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6 June 1991
File No. 535-005

RECEIVED JUN 11 1991

Mr. Robert Marino
Chief, Site Control Section
Bureau of Hazardous Site Control
New York State Department of
Environmental Conservation
50 Wolf Road
Albany, NY 12233

Re: **Flintkote (Orangeburg Pipe Company)**
Site No. 344013

Dear Mr. Marino:

On 22 March 1991, the Department approved the delisting petition submitted on behalf of the Flintkote Company regarding the above-referenced site. In the letter from Mr. Michael J. O'Toole, Jr., P.E., to Mr. Thomas West, which notified Flintkote of the delisting of the site, the Department indicated that the northwest portion of the Flintkote property will be the subject of a Preliminary Site Assessment to determine whether there has been previous hazardous waste disposal at the site and, if so, whether such disposal explains the presence of the volatile organic chemicals (VOCs) that have been detected in the area groundwater. That letter also noted that the investigation of the site that Lawler, Matusky & Skelly Engineers (LMS) has been performing on behalf of Parkway Land Resources (Parkway) will aid the Department's assessment of the site.

Enclosed is a copy of the Summary Report *Soil and Groundwater Investigations Conducted on Block 754 of the Former Orangeburg Pipe Manufacturing Site, Orangeburg, New York* (April 1991), prepared by LMS on behalf of Berbor Realty, Inc. Parkway and Berbor Realty have common management. Flintkote has reviewed this document and approved its release to the State.

This report summarizes the results of the comprehensive site investigation that LMS has performed. The investigation included a large number of wells and test pits on Block 754 (the Flintkote parcel), and some on Block 756 (the Parkway parcel), which were used to obtain groundwater and soil samples. The scope of the investigation significantly exceeded typical phase II environmental assessments.

More intense sampling was concentrated on the area of Blocks 754 and 756 in closest proximity to MW-18. MW-18 is located downgradient of the Flintkote parcel on Block 756 and was found to have the highest VOC concentrations based on the LMS study of this area during 1989-1990. Though some VOCs were present in four upgradient wells, which are located on Flintkote's parcel, the concentrations were far below those measured in MW-18. On the basis of lower VOC concentrations found in the upgradient wells, groundwater flow from Flintkote's property does not appear to be the cause of the VOCs found on the Parkway parcel.

In addition, the investigation demonstrated that there is no discrete plume of VOCs or pattern of VOCs present in the wells or test pits sampled. No VOCs were measured in the soil from test pits located between the wells which yielded groundwater samples containing VOCs. We have concluded therefore, that the VOCs found at this site are localized with no specific source being clearly apparent. Though an extensive exploratory program was conducted, we found no continuing source (within the context of New York's inactive hazardous waste sites program) of VOCs to the groundwater which, if excavated or otherwise remediated, would be expected to result in a decrease in VOC groundwater concentrations.

Furthermore, results of the investigation conducted by LMS and submitted to DEC in March 1990 on the Parkway parcel, indicate that concentrations of VOCs in wells downgradient of MW-18 are significantly less than were found in MW-18. The two wells located at the most downgradient point of the Parkway parcel (MW-11 and MW-12), were found to contain the lowest VOC concentrations.

There has been no industrial activity on this site for almost 20 years. If a source of VOCs was contributing to a plume of VOCs that was a potential threat to human health and the environment, that threat should certainly have materialized by now, as a plume moving off-site. Clearly no source nor a moving plume is apparent from the latest LMS investigation. There are also no drinking water wells within at least a mile downgradient of the site that could potentially be contaminated from the Flintkote site.

Therefore, since the site does not pose a significant threat to human health and the environment, it should not be further considered for listing on the state Registry of Inactive Hazardous Waste Sites. The plans for the site include construction of retail stores and parking areas. Such development will result in a decrease in the percolation of rainwater, a lowering of the water table and a decreased potential for any movement of VOCs through the groundwater. The zoning and site plan approvals will be completed pursuant to the requirements of the State Environmental Quality Review Act (SEQRA). We anticipate that all data compiled on the site will be subject to review by the DEC Divisions of Water and/or Solid Waste. However, prior to approaching these agencies, positive steps by Bureau of Hazardous Site Control will be necessary to remove this site from the list of candidates for hazardous waste preliminary site assessments.

Both Parkway and Flintkote request an expedited review of the summary report and decision on the disposition of the site. We are available on short notice to meet with you to discuss the findings, if that will assist you in the review process. In the near future, you will be receiving the full documentation on the study, including drill logs, field data sheets, laboratory reports, etc.

Your attention is appreciated.

Sincerely yours,

Stuart E. Bassell

Stuart E. Bassell, P.E.
Project Engineer

SEB/rms
Enc.

cc: John Swartwout (NYSDEC Eastern Investigation Section)
Ram Pergadia (NYSDEC Region 3)
Barry Tornick (Dames & Moore)
Dexter Lindberg (Flintkote)
Sean Mullany (Nixon, Hargrave, Devans & Doyle)
Eric Bergstol (Berbor Realty)
Neil Bordan (Berbor Realty)

BERBOR REALTY, INC.
New City, New York

SUMMARY REPORT

SOIL AND GROUNDWATER INVESTIGATIONS CONDUCTED ON BLOCK 754 OF THE FORMER ORANGEBURG PIPE MANUFACTURING SITE

Orangeburg, New York

April 1991

LMSE-91/0321&535/005

LAWLER, MATUSKY & SKELLY ENGINEERS
Environmental Science & Engineering Consultants
One Blue Hill Plaza
Pearl River, New York 10965

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CHAPTER 1

INTRODUCTION

1.1 PURPOSE

The site of the former Orangeburg Manufacturing Company in Orangeburg, New York (Figures 1-1 and 1-2), consists primarily of two blocks owned by the Flintkote Company (Block 443, Lot 1, and Block 754, Lot 1) and a block owned by Eric Bergstol (Block 756, Lots 1.1 and 1.2) that was also once owned by Flintkote. Mr. Bergstol is a principal of Berbor Realty, Inc., New City, New York. As detailed below, these properties have been the subject of extensive subsurface environmental investigations. The site also includes properties north of Highview Avenue.

