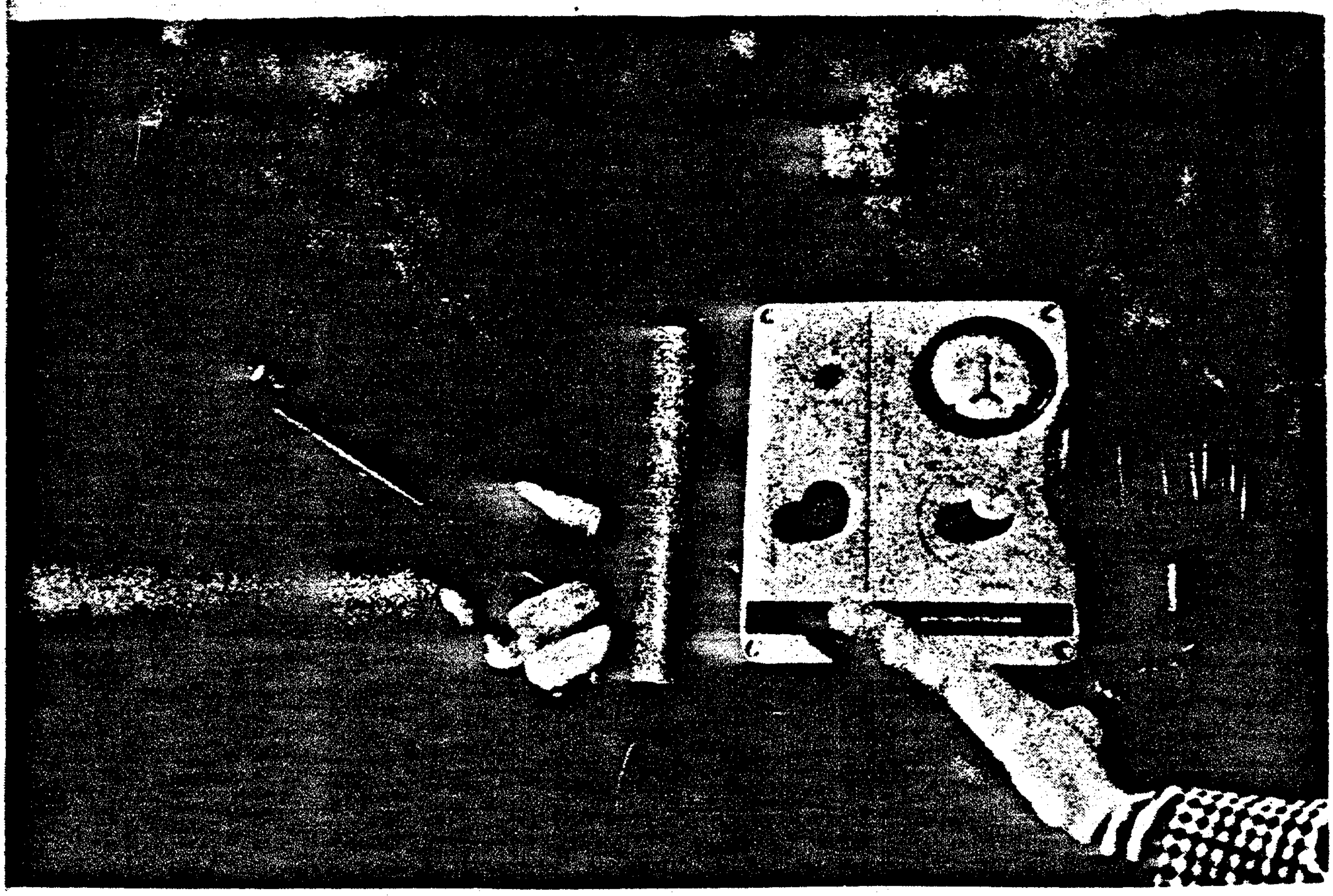

MAP LOCK 4
SPOIL SITE
Scale 1" = 200'
Key --- Road
River Bank
Dike
X Elev. 8|15|77
Box Elev. 10|3|77
N
91.7
Box 2, Top W. Weir 87.3 10|3|77
88+
Canal
HUDSON RIVER
HOOSIC RIVER
114.7
Box 0, Top West Weir 107.0
106
Box 1, Top West Weir Board 105.0, 10|3|77
106.
Box N, Not Used Top of So. Weir 109.1
Top Stake 105.3
114
INFLUENT PIPELINE

