COMPILATION OF HISTORICAL C-8 DATA DUPONT WASHINGTON WORKS MAIN PLANT AND LANDFILLS

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CORPORATE REMEDIATION GROUP
An Alliance between
DuPont and URS Diamond

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1.0 INTRODUCTION

A multi-media Consent Order was entered into between the West Virginia Department of Environmental Protection (WVDEP), the West Virginia Department of Health and Human Resources-Bureau for Public Health (WVDHHR-BPH) and DuPont on November 14,2001. A copy of the Consent Order (Order No. GWR-2001-019) is contained in Appendix 1.

The Consent Order identified a series of requirements to be performed by the Parties (WVDEP, WVDHHR-BPH, and DuPont) in order to determine whether there has been any impact on human health and the environment as a result of releases of ammonium perfluorooctanoate (C-8), CAS Number 3825-26-1, to the environment from DuPont operations at the Washington Works main plant and the associated landfills (Local, Letart and Dry Run). The C-8 Groundwater Investigation Steering Team (GIST) was established in the Consent Order to oversee investigations and activities that will be conducted to assess the presence and extent of C-8 in drinking water, groundwater, and surface water at and around the main plant, and the Local, Letart and Dry Run Landfills.

Pursuant to Attachment A of the Consent Order, three tasks will be performed by DuPont and evaluated by the GIST, Tasks A, B, and C. This report addressed Task B. The primary objective of Task B is to develop and implement a monitoring plan that determines the presence and extent of C-8 in drinking water, groundwater and surface water in and around the main plant, and the Local, Letart and Dry Run Landfills, and to provide a compilation of available groundwater/surface water monitoring results and hydrogeologic characterization data for each location. This document was prepared to meet the data compilation objective.

1.1 Document Organization

Sections 2.0, 3.0, 4.0, and 5.0 present the historical data available for the main plant and the Local, the Letart and the Dry Run Landfills, respectively. Each section includes text, tables, and figures specific to the site being discussed in that section. At the end of each section, data gaps are identified. The same outline is used for each section. Data presented in each section includes information (to the extent that information was available) as requested in Table A-1 of the Consent Order. In addition, supplemental information is provided as needed to develop and present a site conceptual model for the four locations discussed.

1.2 C-8 Historical Laboratory Analysis of *C-8*

The analytical method, method detection limit, and laboratory utilized for C-8 analysis has changed over time. Prior to 1991, DuPont performed C-8 analysis at the DuPont Experimental Station in Wilmington, Delaware. In 1991, when the RCRA Verification Investigation was conducted, the analysis was contracted to the CH_2MHill Laboratory in Montgomery, Alabama. Both labs used a Gas Chromatography/Mass Spectrometry based analytical method with detection limits for C-8 that ranged from 0.1 to 1.0 ug/l.

CH_2MHill conducted C-8 analysis for **DuPont** into the fall of 1998 when the laboratory ceased operation. At that time, DuPont had completed one round of analysis for the RCRA Facility Investigation (RFI). The analytical work was transferred to Lancaster Laboratories, Lancaster, **PA,** for the RFI second round analysis in February 1999. Lancaster Laboratories continued to conduct **C-8** analysis using GC/MS for DuPont until October 2001, when development and testing was initiated on a new analytical method developed by Exygen Research, Inc. (located in State College, PA) that utilizes Liquid Chromatography/Tandem Mass Spectrometry (LC/MS/MS). DuPont adopted the use of LC/MS/MS for **C-8** analysis in November 2001.

DuPont intends to submit to WVDEP/EPA all documentation relating to C-8 analysis using the LC/MS/MS. The analytical methodology, sampling methodology, and applicable quality control/quality assurance program will be documented in a Quality Assurance Project Plan (QAPP) to **be** submitted to the Groundwater Investigation Steering Team (GIST) in early 2002.

1.3 Physicochemical Data for Ammonium Perfluorooctanoate (C-8)

C-8, also identified as FC-143, is a fluorinated surfactant used in the fluropolymer manufacturing at the main plant. Figure 1.0 shows the solubilities of $C_7F_{15}COOM$ in water as a function of temperature (Figure 6.9 in Kissa, 1994). The following summary lists the physicochemical data available for C-8 (Kissa, 1994):

- Molecular Formula = $CF_3(CF_2)_6COO^-NH_4^+$
- Molecular weight = 431.098 g/mole
- LD_{50} acute oral rat = 680 mg/kg
- BCF = 1.8
- pH = 5 (0.5% aqueous)
- pKa = 2.8 (-COOH)
- Melting Point = 56-53°C (-COOH)
- COD = 700 mg/kg
- Koc = 25
- Water Solubility > 1000 mg C-8/L
- Vapor pressure (at 22°C) = 7.1×10^{-05} mm Hg
- Kraft Point = 2.5 °C
- Critical Micelle Concentration = 33 mmol/L

LD_{50}: Lethal Dose 50 – Dose having 50% probability of causing death
BOD_{20}: Biochemical Oxygen Demand – Standard measurement is made for 5 days at 20 degrees C
BCF: Bioconcentration Factor
pKa: Negative log of the ionization constant – Measure of acidity or acid strength
COD: Chemical Oxygen Demand
Koc: Organic Carbon Partitioning Coefficient

1.4 References

Kissa, E. 1994. Fluorinated Surfactants. New York: Marcel Dekker, Inc.

FIGURES

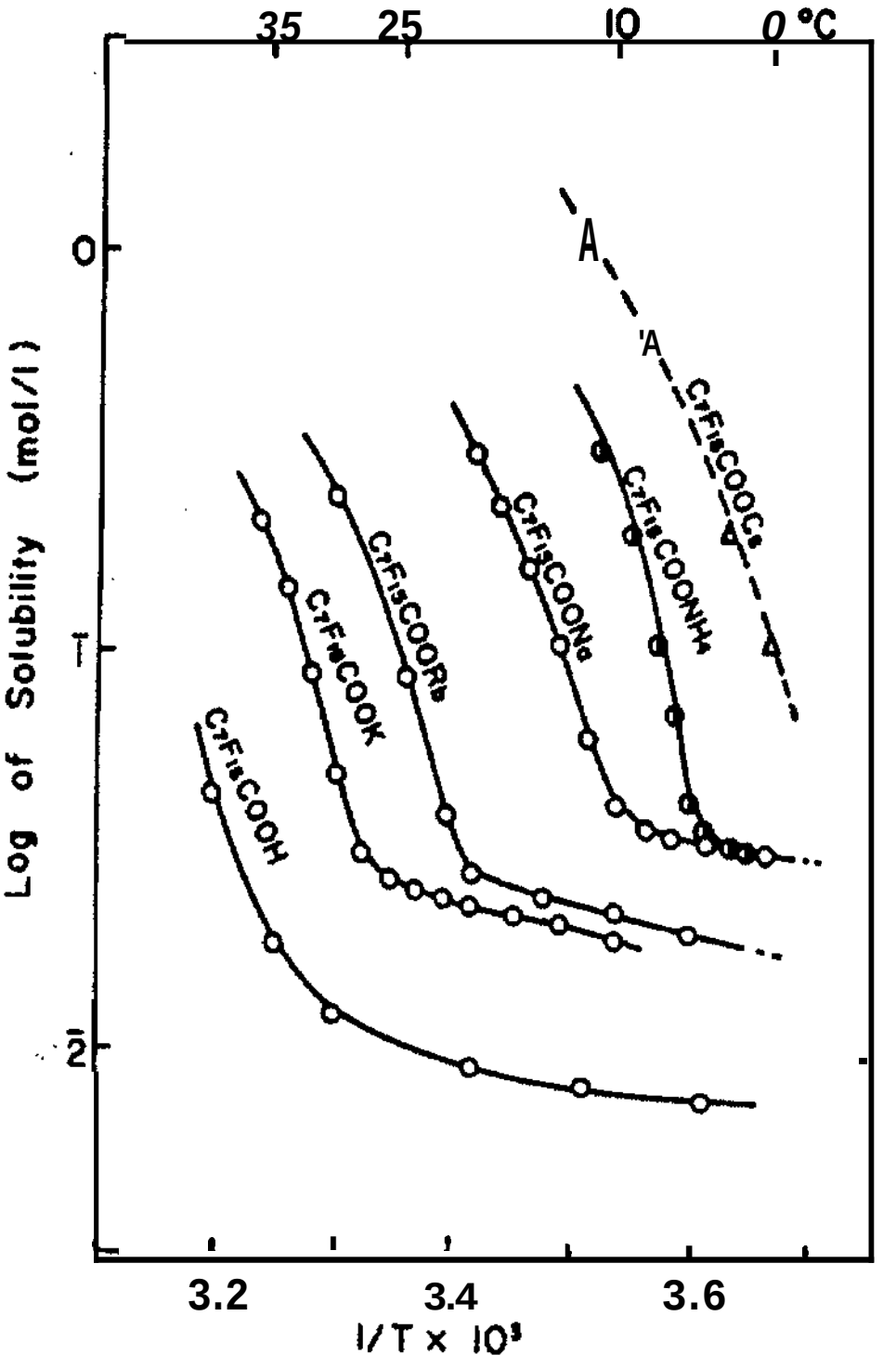

Figure 1.0
Solubilities of C_7F_{15} COOM in water as a function of temperature (Kissa, 1994).

2.0 WASHINGTON WORKS MAIN PLANT

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2.1 Introduction

The Washington Works Main Plant (main plant) is located along the Ohio River in Washington, West Virginia, approximately-seven miles southwest of Parkersburg, West Virginia (Figure 2.0). A water use and well survey is currently being conducted for the area within a 1-mile radius of the main plant and Local Landfill property boundaries (Figure 2.1).

Significant historical hydrogeologic and groundwater quality data for C-8 at the main plant is available from previous investigations that have been conducted. The most significant study was a Resource Conservation and Recovery Act (RCRA) Facility Investigation (RFI) conducted in the fall of 1998 on four Solid Waste Management Units (SWMUs) at the main plant to satisfy requirements of the RCRA Hazardous and Solid Waste Amendments (HSWA) Permit Number WVD 04-587-2591 (DuPont, 1999). A brief description of each of the SWMUs investigated is presented below. SWMU locations are shown on Figure 2.0.

- SWMU A-3, Riverbank Landfill: The Riverbank Landfill is about 4,500-feet long and lies along the northern edge of the site near the Ohio River. It was operated between 1948 and the late 1960s and received powerhouse ash, incineration ash, plastics, rubble, and plant trash. After closure, it was covered with 6 to 35 inches of soil. Currently, the Riverbank Landfill is covered with dense vegetation (on the sloped area) or by buildings and pavement in the manufacturing area.
- SWMU B-4, Anaerobic Digestion Ponds (Digestion Ponds): Three former digestion ponds are co-located within a portion of the Riverbank Landfill. One pond dates from the 1950s and two others from the 1970s. The ponds received waste from the fluorocarbon manufacturing process (including C-8) until 1388, when the pond contents and upper few feet of clay liner and pond berm material were removed and disposed of off-site. The pond area was backfilled and capped with topsoil, and the area is currently vegetated with grass.
- SWMU C-6, Polyacetal Waste Incinerators (Waste Incinerators): The former Waste Lncinerators consisted of two brick-lined pits in the western portion of the manufacturing area. The Waste Incinerators operated between 1959 and 1990. The Waste Incinerators have been excavated and backfilled with clean soil.
- SWMU H-14, Burning Ground: The Burning Ground is located in the central portion of the manufacturing area and was operated between 1948 and 1965. Since 1990, the Burning Ground has been leveled, backfilled with clean fill and gravel, and covered by buildings and asphalt.

A previous Verification Investigation (VI) found evidence of releases of C-8 to soil and groundwater at the Riverbank Landfill, Digestion Ponds, and Burning Ground (DuPont 1992). Little evidence of releases were found in soil at the site of the former Waste Incinerators. Further investigations and evaluations were performed during the RFI to determine the extent of releases in groundwater.

Plant-wide groundwater sampling was also conducted during two separate monitoring events, the first in November 1998 and the second in February 1999, during the RFI. The sampling events focused on evaluating groundwater quality at existing and newly installed wells associated with the Burning Ground and Riverbank Landfill/ Digestion Ponds SWMUs.

All plant wells sampled during the RFI were analyzed for C-8. C-8 was detected in all groundwater samples. C-8 concentrations and the extent in groundwater is discussed in Section 2.3 Water Quality.

2.2 Environmental Setting

2.2.1 Geology

The geology of the main plant is shown on six geologic cross-sections developed during the VI (DuPont, 1992) and revised based on additional findings from the RFI. The locations of the geologic cross-sections are shown in Figure 2.3. Two east-west cross-sections, A-A' and F-F', are shown on Figures 2.4A and 2.4F. Four north-south cross-sections, B-B', C-C', D-D', and E-E' are shown on Figures 2.4B, 2.4C, 2.4D and 2.4E, respectively. The cross-sections were developed from detailed geologic logs recorded during the VI and RFI, and from less detailed historic geologic logs from test and production wells and geotechnical borings drilled in the late 1950s through the early 1980s. Some monitoring wells shown in Figure 2-3 were later abandoned. The current site map (Figure 2.2) shows the monitoring wells that currently exist at the site.

The main plant rests on Quaternary alluvial terrace deposits in the Ohio River Valley. The alluvial terrace is topographically flat and lies approximately 50 feet above the Ohio River, which flows east to west past the main plant (see Figure 2.0). The alluvial terrace is underlain by a flat, river-scoured bedrock surface of the Dunkard Series that rises steeply and outcrops in the southern edge of the site to form the valley wall.

The Quaternary alluvium ranges from 60 to 100 feet in depth and consists of coarsening downward unconsolidated river deposits of poorly to well-sorted, brown and gray sand, silts, clay and gravel. The Dunkard Series bedrock consists primarily of red and varicolored sandy shale; gray, green and brown sandstone; and minor beds of coal, claystone, black carbonaceous shale, and limestone.

The average river water elevation is about 580 feet above Mean, Sea Level (MSL) and the elevation of the Ohio River terrace deposits under the main plant are about 630 feet above MSL. Due to riverbank undercutting, some slumping of clay and silt exists along the northern boundary of the main plant along the river's edge. Figure 2.4C shows an example of the relationship of fill and clay layers along the riverbank.

2.2.2 Hydrology, Hydrogeology and Groundwater Flow

Hydrology

Regional water needs are primarily satisfied by the Ohio River and Little Kanawha River near Parkersburg. These sources provide water to the cities of Parkersburg,

West Virginia and Belpre, Ohio. In less populated areas (i.e., near the main plant), the local communities receive water 6-om small local water companies that obtain their water from production wells screened in the Quaternary river alluvium.

Surface water at the main plant discharges through drains and storm sewers, and drainage swales. Seeps located along the riverbank may originate from precipitation that has infiltrated topsoil or fill and that flows along the top of the underlying shallow clay and discharges along the riverbank. Two drainage swales, one Iocated in the facility's southwest comer, and the other located on the extreme eastern end of the facility, convey surface runoff during rainy weather to the Ohio River. During dry weather, the drainage swales are *dry.*

Hydrogeology

Regional groundwater supplies are obtained from the Dunkard Group bedrock and Ohio River alluvial terrace deposits. The saturated portion of the Ohio River alluvial terrace deposits comprise the principal regional aquifer used for water supply purposes. Production wells completed in this aquifer have been known to yield up to 500 gallons per minute (gpm) (Schultz, **1984).** Based on these high yields, numerous industrial and commercial water supply companies obtain water from the alluvial aquifer. The yield from alluvial aquifer wells is related to the well's position with respect to the river, as well as formation grain size and thickness.

The Ohio River alluvial terrace deposits contain a single key aquifer underlying the main plant. The water table occurs at a depth of about 60 to 70 feet below ground surface in the main plant area. The saturated zone is approximately 30 to 40 feet thick, extending to the surface of the underlying Dunkard Group. The on-site production water wells completed in the site aquifer yield 200 to 450 gpm. The underlying Dunkard Group is not a major aquifer. The upper zone of the Dunkard Group (Washington Formation), which consists primarily of shale and silt, likely bounds the lower extent of the site aquifer. In addition, regional groundwater communication between the Ohio River and bedrock will likely result in upward gradients to the alluvial aquifer.

Groundwater quality in the alluvium in this region tends to be naturally poor, having the highest median chloride, sulfate, hardness (as calcium carbonate), iron, and manganese concentrations of all hydrogeologic units in the region (Schultz 1984). Water from the alluvium generally is a calcium bicarbonate type, with near neutral pH and high dissolved solids content.

Natural recharge to the alluvial aquifer comes from various sources, including:

- Infiltration of precipitation falling directly on the alluvium
- Lateral movement of the river water through the alluvium via permeable sand and gravel zones
- Seepage from stream tributaries that discharge to the Ohio River

The maximum amount of water available to the alluvium depends on the degree of hydraulic connection to the river. The degree of hydraulic connection is a function of the permeability and thickness of the riverbed, permeability and thickness of the alluvium, and hydraulic gradient between the groundwater and the river. Pumping of on-site active

well fields near and parallel to the river (i.e., the Ranney Well, the DuPont-Lubeck Well Field, and the East Well Field shown in Figure 2.2) lowers the groundwater level in the alluvial aquifer to below river stage. This induces water from the river to flow into the alluvium toward the wells, which replaces water pumped from storage in the aquifer, and helps sustain high-yield pumping wells.

Groundwater Flow

Groundwater generally flows to the south-southwest in the alluvial aquifer. However, groundwater elevations, flow directions, and flow rates on-site are strongly influenced by the Ohio River and by pumping of on-site production wells. The on-site production wells include the Ranney Well, a radial collector well which pumps 800 to 1,000 gpm; the seven wells in the East Well Field, which pump a combined average rate of 2,000 gpm; and the five DuPont-Lubeck wells, which pump about 700 gpm combined.

Groundwater elevation contour maps for the alluvial aquifer developed from data measured in November 2000, February 1999, and November 1998 are presented as Figures 2.5A, B, and C, respectively. The direction of groundwater flow is indicated by the flow arrows. As shown on the groundwater elevation contour maps, groundwater flow in the northeast part of the site is toward the East Well Field wells. In the north-central portion of the site, groundwater flow is toward the Ranney Well. In the central and western portion of the site, groundwater flow is south-southwest towards the DuPont-Lubeck Well Field. Pumping of the production wells (Ranney Well, East Well Field, and the DuPont-Lubeck Well Field) eliminates off-site migration of impacted groundwater that may originate from the SWMU areas. Additional groundwater elevation data was obtained from the General Electric (GE) property located to the west of the main plant. Data from the main plant and GE were used in calibrating the Washington Works groundwater model (DuPont, 1999). The groundwater model conclusions indicated that groundwater from the main plant area is contained to the DuPont property by operation of the site production wells.

In a 1990 hydrogeologic assessment, production well specific capacity testing of the DuPont-Lubeck Well Field and the East Well Field was conducted. The results were used to calculate the transmissivity and the hydraulic conductivity of the alluvial aquifer (DuPont 1990). In the vicinity of the DuPont-Lubeck Well Field, transmissivity values ranged between 114,900 and 127,500 gallons per day per square foot (gpd/ft^2). In the vicinity of the East Well Field, the transmissivity values ranged between 16,050 and 50,000 gpd/ft^2. Hydraulic conductivity values were calculated from the transmissivity values for the East Well Field. For Wells AX13-PW01 and AZ13-PW01, the hydraulic conductivity values ranged from 0.013 to 0.055 centimeters/second (cm/sec) and from 0.01 to 0.049 cm/sec, respectively.

Using the hydraulic conductivity values from the 1990 study and the hydraulic gradient values determined from groundwater elevations measured in 1990 and assuming an effective porosity value for sand and gravel of 35 %, the groundwater flow velocity for several well pairs was calculated. The groundwater flow velocity was estimated at 5 feet/day (ft/d) between monitoring wells T13-MW01 and L18-MW01 in the southwest portion of the site. A groundwater flow velocity of 3 ft/d was estimated between monitoring wells P06-MW01 and K14-MW01 in the western central portion of the site.

In the eastern portion of the site, a groundwater flow velocity of 2.5 ft/d was estimated for the site aquifer between monitoring wells AL10-MW01 and AQ09-MW01.

Groundwater seeps at the Riverbank Landfill were identified and sampled during the VI (DuPont 1992). An active French-Drain groundwater collection has been in operation at the Riverbank Landfill since 1991. The RFI verified that the collection system effectively captures water at the seep area.

2.3 Water Quality

2.3.1 Surface Water Quality

Historical surface water C-8 concentrations are presented in Table 2.1A. Surface water sample locations are shown on Figure 2.2. Surface water C-8 concentrations were measured in 2000 and 2001 at two outfalls, 002 and 005 and at two river locations. The outfalls have been sampled monthly since February 2001. Outfall 005 C-8 concentrations have ranged from 1.43 ug/l to 199 ug/l, while Outfall 002 C-8 concentrations overall have been much lower, ranging from 0.436 ug/l to 8.54 ug/l. In general, Outfall C-8 concentrations have significantly declined in 2001. This is the result of installation of a carbon adsorption treatment system in the fluropolymers process. The system is designed to remove a major percentage of C-8 from the process wastewater.

2.3.2 Groundwater Quality

Concentrations of C-8 in groundwater sampled at the main plant have been evaluated since 1991 (Table 2.1B), however, the wells sampled and the sampling frequency has been variable. Some wells have been monitored annually since 1996 and others have been monitored quarterly starting in January 2001. Two plant-wide groundwater-sampling events were conducted as part of the RFI (November 1998 and February 1999) and are discussed below. The sampling events focused on evaluating groundwater quality from existing and newly installed wells associated with the Burning Ground and Riverbank Landfill/Digestion Ponds SWMUs.

All plant wells sampled during the RFI were analyzed for C-8. At the Riverbank Landfill/Digestion Ponds area (in the western portion of the Riverbank Landfill), C-8 was detected in groundwater and previous seep samples. Figures 2.6C and 2.6D depict the well locations and results for C-8. Measured concentrations ranged from <0.1 to 13,600 µg/L. Concentrations were below 40 µg/L in 28 of the 37 wells sampled; in the other 9 wells. maximum concentrations ranged from 380 to 13,600 µg/L. The highest concentrations were measured in monitoring wells P04-MW02 and R04-MW02, near the Digestion Ponds area.

The RFI C-8 concentration values were utilized for contouring. Isoconcentration maps were prepared and are presented in Figures 2.6A and 2.6B.

2.3.3 Drinking/Tap Water Quality

Production Well AM07-PW01 (historically known as well 336) supplies potable water to the main plant. C-8 concentrations in drinking/tap water have been measured at four distribution points on the plant periodically since May 1999 (Table 2.1C). Concentrations ranged fiom 0.213 ug/l lo 0.589 ug/l. C-8 concentrations detected at three sampling points in the distribution system on October 11,2001 were 0.507, 0.45, and 0.423 ug/l, respectively. No obvious trends are seen in the data.

2.4 Site Conceptual Model

The main plant site conceptual model describes the potential exposure routes for current and future human and ecological receptors. Potential exposure routes were evaluated and classified as complete or incomplete.

Direct exposure to C-8 bearing materials contained within the SWMUs is minimal or non-existent, because these materials have been removed and regraded or paved (Burning Ground, Waste Incinerators, and Digestion Ponds) or covered and vegetated. Therefore, contact with these materials is considered to be an incomplete exposure pathway.

A large portion of the plant site is covered with asphalt and concrete. Hence surface water contact with C-8 impacted soils or groundwater is not likely in these areas. Therefore, surface water contacting C-8 impacted soils is Considered to be an incomplete exposure pathway. Much of the precipitation falling on site is routed toward drains and stonn sewers, which ultimately discharge into the Ohio River. Precipitation falling on the riverbank slope either percolates into the soil or runs off to the river. The seeps that occur in places along the riverbank are probably caused by percolated water that accumulates above the slumped, low-permeability clay and silt of the Ohio River deposits that underlie topsoil and fill along the riverbank. Contact with impacted seep water is considered to be an incomplete exposure pathway due to the active french-drain groundwater collection system.

Direct exposure to groundwater impacted by C-8 is also considered to bc an incomplete pathway because groundwater is located at about 60 feet bgs. The only potential contact route for groundwater is via contact with water pumped from production wells. Water pumped fiom production wells is used for two purposes, supplying drinking water and providing industrial process water.

Well AM07-PW01 is one of three production wells that provides drinking water to the main plant. Other wells are AO08-PW01 and AQ09-PW01. AM07-PW01 was sampled eight times. Measured concentrations of C-8 in this well suggested that this exposure pathway is considered to be complete. However, average concentrations of C-8 in drinking water at point of use (which is a mixture of water fiom the three wells) will be lower than the maximum concentrations detected in any single well. Contact with impacted drinking/tap water is a complete exposure pathway.

C-8 was detected in production wells providing industrial process water (K16-PW01, V05-PW01, and L04-PW01). The maximum concentration of C-8 was detected in well K16-PW01 (16.2 ug/l). Water from these wells is not used for drinking, but rather for industrial processes including non-contact and contact cooling water, fire water, process

water, conversion to demineralized water to generate steam, and/or consumption in the manufacturing processes. There is a potential for limited contact, however, this contact is expected to be minimal. Average concentrations of C-8 in process water at the point of use (which is a mixture of water from several production wells) will be lower than maximum concentrations detected in any single well. Therefore, while this exposure pathway is complete, it is considered to be minimal.

The RFI ecological evaluation focused on identifying whether significant ecological resources may be exposed to site-related constituents released from the SWMUs. This evaluation concluded that surface soil at the Riverbank Landfill/Digestion Ponds is the only potential ecological exposure medium within the RFI study area. Surface water contact with C-8 impacted soils or groundwater is not likely because the Waste Incinerators and Burning Ground SWMUs are covered with gravel, asphalt, or buildings and do not provide ecological habitat. Subsurface soil (greater than 2 feet) and groundwater are not exposure media of concern for ecological receptors, and groundwater does not discharge to surface water at the site.

2.5 Data Gaps

The following data gaps were identified for the main plant:

- Additional monitoring wells are needed to further delineate C-8 concentrations in groundwater and to evaluate groundwater flow directions, particularly for groundwater flow in the bedrock below the unconfined alluvial aquifer.
- Continued refinement of the groundwater model for the main plant is required to reevaluate that groundwater capture by the pumping wells is occurring at the site and that no off-site migration of C-8 impacted groundwater is occurring.
- Surface water quality in the Ohio River should be evaluated. A separate work plan is currently being designed to address this issue.

Activities to fill the data gaps will be proposed and discussed in the work plan.

2.6 References

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TABLES

Table 2.0
Monitoring Well Construction Data
DuPont Washington Works Main Plant
Washington, WV

Monitoring Wells		Surface Elevation (feet)	Total Depth (feet)	Well Diameter (inches)	Slot Size (inches)	Screen Length (feet)	Elevation of Screen Interval (feet)
New ID	Old ID						
Q04-MW02	Ron's MW-1	629.39	71	2		10	566.0 - 556.0
Q05-MW01	Ron's MW-2	598.76	42	2		10	567.0 - 557.0
P06-MW02	Ron's MW-3	629.29	71	2		10	567.0 - 557.0
P08-MW01	Ron's MW-4	630.82	75	2		5	559.0 - 554.0
N13-MW01	Ron's MW-5	625.87	70	2		5	560.0 - 555.0
M16-MW01	Ron's MW-6	627.14	70	2		10	565.0 - 555.0
AO08-PW01	331	632.91	95	18		20	558.7 - 538.7
AQ09-PW01	332	634.36	96	18		20	553.8 - 533.8
AT10-PW01	333	634.37	97	18		20	553.5 - 533.5
AV11-PW01	334	633.49	93.9	18		19	555.7 - 536.7
AX13-PW01	335	630.69	90	18		13	556.0 - 543.0
AM07-PW01	336	634.26	96	18		20	555.0 - 535.0
AZ13-PW01	337	628.04	92	18		20	555.0 - 535.0
L04-PW01	GALLERY	589.75				NA	
L17-PW01	L1(351)	633.93				18	
K18-PW01	L2(352)	634.92		18			
K19-PW01	L3(353)	634.2		18			
K16-PW01	L4(354)	623.24		18			
J17-PW01	L5(355)	624.78		18			
V05-PW01	RANNEY	632	92	NA		1	542.0 - 541.0
	TW-1 (tw-28)						
J08-MW01	TW-20	630.21	*95.21*	6		*20*	*555 - 535*
Q07-MW01	TW-21 (307)	630.35		6			
Z07-MW01	TW-22	632.49		6		*20*	*550 - 530*
G10-MW01	TW-23	631.4	*101.4*	6		*20*	*550 - 530*
T13-MW01	TW-24	632.69	*102.69*	6		*20*	*550 - 530*
U16-MW01	TW-25	638.23	*108.23*	6		*20*	*550 - 530*
AO09-MW01	TW-26	632.89		6			
L18-MW01	TW-27	635.82		6			
V09-MW01	TW-3 (pw-3)	628.5	*98.5*	6		*20*	*550 - 530*
N04-MW01	TW-32	594.48		6			
P06-MW01	TW-33	630.63		6			
AR09-MW01	TW-38	635.27	*105.27*	6		*20*	*550 - 530*
AX12-MW01	TW-39	635.23		6			
AG07-MW01	TW-40	632.87		6			
AJ06-MW01	TW-41	635.09		6			
	TW-46						
AO08-MW01	TW-48	636.02		6			
	TW-5						
	TW-60						
	TW-61						
	TW-E4						
Y05-MW01	TW-E5	631.16	*101.16*	4		*20*	*550 - 530*
AC05-MW01	TW-E6	635.22		6			
AL10-MW01	TW-M1	631.61	*101.61*	4		*20*	*550 - 530*

Table 2.0
Monitoring Well Construction Data
DuPont Washington Works Main Plant
Washington, WV

Monitoring Wells		Surface Elevation (feet)	Total Depth (feet)	Well Diameter (inches)	Slot Size (inches)	Screen Length (feet)	Elevation of Screen Interval (feet)
New ID	Old ID						
	TW-M2					*20*	*550 - 530*
I07-MW01	TW-M3	610.23		4			
K14-MW01	TW-M4	627.34	*97.34*	4		*20*	*550 - 530*
D08-MW01	TW-M5	600.67		4			
F06-MW01	TW-M6	601.14	*62.8*	4			
U03-MW01	TW-N2	592.44		6			
U05-MW02	TW-P12	631.17		6			
U05-MW01	TW-W1	632.11	*102.11*	6		*20*	*550 - 530*
L04-MW01	W00-577						
AA04-MW01	TW-70	597.4	43	2	10	10	564.4 - 554.4
AA05-MW01	TW-71	630.8	70	2	10	10	570.8 - 560.8
AB07-MW02	TW-72	630.6	72	2	10	10	568.6 - 558.6
AC07-MW02	TW-73	633.2	74	2	10	10	569.2 - 559.2
AE11-MW01	TW-74	629.51	72	2	10	10	567.51 - 557.1
AI06-MW01	TW-75	634.04	72	2	10	10	572.04 - 562.04
E13-MW01	TW-76	623.5	74	2	10	10	559.5 - 549.5
G17-MW01	TW-77	630.5	80	2	10	10	560.5 - 550.5
L06-MW01	TW-78	629.85	77	2	10	10	562.85 - 552.85
M04-MW02	TW-79	593.5	25	2	10	10	578.5 - 568.5
M04-MW03	TW-80	593.6	26	2	10	10	577.6 - 567.6
N04-MW02	TW-81	593.6	26	2	10	10	577.6 - 567.6
N05-MW01	TW-82	633.48	82	2	10	10	561.48 - 551.48
P04-MW02	TW-83	590.6	28	2	10	10	572.6 - 562.6
P05-MW02	TW-84	631.68	80	2	10	10	561.68 - 551.68
R04-MW02	TW-85	593.2	28	2	10	10	575.2 - 565.2
S05-MW02	TW-86	631.18	78	2	10	10	563.18 - 553.18
U04-MW01	TW-87	593.1	27	2	10	10	576.1 - 566.1
V06-MW01	TW-88	629.93	77	2	10	10	562.93 - 552.93
W05-MW01	TW-89	630.25	76	2	10	10	564.25 - 554.25
Y14-MW01	TW-90	629.93	90	2	10	10	549.93 - 539.93
Z06-MW02	TW-91	640.1	72	2	10	10	578.1 - 568.1
Z07-MW01	TW-92	629.64	74	2	10	10	565.64 - 555.64
Z09-MW01	TW-93	630.7	70	2	10	10	570.7 - 560.7
M16-MW01	TW-55	627.14					
N13-MW01	TW-54	625.87					
P08-MW01	TW-53	629.29					
Q04-MW02	TW-50	598.76					

Red and Italics -- approximate -- taken off cross-section
Bold -- Taken from RFI WP

Table 2.1A
Summary of Analytical Results:
C-8 in Surface Water Samples
DuPont Washington Works Main Plant
Washington, WV

Sample	Date	C-8 (ug/l)
OUTFALL 002	10/25/01	2.8
	9/19/01	0.116
	7/11/01	0.558
	6/14/01	0.594
	5/31/01	0.436
	4/11/01	1.5
	3/21/01	8.54
	2/14/01	1.74
OUTFALL 005	10/25/01	65.7
	9/19/01	2.86
	8/30/01	2.16
	7/11/01	120
	6/14/01	7.4
	5/31/01	1.43
	4/11/01	4.31
	3/21/01	199
	2/14/01	153
RIVER BELOW 005	6/14/01	0.034 J
RIVER BELOW PAGES RUN	6/14/01	0.075 J

J = estimated value (below laboratory quantitation limit)

Table 2.1B
Summary of Analytical Results:
C-8 in Groundwater
DuPont Washington Works Main Plant
Washington, WV

Sample	Date	C-8 (ug/l)
AA04-MW01	2/6/99	5.43
	11/12/98	<0.1
	11/12/98 (dup)	0.42
AA05-MW01	2/4/99	1.46
	11/11/98	0.77
AB07-MW02	2/4/99	0.535
	11/16/98	<0.2 I
AC07-MW02	2/4/99	0.356
	11/16/98	0.79
AE11-MW01	2/2/99	0.69 L
	11/10/98	0.41
AI06-MW01	2/3/99	0.13 B
	11/16/98	<0.1
AM07-PW01	11/20/00	0.24
	8/16/00	0.071 J
	5/12/99	0.578
	2/3/99	0.082 B
	11/18/98	1.9 L
	6/19/98	0.4
	6/2/97	0.79
	4/2/96	0.48
AO08-PW01	11/20/00	0.4
	11/20/00 (dup)	0.26
	8/15/00	0.167
	5/12/99	0.307
	6/19/98	1
	6/2/97	0.55
	4/2/96	0.52
AQ09-PW01	10/11/01	0.498
	5/12/99	1.45
E13-MW01	5/12/99	0.882
	2/2/99	0.59 L
	11/11/98	2
F06-MW01	2/2/99	0.35 L
	11/11/98	<0.1
G17-MW01	5/12/99	2.47
	2/2/99	2.11 L
	11/11/98	13
K16-PW01	11/20/00	7.5
	2/9/99	16.2
	11/18/98	0.46 L
L04-PW01	7/11/01	0.202
	4/11/01	3.99
	11/20/00	13.8
	2/7/99	5.89
	11/18/98	7.9 J
	11/18/98 (dup)	3.9 J
L06-MW01	2/5/99	4.91
	11/13/98	870
L17-PW01	7/11/01	2.31
	4/11/01	1.58
	9/14/00	0.819
	6/3/99	1.63
	2/9/99	2.76
	11/18/98	0.33
	6/2/98	16
	5/29/97	7.9
	4/11/96	3.7
	2/16/94	2

Table 2.1 B
Summary of Analytical Results (con't.):
C-8 in Groundwater DuPont Washington Works Main Plant, Washington, WV

Sample	Date	C-8 (ug/l)
M04-MW02	2/7/99	17
	11/12/98	0.2
M04-MW03	2/7/99	21.1
	11/12/98	<0.1
M16-MW01	2/3/99	3.66 L
	11/10/98	0.86
N04-MW02	1/25/01	698
	1/25/01 (dup)	696
	2/7/99	329
	11/12/98	380
N05-MW01	2/5/99	815
	11/13/98	13
MW-AJP	4/18/96	<0.4
MW-MGM	4/18/96	0.69
MW-TWW	4/18/96	0.85
MWBG	4/2/96	<0.1
N13-MW01	2/2/99	29.6 L
	11/11/98	<0.1
P04-MW02	1/25/01	12600
	2/6/99	13600
	11/12/98	8300
P05-MW02	2/5/99	434
	11/13/98	1200
P06-MW02	2/5/99	414
	11/13/98	31
P08-MW01	2/4/99	43.4
	11/13/98	36
Q04-MW02	2/4/99	994
	11/13/98	660
Q05-MW01	11/13/98	38
R04-MW02	1/25/01	13800
	2/6/99	9420
	11/12/98	1300
V05-PW01	7/11/01	11.4
	4/11/01	5.48
	11/20/00	13.7
	2/7/99	12.4
	2/7/99 (dup)	3.95
	11/18/98	0.66 L
T13-MW01	2/3/99	0.64 L
	2/3/99 (dup)	1.30 L
	11/17/98	<0.1 R
U04-MW01	2/6/99	4.2
	11/12/98	1.6
U16-MW01	5/11/00	4.7
	5/20/99	2
	6/19/98	11
S05-MW02	2/5/99	174
	11/13/98	690
V06-MW01	2/4/99	1.91
	11/16/98	1.7
W05-MW01	2/6/99	0.729
	11/17/98	0.31
Y14-MW01	2/2/99	4.95 L
	11/10/98	12
Z06-MW02	2/4/99	0.803
	11/16/98	4.5
Z07-MW01	2/4/99	2.05
	11/16/98	3.8
Z09-MW01	2/6/99	2.74
	11/17/98	<0.1 R

Table 2.1 B
Summary of Analytical Results (con't.):
C-8 in Groundwater DuPont Washington Works Main Plant, Washington, WV

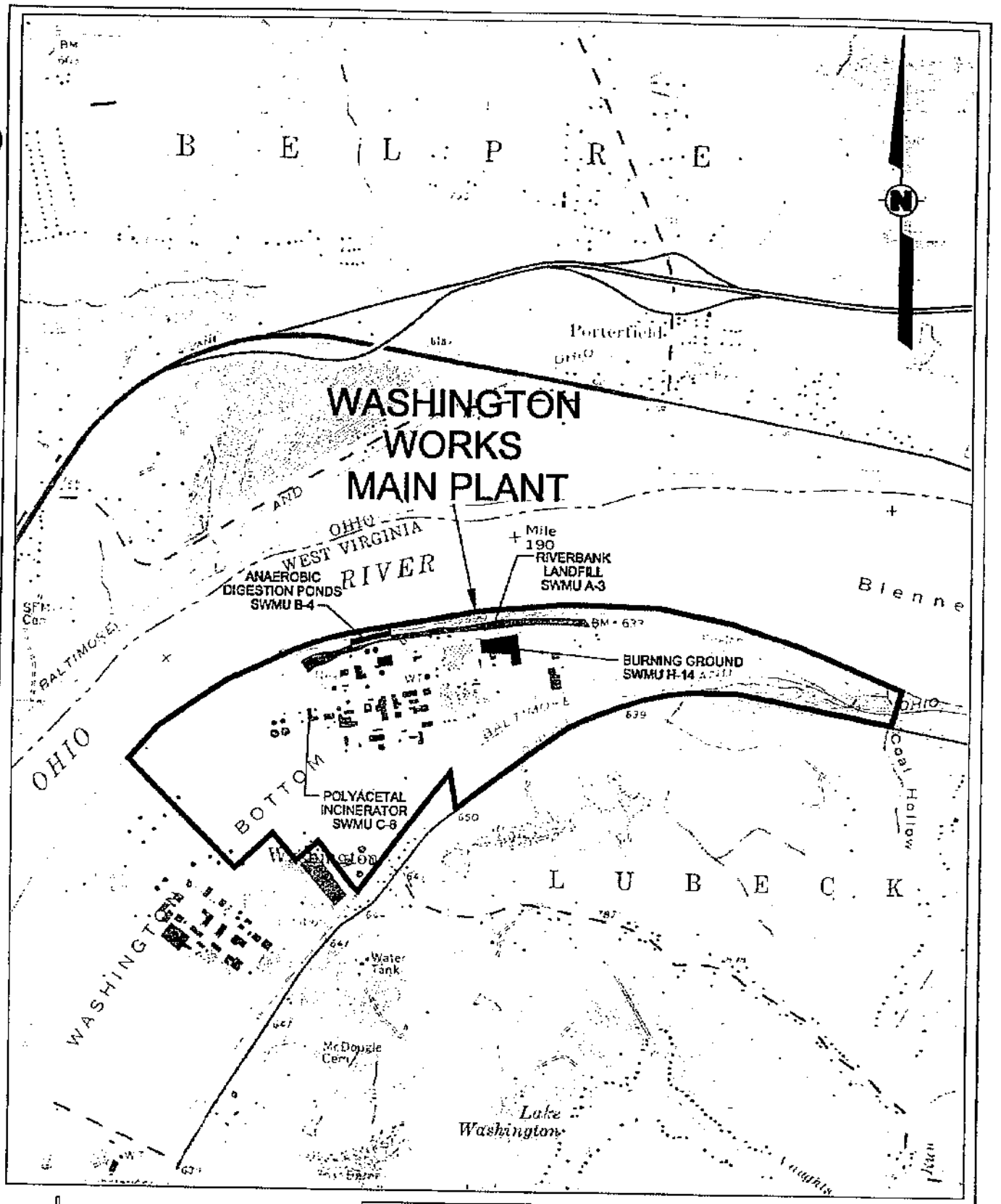
Sample	Date	C-8 (ug/l)
RBLMW1	12/5/91	140
	12/5/91 (dup)	140
RBLMW2	12/11/91	65
	12/11/91 (dup)	67
RBLMW3	12/11/91	7100
RBLMW4	12/5/91	550
RBLMW5	12/10/91	1300
RBLMW6	11/21/91	3300
RBLMW7	11/21/91	46
	11/21/91 (dup)	52
RBLMW8	12/10/91	2.4
RBLMW9	12/10/91	3.4
RBLMW10	11/20/91	14
RBLMW11	11/20/91	47
RBLMW12	12/10/91	4.6
BGMW2	12/13/91	2.3
BGMW3	12/13/91	4
	12/13/91 (dup)	3.6
BGMW5	12/11/91	5.5
ADPMW 1	12/6/91	7800
ADPMW 2	12/6/91	25
ADPMW 3	12/6/91	20000

R = unusable **data** result (relative to QA/QC)
J = **estimated** value **(below** laboratory quantification limit)
L = possible low bias result (relative to QA/QC)
B= compound **detected** in ***QC*** **blank**
< ◘ Non-detect at slated laboratory method detection limit

Table 2.1C
Summary *of* C-8 Analytical Results:
Drinking/Tap Water Samples
DuPont Washington Works Main Plant
Washington, WV

Sample	Date	C-8 (ug/l)
BLDG 1 MAIN	10/11/01	0.507
	10/11/01 (dup)	0.471
	8/15/00	0.589
BLDG 231	10/11/01	0.45
	5/12/99	0.306
	5/12/99 (dup)	0.269
BLDG 293	10/11/01	0.423
	5/12/99	0.496
BLDG 5	5/12/99	0.213

FIGURES



Source: MAP TAKEN FROM *THE* LUBECK, WV USGS QUADRANGLE

Group

An *Alliance between DuPont and URS Diamond*

Barley Mill Plaza, Building 27
Wilmington, Delaware 19805

Washington, West Virginia

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DATE 9/27/01	CHECKED M. HOLIDAY	APPROVED	REVISION 2.0

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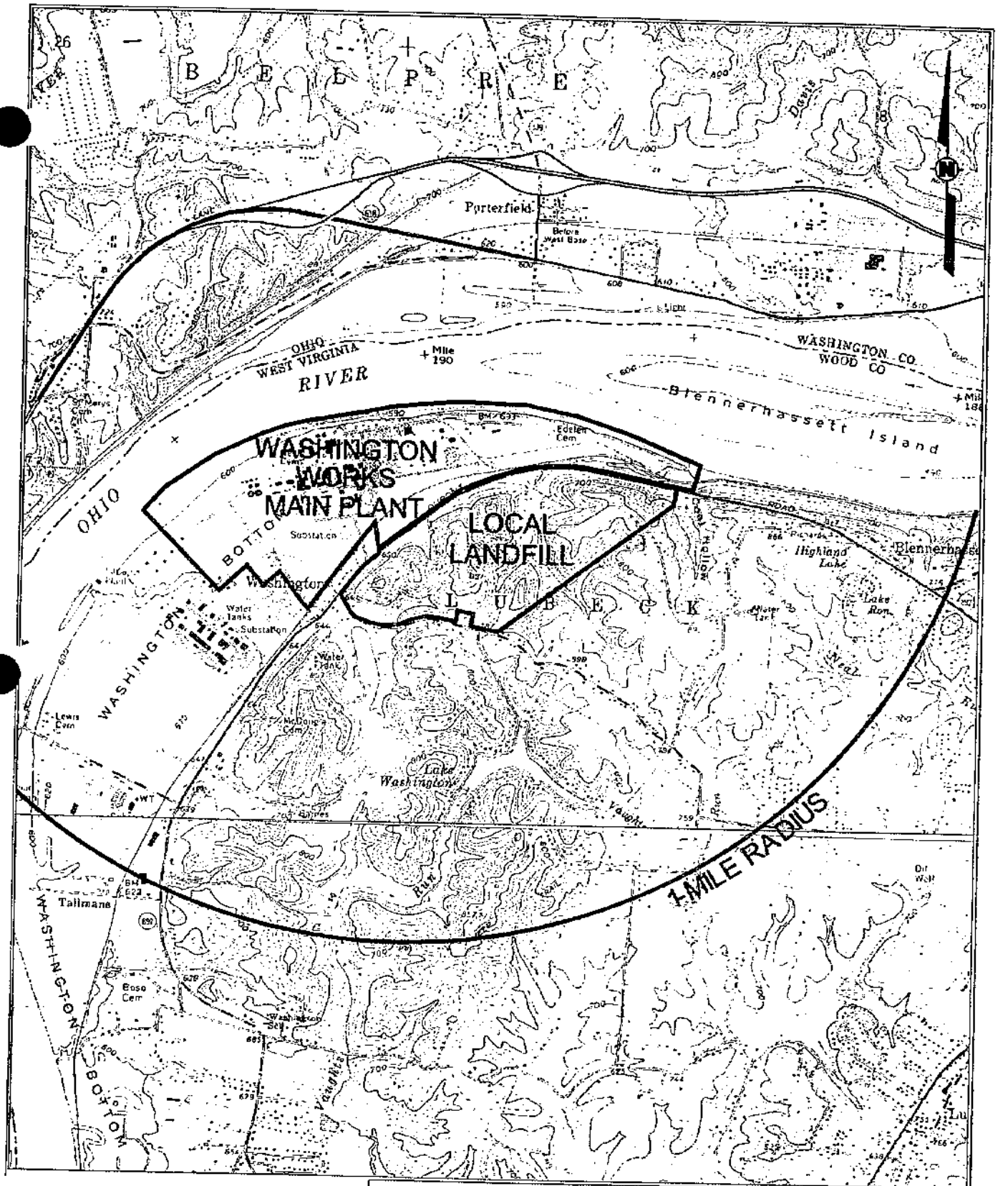