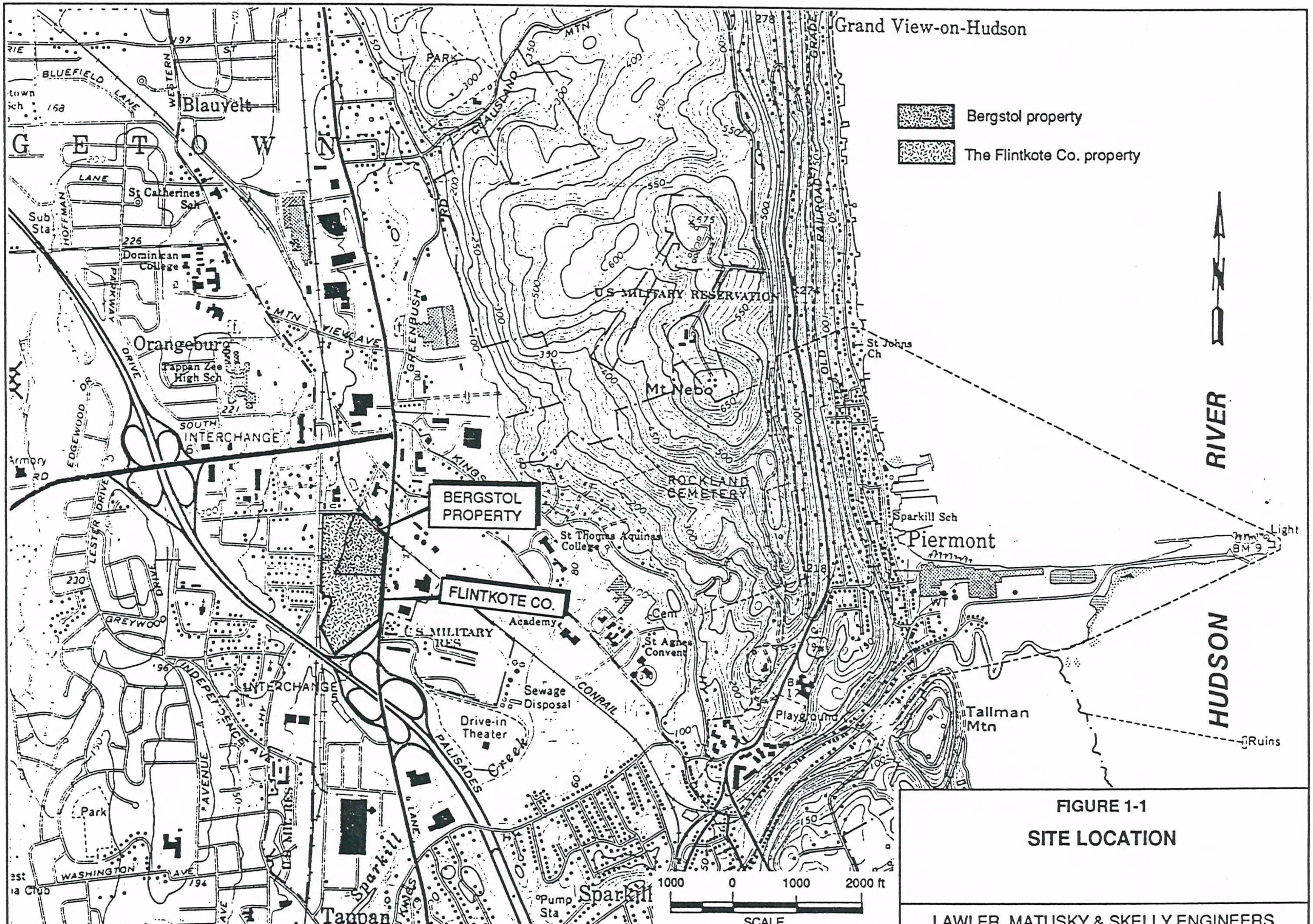
Until March 1991, a five-acre portion of the site was listed as a "2a" site on the New York State Registry of Inactive Hazardous Waste Sites. The listing was apparently based on the past practice of filling and leveling the site with pipe fragments generated during manufacturing.

This report summarizes the results of investigations conducted by Lawler, Matusky & Skelly Engineers (LMS) to describe the subsurface soil and groundwater at Block 754, one of two blocks (see Figure 1-2) that Berbor Realty is considering purchasing from Flintkote, the property's present owner. LMS conducted the investigation at the request of Berbor Realty.

LMS is in the process of preparing a detailed report that fully documents the investigations. This summary report is being issued to expedite review of the property by the involved parties and government agencies.

1.2 SITE DESCRIPTION

The three blocks owned by Flintkote and Eric Bergstol total 38 acres. They are bounded by Route 303, the Palisades Interstate Parkway, Conrail railroad tracks, and Highview Avenue -

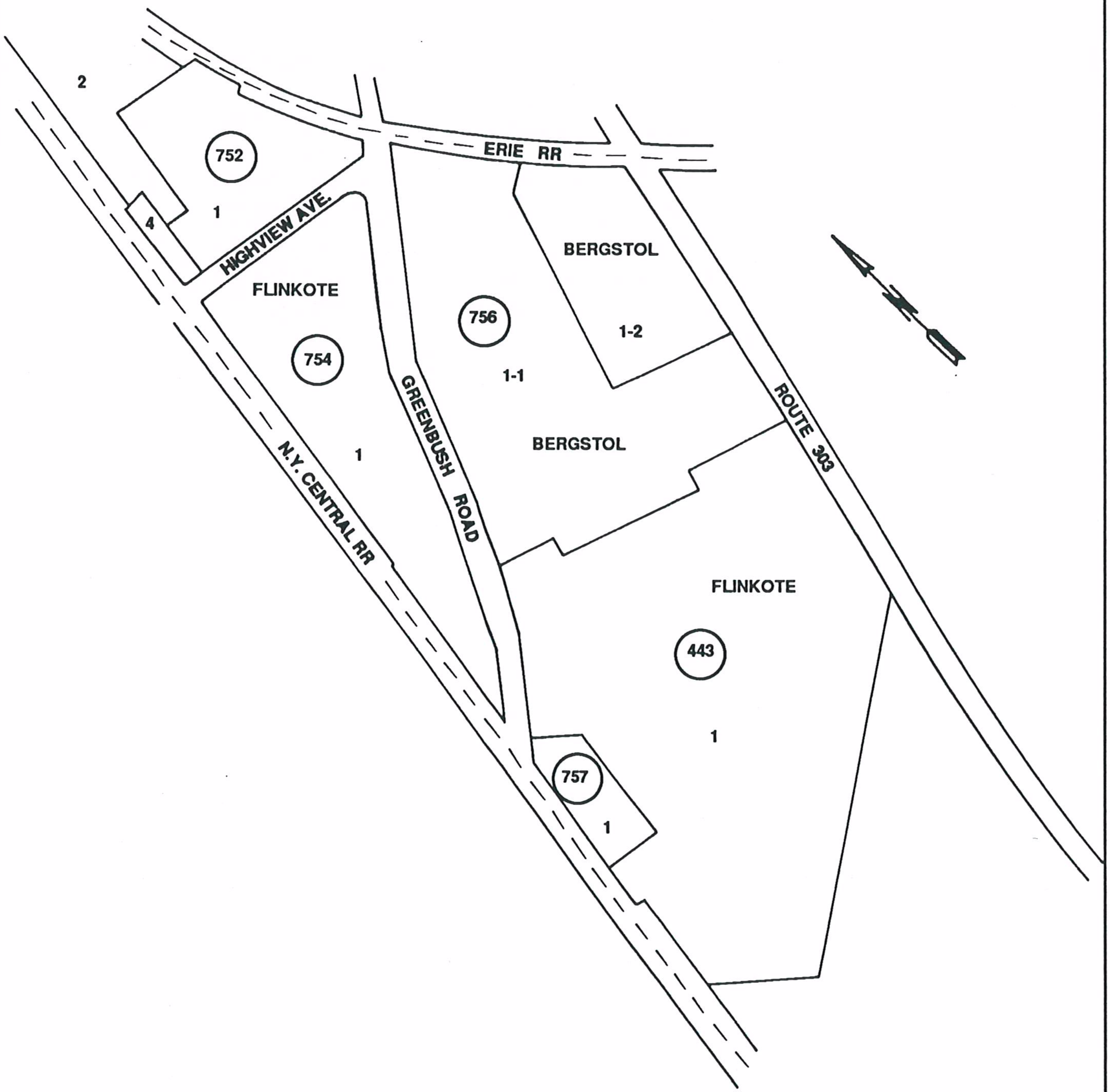


Source: Taken from USGS topographic map, Nyack, NY Quadrangle, 1973.