FIGURE 3



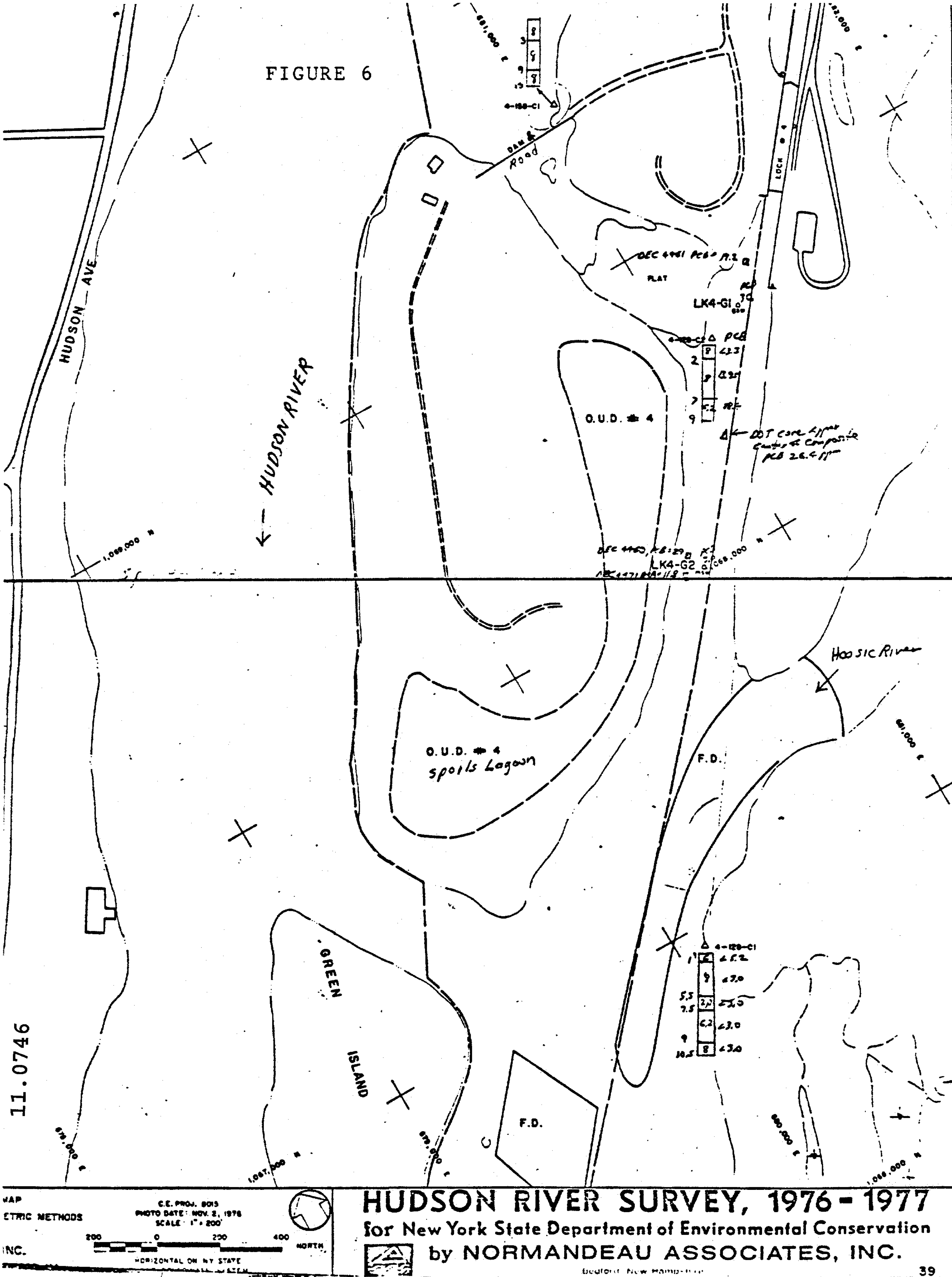
11.0744

FIGURE 5



11.0745

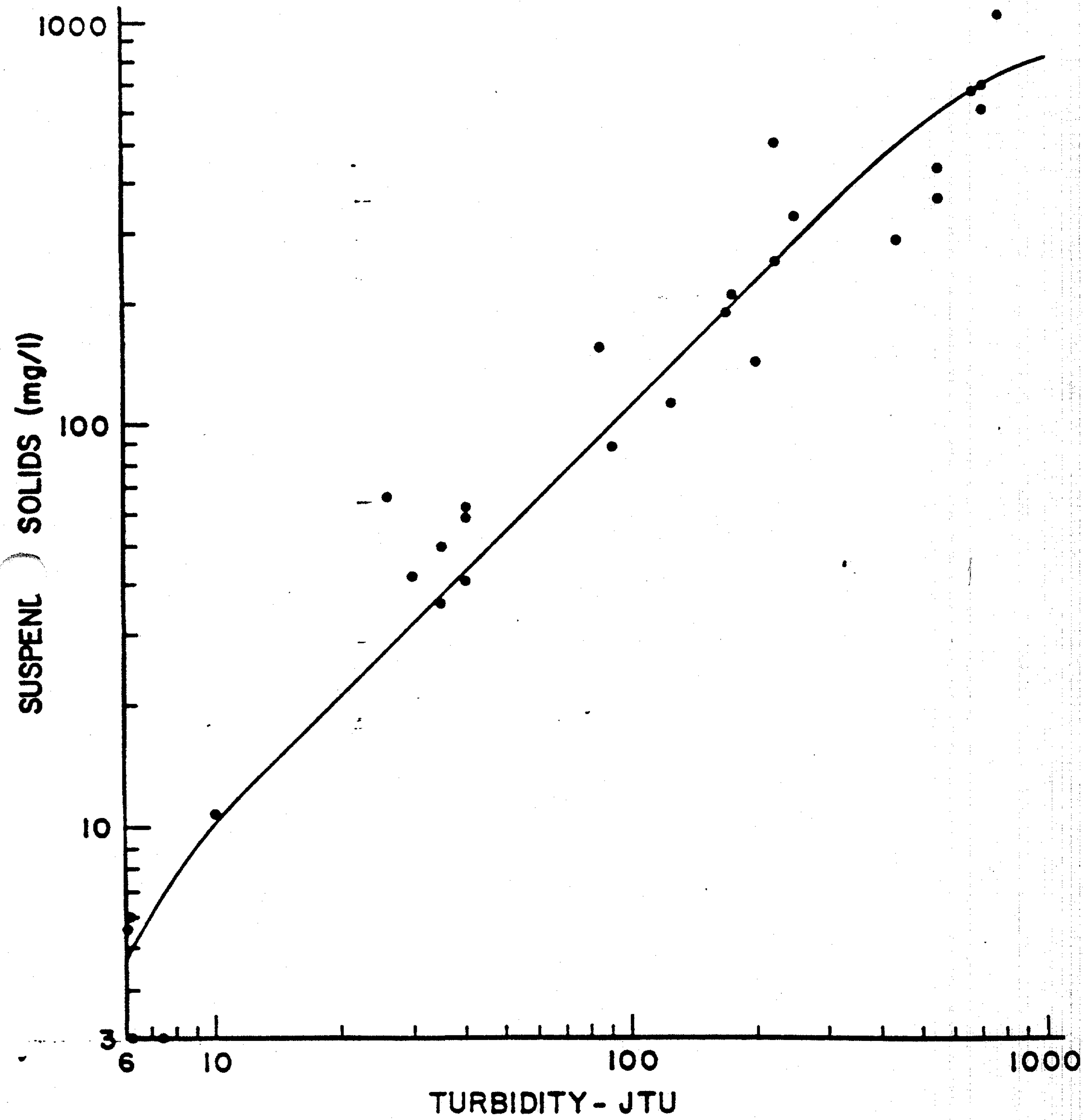
FIGURE 6



11.0746

FIGURE 7

LOCK 4
TURBIDITY VS SUSPENDED SOLIDS

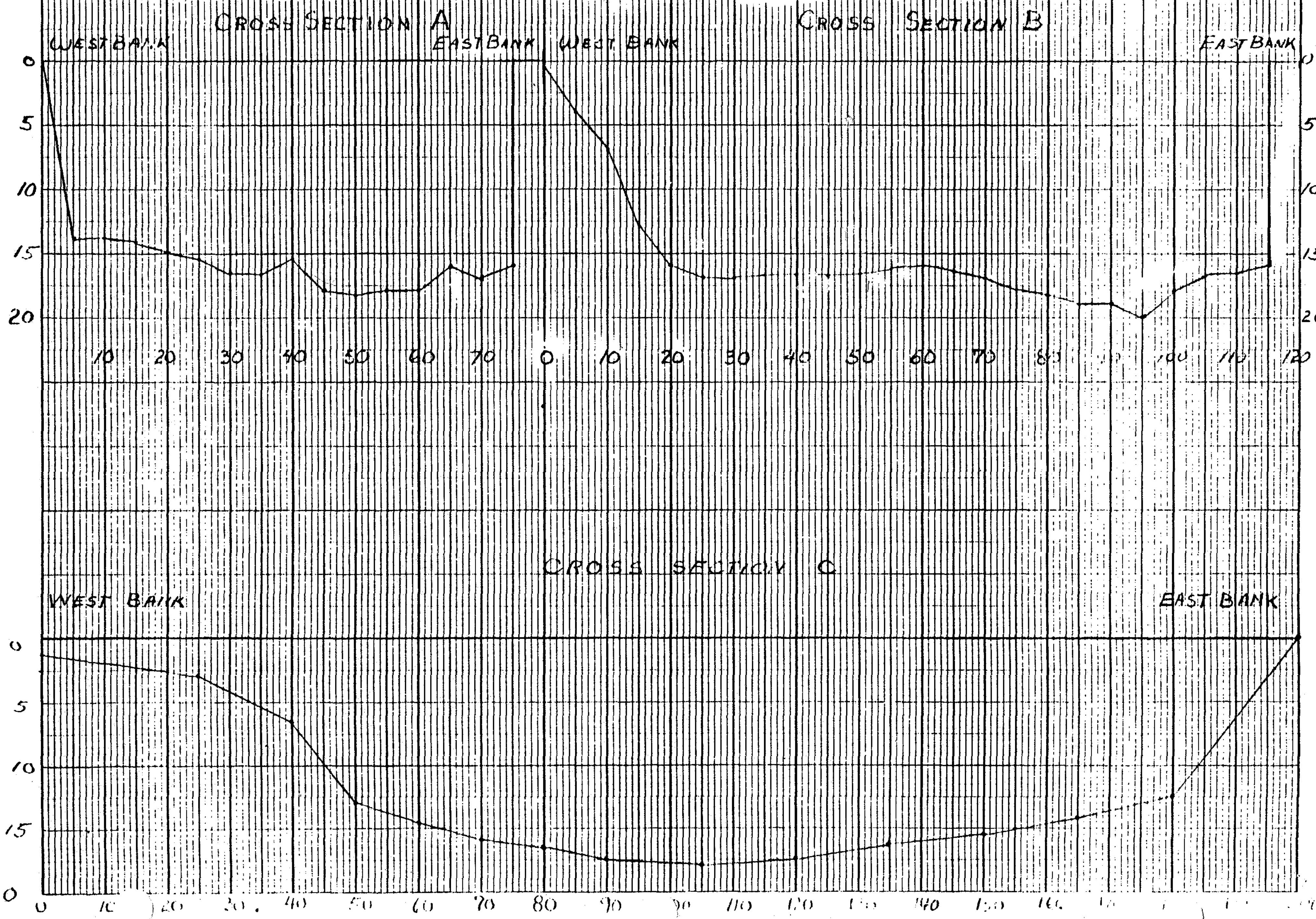


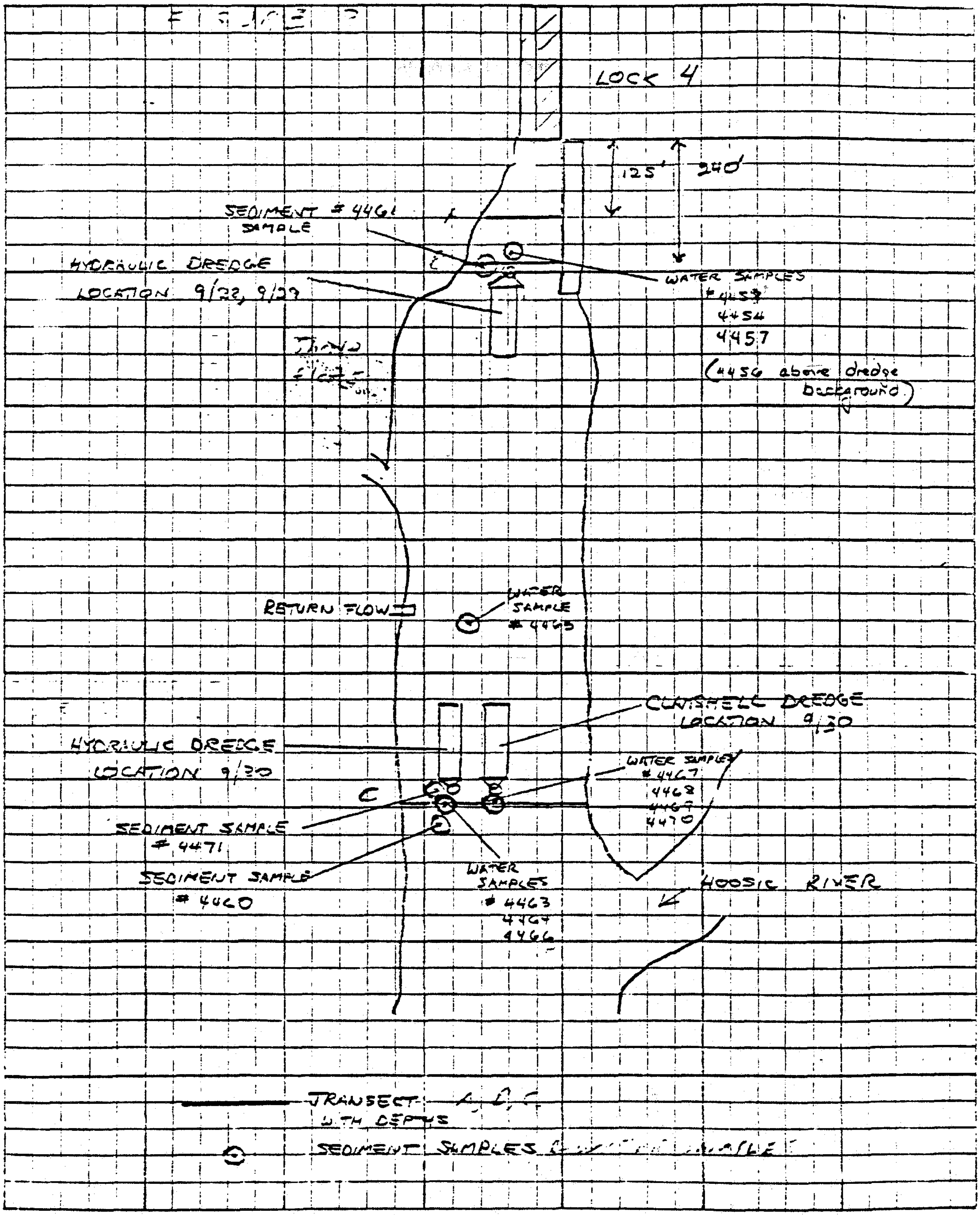
11.0748

K·E 20 X 20 TO THE INCH • 7 X 10 INCHES KEUFFEL & ESSER CO. MADE IN U.S.A.

46 1240