DUPONT

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Barley Mill Plaza, Building 27
Wilmington, Delaware 19805

1-MILE RADIUS MAP

DuPont Washington Works Main Plant
Washington, West Virginia

SCALE	DESIGNED	DRAWN	CAD FILE NO.
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DATE	CHECKED	APPROVED	FIGURE
12/19/01	TDL		2.1

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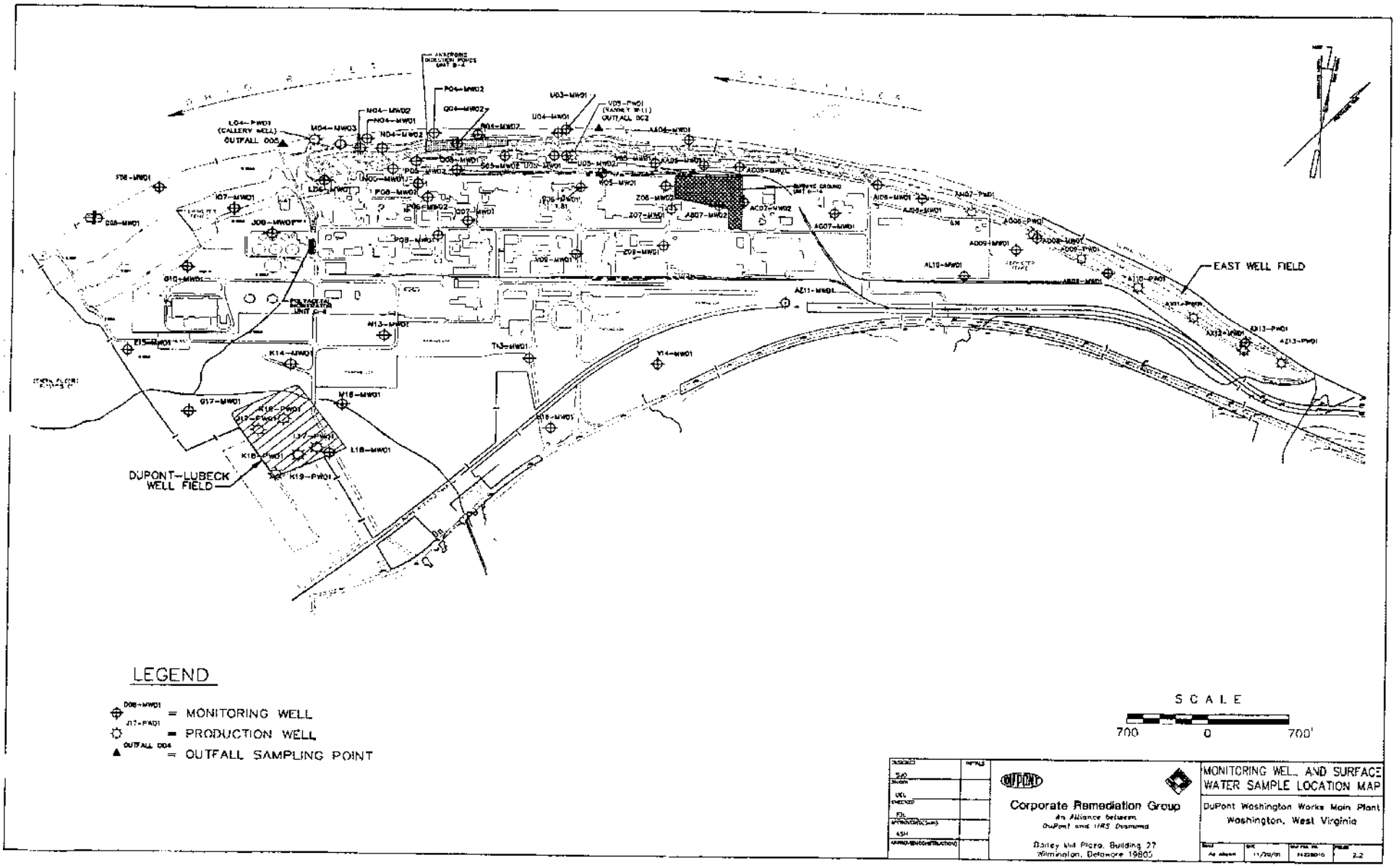

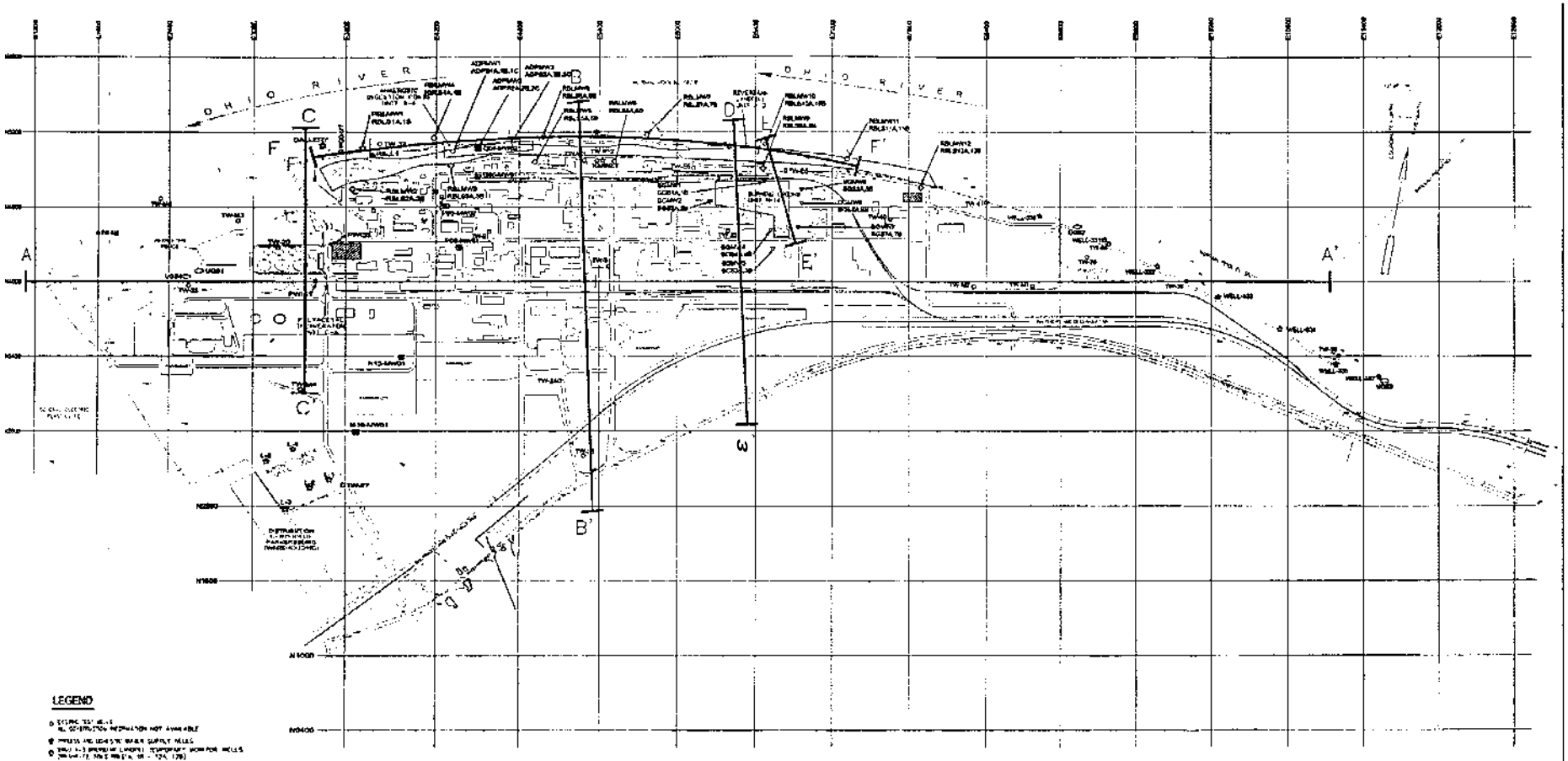

DUPONT

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Barley Mill Plaza, Building 27

CROSS-SECTION LOCATION MAP

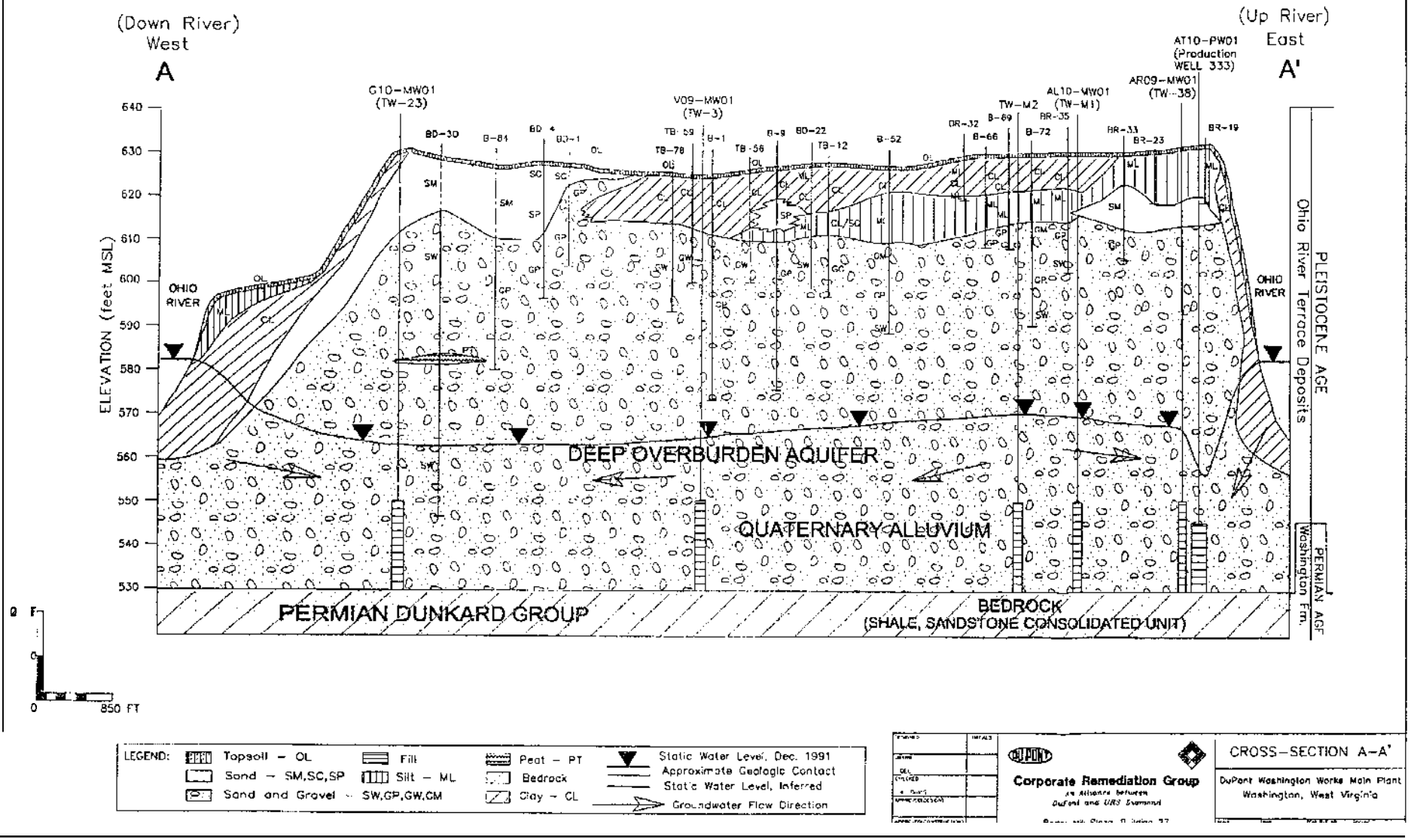
DuPont Washington Works Main Plant

Washington, West Virginia

000525

EID168090

MAH000462



DUPONT

Corporate Remediation Group

An Alliance between DuPont and URS Dames

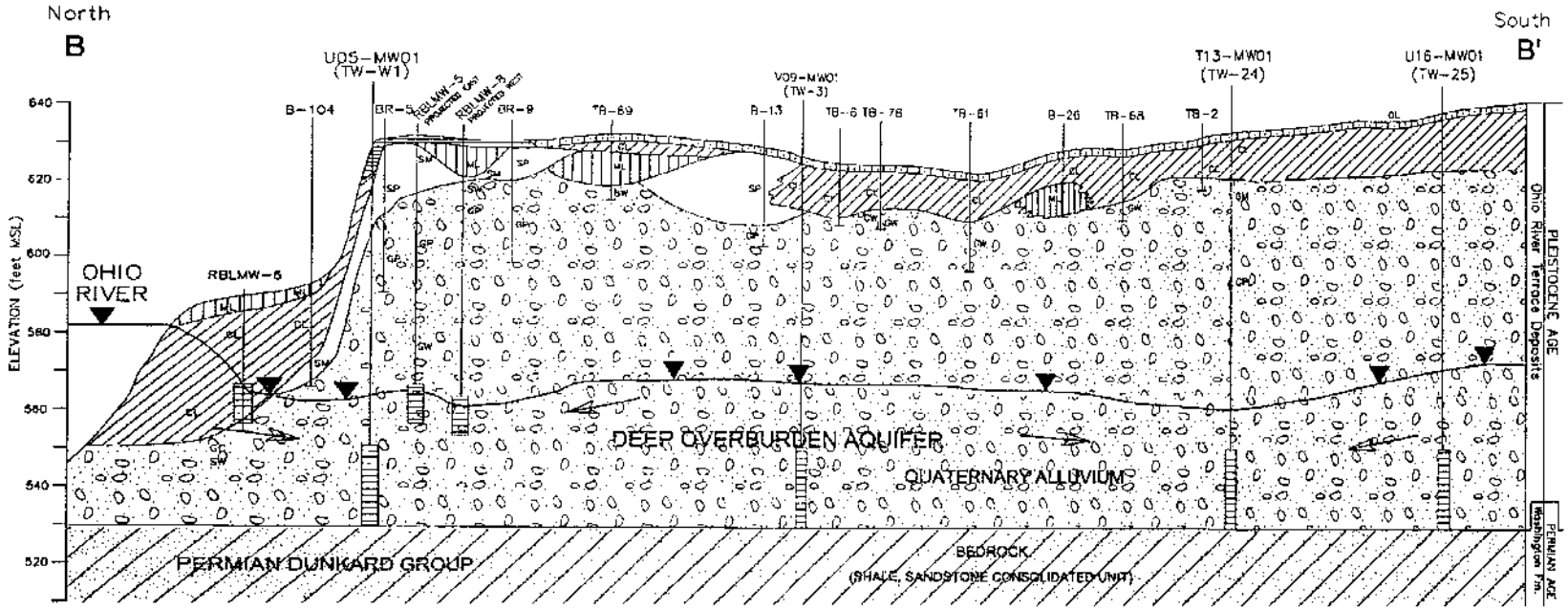
CROSS-SECTION A-A'

DuPont Washington Works Main Plant
Washington, West Virginia

000526

EID168091

MAH000463



DUPONT

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Barley Mill Plaza, Building 27
Wilmington, Delaware 19805

CROSS-SECTION B-B'

DuPont Washington Works Main Plant
Washington, West Virginia

Scale	Date	File No.	Figure
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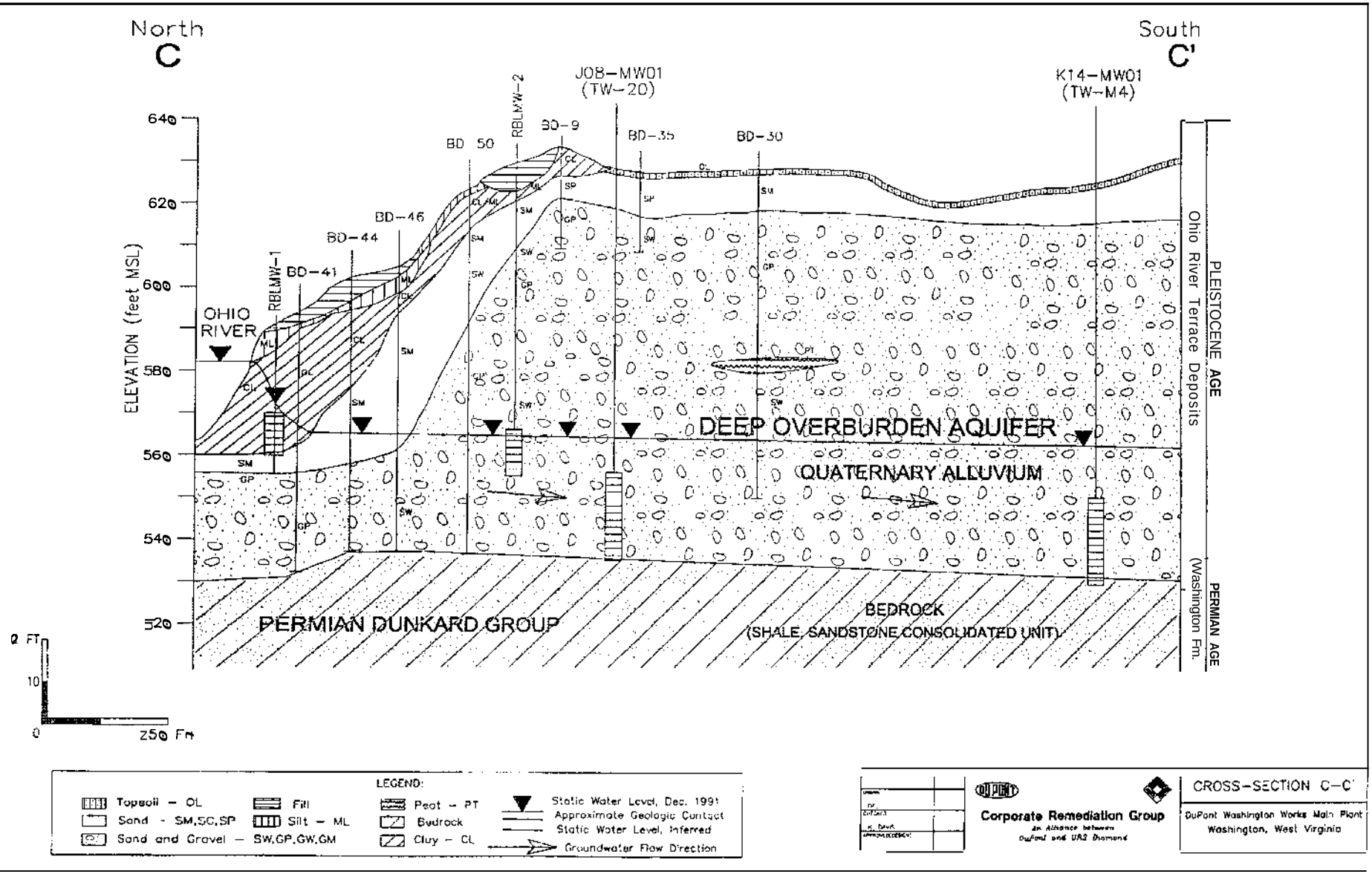

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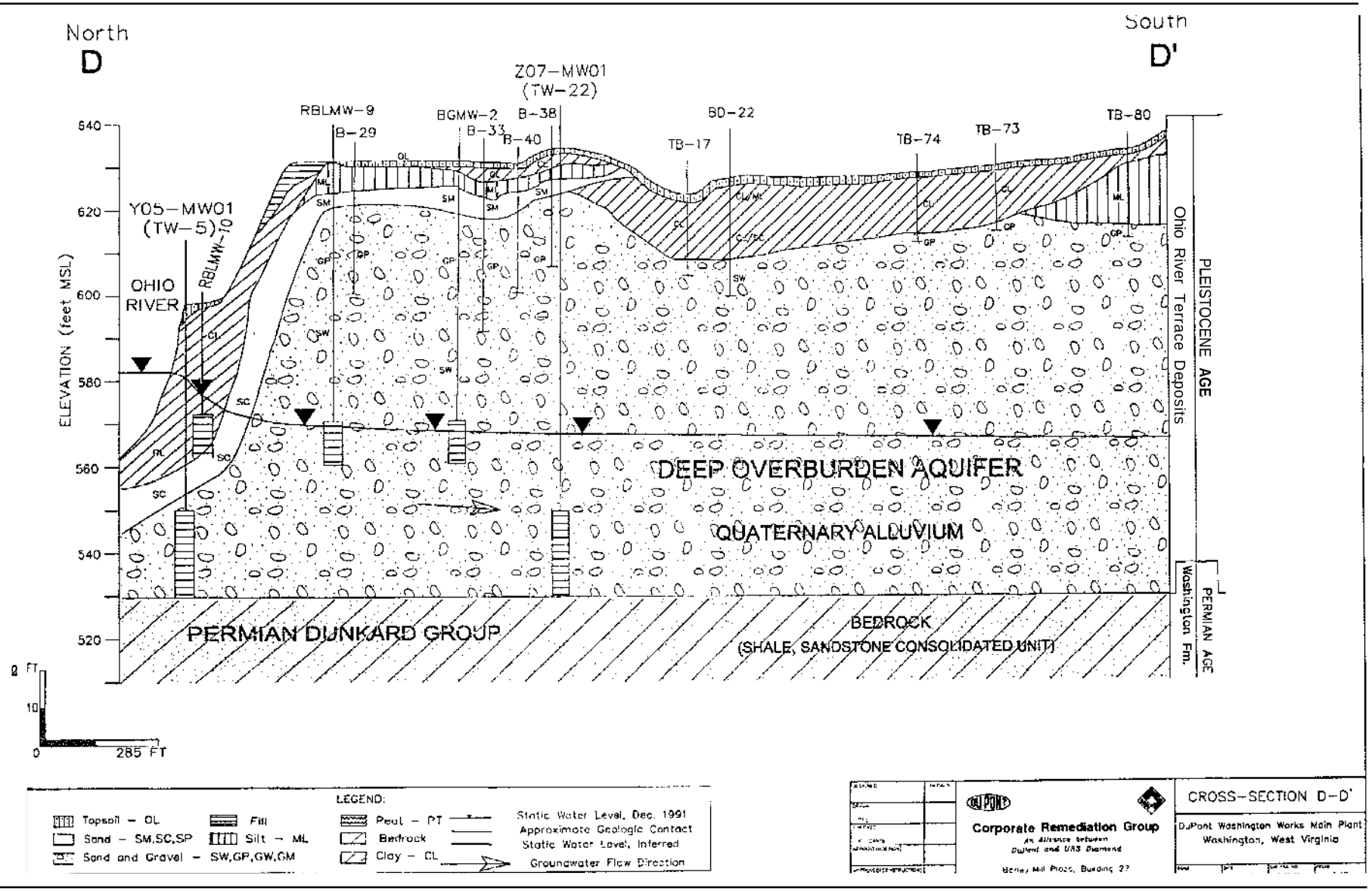
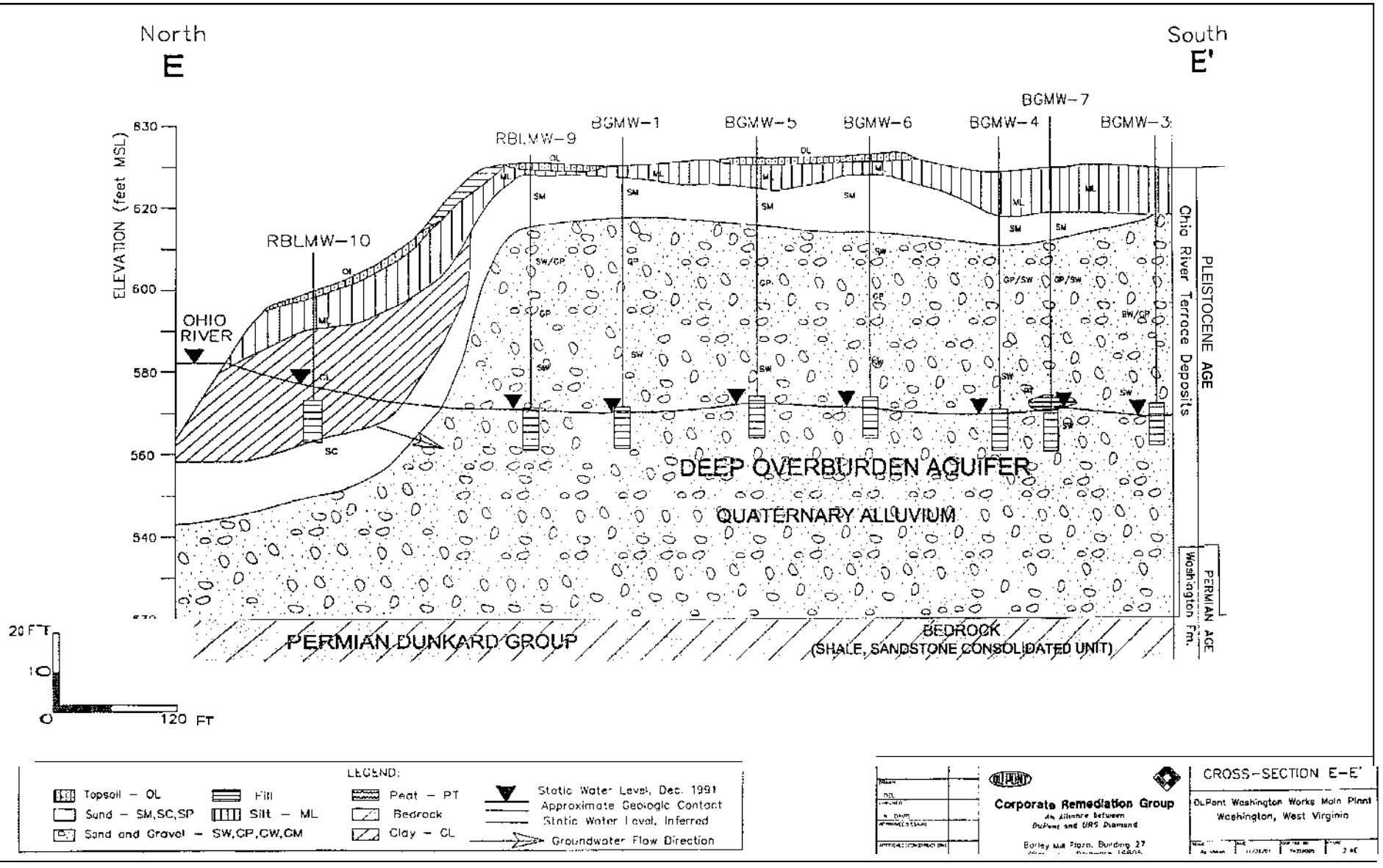
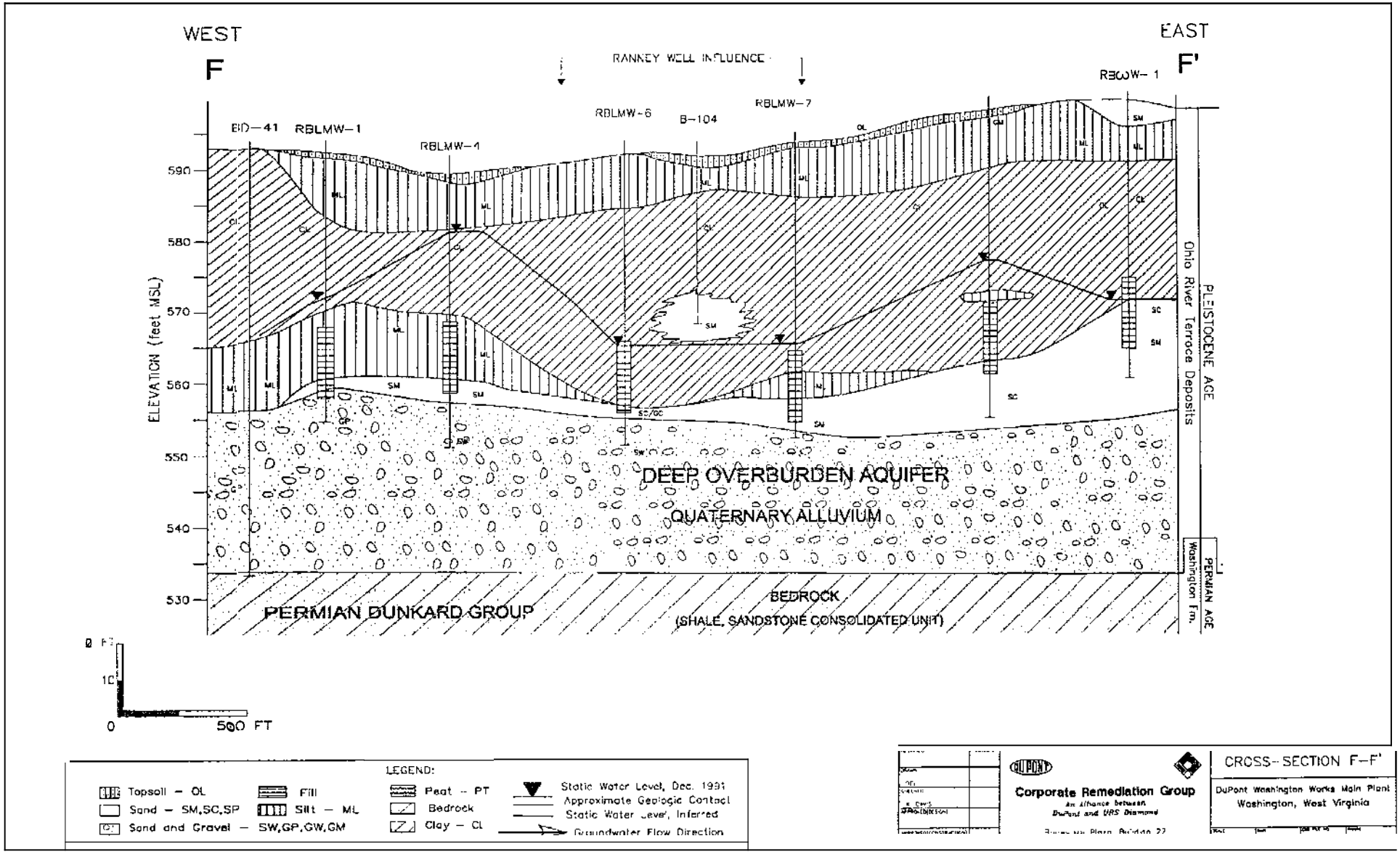






DUPONT

Corporate Remediation Group

An Alliance between DuPont and URS Diamond

Barley Mill Plaza Building 22

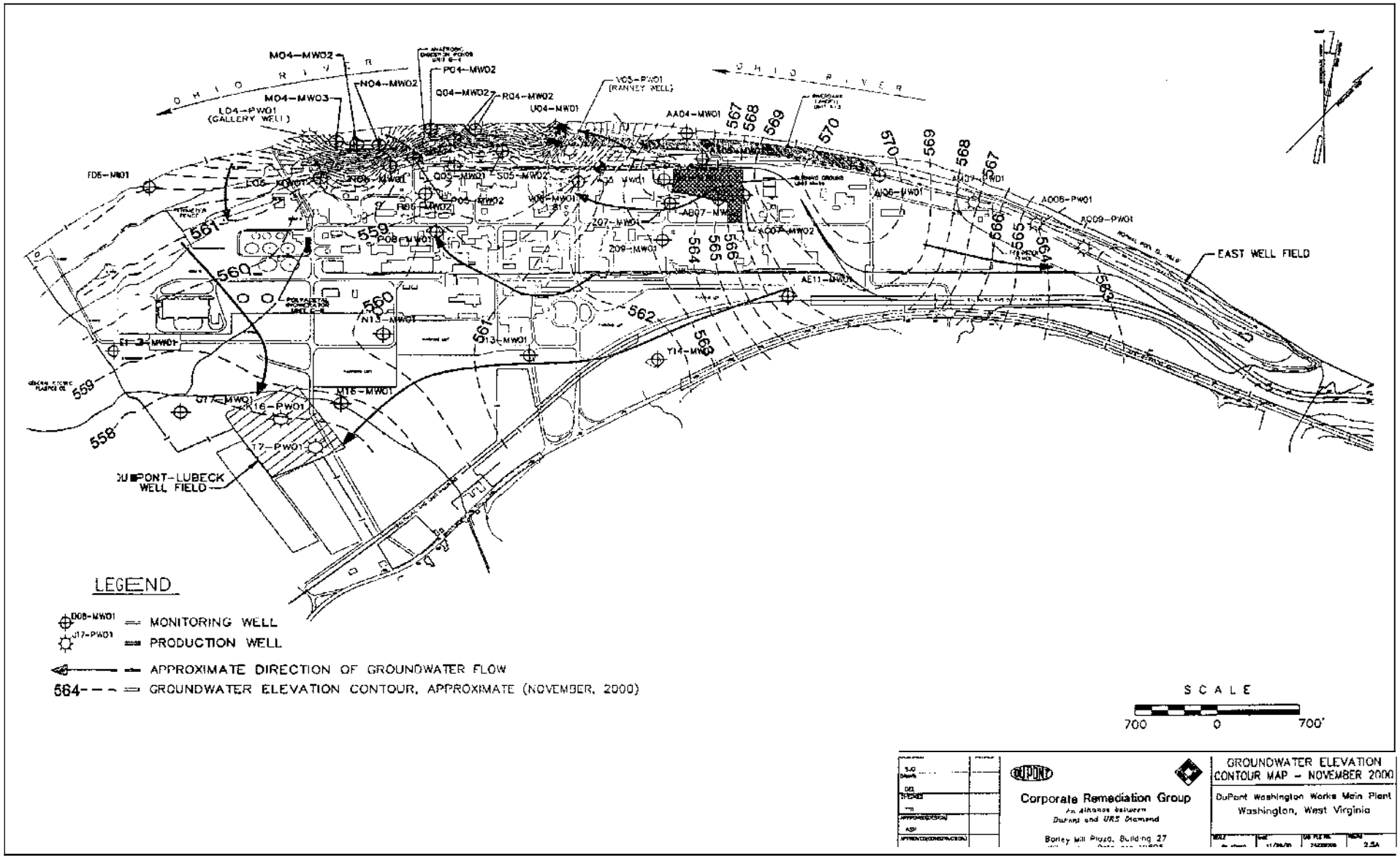
CROSS-SECTION F–F'

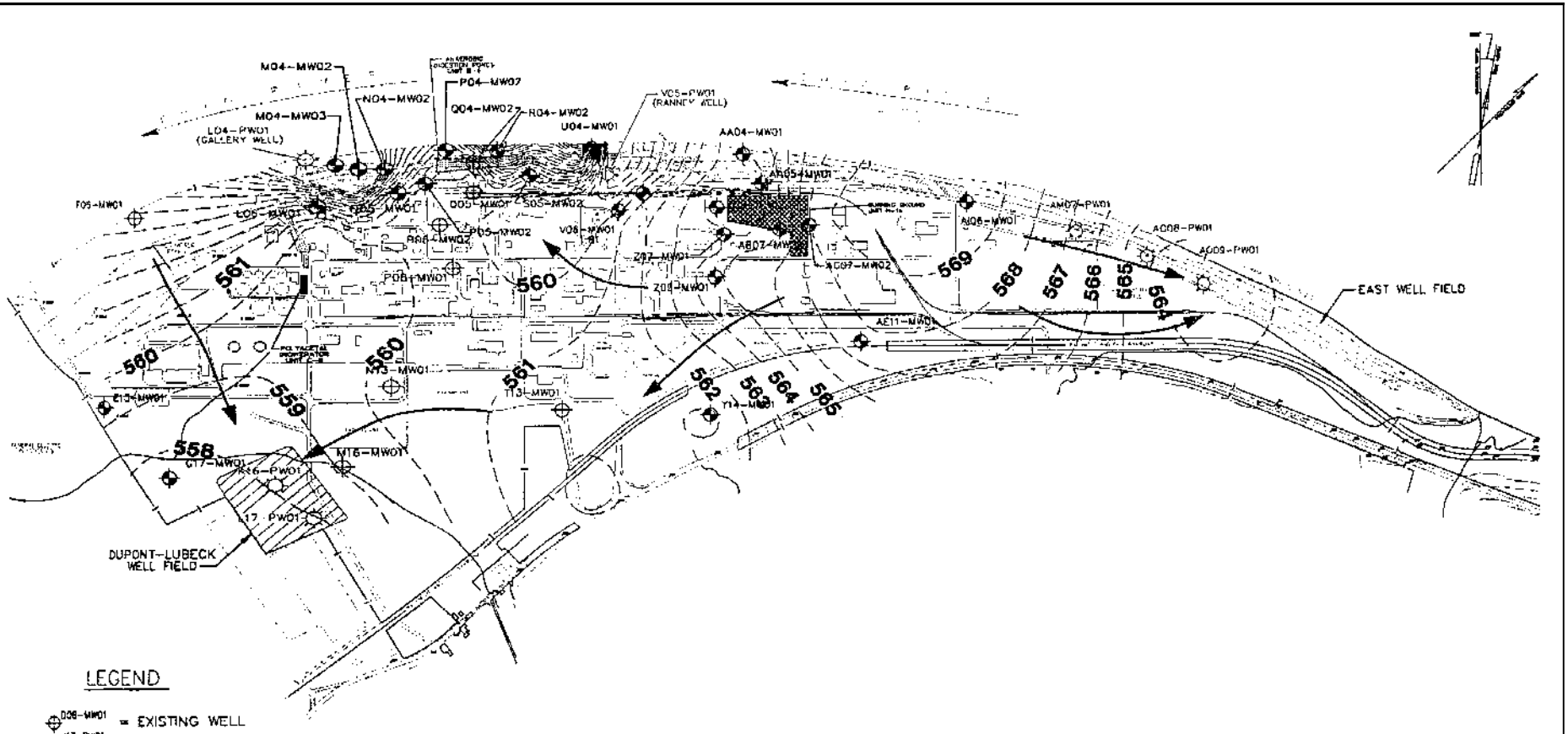
DuPont Washington Works Main Plant
Washington, West Virginia

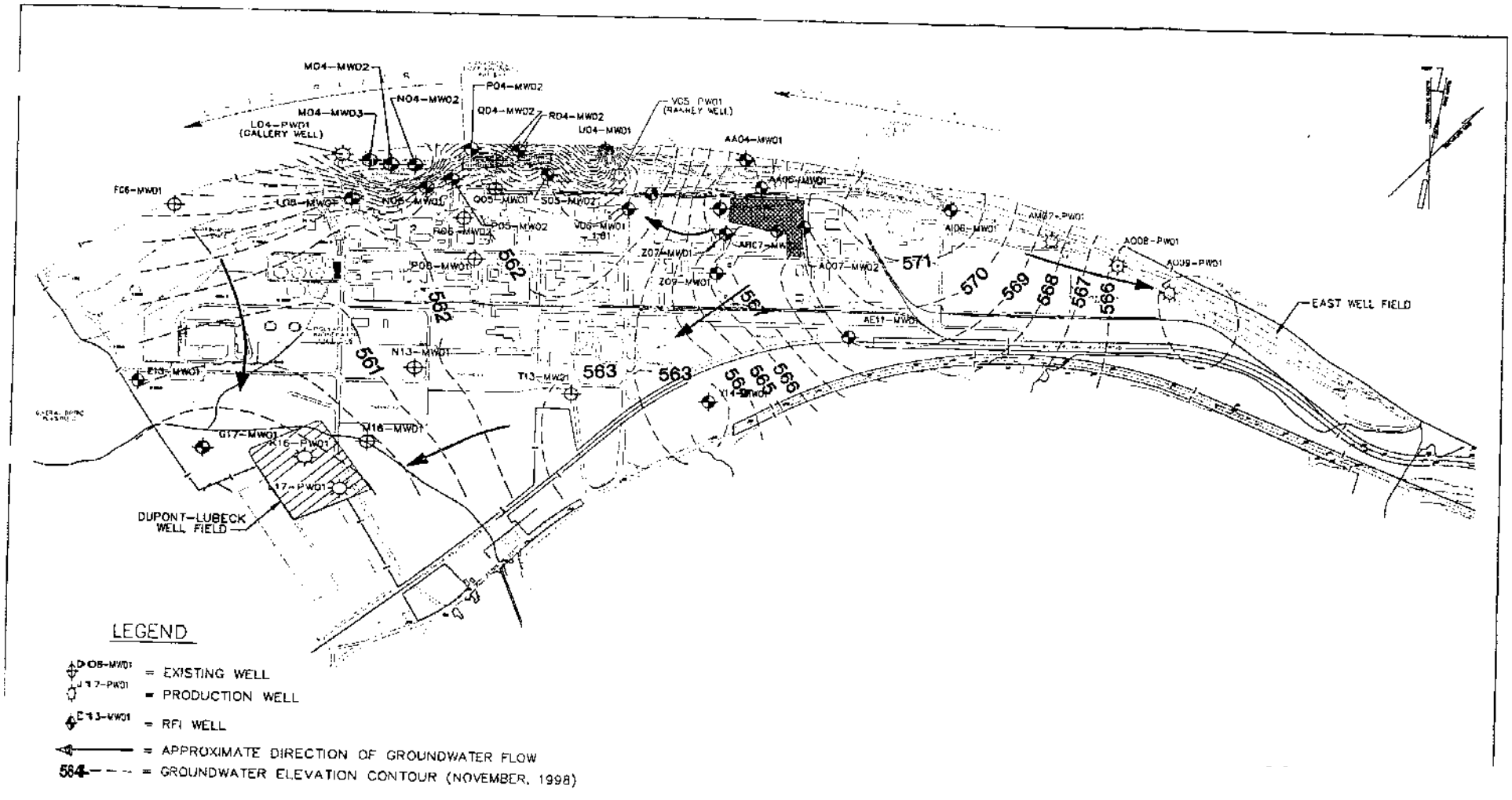
000531

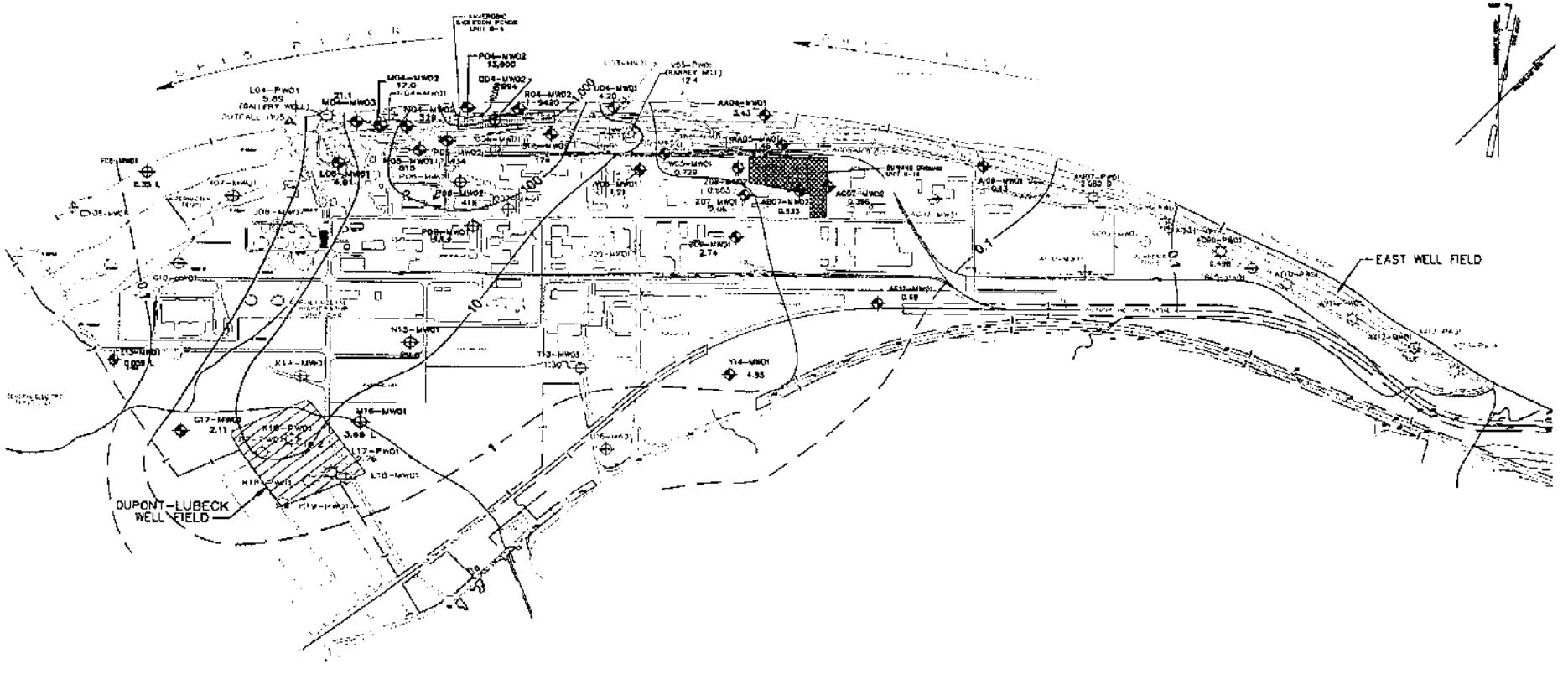
EID168096

MAH000468









LEGEND

= EXISTING WELL
= PRODUCTION WELL
= C-8 CONCENTRATION (ug/l)
= EXISTING WELL
—10— = C-8 ISOCONCENTRATION LINE

SCALE
700 0 700'

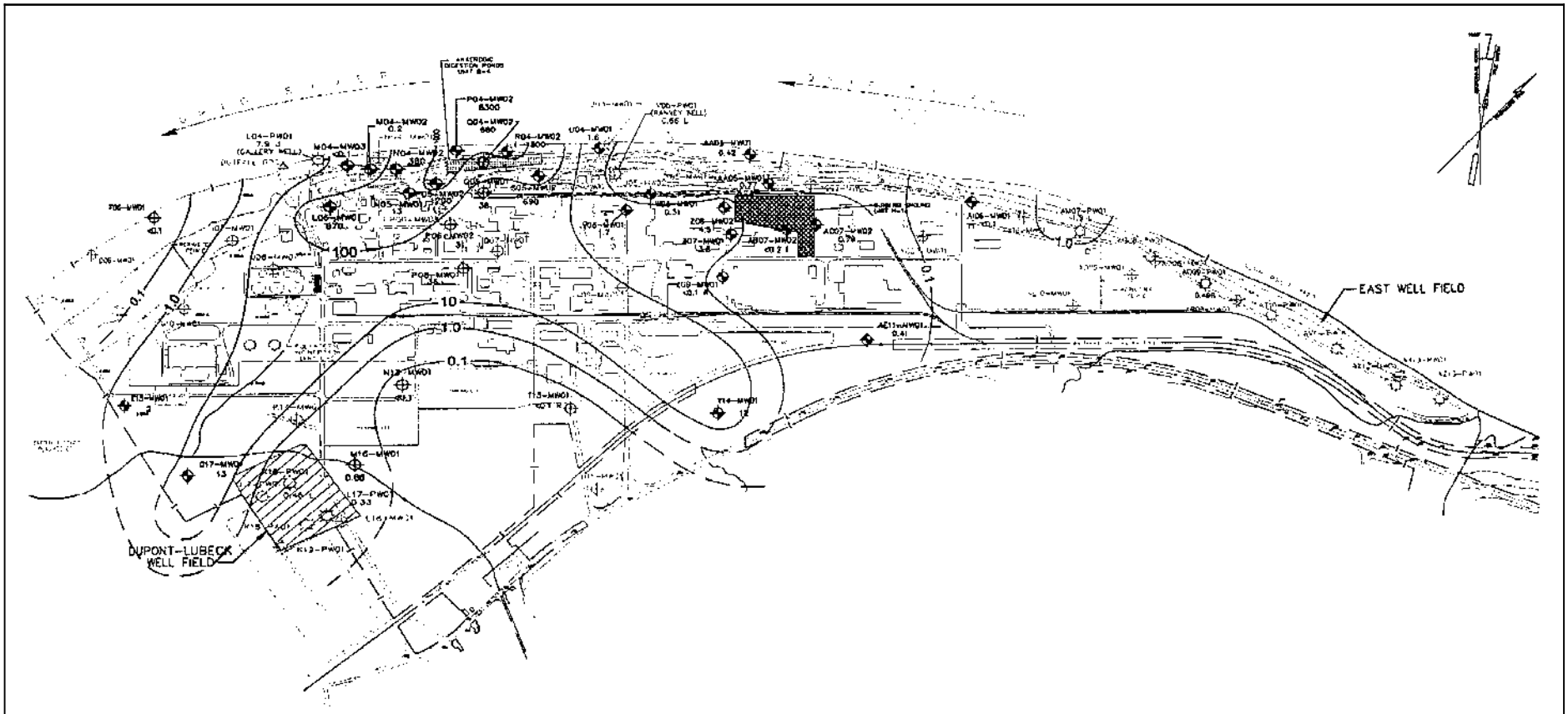
Corporate Remediation Grwp
An Alliance between DuPont and URS Diamond
Barley Mill Plaza, Building 27
Wilmington, Delaware 19805

C-8 IN GROUNDWATER
FEBRUARY, 1999
DuPont Washington Works Main Plant
Washington, West Virginia

000535

EID168100

MAH000472



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MAH000473

Section 3

3.0 LOCAL LANDFILL

Tables

Figures

3.1 Introduction

The Local Landfill is located immediately adjacent to the main plant off the southern perimeter (Figure 3.0). The landfill and plant are located along the Ohio River in Washington, West Virginia, approximately seven miles southwest **of** Parkersburg, West Virginia. **A** water use and well survey is currently being conducted for the area within a I-mile radius of the landfill perimeter (Figure **3.1).**

The Local Landfill consists **of** three separate closed cells located on the heavily wooded 250-acre site. The cells were operated from 1964 to the middle 1980s under West Virginia/National Pollutant Discharge Elimination System (WVNPDES) Permit No. 0076538. The permit is currently undergoing renewal and is expected to be effective in January 2002. The permit requires monthly surface water sampling and semi-annual groundwater monitoring.