FIGURE 1-1

SITE LOCATION

LAWLER, MATUSKY & SKELLY ENGINEERS
One Blue Hill Plaza, Pearl River, NY



LEGEND

757 Block No.

1 Lot No.

FIGURE 1-2

PROPERTIES IN VICINITY OF FORMER ORANGEBURG MANUFACTURING SITE

LAWLER, MATUSKY & SKELLY ENGINEERS
Pearl River, New York

Greenbush Road on the east, south, west, and north, respectively. The south end of Greenbush Avenue separates Block 754 from the other parcels; one residence accesses that section of road.

All buildings associated with the pipe manufacturing plant have been demolished. A one-story restaurant (now closed) constructed subsequent to the demolition stands on the northeast edge of the Orangeburg Pipe site. Much of the land is still covered with concrete building slabs, pipe fragments, and asphalt paving. Commercial and noncommercial buildings, including the Orangetown town offices, a library, and a car dealership, are located north of the site; Blocks 443 and 754 are vacant.

The Rockland County Health Department files indicate that most of the area downgradient of the site is served by the Spring Valley Water Company (SVWC), a public water purveyor.

Farther downgradient of the site, along Sparkill Creek, SVWC has two well fields. The Sparkill well field is located in Tappan, off Kings Highway, about 1 mile from the site. One of the three wells (Well No. 8) was used continuously until closed in January 1990 because of gasoline contamination. It is rated at 225 gpm, but delivered 240 gpm. The well is constructed in rock and is 200 ft deep. The other two wells (No. 10 and No. 11) have been out of service for some time, and there are apparently no plans to rehabilitate them. The second well field is located in Piermont, approximately 3 miles from the site. The single well (No. 25) is reported to be constructed in the overburden and has a rated capacity of 400 gpm. This well has also been out of service for some time.

1.3 TOPOGRAPHY AND GEOLOGY

The land slopes gently from west to east. Elevation ranges from 86 ft above sea level in the southwest portion to 74 ft in the southeast. Soils on the site are listed as udorthents, which include man-made fill materials placed over somewhat poorly drained to very poorly drained soils (Rockland County Soil and Water Conservation District, unpub. data). Bedrock in this area is a sandstone conglomerate known as the Brunswick Formation (Perlmutter 1959), part of the Newark group of sedimentary rocks composed of sandstone, shale, and conglomerate rock formation of Triassic origin. The upper bedrock zone is moderately weathered. The site stratigraphy is characterized by four main units that are, in descending elevation, fill, organic and fine-grained marsh sediments, stratified glacial drift and till, and bedrock. Depth to bedrock is approximately 30-35 ft.

A tributary to Sparkill Creek originates on the southeast portion of the site and flows southeast. The tributary (No. H-13-6a-2) is currently a Class D stream; Sparkill Creek is classified A, B, C, or D, depending on the particular reach (6 NYCRR 856.3). Some portions of the creek and its tributaries, particularly those now classified as D, will undoubtedly be upgraded during the upcoming reclassification of the lower Hudson drainage basin.

1.4 SITE HISTORY

The facility began operation in 1893 as the Fibre Conduit Company, but was known more recently as the Orangeburg Manufacturing Company, or Orangeburg Pipe. In 1958 the company was acquired by Flintkote, which operated the site until it was closed in 1973. Mr. Bergstol purchased a now vacant restaurant property in 1986 (Block 756, Lot 1.2) and the adjacent parcel (Lot 1.1) in 1987. LMS has not researched the dates when the properties to the north of Highview Avenue were acquired from Orangeburg Pipe.

A report prepared in 1980 by EWK Consultants, Inc., describes the historical manufacturing process and ancillary operations on the site. That report, a 1966 fire insurance map, and a 1968 Flintkote site map provide most of the information for the discussion that follows.

Pipe manufactured at the facility was known as Orangeburg pipe. Before 1946 it was made by impregnating paper fiber cylinders with coal tar pitch. The cylinders were made from a paper-asbestos mixture from 1946 until 1970 when a magnesium oxide fibrous mineral called Wollastonite was used in place of asbestos. Limited quantities of plastic pipe and fittings were also manufactured on-site in later years. The manufacturing process did not involve polymerization. The original manufacturing was apparently conducted on the triangular property west of Greenbush Road (Block 754). Pipe not meeting quality standards was disposed of on-site as fill; as the facility expanded, the filled areas were either paved over for storage of finished product or covered with buildings. In this way the manufacturing expanded to the east and south.

The fire insurance map demonstrates that many of the manufacturing operations were located on the current Bergstol property. The property on the south (Block 443) was used mainly for storage.

The basic pipe manufacturing process was apparently relatively simple. Fiber was pulped in water and suction-filtered onto round mandrels to form a paper tube. The fibers were generally composed of waste paper augmented with additives such as diatomaceous earth, asbestos, or Wollastonite. The paper tubes were transferred to a kiln for drying, and the dried tubes were then impregnated with pitch composed of 70% hard coal tar pitch and 30% asphaltic pitch. This material was kept heated (340°F) in large tanks (approximately 10 ft in diameter and 14 ft high) that were capable of treating about 200 pipes at a time. After the pitch hardened, the pipes were broken apart, end-machined for tapered fittings, and, if used for drainage pipes, perforated. A water-based asphalt emulsion was applied to the pipe surface in later years.

Pitch was delivered by rail car and stored in a series of large aboveground tanks (25,000 to 30,000 gal) on the northwestern part of the Bergstol site. Overflow from the pulping process went to the on-site waste treatment plant after most of the fibers had been removed for recycling through the process. Small amounts of oils with low boiling points were also discharged from the heated pitch tanks to the waste treatment plant. Sludges from the lagoon located in the center of the Bergstol property was reportedly disposed of in borrow pits on the southern part of the Flintkote property. The exact location of these pits has not been identified, but the pits are believed to be those excavated for fill to construct the Palisades Parkway. Sanitary wastes were treated in a small primary plant; no information on sludge disposal is available, but some sludge may have been disposed of off-site. Both sanitary and industrial wastes were diverted to the Orangetown treatment plant in mid-1969. No sludge deposits have been encountered during the various LMS investigations of this site.

Coal was used to heat the pitch tanks as well as the buildings until approximately 1965 when conversion to fuel oil was made. Coal storage and the boiler and generator rooms were located on the present Bergstol property. Ash was apparently hauled off-site. Fuel tanks were located west of Greenbush Road and near the former coal storage area. The latter tanks appear to have been installed at the time of conversion to fuel oil. The EWK Consultants report contains a document certifying the removal of all tanks and stating that no leaks were found. No remaining tanks have been discovered by LMS. Other former facilities located on the Bergstol property include a filter house whose use is not known, a garage, a transformer pad, and several large buildings where paper was stored and the pipes manufactured. A laboratory was located within one of the large buildings; the types of tests conducted were not discussed in the report.

Numerous facilities were located on the property west of Greenbush Road, including a maintenance shop, tooling room, drying and forming rooms, transformer areas, and a shipping area. The plastic pipe facilities were also located west of Greenbush Road. Limited amounts of solvents were used in testing (EWK Consultants 1980), but no information is available on quantities, locations, or disposal practices. LMS has uncovered no record or report of hazardous waste disposal anywhere on the Flintkote site.