FIG 8 CROSS SECTIONS - LOCK 4 LOWER POOL - 708 DOT ELEV.





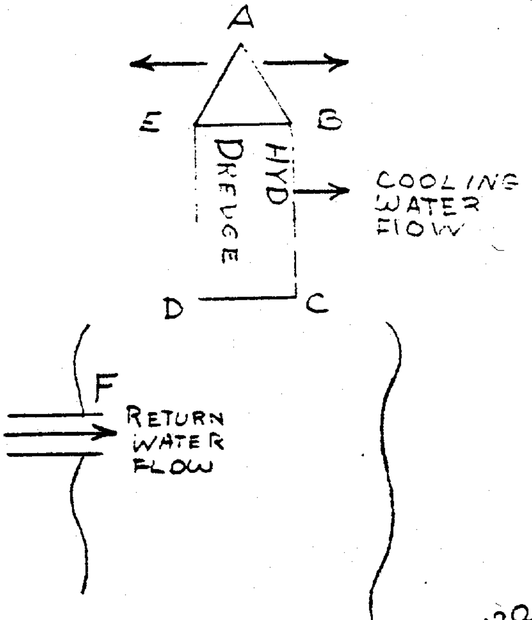
BY JSK DATE 9/22, 9/29, 9/30 **MALCOLM PIRNIE, INC.** SHEET NO. 14 OF 14

2 CORPORATE PARK DRIVE
WHITE PLAINS, N.Y. 10602

CHKD. BY .... DATE .... JOB NO. ....

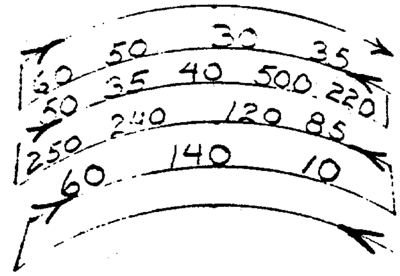
SUBJECT Location of Transects, Sediment Samples, and Water Samples

FIGURE 10 DREDGE HEAD TURBIDITIES - FTU