Materials landfilled included scrap product, scrap metal, wood pallets and bins, and Powerhouse ash. Approximately 144 tons of waste per year were disposed in the landfill. Powerhouse ash comprised about 70 percent of the total waste. The specific source of C-**8** in historical groundwater and surface water samples collected from on-site locations has not yet been determined. The cells were closed and covered with approximately two feet of low permeability soil.

Figure 3.2 shows the location of the three cells, monitoring wells, and surface water sampling points. The cells have no compactcd or synthetic bottom liners. However, a hydrogeologic evaluation indicated that the natural soil present under the cell materials is composed of reddish brown clay and weathered shale having a very low hydraulic conductivity of about 5×10^{-7} cm/sec (DuPont, 1990) **and** ranges from 3.5 to 19.5 feet in thickness.

3.2 Environmental Setting

3.2.1 Geology

The Local Landfill is situated in **a** hilly area with relief of approximately **30** to 40 feet. The slopes appear to be a combination **of** natural topography with terraced outcrops of massive sandstone and siltstone underlying varying amounts of soil cover and man-made landfill plateaus. The locations of **two** cross-sections developed for the Local Landfill are shown in Figure **3.3.** The hvo cross-sections, **A-A'** and **B-B',** are shown in Figures 3.4A and 3.4B, respectively.

A shallow tight clay layer starting **at** ground surface ranges from three to 25 feet thick. The clay contains some minor sandy and silty zones, and some pebbles and fragments **of** sandstone in some locations. The clays are of low plasticity and appear to be well compactcd, often displaying a laminar structure (DuPont, 1990). Underlying the shallow clay layer is weathered shale ranging **from** 10 to 35 feet thick. Below this compctcnt bedrock is present at depths ranging from **21** to 40 feet below ground surface.

The bedrock at the Local Landfill consists of intcr-bedded red and varicolored sandy or calcareous shale, and gray, green, and brown sandstone of the Permian age Dunkard Group. The maximum thickness of the Dunkard Group in this region is 570 feet. The cross-sections show that the sandstone layers dip gently towards the north. Most of the sandstone layers located in the upper portion of the stratigraphic section are lenticular and laterally discontinuous. Two laterally continuous sandstone layers arc located in the lower stratigraphic section.

3.2.2 Hydrology, Hydrogeology and Groundwater Flow

Hydrology

In general, infiltration of precipitation is limited due to the very low hydraulic conductivity (5×10^{-7} cm/sec) of the surficial clays (where these clays exist) and the weathered bedrock (DuPont, 1992). In addition, infiltration of precipitation into the cells is limited by approximately 2-feet of low permeability soil and vegetative cover capping of the cells. Leachate from the southern cell and the eastern cell flows from the seeps in the steep valley walls to leachate collection ponds, Pond 1, 2 and 3 (Figure 3.2). Leachate from these ponds is discharged into a pipeline and conveyed to the main plant where it passes through storm water Outfall no. 001 into the Ohio River. Monitoring of combined pond effluent conveyed in the pipeline is conducted at Outlet 101.

Hydrogeology

Groundwater underlying the Local Landfill occurs in hvo zones. The discontinuous upper zone consists of the clays and underlying weathered bedrock and has a very low hydraulic conductivity (DuPont, 1992). The lower zone consists of the continuous and discontinuous sandstone layers having low permeability of 1×10^{-5} cm/sec. The sandstonc layers are separated by laterally continuous shale layers. Well yields from the sandstone layers are very low, ranging from <0.5 gpm to 1.5 gpm (DuPont, 1332). The upper (and thicker) of the two laterally continuous sandstone layers located in the lower zone at elevations between 710-740 feet above Mean Sea Level (Figures 3.4A and 3.4B) has been designated as the "underlying significant aquifer" and is currently monitored semiannually as required by the permit.

In 1989, eight monitoring wells were installed at the Local Landfill by Tetra Tech Richardson (LLMW-I through 8). However, five of these monitor wells (LLMW-1, -2, -3, -5, and –7) were closed in 1996 because they were screened in the discontinuous shallow clays and underlying weathered bedrock. LLMW-8, a bedrock well, was closed in 1997 because it was dry. Two additional bedrock wells, LLMW-9 and -10 were installed in 1995 and 1997, respectively. LLMW-9 was installed as a background well. These wells are screened within the significant underlying aquifer. Table 3.0 summarizes the well construction data for the existing monitoring wells.

Groundwater Flow

Groundwater elevations have been measured semiannually since 1994. Groundwater elevation contour maps for the significant underlying aquifer have been prepared from this data as required by the WVNPDES Permit No. **0076538.** Figures 3.5A through 3.5G present maps for 2001 through 1996 and 1994. The groundwater contours were

transferred from the original maps submitted for the permit to the updated Local Landfill base map.

Evaluation of limited groundwater elevation data for the closed wells (based on well installation information) indicates a downward vertical gradient between the upper discontinuous water bearing zone and the lower sandstone layers containing the underlying significant aquifer. In addition, C-8 present in the underlying significant aquifer provides further support for a downward vertical gradient.

The groundwater contour maps for the underlying significant aquifer show that flow is from the south to the north towards the plant. The sandstones of the underlying significant aquifer outcrop in the valley walls where discharge may occur as seeps. However, groundwater may also flow downslope within the fractured rocks of the valley walls and ultimately enter the alluvial terrace deposit on the main plant. Groundwater discharging to seeps ultimately migrates to the plant through a number **of** pathways. It can discharge downward to leachate collection ponds and pipes to the main plant where it enters storm sewers and discharges to the Ohio River. Groundwater also can seep to small streams draining the property to the north and flowing to the Quaternary alluvial terrace unconfined aquifer where pumping of on-site active well fields controls groundwater flow. Groundwater flow in the alluvial aquifer, adjacent to the valley walls of the Local Landfill, is towards the pumping wells located near and parallel to the Ohio River. The pumping of these well fields also lowers the groundwater level to below river stage, inducing surface water from the river to flow into the alluvium towards the pumping wells. Water from the pumping wells is used for non-contact cooling purposes and ultimately is discharged to the Ohio River.

3.3 Water Quality

3.3.1 Surface Water Quality

Table 3.1A prcscnts the historical C-8 concentration data available for surface water. Figure 3.2 shows the surface water sampling locations, *if* the location currently exists. Samples from two outfalls, four outlets: two streams, and one leachate sampling location have been collected periodically since 1994. C-S concentrations in the outfalls and outlets range from <0.2 ug/l to 80 ug/l. Stream sample C-8 concentrations ranged from 4.12 ug/l to 15 ug/l. The leachate sample, collected in the pipe from the leachate ponds, had a concentration of 31 ug/l (February 1994). For sample locations having more than two sampling events, the concentration of C-S is decreasing with time although it is difficult to accurately identify trends in samples with the limited data set. The C-8 concentration at Outlet 101, located at the northeastern portion of the side, have decreased from 54 ug/l to **12** ug/l over the course of three sampling events.

3.3.2 Groundwater Quality

Analysis of **C-8** in groundwater has been conducted annually on a voluntary basis since **1996.** Table 3.1B presents the data available for C-8 in Local Landfill monitoring wells. Groundwater was sampled annually in 1996, and 1998 **through 2001 for** three wells, LLMW-4, -6, and –9. LLMW-IO was sampled twice in 1998 and 1999. The limited

amount of data makes it difficult to develop concentration contour maps. In addition, the monitoring wells are located at three separate areas (cells) of the landfill; therefore, annual data for the past four years is posted in Figures 3.6A through 3.6D but is not contoured.

C-8 concentrations in LLMW-9 and **-10** range from non-detectable to 0.22 ug/l. The other two wells, LLMW-4 and -6, have the highest concentrations, ranging from **1.4** to 39 ug/l and from 1.32 to **15** ug/l respectively. Although there is limited data, the data shows a distinct reduction in **C-8** concentration over time for wells LLMW-4, -6, and -9.

3.4 Site Conceptual Model

The Local Landfill site conceptual model describes the potential exposure routes for current and future human and ecological receptors. Potential exposure routes were evaluated **and** classified as complete or incomplete.

Access to the Local Landfill is restricted by electronic and locked gates at the road entrances, However, a posted nature trail has been established on the east side of the landfill property. The trail loops around the eastern part of the landfill starting and ending near the landfill's electrically operated gate. The nature trail is a marked trail and docs not cross the cells. Access to the site from surrounding roads is possible but is discouraged due to the heavily wooded nature of the property and the hilly terrain.

The three cells at the Local Landfill are covered with a low permeability soil and vegetative cover. This cover prevents human and ecological receptors' exposure to the landfilled materials and to the soils potentially impacted by the landfill materials. However, these materials could potentially be exposed by extensive digging or rooting in the soil by animals or unauthorized people. Therefore this pathway is considered to be potentially complete but minimal.

An additional potentially complete exposure pathway exists if the soil and vegetative cap is eroded by precipitation. Permit WV0076538 requires that the landfill surface will be inspected quarterly for evidence of cracking or erosion (which could allow surface water to enter the solid waste deposit) and evidence of settling of solid waste (causing ponding of surface water). Per Condition G-16 of the permit, a stormwater erosion inspection is conducted annually. Therefore, this potentially complete pathway is considered to be minimal.

At the landfill, precipitation is expected to take one of two paths. It may infiltrate downward through the vegetated soil cover and into the cells. However, the low permeability of the soil cover reduces the amount of infiltration. If the precipitation infiltrates the soil cover, it will possibly encounter the landfill materials and will continue downwards. It may be prevented from further downward migration by the low permeability clays and weathered bedrock. However, if this water migrated further downward, it should encounter the sandstones and shale layers. Groundwater flowing through the sandstone layers that outcrop in the valley walls located above the plant site's southern edge would be exposed at the surface in seeps, **if** seeps exist. The existence and location of seeps at some places on the property have been observed, particularly those mentioned near the leachate collection ponds. Much of the site remains unexplored,

therefore, complete evaluation of this potential exposure pathway (surface water to groundwater to surface water) is currently not available.

Another possible migration route for precipitation is direct flow as surface water via overland flow downslope. In this case the water would not encounter the fill materials at any point it time. This potential exposure pathway is considered incomplete.

Contact with groundwater impacted by C-8 is another potential exposure route for current and future human and ecological receptors. However, contact with groundwater under the landfill is limited, although, contact with leachate that has reached the ground surface via seeps is possible in the vicinity of Pond 1, near the southern most cell. Ponds are open and accessible to limited number of DuPont employees. As stated previously, groundwater flowing through the sandstone layers that outcrop in the valley walls located above the plant site's southern edge would be a possible contact location. However, because seeps in this area are not evident, it is likely that groundwater flows downslope within the fractured rocks of the valley walls and discharges to the main plant alluvial terrace. Determining the existence and location of seeps on the property has not been completed therefore, this potential exposure pathway cannot be fully evaluated.

3.5 Data Gaps

The following data gaps were identified for the Local Landfill:

- Identify the locations of seeps in the valley walls and determine water quality with respect to C-8 concentration.
- Determine the C-8 concentration in streams and other surface water bodies.
- Acquire additional geological data to refine the Site Conceptual Model.
- Install additional monitoring wells to provide additional groundwater flow data and groundwater quality data.
- Gather additional C-8 concentration data from monitoring wells for plume delineation.

Activities to fill the data gaps will be proposed and discussed in the work plan.

3.6 References

DuPont. 1990. *Washington Works 1990 Preliminary Hydrogeologic Assessment.* Solid Waste & Geological Engineering Department.

_____. 1992. *Verification Investigation E.I. DuPont de Nemours Co.* Washington Works April 1992. (Vol. 1).

TABLES

Table 3.0
Monitoring Well Construction Data
Local Landfill
Washington, WV

Monitoring Wells	Surface Elevation (feet)	Total Depth (feet)	Well Diameter (inches)	Slot Size (inches)	Screen Length (feet)	Elevation of Screen Interval (feet)
LLMW-4	844.7	155	4	0.020	20	717.2-697.2
LLMW-6	793.2	90	4	0.020	20	723.2-703.2
LLMW-9	788.54	80	4	0.020	20	728.54-708.54
LLMW-10	805.94	87	4	0.020	20	738.94-718.94

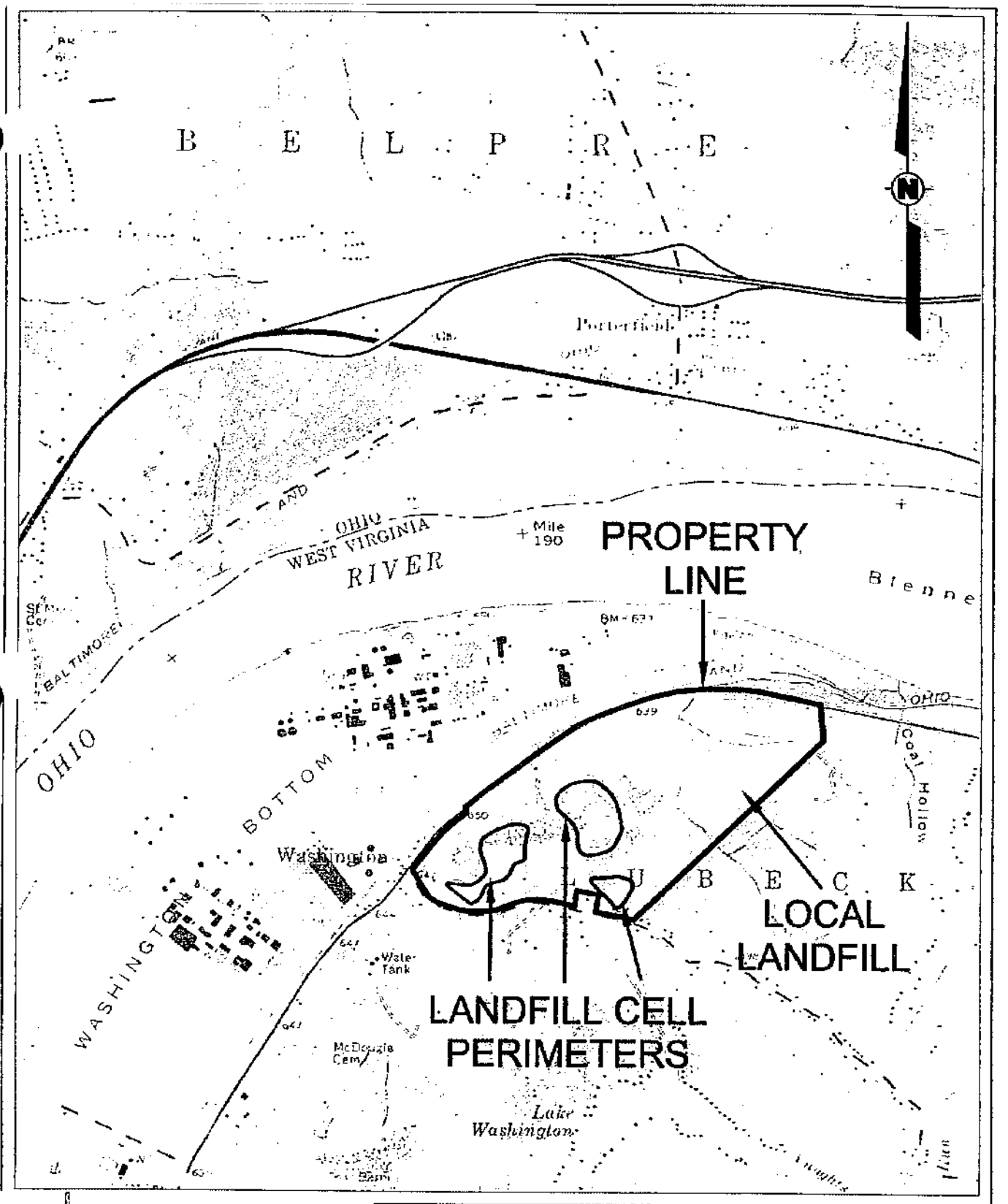
Table 3.1A
Summary of Analytical Results:
C-8 in Surface Water Samples
Local Landfill
Washington, WV

Sample	Date	C-8 (ug/l)
LEACHATE	2/16/1994	31
OUTFALL 004	9/27/2000	4.73
	12/10/1999	7.1
	6/3/1999	3.06
	6/2/1998	12
	5/29/1997	13
	4/2/1996	13
	2/16/1994	11
OUTFALL 005	9/27/2000	13.3
	12/10/1999	34
	6/3/1999	6.8
	6/2/1998	39
	5/29/1997	41
	4/2/1996	39
	2/16/1994	35
OUTLET 001	5/29/1997	80
	4/2/1996	61
OUTLET 002	512911997	c0.2
	4/2/1996	72
OUTLET 003	5/29/1997	23
	4/2/1996	20
OUTLET 101	9/14/2000	12
	6/3/1999	15
	6/2/1998	54
STREAM 1	5/29/1997	11
	4/2/1996	7.2
STREAM 2	9/14/2000	4.12
	12/29/1999	10.7
	6/2/1998	15
	4/2/1996	14

Table 3.1B
Summary of Analytical Results:
C-8 in Groundwater
Local Landfill
Washington, WV

Sample	Date	C-8 (ug/l)
LLMW-4	5/16/2001	1.4
	5/11/2000	10
	5/19/1999	16.2
	5/27/1998	26
	4/11/1996	39
LLMW-6	5/16/2001	3
	5/10/2000	1.42
	5/19/1999	1.32
	5/27/1998	9
	4/11/1996	15
LLMW-9	5/16/2001	0.039 J
	5/10/2000	<0.029
	5/20/1999	0.046 J
	5/27/1998	<0.1
	4/11/1996	0.14
LLMW-10	5/20/1999	0.15
	5/28/1998	0.22

FIGURES



Quadrangle
Source: USGS Little Hocking, Ohio - West Virginia

DUPONT

Corporate Remediation Group

Barley Mill Plaza, Building 27
Wilmington, Delaware 19805

SITE LOCATION MAP

Local Landfill
Washington, West Virginia

SCALE	DESIGNED	DRAWN	CAD FILE NO
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DATE	CHECKED	APPROVED	FIGURE
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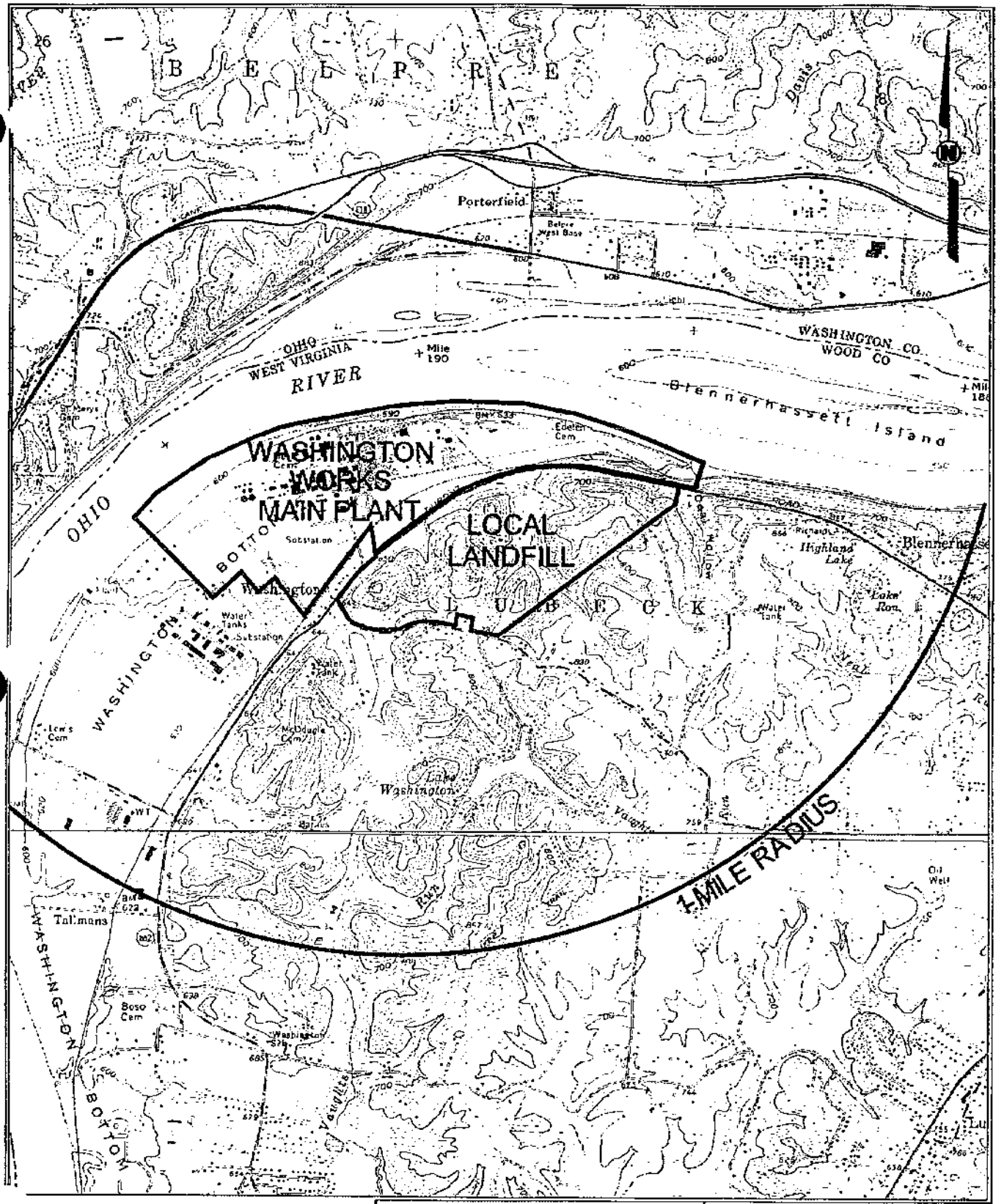

SCALE

2400 0 2400'

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Barley Mill Plaza, Building 27
Wilmington, Delaware 19805

1-MILE RADIUS MAP

Local Landfill
Washington, West Virginia

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DATE	CHECKED	APPROVED	FIGURE
12/19/01	TDL		3.1

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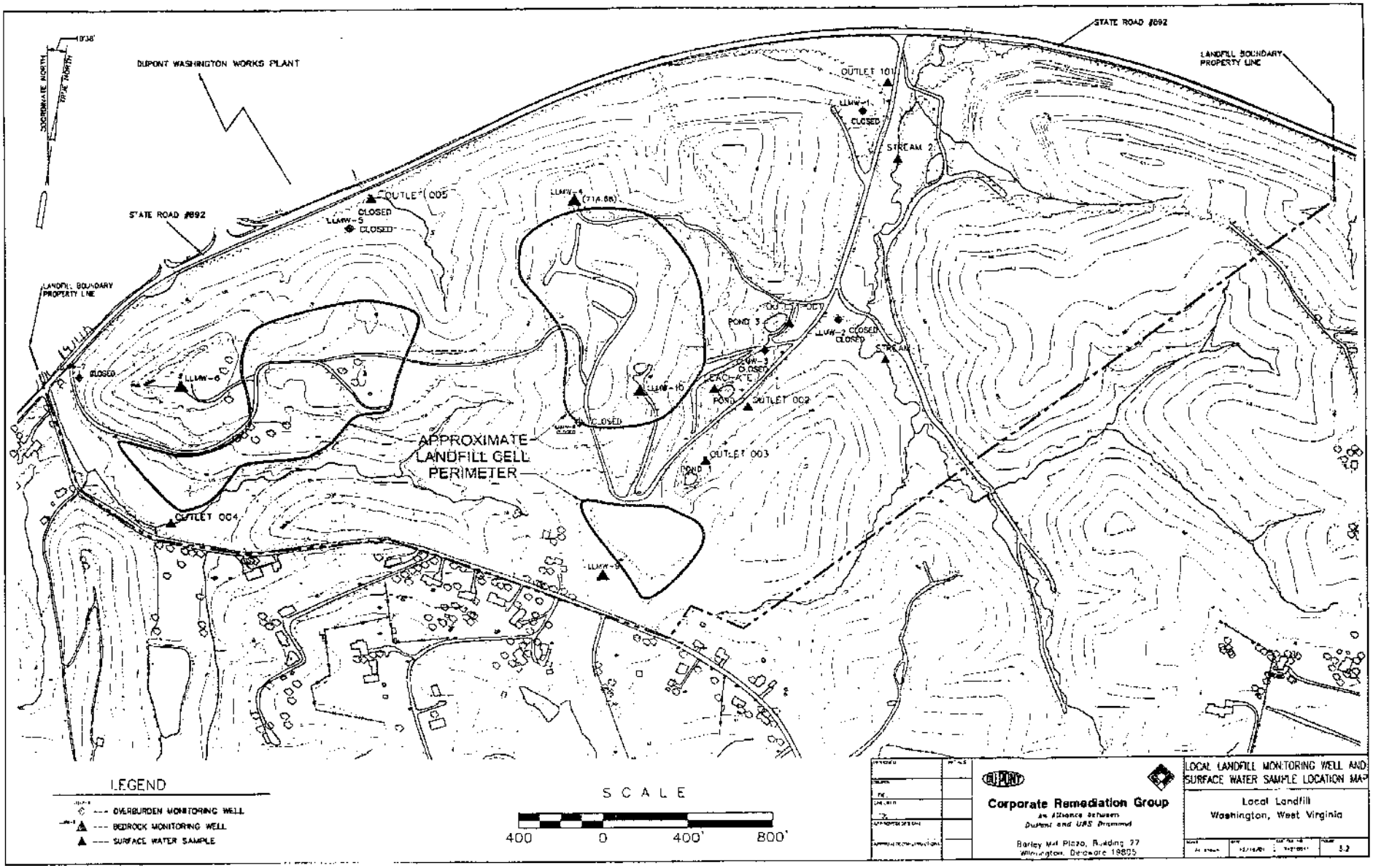

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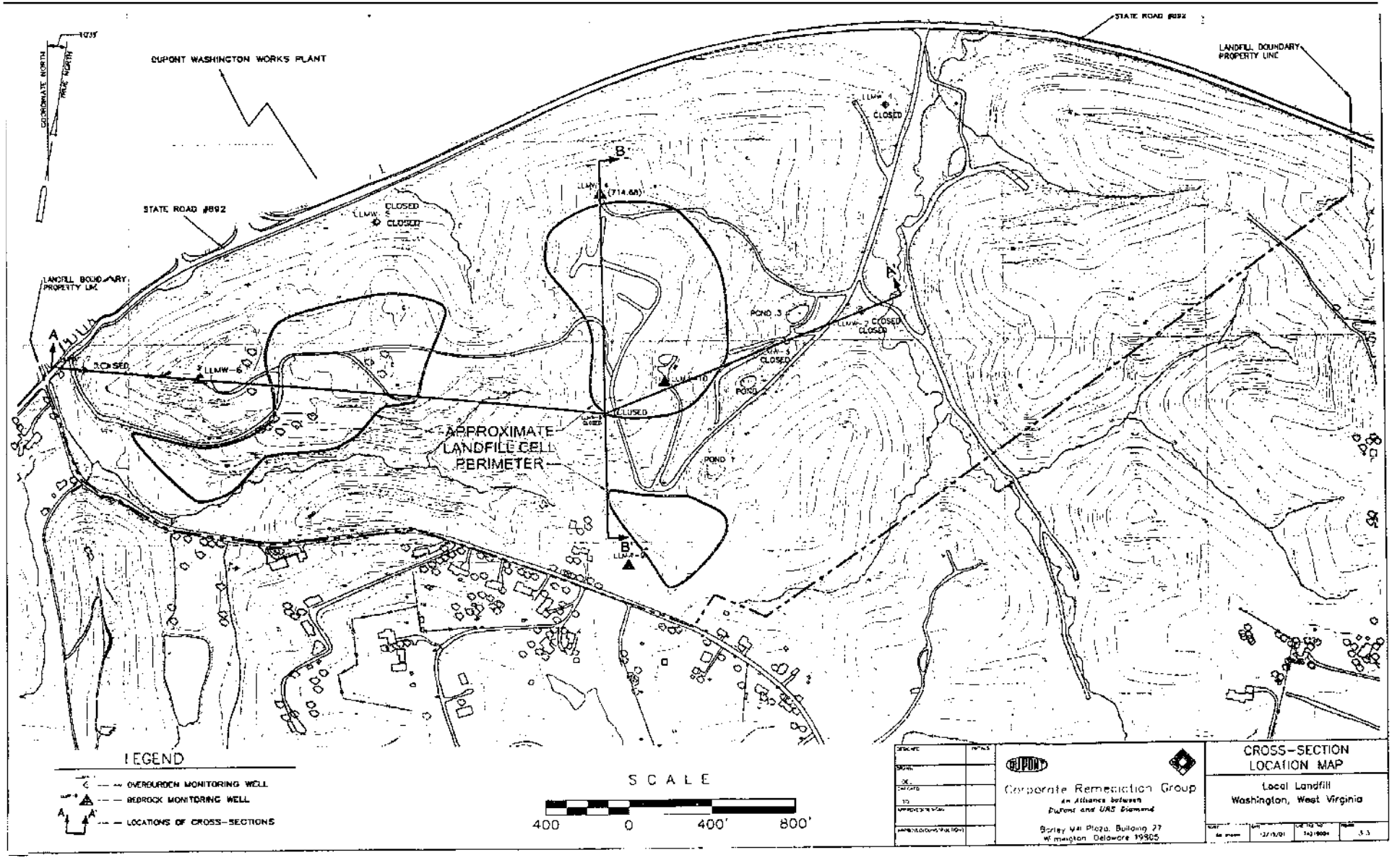

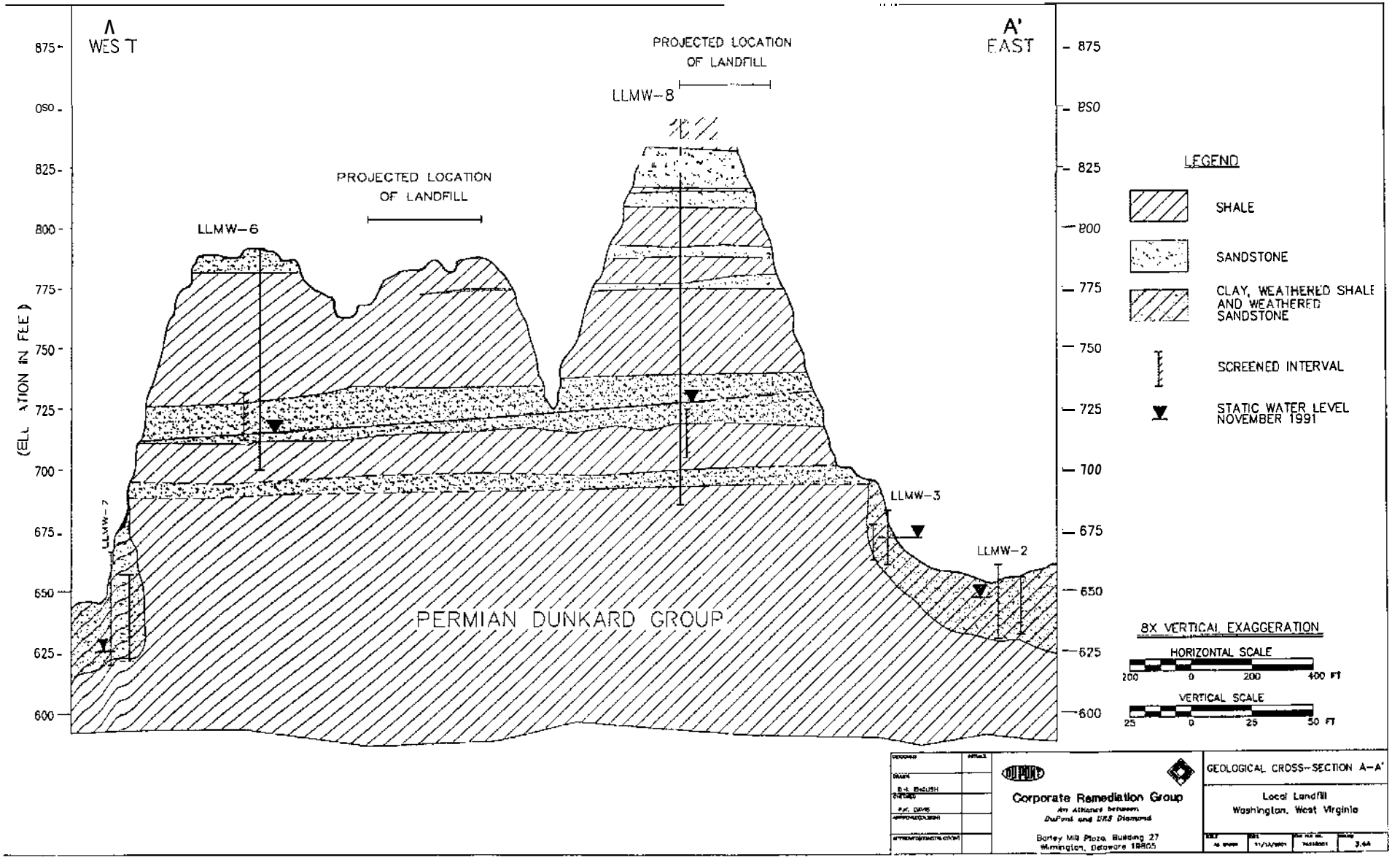

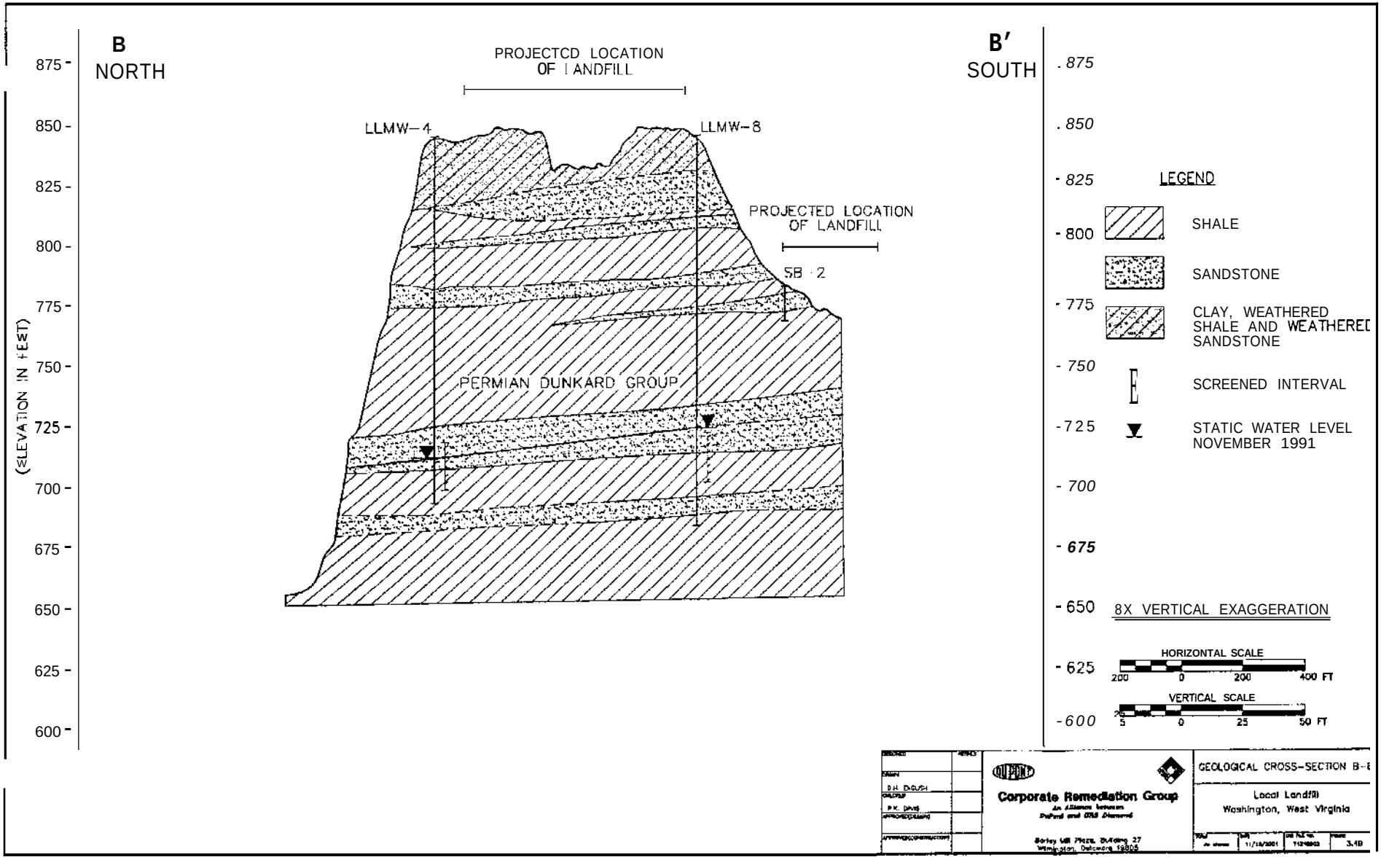

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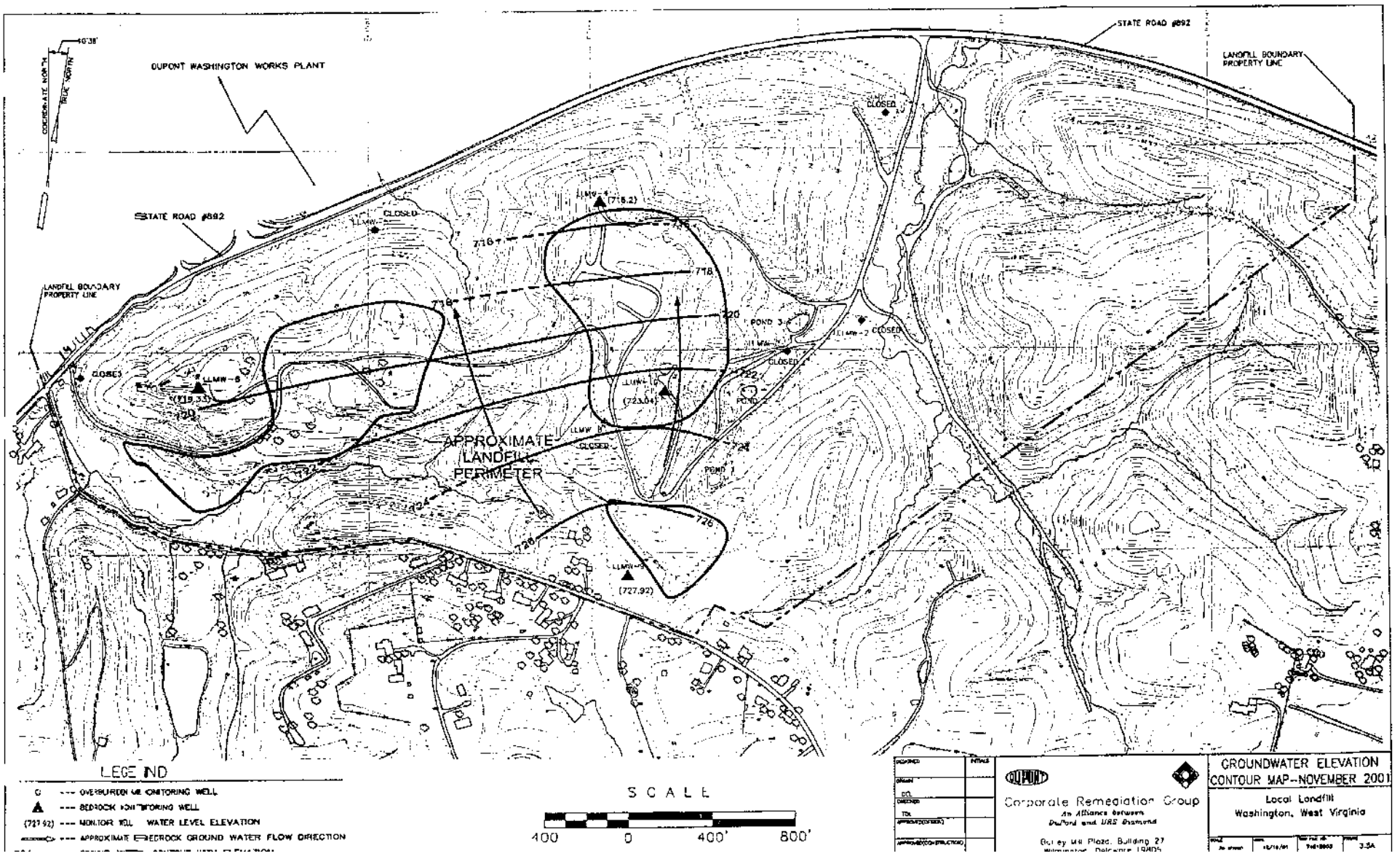

