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STATE OF DELAWARE

**DEPARTMENT OF NATURAL RESOURCES AND ENVIRONMENTAL CONTROL-
SITE INVESTIGATION AND RESTORATION BRANCH**

FINAL PLAN OF REMEDIAL ACTION



SCANNED

APR 04 2005

Fig # *DE 1129*
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**Diamond Oil
Wilmington, DE**

DNREC Project No. DE-1129

This final plan of remedial action (final plan) presents the Department of Natural Resources and Environmental Control's (DNREC's) preferred cleanup alternative for the Diamond Oil site in Wilmington.

This document is the Department's final plan for the site. It is based on the results of the previous investigations performed at the site. This final plan is issued under the provisions of the Hazardous Substance Cleanup Act, 7 Del. C. Chapter 91 (HSCA) and the Regulations Governing Hazardous Substance Cleanup (Regulations). It presents the Department's assessment of the potential health and environmental risk posed by the site.

In accordance with Section 12 of the Regulations, DNREC provided notice to the public and an opportunity for the public to comment on the proposed plan of remedial action (proposed plan). During the comment period of April 26, 2004 through May 10, 2004, DNREC received one comment on the proposed plan. This comment clarified that DNREC misidentified the name of the present property owner. The correct name of the present property owner is the Louis Dreyfus Energy Credit Corporation. This clarification does not have any impact on the remedy selection, and thus DNREC subsequently issued this final plan of remedial action (final plan). The final plan designates the selected remedy for the site. All prior investigations of the site, the proposed plan, and the final plan constitute the remedial decision record.

INTRODUCTION

The former Diamond Oil facility (site) is located on the south side of the Christina River immediately upstream from the Fourth Street Bridge in the Southbridge section of Wilmington, New Castle County, Delaware (Figure 1). The site is currently vacant.

The site has been under continuous industrial usage for over 130 years, for the past 75 years as a bulk oil storage and retail facility. The property was purchased by the Louis Dreyfus Energy Corporation in 1992. The present owner, Louis Dreyfus Energy Credit Corporation, has owned the site since 1998, whereupon all operations at the site ceased.

Numerous limited environmental investigations were performed between 1989 and 1997, mostly involving the removal of several small underground storage tanks and small surface releases, or in association with transaction of the property. In April 1999, the property owner and DNREC entered into a Voluntary Cleanup Program (VCP) agreement under the provisions of the Delaware Hazardous Substance Cleanup Act, 7 Del. C. Chapter 91 (HSCA) to perform a comprehensive remedial investigation (RI) of the property for purposes of defining the nature and extent of contamination at the property.

SITE DESCRIPTION

The former Diamond Oil facility (site) is located on the south side of the Christina River immediately upstream from the Fourth Street Bridge in the Southbridge section of Wilmington, New Castle County, Delaware (Figure 1). The site comprises approximately 24.78 acres, and is bordered to the west by the Christina River, and to the east by the intersection of Lobdell and Heald Streets. A gas station stands at the intersection of these two streets.

The site is currently vacant. Five structures remain, but are unoccupied, and a steel and wooden loading dock extends into the Christina River. Except for the buildings and a small paved area near Lobdell and Heald Streets, much of the property is covered by fill from the large berms that used to surround the large above ground storage tanks that were on the property. No tanks presently remain. The site is secured by a chain-link fence topped with razor wire.

The site is described on the tax maps of New Castle County, as tax parcel numbers 2605100001, 2605100003, 2605100004, and 2605100028.

SITE OPERATIONAL HISTORY

The site has been under continuous industrial usage for over 130 years, for the past 75 years as a bulk oil storage and retail facility. The former Diamond Oil facility is comprised of four separate tax parcels, each of which has had separate and common ownership at different times in the past. Prior to 1900, portions of the site were owned by Wilmington Rolling Mill, Christina River Improvement Company, and the Lobdell Car Wheel Company. From 1901-1936, much of the site was transferred to the Delaware State Iron Company (later Delaware State Steel), then Diamond Ice and Coal, with the northern portion sold to Delaware Solvents and Sacony Oil. In 1936, Sun Oil purchased much of the entire 4 parcels. Large aboveground storage tanks were installed in the 1940s and 1950s.

