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BH

Massachusetts Department of Environmental Protection
Bureau of Waste Site Cleanup

BWSC-108

COMPREHENSIVE RESPONSE ACTION TRANSMITTAL FORM & PHASE I COMPLETION STATEMENT

Pursuant to 310 CMR 40.0484 (Subpart D) and 40.0800 (Subpart H)

Release Tracking Number 4 - 0734

A. SITE LOCATION:

Site Name: (optional) former Graves Texaco Station

Street: Uncas Avenue   Location Aid:

City/Town: Oak Bluffs   ZIP Code: 02557

Related Release Tracking Numbers that this Form Addresses:

Tier Classification: (check one of the following) ☐ Tier IA ☐ Tier IB ☐ Tier IC ☒ Tier II ☐ Not Tier Classified

If a Tier I Permit has been issued, state the Permit Number:

B. THIS FORM IS BEING USED TO: (check all that apply)

☐ Submit a **Phase I Completion Statement**, pursuant to 310 CMR 40.0484 (complete Sections A, B, C, G, H, I and J).

☐ Submit a **Phase II Scope of Work**, pursuant to 310 CMR 40.0834 (complete Sections A, B, C, G, H, I and J).

☐ Submit a final **Phase II Comprehensive Site Report and Completion Statement**, pursuant to 310 CMR 40.0836 (complete Sections A, B, C, D, G, H, I and J).

☑ Submit a **Phase III Remedial Action Plan and Completion Statement**, pursuant to 310 CMR 40.0862 (complete Sections A, B, C, G, H, I and J).

☑ Submit a **Phase IV Remedy Implementation Plan**, pursuant to 310 CMR 40.0874 (complete Sections A, B, C, G, H, I and J).

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☐ Submit an **As-Built Construction Report**, pursuant to 310 CMR 40.0875 (complete Sections A, B, C, G, H, I and J).

☐ Submit a **Phase IV Final Inspection Report and Completion Statement**, pursuant to 310 CMR 40.0878 and 40.0879 (complete Sections A, B, C, E, G, H, I and J).

☐ Submit a periodic **Phase V Inspection & Monitoring Report**, pursuant to 310 CMR 40.0892 (complete Sections A, B, C, G, H, I and J).

☐ Submit a final **Phase V Inspection & Monitoring Report and Completion Statement**, pursuant to 310 CMR 40.0893 (complete Sections A, B, C, F, G, H, I and J).

You must attach all supporting documentation required for each use of form indicated, including copies of any Legal Notices and Notices to Public Officials required by 310 CMR 40.1400.

C. RESPONSE ACTIONS:

☐ Check here if any response action(s) that serves as the basis for the Phase submittal(s) involves the use of Innovative Technologies. (DEP is interested in using this information to create an Innovative Technologies Clearinghouse.)

Describe Technologies:

D. PHASE II COMPLETION STATEMENT:

Specify the outcome of the Phase II Comprehensive Site Assessment:

☐ Additional Comprehensive Response Actions are necessary at this Site, based on the results of the Phase II Comprehensive Site Assessment.

☐ The requirements of a Class A Response Action Outcome have been met and a completed Response Action Outcome Statement (BWSC-104) will be submitted to DEP.

☐ The requirements of a Class B Response Action Outcome have been met and a completed Response Action Outcome Statement (BWSC-104) will be submitted to DEP.

☐ Rescoring of this Site using the Numerical Ranking System is necessary, based on the results of the final Phase II Report.

E. PHASE IV COMPLETION STATEMENT:

Specify the outcome of Phase IV activities:

☐ Phase V operation, maintenance or monitoring of the Comprehensive Response Action is necessary to achieve a Response Action Outcome. (This site will be subject to a Phase V Operation, Maintenance and Monitoring Annual Compliance Fee.)

☐ The requirements of a Class A Response Action Outcome have been met. No additional operation, maintenance or monitoring is necessary to ensure the integrity of the Response Action Outcome. A completed Response Action Outcome Statement (BWSC-104) will be submitted to DEP.

☐ The requirements of a Class C Response Action Outcome have been met. No additional operation, maintenance or monitoring is necessary to ensure the integrity of the Response Action Outcome. A completed Response Action Outcome Statement (BWSC-104) will be submitted to DEP.

SECTION E IS CONTINUED ON THE NEXT PAGE

COMPREHENSIVE RESPONSE ACTION TRANSMITTAL FORM & PHASE I COMPLETION STATEMENT

Pursuant to 310 CMR 40.0484 (Subpart D) and 40.0800 (Subpart H)

Release Tracking Number 4 - 0734

E. PHASE IV COMPLETION STATEMENT: (continued)

☐ The requirements of a Class C Response Action Outcome have been met. Further operation, maintenance or monitoring of the remedial action is necessary to ensure that conditions are maintained and that further progress is made toward a Permanent Solution. A completed Response Action Outcome Statement (BWSC-104) will be submitted to DEP.

Indicate whether the operation and maintenance will be Active or Passive. (Active Operation and Maintenance is defined at 310 CMR 40.0006.):

○ Active Operation and Maintenance ○ Passive Operation and Maintenance

(Active Operation and Maintenance makes the Site subject to a Post-RAO Class C Active Operation and Maintenance Annual Compliance Fee.)

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F. PHASE V COMPLETION STATEMENT:

Specify the outcome of Phase V activities:

☐ The requirements of a Class A Response Action Outcome have been met and a completed Response Action Outcome Statement (BWSC-104) will be submitted to DEP.