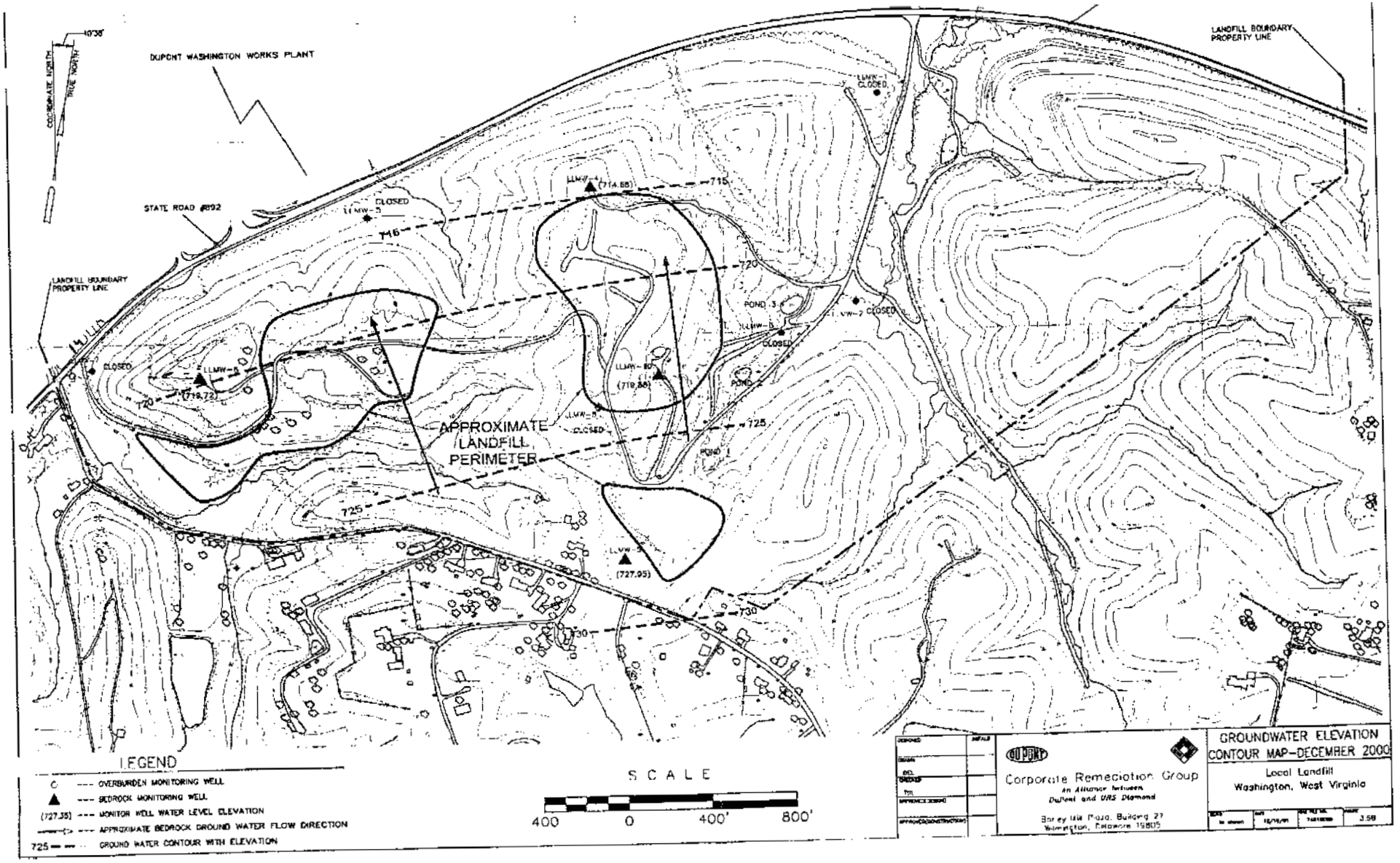

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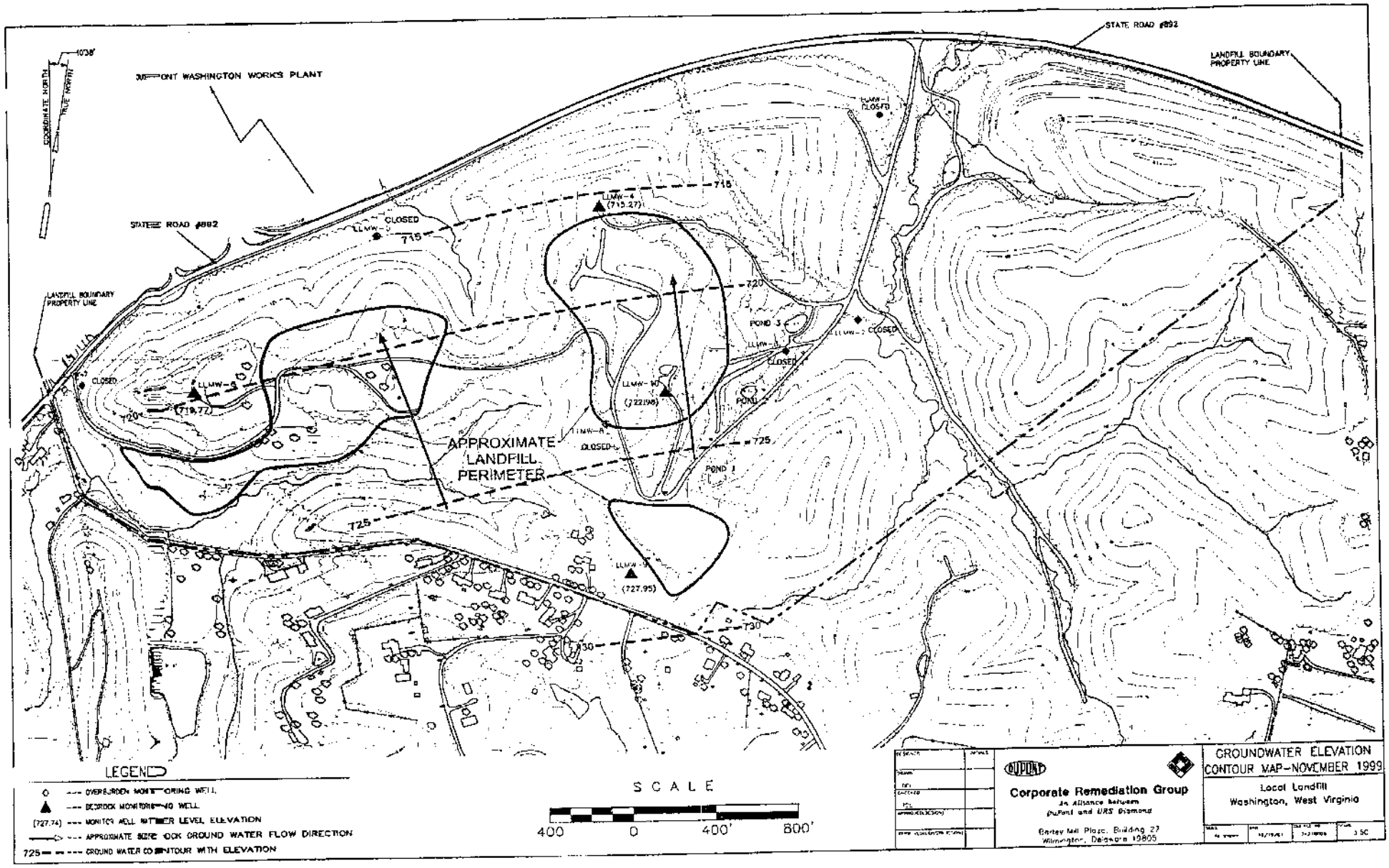

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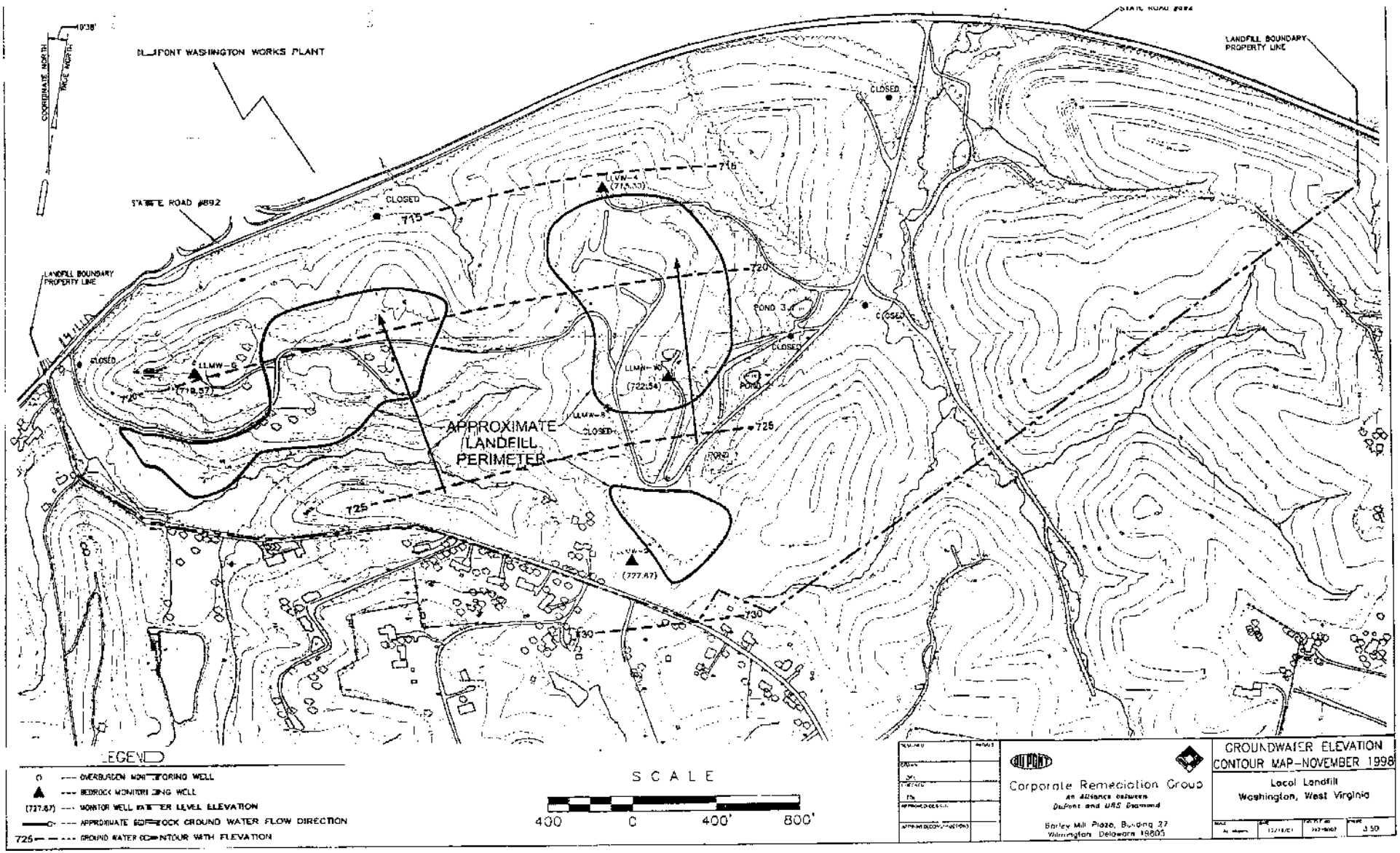

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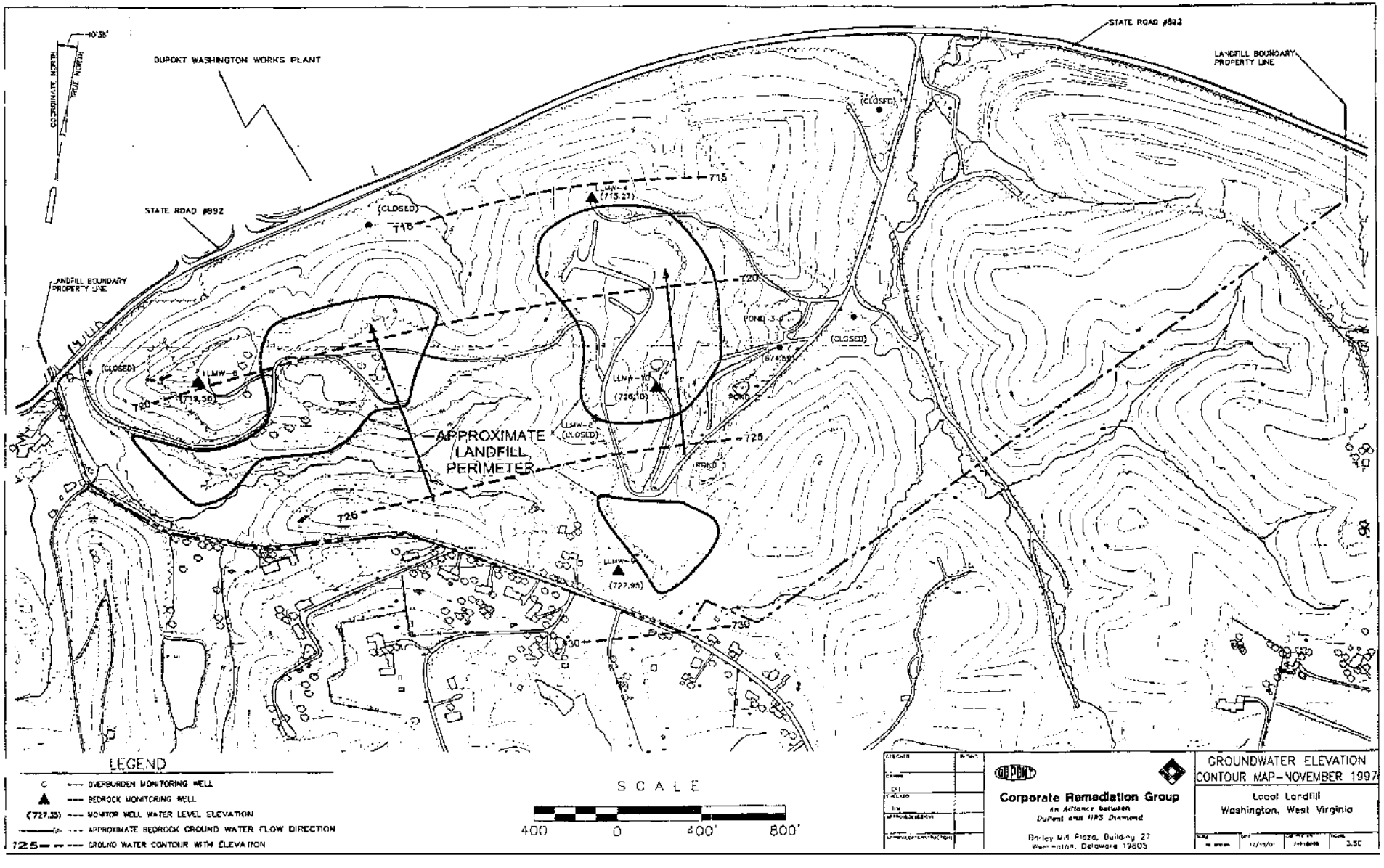

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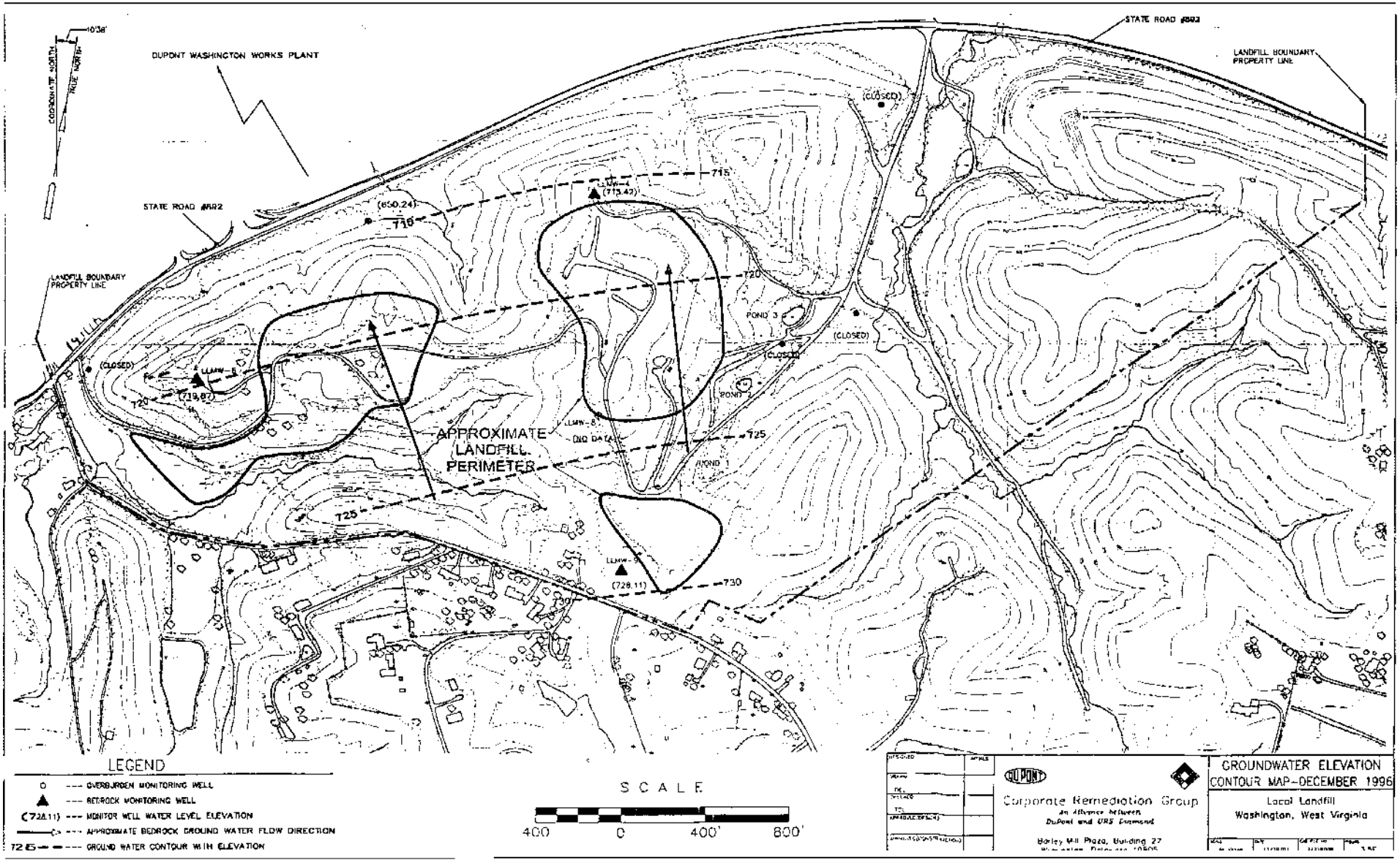
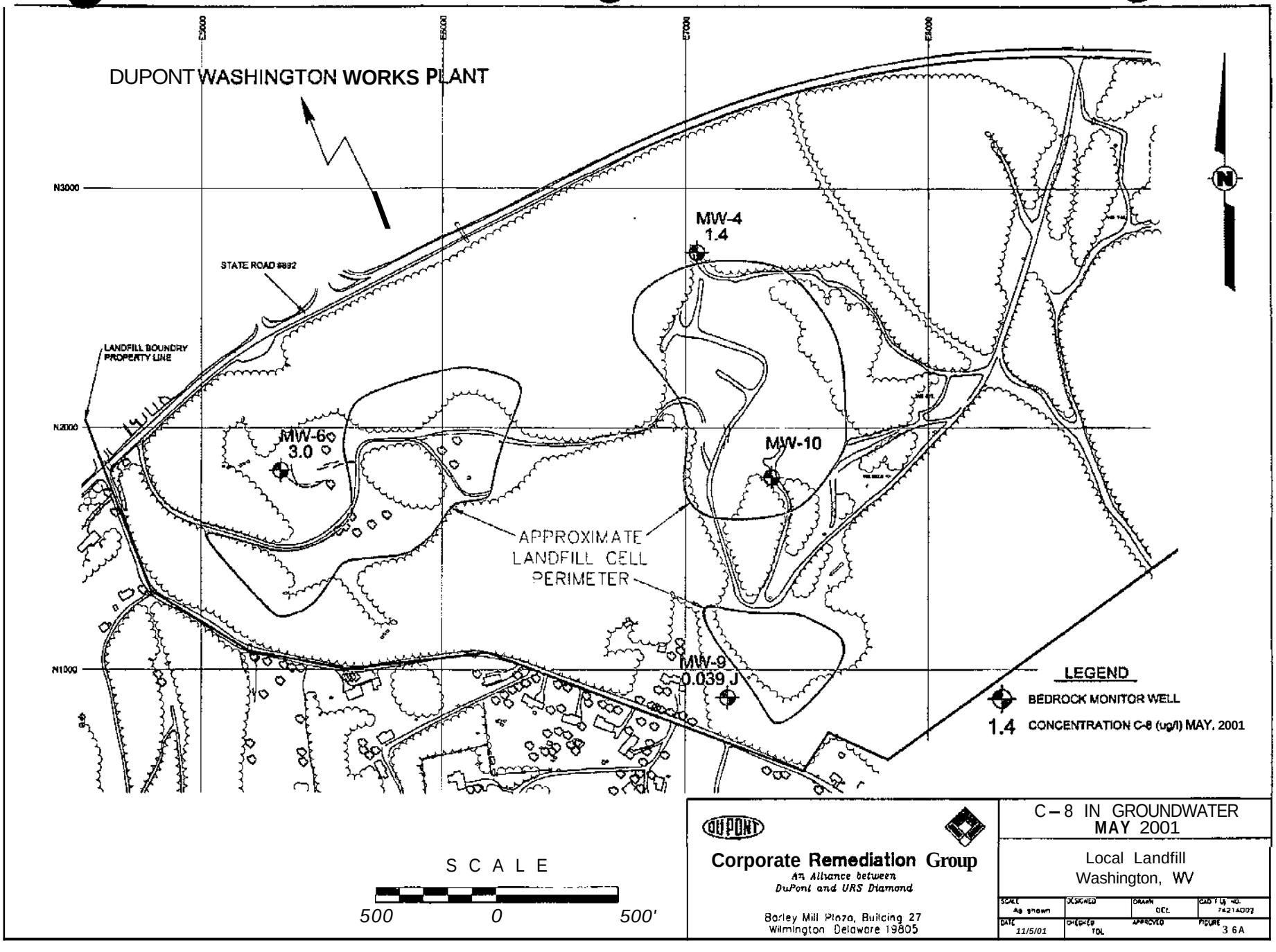
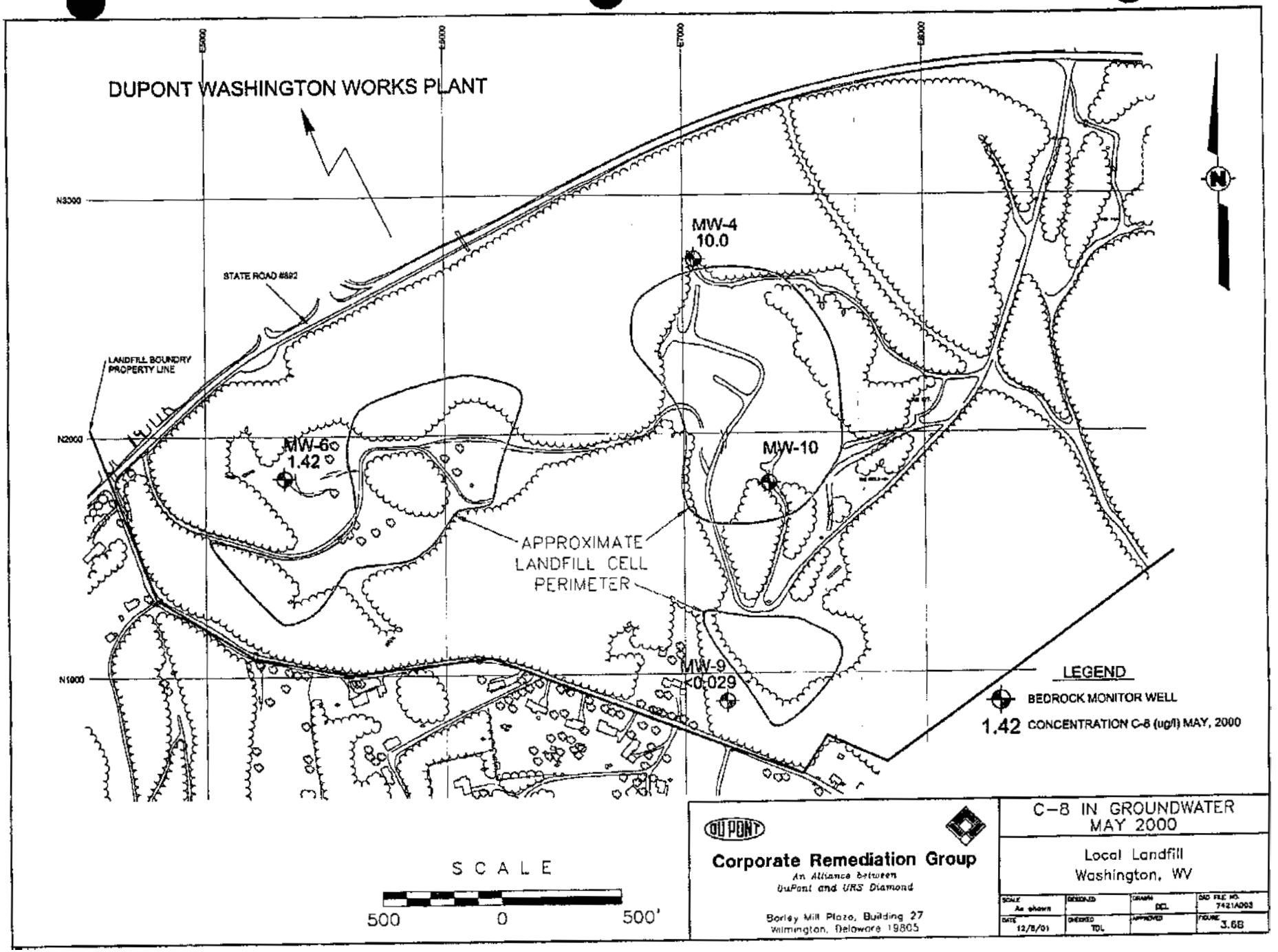
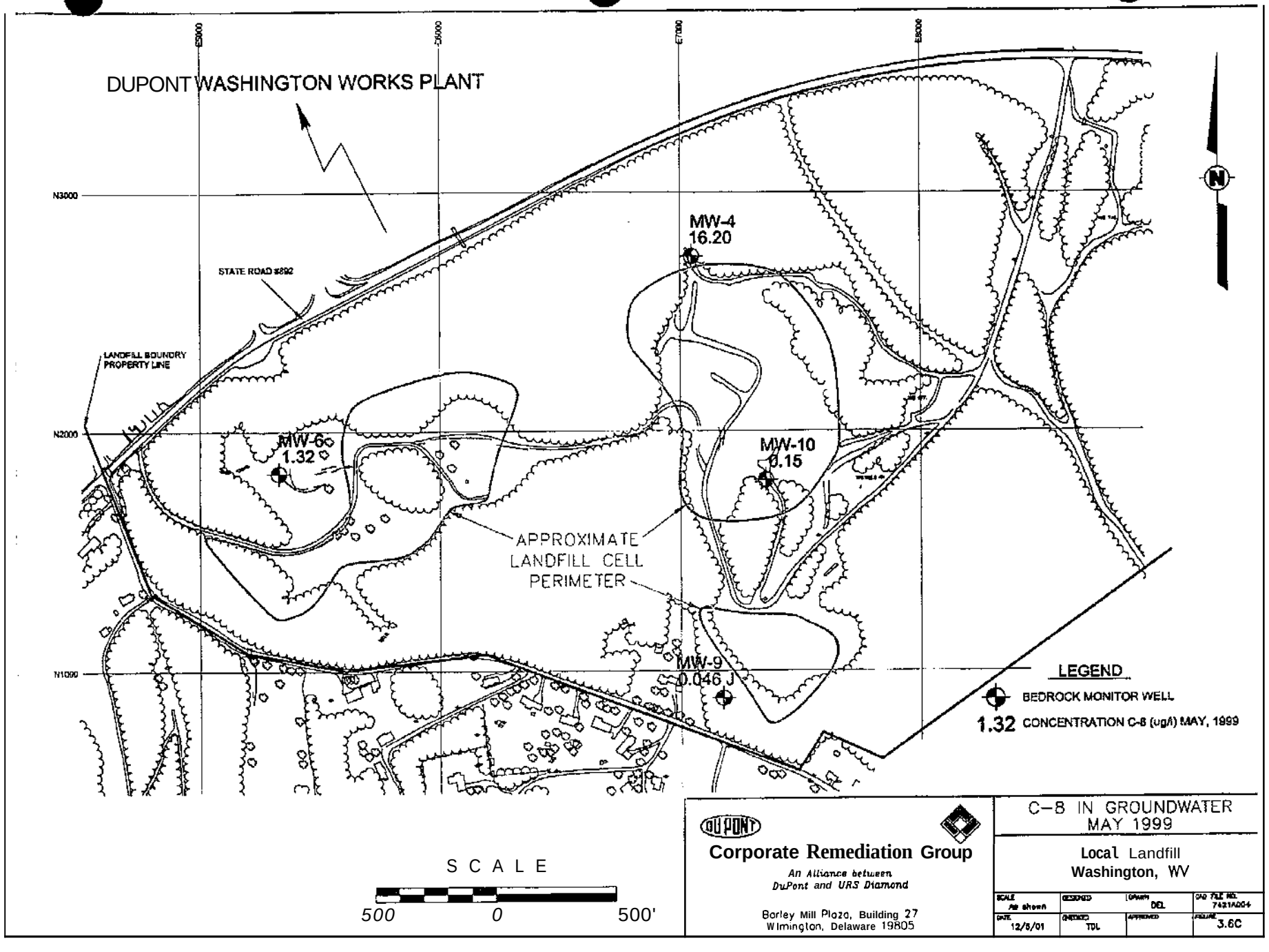
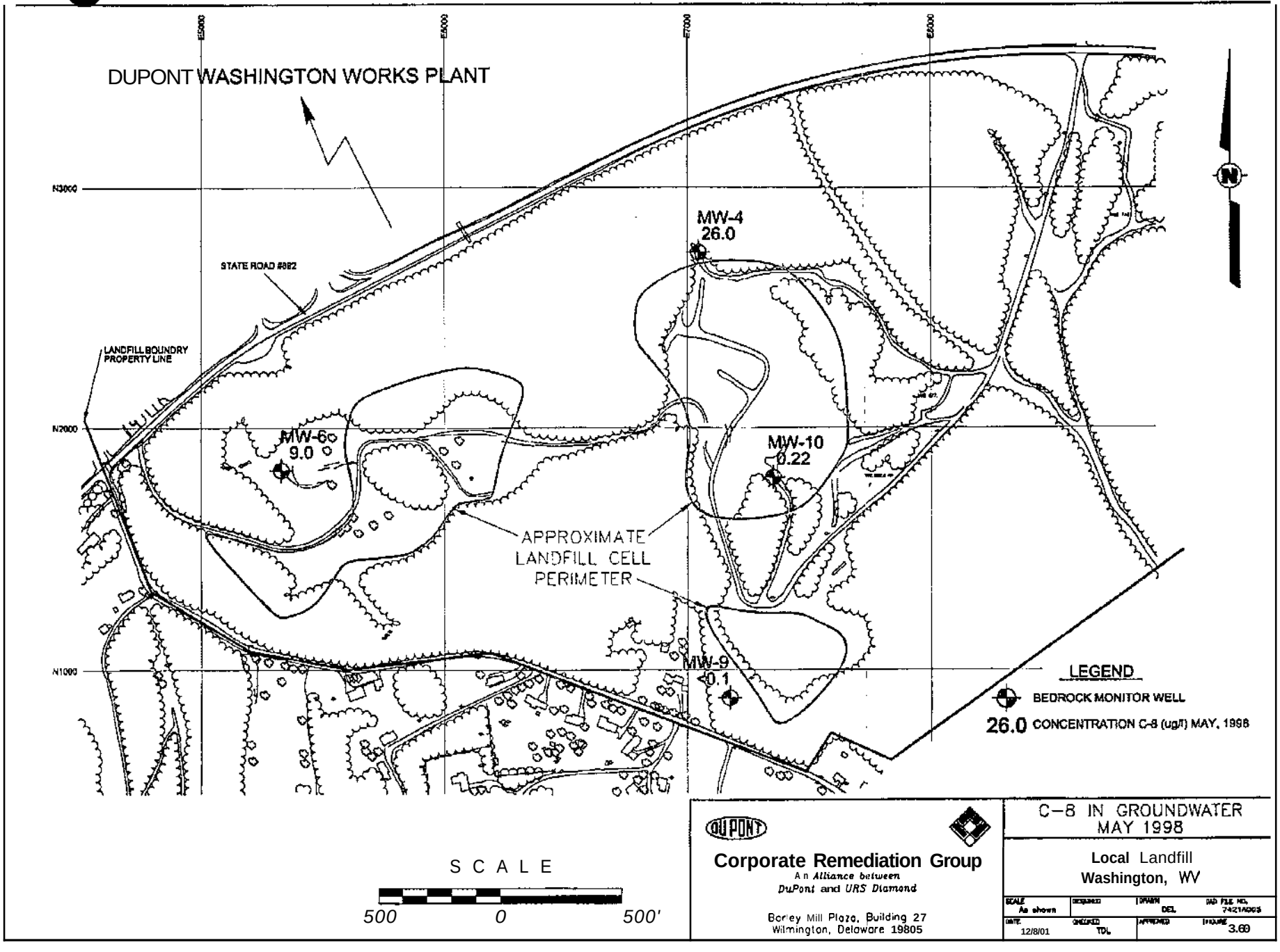


GROUNDWATER ELEVATION
CONTOUR MAP–DECEMBER 19
Local Landfill
Washington, West Virginia
Conestoga Rovers & Associates
An Alliance between
Dupont and CRS Companies
Boeing Hall Place, Building 27
Wilmington, Delaware 19805
SCALE
400 0 400' 800'
LEGEND
OVERBURDEN MONITORING WELL
BEDROCK MONITOR AND WELL
MONITOR WELL AND WATER LEVEL ELEVATION
APPROXIMATE BEDROCK GROUND WATER FLOW DIRECTION
GROUND WATER CONTOUR WITH ELEVATION
APPROXIMATE LANDFILL PERIMETER
LANDFILL BOUNDARY PROPERTY LINE
STATE ROAD #892
DUPONT WASHINGTON WORKS PLANT
POND
LLMW-1
LLMW-2
LLMW-3
LLMW-4
LLMW-5
LLMW-6
LLMW-7
LLMW-8









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Wilmington, Delaware 19805

C-8 IN GROUNDWATER
MAY 1998

Local Landfill
Washington, WV

SCALE	DESIGNED	DRAWN	CAD FILE NO.
As shown		DEL	7421A003
DATE	CHECKED	APPROVED	FIGURE
12/8/01	TDL		3.69

000565

EID168130

MAH000502

4.0 LETART LANDFILL

Tables

Figures

4.1 Introduction

The Letart Landfill is located just north of the town of Letart in Mason County, West Virginia (Figure 4.0). A water use and well survey is being completed for the area within a 1-mile radius from the landfill perimeter (Figure 4.1).

The landfill covers approximately 17-acres of a 205-acre parcel of land owned by DuPont Washington Works. It was in operation from the early 1960s to 1995. The landfill was operated and closed under West Virginia Solid Waste /National Pollutant Discharge Elimination System Permit No. WV 0076066. This permit requires quarterly groundwater monitoring, outfall and surface water monitoring and engineered cap maintenance.

Figure 4.2 shows the landfill extent, orientation, topography, and monitoring well locations. The landfill was constructed within a natural ravine and has no compacted or synthetic bottom liners. However, a hydrogeologic evaluation indicated that the natural soil present under the landfill material is composed of highly plastic clay and silt having a permeability of about 10^{-7} cm/sec (DuPont, 1993). The soil thickness ranges from 4 to 14 feet, averaging about 8 feet in thickness.

Letart Landfill received waste was from the Fluoropolymer manufacturing process at the plant that consisted primarily of scrap product, scrap metal, wood pallets and bins, and miscellaneous trash. Approximately 5,000,000 pounds of waste per year were disposed in the landfill. This waste is believed to be the source of C-8 in the historical groundwater and surface water samples collected from on-site locations.

The Letart Landfill was permanently closed by installing an engineered multi-layer geosynthetic and soil cap (DuPont, 2001). Included in the closure activities were the installation of a leachate collection system, erosion and drainage control measures and chain-link fencing. The cap construction was completed in April 2001.

4.2 Environmental Setting

4.2.1 Geology

The Letart Landfill is situated on a heavily dissected plateau consisting of several steep V-shaped valleys. Residual soil covers most landfill areas. In general, the soil at the site has been described as residual in nature, consisting primarily of heavy clays derived from the weathering of bedrock. At most landfill areas, the soil is less than ten feet thick, with a maximum thickness of 20.5 feet.

The underlying bedrock at the Letart Landfill consists of inter-bedded red and varicolored sandy or calcareous shale, and gray, green, and brown sandstone of the Permian age Dunkard Group. The maximum thickness of the Dunkard Group in this region is 570 feet. The location of two cross-sections, A-A' and B-B', crossing the landfill are shown in Figure 4.3. The two cross-sections of the underlying geology are shown on Figures 4.4A and 4.4B.

Geologic investigations conducted at the Letart Landfill identified six stratigraphic water-bearing zones that were designated as Zone **A** through Zone F, with Zone **A** being the shallowest zone and Zone F the deepest. These zones consist of massive, very fine to fine grained crystalline sandstone with occasional shale lenses. Zones **A** through F are separated by locally continuous shale units that are generally ten feet or greater in thickness. Zones **A** through D/E are discontinuous. Zone F is the first laterally continuous zone under the landfill. Zones **A,** C, D/E **and** F outcrop on the valley sides and along the Ohio River near the southern end of the landfill.

4.2.2 Hydrology, Hydrogeology and Groundwater Flow

Hydrology

The Letart Landfill engineered cap system prevents surface water from contacting landfilled materials. Precipitation falling on the engineered cap system takes one of two paths. It may infiltrate downward through the vegetated soil and encounter the impermeable geomembrane and then **flow** laterally downslope on top of the geomembrane. Alternatively, precipitation may **flow** via overland flow on **top** of the vegetative layer downslope. In either situation, this surface water does not contact the landfilled materials and migrates downslope towards drainage ditches constructed in or adjacent to the cap system. Precipitation falling on the northwest side of the upper part of the cap flows downslope towards the southwest, away from the landfill, into a drainage ditch that flows to a sediment trap near LMW-6. Precipitation falling on the remaining portions of the cap flow downslope and towards the south in drainage ditches.

Hydrogeology

Hydraulic conductivity testing [i.e., slug tests (Zone **A)** and borehole packer tests (Zones C, D/E and F)] of the bedrock zones indicates that these zones display low hydraulic conductivity (Tetra Tech Richardson, 1990). Zone **A** hydraulic conductivity is low, ranging from 10^{-4} cm/sec to less than 10^{-5} cm/sec. (There are no wells monitoring Zone **B,** therefore, it was not tested.) Zones C and F have very low hydraulic conductivities ranging from 10^{-6} cm/sec to less than 10^{-8} cm/sec. Zone D/E hydraulic conductivities are also very low and range from 10^{-5} cm/sec to 10^{-8} cm/sec.

Zone F has been designated the "underlying significant aquifer" as defined by to the West Virginia Solid Waste Management Regulations because it is laterally continuous under the landfill and is thought to be hydraulically connected to the Ohio River south of the landfill. Most current groundwater monitoring is conducted in Zone F.

The low hydraulic conductivity can be attributed to the very fine-grained nature of the water-bearing units. In addition, many sandstone units in the region typically display effective porosity as **low** as 1 percent. This low porosity results from pore space being filled in by authigenic minerals (e.g. kaolinite) sometime after original sediment deposition.

Zone F groundwater average linear velocities were calculated for flow from the north to the southwest and from the north to the southeast (DuPont, 2000). These values are relatively low, 0.01 and **0.003** ft/day rcspcctively. The low velocities calculated in the **F** zone indicate that groundwater flow beneath the landfill is very slow, attributable to the

low hydraulic conductivity present in the F zone and all the overlying units as well. Low vertical hydraulic conductivities in the overlying shallow zones limit infiltration and recharge down to the F zone.

The saturated thickness of Zone F ranges from 22 feet in the upgradient well (LMW-2A) to between 2 and 8 feet in five downgradient wells (LMW-SA, -6, -9, -10, and –11). In many instances, the monitoring wells at the landfill cannot be sampled until 48 hours (or longer) after purging, when a sufficient quantity of groundwater has recovered in the well screen interval.

Groundwater Flow

Thirteen monitoring wells have been installed at the Letart Landfill in the Zone A, C, D/E, and F sandstone units (Tetra Tech Richardson, 1989; 1990). Two of these wells, LMW-10 and LMW-I 1, were installed in October 2001 to provide additional data from Zone F to the north and south of the landfill. Table 4.0 lists the wells monitoring each zone and provides well construction information. Water level measurements and calculated groundwater elevations have been measured quarterly. Figures 4.5A through 4.5F provide available annual groundwater elevation contour maps for Zone F as required for the permit. This data was transferred from the original maps submitted for the permit to the updated Letart Landfill base map.

The location and limited number of monitoring wells within Zones A, C and D/E prevents determination of groundwater flow directions within these zones. However, elevations measured in the monitoring wells indicate a downward vertical gradient within the site groundwater system. Within Zone F, a groundwater divide exists under the center of the landfill in a north-south direction. Groundwater east of the divide flows southeast towards the Ohio River. Groundwater west of the divide flows towards the west and southwest. Groundwater elevation data, including the newly installed LMW-I1, the most northern monitoring well, indicates a slight component of northward groundwater flow in Zone F in this area.

Rapid decreases in the observed volume of water discharging from the leachate collection system in 2001 indicate that groundwater flow under the landfill is being greatly reduced in response to the installation of the engineered cap system. In addition, this reduction indicates that a new equilibrium state for groundwater flow has not yet been reached. Continued monitoring of groundwater elevations of Zones A through F is required to evaluate long-term changes in groundwater flow resulting from closure activities.

4.3 Water Quality

4.3.1 Surface Water Quality

Voluntary surface water sampling for C-8 has been performed periodically since 1991. This data is presented in Table 4.1A. The two locations sampled most frequently, the Upper and Lower ponds, no longer exist. During construction of the engineered cap system, these ponds were de-watered and the sediments underlying the ponds were excavated and placed in low areas of the landfill prior to the installation of the cap. Currently, only two surface water locations still exist (due to landfill cap construction)

and are being sampled. These locations include the leachate from the landfill [location 002(leachate basin)] and the stream located slightly east of the property line along Rt. 33. The locations of these surface water-sampling points are shown in Figure 4.2.

4.3.2 Groundwater Quality

Groundwater from the monitoring wells has also been voluntarily sampled and analyzed for C-8 periodically since 1991. However, sampling did not take place on an annual basis until 1996 and quarterly sampling began the second half of 1999, when C-8 was added to the permit as a monitoring parameter. Table 4.1B presents all historical analysis available for C-8 from monitoring wells at the Letart Landfill. The limited data set makes contouring the values difficult, therefore, the values were posted on maps and not contoured. Figures 4.6A through 4.6D present the C-8 concentration values for July 2001, January 2000, July 1999, and Novcmbcr 1991, respectively.

An initial examination of the groundwater data does not show any obvious overall concentration trends (Table 4.1B). For wells having data from 1991 through 2001, it appears that the concentrations measured in 1991 were the lowest. From 1991, the concentrations in ell wells increased. Currently, concentrations are now decreasing again in the most recent sampling events. However, identifying trends in the data is complicated by the fact that three different analytical laboratories have been contracted to perform the analyses between 1991 and 2001. In addition, the effects of the installation of the engineered cap system (preventing further surface water infiltration) may or may not be observable in the limited recent data.

For the most recent sampling event and analysis (October 2001), the sampling and analytical procedures, and the analytical instrumentation used were modified to gain better accuracy in the C-8 analytical results. These modified procedures will be utilized for all future analysis of groundwater samples for C-8. Continued monitoring of C-8 concentrations in groundwater is required to accurately evaluate the long-term trends in groundwater quality.

If it is assumed that impacted groundwater flows from Zone A downward to Zone F and ultimately migrates to the Ohio River, the C-8 historical mean for LMW-5B (Table 4.1B) can be used along with the estimated groundwater flux to calculate the C-8 loading to the river. The following assumptions were made in this calculation.

- The saturated thickness is 25 ft at LMW-5B. This is higher than thc most recent groundwater elevation measurement and therefore, is a conservative value.
- The length of the aquifer discharging to the Ohio River is 1000 ft based on the geologic cross-sections.
- The historical mean value of 855 ug/l for LMW-5B, a downgradient well, represents the concentration of C-8 in the aquifer.
- The velocity of groundwater in the aquifer is 0.01 ft/day. Groundwater average linear velocities for the F zone are calculated to be 0.01 ft/day from the north to the southwest and 0.003 ft/day from the north to thc southcast (DuPont, 2000).

Using these assumptions, the calculation for loading to the Ohio River is shown below:

A = Area = 1000 ft length x 25 ft saturated thickness for Zone F = 25,000 ft^2

V = Velocity = 0.01 ft/day (estimated)

Q = flux = A x V = (25,000 ft^2) x (0.01 ft/day) x (7.48 gal/ft^3) x (365 day/yr.)

= 682,550 gal/yr

Mass = (855 ug/l) x (1g/10^9ug) x (1kg/1000g) x (1 lb/2.205 kg) x (4.785 l/gal)

= 1.47×10^{-9} lb/gal x 682,550 gal/yr

= 1×10^{-3} lb/yr

Estimated annual loading to the Ohio River is very low based on the calculated mass and should result in a very low C-8 concentration in the Ohio River. The low calculated mass is reasonable given the low hydraulic conductivities and low average linear velocities observed in the F zone.

4.4 Site Conceptual Model

The Letart Landfill site conceptual model describes the potential exposure routes for current and future human and ecological receptors. Potential exposure routes were evaluated and classified as complete or incomplete.

The Letart Landfill closure was completed in April 2001 with the installation of an engineered cap system. The engineered cap system prevents human and ecological contact with the landfilled materials. Contact with landfilled materials would only be possible if the cap system were to be intentionally breached by workers or trespassers or by extensive, vigorous digging by animals. However, dense vegetation and appropriately installed fencing restricts access by unauthorized individuals and animals. Therefore, direct exposure to landfilled materials is a potentially complete but very limited exposure pathway.

Exposure of landfilled material because of erosion of the engineered cap system due to storm runoff is also a potential human and ecological exposure pathway. However, cap system drainage controls were designed to convey the runoff from the landfill cap to a designated discharge point and to eliminate the potential for runoff-related erosion of the cap. In addition, the landfill cap is required to be inspected at least quarterly (permit requirement C.12.A) for evidence of erosion as part of the site Storm Water Pollution Prevention Plan. Therefore, this potential exposure pathway is also a potentially complete but minimal exposure pathway.

The Letart Landfill engineered cap system prevents surface water from contacting landfilled materials. Surface water migrates towards drainage ditches constructed in the cap system and is discharged at the southern edge of the landfill. Because this surface water does not contact the landfilled materials, it is not impacted by C-8. Therefore, contact with this surface water is an incomplete exposure pathway.

Groundwater contacting the landfilled material has been impacted by C-8. Contact with this impacted groundwater presents a possible human and ecological exposure pathway due to groundwater flow patterns. Groundwater flow under the landfill has shown that prior to the installation of the engineered cap, surface water impinging on the landfill

migrated downward through the landfill material. These waters continued to flow as groundwater downward towards Zone F where it then flowed laterally to the west and south. Currently, the engineered cap prevents surface water fiom contacting the landfilled materials although groundwater migrating laterally and vertically underneath the landfill may still contact the landfilled materials. Groundwater under the engineered cap migrates to the leachate collection system. Discharge **fiom** the leachate collection system is piped to an outfall [002(leachate basin)] where it enters a small, shallow, wet weather stream that flows approximately 400 feet before **it** discharges to the Ohio River. Contact with leachate **is** a potential pathway exposure route for current **and** future human and ecological receptors, however, this pathway is considered complete **but** limited due to the restricted access to the area.

Zones D/E and F occur at elevations lower than the leachate collection system. Groundwater flowing from these zones to the south discharges to the Ohio River. Contact with this water is limited to the areas where these zones may outcrop on the valley walls. However, in general, groundwater flows downslope within the shallow soil, colluvium, and fractured rocks of the valley walls and would only be exposed **at** the surface if seeps exist. Currently, there is no data available on the existence or location of seeps on the slopes adjacent to the landfill or along the Ohio River. Therefore, evaluation of this potential pathway exposure route for current and future human and ecological receptors is not possible at **this** time.

Groundwater that flows to the west **fiom** Zone F is likely to discharge to nearby valley drainage systems and to ultimately migrate to the Ohio River. Again, groundwater flows downslope within the fractured **rocks** of the valley walls and would only be exposed at the surface if seeps exist. Currently, there is no data available on the existence or location of seeps in the valleys south of the landfill. Therefore, evaluation of this potential pathway exposure route for current and future human and ecological receptors is not possible at this time.

4.5 Data Gaps

The following data gaps were identified for the Letart Landfill:

- Identify the locations **of** seeps in the valley walls, particularly in the steep valley wall along the Ohio River, and determine water quality with respect *to* C-8 concentration.
- Determine the **C-8** concentration in the Ohio River.
- Determine the C-8 concentration in streams and other surface water bodies.
- Acquire additional geological data **to** refine the Site Conceptual Model.
- Install additional monitor wells to provide additional groundwater flow data and groundwater quality data.
- Gather additional C-8 concentration data fiom monitoring **wells** for plume delineation.

Activities to fill the data gaps will be proposed **and** discussed in the work plan.

4.6 References

DuPont. **1993.** *Letart Landfill Hydrogeologic Evaluation,* **July** 1993. Corporate Remediation Group.

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Tetra Tech Richardson. 1989. Monitoring Well Installation Program, October 1989.