Diamond Oil purchased the facility from Sun Oil in the early 1970s and expanded the operations into a bulk oil storage facility. In July 1988, a large above ground storage tank located adjacent the Christina River ruptured, releasing 67,000 gallons of fuel oil into the surrounding area, including the river. Approximately 30,000-45,000 gallons were recovered immediately following the release. Another 1,000+ gallons were recovered in subsequent months.

The property was purchased by the Louis Dreyfus Energy Corporation in 1992. The present owner, Louis Dreyfus Energy Credit Corporation, has owned the site since 1998, whereupon all operations at the site ceased.

SITE INVESTIGATION HISTORY

In 1998, the site was included in regional brownfields preliminary assessment (BPA), performed by DNREC, of the Southbridge area of Wilmington. The scope of the BPA included the excavation of 28 test pits, installation of two monitoring wells, and the collection of groundwater and soil samples for laboratory analysis. The results confirmed the previous observations that subsurface soils and groundwater at the site had been impacted by petroleum.

In April 1999, the property owner and DNREC entered into a VCP agreement to perform a comprehensive RI of the property for purposes of defining the nature and extent of contamination at the property. RI field sampling was conducted in 1999-2000. The RI report was completed in June 2000. The results of the RI are summarized in the following section.

INVESTIGATION RESULTS

Results of the environmental investigations performed at the site are summarized below. Detailed discussion of the sampling results is included in the RI Report, dated June 2000, prepared by Cody Ehlers Group. One hundred thirteen (113) soil samples were collected, and 33 groundwater monitoring wells were installed, and subsequently sampled, for laboratory analysis for volatile and semi-volatile organic compounds, metals, pesticides and polychlorinated biphenyls (PCBs).

Soil and Christina River Sediments

Elevated concentrations of petroleum hydrocarbons and various polycyclic aromatic hydrocarbon (PAHs) compounds were detected in numerous surface and subsurface soil samples across the site at concentrations exceeding the DNREC Uniform Risk-Based Standards (URS) for soils in both residential and restricted-use land-use settings. Please refer to the tables below. PAHs are organic compounds associated with petroleum, tar, oil and the incomplete burning of organic matter. Low concentrations of PAHs can be found naturally. PAHs generally occur as complex mixtures of similar chemicals, and are rarely found as individual chemicals.

Arsenic was also detected in several soil samples at concentrations exceeding restricted use URS values, with the highest concentration being 54.9 mg/kg (restricted-use URS of 11 mg/kg). Please refer to the tables below.

SURFACE SOIL

Benzo(a)anthracene	11	8	n/a
Benzo(a)pyrene	7.7	0.8	n/a
Dibenz(a,h)anthracene	1.2	0.8	n/a
C9-C18 aliphatic hydrocarbons	11,700	2,500	n/a
C19-C36 aliphatic hydrocarbons	14,200	5,000	n/a
Arsenic	54.9	4	11

SUBSURFACE SOIL

Benzo(a)pyrene	6.2	0.8	n/a
Dibenz(a,h)anthracene	0.81	0.8	n/a
C9-C18 aliphatic hydrocarbons	15,400	2,500	n/a
C19-C36 aliphatic hydrocarbons	12,700	5,000	n/a
Arsenic	43.2	4	11

The URS values referenced above are guidance values based upon very conservative assumptions of exposure and risk. In lieu of their usage, the Regulations allow, and indeed encourage, the performance of a site-specific risk assessment which takes into account site-specific factors of exposure and risk. At the Diamond Oil site, this site-specific risk assessment concluded that there was no elevated risk posed by soils at the site assuming a restricted-use setting. The cumulative carcinogenic risk for soil was calculated at 5.9×10^{-6} , which is below the 1×10^{-5} HSCA threshold, and a non-carcinogenic risk of Hazard Index (HI) of 0.10, which is below the 1.0 HI HSCA threshold.

