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NSB NEW LONDON
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Oil Contamination of Groundwater
2-28-79

NESO 1-026

"Oil Contamination of the Groundwater
at SUBASE New London, CT"

on

11 February 1979

For further information contact Mr. Jeffery C. Heath at AUTOVON 360-5071, FTS 799-5071, or Commercial 805-982-5071.

This report is not cleared for public release. To clear the report for public release, requires (1) concurrence of the commanding officers of the included shore activities and (2) compliance with NAVMATINST 5720.7 (current edition).

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EXECUTIVE SUMMARY

NESO conducted a study at SUBASE New London to determine the source and the extent of oil found in the soils in the riverfront area of the base. This oil is believed to leach from the soil into the Thames River causing unexplained oil spills and slicks to be reported in the pier area.

To determine the extent and magnitude of the problem, 12 borings were drilled in the pier area. Soil samples were analyzed for oil content. The resultant "wells" were sampled to determine the amount of oil floating on the groundwater table.

Three areas of contamination were found. Area 1, encompassing the power plant, is contaminated with a heavy oil similar to Bunker C. The oil originates from the heated day storage tanks and the reclamation tank directly behind the power plant (see figure 3). The oil is viscous; therefore, it is doubtful that it can seep from the tanks through the soil to the waterfront and into the river; more likely, the oil seeps into cracks in the stormsewer(s) near the tanks and is then discharged into the river. Recommended actions include inspection of the tanks and storm sewers for signs of oil leakage and sealing of abandoned lines and any cracks found as a result of the inspections.

Area 2 is situated near oil storage tanks E, F, G, K, and L (see figure 3). This area of contamination poses no environmental threat; however, the adjacent well should be monitored regularly.

Area 3, located northwest of bldg. 79 (see figure 3), is contaminated with an oil similar to lubricating oil. The contamination appears to originate from an abandoned exfiltration well or basin previously used when bldg. 79 was a diesel engine service facility. Recommended action for this area is the installation of a well system to remove the oil from the soil.

TABLE OF CONTENTS

	Page
INTRODUCTION	1
DATA ACQUISITION	1
INTERPRETATION OF DATA	2
Table 1	4
Table 2	5
Table 3	6
Figure 1	7
Figure 2	8
Figure 3	9

SAYS WHO?

INTRODUCTION

SUBASE New London experiences oil slicks in the Thames River in the waterfront area at piers 2-5 and 10-12. The oil resembles #6 fuel oil and diesel oil. Because the slicks usually occur at low tide or after heavy rain, it is suspected that the source of the slicks is oil leaching from the soil into the river. Excavation in the area has shown that the oil present in the soil is probably a result of past spills, or pipeline or tank leaks.

In November 1977, NORTHDIV requested NESO to conduct a study to determine the source and extent of the contamination.

On 13-15 December 1977, a NESO field team visited SUBASE New London to gather information and determine study and sampling methodologies.

Soil and water sampling was performed on 12-15 June 1978 by a NESO field team in conjunction with SUBASE New London and NORTHDIV personnel. Soil borings were drilled by a NORTHDIV contractor.

Persons contacted during this study include: Dave Smith, NORTHDIV; CDR David Harned, public works officer; LCDR Sommers, ass't public works officer; Jack Wallace, director, Engineering Division, Public Works Department; Max Browning, director, Utilities Division, Power Plant; Dom Gabriel, Public Works Dept. engineer; Bob Morgan, Public Works Dept. engineering technician; TM Chief D. L. Miller, Fast Response Team; and Chief Bryant, environmental and energy conservation coordinator.

DATA ACQUISITION

Using a continuous flight auger, 12 soil borings, each between 7 and 16 feet deep, were drilled several feet below the groundwater table. Location of these "wells" are shown in figure 1. Well 5 was drilled in an area free from oil contamination to allow collection of baseline samples. Each of the borings was converted into a permanent well by inserting a casing with perforations in the bottom 5 feet.