_____. 1990. *Monitoring Well Installation Program at Letart Landfill – Summary Report,* August 1990.

TABLES

Table 4.0
Monitoring Well Construction Data
Letart Landfill
Letart, WV

Zone	Monitoring Wells	Surface Elevation (feet)	Total Depth (feet)	Well Diameter (inches)	Slot Size (inches)	Screen Length (feet)	Elevation of Screen Interval (feet)
A	LMW-1	766.53	33	2		5	738.53-733.53
	LMW-7	770.24	35	4		10	745.24-735.24
	LMW-8	777.06	38.5	4		9	748.06-739.06
C	LMW-3	673.1	30	2		5	650.1-645.1
D	LMW-3A	672.61	60.1	4	0.010	5	619.61-614.61
	LMW-4	649.17	28	2		5	626.17-621.17
	LMW-5A	645.23	28	4	0.010	10	627.23-621.23
F	LMW-2A	778.53	180.8	4	0.010	30	628.53-598.53
	LMW-5B	644.39	72	4	0.010	20	594.39-574.39
	LMW-6	754.22	183	4	0.010	30	606.22-576.22
	LMW-9	774.85	225	4	0.010	20	572.85-552.85
	LMW-10	732.37	189.85	4	0.010	20	562.52-542.52
	LMW-11	774.34	161.5	4	0.010	25	637.84-612.84

Table 4.1A
Summary of Analytical Results:
C-8 in Surface Water Samples
Letart Landfill
Letart, WV

Sample	Date	C-8 (ug/l)
002(LEACHATE BASIN)	7/25/2000	1350
	4/3/2000	1900
	1/14/2000	920
	10/21/1999	3240
LEACHATE	11/27/2001	53.2
	7/20/01	159
	7/25/2000	2250
	7/20/1999	1030
LOWER POND	1/14/2000	1410
	4/3/2000	1260
	10/21/1999	2530
	7/19/1999	1190
	5/28/1998	1100
	7/23/1997	1600
	4/17/1996	1900
	9/20/1994	2200
	3/15/1994	730
	12/27/1991	1300
	11/22/1991	1000
	4/26/1991	670
	3/22/1991	340
	2/8/1991	400
	1/18/1991	1200
N SPRING FLOW	3/12/1992	0.3
	3/12/1992	0.3
RT 33 STREAM	7/20/2001	2.01
	7/31/2000	0.573
	7/20/1999	2.23
	7/23/1997	2
	4/17/1996	1.8
STREAM MN RD	3/15/1994	0.5
	9/20/1994	0.9
SW SPRING FLOW	3/12/1992	1
UPPER POND	7/19/1999	517
	5/28/1998	480
	7/23/1997	<200
	4/17/1996	2100
	3/15/1994	4400
	12/27/1991	4100
	11/22/1991	790
	4/26/1991	930
	3/22/1991	500
	2/8/1991	2300
	1/18/1991	2900

Table 4.1B
Summary of Analytical Results:
C-8 in Groundwater
Letart Landfill
Letart, WV

F-Zone Wells		
Sample	Date	C-8 (ug/l)
LMW-2A	7/19/2001	242
	1/30/2001	423
	10/5/2000	248
	7/25/2000	275
	4/3/2000	306
	1/14/2000	453
	10/21/1999	370
	7/20/1999	350
	5/28/1998	990
	7/23/1997	460
	4/17/1996	460
	9/20/1994	270
	3/15/1994	260
	11/22/1991	63
	3/22/1991	50
LMW-5B	7/20/2001	483
	7/20/01(dup)	592
	1/31/2001	615
	10/5/2000	1190. J
	10/5/00 (dup)	780
	7/25/2000	900. J
	4/3/2000	1100
	4/3/00 (dup)	1020
	1/14/2000	1030
	10/21/1999	1750
	10/21/99 (dup)	1700
	7/20/1999	445
	7/23/1997	480
	9/20/1994	530
	3/15/1994	1200
	11/22/1991	380
	3/22/1991	340
LMW-5	1/13/2000	9.4
	5/28/1998	30
	11/22/1991	24
	3/22/1991	25
LMW-9	10/7/1992	0.2

J = estimated value (below laboratory quantitation limit).

D/E-Zone Wells		
Sample	Date	C-8 (ug/l)
LMW-3A	7/19/1999	60.3
	11/22/1991	350
	3/22/1991	380
LMW-4	4/3/2000	272
	1/14/2000	172
	11/22/1991	830
	3/28/1991	690
LMW-5A	11/22/1991	0.8
	3/22/1991	1.6

Table 4.1B Summary of Analytical Results (Con't): C-8 in Groundwater Letart Landfill Letart, WV

C-Zone Wells		
Sample	Date	C-8 (ug/l)
LMW-3	11/22/1991	1000
	3/22/1991	390

A-Zone Wells		
Sample	Date	C-8 (ug/l)
LMW-1	7/19/2001	6100
	1/31/2001	9190
	10/4/2000	10600
	7/24/2000	8990
	4/3/2000	13600
	1/13/2000	17400
	10/21/1999	12600
	7/20/1999	6920
	5/28/1998	24000
	7/23/1997	5100
	4/17/1996	1700
	11/22/1991	68
	3/22/1991	60
LMW-7	7/20/2001	242
	1/31/2001	249
	10/4/2000	231
	7/25/2000	158
	4/3/2000	211
	1/13/2000	219
	10/20/1999	339
	7/20/1999	78.3
	5/28/1998	260
	7/23/1997	53
	4/17/1996	15
	11/22/1991	0.1
LMW-8	7/19/2001	1120
	1/30/2001	2650
	10/4/2000	2300
	7/24/2000	2160
	4/3/2000	2180
	1/13/2000	2100
	10/20/1999	3260
	7/20/1999	1790
	5/28/1998	2700
	7/23/1997	2000
	4/17/1996	2200
	11/22/1991	280

Table 4.18
Summary of Analytical Results:
C-8 in Groundwater
Letart Landfill
Letart, WV

F-Zone Wells		
Sample	Date	C-8 (ug/l)
LMW-2A	7/19/2001	242
	1/30/2001	423
	10/5/2000	248
	7/25/2000	275
	4/3/2000	306
	1/14/2000	453
	10/21/1999	370
	7/20/1999	350
	5/28/1998	990
	7/23/1997	460
	4/17/1996	460
	9/20/1994	270
	3/15/1994	260
	11/22/1991	63
	3/22/1991	50
LMW-5B	7/20/2001	483
	7/20/01(dup)	592
	1/31/2001	615
	10/5/2000	1190. J
	10/5/00 (dup)	760
	7/25/2000	900. J
	4/3/2000	1100
	4/3/00 (dup)	1020
	1/14/2000	1030
	10/21/1999	1750
	10/21/99 (dup)	1700
	7/20/1999	445
	7/23/1997	480
	9/20/1994	530
	3/15/1994	1200
	11/22/1991	380
	3/22/1991	340
LMW-5	1/13/2000	9.4
	5/28/1998	30
	11/22/1991	24
	3/22/1991	25
LMW-9	10/7/1992	0.2

J = estimated value (below laboratory quantitation limit).

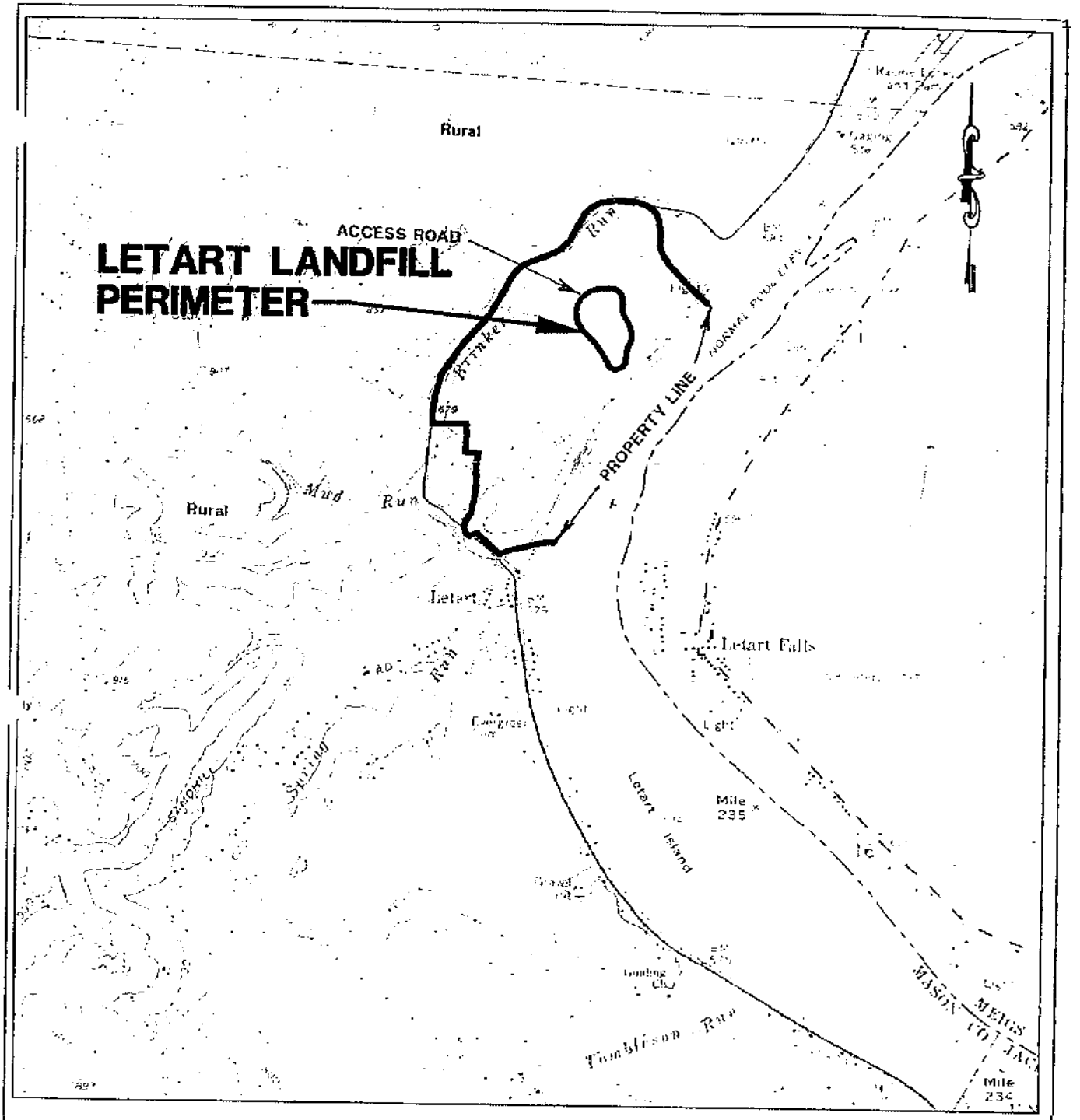
D/E-Zone Wells		
Sample	Date	C-8 (ug/l)
LMW-3A	7/19/1999	60.3
	11/22/1991	350
	3/22/1991	380
LMW-4	4/3/2000	272
	1/14/2000	172
	11/22/1991	830
	3/28/1991	690
LMW-5A	11/22/1991	0.8
	3/22/1991	1.6

Table 4.16
Summary of Analytical Results (Con't):
C-8 in Groundwater
Letart Landfill
Letart, WV

C-Zone Wells		
Sample	Date	C-8 (ug/l)
LMW-3	11/22/1991	1000
	3/22/1991	390

A-Zone Wells		
Sample	Date	C-8 (ug/l)
LMW-1	7/19/2001	6100
	1/31/2001	9190
	10/4/2000	10600
	7/24/2000	8990
	4/3/2000	13600
	1/13/2000	17400
	10/21/1999	12600
	7/20/1999	6920
	5/28/1998	24000
	7/23/1997	5100
	4/17/1996	1700
	11/22/1991	68
	3/22/1991	60
LMW-7	7/20/2001	242
	1/31/2001	249
	10/4/2000	231
	7/25/2000	158
	4/3/2000	211
	1/13/2000	219
	10/20/1999	339
	7/20/1999	78.3
	5/28/1998	260
	7/23/1997	53
	4/17/1996	15
	11/22/1991	0.1
LMW-8	7/19/2001	1120
	1/30/2001	2650
	10/4/2000	2300
	7/24/2000	2160
	4/3/2000	2180
	1/13/2000	2100
	10/20/1999	3260
	7/20/1999	1790
	5/28/1998	2700
	7/23/1997	2000
	4/17/1996	2200
	11/22/1991	280

FIGURES



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SOURCE: NEW HAVEN, WV-OHIO QUADRANGLE 7.5' SERIES

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SITE LOCATION **MAP**

Letart Landfill Site
Letart, WV

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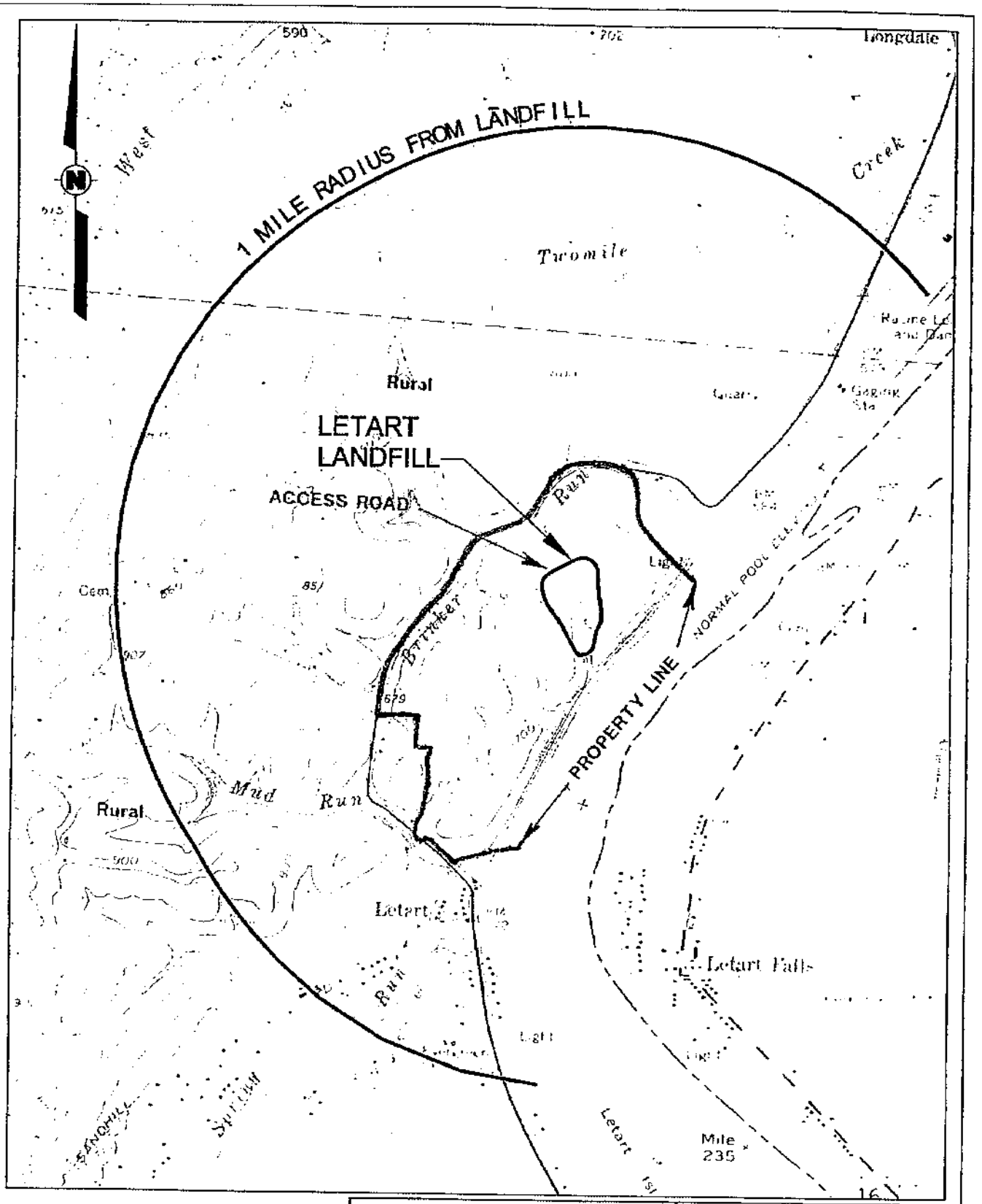

SCALE

1600 0 1600'

SOURCE: MAP TAKEN FROM THE USGS NEW HAVEN, WV 7.5' SERIES QUADRANGLE

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1—MILE LANDFILL RADIUS MI

Letart Landfill Site
Letart, West Virginia

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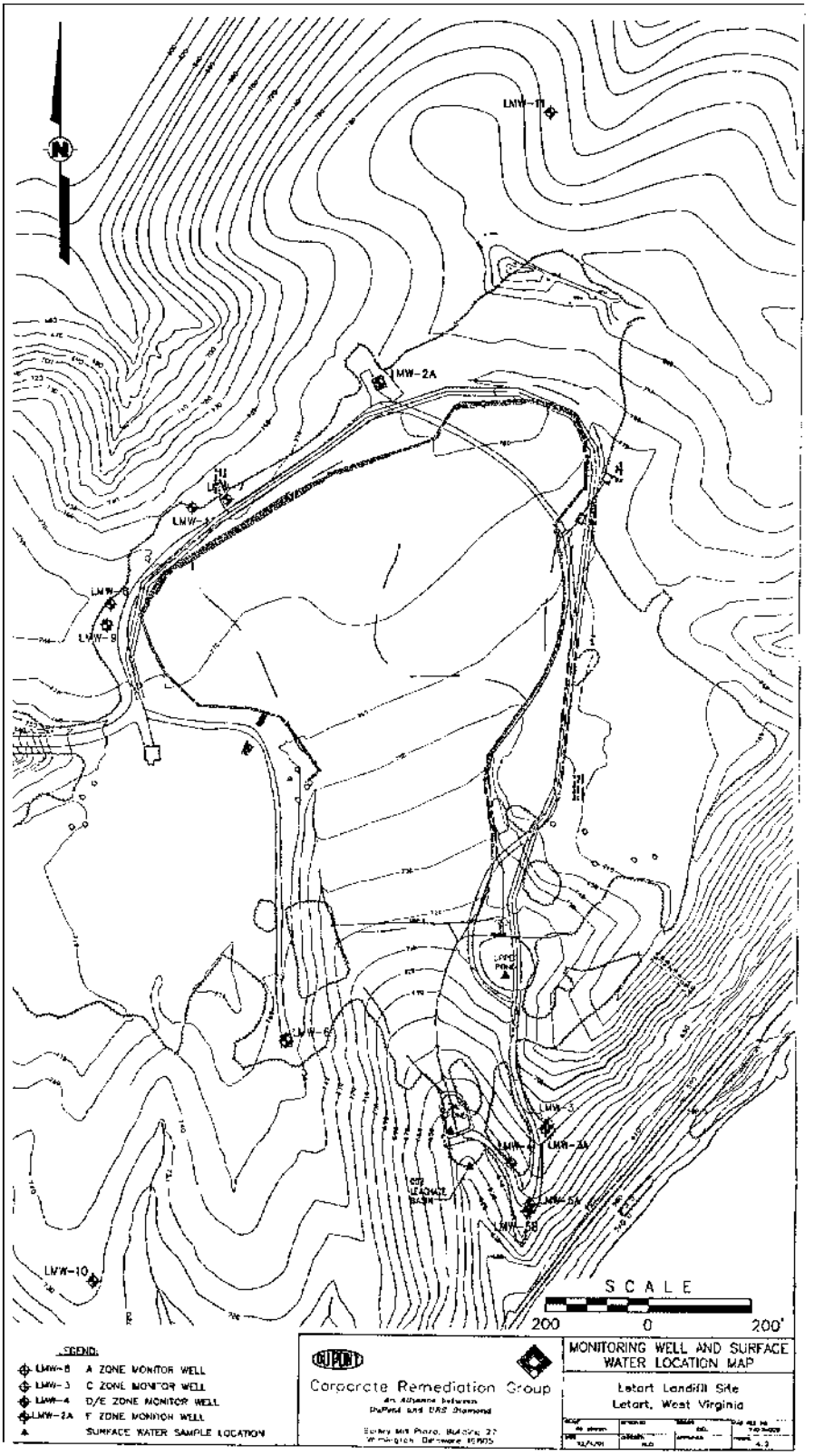

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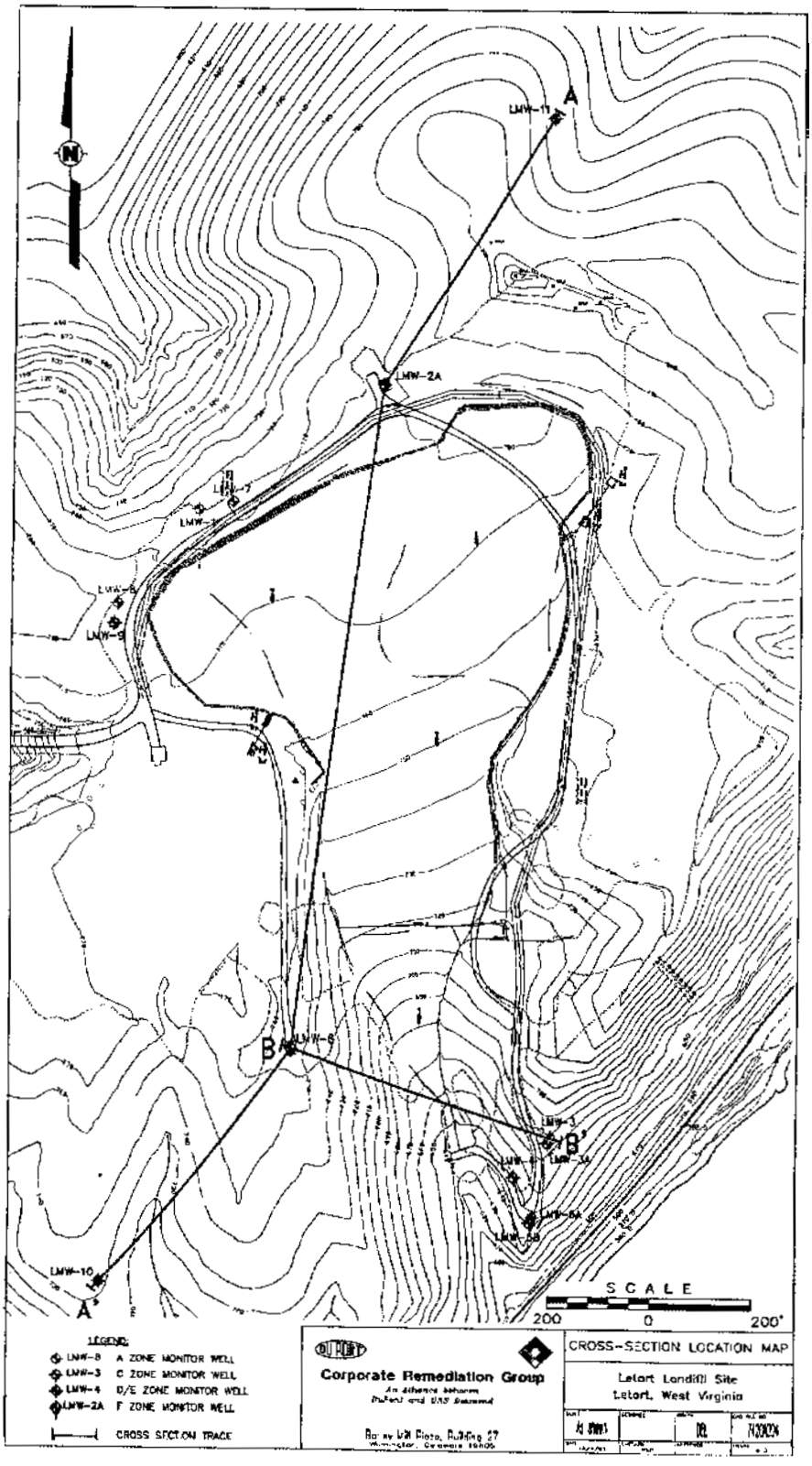

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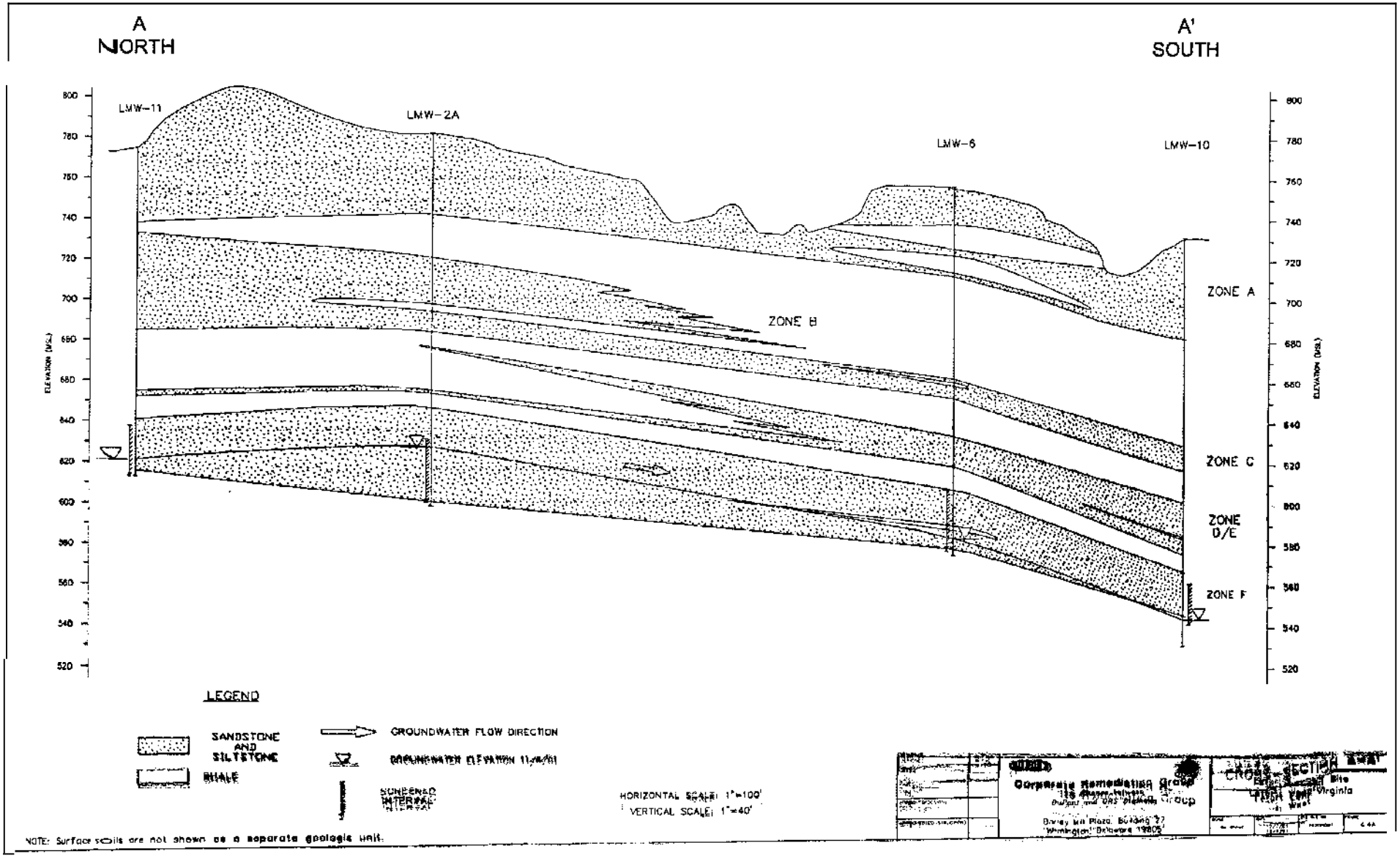

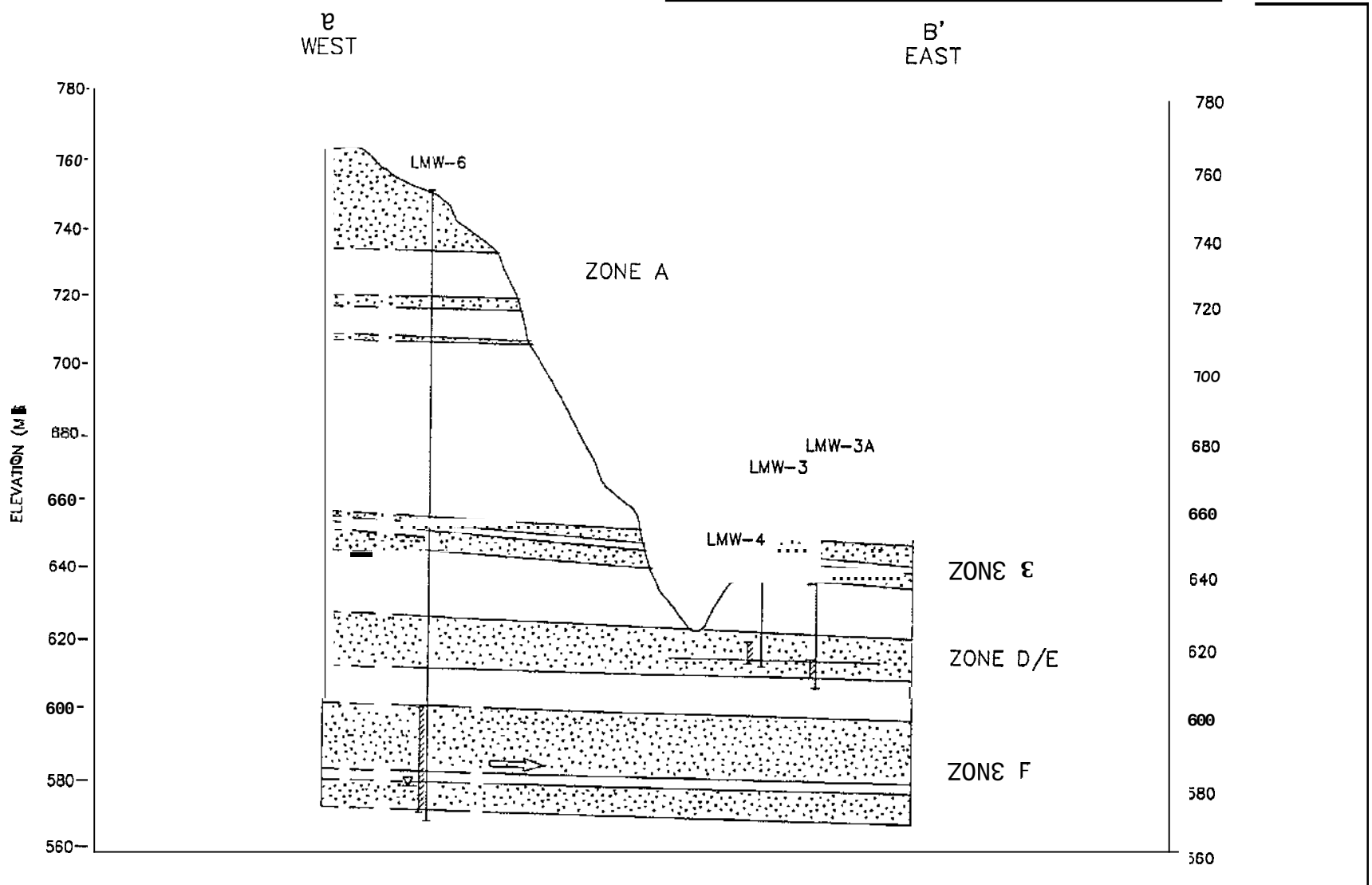

LEGEND

SANDSTONE AND SILTSTONE

SHALE

GROUNDWATER ELEVATION 11/6/01

GROUNDWATER FLOW DIRECTION

SCREENED INTERVAL

SCALE

0 100 200 FT

NOTE: Surface soils are not shown as a separate geologic unit.

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CROSS-SECTION B-B'

Letart Landfill Site
Letart, WV

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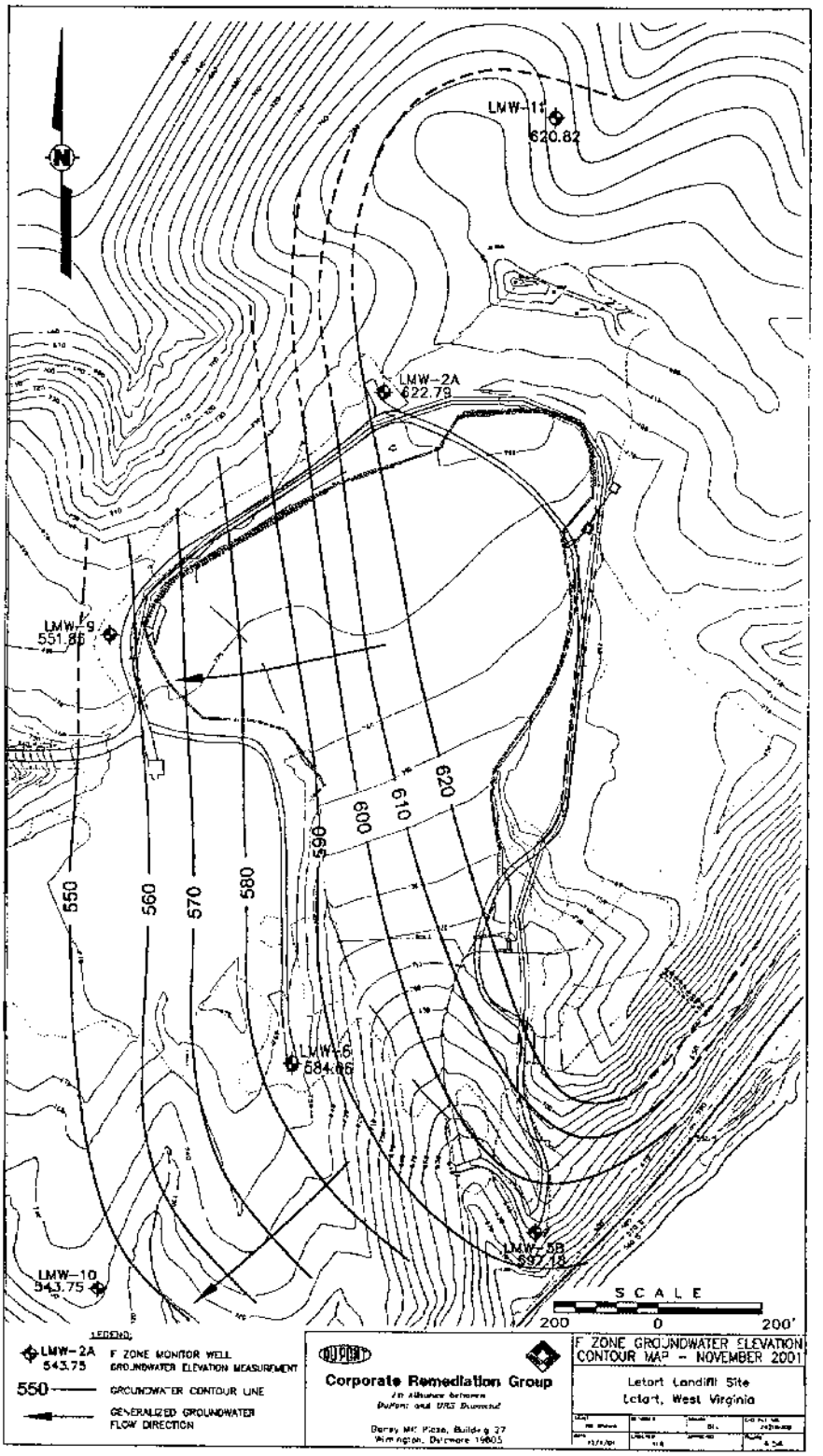

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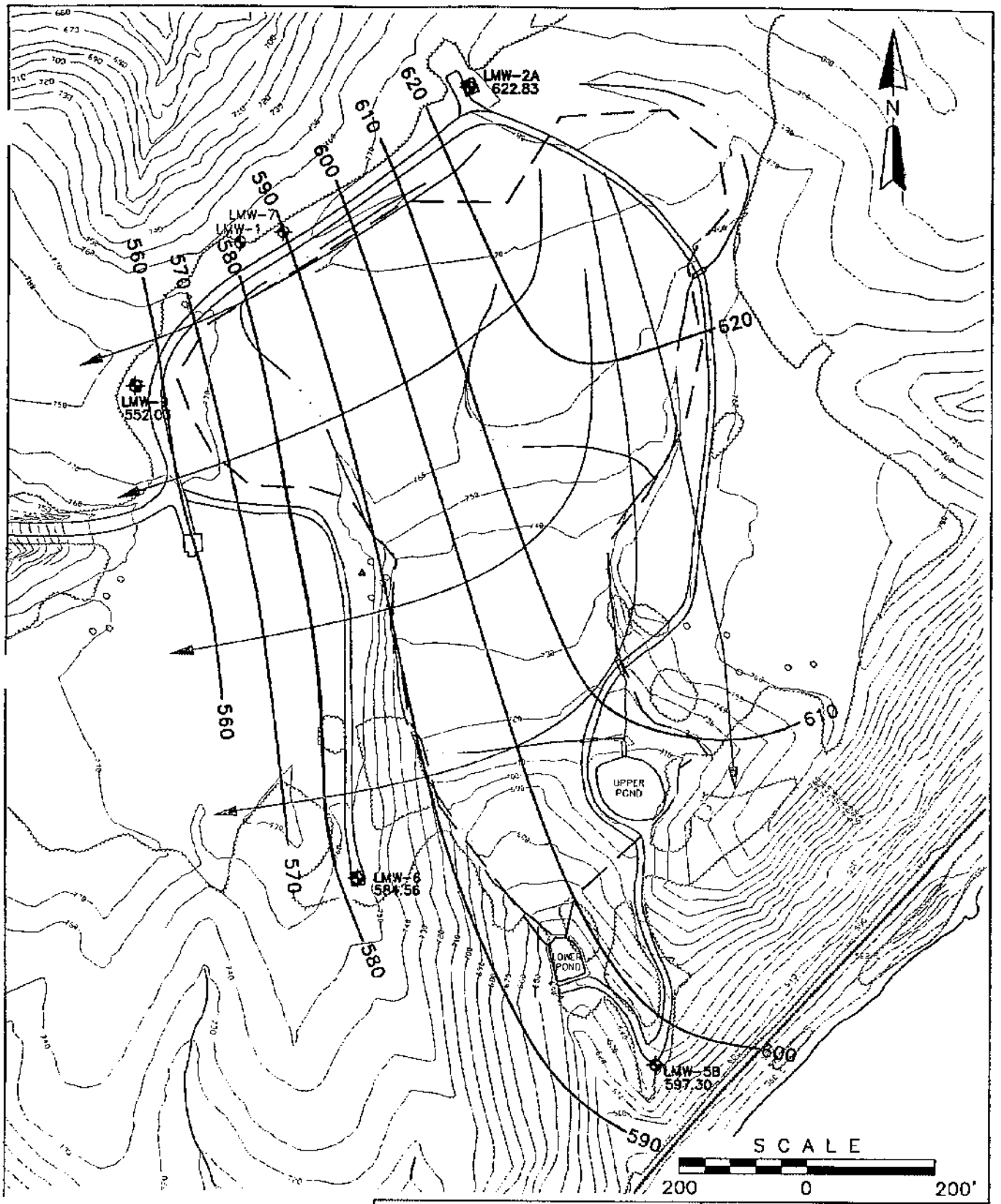

LEGEND:

- LMW-8 / 584.56 — F ZONE MONITOR WELL GROUNDWATER ELEVATION JAN. 2001
- 560 — GROUNDWATER CONTOUR & ELEVATION
- GROUNDWATER FLOW ARROW

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F ZONE GROUNDWATER ELEVATION CONTOUR MAP JANUARY 2001

Letart Landfill Site
Letart, West Virginia

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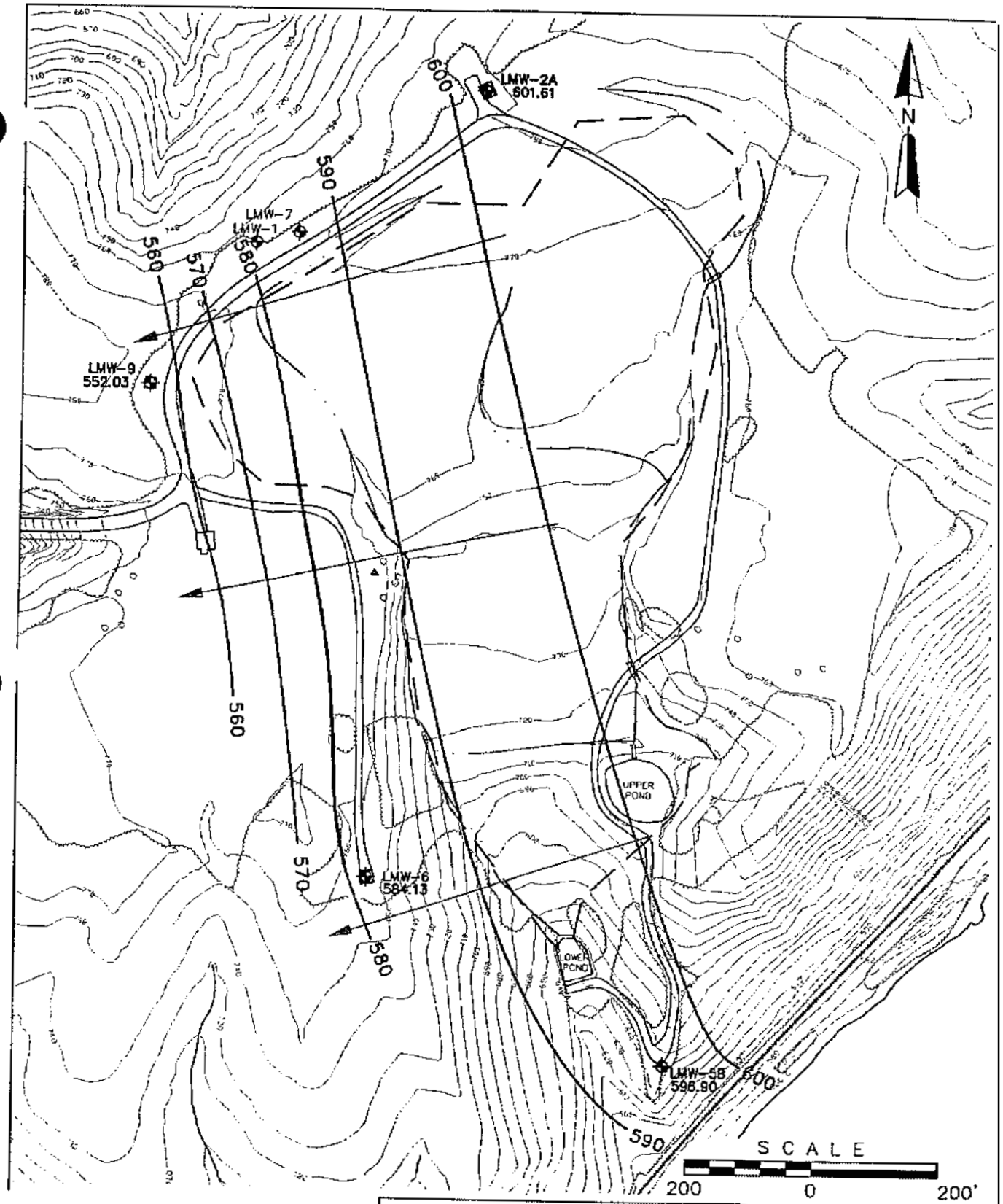

LEGEND:

- LMW-6 / 596.90 — F ZONE MONITOR WELL GROUNDWATER ELEVATION OCT. 1999
- 560 — GROUNDWATER CONTOUR & ELEVATION
- GROUNDWATER FLOW ARROW

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F ZONE GROUNDWATER ELEVATION CONTOUR MAP OCTOBER 1999

Letart Landfill Site
Letart, West Virginia

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DATE	CHECKED	APPROVED	FIGURE
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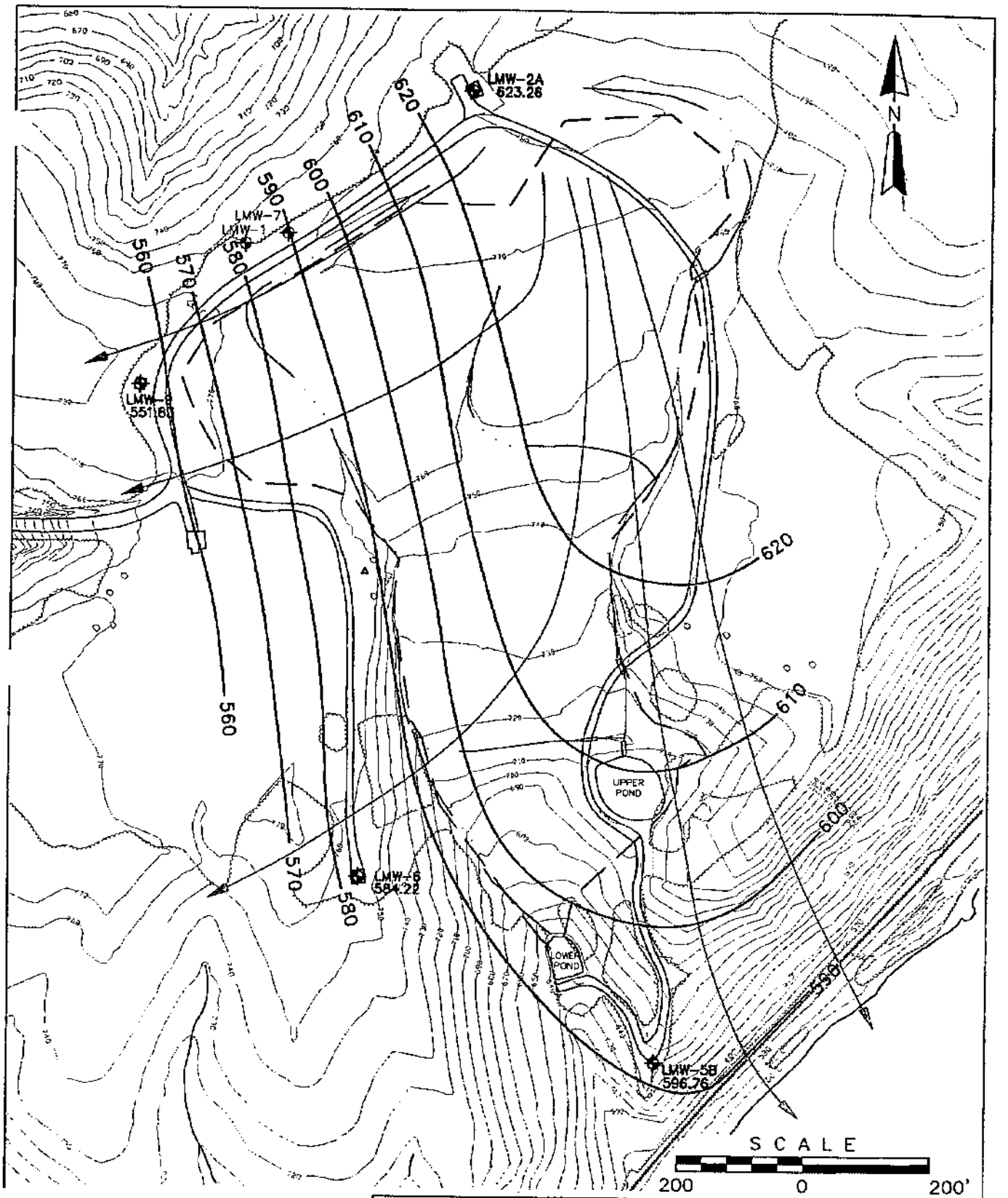