Lead, mercury and zinc were detected in one or more of the three sediment samples collected from the Christina River, with the highest concentrations above the National Oceanographic and Atmospheric Administration sediment guidance values for protection of aquatic life. However, none of these metals were detected in site soils above state background concentrations, and are not associated with the petroleum storage history of the site. Observed concentrations of these metals in the river sediments were consistent with those found upstream and downstream from the site during the Tidal Christina River Basin Study conducted by DNREC in 1997. Please refer to the table below

CHRISTINA RIVER SEDIMENTS

SED-1	Lead	280	46.7	218	1,000
	Mercury	0.75	0.15	0.71	610
	Zinc	1,080	150	410	61,000
SED-2	Mercury	1.0	0.15	0.71	610
	Zinc	1,630	150	410	61,000
	Phenanthrene	1.8	0.24	1.5	5,000
SED-3	Anthracene	1.2	0.853	1.1	5

Groundwater

Benzene, four PAHs, carbazole, iron and manganese were detected in groundwater samples at concentrations exceeding the groundwater URS. Please refer to the table below. The PAHs were detected in only one groundwater sample, from a well that also contained free product petroleum. The presence of PAH compounds in the water sample from this well are related to the presence of this free-product, and are not representative of actual groundwater quality.

Iron and manganese were detected at concentrations in all groundwater samples above their respective groundwater URS values of 300 µg/L and 50 µg/L, respectively. The detection of elevated concentrations of iron and manganese in groundwater is related to the presence of petroleum at the site, as the metals are leached from the soil during natural biological degradation of petroleum. This is a common and well-documented phenomenon. The URS values for both iron and manganese represent threshold values based upon aesthetic, taste concerns rather than health standards.

GROUNDWATER

MW-105S	Benzene	10	5
MW-106S	Benzene	310	5
MW-109	Benzene	6.5	5
MW-16	Benzene	27	5
	Benzo(a)anthracene	14	0.1
	Chrysene	24	0.2
	Benzo(a)pyrene	7	0.2
	Indeno(1,2,3-cd)pyrene	5	0.4
MW-21	Benzene	1,500	5
	Carbazole	26	3.4

The risk assessment concluded that consumption of site groundwater was deemed to pose a potential health risk, if actually consumed. However, groundwater at the site and surrounding areas is not used as a source of drinking water as public water is provided by the city to the entire area. Furthermore, the water-bearing zone within site soils is very thin, and the groundwater yield extremely limited, making the installation and use of potable wells impractical. Finally, the site and surrounding areas fall within the City of Wilmington Groundwater Management Zone (GMZ). The GMZ restricts use of groundwater throughout Wilmington, and prevents the extraction of groundwater for potable uses.

At DNREC's request, Cody Ehlers Group conducted groundwater to surface water loading calculations in order to assess whether the observed groundwater contamination might pose a threat to the Christina River in terms of exceeding any surface water quality standards when the groundwater discharges to the river. These conservative calculations utilize the contaminant concentrations for all compounds detected in groundwater and a ratio of the groundwater discharge flow rate into the river to the lowest (i.e., most conservative, least diluting) flow of the Christina River. The results of these calculations showed that the resultant surface water contaminant concentrations were many orders of magnitude below Delaware's Surface Water Quality Standards. Please refer to Appendix A.

Free Product

Free product petroleum was identified in four monitoring wells and several test pits during the RI. It has also been observed as periodic sheens and slicks along the bank of the Christina River. The product thickness in the wells and test pits ranged from 0.02 to 0.132 foot (1.5 inches). The product consisted of heavier petroleum fuel and bunker oil. The presence of the product occurred in five areas of the site (please refer to Figure 2): the former loading dock along the Christina River, the former loading racks, the central containment area, the northern containment area, and the location of the observed seeps along the river (called the pipe seep area).

INTERIM RESPONSE REMOVAL ACTIVITIES

Beginning in June 2003, Cody Ehlers Group initiated a program of trench excavation and product recovery at the site.

Former Loading Dock and Areas Adjacent the Christina River

Along the river, fifteen test pits and a product recovery trench were excavated to delineate the extent of product. Petroleum-impacted soils excavated from the trench and test pits were transported and treated offsite at the Clean Earth soil incineration facility in New Castle. Excavations have been kept open, and are inspected weekly for the presence of free product, which is vacuumed out bi-weekly for recycling at the U.S. Filter oil recycling facility in New Castle.