Soil samples were taken from various depths during the boring process, either from the tip of the auger or by using a spoon sampler. The samples, in glass jars, were refrigerated and transported to the Navy Materials Laboratory, Philadelphia Naval Shipyard, Philadelphia, PA. The samples were analyzed for oil content by the "Extraction Method for Sludge Samples," Standard Methods, 14th edition, pp. 519-20. The results of these analyses are shown in table 1.

Water samples were taken from each well 1 to 2 days after drilling was completed. The samples, obtained by dropping a glass bottle on a string into the well, indicate the presence of oil in the wells. SUBASE personnel took additional samples approximately one week later. All samples were refrigerated during storage and transport. The Navy Materials Laboratory analyzed the samples using the "Partition - Gravimetric Method," Standard Methods, 14th edition, pp. 515-516. The results of the analyses are shown in table 2.

SUBASE personnel monitored water and oil levels and the amount of oil in each well weekly from 1 October 1978 to 15 November 1978 to determine static oil layer thickness on the groundwater. The oil layer thickness was measured by placing oil sensing paste on a pole, inserting the pole into the well for about 30 seconds, and measuring how much of the paste indicated the presence of oil. The wells were pumped empty of all fluid on 24 October 1978 to aid in determining the permeability of the soil and the ease of oil removal. These data are summarized in table 3. The maximum and minimum fluid levels, along with well depths, are shown in figure 2.

INTERPRETATION OF DATA

Do their data support these statements? In my opinion no.

Interpretation of the data indicates three areas of oil contamination; area 1, the power plant area extending along the waterfront from near pier 12 to pier 8, and inland a maximum of 200 ft; area 2, storage tanks E, F, G, K, and L adjacent to well 7, extending an estimated maximum of 50 ft.; and area 3, bldg. 79 area, extending an estimated maximum of 100 ft. north from the northwest corner of bldg. 79 and westward to the waterfront. The three areas are shown on figure 3.

Wells 1-4

Area 1. The source of soil contamination in area 1 appears to be the day tanks and/or reclamation tank adjacent to the rear of the power plant (indicated as tanks A, B, and C in figure 3). The soil analyses indicate increasing oil concentration in the soil samples taken closer to the tanks and on the north side of the power plant. The type of oil found in the soil in this area is thick and heavy and corresponds to the type of oil stored in those tanks. The oil is heated to decrease its viscosity during piping and storage.

The oil reclamation tank at the power plant (Bldg. 29) was drained and cleaned in June 1978. At that time, the NESO field team inspected the tank for possible leaks. Except for several small cracks the tank appeared in good condition. The field team noted several apparently abandoned pipelines leaving the tank, and were unable to determine where these lines terminate or if they are plugged.

Only trace amounts of oil infiltrated into the wells; because of the high viscosity of the oil it is doubtful that any significant amounts pass through the soil to the pier area and leach into the Thames River.

It is more likely that oil seeps out of the tanks through cracks or abandoned lines into the soil and then infiltrates a storm sewer(s) near the tanks. This can easily happen because the oil, still warm and less viscous, could pass the short distance through cracks, gaps, and joints into the storm sewer(s). The oil then can be carried out with water in the sewers and enter the river.

RECOMMENDED ACTIONS:

1. Tanks A, B, C, and D and the reclamation tank should be inspected, and all cracks and abandoned lines should be sealed.

2. The storm sewer(s) should be inspected for signs of oil. Any cracks should be sealed to prevent oil from entering the sewer. Because of the viscosity, it is doubtful whether the oil in the soil can be removed using a pumping well.

Area 2. The source of the oil contamination in area 2 is oil storage tanks E, F, G, K, and/or L. The soil and water samples showed only minor contamination of the area with a light fuel oil, and the well had only trace amounts of oil present. The area of contamination, localized close to the tanks, poses no environmental threat. WELL 7

RECOMMENDED ACTION:

Monitor the amount of oil in well #7 quarterly or semiannually. Action should be taken if at any time the amount of oil increases to measurable levels (greater than 1 inch).