9/8 - 430 PM - NO LOCK FLOW

A-VALUES

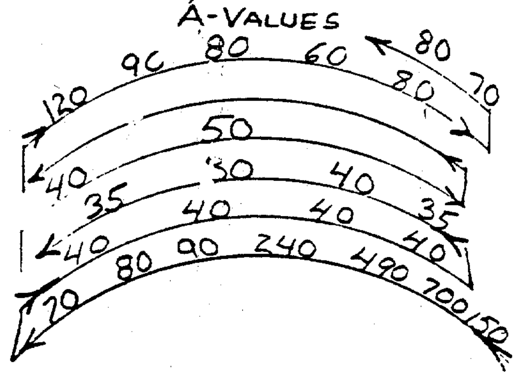


VALUES @ 1 Ft.

F 110
E 8
B 15

9/14 - 5:50 PM - NO LOCK FLOW

A-VALUES

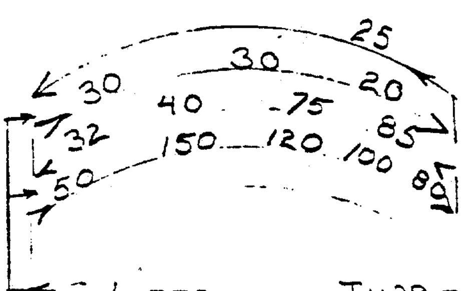


VALUES @ 1 Ft.

F 180
B 40
E 10 - 15

9/28 - 2:40 PM SOME LOCK FLOW

A-VALUES



2 LITER COMPOSITE SAMPLE

TURB - 76

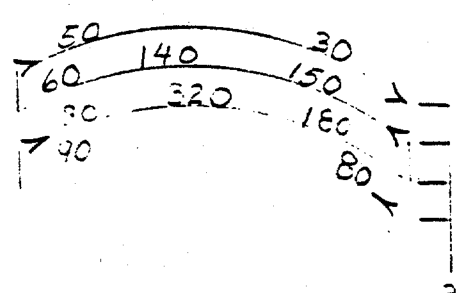
PCB - 2.3 µg/l

VALUES @ 1 Ft.