The limited free product (<0.01 foot) noted in the dockside area test pits (Figure 2) has not returned following the initial removal in June. The actual amount of free product in this area appears to have been limited, and was removed as a result of excavation of the impacted soils

and initial product recovery efforts. The excavations will be kept open until early Spring 2004. At that time, if no more product has been observed, the test pits will be backfilled with clean fill.

Excavation of the recovery trench along the river in the area of the seeps uncovered an abandoned, terracotta storm water pipe, the end of which contained visible oil (Figure 2). It was clearly the source of much of the petroleum seep. A 50-foot section of this pipe, its contents, and associated contaminated soil, was excavated and disposed offsite. The pipe end was then plugged. The trench excavation was extended to a length of 85 feet. This trench will be converted into a product recovery trench in Spring 2004 through the installation of recovery pipes into the excavation, which will then be backfilled with gravel. The recovery trench will be kept open and monitored for a period of at least two years. Any observed product will be recovered and recycled offsite.

Northern and Central Containment Areas

The twenty-seven test pits excavated in the northern and central containment areas identified little free product. Limited contaminated soils were excavated and disposed offsite. The test pits will remain open until Spring 2004, at which time, if no further product has been identified, they will be backfilled.

Loading Rack Area

Twenty-two test pits were excavated in the loading rack and former oil-water separator areas located near Heald Street (Figure 2). A thin film of product was noted in twelve of these pits, with measurable and recoverable amounts noted in eight. Product thickness ranged up to 0.73 feet (8.76 inches). Contaminated soils excavated from the test pits were transported and treated offsite, and recovered free product was recycled offsite. Unlike the other areas, small amounts of oil continue to flow into a number of the test pits in this area. As a result, they are vacuumed out weekly. The test pits will remain open until Spring 2004. If free-product is still observed at that time, several will be converted into product recovery trenches, similar to the pipe seep area described above.

As of December 2003, approximately 1,070 tons of petroleum-impacted soil had been excavated, removed, and treated off-site at Clean Earth as part of the interim response activities. Approximately 4,718 gallons of oil and 2,000 gallons of oily water have been removed from the site and recycled at the U.S Filter facility.

REMEDIAL ACTION OBJECTIVES

According to Section 8.4(1) of the Regulations, site specific remedial action objectives (RAOs) must be established for all plans of remedial action. The Regulations provide that DNREC will set objectives for land use, resource use, and cleanup levels that are protective of human health and the environment.

Qualitative objectives describe, in general terms, what the ultimate result of the remedial action, if necessary, should be. The following qualitative objectives are determined to be appropriate for the site:

- Continued removal of separate-phase free product petroleum to the extent practicable;

- Prevent human residential exposure to petroleum-impacted soil; and
- Prevent human exposure to impacted groundwater.

These objectives are consistent with the current commercial use of the site for storage of construction equipment, New Castle County zoning policies, and state regulations governing water supply, and worker health and safety.

Quantitative objectives define specific levels of remedial action to achieve protection of human health and the environment. Based on the qualitative objectives, the quantitative objectives are:

- Prevent human exposure to petroleum-impacted soil and groundwater that would result in a carcinogenic risk exceeding 1×10^{-5} , or a non-carcinogenic hazard index of 1.0; and
- Continued removal of separate-phase free product petroleum to the extent practicable.