1.5 PREVIOUS STUDIES

1.5.1 EWK Consultants

In 1980 EWK Consultants prepared a site history and assessment of the past on-site disposal practices of the former pipe manufacturer. One groundwater monitoring well was constructed and sampled at that time.

1.5.2 LMS 1986

In 1986 LMS conducted a subsurface investigation of the more southern of the two Flintkote parcels (Block 443) for Kurdistan Properties, Inc., a prospective purchaser. Seventeen test pits were dug and 14 groundwater monitoring wells were installed. The upgradient wells were installed on the west side of Block 754. Soil, groundwater, and surface water samples were analyzed for priority and nonpriority pollutants. In addition, air monitoring for asbestos was conducted when the test pits were dug. The results were provided to the New York State Department of Environmental Conservation (NYSDEC) as a preliminary report on the investigation (LMS 1986).

Data from test pits and the soil borings advanced for the monitoring wells showed that Block 443 had been extensively filled with debris that ranges from 2 to over 12 ft in thickness. The debris consists of waste coal tar pipe, small quantities of plastic pipe, and demolition debris, including brick, wood, and metal fragments. The fill on the eastern half of Block 443 is underlain by organic silt deposits (peat) 1-4 ft thick. Glacial till and drift approximately 25-30 ft thick were found beneath the organic layer. The general direction of groundwater flow in the fill, glacial till and drift, and bedrock is from west to east.

LMS reported asbestos, base neutral extractable priority pollutants, petroleum hydrocarbons (PHCs), and some metals in groundwater in the fill; base neutral compounds, PHCs, and iron were identified in the glacial deposits. One groundwater sample from the bedrock also had detectable levels of base neutral compounds. No PCBs or pesticides were detected. Two acid extractable organic compounds (4-methylphenol and 2,4-dimethylphenol) were reported in one shallow monitoring well. Volatile organic compounds (VOCs) were detected in some groundwater samples at trace levels (less than 10 $\mu g/l$); LMS attributed this to laboratory contamination because some of the compounds (acetone and chloroform) were also found in trip and method blanks. LMS questioned the validity of the asbestos data and data for semivolatiles. The asbestos data were suspect because of the wide range in values reported on split samples sent to two different laboratories. Minute particles of fill in the well water, not groundwater contamination, is a possible source of the detectable base neutrals.

The original work scope submitted to NYSDEC encompassed Blocks 754 and 756. However, access could not be gained to Block 756 by Kurdistan Properties, Inc. Subsequent to the preparation of LMS' preliminary report, Kurdistan Properties' purchase option on the several properties expired and the LMS study was not completed.

1.5.3 Dames & Moore 1988

In 1988 Dames & Moore, retained by Flintkote, redeveloped and sampled the monitoring wells constructed by LMS. Dames & Moore confirmed that base neutral compounds were present in the groundwater in the saturated fill, but found no groundwater contamination in the glacial deposits or bedrock. The further development of the monitoring wells lowered the well water turbidity and removed soils containing the base neutral compounds from the well and surrounding pack.

1.5.4 LMS 1990

In 1989 LMS was retained by Rockland Parkway Enterprises, Ltd., of which Eric Bergstol is a principal, to complete a soil and groundwater study of Block 756, the current Bergstol property. Fifty-five borings were advanced, eight of which were completed as groundwater monitoring wells. Groundwater samples were analyzed for priority and nonpriority pollutant volatile and semivolatile compounds and metals as well as PCBs and PHCs. Soil samples were similarly tested except that no volatiles analyses were conducted. The results were reported to NYSDEC (LMS 1990).

Initial sampling indicated that semivolatile compounds occurred over a wide area in the groundwater at Block 756. The wells were redeveloped and sampled again. No semivolatile compounds were detected in this subsequent sampling. Findings in this regard were similar to those for Block 443 to the south. No PCBs were detected in any groundwater or soil samples.

Unlike the results for Block 443, VOCs were discovered in the groundwater at Block 756. The highest concentrations were found in upgradient well MW-18. The dominant chemical was 1,1-dichloroethane, which ranged from 150 to 700 µg/l in concentration. Chloroethane, 1,2-dichloroethane, 1,1-dichloroethylene, and 1,1,1-trichloroethane were present in at least one water sample collected from MW-18. The findings suggested that 1,1,1-trichloroethane might have been released upgradient of Block 756. (The other four compounds listed above are common environmental breakdown products of 1,1,1-trichloroethane.)

subsurface conditions near the former plastics processing building and to provide an overall profile of the soils on this property.

CHAPTER 2

FIELD INVESTIGATIONS

This chapter briefly summarizes the procedures used during the field investigations.

2.1 GROUND PENETRATING RADAR (GPR)

On 18 October 1990 GPR was employed to help determine whether subsurface structures were present at the proposed drilling locations in Block 754. The survey was conducted by Subsurface Consulting Ltd. of New Fairfield, Connecticut. Approximately 3000 linear feet of radar scans were run at 10-ft intervals, encompassing about 5000 ft^2 of area. The survey utilized 300- and 500-Mhz antennas. Although the site had been cleared of brush and small trees beforehand, the disturbance of the terrain and extent of concrete foundation limited the survey.

On 16 November 1990 a second GPR survey was run in an area of the site where underground tanks were indicated, according to old insurance maps and interviews with a local resident. Additionally, the location of a possible tunnel near Greenbush Road was screened. Over 4800 linear feet of radar scans (300 and 500 Mhz) that encompassed an area of approximately 5500 ft^2 were studied. The presence of the underground tanks and the tunnel were indicated by the GPR and were subsequently investigated further with a backhoe (see Section 2.6.1).

2.2 SOIL GAS

A soil gas survey was conducted on 28 October 1990 to help identify the source of 1,1,1-trichloroethane found at MW-18. Analyses were conducted on-site by Tetra-K Testing of Westfield, Massachusetts, with an HNU Model 421 gas chromatograph equipped with photoionization, flame ionization, and electron capture detectors (PID, FID, and ECD).

Attempts were made to complete 10 probes. Three (SG-1, SG-2, and SG-3) were abandoned because of the inordinate amount of time it took to penetrate the ground with a rotary hammer. Four probes yielded no sampleable gas because the surficial soil was wet and tight; one of these probes (SG-16) produced sufficient water for a VOC test (trichloroethylene and perchloroethylene were reported present at concentrations below the method quantification limits of 5 and 10 μg/l, respectively).

Gas samples were collected at SG-17, SG-18, and SG-30. Only the SG-18 sample contained detectable concentrations of VOCs:

Perchloroethylene	0.36 ppm
Benzene	Present below 0.01 ppm
Xylene	Present below 0.15 ppm

The locations of these probes are shown in Figure 2-1.

Originally, 30 soil gas probes had been planned for the investigation. However, because of the wetness and tightness of the soils and the low concentrations present, this portion of the program was curtailed.