E 5-10
B 15

9/29 - 2:40 PM SOME LOCK FLOW

A-VALUES



2 Liter Composite

TURB = 85
S.S. = 156
PCB = 17 µg/l

OTHER VALUES

@ 10 Ft = 5-10
SS = 1.8
PCB = < .3 µ

BACKGROUND ABOVE DREDGE

TURB = 5

PCB = < .66 µg/l

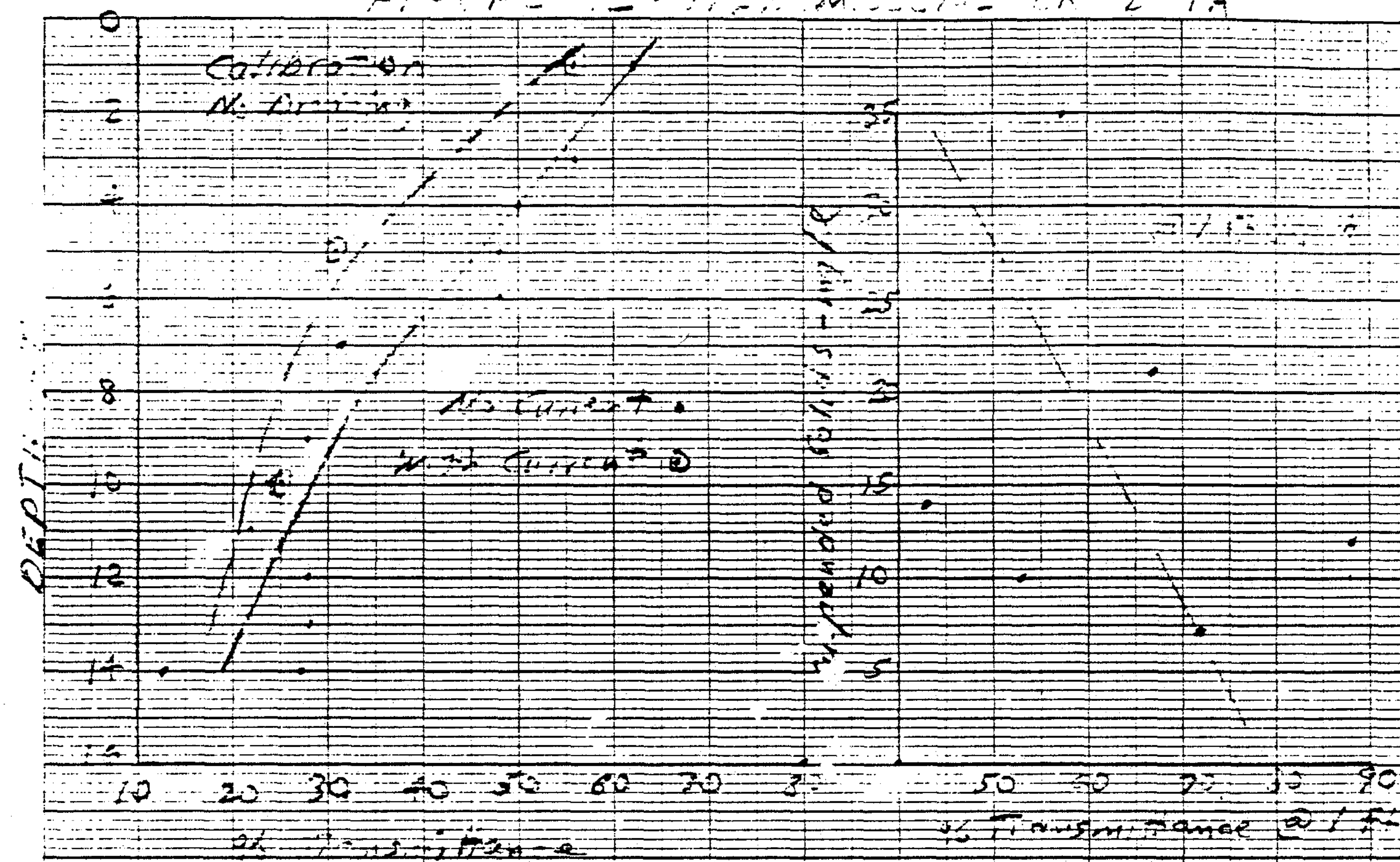
11.0750

Figure 11. DREDGE HEAD PCB LOSS

	River Section	Dredge Head
Area	149 m^2	14.9 m^2
Velocity	.198 m/s	.198 m/s
Total PCB	.1-.5 ppb	2.1 ppb
Suspended Solids	10-35 mg/l	120 mg/l
Increase in PCB*	.018 ppb	---------
Increase in PCB*	43.5 g/d	---------
Increase in Suspended Solids*	1.0 mg/l	---------