Area 3. An abandoned oil exfiltration pit/sump believed to have been located at the northwest corner of bldg. 79 is considered to be the source of oil contamination. The pit/sump was used for waste lubricating oil drained from diesel engines serviced in bldg. 79.

The drilling log and results of the soil analysis indicate that the contamination at well #9 is confined to the 6 to 9-ft. depth. The water/oil level monitoring data indicate that the contamination is shallower in areas adjacent to well #9. The oil samples from well #9 resemble lubricating oil, similar to motor oil, and is easy to extract from the soil. It is estimated that the saturated area is approximately 50 ft. by 50 ft. by 4 ft. thick. Assuming a soil porosity of .15, the amount of oil present is approximately 10,000 gallons.

RECOMMENDED ACTION:

1. Install a well system near well #9, but located nearer to the waterfront, to remove the oil from the water table in the soil. The recovered oil can be sold or disposed of using conventional means.

Table 1

Results of Soil Analyses

Sample #	Boring (Well) Location	Depth Below Ground Surface	Oil & Grease Percent, in %	Physical Appearance of Sample
1-001	Well 1	3½ ft	0.08	sandy with gravel
1-002	Well 1	7 ft	0.83	sandy with gravel
1-003	Well 1	11 ft	0.38	sandy with gravel
2-001	Well 2	4½ ft	0.06	dark, sandy with gravel
2-002	Well 2	5 ft	0.16	sandy, slight oil odor
2-003	Well 2	8 ft	0.49	dark, sandy, oil odor
2-004	Well 2	9 ft	0.08	watery, sandy
3-001	Well 3	3½ ft	0.38	sandy, gravel, slight oil odor
3-002	Well 3	5 ft	3.29	sandy, moist, thick with oil
3-003	Well 3	10 ft	0.17	sandy, watery, & oily
4-001	Well 4	3 ft	0.21	dark, sandy, no oil detected
4-002	Well 4	6 ft	0.18	sandy, gravel, oil odor
4-003	Well 4	10 ft	0.04	watery, strong oil odor
5-001	Well 5	3 ft	0.05	dry, sandy, no oil
5-002	Well 5	10 ft	0.04	light brown sandy, no oil
6-001	Well 6	3 ft	0.11	silty, no oil
6-002	Well 6	5 ft	1.41	silty, no oil detected
6-003	Well 6	9 ft	0.29	silty, no oil detected
7-001	Well 7	3 ft	0.05	sandy, dry
7-002	Well 7	5 ft	0.08	sandy, dry, light brown
7-003	Well 7	10 ft	0.68	sandy, moist, slight oily odor
7-004	Well 7	15 ft	0.20	fine, sandy, moist, oily odc
8-001	Well 8	3 ft	0.37	dry, sandy
8-002	Well 8	6 ft	0.08	moist, sandy, no odor
8-003	Well 8	10 ft	0.12	moist, sandy, gravel, no odc
9-001	Well 9	3 ft	0.16	sandy, no odor
9-002	Well 9	6 ft	0.15	silty, no odor
9-003	Well 9	9 ft	0.06	sandy, strong oil odor
10-001	Well 10	3 ft	0.06	dry, sandy with pebbles
10-002	Well 10	6 ft	0.07	dry, sandy, no oil odor
10-003	Well 10	10 ft	0.11	moist, sandy with gravel
11-001	Well 11	3 ft	0.09	dry, sandy with gravel
11-002	Well 11	6 ft	0.05	moist, sandy, no odor
11-003	Well 11	9 ft	0.05	moist, sandy, no oil detected
11-004	Well 11	10 ft	0.05	wet, sandy, no oil detected
12-001	Well 12	3 ft	0.06	sandy, silty, broken glass, no oil odor
12-002	Well 12	6 ft	0.07	moist, sandy, no oil detected
12-003	Well 12	10 ft	0.15	sandy silt, no oil detected

ACCORDING TO THIS, ONLY WELL #3 SHOWED VISUAL EVIDENCE OF OIL. OILY ODOR IS VERY SUBJECTIVE, ESPECIALLY AT THE SUBASE.