2.3 DRILLING AND MONITORING WELL CONSTRUCTION

During 5-12 November 1990, 13 shallow (less than 14 ft) borings were advanced with continuous split-spoon sampling by Kendrick Enterprises of Monroe, New York. The locations of these borings are depicted on Plate 1 at the back of this report. One of the borings (MW-22) was completed as a monitoring well (2-in.-diameter piezometer in an 8-in. 00 Morie sand pack). Ten were completed as water level observation piezometers (1.25-in. in diameter in a 6-in. 0 Morie sand pack). Only one monitoring well was constructed. However, eight of the 10 piezometers were used to collect groundwater samples. It should be noted that only three (B-17, B-20, and B-21) of the 10 piezometers had fully penetrating screens (screening across the water table).

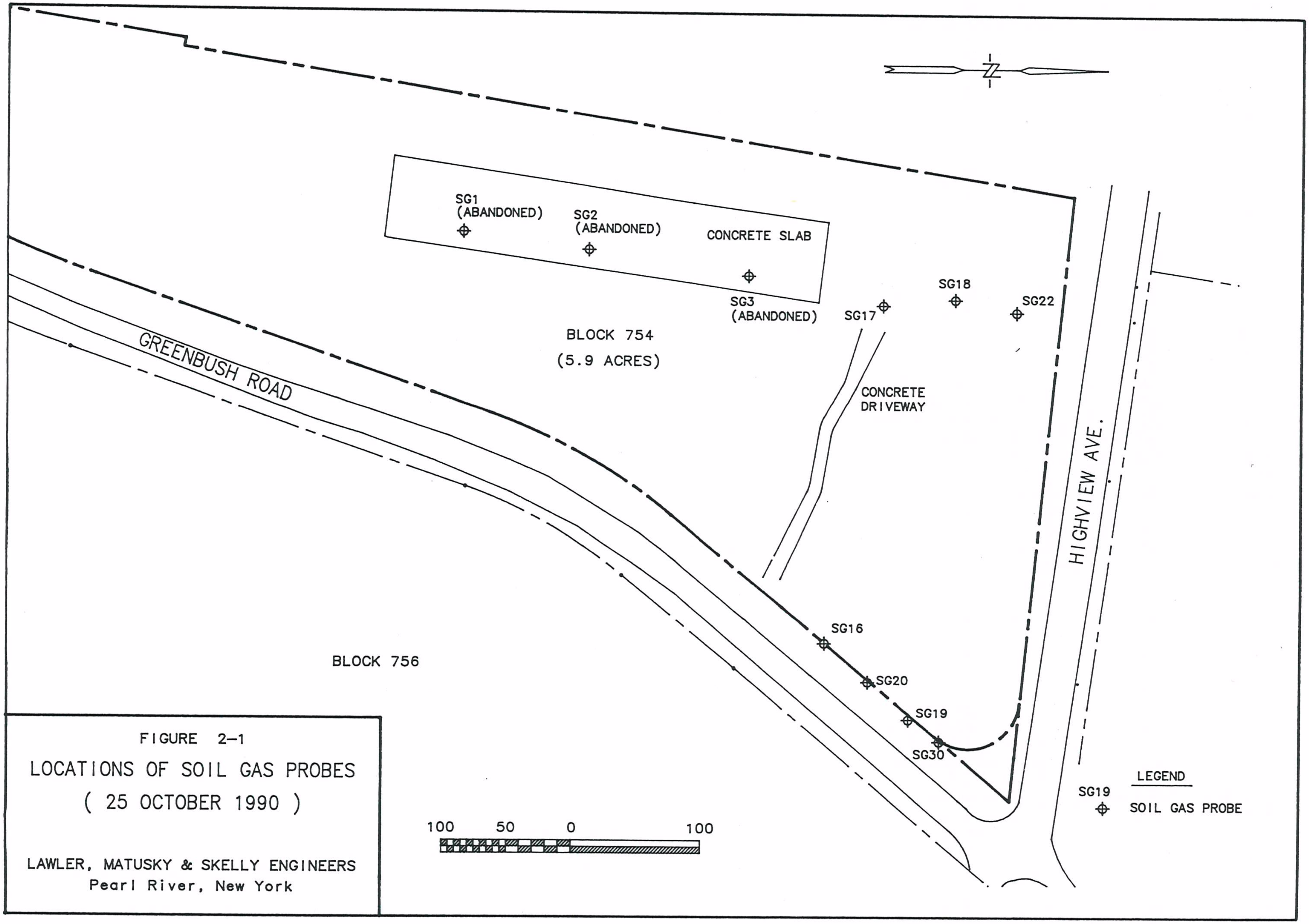


FIGURE 2-1

LOCATIONS OF SOIL GAS PROBES

(25 OCTOBER 1990)

LAWLER, MATUSKY & SKELLY ENGINEERS
Pearl River, New York

Two additional shallow, prepacked wells (PP-1, 20 February 1991; PP-2, 8 February 1991) were installed in test pits completed with a backhoe (see Section 2.6).

Oil-saturated soil was encountered throughout the completed borehole at B-11, positioned downgradient of the former fuel oil tanks. LMS reported these findings to the Rockland County Health Department (RCHD) and NYSDEC (NYSDEC Spill No. 90-08717; RCHD Spill No. 90-163).

2.4 DEVELOPMENT

On 20, 21, and 26 November 1990 development was completed for MW-22, B-6, B-9, B-14, B-17, B-18, and B-20. Final turbidities for all locations were less than 50 NTU.

On 5 February 1991 B-11 was developed and B-6, MW-18, and MW-22 were redeveloped because of anomalously high concentrations of semivolatiles in samples collected at these locations in December 1990. MW-20 was also redeveloped at that time. Final turbidities were below 15 NTU.

On 25 February 1991 PP-1 and PP-2 were developed. Final turbidities were below 20 NTU.

2.5 GROUNDWATER SAMPLING

On 11 December 1990 groundwater samples were collected from MW-18, MW-20, B-6, B-9, B-14, B-17, B-18, and B-20. All samples were analyzed for VOCs (Method 624), base neutrals (Method 625), and petroleum hydrocarbons (Method 418.1) by CAMO Laboratories of Poughkeepsie, New York. Metals, PCBs, acid extractable compounds, and asbestos were not tested for as these analytes were found to be of no concern for the downgradient properties.

On 5 February 1991 a sample of floating oil in MW-18 was collected for analysis for VOCs and base neutrals.

On 12 February 1991 MW-18, MW-20, MW-22, B-6, and B-11 were resampled for VOCs. A base neutral sample was also collected from MW-18. Two sets of VOC and base neutral samples were collected from MW-18, one with a peristaltic pump and Teflon tubing (silicone tubing in the pump head) and the other with a conventional Teflon bailer. The purpose was to determine the impact of sampling methods on the groundwater sample. It was theorized that the bailer surged formation fines from the well bottom/pack into the sample, resulting in erroneously high semivolatiles concentrations in the December samples. The volatiles samples for MW-20, MW-22, B-6, and B-11 were collected with a peristaltic pump rather than with a bailer, as had been specified in the work plan; based on the special study for MW-18, this procedure did not have an adverse impact on the samples (see Chapter 3).

On 5-6 March 1991 the new prepacked wells (PP-1 and PP-2) were sampled for VOCs and base neutrals; B-6 was resampled for base neutrals only. The base neutral samples were collected with a peristaltic pump.

On 9 April 1991 a water sample was collected from B-11 for VOC analysis.