FINAL PLAN OF REMEDIAL ACTION

Based on DNREC's evaluation of the site information, the above remedial action objectives, and the interim remedial actions already taken, including: excavation, removal and offsite disposal of petroleum-containing soils and removal for offsite recycling of over 4,000 gallons oil, the recommended actions for the site will include the following:

1. Continue the site's inclusion in the existing City of Wilmington Groundwater Management Zone. The GMZ is an internal DNREC document restricting the use of groundwater at the site;
2. Placement of a deed restriction on the property within ninety (90) days following DNREC's adoption of the final plan : a) prohibiting current and future residential use of the property; b) prohibiting any digging, drilling, excavating, grading, constructing, earth moving, or any other land disturbing activities on the property without the prior written approval of the DNREC; and c) prohibiting the installation of any water well on, or use of groundwater at, the site without the prior written approval of DNREC, as well as noting the site's location within a GMZ;
3. Expand and convert the existing product recovery trench in the pipe seep area to a permanent product recovery trench, based upon a design approved by DNREC, and submitted for review within 90 days. Continue monitoring, recovery, and removal of free product petroleum from this trench for a period as outlined in the approved Operations and Maintenance Plan (see Item #5). Continue monitoring, recovery and removal of free product petroleum from the existing test pits in the loading rack area, to the extent practicable;
4. Prepare and implement a DNREC-approved Waste Management Plan related to managing remediation wastes and petroleum-impacted soils generated during cleanup actions in accordance with all applicable, relevant, and appropriate requirements, including Delaware Regulations Governing Solid Waste. The Waste Management Plan should also address contingencies concerning how to manage impacted soils encountered during site development. The plan shall be submitted to DNREC for approval within 90 days; and

5. When the Site is to be developed, prepare and implement a DNREC-approved Stormwater and Sediment Erosion Control Plan at least 90 days prior to the initiation of remedial actions and/or construction.
6. Prepare and implement a DNREC-approved Operation & Maintenance plan pertaining to the operation and maintenance of the recovery trench system, maintaining land-use and access restrictions and Waste Management Plan. The plan shall be submitted for DNREC approval within 90 days.

PUBLIC PARTICIPATION

The Department actively solicited public comments or suggestions on the proposed plan of remedial action. The public comment period began on April 26, 2004 and ended at the close of business on May 10, 2004. DNREC received one comment on the proposed plan, which clarified that DNREC misidentified the name of the present property owner, who provided the comment. The correct name of the present property owner is the Louis Dreyfus Energy Credit Corporation. This clarification does not have any impact on the remedy selection, and thus DNREC subsequently issued this final plan.

DECLARATION

This final plan of remedial action for the Diamond Oil site is protective of human health, welfare, and the environment and is consistent with the requirements of the Delaware Hazardous Substance Cleanup Act.