LEGEND:

- LMW-6 / 584.22 — F ZONE MONITOR WELL GROUNDWATER ELEVATION OCT. 1998
- 560 — GROUNDWATER CONTOUR & ELEVATION
- GROUNDWATER FLOW ARROW

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F ZONE GROUNDWATER ELEVATION CONTOUR MAP OCTOBER 1998

Letart Landfill Site
Letart, West Virginia

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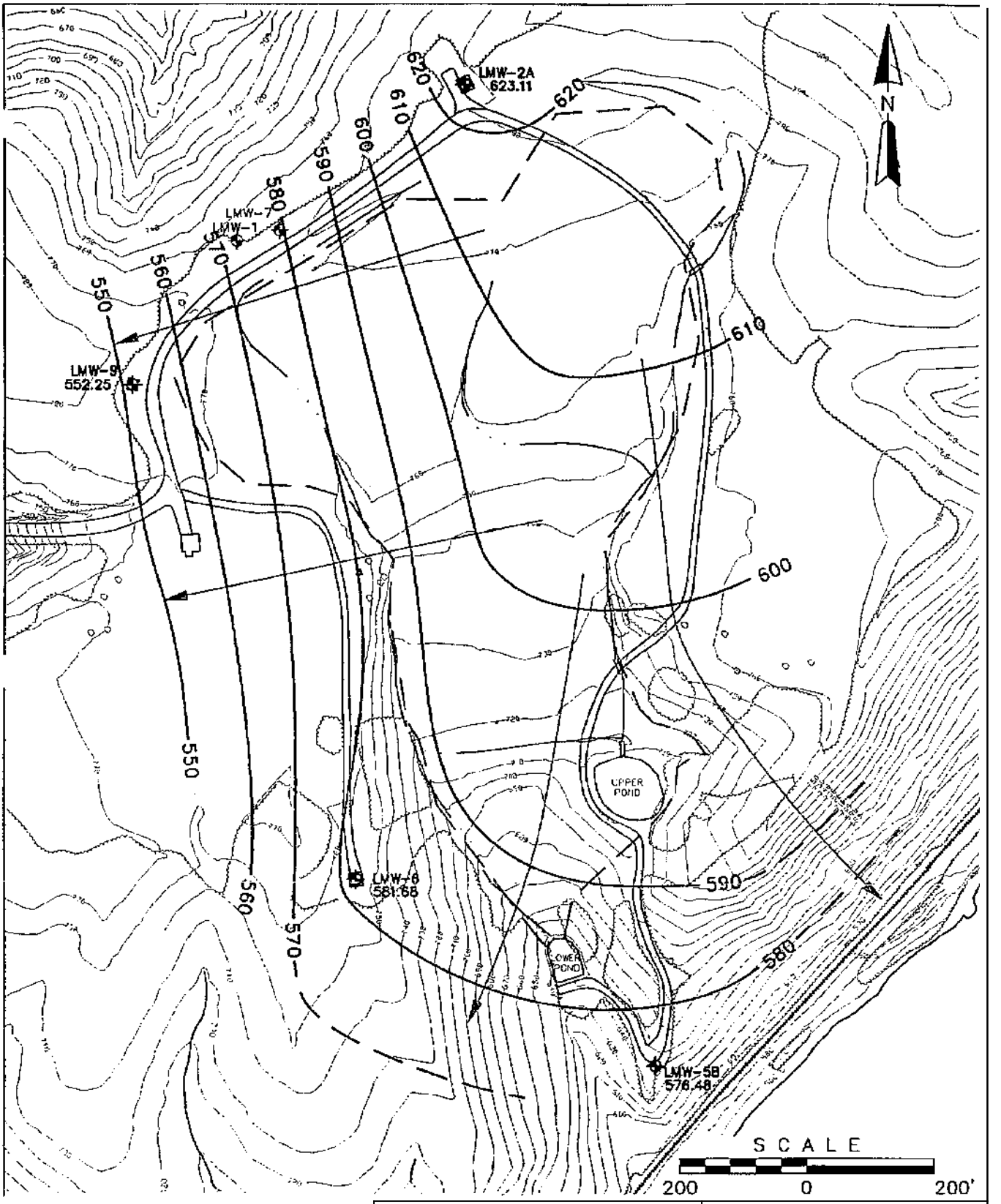

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- LMW-8 / 576.48 — F ZONE MONITOR WELL GROUNDWATER ELEVATION DEC. 1994
- 560 — GROUNDWATER CONTOUR & ELEVATION
- GROUNDWATER FLOW ARROW

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F ZONE GROUNDWATER ELEVATION CONTOUR MAP DECEMBER 1994

Letart Landfill *Site*
Letart, West Virginia

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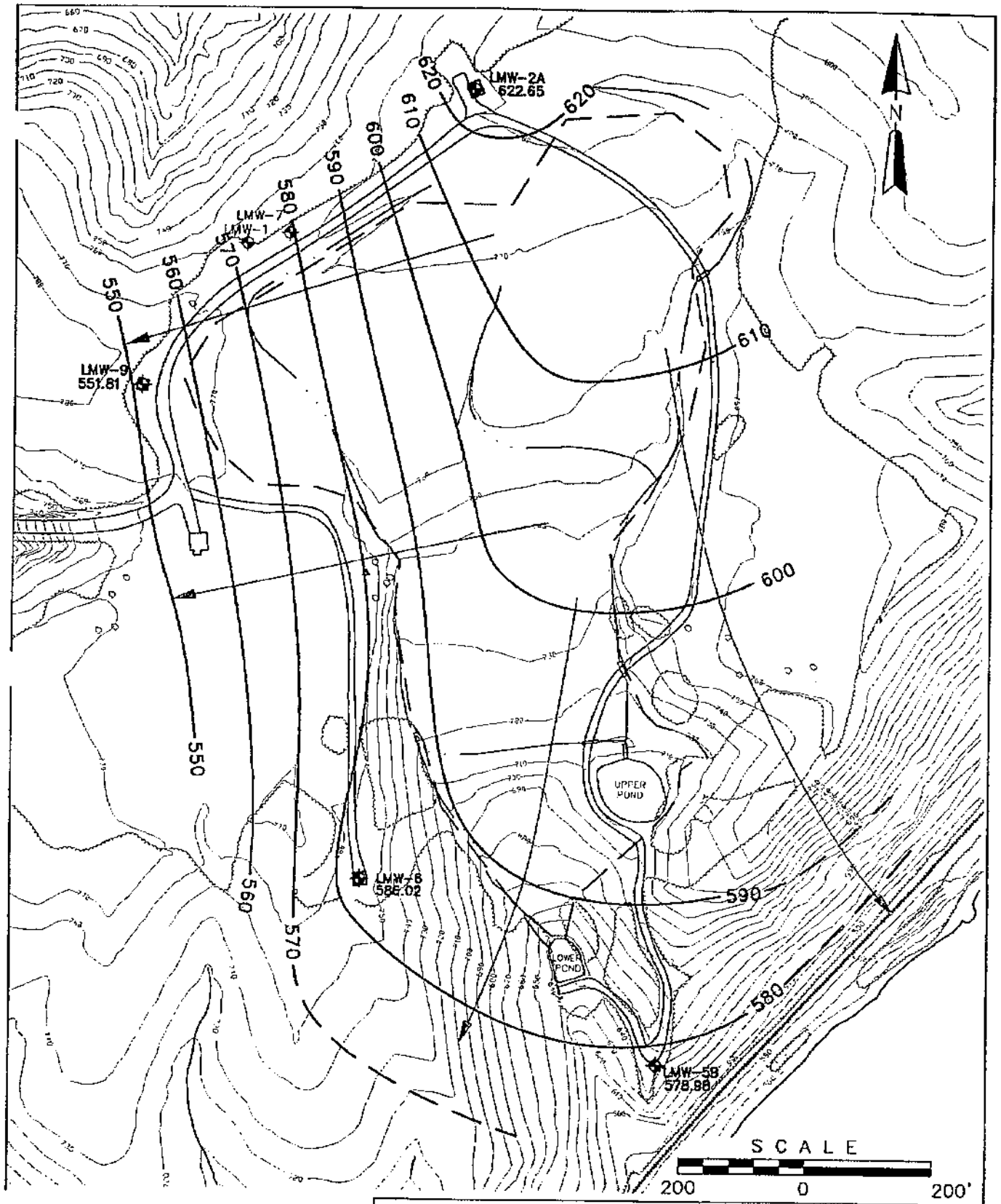

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- LMW-6 / 578.98 — F ZONE MONITOR WELL GROUNDWATER ELEVATION DEC. 1992
- 560 — GROUNDWATER CONTOUR & ELEVATION
- GROUNDWATER FLOW ARROW

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F ZONE GROUNDWATER ELEVATION CONTOUR MAP DECEMBER 1992

Letart Landfill Site
Letart, West Virginia

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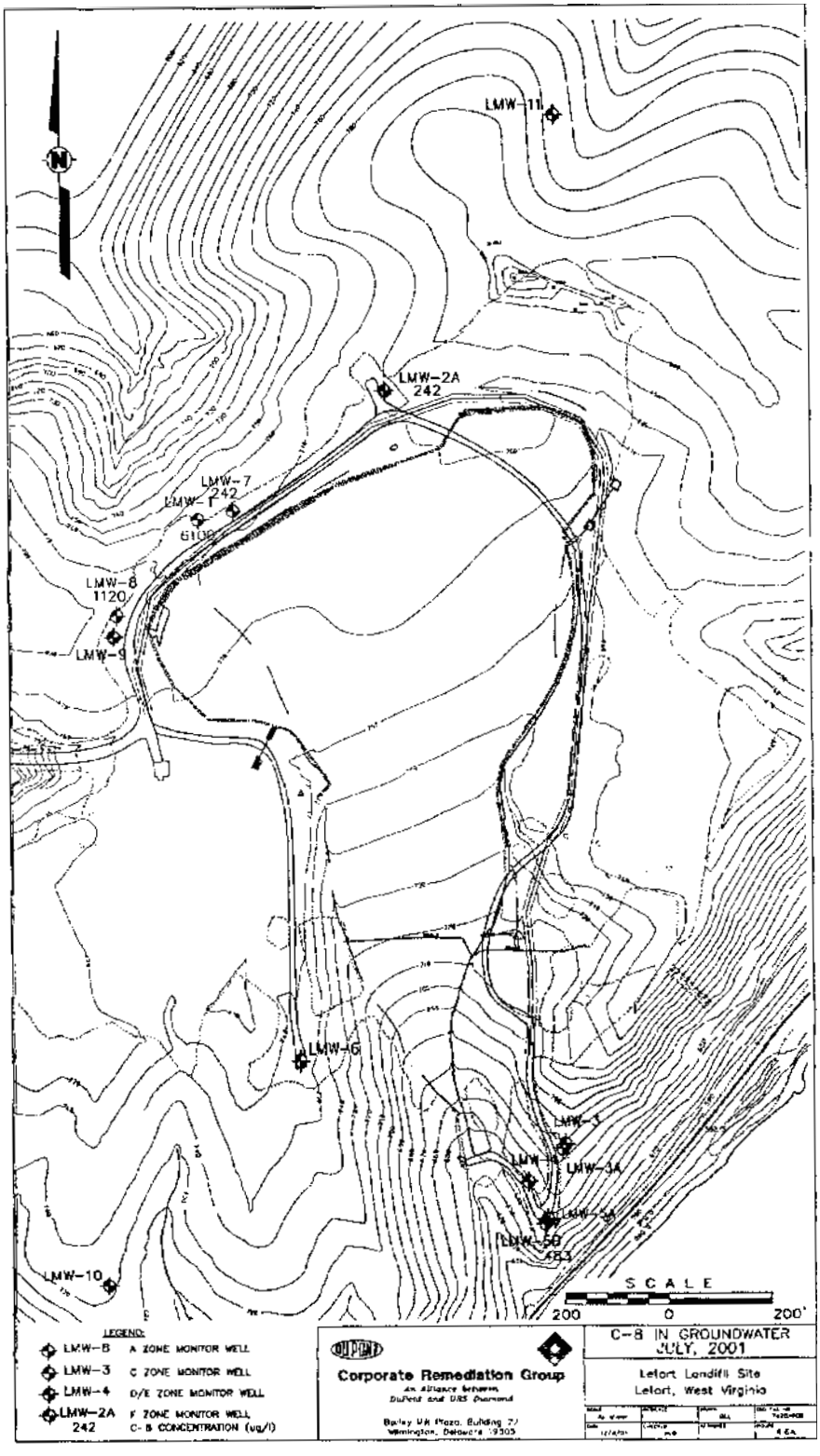

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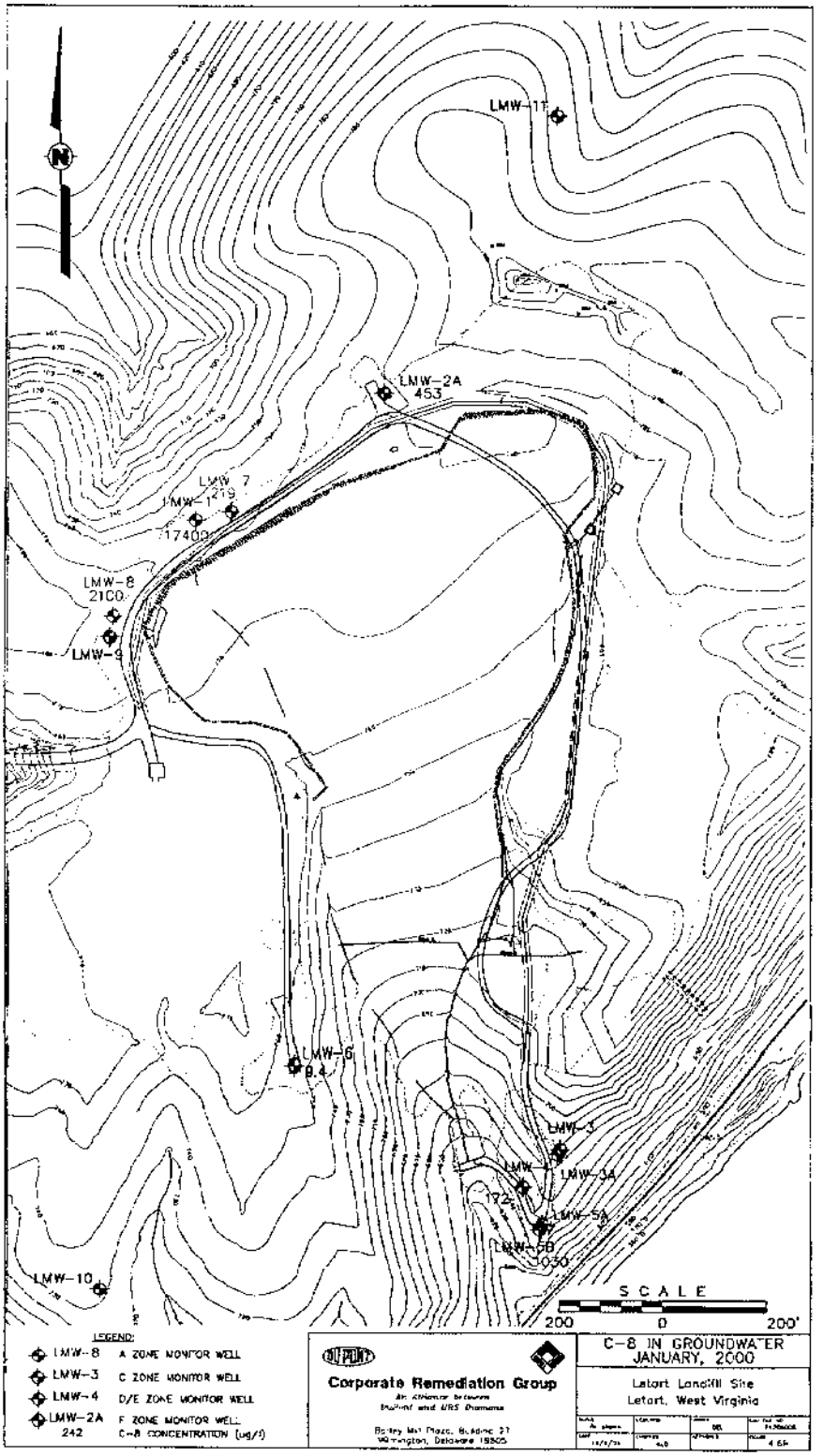

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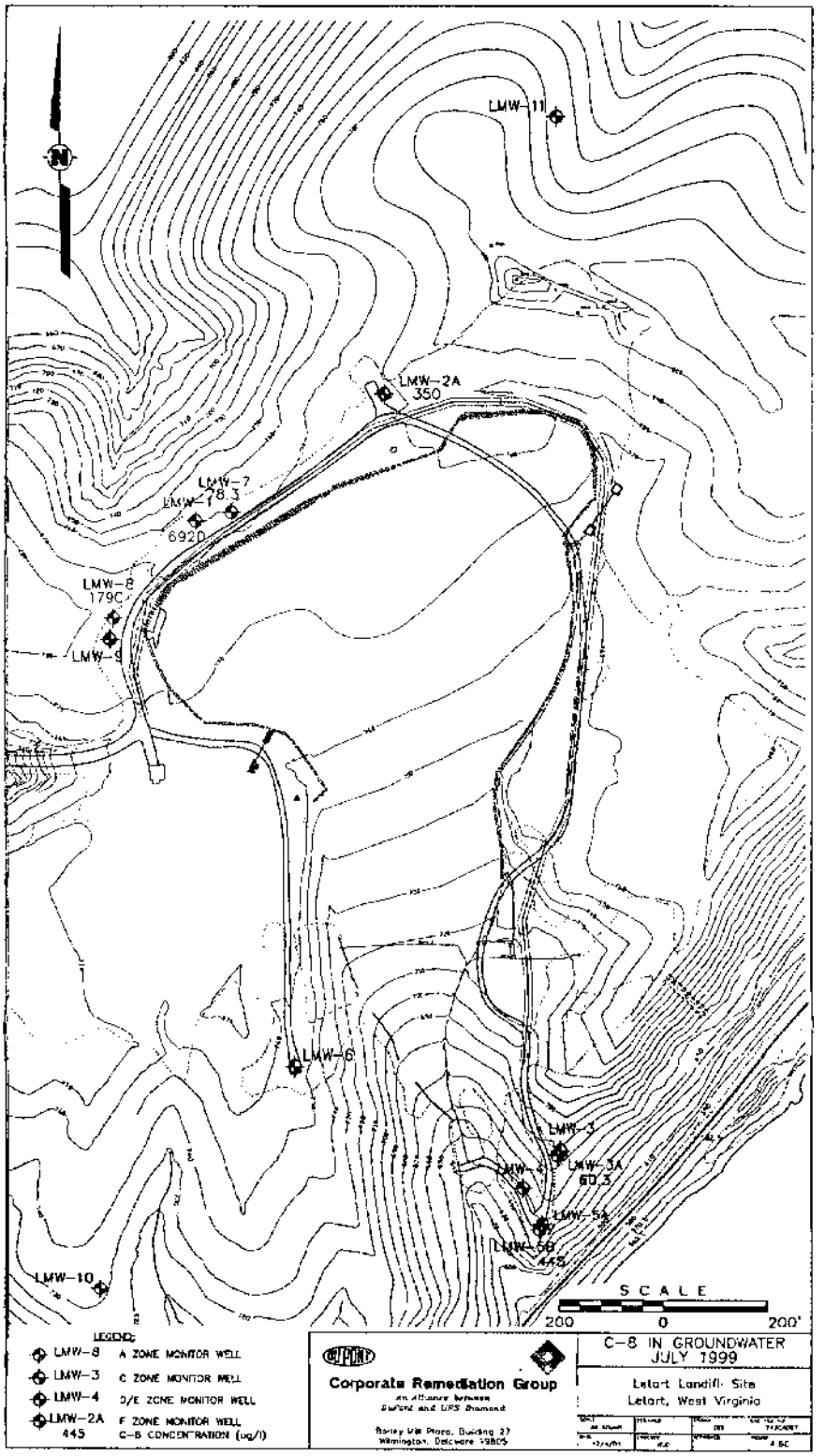

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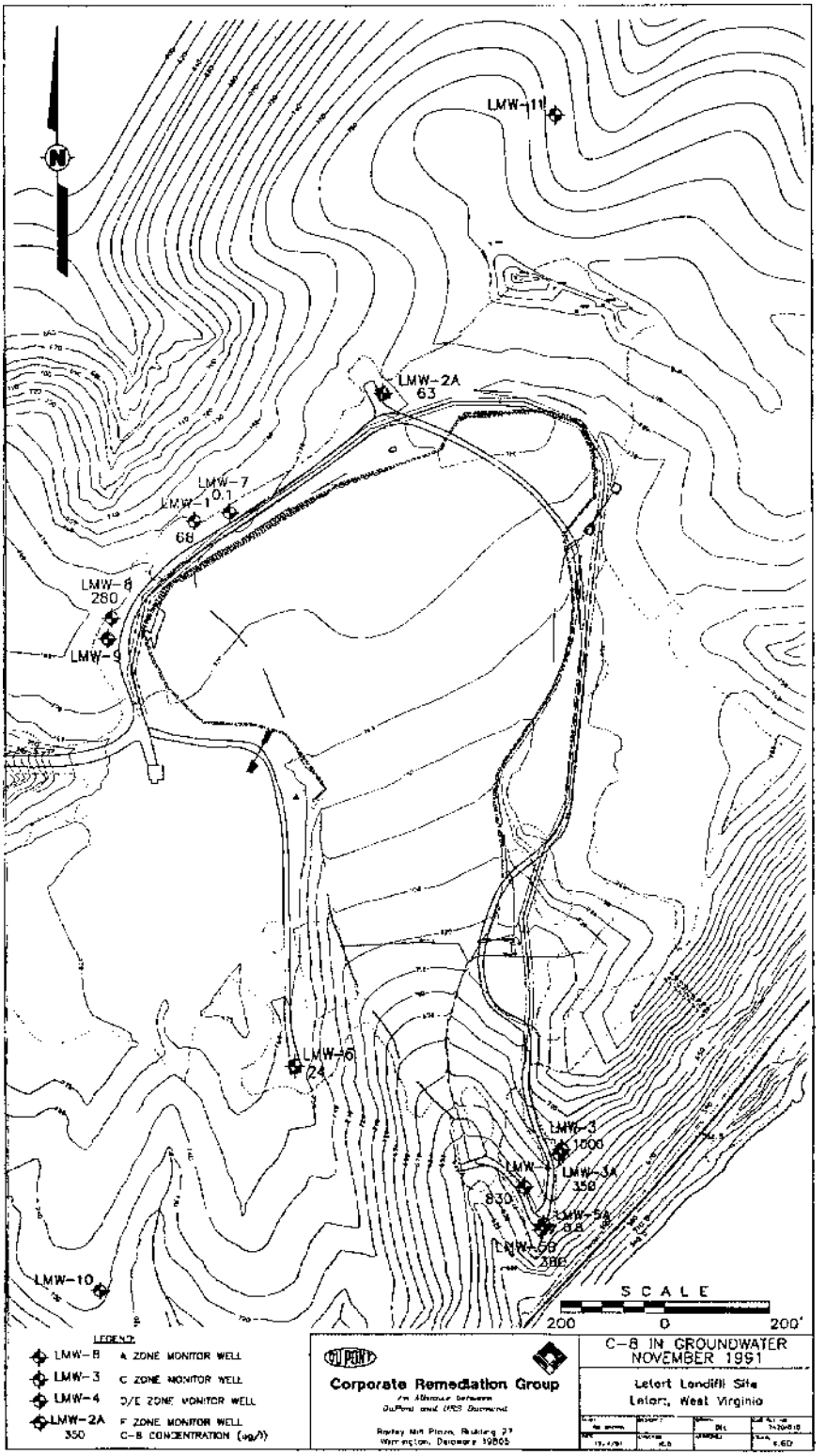

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5.0 DRY RUN LANDFILL

Tables

Figures

5.1 Introduction

The Dry Run Landfill is located west of the town of Lubeck, in Wood County, West Virginia (Figure 5.0) and is about eight miles southwest of the Washington Works main plant and the Local Landfill. A water use and well survey search is being completed for the area within a 1-mile radius From the Dry Run Landfill perimeter (Figure 5.1).

The Dry Run Landfill covers approximately 17-acres of a 535-acre parcel of land owned by DuPont. The landfill began operation in 1986 and is still active at present. The landfill is operated under West Virginia Solid Waste /National Pollutant Discharge Elimination System Permit No. WV 0076244. This permit requires quarterly groundwater monitoring and monthly outfall surface water monitoring.

Figure 5.2 shows the location of the landfill, monitoring wells and surface water sampling points. The landfill was constructed within the drainage basin of Dry Run, a tributary of the North Fork of Lee Creek, which is a tributary of the Ohio River. The Dry Run Landfill has no compacted or synthetic bottom liners. However, natural soil present under the landfill material is composed of clay and weathered shale.

The Dry Run Landfill receives waste from the main plant consisting of non-hazardous waste including scrap product, scrap metal, wood pallets, fly ash and bins, and miscellaneous trash. Approximately 50,000,000 pounds of waste per year have been disposed in the landfill. Currently, the C-8 source is believed to be the sludges from the closure of the main plant anaerobic digestion ponds that were landfilled at Dry Run in 1988. The Dry Run Landfill remaining capacity calculations for 2001 show 4.4 years of remaining life on the existing cell based on a 128,000 yd^3/yr net fill volume consumption (DuPont 2000).

5.2 Environmental Setting

5.2.1 Geology

The Dry Run Landfill is situated on a heavily dissected plateau consisting of several steep V-shaped valleys. Residual soil covers most landfill areas. In general, the soil at the site has been described as residual in nature, consisting primarily of heavy clays derived from the weathering of shale.

A geotechnical investigation for the Dry Run Landfill was completed by DuPont (1996). The investigation consisted of advancing soil test borings, test pits, laboratory testing of soil physical properties, stability analyses, and settlement analyses. DuPont (1996) determined that the natural residual soil underlying the landfilled materials consisted of stiff to very hard silty clay and clayey silt with occasional rock fragments and a trace of sand. The thickness of this natural soil ranged from 12 to 28 feet in the test borings within the landfilled area. A 1989 monitoring well installation program, prepared by Tetra Tech Richardson Inc., indicated similar silty clay and weathered shale overburden. Four

overburden wells (DRMW 12A, 12B, 13A, 6A) were installed to depths ranging from 11 to 17 feet.

The underlying bedrock at the Dry Run Landfill consists of inter-bedded red and varicolored sandy or calcareous shale, and gray, green, and brown sandstone of the Permian age Dunkard Group (Tetra Tech Richardson, 1989). The maximum thickness of the Dunkard Group in this region is 570 feet. The location of two cross-sections, A-A' and B-B', crossing the landfill and downgradient of the landfill are shown in Figure 5.3. The two cross-sections are shown in Figures 5.4A and 5.4B.

There are only a limited number of deep monitoring wells around and upgradient from the landfill (DRMW-14). Dashed geologic contact lines were drawn on cross-section A-A' (Figure 5.4A) because there is not sufficient data to confidently extrapolate between DRMW-14, the upgradient well, and DRMW-13, the downgradient well. More geological data is available (DRMW-6, -11, -12, and –13) and was used in developing the downgradient cross-section, B-B' (Figure 5.4B) with more confidence. Cross-section B-B' supports the interpretations made in cross-section A-A' of rather flat lying stratigraphic units of sandstone layers separated by shale layers.

5.2.2 Hydrology, Hydrogeology and Groundwater Flow

Hydrology

The Dry Run Landfill is situated on a heavily dissected plateau consisting of several steep V-shaped valleys. Dry Run drains the valley in which the landfill is located. Many small tributaries discharge from the nearby valleys into Dry Run before it joins up with the North Fork of Lee Creek.

Potesta & Associates, Inc. (1989) completed a hydrologic and hydraulic analysis of the receiving stream below the Dry Run Landfill. They determined that the watershed soils are split between hydrologic soil groups (HSG) C and D and estimated the flow capacity at 481 cubic feet per second (that is greater than the 100-year 24-hour storm). Potesta (1989) also evaluated the 24-hour precipitation amount that would result in full flow conditions at the location where the capacity was estimated. Potesta determined that precipitation values between 5.25-5.99 inches in 24 hours would result in full flow.

The installation of a leachate collection system at the Dry Run Landfill encompassing the inactive lower half of the landfill was completed by Potesta & Associates Inc. in 1999. Leachate from the landfill discharges into a leachate collection sump located northwest of the landfill (Figure 5.2) through perforated pipes buried at the low edge of the fill area. The leachate is pumped from the collection sump to a 50,000-gallon collection tank located at the top of the hill. Leachate is pumped from the collection tank to a tanker truck, which is then hauled to the main plant for treatment in the site's wastewater treatment plant.

Hydrogeology

Groundwater is found in the overburden and the underlying bedrock aquifer. The bedrock aquifer is considered the underlying significant aquifer for NPDES permit required groundwater monitoring. A total of 15 monitoring wells have been installed at Dry Run to monitor the overburden and bedrock aquifers. At this time, four overburden

wells (DRMW-6A, -12A, -12B, and 13A), and four bedrock wells (DRMW-12, -13, -14, and –15) still exist. The other seven wells were abandoned in 1999 by Potesta & Associates, Inc. as required by the permit because they were not being utilized for quarterly monitoring (Potesta, 1999). Table 5.0 provides the well construction data for existing monitoring wells.

Groundwater Flow

Water levels measured in November 2001 indicated overburden groundwater was encountered between 4 and 6 feet below ground surface. **Although** 3 of the 4 wells completed in the overburden monitor the same hydrogeologic unit, well DRMW-6A is completed at a relatively higher zone, which is discontinuous at lower topographic areas. No groundwater flow maps were prepared for the shallow water encountered in the overburden section.-

Annual groundwater elevation maps for the underlying significant aquifer were available for the years 1992-1994, and 1998-2001. These maps are presented in Figures 5.5A through 5.5G. The groundwater contours were transferred from the original maps submitted for the permit to the updated **Dry** Run Landfill base map. These maps show that groundwater in the bedrock aquifer flows from the southeast towards the northwest. The groundwater elevations measured for nested wells (DRMW-I 2, -12A, and 12B, and DRMW-13 and –13A) are similar and the screened zones are constructed relatively close to each other, indicating that the overburden and bedrock aquifers may be in hydraulic communication downgradient of the landfill.

5.3 Water Quality

5.3.1 Surface Water Quality

Historical surface water C-8 concentrations *arc* prcscnted in Table 5.1**A** for six sampling points. Sampling location for surface water sampling points still in existence can be found on Figurc 5.2. Surfacc water samples have been collected periodically from these locations since 1996 and have been collected consistently for three locations (DRLeachate, Outlet 001 and at the property boundary) since 1998. The concentration of C-8 in the leachate samples have been decreasing over time (from 62 ug/l down to 27.4 ug/l) while concentration from the other locations are variable and do not indicate a clear trend (Table 5.1**A).**

5.3.2 Groundwater Quality

Historical groundwater sampling began in 1996. For wells that currently exist, sampling continues (DRMW-6 was abandoned in 1999; Potesta, 1999). C-8 concentration were contoured **for** some of the sampling events for the overburden **and** bedrock **wells.** These concentration contours can be found in Figures 5.6A through 5.6 F. Data shown in Figure 5.6E was plotted but not contoured due **to** the data spread. The data for DRMW **12-B** and DRMW13-A for July 1999 appears anomalous compared to the other data for these two wells. The contour maps show that the **highest** concentration of **C-8** exists in monitoring wells 13 **and** 13A, bedrock and overburden wells, respectively.

These two wells are located downgradient from the central axis of the landfill. For the majority of the sampling events for most of the other wells, both overburden and bedrock, the C-8 concentration has been less than 1 ug/l. The C-8 concentration for the 1999 sampling event in DRMW-14 was higher than other values measured for this well. Given that this well is an open bedrock well, and is relatively close to the landfill, this higher concentration may indicate communication of surface or shallow aquifer waters through the open well, particularly because groundwater flow in the underlying significant bedrock aquifer flows from DRMW-14 north west toward the landfill area as opposed to groundwater flowing from the landfill toward the DRMW-14 well.

5.4 Site Conceptual Model

The Dry Run site conceptual model describes the potential exposure routes for current and future ecological receptors. Potential exposure routes were evaluated and classified as complete or incomplete.

Access to the Dry Run Landfill by is controlled by electronic gates on the major roads and locked gates on smaller roads. In addition, because the landfill is active, there is a crew ofworkers on the landfill area during normal working hours. The daily activity discourages trespassers on the site. Therefore, direct contact with landfilled materials is a complete but minimal exposure route, limited to the workers in active portions of the landfill. Direct contact with landfill materials in the inactive, lower half of the landfill is incomplete due to the leachate collection system's geotextile and geomembrane cover. Contact with leachate at the landfill (or at the main plant where the leachate is treated) is considered a potentially complete but limited exposure route for the landfill and plant workers and samplers.

Currently, the inactive lower half of the landfill is covered by geotextiles and geomembranes of the leachate collection system. Therefore, precipitation falling on this portion of the landfill does not come in contact with the landfilled materials. This precipitation flows downslope via overland flow and discharges into storm water drainage ditches and eventually reaches Dry Run Creek. Therefore, this potential exposure route is considered incomplete.

Precipitation falling in the upper half of the landfill may also flow via overland flow down slope to the drainage ditches, again, an incomplete exposure route. Alternatively, this precipitation may infiltrate and come in contact with the landfilled materials as it migrates downgradient. However, this impacted water flowing within the landfill may be collected by the leachate collection system. If this impacted water migrates downward through the landfilled materials, it may eventually come in contact with the underlying shales and sandstone of the bedrock and migrate downgradient within the bedrock aquifer. Contact with impacted groundwater is a potentially complete exposure route although currently, not enough hydrogeologic data exists to accurately evaluate this exposure pathway.

Plans are underway for the expansion of the leachate collection system and for a final cap/cover system. These activities in the future will further reduce precipitation infiltrating and contacting landfilled materials.

5.5 Data Gaps

The following data gaps were identified for the Dry Run Landfill:

- Identify the locations of seeps in the valley walls and determine water quality with respect to C-8 concentration.
- Determine the C-8 concentration in streams and other surface water bodies.
- Acquire additional geological data to more accurately develop the Site Conceptual Model.
- Install additional monitor wells to provide additional groundwater flow data and groundwater quality data.
- Gather additional C-8 concentration data from monitoring wells for plume delineation.

Activities to fill the data gaps will be proposed and discussed in the work plan,

5.6 References

DuPont. 1996. *Report of Geotechnical Investigation Dry Run Landfill*, Washington Works Main Plant, Parkershurg, WV. Geotechnical Group, Civil Engineering Systems, DuPont Engineering. April 23, 1996.

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_____. 1999. *Monitoring Wells MW-1, MW-1A, MW-4, MW-4A, MW-6, MW-10, MW-10 Abandonment Report*, Dry Run Landfill, DuPont Washington Works. March 1999.

Tetra Tech Richardson. 1989. Monitoring Well Installation Program, October 1989.

TABLES

Table 5.0
Monitoring Well Construction Data
Dry **Run Landfill**
Lubeck, WV

Monitoring Wells	Surface Elevation (feet)	Total Depth (feet)	Well Diameter (inches)	Slot Size (inches)	Screen Length (feet)	Elevation of Screen Interval (feet)
DRMW-14	936.14	260	I0	NA	NA	NA
DRMW-13	720.6	35	4	0.010	15	700.6-685.6
DRMW-13A	720.3	11	4	0.010	5	714.3-709.3
DRMW-12	730.5	35	4	0.010	15	710.5-695.5
DRMW-12A	730.3	17	4	0.010	5	718.3-713.3
DRMW-12B	730.5	15	4	0.010	10	725.5-715.5
DRMW-6A	744.93	12.2	2			
DRMW-15	730.87	45	2	0.010	20	705.87-685.87

Table 5.1A
Summary of Analytical Results:
C-8 in Surface Water Samples
Dry Run Landfill
Lubeck, WV

Sample	Date	C-8 (ug/l)
DOWN STREAM	4/9/1996	25
DRLEACHATE	10/3/2000	27.4
	12/29/1999	34
	5/19/1998	56
	7/22/1997	62
OUTLET 001	10/3/2000	31.5
	12/29/1999	66
	5/19/1998	17
	4/9/1996	86
PROPERTY BOUNDARY	10/3/2000	10.3
	4/9/1996	9.9
	7/14/1998	0.88
	12/29/1999	39
STREAM SAMPLING POINT#1	10/3/2000	0.758
	12/29/1999	0.54
	5/19/1998	1
STREAM SAMPLING POINT#2	10/3/2000	27.6
	12/29/1999	87
	5/19/1998	4.6

Table 5.1B
Summary of Analytical Results:
C-8 in Groundwater
Dry Run Landfill
Lubeck, WV

Sample	Date	C-8 (ug/l)
DRMW-12	7/19/2000	0.16
	7/21/1999	0.134
	5/26/1998	<0.10
	7/22/1997	<0.1
	4/10/1996	<0.1
DRMW-12A	7/19/2000	0.128
	7/21/1999	0.081 J
	5/26/1998	<0.10
	7/22/1997	<0.1
	4/10/1996	<0.1
DRMW-12B	7/20/2000	ND (0.029)
	7/21/1999	5.4
	6/16/1998	<0.1
DRMW-13	7/20/2000	9.8
	7/21/1999	3.6
	5/26/1998	9.2
	7/22/1997	7
DRMW-13A	7/20/2000	9.9
	7/21/1999	0.070 J
	5/26/1998	8.7
	7/22/1997	15
	4/10/1996	8.2
	4/10/1996 (dup)	11
DRMW-14	7/20/2000	0.115
	7/21/1999	2.5
	6/16/1998	<0.1
	7/21/1997	<0.1
	4/10/1996	<0.1
DRMW-15	7/20/2000	0.763
	7/21/1999	0.263
DRMW-6	7/22/1997	1
	4/10/1996	0.97
DRMW-6A	7/20/2000	0.212
	7/21/1999	0.096
	5/26/1998	0.27
	7/22/1997	0.36
	4/10/1996	0.19

J = **estimated value (below laboratory quantitation** limit).

FIGURES

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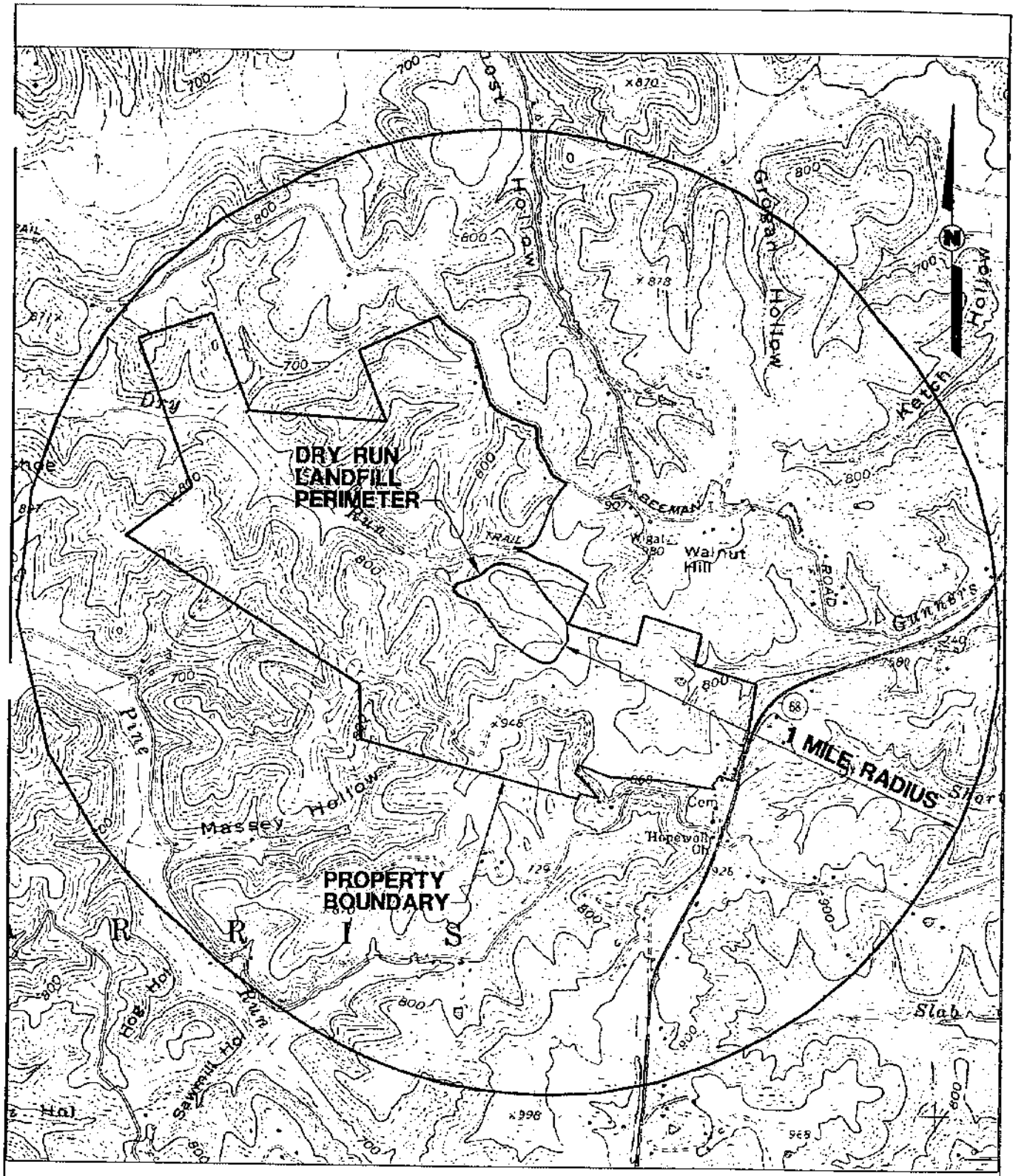

SCALE

1610 0 1610'

MAP TAKEN FROM THE LUBECK, WV USGS QUANDRANGLE

DU PONT

Corporate Remediation Group

An Alliance between DuPont and URS Diamond

Barley Mill Plaza, Building 27
Wilmington, Delaware 19805

1–MILE RADIUS MAP

Dry Run Landfill
Lubeck, West Virginia

SCALE	DESIGNED	DRAWN	CAD FILE NO.
As shown		DEL	74ZZA019
DATE	CHECKED	APPROVED	FIGURE
12/19/01	TDL		5.1

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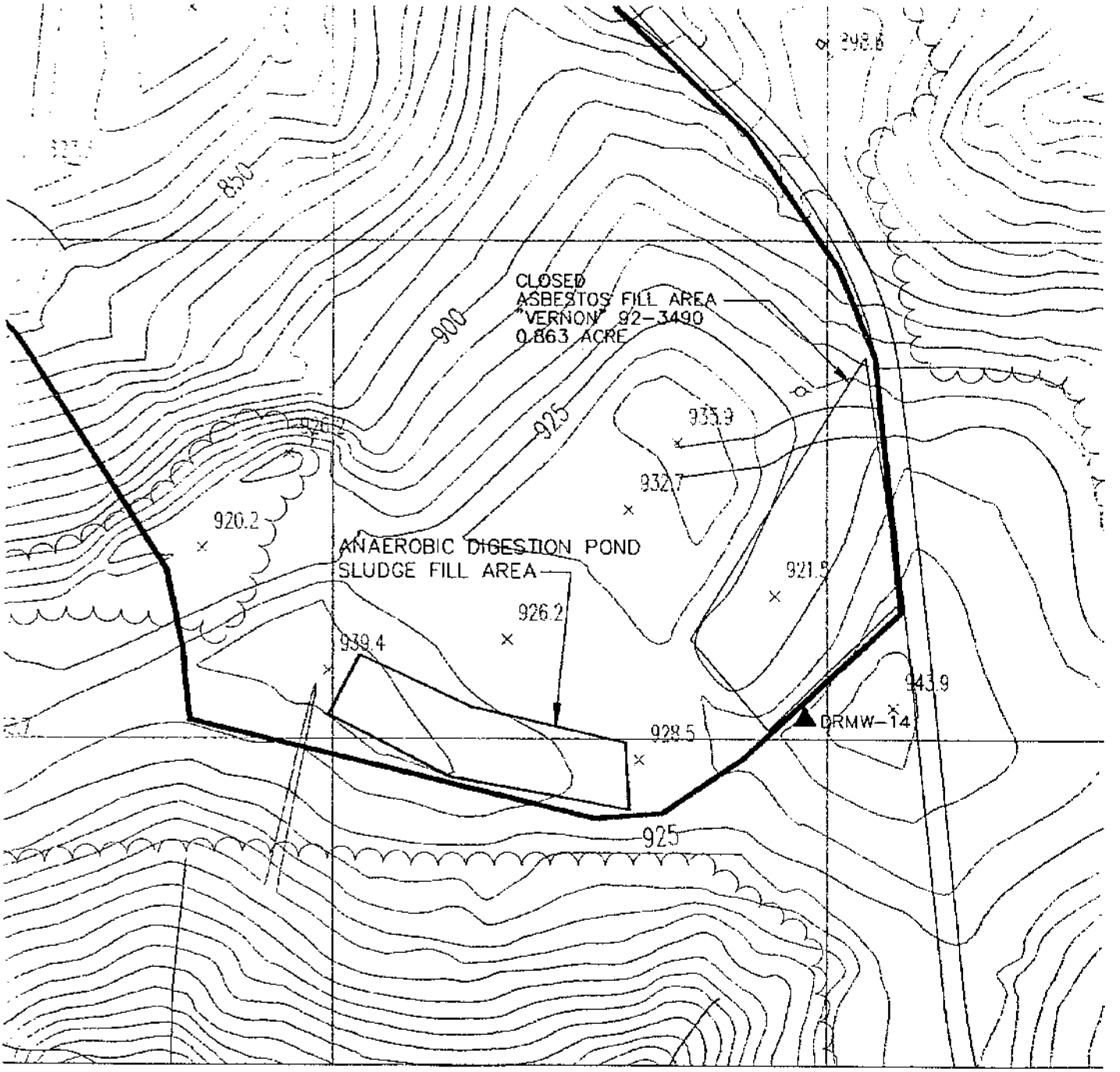

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280'

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APPROVED(CONSTRUCTION)	