2.6 TEST PITS

2.6.1 18 January 1991

On 18 January 1991 a backhoe was mobilized to access a subsurface tunnel shown by the fire insurance map to lead from the center of Block 754 to the immediate vicinity of MW-18. It had been theorized that, in light of the generally low VOC concentrations measured in the Block 754 groundwater samples (Chapter 3), the tunnel may have been the route by which chemicals migrated to MW-18. The tunnel was successfully accessed (Plate 1) and was found to contain 1-4 ft of water, which was sampled for VOCs and none were found, indicating that the tunnel is not the source of VOCs at MW-18. Debris in the tunnel blocked its exploration.

2.6.2 **7-8 February 1991**

On 7-8 February 1991 several test pits and trenches were dug at Block 754. Test pits TP-1, TP-2, TP-3, TP-4, and TP-5 were completed along the east (downgradient) side of a concrete slab that held the plastics processing building, according to the old fire insurance map. A sixth pit was completed to construct a prepacked well (PP-2). Soil samples from each of the five pits were collected for VOC analyses; the soil in TP-2 was tested for base neutrals.

Groundwater was encountered in all pits. At TP-3 a broken pipe filled with water was quickly emptied. The water had a slight sheen; a sample of the liquid in the pit was collected for VOC analysis. At TP-5 another broken pipe yielded oily water that flooded the pit. This water was also sampled for VOC analysis.

Test pits TP-6, TP-7-1, TP-7-2, and TP-8 were dug along Greenbush Road to determine whether oil might be crossing under Greenbush Road from Block 754 to MW-18. Test pits TP-6, TP-7-2, and TP-8 did not exhibit any oil contamination. Groundwater was encountered in all pits. Although a sheen was observed in TP-7-1, the signs of oil in this test pit do not explain the levels of contamination found in samples drawn from MW-18.

TP-8 was completed as a south-to-north trench along the east edge of a concrete foundation slab shown on the 1968 map as a maintenance area. At the north end of the trench, a broken pipe originated out of the south face of the concrete foundation wall. The water that flooded the pit was sampled for VOC analysis.

TP-9 was completed as a west-to-east trench along the subsurface trench that had been accessed on 18 January. The objective was to study the alignment of this structure to gain insight into the possible influence on groundwater and oil migration. From the January access point, the tunnel was followed for approximately 100 ft before it disappeared beneath a large concreted area. The tunnel was largely filled with rubble. At one point (Plate 1) the trench flooded and a water sample was collected for VOC analysis. Soil saturated with oil was discovered during the exploration of the area southwest of the concrete between MW-22 and B-11. At that point the digging was stopped.

The area identified by the GPR as possibly still containing underground tanks was also excavated on 7 February. A brick vault was unearthed, but no tanks were found.

2.6.3 **20 February 1991**

On 20 February 1991 six test pits (TP-A, TP-B, TP-C, TP-D1, TP-D2, and TP-E) were advanced on Block 756, the Bergstol property, near MW-18. Water samples were collected from each pit for VOC analysis. Soil samples were also collected from TP-A and TP-B for VOC analysis. A prepacked well (PP-1) was installed in a seventh pit. The objective of this activity was to investigate the extent of oil in the subsurface and determine how subsurface structures might be affecting the migration of the oil and VOCs.

During the course of digging it became clear that MW-18 had been constructed close to a subsurface foundation wall. A pipe (broken at TP-B) parallels this subsurface wall and aligns (east-west) almost directly with MW-18. The pipe had been laid in a permeable gravel bedding, now oil saturated. A sample of water draining from the pipe was collected for VOC analysis.

2.7 SURFACE WATER SAMPLING

On 11 December 1990 surface water samples were collected from the drainage system at two locations identified as S-1 and S-2 (Plate 1). Soil samples were also collected from the stream bottom. Both sets of samples were analyzed for VOCs and base neutrals.

CHAPTER 3

RESULTS

3.1 CHEMICAL SUMMARY

The chemical data gathered on soil, groundwater, surface water, and test pit water samples during the investigations are summarized in the following tables:

Table 3-1	*VOC and PHC Chemical Summary for MW-18 and PP-1 Groundwater Samples.* These wells are on the Bergstol property. This table also summarizes the data on the 1989 LMS samples for MW-18.
Table 3-2	*Base Neutrals Chemical Summary for MW-18 and PP-2 Groundwater Samples.* These data are displayed similarly to those in Table 3-1.
Table 3-3	*Chemical Summary for Groundwater Samples Collected Along Greenbush Road and Highview Avenue.* VOC, PHC, and base neutrals data are summarized in this table for the nine wells located along these two streets. The results for the 1989 MW-20 samples are also presented.
Table 3-4	*Chemical Summary for Groundwater Samples Collected From MW-22, PP-2, and B-11.* These wells are located near the center of Block 754.
Table 3-5	*Chemical Summary for Surface Water and Test Pit Sampling.* This table notes whether the test pit water samples were derived from a pipe drainage or ground seepage into the pit.
Table 3-6	*Base Neutral Concentrations for Surface Water and Test Pit Samples.* This table supplements the information summarized in Table 3-5 for the seven samples analyzed for base neutrals.

The 5 February 1991 MW-18 oil sample had to be diluted 5000 and 10,000 times for the VOC and base neutral analyses, respectively. With such high dilutions only three VOCs and two base neutrals were detected at concentrations below the practical quantitation limit:

TABLE 3-1

VOC AND PHC CHEMICAL SUMMARY FOR MW-18 AND PP-1 GROUNDWATER SAMPLES

(Block 756)

	MW-18								PP-1
							2/12/91		
PARAMETER	**2/24/89 PREDEVELOPMENT**	**3/14/89**	**5/25/89**	**8/31/89 (PHC ON 8/25)**	**11/1/89 (1,1-DCA ONLY)**	**12/11/90**	**PUMP**	**BAILER**	**3/5-6/91**
Volatiles (ug/l)[a]									
Chlorobenzene	15				-				
Chloroethane		60	61		-	260	160	130	
1,1-Dichloroethane	700	480	240	150	210	160	140	120	
1,2-Dichloroethane		5			-	8	6	6	
Ethylbenzene	13				-				
Tetrachloroethylene	36				-				
Toluene	26				-				
1,1,1-Trichloroethane	60	14	18		-				
Xylenes	73		20		-				
PHC (mg/l)	170	2.8	1.0	800	-	558	-	-	-

- Not analyzed.

[a]None detected except as noted.

TABLE 3-2

BASE NEUTRALS CHEMICAL SUMMARY FOR MW-18 AND PP-2 GROUNDWATER SAMPLES

(Block 756)

PARAMETER	MW-18					PP-1
				2/12/91		
	3/14/89[b]	5/25/89[b]	12/11/90	PUMP[b]	BAILER[c]	3/5-6/91[b]
Base Neutrals[d]						
Anthracene					13	
Benzo(a)anthracene			530		85	
Bis(2-ethylhexyl)phthalate					64	
Chrysene			410			
Fluoranthene	12		500	15	130	
Fluorene					11	
Naphthalene					14	
Phenanthrene			120		33	
Pyrene	21		2800	18	120	
Benzo(b)fluoranthene			490		62	
Benzo(k)fluoranthene			460		55	
Benzo(a)pyrene			430		64	
Acenaphthene					13	

[a]Also acid extractables analysis: only tentatively identified compounds (TICs) detected with a total concentration of 36 μg/l.
[b]Collected with peristaltic pump.
[c]Also indeno(1,2,3-cd)pyrene: 25; benzo(g,h,i)perylene: 25; N-nitrosodiphenylamine: 10.
[d]None detected except as noted.