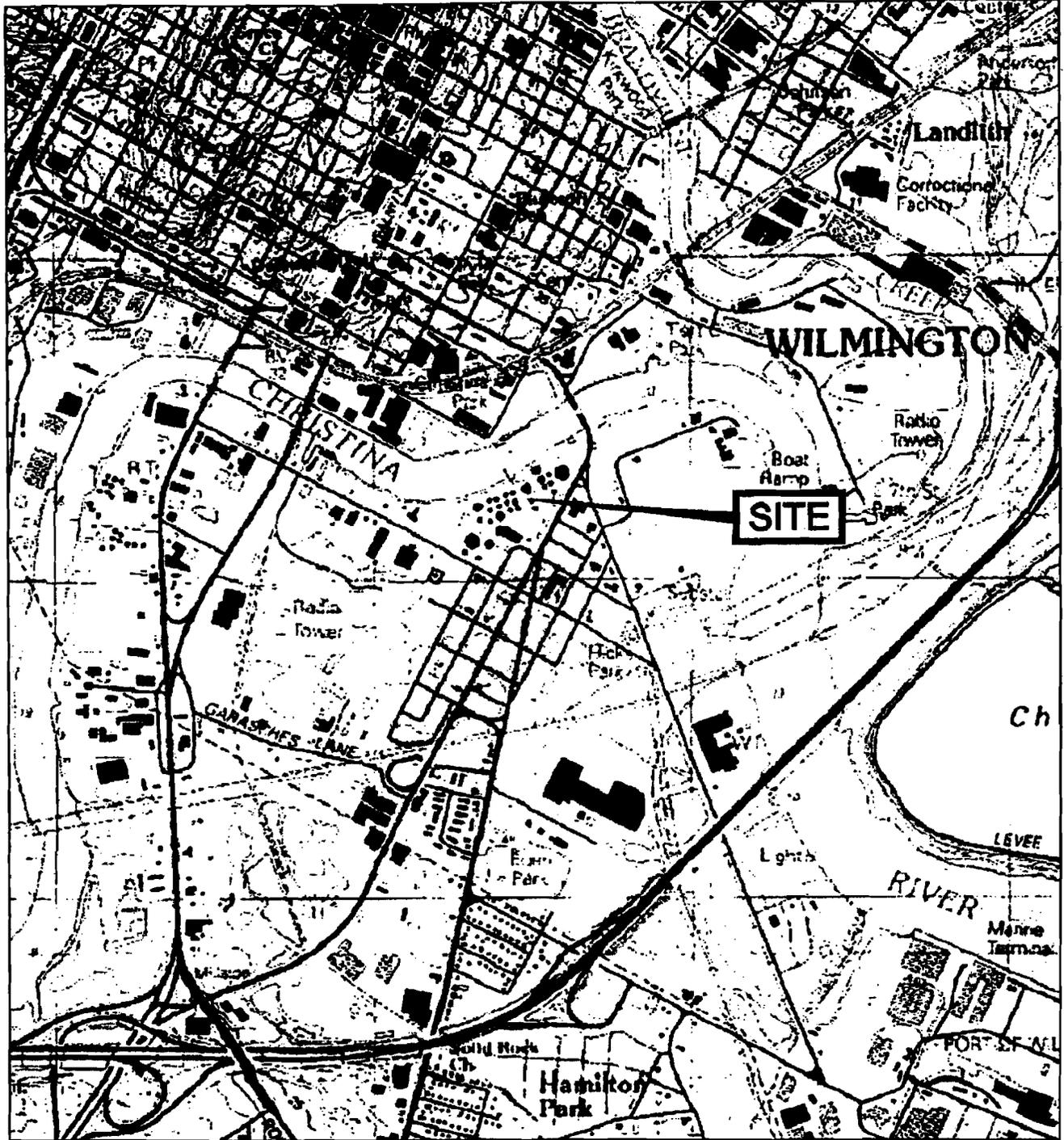

John Blevins, Director

5/26/04
Date

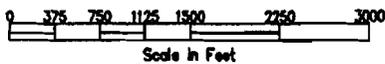
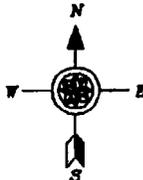
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Figure 1: Site Location