* Due to dredge head values

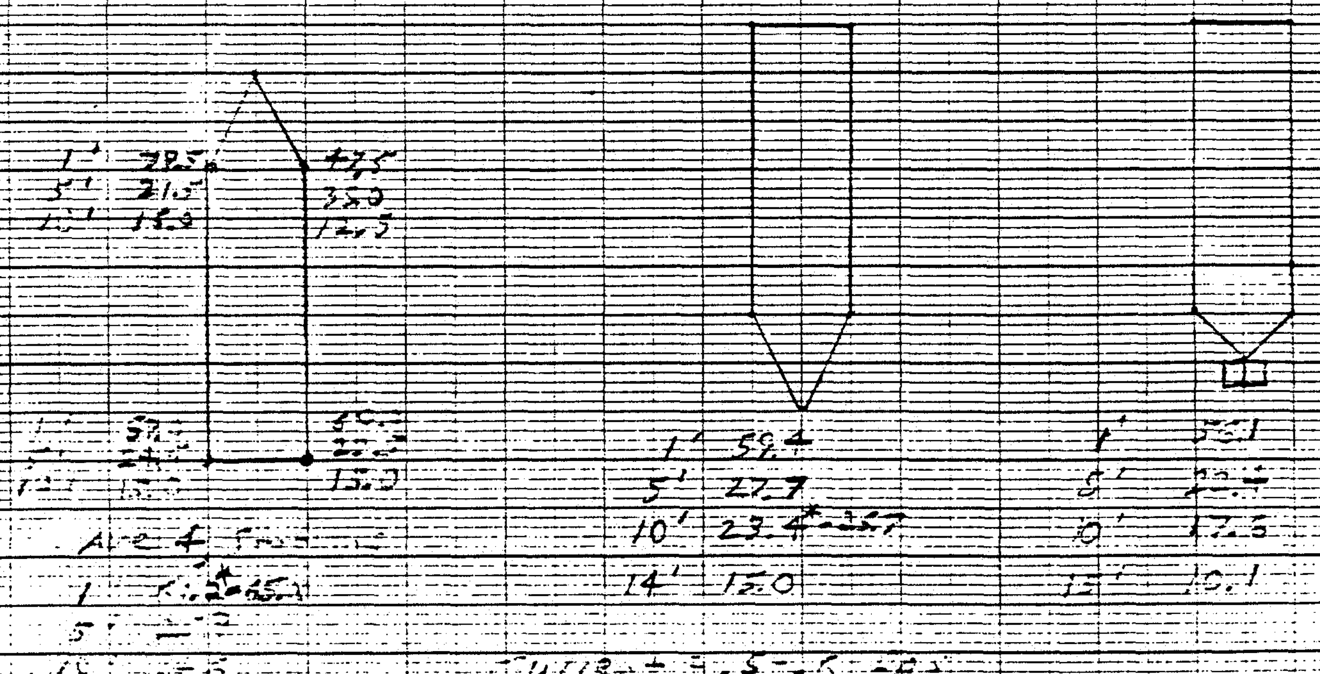
FIGURE • TRANSMISSOMETER DATA



9/29 - DREDGING Ave of 2 values

9/30 DREDGING Ave of 26 values

9/30 DEBRIS Ave of 16



Current 0.5 - 0.6 fps

*Note: Preferred Ave with the value omitted

11.0752

'46 1470

MALCOLM PIRNIE. INC.

Inter-Office Correspondence

Appendix 1

To: RFT, JCH, SCS

Date: October 5, 19

From: JSR

Subject: Lock 4 Monitoring

On September 28, 29 and 30 a field survey was undertaken by NYSDEC and Malcolm Pirnie Inc., in cooperation with NYSDOT, to monitor the downstream turbidity plume created by hydraulic and clamshell dredging. The plumes from the two types of dredging were to be compared in terms of downstream and lateral extent, and the total resulting transport of suspended solids.

The basic design of the survey was to regulate flow through Lock 4 to establish a current of approximately 0.5 feet per second past the dredging operation. A Beckman transmissometer was then used to delineate the downstream and lateral extent of the turbidty plume. By relating percent transmittance to suspended solids, the mass-balance of the plume could be calculated. In addition to the transmissometer data, grab samples of sediments in the dredge areas were obtained with a ponar sampler. Grain size as well as PCB analysis will be performed on these samples. Water samples were also collected to provide additional data on suspended solids, as well as ambient river PCB levels. Cross-sectional depths of the river a various points were also measured, in order to relate velocities to total flow.

The principal problem encountered in the field was the malfunctioning of the Beckman transmissometer. Leakage around the light source interfered with the light path and created variability. In addition, the instrument was strongly affected by ambient light levels. For example, consistently low transmittance readings were obtained at depths greater than 3 feet. When a sample was pumped from 14 feet (percent transmittance in situ: 12) and measured on board the boat in a glass jar in the shade, the percent transmittance obtained was 70.

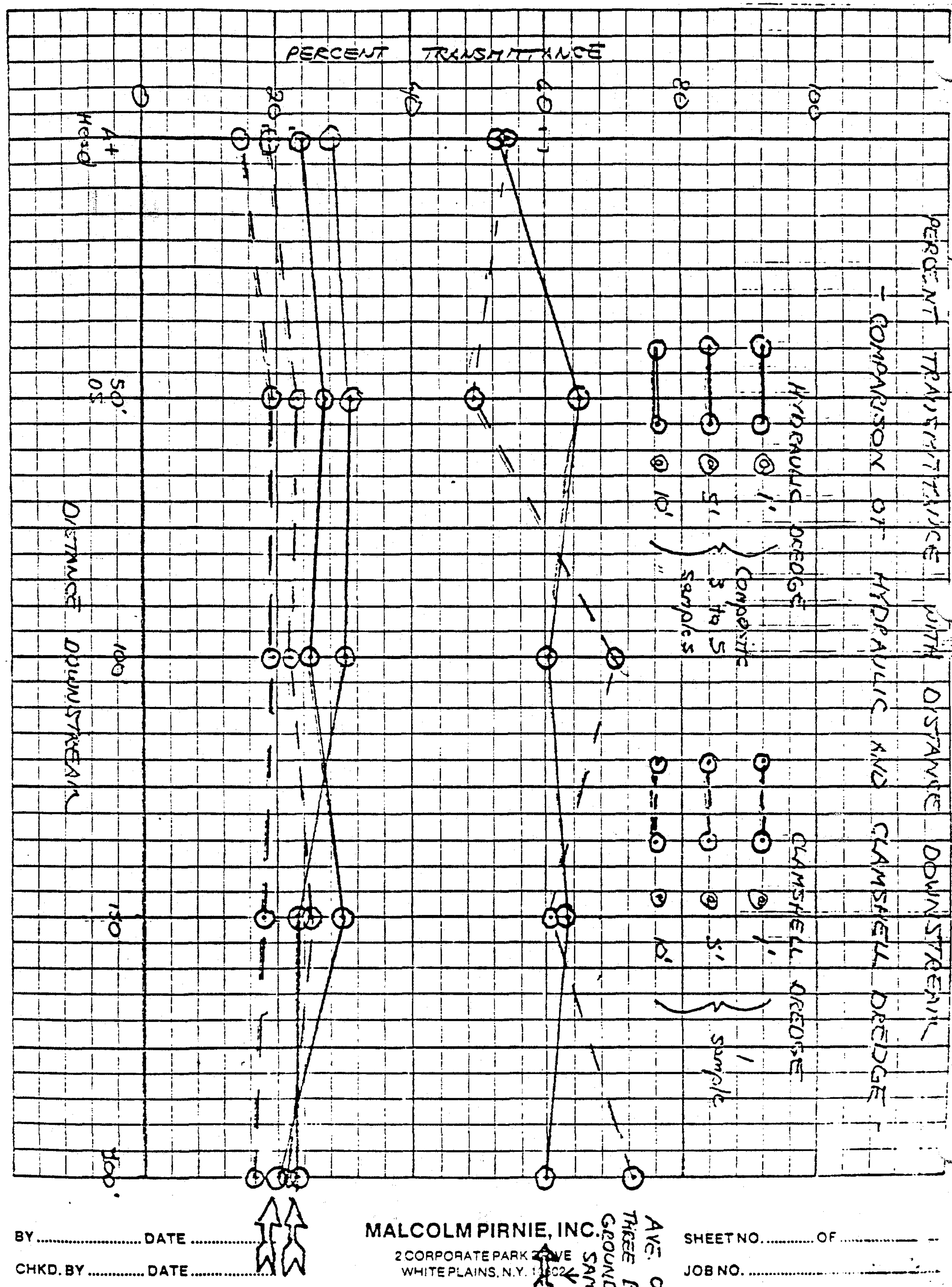
The transmissometer data is shown in tabular and graphic form in the accompanying notes. As a result of equipment problems and the high background turbidity (average 60% transmittance 1 foot below the surface) it is difficult to isolate the differences in turbidity which are actually caused by dredging. The following hypotheses, therefore, are presented only as an attempt to spot gross trends in the transmissometer data.