TABLE 3-3

CHEMICAL SUMMARY FOR GROUNDWATER SAMPLES COLLECTED ALONG GREENBUSH ROAD AND HIGHVIEW AVENUE

PARAMETER	ALONG GREENBUSH ROAD									ALONG HIGHVIEW AVENUE		
	B-6			B-9	MW-20				B-14	B-17	B-18	B-20
	12/11/90	2/12/91[a]	3/5-6/91[b]	12/11/90	7/26/89[a,b]	8/31/89 PHC on 8/25	12/11/90	2/12/91[a]	12/11/90	12/11/90	12/11/90	12/11/90
Volatiles[c]												
1,1-Dichloroethane			-	18	10	9	18	6				
PHC	25	-	-	<3	1	<0.5	<3	-	<4	8	2	3
Base Neutrals[c]								-				
Phenanthrene	20	-				-		-				
Fluoranthene	240	-				-		-				
Pyrene	100	-				-		-				
Benzo(a)anthracene	130	-				-		-				
Chrysene	130	-				-		-				
Benzo(b)fluoranthene	190	-				-		-				
Benzo(k)fluoranthene	130	-				-		-				
Benzo(a)pyrene	150	-				-		-				
Fluorene		-			37	-		-				
Acenaphthene		-			170	-		-				

\- Not analyzed.
[a]Volatiles sample collected with peristaltic pump.
[b]Base neutral sample collected with peristaltic pump.
[c]None detected except as noted.

TABLE 3-4

CHEMICAL SUMMARY FOR GROUNDWATER SAMPLES COLLECTED FROM MW-22, PP-2, AND B-11

PARAMETER	MW-22		PP-2	B-11	
	12/11/90	2/12/91[a]	3/5-6/91[b]	2/12/91[a]	4/9/91
Volatiles[c] (µg/l)					
1,1-Dichloroethane	24	19			4
1,1,1-Trichloroethane	65	52			
PHC (mg/l)	4	-	-	-	-
Base Neutrals[c]					
Pyrene	10	-		-	-
Anthracene	39	-		-	-
Fluorene	12	-	13	-	-
Acenaphthene		-	25	-	-
Phenanthrene		-	13	-	-

\- Not analyzed.
[a]None detected except as noted.
[b]Sample collected with peristaltic pump.
[c]Base neutral sample collected with peristaltic pump.

TABLE 3-5

CHEMICAL SUMMARY FOR SURFACE WATER AND TEST PIT SAMPLING

SAMPLE LOCATION	MATRIX	PHC (mg/l or mg/kg)	VOC (µg/l or µg/kg)[a] 1,1-DICHLOROETHANE	VOC 1,1,1-TRICHLOROETHANE	VOC OTHERS	BN (µg/l or mg/kg)[b] No. OF COMPOUNDS	BN TOTAL CONCENTRATIONS
12/11/90							
S-1	W	<3				0	
S-1	S	8800				13	811
S-2	W	58				9	642
S-2	S	1800				13	881
1/18/91							
Tunnel-1	W	-				-	-
2/7-8/91							
TP-1	S	-				-	-
TP-2	S	-				7	207.2
TP-3	S	-		8[a]	c	-	-
TP-3	W (Pipe)	-				-	-
TP-4	S	-				-	-
TP-5	S	-		25		11	911
TP-5	W (Pipe)	-				-	-
TP-6	S	-				11	311.8
TP-6	W	-				-	-
TP-7-1	S	-				-	-
TP-7-2	W	-				-	-
TP-8	W (Pipe)	-	720	12,000	d	-	-
TP-9	W	-				-	-
2/20/91							
TP-A	W	-	160			-	-
TP-A	S	-			e	-	-
TP-B	W (Pipe)	-	1200	11,000		-	-
TP-B	S	-	579		f	-	-
TP-C	W	-				-	-
TP-D1	W	-				-	-
TP-D2	W	-				-	-
TP-E	W	-			g	-	-

B - Compound present in method blank.
W - Water
S - Soil
\- Not analyzed
[a]None detected except as noted.
[b]See Table 3-6 for additional information on base neutrals.
[c]Chloroform 8 µg/kg.
[d]Toluene 1000 µg/l, ethylbenzene 650 µg/l, xylenes 3500 µg/l.
[e]Methylene chloride 7 µg/kg (B), acetone 55 µg/kg (B).
[f]Methylene chloride 239 µg/kg (B), acetone 1400 µg/kg (B), 4-methyl-2-pentanone 316 µg/kg, chlorobenzene 447 µg/kg.
[g]Chloroethane 13 µg/l.

TABLE 3-6

BASE NEUTRAL CONCENTRATIONS FOR SURFACE WATER AND TEST PIT SAMPLES

COMPOUND[a]	CONCENTRATION (mg/kg or µg/l)						
	S-1 (12/11/90)		S-2 (12/11/90)		2/7-8/91		
	WATER	SOIL	WATER	SOIL	TP-2 SOIL	TP-5 SOIL	TP-6 SOIL
Fluoranthene		66	55	37	77	113	45
Pyrene		257	89	366	94	169	48
Benzo(a)anthracene		68	58	74	7.6	133	35
Chrysene		69	70	83	8.4	122	37
Benzo(b)fluoranthene		65	83	60	6.0		41
Benzo(k)fluoranthene		55	66	54	6.9	169	29
Benzo(a)pyrene		60	89	68	7.3		38
Indeno(1,2,3-cd)pyrene		22	32	22		31	8.8
Benzo(g,h,i)perylene		17	30	25			8.4
Dibenzo(a,h)anthracene				6		16	
Anthracene		17		15		28	5.8
Phenanthrene		87		65		101	16
Acenaphthylene		18		6		16	
Fluorene		10				13	

[a]None detected except as noted.

COMPOUND	ESTIMATED CONCENTRATION (µg/l)
1,1-Dichloroethane	3900
Toluene	3300
Ethylbenzene	3100
Fluoranthene	8000
Pyrene	9000

3.2 SAMPLING METHOD

On 12 February 1991 pairs of VOC and base neutral samples were collected with a Teflon bailer and a peristaltic pump. Except for a short length of silicone tubing in the pump head, Teflon tubing was used with the pump. Although it is known that high static lifts with a peristaltic pump can result in the loss of volatiles from a groundwater sample, researchers have shown that more representative VOC samples can be obtained with a peristaltic pump in low lift conditions. The lifts for the wells sampled for the Block 754 investigations are only a few feet.

Table 3-1 indicates that higher VOC concentrations were measured in the MW-18 sample collected with the peristaltic pump than in the one collected with the bailer. The conclusion, therefore, is that the analytical results for the several VOC samples collected with the peristaltic pump are representative of the actual chemistry of the groundwater.

Table 3-2 provides a comparison of base neutral concentrations in samples collected with a pump and bailer. Only two compounds were present, at concentrations of 15 and 18 µg/l, in the pump sample. The bailer sample contained 12 compounds with a total concentration of 664 µg/l. The VOC test demonstrates that the pump collected representative samples. Therefore, it is concluded that the base neutrals reported in the bailer sample are a result of solid particles from the formation being surged into the water column, not the actual condition of the groundwater. This bias is present for any well, particularly shallow ones, constructed over the site fill.