☐ The requirements of a Class C Response Action Outcome have been met. No additional operation, maintenance or monitoring is necessary to ensure the integrity of the Response Action Outcome. A completed Response Action Outcome Statement (BWSC-104) will be submitted to DEP.

☐ The requirements of a Class C Response Action Outcome have been met. Further operation, maintenance or monitoring of the remedial action is necessary to ensure that conditions are maintained and that further progress is made toward a Permanent Solution. A completed Response Action Outcome Statement (BWSC-104) will be submitted to DEP.

Indicate whether the operation and maintenance will be Active or Passive. (Active Operation and Maintenance is defined at 310 CMR 40.0006.):

○ Active Operation and Maintenance ○ Passive Operation and Maintenance

(Active Operation and Maintenance makes the Site subject to a Post-RAO Class C Active Operation and Maintenance Annual Compliance Fee.)

G. LSP OPINION:

I attest under the pains and penalties of perjury that I have personally examined and am familiar with the information contained in this transmittal form, including any and all documents accompanying this submittal. In my professional opinion and judgment based upon application of (i) the standard of care in 309 CMR 4.02(1), (ii) the applicable provisions of 309 CMR 4.02(2) and (3), and (iii) the provisions of 309 CMR 4.03(5), to the best of my knowledge, information and belief,

> *if Section B indicates that a **Phase I, Phase II, Phase III, Phase IV or Phase V Completion Statement** is being submitted*, the response action(s) that is (are) the subject of this submittal (i) has (have) been developed and implemented in accordance with the applicable provisions of M.G.L. c. 21E and 310 CMR 40.0000, (ii) is (are) appropriate and reasonable to accomplish the purposes of such response action(s) as set forth in the applicable provisions of M.G.L. c. 21E and 310 CMR 40.0000, and (iii) complies(y) with the identified provisions of all orders, permits, and approvals identified in this submittal;

> *if Section B indicates that a **Phase II Scope of Work** or a **Phase IV Remedy Implementation Plan** is being submitted*, the response action(s) that is (are) the subject of this submittal (i) has (have) been developed in accordance with the applicable provisions of M.G.L. c. 21E and 310 CMR 40.0000, (ii) is (are) appropriate and reasonable to accomplish the purposes of such response action(s) as set forth in the applicable provisions of M.G.L. c. 21E and 310 CMR 40.0000, and (iii) complies(y) with the identified provisions of all orders, permits, and approvals identified in this submittal:

> *if Section B indicates that an **As-Built Construction Report** or a **Phase V Inspection and Monitoring Report** is being submitted*, the response action(s) that is (are) the subject of this submittal (i) is (are) being implemented in accordance with the applicable provisions of M.G.L. c. 21E and 310 CMR 40.0000, (ii) is (are) appropriate and reasonable to accomplish the purposes of such response action(s) as set forth in the applicable provisions of M.G.L. c. 21E and 310 CMR 40.0000, and (iii) complies(y) with the identified provisions of all orders, permits, and approvals identified in this submittal.

I am aware that significant penalties may result, including, but not limited to, possible fines and imprisonment, if I submit information which I know to be false, inaccurate or materially incomplete.

☐ Check here if the Response Action(s) on which this opinion is based, if any, are (were) subject to any order(s), permit(s) and/or approval(s) issued by DEP or EPA. If the box is checked, you MUST attach a statement identifying the applicable provisions thereof.

LSP Name: Denis D'Amore LSP #: 6039

Telephone: 978-368-1802 Ext.:

FAX: (optional)

Signature: [signature]

Date: 5/21/01

Stamp: COMMONWEALTH OF MASSACHUSETTS — DENIS W. D'AMORE No. 6039 REGISTERED — LICENSED SITE PROFESSIONAL

Massachusetts Department of Environmental Protection **BWSC-108**
Bureau of Waste Site Cleanup

DEP

COMPREHENSIVE RESPONSE ACTION TRANSMITTAL FORM & PHASE I COMPLETION STATEMENT
Pursuant to 310 CMR 40.0484 (Subpart D) and 40.0800 (Subpart H)

Release Tracking Number: 4 - 0734

H. PERSON UNDERTAKING RESPONSE ACTION(S):

Name of Organization:

Name of Contact: Mr. Robert Graves Title: Owner

Street: P.O. Box 1417

City/Town: Oak Bluffs State: MA ZIP Code: 02557

Telephone: 508-693-5070 Ext.: FAX: (optional)

☐ Check here if there has been a change in the person undertaking the Response Action.

I. RELATIONSHIP TO SITE OF PERSON UNDERTAKING RESPONSE ACTION(S): (check one)

☑ RP or PRP Specify: ◉ Owner ○ Operator ○ Generator ○ Transporter Other RP or PRP:

☐ Fiduciary, Secured Lender or Municipality with Exempt Status (as defined by M.G.L. c. 21E, s. 2)

☐ Agency or Public Utility on a Right of Way (as defined by M.G.L. c. 21E, s. 5(j))

☐ Any Other Person Undertaking Response Action Specify Relationship:

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J. CERTIFICATION OF PERSON UNDERTAKING RESPONSE ACTION(S):

I, Robert Graves, attest under the pains and penalties of perjury (i) that I have personally examined and am familiar with the information contained in this submittal, including any and all documents accompanying this transmittal form, (ii) that, based on my inquiry of those individuals immediately responsible for obtaining the information, the material information contained in this submittal is, to the best of my knowledge and belief, true, accurate and complete, and (iii) that I am fully authorized to make this attestation on behalf of the entity legally responsible for this submittal. I/the person or entity on whose behalf this submittal is made am/is aware that there are significant penalties, including, but not limited to, possible fines and imprisonment, for willfully submitting false, inaccurate, or incomplete information.