Table 2

Results of Soil Analyses

Well #	Sample #	Date	Oil & Grease, ppm	
1	1-005	15 June 79	100	0.01%
2	2-005	15 June 79	30	
4	4-005	15 June 79	20	
5	5-005	15 June 79	<10	
6	6-005	15 June 79	150	0.015%
7	7-005	15 June 79	120	
8	8-005	15 June 79	25	
9	9-005	15 June 79	9,055	0.9%
10	10-005	15 June 79	15	
11	11-002	15 June 79	15	
12	12-003	15 June 79	20	
3	3-007	22 June 79	670	
7	7-006	22 June 79	180	
7	7-007	22 June 79	100	
9	9-006	22 June 79	261,000	26% ?
9	9-007	22 June 79	982,000	98% ?

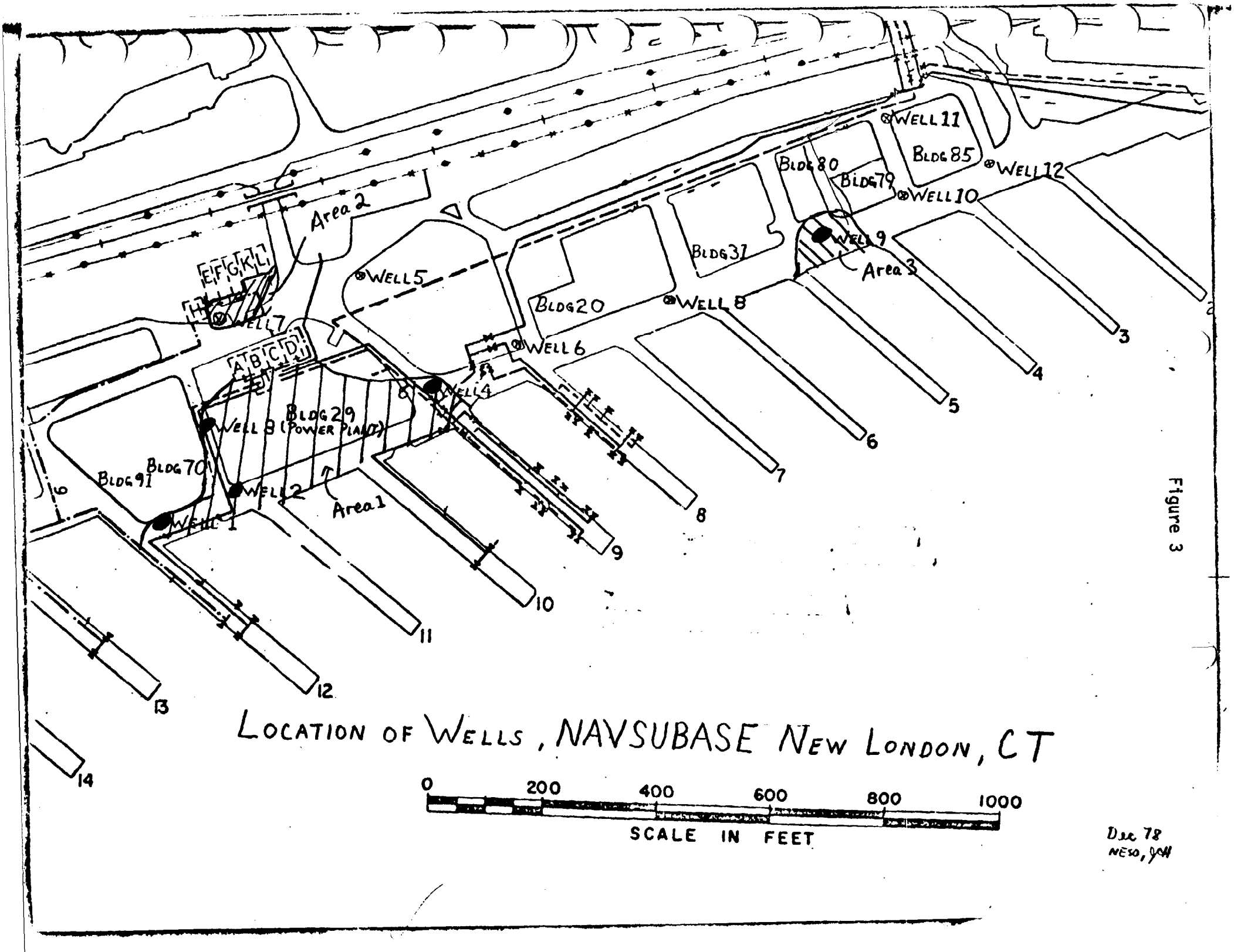
Table 3

Well Monitoring Data

Well #	22 Jun 78 DTLS	22 Jun 78 OLT	1 Oct 78 DTLS	1 Oct 78 OLT	10 Oct 78 DTLS	10 Oct 78 OLT	17 Oct 78 DTLS	17 Oct 78 OLT	23 Oct 78 DTLS	23 Oct 78 OLT	30 Oct 78 DTLS	30 Oct 78 OLT	7 Nov 78 DTLS	7 Nov 78 OLT	15 Nov 78 DTLS	15 Nov 78 OLT
1	5'7"	T	NR	ND	3'5"	ND	2'4"	ND	NR	ND	NR	ND	NR	ND	4'11"	ND
2	6'11"	T	NR	ND	5'7"	ND	4'10"	ND	NR	ND	NR	ND	NR	ND	5'2"	ND