In Graph 2, it appears that the clamshell dredge causes a increase in turbidity (shown by a decrease in transmittance) at a depth of 1 foot for a distance of at least 50 feet downstream from the dredging site. At 100 feet the transmittance increases to levels higher than background levels. It can further be hypothesized from this graph that at depths of 5 and 10 feet the clamshell causes greater turbidity for 100 feet downstream than the hydraulic dredge. At a depth of 10 feet this effect extends to 200 feet.

Graph 3 illustrates percent transmittance across a transect 50 to 75 feet below the hydraulic dredge. The results indicate greater turbidity (lower transmittance) along the east shore and in the middle of the channel in comparison to the west side of the channel. If accurate, this difference may be due to one of two factors: greater background turbidity in the mainstream of the channel (in the middle and along the east shore) originating of Lock 4 or above; or the actual effects of hydraulic dredging.

It is our opinion that the transmissometer data are too variable and unreliable to provide confirmation for the hypotheses presented above. Conclusions will have to await the results of the suspended solids analyses derived from water samples. A total of 12 samples were collected; the locations are described on page 14 of the notes. According to J. Tofflemire of NYSDEC, a visual inspection of the samples shows that all samples including background contain sand particles. The background samples contain the fewest particles, while those taken below the clamshell dredge have the greatest number. The hydraulic dredge samples are intermediate.

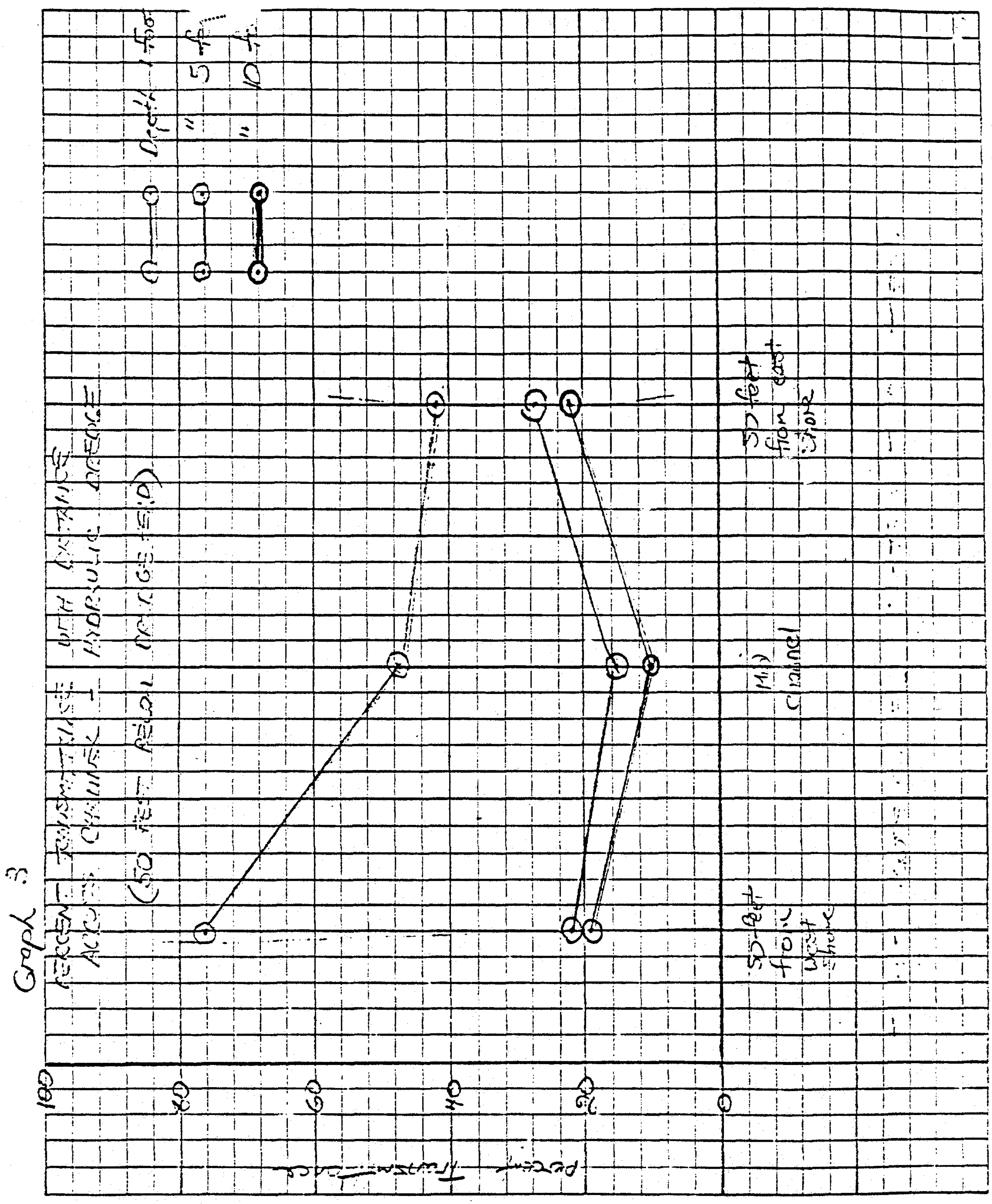
The plumes from both the hydraulic and the clamshell dredges were visible at the surface. The hydraulic dredge created a more noticeable plume when the operator worked in rapid arcs across the river. On the first day a more conservative operator created less disturbance by moving the head more slowly. The clamshell plume consisted of an opaque cloud which gradually dissipated at distances of 25 to 50 feet from the point at which the bucket broke water.