By: Robert Graves Title: Owner
(signature)

For: Robert Graves Date: May 18-01
(print name of person or entity recorded in Section H)

Enter address of the person providing certification, if different from address recorded in Section H:

Street:

City/Town: State: ZIP Code:

Telephone: Ext.: FAX: (optional)

YOU MUST COMPLETE ALL RELEVANT SECTIONS OF THIS FORM OR DEP MAY RETURN THE DOCUMENT AS INCOMPLETE. IF YOU SUBMIT AN INCOMPLETE FORM, YOU MAY BE PENALIZED FOR MISSING A REQUIRED DEADLINE.

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Phase III Feasibility Study

And

Phase IV Remedy Implementation Plan

for

Graves Texaco Station
Oak Bluffs

RTN # 4-0734

Prepared pursuant to:

Massachusetts Contingency Plan (310 CMR 40.00)

Prepared for:

Mr. Robert Graves
P.O. Box 1417
Oak Bluffs, MA 02557

May 14, 2001

D'AMORE ASSOCIATES, INC.
148 Ponakin Road
Lancaster, Massachusetts 01523

Environmental Engineering / Ground Water Consulting

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1.0 Introduction

The following report includes Phase III Focused Feasibility Study (FFS) and Phase IV Remedy Implementation Plan (RIP) for the former Graves Texaco Station located on Uncas Avenue in the Town of Oak Bluffs (Figure 1). The property, which is located within walking distance from the center of town, is comprised of three house lots totaling 0.25 acres. A 3,250-sq. ft. structure occupies approximately the middle two thirds of the site. The present uses of the site include a machine shop and bait and tackle shop. Use of the site as a gas station was discontinued in 1989. Commercial properties are situated north of the site while lots west and south of the site are residential. The lot directly across Uncas Avenue (i.e., hydraulically downgradient from the site) is currently used as a substation for Commonwealth Electric Company. In the 1940's, a manufactured gas plant was located on the lot. Municipal water, overhead electrical and telephone service the site. On-site sewage disposal systems service the site and surrounding properties. Depth to ground water, which was determined from monitoring wells, is approximately 15 feet below the ground surface.

Originally, there were four underground storage tanks (USTs) and two above ground tanks (ASTs) on the site. The size, type of tank, capacity and status are summarized in the following table:

Tank Type	Size (gal)	Fuel	Status
AST	350	Fuel Oil	in use
AST	350	Kerosene	in use
UST # 1	3,000	Gasoline	removed
UST # 2	1,000	Gasoline	removed
UST # 3	1,000	Gasoline	removed
UST # 4	2,000	Diesel	removed

The locations of the storage tanks are depicted on Figure 2. The fuel oil AST is located outside of the office and the kerosene AST is located within the building next to the Tackle Shop. Prior to February 2000, three of the four USTs had been removed from the site. The remaining UST and the dispenser island were removed on February 8, 2000. The results of the last tank removal are summarized in a RAM Completion report submitted to the Department on March 13, 2000.

1.1 Phase II CSA Conclusions

The Phase II Comprehensive Site Assessment identified two separate areas of contamination. The principal area of contamination is related to the release gasoline from underground storage tanks on the north side of the building. In this area, petroleum hydrocarbon contamination is present in both soil and ground water where off site migration of contamination has occurred in ground water. The second area is located on the south side of the building where a prior owner had disposed of waste oil to the ground surface. In this area contamination is restricted to the top two feet of soil. The principal findings and conclusions of the Phase II Comprehensive Site Assessment were as follows:

South Side

1. Petroleum and lead contamination is present in excess of risk based standards in near surface soil where historical disposal of waste oil occurred.
2. There is no evidence of contamination to soil or ground water from the diesel UST or pump that were located on the south side of the building or from the disposal of waste oil to the ground.

North Side

1. Soil contamination is present beneath the former 3,000-gallon gasoline UST cavity.
2. Shallow ground water, which is present at a depth of approximately 13 to 15 feet below grade, is contaminated with VPH constituents in excess of risk-based standards.
3. Contaminated ground water is migrating away from the former tank cavities in a northeasterly direction beneath an open parcel of land. The estimated seepage velocity is 0.48 ft/d.
4. Because of the extremely flat hydraulic gradient, contamination has migrated westerly toward the office and northerly toward the laundromat.
5. The limit of contamination does not extend beyond Bradley Avenue, which is 140 feet east of where the release occurred.

2.0 Nature and Extent of Contamination

2.1 South Side

Shallow soil on the south side of the building has been impacted with EPH compounds and lead due to the historical disposal of waste oil on the ground. This contamination extends to a depth of approximately two feet below the ground surface and has not impacted the water table, which is greater than 13 feet below grade. There is no evidence that a petroleum release occurred from the diesel UST or dispenser that was removed from the south side of the building. There is no evidence of either nickel or VOC contamination in soil or ground water. The field and analytical sampling results are summarized in Tables 1 and 2, respectively. The sampling locations are depicted on Figure 3.