3	5'2"	T	NR	ND	2'9"	T	7"	ND	NR	ND	NR	ND	NR	ND	1'3"	ND
4	7'8"	ND	NR	ND	5'11"	T	5'7"	ND	NR	ND	NR	ND	NR	ND	5'0"	ND
5	13'9"	ND	NR	ND	5'7"	ND	8'9"	T	NR	ND	NR	ND	NR	ND	11'7"	ND
6	6'9"	ND	NR	ND	3'8"	ND	2'9"	ND	NR	ND	NR	ND	NR	ND	6'10"	ND
7	9'10"	T	NR	ND	12'8"	ND	9'4"	ND	NR	ND	NR	ND	NR	ND	10'0"	ND
8	6'4"	ND	NR	ND	5'4"	ND	4'2"	T	NR	ND	NR	ND	NR	ND	7'5"	ND
9	7'2"	10"	NR	4'8"	7'0"	1'10"	4'2"	4'2"	NR	4'2"	NR	3'10"	NR	11"	5'2"	5'2"
10	7'4"	ND	NR	ND	6'7"	ND	5'2"	T	NR	ND	NR	ND	NR	ND	5'6"	ND
11	6'0"	ND	NR	ND	5'3"	ND	5'7"	ND	NR	ND	NR	ND	NR	ND	5'4"	ND
12	5'6"	ND	NR	ND	5'2"	ND	3'5"	ND	NR	ND	NR	ND	NR	ND	4'9"	ND

DTLS: Depth to liquid surface from ground surface
OLT: Oil layter thickness
T: Trace
ND: None detected
NR: Not reported

HOW CAN THERE BE SUCH THICKNESSES OF OIL IN THESE WELLS?
THE PASTE THEY USED PROBABLY REACTS TO 10 ppm OF OIL, SO THESE FIGURES ARE LARGELY WORTHLESS.