DUPONT

Corporate Remediation Group
An Alliance between DuPont and URS Diamond

Barley Mill Plaza, Building 27
Wilmington, Delaware 19805

MONITORING WELL AND SURFACE WATER SAMPLE LOCATION MAP

Dry Run **Londfill**
Lubeck, West Virginia

SCALE	DATE	CAD FILE NO.	FIGURE
As shown	12/18/01	74220004	5.2

000613

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CROSS-SECTION LOCATION MAP
Dry Run Landfill
Lubeck, West Virginia
Corporate Remediation Group
An Alliance Business
DuPont and ICI Planned
Barley Mill Plaza, Building 77
SCALE
LEGEND:
OVER BURDEN MONITOR WELL
BEDROCK MONITOR WELL
MONITOR WELL WATER LEVEL ELEVATION
CROSS SECTION LINE
BORING LOCATION
TEST PIT LOCATION
SURFACE WATER LOCATIONS
A
A'
B
B'
ANAEROBIC DIGESTION POND SLUDGE FILL AREA
CLOSED ASBESTOS FILL AREA
LARGE SCRAP TANK
LEACH-1
LEACH-2
DRAIN-1
DRAIN-2
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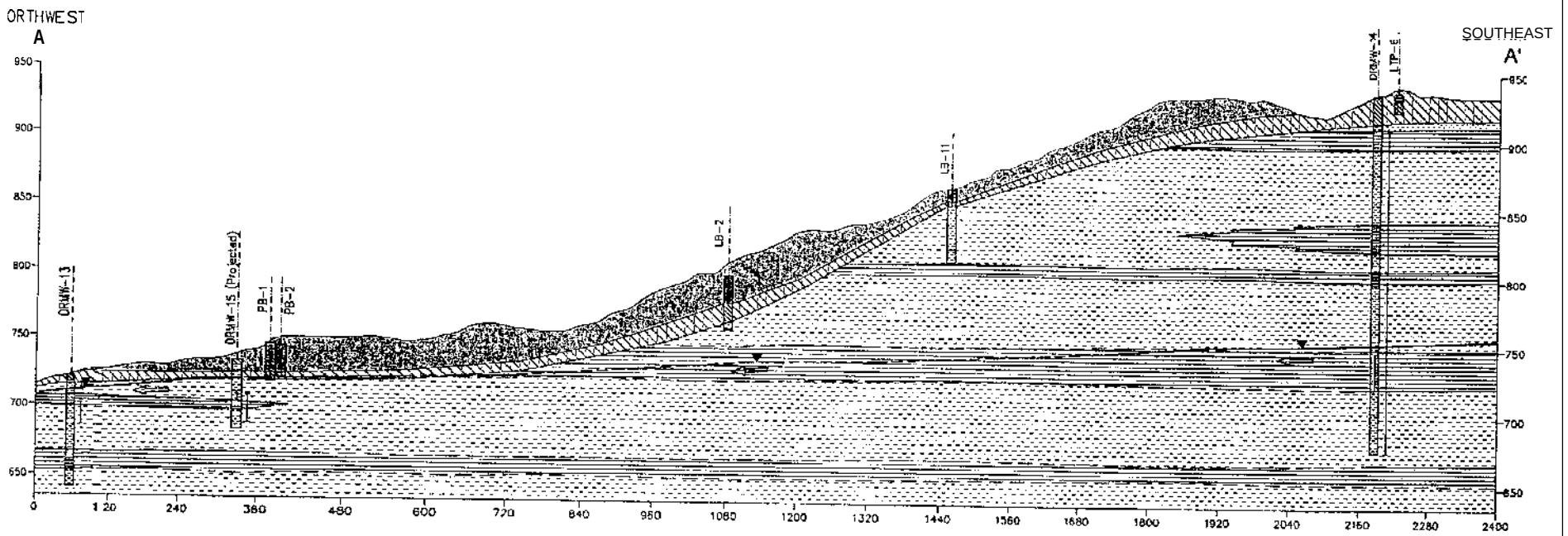

SECTION A-A'

LEGEND:

- FILL MATERIAL
- SILTY CLAY
- SHALE/WEATHERED SHALE
- SILT
- SANDSTONE
- SILTSTONE
- MONITORING INTERVAL
- GROUNDWATER ELEVATION (Nov. 2001)
- GROUNDWATER FLOW DIRECTION

2.4X VERTICAL EXAGGERATION

HORIZONTAL SCALE

160 0 160 320 FT

VERTICAL SCALE

66 0 66 132 FT

DUPONT

Corporate Remediation Group
An Alliance between DuPont and URS Diamond
Barley Mill Plaza, Building 27
Wilmington, Delaware 19805

CROSS-SECTION A-A'

Dry Run Landfill
Lubeck, West Virginia

000615

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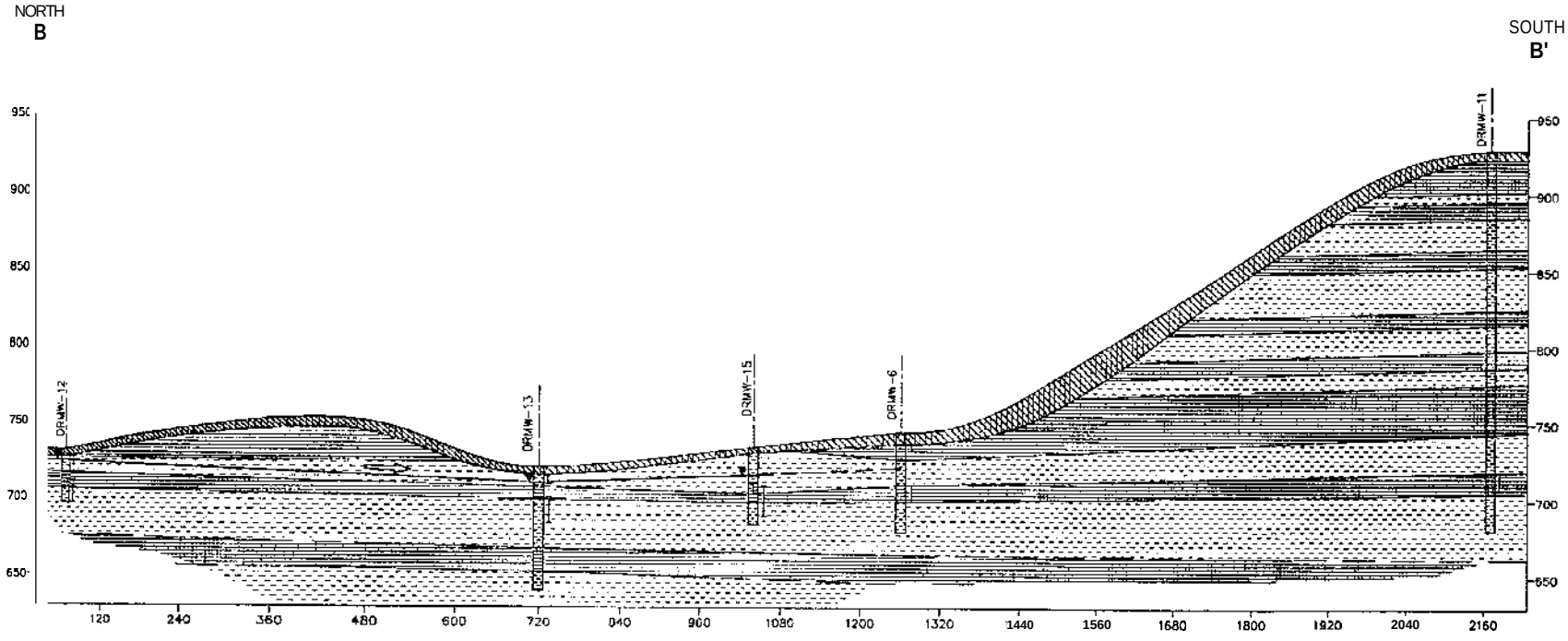

SECTION B – B'

LEGEND:

- SILTY CLAY
- SHALE/WEATHERED SHALE
- SILT
- SANDSTONE
- SILTSTONE
- MONITORING INTERVAL
- GROUNDWATER ELEVATION (Nov 2001)
- GROUNDWATER FLOW DIRECTION

2 4X VERTICAL EXAGGERATION

HORIZONTAL SCALE

160 0 160 **320** FT

VERTICAL SCALE

66 0 66 122 FT

Corporate Remediation Group
An Alliance between DuPont and URS Diamond
Barley Mill Plaza, Building 27
Wilmington, Delaware 19805

CROSS-SECTION B–B'

Dry Run Landfill
Lubeck, West Virginia

5.48

GROUNDWATER ELEVATION CONTOUR MAP
Dry Run Landfill
Wood County, West Virginia
Corporate Remediation Group
FILL AREA
GROUNDWATER FLOW DIRECTION
SCALE
250
0
250'
500'
LEGEND:

GROUNDWATER ELEVATION
CONTOUR MAP OCTOBER 19
Dry Run Landfill
Lubeck, West Virginia
Corporate Remediation Group
Berkey Hill Plaza, Building 27
Warmerdam, Delaware 15905
LEGEND:
SCALE
250
0
250'
500'
GROUND WATER FLOW DIRECTION
FILL AREA
EXISTING
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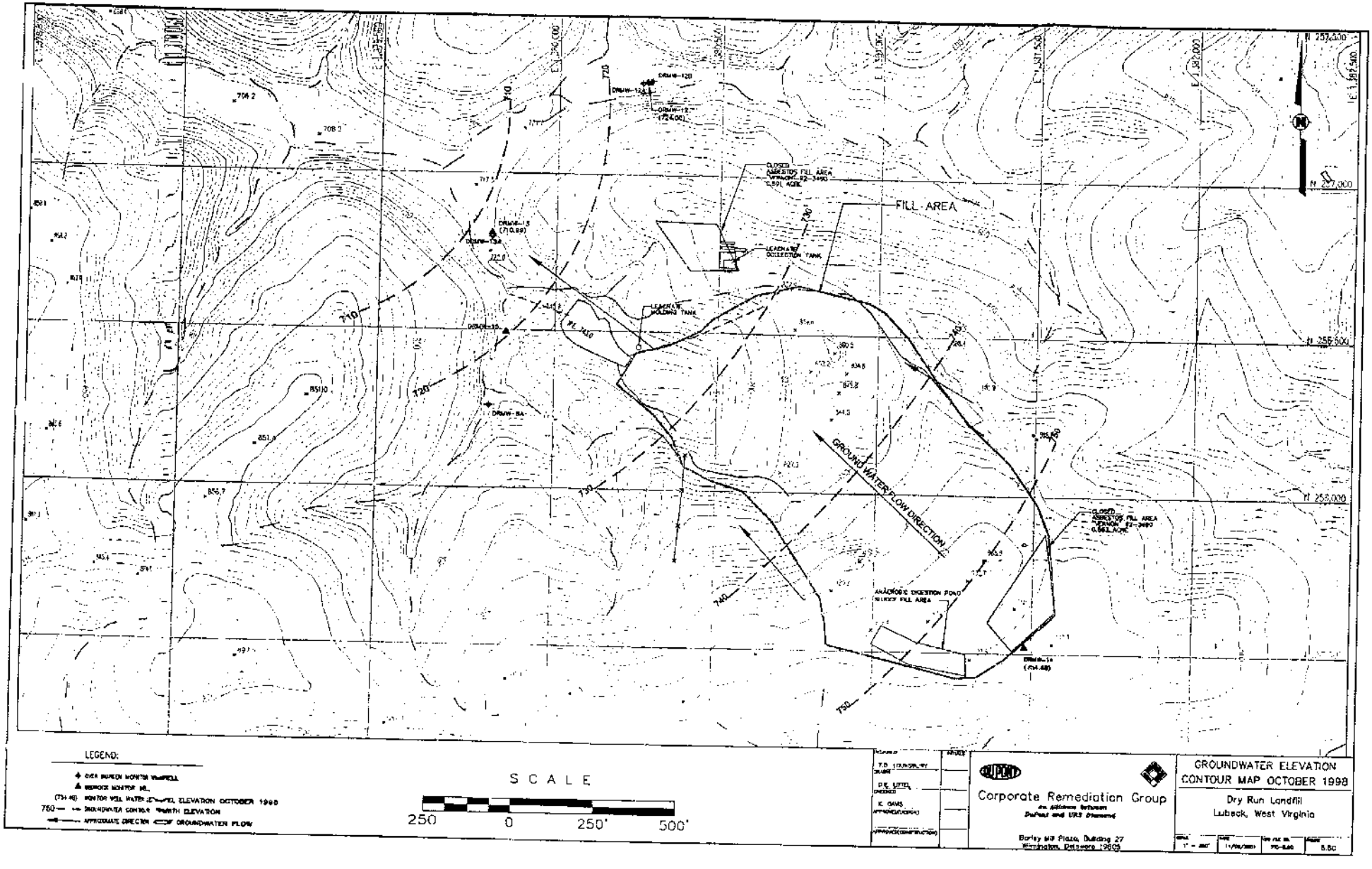

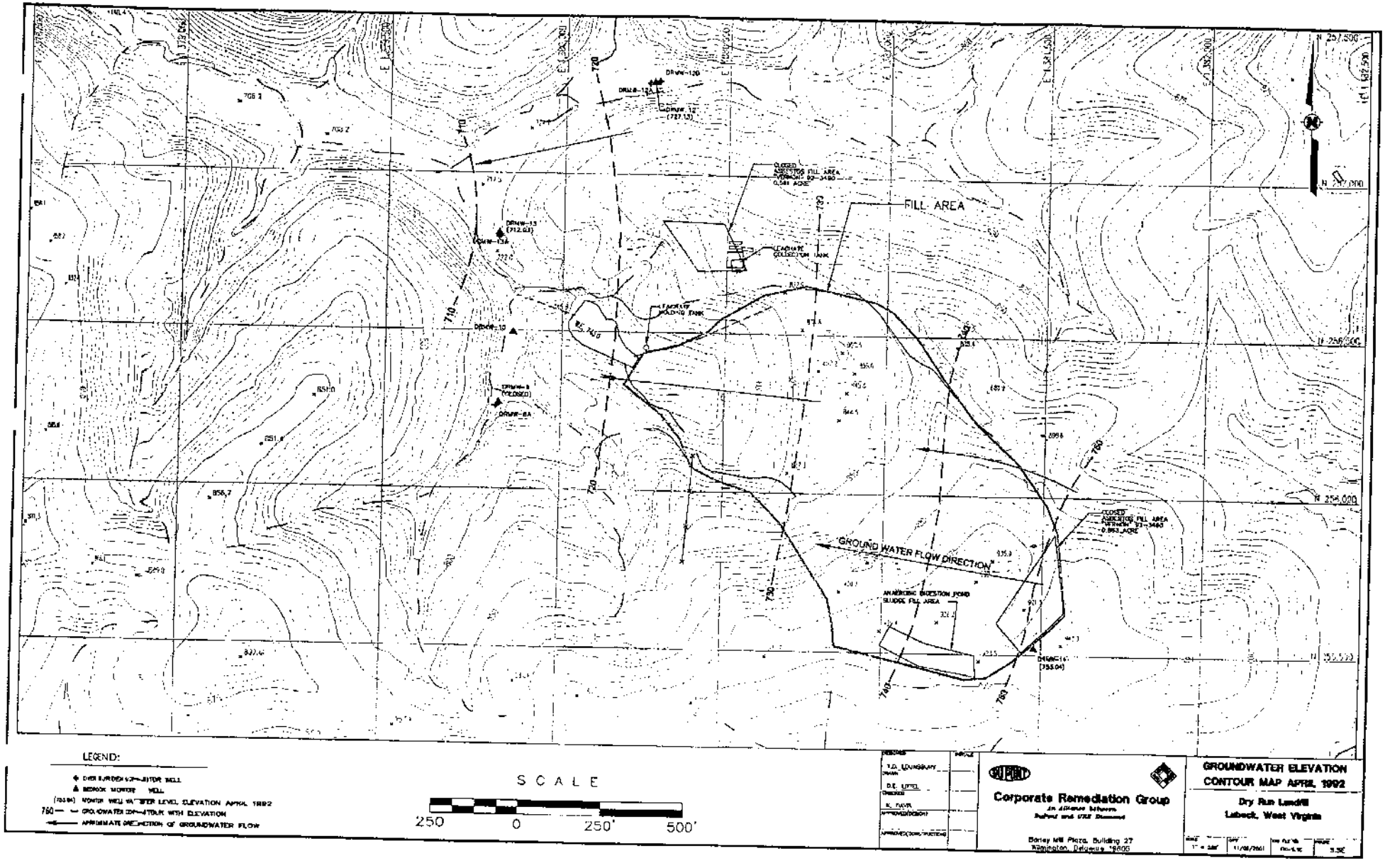

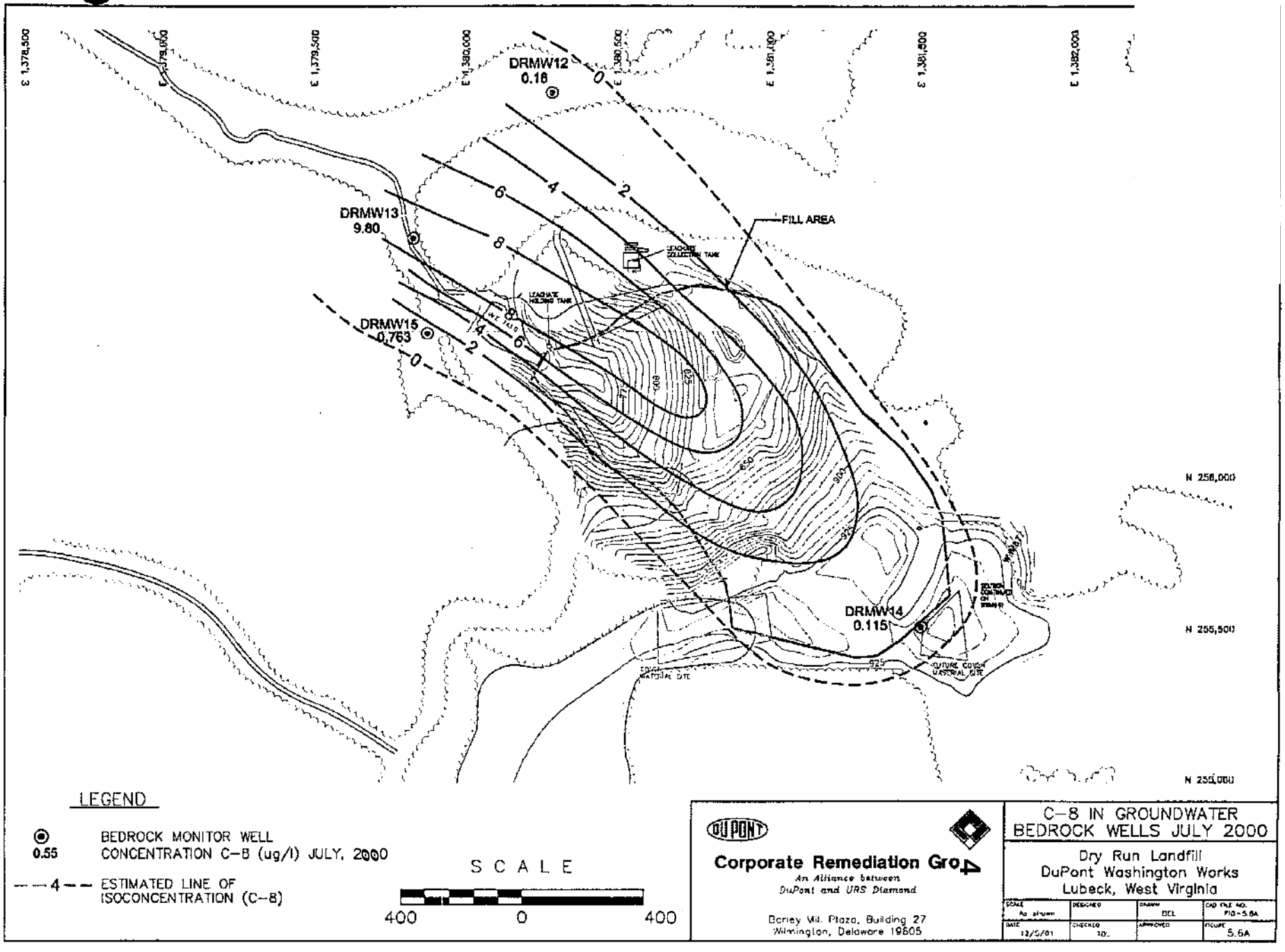

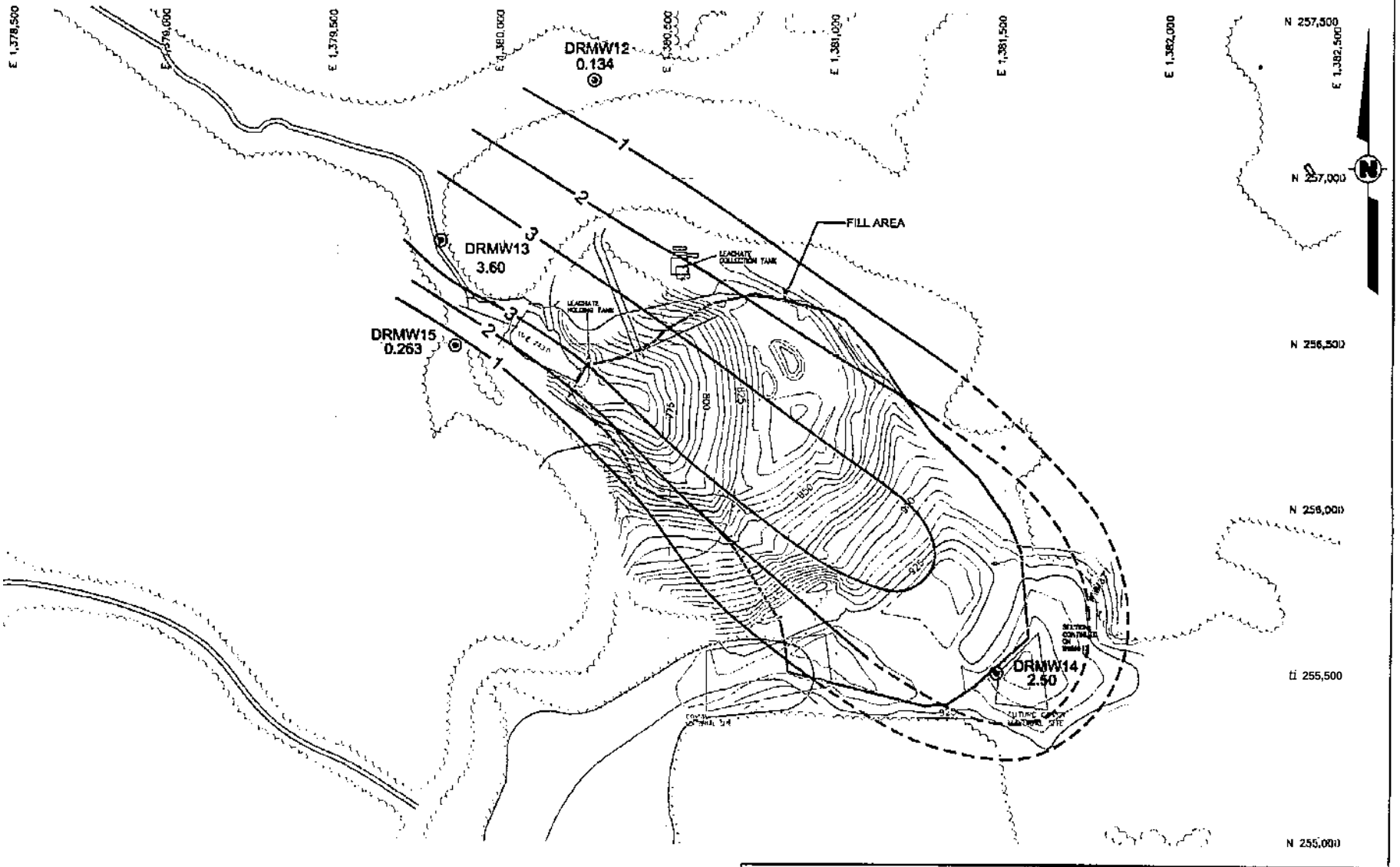

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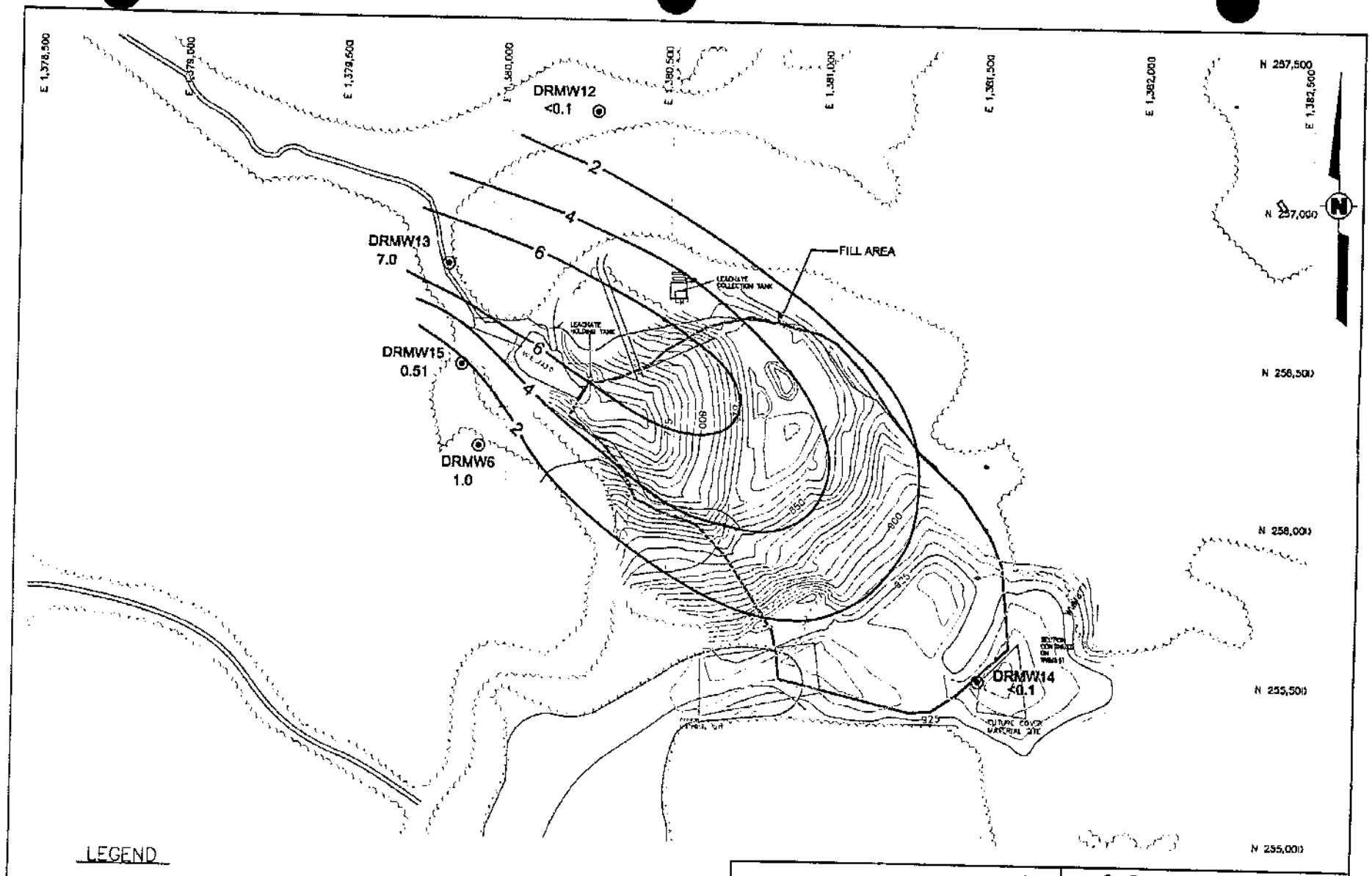

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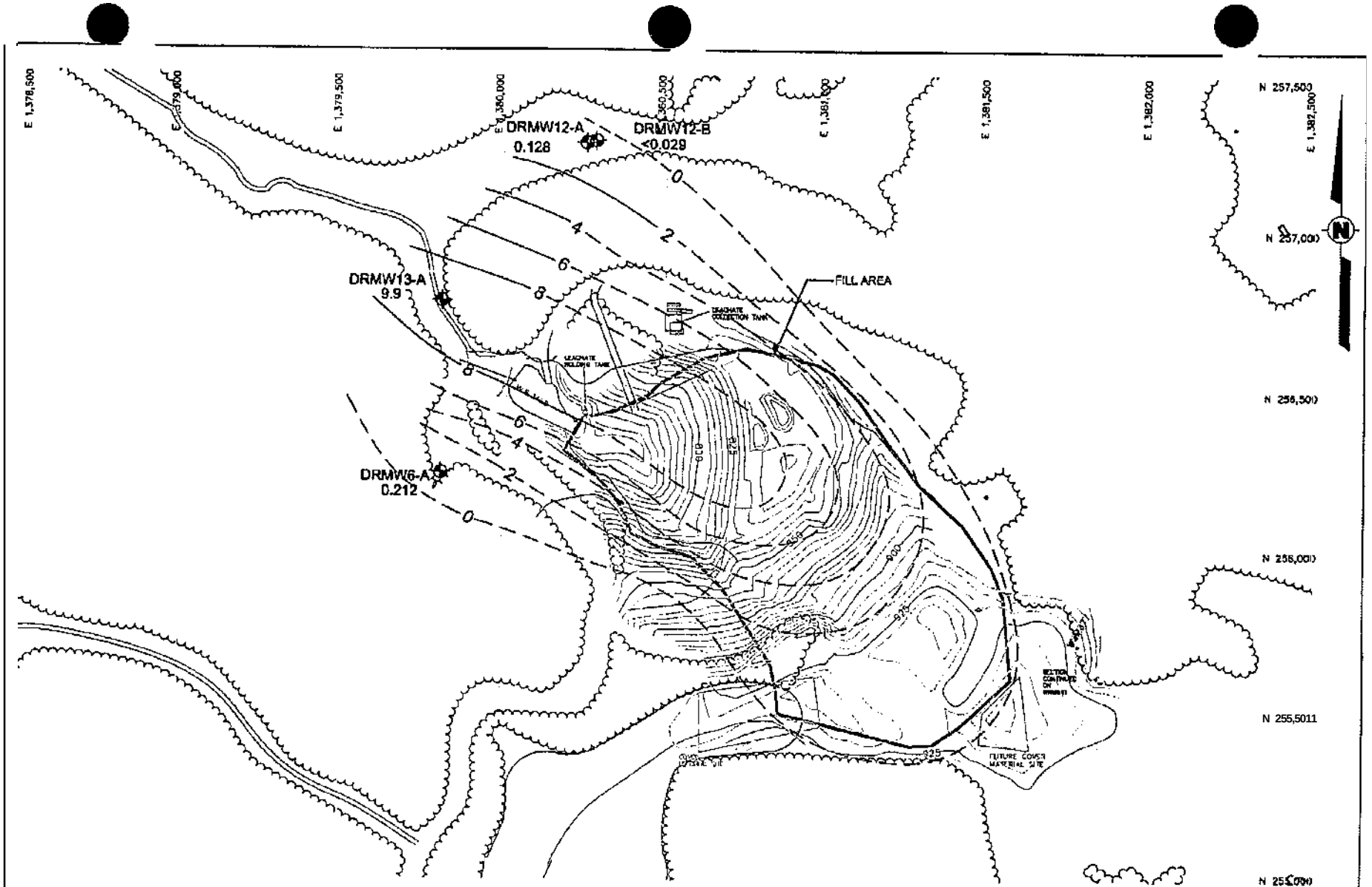

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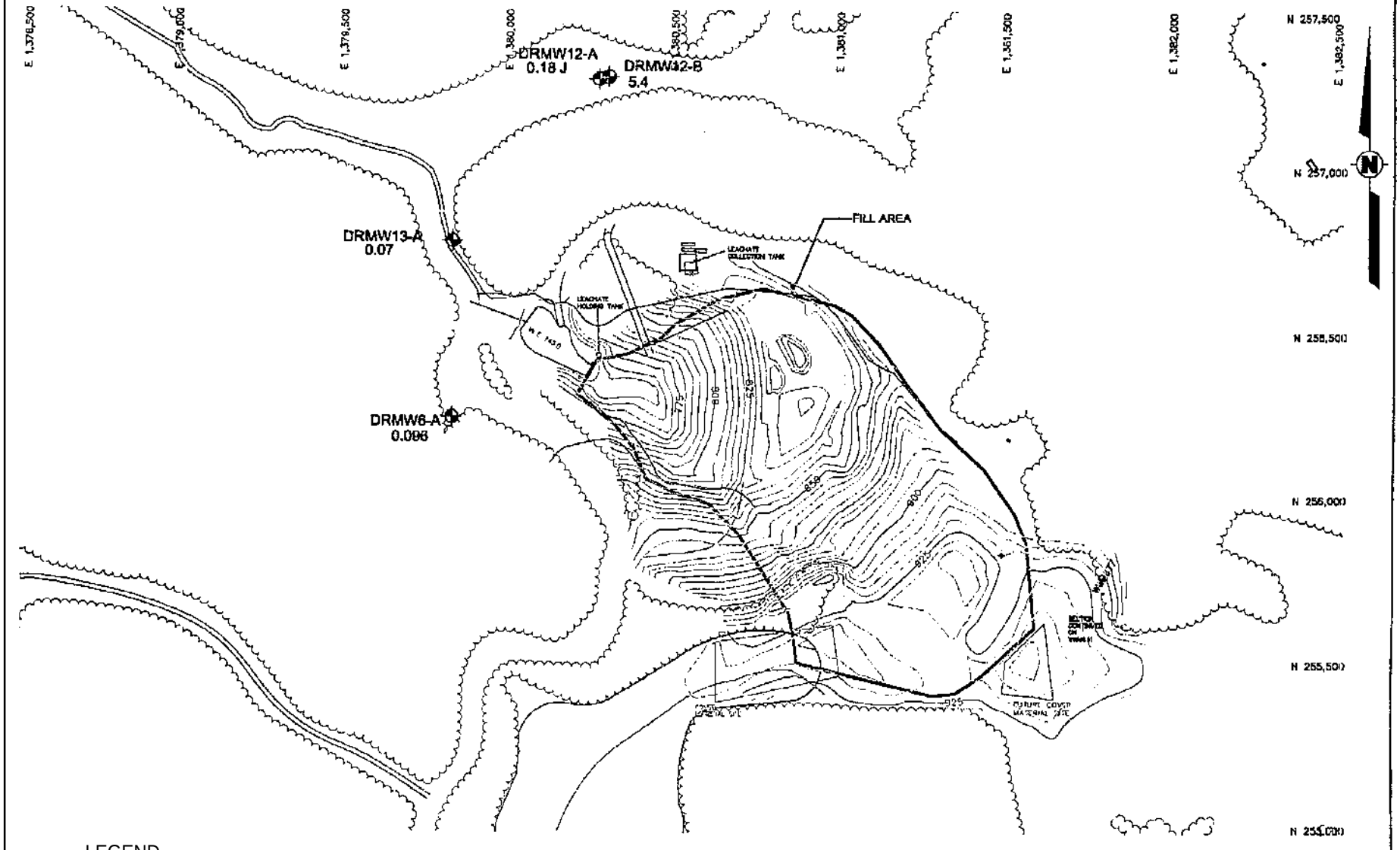

DUPONT

Corporate Remediation Group

An *Alliance between DuPont and URS Diamond*

Barley Mill Plaza, Building 27
Wilmington, Delaware 19805

C-8 IN GROUNDWATER
OVERBURDEN WELLS, JULY, 1999

Dry Run Landfill
DuPont Washington Works
Lubeck, West Virginia

SCALE	DESIGNED	DRAWN	CAD FILE NO.
As shown		OEL	FIG-5.6E
DATE	CHECKED	APPROVED	FIGURE
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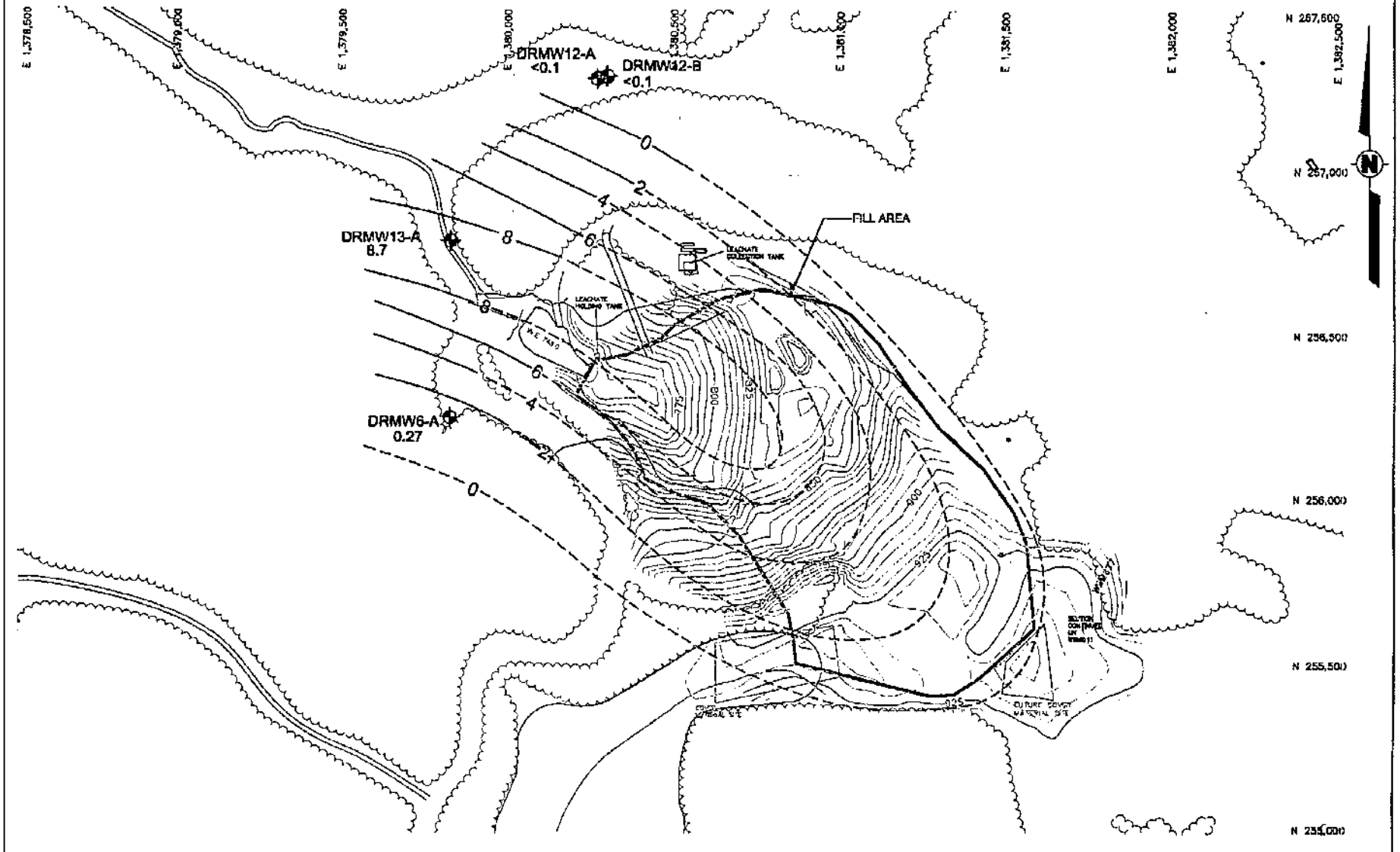

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Appendix 1

APPENDIX I

CONSENT ORDER
(ORDER NO. GWR-2001-019)

CONSENT ORDER ISSUED PURSUANT TO ARTICLES 5 and 12, CHAPTER 22 *AND* ARTICLE 1, CHAPTER 16 OF THE WEST VIRGINIA CODE.

TO: E. I. DU PONT DE NEMOURS AND ***COMPANY*** DATE: November 14,2001

West Virginia Department of Environmental Protection **Order No. GWR-2001-019**
West Virginia Department of Health and Human Resources

This **CONSENT ORDER** is issued **by** the Director of the Division of Water Resources and Director of the Division of Air Quality, West Virginia Department of Environmental Protection, and the Commissioner **of** the Bureau for Public Health, West Virginia Department of Health and Human Resources, pursuant to the authority set forth in more detail below.

1. INTRODUCTION OF PARTIES.

This Consent Order is entered into by and between the West Virginia Department of Environmental Protection [WVDEP], the West Virginia Department of Health **and** Human Resources – Bureau for Public Health [WVDHHR-BPH], and E. I. du Pont de Nemours and Company [DuPont][collectively referred to as the "Parties"].

II. PURPOSE OF CONSENT ORDER.

This Consent Order sets forth **a** series of tasks to be performed by the Parties in order to determine whether there has been any impact on human health and the environment as a result of releases of ammonium perfluorooctanoate [C8], **CAS** Number 3825-26-1, to the environment from DuPont operations. C8 is a material used by DuPont in its fluoroproducts manufacturing process at its Washington Works facility located at Washington, Wood County, West Virginia. C8 is not identified as a hazardous substance, hazardous waste or otherwise specifically regulated under West Virginia or federal statute or regulation.

This Consent Order has been negotiated in good faith **and** the actions undertaken by DuPont pursuant to this Consent Order do not constitute an admission of any liability on its part. DuPont retains the right to controvert in any other proceedings, other than proceedings to implement or enforce this Consent Order, the validity of the findings of fact and conclusions of law set forth herein. DuPont agrees to comply with and be bound by the terms of this Consent Order and further agrees in any proceeding to implement or enforce this Consent Order that it

will not contest the validity of this Consent Order or the jurisdiction of WVDEP **and** WVDHHR-BPH to issue it.

111. DEFINITIONS.

Whenever the terms identified below are used in the Consent Order or in any exhibit **or** attachment hereto, the following definitions shall apply:

1. "The Agencies" shall mean the Department of Health and Human Resources, Bureau for Public Health and the Department of Environmental Protection, including the Divisions of Air Quality and Water Resources.

2. "C8" shall mean the chemical compound ammonium perfluorooctanoate.

3. "Detection Limit" means the lowest analytical level that can be reliably achieved within specified limits of precision and accuracy under routine laboratory conditions for a specified matrix. It is based on quantitation, precision and accuracy under normal operation of a laboratory and the practical need in a compliance-monitoring program to have a sufficient number **of** laboratories available to conduct the analyses.

4. "Effective Date" shall mean the date set forth in Section XVII of this Consent Order.

5. "EPA" shall mean the United States Environmental Protection Agency.

6. "Force Majeure" shall mean conditions or circumstances beyond the reasonable control of DuPont which could not have been overcome by due diligence and shall include, without limitation, acts of God, action or inaction of governmental agencies, or administrative or judicial tribunals **or** other third parties, or strikes or labor disputes (provided, however, DuPont shall not be required to concede *to* any labor demands), which prevent or delay DuPont from complying with the work plan.

7. "Groundwater Monitoring Well" shall mean any cased excavation or opening into the ground made by digging, boring, drilling, driving, jetting, or other methods for the purpose of determining the physical, chemical, biological, or radiological properties of groundwater. The term "monitoring well" includes piezometers and observation wells, which **are** installed for purposes other than those listed above, but does not include wells whose primary purpose is to provide a supply of potable water.

8. "Groundwater Well" or "Well" shall mean any drilled or excavated groundwater collection system that supplies water for public, private, industrial, or agricultural use and shall include drinking water wells. **As** used in this Consent Order, this term applies only to wells

located in West Virginia.

9. "Reimbursable Costs" shall mean costs attributable (on an hourly basis) to the **work** of Dee *Ann* Staats, Ph.D. in the negotiation and implementation of this Consent Order, the costs attributable to any other participants on the C8 Assessment of Toxicity Team, as described in Attachment C to this Consent Order, who are serving in that position as contractors to WVDEP, costs incurred by WVDEP in connection with the public meetings described in Attachment C, and costs attributable to **any** contractor retained at the direction **of** the Groundwater Investigation Steering Team (GIST).

10. "Washington Works" shall mean the manufacturing facility owned by DuPont and located in Washington, Wood County, West Virginia, **as** depicted on Exhibit 1 to this Consent Order.

11. "The Facilities" shall mean the Washington Works and the Local Landfill, depicted on Exhibit **1,** the Letart Landfill, depicted on Exhibit 2, and the Dry Run Landfill, depicted on Exhibit 3.

12. "Reference Dose" or "RfD" shall mean an estimate (with uncertainty spanning perhaps an order of magnitude or greater) of **a** daily exposure level for the human population, including sensitive subpopulations, that is likely to be without an appreciable **risk** of deleterious effects during a lifetime. Chronic RfDs are specifically developed to be protective for long-term exposure to a compound.

13. "Screening Level" shall mean the concentration in **a** specific media such as air, water, **or** soil, that is likely to be without an appreciable **risk** of deleterious effects during a lifetime in the human population.

IV. WAIVER OF RIGHTS.

DuPont waives any and all rights it may have to appeal or challenge the validity or requirements of this Consent Order, and shall not challenge the jurisdiction of the Agencies to issue this Consent Order.

This Consent Order applies to and is binding upon the Parties, and their successors and assigns.

V. FINDINGS OF FACT.

1. C8 is a chemical substance which has no established state or federal effluent or emission standards.

2. C8 is a perfluorinated surfactant manufactured by the 3M Company and others.

Since the early 1950's C8 has been used by DuPont in its fluoropolymer-related manufacturing processes at its Washington Works facility, located in Wood County, West Virginia.

3. Residues containing C8 from fluoropolymer manufacturing processes at Washington Works are or have been released to the air, discharged to the Ohio River, disposed of at the Facilities, and otherwise shipped off-site for destruction and/or disposal. DuPont also captures for recycle a significant portion of used C8.

4. No permits issued to DuPont authorizing releases of pollutants to the environment contain specific limitations on the amount of C8 that may be released to the environment. Howcvcr, C8 releases are addressed more generally in WVDEP Division of Air Quality permits as particulate matter, PM_{10} (particulate matter with an aerodynamic diameter less than or equal to 10 microns), or as a volatile organic compound.

5. Since as early as 1990, DuPont has performed regular, voluntary water sampling to detect the presence and level of C8 in and around certain of its Facilities in West Virginia and has reported the results of this sampling to various government agencies. Currently, DuPont also samples and reports C8 concentrations in water as required by permits issued by WVDEP and EPA.

6. **As** a result of DuPont's sampling, C8 has been detected in varying concentrations in and around certain of its Facilities in West Virginia, including private drinking water wells and public water supplies.

7. Analyses of water samples have reported levels of C8 in the Lubeck Public Service District ("LPSD") drinking water supply.

8. DuPont. by and through its use of C8 in the fluoropolymer manufacturing process, is the likely source of C8 presence in and around certain of its Facilities in West Virginia.

9. Along with environmental sampling for C8, DuPont has performed and participated in multiple studies examining the potential effects of C8 exposure on human health and **the** environment.

10. Studies performed by DuPont and 3M have determined that C8 in sufficient doses. i.e., considering both amount and duration of exposure, is toxic to animals through ingestion, inhalation and dermal contact. Studies have also found that C8 is persistent in humans and the environment.

11. Although DuPont has collected a large amount of data on the presence of C8 in the environment, the Agencies believe that additional information will assist them in delineating the extent and concentrations of C8 in the environment at or near the Facilities. Available data collected **by** DuPont indicates that C8 is present in the surface and groundwater at the Letart and

Dry Run Landfills and at or near the Washington Works facility.