2.2 North Side

Soil and ground water on the north side of the building in the area of the tank cavity and the dispenser island have been impacted principally by the release of gasoline and to a much lesser degree by diesel fuel emanating from the former USTs. Because of the flat hydraulic gradient on the site, VPH contamination has spread across the yard in upgradient (MW-4) and cross gradient (MW-16) directions. Contamination has migrated off the site in a northeasterly direction under a very shallow hydraulic gradient and is present in ground water near the water table. Data from a deeper monitoring well, MW-8D, indicates that ground water is moving horizontally and that there has been little impact to ground water 10 feet below the water table. Contamination has migrated beneath Uncas Avenue and has impacted ground water to a much lesser degree on Bradley Avenue. The soil and ground water results are summarized in Tables 3 and 4, respectively. The soil sampling results are depicted on Figure 4. An approximation of the limit of contamination in ground water is presented in Figure 5. Although leaded gasoline was historically used on the site, there is little evidence that soil or ground water has been impacted. Neither EDB nor lead was detected in soil and in ground water, only dissolved lead was present at a concentration of 0.03 mg/l.

Table 1
South Side Field Summary
Graves Texaco Station, Uncas Avenue, Oak Bluffs

Sampling Location	Sampling Depth (ft.)	Blow Counts per 6 in.	Recovery (inches)	PID/OVM (ppmv)	Sample Description
SS-1A	0 to 2	2-3-4-3	12	0	Brown fine to medium sand, no petroleum staining
SS-1B	2 to 4	3-3-4-5	12	0	Brown fine to medium sand, no petroleum staining
SS-2A	0 to 2	3-2-6-6	8	0	Top 3 in. of sample dark stained
SS-2B	2 to 4	3-3-4-3	14	0	Brown fine to medium sand, no petroleum staining
SS-3A	0 to 2	4-3-3-5	14	0	Black stained soil throughout the sampling interval
SS-3B	2 to 4	6-4-4-4	12	0	Brown fine to medium sand, no petroleum staining
SS-4A	0 to 2	9-6-4-6	14	0	Black stained soil throughout the sampling interval
SS-4B	2 to 4	5-6-6-6	6	1	Brown fine to medium sand, staining in top 3 in. of sample
SS-5A	0 to 2	11-7-4-6	24	7	Brown fine to medium sand, staining in top 4 in.of sample
SS-5B	2 to 4	4-3-3-4	13	12	Brown fine to medium sand, no petroleum staining
SS-6A	0 to 2	1-1-3-7	14	0	Black stained soil throughout the sampling interval
SS-6B	2 to 4	4-4-3-4	14	0	Black stained soil throughout the sampling interval
SS-6C	4 to 6	2-6-4-6	14	0	Brown fine to medium sand, staining in top 5 in. with coal fragments
SS-7A	0 to 2	2-2-3-5	18	0	Black stained soil throughout the sampling interval
SS-7B	2 to 4	4-4-4-5	16	0.7	Brown fine to medium sand, staining in top 2 in. of sample
SS-8A	0 to 2	6-4-5-5	8	0	Black stained soil throughout the sampling interval, some brick fragments
SS-8B	2 to 4	3-4-5-5	20	0	Brown fine to medium sand, no petroleum staining
SS-9A	0 to 2	6-7-5-5	20	0	Top 18 in. of sample dark stained
SS-9B	2 to 4	5-5-5-6	20	0	Brown fine to medium sand, no petroleum staining
SS-10A	0 to 2	13-5-3-2	9	0	Top 3 in. of sample dark stained
SS-10B	2 to 4	8-6-7-6	20	0	Top 2 in. of sample dark stained
SS-11A	0 to 2	14-9-7-7	14	1	Black staining in top 6 in. and bottom 4 in.
SS-11B	2 to 4	5-3-3-2	22	1	8 in. gray stained soil with petloeum odor, 14 in. brown fine to mediourn sand
SS-12A	0 to 2	9-7-6-6	18	0	Black stained soil throughout the sampling interval, some coal fragments
SS-12B	2 to 4	1-1-1-1	18	0	Black stained soil throughout the sampling interval, some coal fragments
SS-12C	4 to 6	7-10-9-9	6	0	Brown fine to medium sand, no petroleum staining
SS-13A	0 to 2	4-3-4-2	20	0	Gray stained soil throughout the sampling interval
SS-13B	2 to 4	3-3-3-3	14	0	Top 3 in. of sample gray stained
SS-14A	0 to 2	2-3-2-5	16	0	Brown fine to medium sand, no petroleum staining, some brick fragments
SS-14B	2 to 4	4-3-4-4	18	0	Brown fine to medium sand, no petroleum staining
SS-15A	0 to 2	4-7-4-3	12	0	Gray stained soil throughout the sampling interval
SS-15B	2 to 4	5-4-4-4	18	0	Top 3 in. of sample gray stained
SS-16A	0 to 2	14-5-5-4	20	0	Black stained soil throughout the sampling interval
SS-16B	2 to 4	6-6-5-5	20	0	Top 6 in. of sample gray stained
SS-17A	0 to 2	3-5-4-5	19	0.7	Black stained soil throughout the sampling interval, petroleum odor
SS-17B	2 to 4	3-5-5-3	12	0	Top 1 in. of sample gray stained
SS-18A	0 to 2	2-2-2-2	18	0	Gray stained soil throughout the sampling interval
SS-18B	2 to 4	2-2-2-3	12	0	Top 2 in. of sample gray stained
SS-19A	0 to 2	1-2-2-1	18	0	Gray stained soil throughout the sampling interval
SS-19B	2 to 4	5-6-9-7	9	0	Brown fine to medium sand, no petroleum staining
SS-20A	0 to 2	2-2-2-4	12	0	Black stained soil in bottom 5 in., slight petroleum odor
SS-20B	2 to 4	3-4-5-5	20	0	Top 2 in. of sample gray stained
SS-21A	0 to 2	3-3-3-4	12	2.1	Heavy black stained soil in bottom 5 in.
SS-21B	2 to 4	2-2-2-2	14	0	Top 3 in. of sample gray stained
SS-22A	0 to 2	15-9-8-8	24	10.6	Heavy black stained soil in bottom 8 in., petroleum odor
SS-22B	2 to 4	7-5-3-3	18	0	Top 6 in. of sample black stained stained
SS-23A	0 to 2	2-2-2-2	14	0	Top 10 in. of sample black stained
SS-23B	2 to 4	2-1-1-2	3	0	Black stained soil throughout the sampling interval
SS-24A	0 to 2	7-3-4-7	16	0	Black stained soil throughout the sampling interval, some coal fragments
SS-24B	2 to 4	5-7-9-10	18	0	Brown fine to medium sand, no petroleum staining