QUADRANGLE
LOCATION



SOURCE: USGS TOPOGRAPHIC MAP - WILMINGTON SOUTH, DEL.-N.J.
DATED 1993

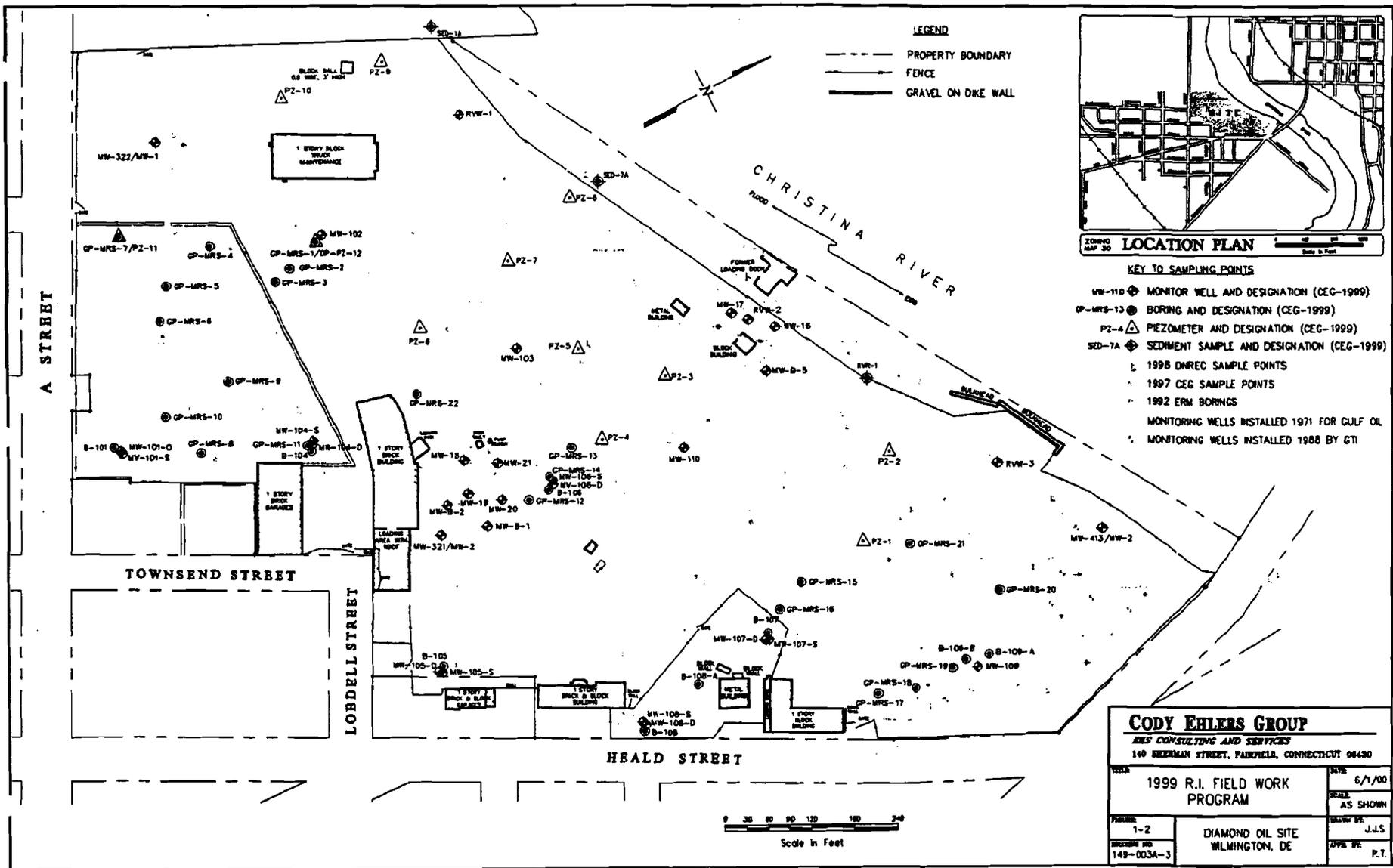
CODY EHLERS GROUP

EHS CONSULTING AND SERVICES

140 SHERMAN STREET, FAIRFIELD, CONNECTICUT 06432

TITLE		DATE
SITE LOCATION MAP		2/14/02
FIGURE		SCALE
1	AS SHOWN	
DRAWING NO.		DRAWN BY
149-0030	PREPARED FOR	J.J.S.
	DIAMOND OIL SITE WILMINGTON, DE	APPROVED BY
		M.C.B.

Figure 2: Site Layout and Sampling Locations



Appendix A: Groundwater-Surface Water Loading Calculations

The following assumptions were made when calculating the groundwater-surface water loading calculations:

1) Cross-sectional area of the Diamond Oil Site:

8 ft (saturated aquifer thickness) x 1,200 ft (waterfront length of the Diamond Oil Site) = 9,600 ft²

2) Groundwater flow gradient (as measured from on-site monitoring wells): 0.001 ft/ft

3) Aquifer hydraulic conductivity (as measured from six onsite well pump tests): 5.5×10^{-3} cm/s

4) Aquifer porosity (default value for a sandy silt aquifer as taken from literature): 0.2

- Using these above values in the calculation, the resultant volumetric discharge of groundwater from the Columbia Aquifer at the Diamond Oil Site into the Christina River is 5,637 gallons of water per day.
- The average flow rate/discharge rate of the Christina River (DNREC, Division of Water Resources) is 138,108,326 gallons per day.

5,637 gallons/138,108,326 gallons yields a dilution factor of 24,500. Therefore, to find the resultant surface water concentration of any chemical discharging into the Christina River from the Diamond Oil site, divide the groundwater concentration by 24,500. Please refer to the following Table 4-3 from the Diamond Oil Remedial Investigation Report.