12. WVDEP and WVDHHR-BPH have determined that it is desirable to ascertain the source of drinking water for persons potentially exposed to C8 in groundwater or surface waters in the area of the Facilities.

13. EPA, WVDEP, and WVDHHR-BPH, in consultation and cooperation with one another, have requested, and DuPont has submitted, information and documents relating to the detection and presence of C8 in and around the Facilities and documents with respect to the human health studies being performed related to C8 exposure.

14. Based upon information submitted by DuPont and reviewed to date by EPA, WVDEP, and WVDHHR-BPH, the Agencies believe that additional data would assist in their evaluation of whether the ground and surface waters now containing C8 have a complete exposure pathway to humans and whether persons in and around the Facilities are at risk of adverse health effects from C8 exposure.

15. There have been no independent governmental or non-industrial studies performed on the human health effects of C8 exposure for the purpose of establishing an exposure standard for C8 applicable to the general public.

16. The Agencies have concluded that full site and health assessments are necessary to ascertain the extent and level of C8 concentrations in the environment and to assist them in determining whether C8 presents any possible danger to the public. DuPont has agreed to participate and assist in this effort.

17. The fluoropolymers industry has committed to EPA to reduce total actual C8 emissions for either the year 1999 or the year 2000 by 50 percent within three to five years of each company's commitment date. DuPont committed to this goal in 2000.

18. DuPont installed, in March 2001, a filter and carbon treatment system at its Washington Works facility that is demonstrating removal efficiency of 90-95% of the C8 in its major C8-containing wastewater stream.

VI. AUTHORITY TO ISSUE CONSENT ORDER

1. The WVDEP is the state agency vested with the authority to protect the environment in West Virginia.

2. Article 12, Chapter 22 of the West Virginia Code, the Groundwater Protection Act, grants to the WVDEP the authority to protect the State's groundwater from any contaminant

and, where contaminated groundwater is found, to institute a civil action or issue an order requiring that groundwater be remediated.

3. Article 5, Chapter 22 of the West Virginia Code, the Air Pollution Control Act, grants to the WVDEP the authority to protect the State's air from pollutants and to institute a civil action or issue orders to enforce the statute.

4. The WVDHHR-BPH is the state agency vested with the authority to regulate and protect drinking water supplies in West Virginia.

5. Article 1, Chapter 16 of the West Virginia Code, grants to the WVDHHR-BPH the authority to protect the public drinking water supply of the state and to perform all investigation necessary to assure its purity and safety, and further grants to the WVDHHR-BPH the authority to institute actions and issue orders to restore the purity of said water supply.

VII. REQUIREMENTS OF CONSENT ORDER.

The Agencies have concluded that it is of great importance to have sufficient data upon which to determine the scope and potential risk of the presence of C8 in the environment in and around the Facilities. Therefore, the Agencies require the following:

A. Establishment of Groundwater Investigation Steering Team.

1. A "Groundwater Investigation Steering Team" (GIST) shall be established with members of the team consisting of WVDEP, WVDHHR-BPH, EPA Region III, and DuPont. The WVDEP representative will be the team leader. The objectives and specific tasks of the team are set forth in full in Attachment A of this Consent Order. However, the primary purpose of the GIST will be to oversee an expeditious, phased approach to fulfilling the majority of the requirements set forth in Sections A through C. The work performed with oversight from the GIST shall be funded by DuPont in accordance with Section VIII of this Consent Order.

2. Upon conclusion of key milestones in the tasks set forth in Attachment A, the GIST shall issue interim or final reports setting forth findings of fact and conclusions regarding background data, groundwater monitoring, and plume identification as described in Attachment A. Any groundwater monitoring plan developed pursuant to Attachment A shall survive the termination of this Consent Order and shall be incorporated as a minor permit modification for the Facilities. DuPont reserves the right to request modification of the plans upon renewal of the Facilities' permits.

B. National Pollutant Discharge Elimination System Requirements.

1. Except as occasioned by no-flow conditions, DuPont shall perform monthly sampling for C8 at the Local Landfill at certain outfalls identified in West Virginia/National Pollutant Discharge Elimination System ("WV NPDES") Permit No. 0076538 as Outfalls 101, 004 and 005.

2. Except as occasioned by no-flow conditions, DuPont shall perform monthly sampling for C8 at the Washington Works facility at certain outfalls identified in WV NPDES Permit No. WV0001279 as Outfalls 001,002,003,005,007, and 105.

3. Except as occasioned by no-flow conditions, DuPont shall perform monthly sampling for C8 at Dry Run Landfill at all outfalls identified in its WV NPDES Permit No. WV0076244.

4. Except as occasioned by no-flow conditions, DuPont shall perform monthly sampling for C8 at Letart Landfill at all outfalls identified in its WV NPDES Pennit No. WV0076066.

5. With respect to the requirements of paragraphs VII.B.1 through **VII.B.4,** all sampling shall be performed pursuant to established EPA guidelines, where applicable, and results shall be delivered to the WVDEP within thirty days of receiving such results. DuPont shall record and report all attempts to sample under no-flow conditions.

6. Within 90 days of the Effective Date of this Consent Order, DuPont agrees to obtain a sample from each surface or alluvial **water** intake for public water supplies along the Ohio River in the area extending ten river miles downstream of the Washington Works facility and one river mile upstream of the Washington Works facility. If concentrations of C8 above the Detection Limit are found in any sampled public water supply within the upstream or downstream segments initially sampled, the segments within which intakes are to be sampled shall be extended to twenty river miles downstream or hvo river miles upstream, as appropriate. If concentrations above the Detection Limit are found in any segment so extended, additional sampling will be performed on water intakes within thirty **river** miles downstream or three river miles upstream, as appropriate.

7. The additional monitoring requirements contained in this subsection shall be incorporated into the Facilities' West Virginia/National Pollutant Discharge Elimination System permits by minor modification. DuPont reserves the right to request **a** modification of these requirements upon renewal of the permits.

C. Toxicological and Human Health Assessment.

1. DuPont agrees to fund the various tasks **set** 'forthbelow **as** a **part** of this Consent Order by establishing an escrow account at **a** bank agreed to by the Parties, or by some other

means agreed to by the Parties. Disbursements from said escrow shall be authorized by the C8 Toxicity Team Leader and DuPont representative jointly as described below.

2. A C8 Assessment of Toxicity Team **("CAT** Team") shall be established with members of the team consisting of representatives of

WVDEP
WVDHHR-BPH
EPA Region III
NICS
ATSDR
DuPont

3. The WVDEP representative shall be the Team Leader.

4. The individual team members, the tasks of the team, and the team objectives are set forth in full in Attachment C of this Consent Order.

5. Upon conclusion of all the tasks set forth in Attachment C, the CAT Team shall issue **a** final report setting forth findings of fact and conclusions as to what extent there may be health **risks** associated with CS at the Facilities.

D. Emission Modeling Assessment.

1. The following information shall be submitted to the Division of Air Quality ("DAQ") within 30 days of the Effective Date except where a different deadline is provided in this subsection:

a. A complete and accurate list of building dimension parameters for all structures located within the Washington **Works** facility **that** have a significant impact on the dispersion of C8 emissions. Significant impact for each structure on the site shall be determined based on the "area of building wake effects" as defined in the EPA User's Guide to the Building Profile Input Program (EPA-454/R-93-038 Revised Feb. 8, 1995).

b. A complete and accurate list of DuPont's current permitted allowable emission rates and confirmed actual C8 emission rates **in** pounds per year for the year 2000 for all sources located within the Washington Works facility. Each emission point shall be listed according to its stack I.D. and corresponding permit number. For each stack identified above **as** emitting C8 DuPont **shall** list all relevant stack parameters to be used in air dispersion modeling.

c. For each emission point (stack) emitting C8, the following information shall be supplied:

i. Phase of C8 (solid, vapor or aqueous solution) at stack conditions.

ii. The particle characterization to be used for modeling including the particle size distribution (microns), the mass fraction of C8 in each particle size category, and the particle density (g/cm^3).

iii. For particulate emissions, scavenging coefficients (hr/s-mm) for both liquid and frozen precipitation to be used for wet deposition modeling based upon the particle size distribution and the EPA's Industrial Source Complex, Version 3 Model Guidance (EPA-454/B-95-003b Sept. 1995)("ISC Guidance"). DuPont may submit, within 30 days of the Effective Date, information to support the use of the normalized scavenging coefficient in the ISC Guidance (Figure 11 of ISC Guidance) for C8's scavenging coefficients. DAQ shall approve or disapprove with justification in writing, DuPont's submission. Should DAQ disapprove, DuPont shall have the right, within seven days, to request a meeting with DAQ and USEPA to address the deficiencies set forth in DAQ's letter and to request reconsideration of DAQ's decision. Following a meeting of the parties, **DAQ** shall issue a decision letter regarding C8's scavenging coefficients within seven days of the meeting. DAQ reserves the **right** to require measurement of C8's scavenging coefficients in its decision and DuPont reserves the right to assert a claim of confidentiality in the event such ***a*** mcasuremcnt is made.

iv. For gaseous emissions, scavenging coefficients (hr/s-mm) for both liquid and frozen precipitation to be used for wet deposition modeling will be provided as a function of droplet size using formulae in the open literature based on the physical properties of CS and consistent with Section 1.4 of the ISC Guidance. DuPont may submit, within 30 days of the Effective Date, information to support the proposed scavenging coefficient for gaseous emissions including information on the percentage of C8 emissions that would be in gaseous form. DAQ shall approve or disapprove with justification in writing, DuPont's submission. Should DAQ disapprove, DuPont shall have the right, within seven days, to request a meeting with DAQ and USEPA to address the deficiencies set forth in DAQ's letter and to request reconsideration **of** DAQ's decision. Following **a** meeting of the parties, DAQ shall issue a decision letter regarding C8's scavenging coefficients within seven days of the meeting. **DAQ** reserves the right to require measurement of C8's scavenging coefficients in its decision and DuPont reserves the right to assert a claim **of** confidentiality in the event such a measurement is made.

d. **To** the extent that the phases exist, a solid, liquid and vapor phase (T-P) diagram for C8 with respect to pressure and temperature. The temperature and pressure ranges shall be representative of exhaust gas conditions before and after control equipment. Estimates of C8's critical properties shall be provided along with measured ranges of phase transition temperatures.

e. In lieu of a binary phase (T-x-y) diagram representing the vapor-liquid equilibrium between water and C8, the solubility and Krafft Point of *C8* in aqueous solutions, measured pK value for C8 dissociation in aqueous solutions, and measurements of C8 concentrations or related acids observed when testkd in a head spacc *GC* at various concentrations, temperatures, and pHs representative of the ranges observed during actual operating conditions. Furthermore a discussion regarding the volatility of C8 in aqueous solutions as a function of pH will be provided. The information in this paragraph shall be submitted to the DAQ within 60 days of the Effective Date.

f. **Henry's** law coefficient for **C8** and **a** discussion of its dependence on pH. The coefficient shall be defined at various temperatures covering thc range observed during actual operations.

g. Any carbon adsorption data in the form of isotherms for *C8* adsorption.

DAQ will provide DuPont an opportunity to comment on modeling methodology and assumptions prior to finalizing the modeling results.

a. Any expenses incurred as **a** result of accurately supplying the information requested above shall be covered by DuPont.

3. Upon submission of the information required **by** this Subsection VII.D, **DAQ** reserves the right ***to*** disapprove any data if the analytical methodology or quality control procedures arc deemed inappropriate.

VIII. REIMBURSEMENT OF COSTS.

1. DuPont agrees to establish an escrow account to fund Reimbursable Costs under this Consent Order. Expenditures from this account shall be made upon joint approval by a duly designated representative of the WVDEP and of DuPont ("designated representatives"). Written notice of such designation shall be sent to the persons identified pursuant to Section XVI of this Conscnt Order. Prior to the execution of this Consent Order, WVDEP has provided DuPont with an cstirnate of Reimbursable Costs that WVDEP expects to incur under this Conscnt Order.

a. Within 10 business days of the Effective Date, DuPont shall deposit in thc escrow account funds in the amount of fifty thousand dollars ($50,000). Each expenditure from the escrow account must be supported by an itemized accounting, including invoices and receipts. Said escrow account shall be replenished with additional funds whenever the balance is less than ten thousand dollars ($10,000), or as agreed to by the designated representatives. Any unexpended amount remaining in the escrow account at the conclusion of the work to be performed under this Consent Order shall be returned to DuPont.

3. DuPont's obligation to pay Reimbursable Costs under this Consent Order shall

not exceed two hundred and fifty thousand dollars ($250,000). Except as to Reimbursable Costs which are addressed separately in this section, all other costs incurred by DuPont in carrying out its obligations under Consent Order shall be the sole responsibility and obligation of DuPont.

IX. QUALITY ASSURANCE/QUALITY CONTROL.

All sampling and analyses performed pursuant to this Consent Order shall conform to EPA guidance regarding quality assurance/quality control, data validation, and chain of custody procedures. The laboratory performing the analyses shall be approved by the Parties prior to sampling.

X. C8 REDUCTION PROGRAM.

1. Notwithstanding current permitted emission levels, DuPont agrees to limit overall CS emissions to the air to no more than actual calendar year 2000 levels on a calendar year basis and shall further provide to the WVDEP monthly emissions reports regarding C8. The reporting requirement contained herein shall be modified to quarterly reports upon the issuance of a Screening Level derived following the procedures set out in Attachment C.

2. DuPont agrees to reduce emissions to the air and discharges to the water of C8 collectively by 50% from actual 1999 levels by December 31, 2003.

3. DuPont shall operate and maintain the filter and carbon bed treatment system at its Washington Works facility with the goal of achieving 90-95% C8 removal efficiency in its major CS-containing wastewater stream.

4. DuPont shall conduct the following construction projects and abide by the specified dates:

a. DuPont shall install an improved scrubber filter to replace recovery device T6IZC on permit R13-815D. Construction shall begin no later than February 28,2002. Initial operation shall begin no later than the date of start up after the April shutdown; or June 28,2002, whichever is earlier.

b. DuPont shall modify the stack for emission point T6IZCE so that the emission point elevation is 170 feet above grade. The stack diameter, velocity, and flow rate shall be sized to provide effective dispersion of particulate emissions according to 45 Code of State Rules, Series 20 (Good Engineering Practice as Applicable to Stack Heights). Construction shall begin no later than February 28,2002. Initial operation shall begin no later than the date of start up after the April shutdown, or June 28,2002, whichever is earlier. At times when device T6IZC is not operating, permitted emissions from scrubber T6IFC shall be emitted to emission point

T6IZCE.

5. DuPont shall conduct a scrubber optimization and recovery improvement program that shall consist of a study of scrubber operation for device C2DWC2 on permit R13-614A. The study shall be complete by the end of March 2002. Provided the results are encouraging, the company shall implement identified improvements for this device and similar improvements for units C2DTC2 on permit R13-614A, C2EHC2 on permit R13-1953, and C1FSC2 on proposed permit for R13-2365A. Implementation of the improvements for the latter devices will be complete no later than the end of November 2002.

XI. COMPLIANCE WITH SCREENING LEVELS.

1. The following requirements shall apply only if the procedures set out in Attachment C have been followed:

a. No later than 60 days after receipt of notification from the Agencies that data or information developed pursuant to this Consent Order or other information that is recent and valid demonstrates that DuPont's operations have resulted in CS exposures above the Screening Levels derived following the procedures set out in Attachment C, DuPont shall submit a plan for review and approval by the Agencies that is designed to reduce such exposures to levels below the Screening Levels within a reasonable time (the "Remedial Plan" or "the Plan").

b. Within 30 days of receipt of the Remedial Plan submitted by DuPont, the WVDEP shall, upon consultation with the WVDHHR-BPH and based upon accuracy, quality, and completeness, either approve or disapprove the Plan. If the WVDEP disapproves the Remedial Plan, the WVDEP shall notify DuPont in writing that the Remedial Plan has been disapproved and shall specify the reasons for such disapproval. DuPont shall resubmit the Remedial Plan as revised to address the deficiencies identified in the notice. DuPont's failure to submit an approvable Remedial Plan shall be deemed a violation of this Consent Order.

2. In the event EPA or the WVDEP develops and finalizes a reference dose/screening level for C8 in accordance with applicable statutory and regulatory requirements ("the Regulatory EPA Standard") that would he applicable to Dupont's activities or the Facilities independent of this Consent Order, DuPont's obligations under this Section shall be determined with reference to the Regulatory EPA Standard. DuPont reserves all rights it may have to comment upon, object to, or appeal the Regulatory EPA Standard in proceedings separate and apart from this Consent Order.

XII. COMPLETION OF CONSENT ORDER.

1. Except as to DuPont's obligations under Section XI, this Consent Order and DuPont's obligations hereunder shall terminate upon issuance of a completion letter(s) from the Secretary of the WVDEP or his designee and from the Commissioner of the WVDHHR-BPH to

DuPont. In a timely manner following receipt of a written request from DuPont the respective Agencies shall issue the completion letter(s) to DuPont or shall issue a letter to DuPont detailing the obligations and work that have not been completed in accordance with this Consent Order. The Parties agree that the Agencies' obligation to issue this letter shall be deemed a non-discretionary duty.

2. DuPont's obligation to achieve and maintain compliance with the Screening Levels as provided in Section XI of this Consent Order shall survive the termination of this Consent Order. Such obligation shall terminate only as provided in Section XI or upon agreement of the Parties.

XIII. ADDITIONAL ACTIONS.

The Agencies, individually or collcctivcly, pursuant to their statutory duty and authority, may determine that additional action, beyond the tasks set forth in this Consent Order, is necessary to protect human health and/or the environment. Nothing in this Consent Order shall be construed as restraining or preventing the Agencies from taking such actions. Nothing in this Consent Order constitutes a satisfaction of or release from any claim or cause of action against DuPont for any liability it may have pursuant to the federal Clean Water Act, the federal Clean Air Act, the federal Safe Drinking Water Act, the West Virginia Groundwater Protection Act, the West Virginia Air Pollution Control Act, other statutes applicable to this matter, or West Virginia common law. Nothing in this Consent Order in any **way** constitutes a modification or waiver of statutory requirements of DuPont and nothing in this Consent Order shall obligate DuPont to undertake any actions not specified herein.

XIV. ENFORCEMENT.

Enforcement of this Consent Order may be had by the filing of **a** civil action by any of the Agencies in the Circuit Court of Wood County, West Virginia. Violation of the terms and conditions of this Consent Order by DuPont is a violation of the West Virginia Code and may result in enforcement action being taken, including a request for civil penalties as set forth by law. DuPont shall not be liable for violations of this Consent Ordcr due to any "Force Majeure" condition.

XV. CONTENTS OF CONSENT ORDER/MODIFICATION.

The entirety of this Consent Order consists of the terms and conditions set forth herein and in any attachments or exhibits referenced herein. Modification of the terms and conditions of this Consent Ordcr including any modification of timeframes or deadlines established in this Consent Order shall be made only by agreement of the Parties in writing, except that modifications to any

requirement set out in the attachments to this Consent Order may be made upon consensus of the members of the GIST or the CAT Team, as appropriate.

XVI. ADDRESSES FOR ALL CORRESPONDENCE

All documents, including reports, approvals, notifications, disapprovals, and other correspondence, to be submitted under this Consent Order shall be sent by certified mail, return receipt requested, hand delivery, overnight mail or by courier service to the following addresses or to such addresses DuPont or WVDEP may designate in writing.

Documents to be submitted to WVDEP should be sent to:

WV Department of Environmental Protection
1356 I-lansford Street
Charleston, West Virginia 25301

Attention: Armando Benincasa, Esq.
Attention: Dee Ann Staats, Ph.D.
Phone No.: (304) 558-2508

Documents to bc submitted to WVDHHR-BPH should be sent to:

WV Department of Health and Human Resources
Bureau for Public Health
815 Quarrier Street, Suite 418
Charleston, West Virginia 25301

Attention: William Toomey, Manager of Source Water Assessment Program
Phone No.: (304) 558-2981

Documents to be submitted to DuPont should be sent to:

E. I. du Pont de Nemours and Company
Washington Works
P.O. Box 1217
Parkersburg, West Virginia 26102

Attention: Paul Bossert
Phone No.: (304) 863-4305

and

E. I. du Pont de Nemours and Company
Legal Department, Suite D-71
1007 Market Street
Wilmington, Delaware 19898

Attention: Bernard J. Reilly, **Esq.**
Phone No.: **(302)** 774–5445

XVII. AUTHORIZED SIGNATORIES/NON-ADMISSION.

The undersigned representatives state that they have had full and fair opportunity to review this Consent Order **and** have had opportunity to allow for their counsel to do the same, and therefore enter this Consent Order freely and with full knowledge of its terms and conditions.

The undersigned do hereby confirm that they have the authority to enter into this Consent Order and have the authority to bind their respective party.

Neither the terms of this Consent Order, nor execution thereof shall constitute an admission by DuPont of any fact or of any legal liability. DuPont expressly reserves **all rights** and defenses that may be available in **any** proceeding involving third parties or involving WVDEP and WVDHHR-BPH in any other matter.

This Consent Order may be signed in counterparts and shall be effective upon signature of all the Parties below ("Effective Date").

Entered this _____ day **of** _____, 2001, by:

WEST VIRGINIA DEPARTMENT OF ENVIRONMENTAL PROTECTION

BY:

_____
WILLIAM E. ADAMS, DEPUTY SECRETARY
West Virginia Department of Environmental Protection
1356 Hansford Street
Charleston, West Virginia 25301

Entered this _____ day **of** _____,2001, by:

WEST VIRGINIA DIVISION OF HEALTH AND HUMAN RESOURCES – BUREAU FOR PUBLIC HEALTH

BY:

_____

DR. HENRY TAYLOR, COMMISSIONER
Bureau for Public Health
West Virginia Department of Health and Human Resources
Diamond Building, Room 702
350 Capitol Street
Charleston, West Virginia 25301

Entered this _____ day of _____,2001, by:

E. I. DU PONT DE NEMOURS AND COMPANY

BY:

_____

PAUL BOSSERT, PLANT MANAGER

Attachment A

C8 GROUNDWATER INVESTIGATION STEERING TEAM

A team of scientists shall be assembled to assess the presence and extent of C8 in drinking water, groundwater and surface water at and around the DuPont Washington Works facility, and the Local, Letart, and Dry Run Landfills. The Groundwater Investigation Steering Team (GIST) shall include scientists from WVDEP, WVDHHR-BPH, EPA Region III, and DuPont. DuPont shall fund the GIST via an escrow account as provided in Section VIII of the attached Consent Order ("the Consent Order"). Disbursements from this account shall be authorized jointly by the WVDEP GIST leader, and the DuPont representative, Andrew S. Hartten.

A schedule summarizing key GIST tasks, submittals, start and end dates is provided at the end of this document.

GIST Member **Organizations/Representatives/General Functions**

WVDEP

David Watkins –Groundwater Protection- GIST team leader; escrow funds disbursement oversight; project management and coordination
George Dasher-advisor and technical review
Dee Ann Staats, Ph.D.-advisor

EPA Region III

Garth Connor-science advisor
Jack C. Hwang – Hydrogeologist
Roger Rheinhart-Environmental Engineer

DuPont

Andrew Hartten-Principal Project Leader/Hydrogeologist-technical review, project management and coordination of field investigation activities; escrow funds disbursement oversight.

WVDHHR-BPH

William Toomey-Manager, Source Water Assessment Program- Bureau for Public Health advisor

GIST Team Objectives **and** Efforts

The primary objective of the GIST **is** to efficiently review and direct groundwater and surface water monitoring and investigation activities as prescribed in the Consent Order and in this Attachment. The GIST will utilize a phased approach and employ rapid team decision making toward meeting the requirements in **an** efficient and timely manner. Unless otherwise directed by the GIST, the tasks outlined below shall be performed by DuPont or its representatives.

The GIST will issue a final report(s) with findings and conclusions regarding groundwater quality in and around the Facilities, **and** the extent of groundwater contamination in and around the Facilities. The GIST final report shall further make recommendations regarding the need for any further work or actions that need to be taken to assure protection of groundwater quality and human health into the future.

The tasks set forth below and in the Consent Order are the minimum tasks to be performed by DuPont and the GIST pursuant to the Consent Order. Additional tasks may be necessary to assure the goals [full groundwater assessment and C8 impact, plume identification, and receptor identification] of the **GIST** and the Consent Order are met. Those tasks shall be agreed upon by the GIST.

Key Tasks of **GIST**

Task A: Groundwater Use **and** Well Survey/Groundwater **Monitoring**

- Objectives: Conduct a distance-phased groundwater well and water use survey within a 1-mile (and possibly 2 and 3-mile) radial distance or directionally focused distance **of** the Washington Works and Local, Letart, and Dry Run Landfills.[1]
- Summary: The phased approach to the water and groundwater well use survey will allow the GIST to focus efforts along established C8 impact transport pathways and cease activities in directions where impacts are not present or where there are minimal concentrations. Data results tables will be generated in a timely manner to allow the GIST to meet, evaluate the data, and determine the next course of action. The GIST will determine when the final groundwater well use survey shall be released.

  DuPont agrees to perform, under the supervision of the GIST and **through** an agreed-to third party, **a** groundwater use and well survey identifying and sampling all groundwater wells within **a** 1-mile radius of the three landfills set forth above and the Washington **Works** facility. The phased approach may be amended by the GIST should field conditions require, e.g., lack of sampling wells in the 1-mile radius, lack of quality sampling points within the I-mile radius.

  Sampling shall be performed with the specific purpose of finding and measuring the C8 concentration in water. Should concentrations **of** C8 found in groundwater wells exceed 1 µg/l within the I-mile radius, the GIST **will** determine

1 The **water** use survey should be **in substantially** the same **format as Attachment B.**

whether to expand the well survey to a 2-mile radius, a 3-mile radius, or in a specific direction only. Drinking water wells that measure above 1 µg/l shall be re-sampled at a frequency to be determined by the GIST.

Note: The level of 1 ug/l is utilized in this Consent Order for monitoring purposes only and not as a benchmark for determining **risk** and this level may be adjusted **as** determined the GIST in furtherance **of** the tasks and objectives set forth in this Attachment.

- Timing: The initial well survey within a 1-mile radius of the Facilities will be conducted within 60 days of the Consent Order's Effective Date. Additional well survey activities will be conducted on a schedule to be determined by the **GIST.**

Task B: Assessmeut of Existing Groundwater and Surface Water Monitoring Data

- Obiectives: Develop and implement a monitoring **plan** that determines the presence and extent of C8 in drinking water, groundwater, **and** surface water in and around the Washington Works facility and Local, Letart, and Dry Run Landfills and provide a compilation of all available groundwater/surface water monitoring **and** hydrogeologic characterization data for each facility, **as** reflected in Table A-1.
- Summary: The GIST will bc tasked with an expedited evaluation of existing historical data and hydrogeologic information in order to prioritize the initial scope of work for continuing groundwater monitoring and any additional investigation activities (e.g., monitoring well installations) required under plume identification. DuPont shall provide all historical data aud hydrogeologic information it may have related to the Facilities.
- Timing: Within 30 days of the completion of Task **A,** the GIST will rcvicw all thc C8 analytical and facility hydrogeologic information to determine the scope of work for groundwater monitoring and additional investigation. Thc **GIST** will then establish a schedule for those activities. It is anticipated that a summary of all historical information for cach facility will be submitted to GIST within 60 days of the Consent Order's effective date.

Task C: Plume **Identification/Groundwater Assessment**

- Objcctivc: Determine the vertical and horizontal extent **of** any and all C8 impacted groundwater exceeding 1 ug/l or as directed by the GIST, which may determine a lower threshold than 1 ug/l. This **task** shall also include an assessment of C8 impacted groundwater at Letart Landfill and its impact on the Ohio River and public water supplies along the river.
- Summary: The GIST shall first review historical data and results of Task **A** to determine an appropriate scope of work. Activities should bc prioritized to address groundwater plumes contributing to or with the potential to flow toward off-site receptors, with emphasis on those arcas whcrc groundwater is used as a drinking water source.

Upon completion of investigation activities, DuPont shall provide the GIST with predicted groundwater flow and contaminant transport models to assess future plume migration.

- Timing: Upon review of all available information and on a schedule to be determined by the GIST, the GIST will complete an initial evaluation of data to determine and prioritize plume identification.

  The timing of the initial phase of plume identification/investigation activities and other activities will be on a schedule established by the GIST. Further investigatory activities needed and agreed to by the GIST to carry out the goals of the GIST shall be performed by DuPont on a schedule established by the GIST.

Modeling

Any and all modeling performed pursuant to this attachment and the Consent Order shall use Groundwater Modeling System, or some other model as approved by the GIST.

TABLE A-1

COMPILATION OF HISTORICAL DATA AND MONITORING PLAN	
a. Dependent upon the availability of certain information, an historical data *summary* documented in a report that includes:	• **A** location map. • **A** site map showing the location **of** all known groundwater monitoring wells, residential groundwater wells and public water supply within a 1-mile radius the Facilities. • Top-of-groundwater maps. These should span the entire sampling life of the site and should be no less than yearly. If DuPont has only one year's worth of data for a given site, then these maps should be for each quarter; **if** DuPont has several years worth of data for each site, then these maps can be annual. • C8 concentration contour maps. These should span the entire sampling life of the site and should be no less than yearly. If DuPont has only one year's worth of data for a given site, then these maps should be for each quarter; if DuPont has several years worth of data for each site, then these maps can be annual. • All the C8 groundwater data that has been collected to date. These data should be submitted in easy-to-read tables. These tables should use the method, "<x", to designate all concentrations below the laboratory's minimum detection limit (not "ND" or some other abbreviation), and they should use "mg/" or "µg/" as the unit designation. • If unable to provide the above data, DuPont shall document the reasons why it is unable to gather and submit the information.
b. **A** groundwater monitoring plan for the Facilities which should address, at a minimum:	• C8 sampling. The samples should be taken from all the wells at the three landfill sites and from **a** select number of wells at the Washington Works plant. These select wells are to be chosen by the GIST before the groundwater monitoring program begins based on evaluation of historical data/information. The frequency of sampling shall be monthly for the first four months following the Effective Date and quarterly thereafter. Any new wells required for monitoring or plume identification purposes **will** be integrated in each site's groundwater monitoring program **on** a schedule agreed ***to*** by the **GIST.**

- Report of Results. Reporting should be quarterly and to the WVDEP Groundwater Program at the following address.

  WVDEP Division of Water Resources
  Groundwater Program
  1201 Greenbrier Street
  Charleston, West Virginia 25311
  Re: DuPont/C8 monitoring.

- Each report should include the following:

  (a) **A** site location map.

  (b) **A** site map showing the groundwater monitoring well locations.

  (c) **A** top-of-groundwater map.

  (d) **A** C8 concentration **map.**

  (e) Groundwater elevation and well screen data.

  (f) **A** table of **all** the historical C8 sampling data. Note: where available information allows, abbreviations should not be used to designate No Detect concentrations and **the** units "ppb" and "ppm" should not bc used.

  (g) Laboratory analysis sheets.

  (h) Chain of custody records.

Attachment B

GROUNDWATER WELL USE SURVEY

Name: _____

Address: _____
_____
_____

Phone: _____

Best Time to Contact Owner: _____

1. Do you have one or more water well(s) on this property? (It need not be in use currently.) If no, stop now and return survey. Yes _____ No _____

   County Water Well Permit No. _____

2. Is the well(s) currently (circle one) used unused or filled in?

3. **is** the well(s) used for drinking water? *Yes* _____ No _____

4. Is this well(s) used for other purposes? **If** yes, please specify uses below:

_____
_____
_____
_____

5. What is the approximate frequency of use? Circle One:

   Daily Weekly Monthly Summer

6. Date **last** used? _____

7. Is there a pump in the well? Yes _____ No _____

8. **Is** there a conditioner, softener, chlorinator, filter, or other form of treatment for the system? Yes _____ No _____

If so, what is the form of treatment? _____

9. Is there **any** faucet where water does not first pass through the treatment system?
Yes _____ No _____

If yes, is **it** (circle one) inside or outside?

10. What year was the well constructed? _____

I 1. Please provide the following information regarding the well(s) if known: (circle one)

A. Total Depth (feet below ground surface):

30-60 60-90 90-120 120 or more

B. Casing Type:

PVC steel stone none other _____

C. Well Construction:

dug drilled open or uncascd bedrock

D. Scrccncd Interval (length **in** feet):

0-10 10-20 20-30 30-60 60 or more

E. Well Diameter (inches):

0-6 6-12 12-24 24 or more

Attachment C

C8 ASSESSMENT OF TOXICITY TEAM

A team of scientists shall be assembled to assess the toxicity and risk to human health and the environment associated with exposure to ammonium perfluorooctanoate (C8) releases from DuPont's activities. The C8 Assessment of Toxicity Team (CAT Team) shall include scientists from academia, government, non-profit organizations, and industry. The CAT Team also shall include the WVDEP Environmental Advocate, Pam Nixon, as a representative of West Virginia's citizens.

The WVDEP, utilizing funds from an escrow account funded by DuPont, shall contract with a non-profit organization, the National Institute for Chemical Studies (NICS), for &heservices described herein. Point of contact for the NICS shall be Jan Taylor, Ph.D. The NICS shall subcontract with Marshall University's Center for Rural and Environmental Health for services in risk communication provided by James Becker, M.D. and his staff. Dr. Becker shall familiarize himself with the toxicity of C8, the work performed by TERA as described herein, and attend public meetings to provide expertise in risk communication. The NICS shall subcontract with the non-profit scientific organization, Toxicology Excellence for Risk Assessment (TERA) whose point of contact is Joan Dollarhide, Ph.D. The TERA shall provide services in toxicology and risk assessment. Work assignments, tasks. and deliverables are described below.

CAT Team Member[1] ization[1] / Repre[illegible]entatives / General Functions

WVDEP

Dee Ann Staats, Ph.D. - Science Advisor - team leader; escrow funds disbursement oversight; project management and coordination; toxicology/risk assessment and communication;

Pam Nixon - Environmental Advocate - advisor;

NICS

Jan Taylor, Ph.D. –contractor administrative oversight;

James Becker, M.D. (Marshall University) - consultant in risk communication;

TERA (point of contact: Joan Dollarhidc, Ph.D.)- consultant in toxicology/risk assessment;

[1] The parties may, in their discretion, elect to substitute their representatives with persons of similar qualifications.

DuPont

Gerald Kennedy, Director of Applied Toxicology and Health, Haskell Laboratory - reviewer toxicology; escrow funds disbursement oversight;

John Whysner, M.D. – toxicology/risk assessment and communications;

Paul Bossert – Washington Works Plant Manager – communications;

The following members of the **CAT** Team shall act as reviewers or advisors.

WV Department of Health and Human Resources – Bureau for Public Health (WVDHHR-BPH)

William Toorney – Manager, Source Water Assessment Program - advisor;
Barbara Taylor – Director, Office of Environmental Health Services - advisor;
Local representative - advisor;

Environmental Protection Agency (EPA)

Headquarters - Jennifer Seed – reviewer and advisor toxicology;
Region III Philadelphia -
Samuel Rotenberg, Ph.D. – reviewer and advisor toxicology/ **risk** assessment;
Garth Connor – advisor hydrogeology;
Roger Reinhart – reviewer and advisor Safe Drinking Water Act;
Cincinnati - John Cicmanec, DVM – reviewer and advisor toxicology;

Agency for Toxic Substances and Disease Registry **(ATSDR)**
Atlanta - John Wheeler, Ph.D. - reviewer and advisor in toxicology/ **risk** assessment;
Philadelphia - Lora Werner - coordinator for ATSDR;

Non-CAT Team Efforts

Other efforts are currently underway which may produce information for the **CAT** Team to utilize. The CAT Team will coordinate and communicate closely with these other efforts. These include:

1. Dupont's air modeling of CS emissions from the Washington Works plant;

2. WVDEP's air modeling of C8 emissions from the Washington Works **plant;**

3. USEPA Draft Hazard Assessment which summarizes the available toxicity information regarding C8, to the extent completed prior to the assessment contemplated herein;

4. ATSDR's Health Consultation that estimates the risk to the community associated with C8 in drinking water from the Lubeck Public Service District, to the extent completed prior to the assessment contemplated herein.

5. Existing C8 concentrations in Lubeck Public Service District data.

6. Groundwater C8 Analysis (see GIST activities described in Attachment A) and Well Use Survey (see example survey in Attachment B) at the residences in the area of the 3 landfills and the Washington Works Plant.

Tasks of CAT Team

The tasks to be performed by the **CAT** Team are described briefly in Table 1, and in more detail below. These tasks are discussed below within the context of a Scope of Work for both Dr. Becker and for TERA as well.

Tasks of the CAT Team shall bc organized into three phases. Phase I includes those tasks necessary to prepare for and hold the first public meeting. In Phase 11, TERA shall conduct such scientific tasks as: reviewing available toxicity and epidemiological studies; developing Provisional Reference Doses and Screening Levels for protection of human health; evaluating existing information relative to ecological health; and conducting one general risk assessment involving comparisons of exposure concentrations to Screening Levels, for the three landfills and the Washington Works Plant, and the Lubeck Public Service District. TERA shall prepare a report on their findings. Phase III includes those tasks necessary to prepare for and hold the second public meeting. The results of the C8 groundwater analysis and risk assessment shall be presented in the second public meeting.

No communication between Dupont representatives and NICS, Dr. Becker, or TERA shall be permitted without the participation of Dr. Staats. All information will be provided to Dr. Becker and TERA by WVDEP; thus, all information contributed to the effort by Dupont shall be sent in triplicate to Dr. Staats for forwarding to Dr. Becker and TERA.

Phase I TASK A-1: First Public Meeting

Two public meetings are anticipated for this project. The First Public Meeting shall occur **in** Phase I for the purposes of introducing the **CAT** Team and other involved parties to the public; relating historical information on previous concentrations of C8 in Lubeck Public Service District water supply; informing the citizens of the ensuing activities; and inviting the public to participate by cooperating with sampling and survey efforts in the Groundwater C8 Analysis and Well Use Survey. In order to prepare for the

First Public Meeting, **CAT** Team members shall familiarize themselves with the available toxicological information concerning C8.

A CAT Team meeting shall be held immediately prior to the first public meeting to: (1) conduct a site visit to the three landfills and the Washington Works Plant, and surrounding residential areas; (2) discuss the toxicity of C8 and other pertinent data; **(3)** prepare an agenda for the public meeting; **(4)** coordinate and prepare for the public meeting. Finally, the First Public Meeting will be held and public questions and comments will be recorded by WVDEP.

TABLE 1. TASKS OF CAT TEAM

Task A: Public Meetings (two meetings are anticipated) Objective: to inform the local citizens of the following: (in Meeting #1) intent to perform a groundwater well use survey and analysis for C8; intent to develop Screening Levels; and to ask for their cooperation in conducting the water use survey; and (in Meeting #2) results of survey, chemical analysis, and risk assessment. Note that an interim public meeting may be required should six months pass from the first public meeting and the **CAT** Team Final Report has not been issued. Primary Responsibility: Staats
Task B: Development of Provisional Reference Doses Objective: to develop Provisional References Doses for C8 for the inhalation and ingestion (and dermal, if possible) routes of exposure. Primary Responsibility: TERA
Task *C*: Development of Screening Levels Based on Protection of Human Health Objective: to utilize the Provisional Reference Doses to develop human health risk-based Screening Levels for C8 in air, water, and soil. Note a determination of the potential carcinogenicity of C8 will be conducted as well. Primary Responsibility: TERA
Task D: Ecological Data Review Objective: to review available information to determine whether sufficient studies have been performed and data have been collected to develop screening criteria for ecological receptors. Primary Responsibility: TERA
Task E: Draft Report and Final Report Objective: to present and discuss the results of the above tasks. Primary Responsibility: TERA

Phase II Tasks B. C. D. and **E** Development of Provisional Reference Doses and Screening Levels. and **Risk** Assessment

In Phase II, TERA shall conduct the toxicological and **risk** assessment activities. After having reviewed the toxicological information regarding C8 provided by WVDEP, TERA shall consult with toxicologists on the **CAT** Team, as coordinated by Dr. Staats, regarding its proposed approach for this project. Following such consultation, TERA

shall develop Provisional Reference Doses for **C8** for the oral, inhalation, and dermal **(if** possible) routes of exposure. Then TERA shall calculate Screening Levels for water, soil and air based on the **risk** factors they have estimated. TERA shall perform one general **risk** assessment involving comparison of exposure concentrations to Screening Levels for the three landfills and the Washington Works Plant, and the Lubeck Public Service District water supply, that focuses on current **risk** to human health, including workers and residents. This risk assessment shall include: (I) identification of reasonably anticipated land use, surface water and groundwater use; (2) identification of receptors; (3) identification of exposure pathways; **(4)**identification of exposure concentrations; and *(5)* comparison of exposure concentrations to appropriate Screening Levels. TERA shall utilize data obtained from the other efforts discussed above such as air modeling; groundwater **C8** concentrations in residential and public wells; residential groundwater well use survey; the USEPA's Draft Hazard Assessment; and ATSDR's Health Consultation (if available). TERA also shall review available information to determine whether sufficient studies have been performed and data have been collected **to** develop screening criteria for protection of ecological health, particularly aquatic life. TERA shall prepare a draft and a final document that discusses the results of their efforts and summarizes the data utilized from other efforts. **As** the tasks of the **CAT** Team and other involved parties' progress, data gaps and research recommendations may become evident. These shall be included in TERA's report as suggestions for further research to elucidate the toxicity of **C8.**

Phase III Second Public Meeting

The purpose of the Second Public Meeting **is** to present to the citizenry the results of the efforts of the **GIST and** CAT Teams including C8 concentrations in groundwater from residential wells and public wells the screening levels and the general **risk** assessment. **Air** modeling results of the efforts of WVDEP and Dupont **will** be discussed also. The WVDEP **will** address any further **actions** that may be necessary.

SCOPE OF WORK FOR
JAMES BECKER, M.D.

Dr. Becker is a medical doctor specializing in environmental health at the Marshall University School of Medicine Center for Rural and Environmental Health. He will be assisting the WVDEP in his specialty area **of risk** communication at the two anticipated public meetings. The specific tasks assigned to Dr. Becker are described below.

Phase I Task A-1: First Public Meeting

Dr Becker will assist in preparation for the first public meeting, and attend the meeting providing expertise in risk communication . He will familiarize himself with the available toxicological data, which will be provided to him by WVDEP, with particular emphasis on the epidemiological studies. Note that the toxicological data already has been summarized in the Draft Hazard Assessment prepared **by** USEPA. No literature search or document retrieval will be required. Specific subtasks required in Phase I to prepare for the first public meeting are described below:

Subtask 1 – Familiarization with toxicological data provided by WVDEP including but not limited to:

a. 8 compact discs of information provided to USEPA under TSCA by 3M *Corp* (note only a small portion of this information concerns CS);
b. Draft Hazard Assessment document from USEPA;
c. **ACGM** Threshold Limit Value (TLV).
d. Journal articles and other information provided by WVDEP.

Subtask 2 – Attend a meeting prior to the first public meeting to:

a. conduct **a** site visit of the 3 landfills and the Washington Works Plant, and local residential areas;
b. discuss and prepare an agenda;
c. discuss the toxicology and risks associated with C8 with the other **CAT** Team members.

Subtask 3 – Attend First Public Meeting

Phase III Task A-2 Second Public Meeting

Dr Becker will assist in preparation for the second public meeting, and attend the meeting providing expertise in **risk** communication. The following subtasks will be required:

Subtask 1 – Familiarization with the toxicological **and risk** assessment report prepared by TERA;

Subtask 2 – Attend a meeting prior to the second public meeting *to:*

a. discuss the toxicology and risks associated with C8 with the other CAT Team members;
b. discuss and prepare an agenda.

Subtask 3 – Attend Second Public Meeting

Note that the second public meeting is assumed to be the final public meeting; however, results of data collection may warrant additional public meetings and an expansion of the Scope of Work.

SCOPE OF WORK FOR TERA

TERA (Toxicology Excellence for Risk Assessment) is a non-profit organization that applies sound toxicological data to the risk assessment process to find common ground between environmental, industry, and government groups. TERA will be providing services in toxicology and risk assessment. TERA scientists will be developing risk factors and screening criteria; and conducting one general risk assessment for the 3 landfills, Lubeck Public Service District water supply and the Washington Works Plant. The specific tasks assigned to TERA are described below.

Phase II Tasks B, C, D, and E: Development of Provisional Reference Doses and Screening Levels, and **General Assessment of Risk**

Subtask 1 – TERA staff will familiarize themselves with the toxicological data provided to by WVDEP. No literature search or document retrieval will be required. Toxicological data to be provided to TERA shall include but is not limited to the following:

a. 8 compact discs of information provided to USEPA under TSCA by 3M Corp (note only a small portion of this information concerns C8);
b. USEPA Draft Hazard Assessment for C8;
c. Journal articles and other information submitted to WVDEP by DuPont.

Subtask 2 – TERA staff will:

a. identify all possible critical toxicological studies suitable for developing Reference Doses for the oral, inhalation, and dermal (if possible) routes of exposure;
b. outline methodology for developing said Reference Doses and for developing Screening Levels for air, water, and soil based on said Reference Doses corresponding to each critical study identified in subtask 2-a;
c. convene a meeting at the TERA facility in Cincinnati, Ohio, to present their findings in subtask 2-a and 2-b, and consult with CAT Team toxicologists as coordinated by Dr. Staats;
d. finalize Reference Doses and Screening Levels based on recommendations of the CAT Team toxicologists as coordinated by Dr. Staats.

Subtask 3 – TERA shall conduct one general risk assessment for the three landfills and Washington Works Plant, and the Lubeck Public Service District water supply based on current risk to human health. This risk assessment shall include:

a) identification of reasonably anticipated land use, surface water and groundwater uses;

b) identification of receptors;
c) identification of exposure pathways;
d) identification **of** exposure concentrations;
e) comparison of exposure concentrations to appropriate Screening Levels;

TERA shall utilize the following data in the risk assessment process:

a) air modeling data from DuPont;
b) air modeling data from WVDEP;
c) water use data from the Well Use Survey;
d) groundwater data from the Groundwater Well Analysis of C8 for residential wells;
e) drinking water data from Lubeck Public Service District wells;
f) any available ATSDR Health Consultation that assesses potential health effects from exposure to C8 in public supply drinking water.

Subtask **4** – TERA shall review the ecological data and determine whether there is sufficient information to support the development of **a** C8 Screening Level **for** protection of ecological health

Subtask 5 – TERA shall compile and discuss the results of the above tasks into a comprehensive report (draft and final versions), which also refers to and provides a brief summary of the following:

a) USEPA's Draft Hazard Assessment of C8;
b) DuPont's air modeling data;
c) WVDEP's air modeling data;
d) groundwater data from the Groundwater CS Analysis and Well Use Survey of Local Residents, and Lubeck Public Service District;
e) ATSDR Health Consultation that assesses potential health effects from exposure to C8 in public supply drinking water, if available.

Additionally, TERA shall include in the report any insights or recommendations for future research gleaned during this process that would further elucidate the toxicity of C8. Also, TERA shall provide in the report of **a** summary discussion of the relevance the carcinogenicity of C8 in rats to humans.