Table 2
South Side Soil Sampling Results (mg/kg)
Graves Texaco Station, Oak Bluffs

VPH Compounds	S1/GW2/GW3	SS-1A	SS-1B	SS-2A	SS-2B	SS-3A	SS-3B	SS-4A	SS-4B	SS-5A	SS-5B	SS-6A	SS-6B
C5-C8 Aliphatics	100	<6.26	<6.17	<6.57	<6.19	<6.48	<6.18	<6.49	<6.24	<6.38	<6.31	<6.49	<6.31
C9-C12 Aliphatics	1,000	<2.24	<2.21	<2.35	<2.22	11.5	2.4	15.7	<2.24	6.44	<2.26	<2.23	<2.26
C9-C10 Aromatics	100	<1.91	<1.88	<2.01	<1.89	6.71	<1.89	8.84	<1.9	4.48	<1.93	<1.98	<1.93
Benzene	40	<0.011	<0.011	<0.012	<0.011	<0.011	<0.011	<0.011	<0.011	0.024	<0.011	<0.011	<0.011
Ethylbenzene	500	<0.011	<0.011	<0.012	<0.011	0.026	<0.011	0.034	<0.011	0.023	<0.011	<0.011	<0.011
MTBE	100	<0.028	<0.027	<0.029	<0.027	<0.029	<0.027	<0.029	<0.028	<0.028	<0.028	<0.029	<0.028
Napthalene	100	<0.0111	<0.0109	<0.0116	<0.0109	0.0803	<0.0109	0.105	<0.011	0.0819	<0.0112	<0.0115	<0.0112
Toluene	500	<0.033	<0.033	<0.035	<0.033	0.051	<0.033	0.098	<0.033	0.14	0.073	0.078	<0.034
Xylene (total)	500	<0.039	<0.038	<0.041	<0.038	0.167	<0.038	0.34	<0.039	0.189	0.123	0.139	<0.039
EPH Compounds													
C9-C18 Aliphatics	1,000	<19.2	<19.1	48.4	<19	<495	<18.9	<495	<19.1	59	49.6	<19.8	<19.4
C19-C36 Aliphatics	2,500	160	32.5	2370	97	**6,090**	83.4	**8,860**	766	**4,780**	980	350	404
C11- C22 Aromatics	800	52	<10.8	295	81.7	**2,070**	204	**1,750**	83.4	**1,410**	677	163	163
Acenapthene	1,000	<0.5	<0.5	<0.6	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Acenapthylene	100	<0.5	<0.5	<0.6	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Anthracene	1,000	<0.5	<0.5	<0.6	<0.5	0.9	<0.5	<0.5	<0.5	0.6	<0.5	<0.5	<0.5
Benzo(a) anthracene	0.7	0.6	<0.5	<0.6	<0.5	**2.7**	<0.5	**0.7**	<0.5	**3.8**	<0.5	**0.9**	<0.5
Benzo(a) pyrene	0.7	0.6	<0.5	<0.6	<0.5	**2.7**	<0.5	**1.2**	<0.5	**4.1**	<0.5	**1**	<0.5
Benzo(b) flouranthene	0.7	<0.5	<0.5	<0.6	<0.5	**2.3**	<0.5	**1**	<0.5	**3.6**	<0.5	**0.9**	<0.5
Benzo(g,h,i)perlyene	1,000	<0.5	<0.5	<0.6	<0.5	1	<0.5	<0.5	<0.5	2.3	<0.5	0.8	<0.5
Benzo(k) flouranthene	7	0.8	<0.5	<0.6	<0.5	1.9	<0.5	1	<0.5	3.8	<0.5	1	<0.5
Chrysene	7	0.7	<0.5	<0.6	<0.5	2.4	<0.5	<0.5	<0.5	4.2	<0.5	1.1	<0.5
Dibenzo(a,h) anthracene	0.7	<0.5	<0.5	<0.6	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Fluoranthene	1,000	1.5	<0.5	0.6	<0.5	3.8	<0.5	0.7	<0.5	7.7	<0.5	1.8	<0.5
Flourene	1,000	<0.5	<0.5	<0.6	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Indeno(1,2,3-cd) pyrene	0.7	0.7	<0.5	**0.7**	<0.5	**1.6**	<0.5	<0.5	<0.5	**2.9**	<0.5	0.8	<0.5
2-Methlynapthalene	500	<0.5	<0.5	<0.6	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Napthalene	100	<0.5	<0.5	<0.6	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Phenanthrene	1,000	0.6	<0.5	<0.6	<0.5	3.6	<0.5	<0.5	<0.5	3.1	<0.5	0.7	<0.5
Pyrene	700	1.5	<0.5	0.7	<0.5	5.2	<0.5	1.5	<0.5	8.1	<0.5	1.7	0.6
RCRA 8 Metals													
Arsenic	30	9.27	<5.27	9.97	10.1	11.9	6.17	6.16	<5.27	5.75	<5.34	7.59	5.57
Barium	1000	41.8	9.35	108	12.9	233	10.2	134	38.2	91.9	45.8	90	75.6
Cadmium	30	0.35	0.07	0.46	0.07	0.05	0.09	0.84	0.15	0.35	0.27	0.26	0.14
Chromium	1000	4.13	3.83	5.23	3.83	8.15	3.52	5.94	4.62	3.93	4.25	4.61	4.05
Lead	300	144	5.01	3.28	8.5	**626**	4.99	**385**	146	292	70.3	163	169
Mercury	20	0.204	0.013	0.601	0.011	0.225	<0.008	0.125	0.033	0.137	0.054	0.605	0.525
Selenium	400	<5.31	<5.27	<5.51	<5.25	<5.47	<5.22	<5.47	<5.27	<5.42	<5.34	<5.48	<5.35
Silver	100	<0.53	<0.53	<0.55	<0.52	<0.55	<0.52	<0.55	<0.53	<0.54	<0.53	<0.55	<0.53