LOCATION OF WELLS, NAVSUBASE NEW LONDON, CT

Dec 78
NESO, JCH

Figure 3

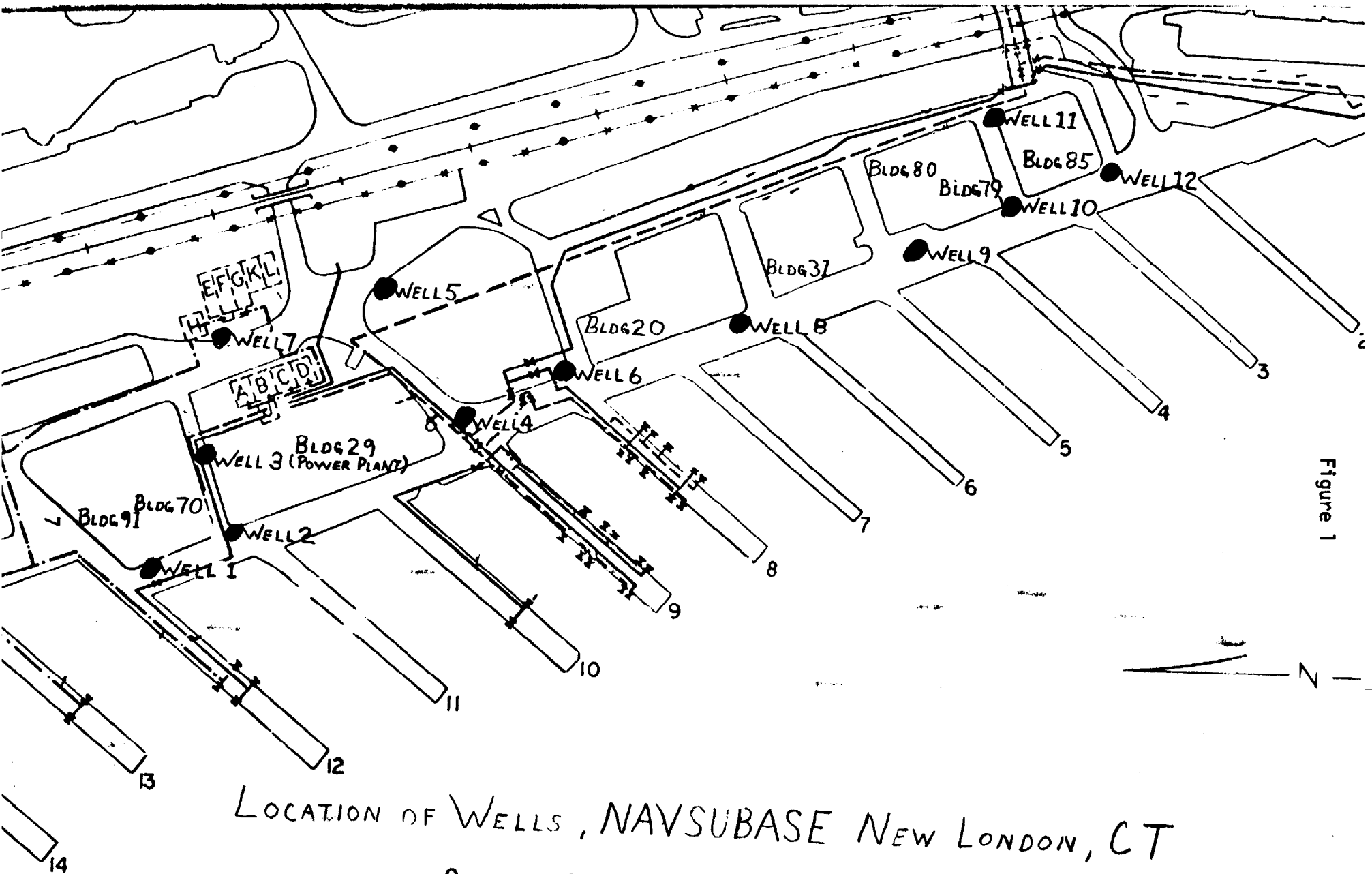


Figure 1

LOCATION OF WELLS, NAVSUBASE NEW LONDON, CT