4.2 RELATIONSHIP OF THE OIL AND VOCs

One of the questions resulting from the 1989 LMS investigation of Block 756 was whether the oil and VOCs had migrated separately (or from separate spills) to MW-18 or whether these substances were the result of a single VOC-contaminated oil source. The oily soil at Block 754 appears largely free of VOCs: the groundwater at B-11, screened in oily soil, contains only 4 µg/l of 1,1-dichloroethane.

The soil encountered in the borings (B-9, B-12, MW-20, and B-14), test pits (TP-6, TP-7-1, TP-7-2), and trench (TP-8) on the west side of Greenbush Road evidenced no, or little, oil: sheens were present in the test pit water at B-6 and B-9 and an oil sheen and odor were present in the 4-6 ft deep soil at MW-20. Therefore, there is little evidence that the oil around MW-18 is derived from Block 754.

Near MW-18, VOCs have concentrated in the oil.

4.3 SOURCE OF VOCs

The major objectives of these investigations were to find the source of any VOCs migrating to MW-18 and to identify the amount and source of any VOCs in the groundwater on the Flintkote property. The results of the groundwater sampling (generally low VOC concentrations in the Block 754 groundwater), do not support the groundwater transport of VOCs to MW-18.

Subsurface pipes (6-8 in. diameter Orangeburg Pipe) encountered at TP-8 and TP-B contained water with the following chemicals:

	CONCENTRATION (μg/l)	
	TP-8	TP-B
1,1,1-Trichloroethane	12,000	11,000
1,1-Dichloroethane	720	1,200
Toluene	1,000	<500
Ethylbenzene	650	<500
Xylenes	3,500	<500

The pipe at TP-B was almost in a direct line with MW-18. It had been speculated that the drilling for MW-18 had fractured this pipe, thus accounting for the VOCs in the groundwater samples collected from this well. However, the well water contains primarily degradation products and the pipe water contains primarily parent chemical, which discounts that theory.

4.4 CONCLUSIONS

LMS has completed a comprehensive investigation of the Flintkote site. Intensive investigation efforts were directed at the 100 ft by 200 ft area in the vicinity of MW-18, B-9, TP-8, and TP-9: construction of seven groundwater monitoring wells (six having been sampled), 10 test pits from which six water samples and two soil samples were collected for VOC analyses, and about 100 ft of backhoe trenching.

The highest concentration of VOCs in any groundwater sample was collected in downgradient well MW-18. Although those compounds were present in the four upgradient wells sampled (MW-20, MW-22, B-9, and B-11), the concentrations were far below those measured at MW-18. No VOCs were measured in the soil or water samples collected from TP-7-1 and TP-7-2, which are located next to or in between these wells. Water samples collected from downgradient test pits TP-D1, TP-D2, and TP-C were largely free of VOCs (13 μg/l in TP-C water). Therefore, groundwater flow from Block 754 does not appear to be the cause of the VOCs at MW-18. No distinct pattern of VOCs in present in the wells or test pits, thus VOCs are localized with no clearly apparent specific source.

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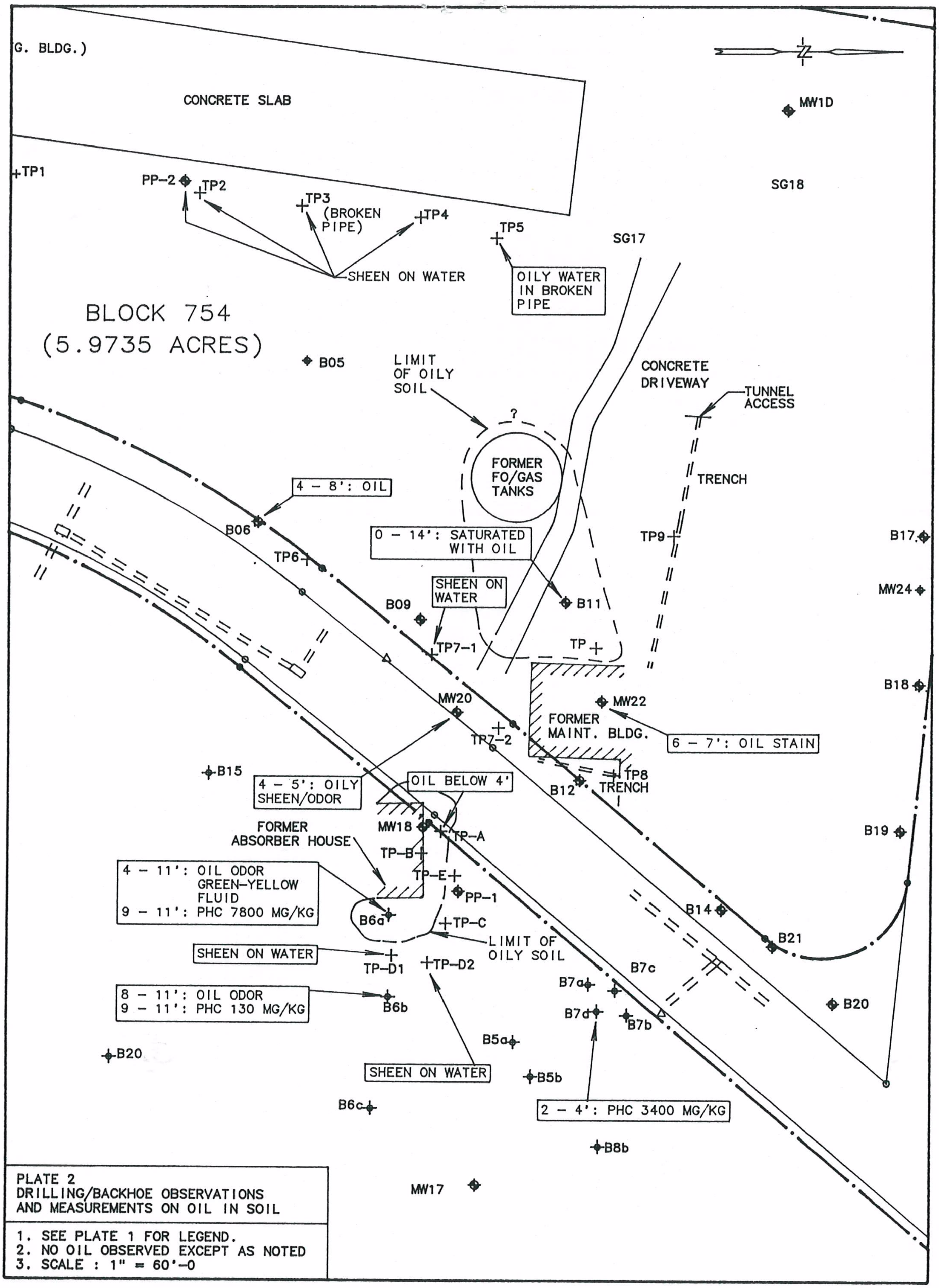

PLATE 2
DRILLING/BACKHOE OBSERVATIONS AND MEASUREMENTS ON OIL IN SOIL

1. SEE PLATE 1 FOR LEGEND.
2. NO OIL OBSERVED EXCEPT AS NOTED
3. SCALE : 1" = 60'-0