Notes:
1. Numbers in bold font indicate exceedance of S-1/GW-2/GW-3 standard
2. SS-1A represents the zero to two foot range, SS-1B represents the two to four foot range

Table 3 Soil Boring Sampling Results (mg/kg) Graves Texaco Station, Oak Bluffs						
VPH Fractions	S1/GW2/GW3	B-1 (14-16)	B-2 (14-16)	B-3 (10-12)	B-5 (12-14)	B-7 (14-16)
C5-C8 Aliphatics	100	<6.26	<6.27	<6.19	NS	NS
C9-C12 Aliphatics	1,000	<2.24	<2.25	<2.22	NS	NS
C9-C10 Aromatics	100	<1.91	<1.92	<1.89	NS	NS
Benzene	40	<0.011	<0.011	NA	NA	NA
Ethylbenzene	500	0.02	<0.011	NA	NA	NA
MTBE	100	<0.028	<0.028	NA	NA	NA
Napthalene	100	<0.0111	<0.0111	NA	NA	NA
Toluene	500	<0.033	<0.033	NA	NA	NA
Xylene (total)	500	0.178	<0.039	NA	NA	NA
EPH Compounds	S1/GW2/GW3	B-1 (14-16)	B-2 (14-16)	B-3 (10-12)	B-5 (12-14)	B-7 (14-16)
C9-C18 Aliphatics	1,000	<19.4	<19.3	<18.9	34.8	44.2
C19-C36 Aliphatics	2,500	43.5	22.7	<2	<2	<2.2
C11- C22 Aromatics	800	53.8	15.4	<10.7	14.3	33.1
Target Analytes		ND	ND	NA	NA	NA
VPH Fractions	S1/GW2/GW3	B-8 (12-14)	MW-3 (11-13)	MW-4 (20-22)	MW-5 (15-17)	MW-6 (8-10)
C5-C8 Aliphatics	100	46.1	123	22.8	1,880	181
C9-C12 Aliphatics	1,000	457	2,040	44.9	2,850	1,400
C9-C10 Aromatics	100	297	1,160	24.4	1,300	677
Target Analytes		NA	NA	NA	NA	NA
EPH Compounds	S1/GW2/GW3	B-8 (12-14)	MW-3 (11-13)	MW-4 (20-22)	MW-5 (15-17)	MW-6 (8-10)
C9-C18 Aliphatics	1,000	84.2	57	<20.3	361	51.7
C19-C36 Aliphatics	2,500	<2	<2	3.7	5.2	2.2
C11- C22 Aromatics	800	33.8	32.7	<11.4	79.9	16.1
Target Analytes		NA	NA	NA	NA	NA
VPH Fractions	S1/GW2/GW3	MW-7 (15-17)	MW-8D (15-17)	MW-9 (15-17)	MW-10 (15-17)	MW-11 (15-17)
C5-C8 Aliphatics	100	<6.7	32.1	42.9	<6.98	<7
C9-C12 Aliphatics	1,000	<2.4	42.3	72.1	<2.5	<2.51
C9-C10 Aromatics	100	<2.05	16.2	33.5	<2.13	<2.14
Target Analytes		NA	NA	NA	NA	NA
EPH Compounds	S1/GW2/GW3	MW-7 (15-17)	MW-8D (15-17)	MW-9 (15-17)	MW-10 (15-17)	MW-11 (15-17)
C9-C18 Aliphatics	1,000	<20.6	<31	<21.3	<21.5	<21.4
C19-C36 Aliphatics	2,500	<2.2	4.2	14.7	16.3	<2.3
C11- C22 Aromatics	800	<11.6	<17.5	<12	<12.1	<12
Target Analytes		NA	NA	NA	NA	NA
VPH Fractions	S1/GW2/GW3	MW-12 (20-22)	MW-13 (15-17)	MW-14 (15-17)	MW-15 (20-22)	MW-16 (15-17)
C5-C8 Aliphatics	100	<6.69	<6.82	<7.13	<7	20.9
C9-C12 Aliphatics	1,000	<2.4	<2.44	<2.56	<2.51	26
C9-C10 Aromatics	100	<2.04	<2.08	<2.18	<2.14	9.18
Target Analytes		NA	NA	NA	NA	NA
EPH Compounds	S1/GW2/GW3	MW-12 (20-22)	MW-13 (15-17)	MW-14 (15-17)	MW-15 (20-22)	MW-16 (15-17)
C9-C18 Aliphatics	1,000	NA	NA	NA	NA	NA
C19-C36 Aliphatics	2,500	NA	NA	NA	NA	NA
C11- C22 Aromatics	800	NA	NA	NA	NA	NA
Target Analytes		NA	NA	NA	NA	NA