0 200 400 600 800 1000

SCALE IN FEET

Dec 78

screened bottom 5' — top of screens

WELL DEPTHS, AND MAXIMUM AND MINIMUM FLUID LEVELS OBSERVED

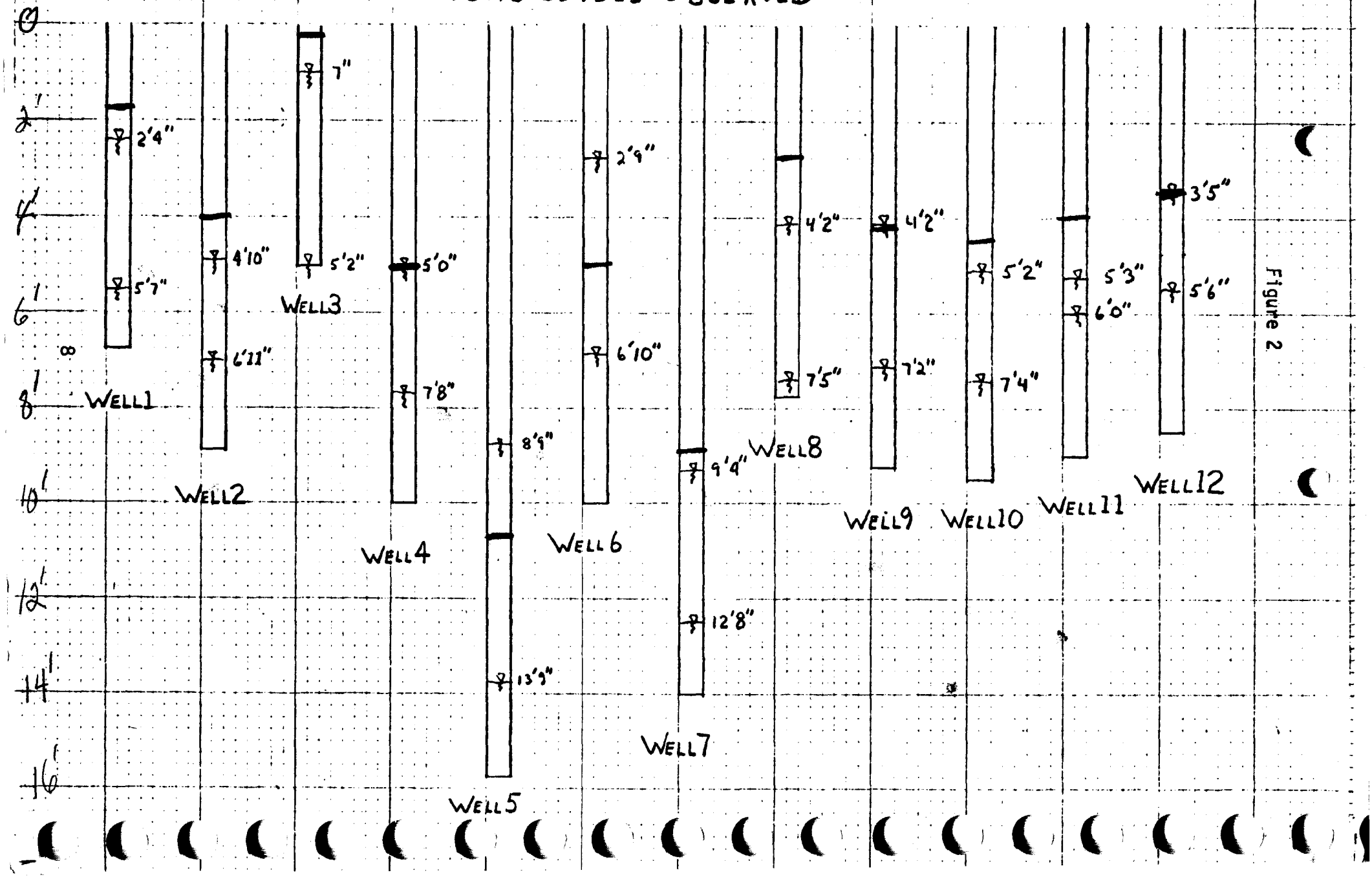


Figure 2