BY .... DATE .... MALCOLM PIRNIE, INC. SHEET NO. .... OF ....

CHKD. BY .... DATE .... 2 CORPORATE PARK DRIVE, WHITE PLAINS, N.Y. 10602 JOB NO. ....

SUBJECT



BY .... DATE ....

CHKD. BY .... DATE ....

SUBJECT ....

MALCOLM PIRNIE, INC.
2 CORPORATE PARK DRIVE
WHITE PLAINS, N.Y. 10602

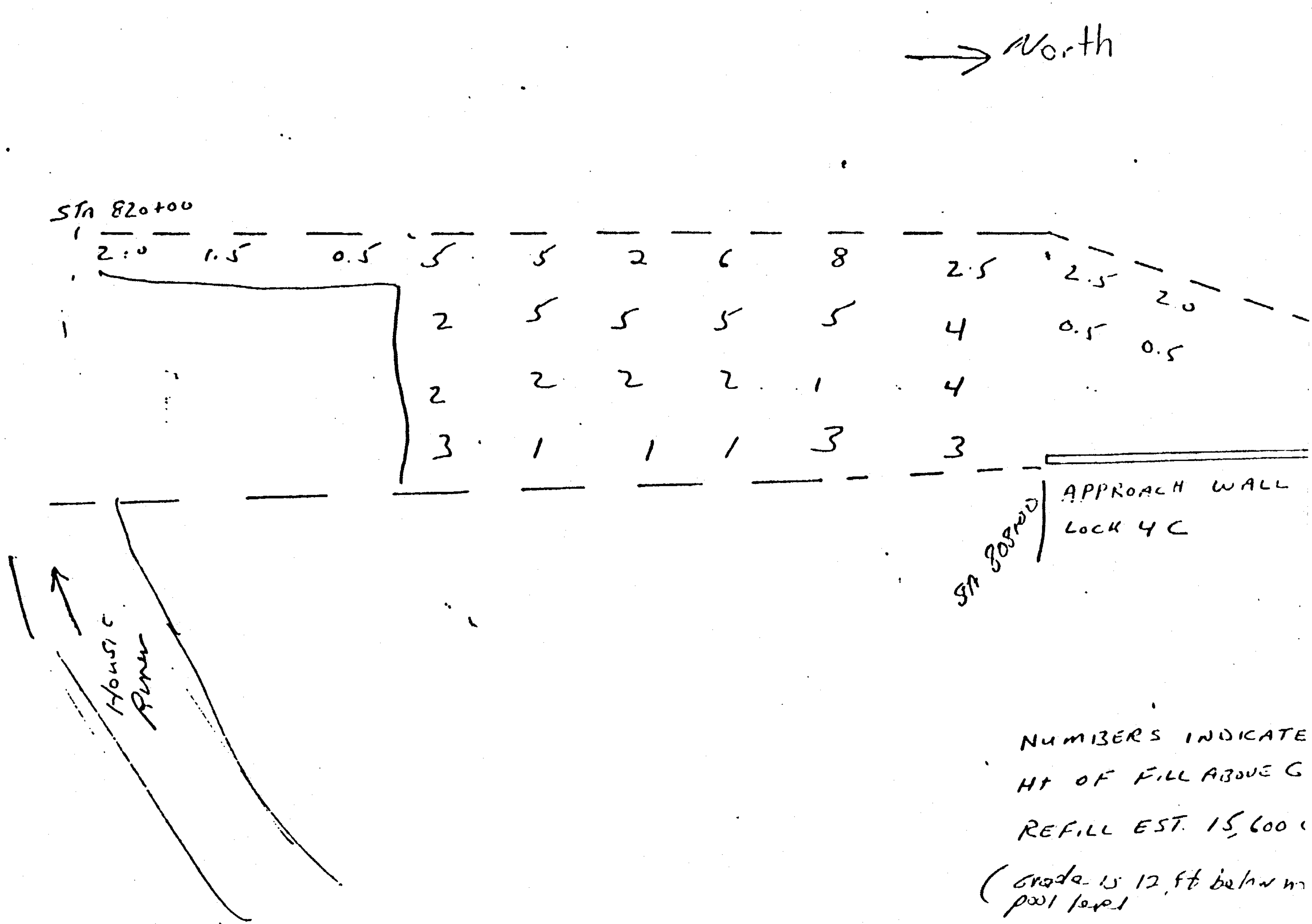
SHEET NO. 11 OF 17

JOB NO. ....

11.0756

APPENDIX 2 - DOT Sweep

Pool



11.0757