Notes:
1. NS - not sampled, vials broken in transit
2. ND - not detected above method detection limit
3. NA - not analyzed
4. (14-16) indicates the sampling depth in feet below the land surface

Table 4
Ground Water Sampling Results, February to April 2000 (ug/l)
Graves Texaco Station, Oak Bluffs

VPH Fractions	GW-2/GW-3	MW-1(F)*	MW-2(F)*	MW-2*	MW-A*	MW-1	MW-2	MW-3
C5-C8 Aliphatics	1,000/4,000	<69	<69	44,200	82,600	<69	28,100	65,100
C9-C12 Aliphatics	1,000/20,000	<34	<34	45,500	37,000	<34	41,600	38,100
C9-C10 Aromatics	5,000/4,000	<20	<20	7,580	6,800	<20	10,600	9,400
Benzene	2,000/7,000	NA	NA	NA	NA	<0.3	NA	NA
Ethylbenzene	30,000/4,000	NA	NA	NA	NA	<0.4	NA	NA
MTBE	50,000/50,000	NA	NA	NA	NA	<2.1	NA	NA
Naphthalene	6,000/6,000	NA	NA	NA	NA	<3.2	NA	NA
Toluene	6,000/50,000	NA	NA	NA	NA	<1.9	NA	NA
Xylene (total)	6,000/50,000	NA	NA	NA	NA	<2.7	NA	NA

EPH Fractions	GW-2/GW-3	MW-1(Foms)*	MW-2(Foms)*	MW-2*	MW-A*	MW-1	MW-2	MW-3
C9-C18 Aliphatics	1,000/20,000	<144	<144	970	177	<144	NA	NA
C19-C36 Aliphatics	na/20,000	<84	<84	<84	<84	<84	NA	NA
C11- C22 Aromatics	50,000/30,000	<48	<48	484	181	<48	NA	NA
Acenaphthene	na/5,000	NA	NA	NA	NA	<5	NA	NA
Naphthalene	6,000/6,000	NA	NA	NA	NA	<5	NA	NA
Phenanthrene	na/50	NA	NA	NA	NA	<5	NA	NA
2-Methylnaphthalene	10,000/3,000	NA	NA	NA	NA	<5	NA	NA

VPH Fractions	GW-2/GW-3	MW-4	MW-5	MW-6	MW-7	MW-8	MW-8D	MW-9
C5-C8 Aliphatics	1,000/4,000	2,640	<1,720	86,800	<69	7,820	204	2,950
C9-C12 Aliphatics	1,000/20,000	6,100	46,300	41,300	<34	7,750	118	4,110
C9-C10 Aromatics	5,000/4,000	2,340	11,100	8,900	<20	3,420	34	2,510
Benzene	2,000/7,000	NA	130	NA	NA	NA	NA	NA
Ethylbenzene	30,000/4,000	NA	5,450	NA	NA	NA	NA	NA
MTBE	50,000/50,000	NA	<52.5	NA	NA	NA	NA	NA
Naphthalene	6,000/6,000	NA	405	NA	NA	NA	NA	NA
Toluene	6,000/50,000	NA	23,200	NA	NA	NA	NA	NA
Xylene (total)	6,000/50,000	NA	30,000	NA	NA	NA	NA	NA

EPH Fractions	GW-2/GW-3	MW-4	MW-5	MW-6	MW-7	MW-8	MW-8D	MW-9
C9-C18 Aliphatics	1,000/20,000	NA	1,040	NA	NA	NA	NA	NA
C19-C36 Aliphatics	na/20,000	NA	<84	NA	NA	NA	NA	NA
C11- C22 Aromatics	50,000/30,000	NA	336	NA	NA	NA	NA	NA
Acenaphthene	na/5,000	NA	<5	NA	NA	NA	NA	NA
Naphthalene	6,000/6,000	NA	236	NA	NA	NA	NA	NA
Phenanthrene	na/50	NA	<5	NA	NA	NA	NA	NA
2-Methylnaphthalene	10,000/3,000	NA	48.8	NA	NA	NA	NA	NA

VPH Fractions	GW-2/GW-3	MW-10	MW-11	MW-12	MW-13	MW-14	MW-15	MW-16
C5-C8 Aliphatics	1,000/4,000	<69	<69	125	<69	<69	142	14,700
C9-C12 Aliphatics	1,000/20,000	<34	<34	<34	<34	<34	<34	16,600
C9-C10 Aromatics	5,000/4,000	<20	<20	54.1	<20	<20	56.1	7,430
Benzene	2,000/7,000	NA	NA	NA	NA	NA	NA	NA
Ethylbenzene	30,000/4,000	NA	NA	NA	NA	NA	NA	NA
MTBE	50,000/50,000	NA	NA	NA	NA	NA	NA	NA
Naphthalene	6,000/6,000	NA	NA	NA	NA	NA	NA	NA
Toluene	6,000/50,000	NA	NA	NA	NA	NA	NA	NA
Xylene (total)	6,000/50,000	NA	NA	NA	NA	NA	NA	NA

EPH Fractions	GW-2/GW-3	MW-10	MW-11	MW-12	MW-13	MW-14	MW-15	MW-16
C9-C18 Aliphatics	1,000/20,000	NA	NA	NA	NA	NA	NA	NA
C19-C36 Aliphatics	na/20,000	NA	NA	NA	NA	NA	NA	NA
C11- C22 Aromatics	50,000/30,000	NA	NA	NA	NA	NA	NA	NA
Acenaphthene	na/5,000	NA	NA	NA	NA	NA	NA	NA
Naphthalene	6,000/6,000	NA	NA	NA	NA	NA	NA	NA
Phenanthrene	na/50	NA	NA	NA	NA	NA	NA	NA
2-Methylnaphthalene	10,000/3,000	NA	NA	NA	NA	NA	NA	NA

Notes:
1. NA - not analyzed
2. * sampled on 2/8/00; Remaining wells sampled on April 20, 2000

3.0 Migration Pathways and Exposure Assessment

Based upon a comparison of contaminant levels that are present in soil and ground water at and downgradient of the release with the appropriate risk-based standards that apply to the site (S-1/GW-2/GW-3), the site in its present state poses a risk to human health, welfare and the environment. Mitigating measures that have occurred to date include the removal of the underground storage tanks, the dispenser islands and associated piping.

3.1 Air/Ground Water

Contaminated ground water in excess of risk-based standards has migrated off site in a northeasterly direction beneath an open field owned by the Commonwealth Electric Company. There are no municipal or private wells in the area. Although the site and surrounding area are located within a sole source aquifer, because of its location in a densely populates section of Oak Bluffs, this portion of the aquifer is not considered a potentially productive aquifer.

An inquiry regarding complaints of petroleum odors by residents surrounding the site was made to the Board of Health (BOH) on September 26, 2000. The BOH has no record of any nuisance complaints in the area.

3.2 Soil

Petroleum contamination is present in excess of risk-based standards in unpaved soil near the land surface on the south side of site. This contamination extends to a depth of approximately two feet below grade. Access to the site is restricted on three sides and is open to Uncas Avenue. Workers are at the site six days a week and there is no evidence of trespass on the property.

On the north side of the building, soil contamination is present at depth beneath the gasoline UST cavity and is not readily accessible to direct contact.

3.3 Surface Water including Sediments

The nearest surface water body is Vineyard Sound, which is 1,800 feet east of the site and has not been impacted by this release. Contamination has migrated in ground water approximately 140 feet from the point of release toward this water body.

3.4 Exposure Potential

On the north side of the building where the gasoline release occurred, there is no known human exposure to oil and hazardous material present at the disposal site, either by inhalation, dermal contact or ingestion of contaminants.

On the south side of the site, the potential for dermal contact with surface soil exists but there is no evidence of trespass on the property.

3.5 Environmental Exposure Potential

The disposal site is in a commercial residential section of Oak Bluffs. As such, there is no known or potential impact of oil and hazardous material present at the disposal site to environmental receptors. There is no known impact to natural resource areas referenced in 310 CMR 40.0483(1)(a) 8c.

4.0 Focused Feasibility Study

4.1 Purpose

The purpose of this Focused Feasibility Study (FFS) is to identify and evaluate remedial response alternatives to facilitate remediation of residually contaminated soil and ground water that is present in the basement and the side yard. In addition, the intent of the FFS will be to remediate ground water that has migrated of off the property in a northerly direction. The screened alternatives were analyzed in detail against feasibility criteria in order to select and recommend a Final Remedial Response Plan (FRRP).

The format of this FFS follows the general requirements outlined in the Massachusetts Contingency Plan (MCP), and is divided into the following three steps:

A. Development of remedial response alternatives which include: 1) identification of remedial response goals and objectives; 2) development of general response alternatives for each remedial objective; 3) identification and characterization of volumes, areas, and/or media to which remedial response alternatives might be applied; 4) identification and screening of feasible technologies associated with each general remedial response goal; and 5) development of technologies into remedial response alternatives.

B. Screening of alternatives including: 1) description of each alternative and the basis for its development; 2) screening of alternatives focusing on effectiveness, implementability and cost; and 3) selection of alternatives for detailed evaluation.

C. Detailed evaluation of the Selected Remedial Response Alternative which, in this case will be the Phase IV Remedy Implementation Plan. The plan will include: 1) description of the alternative with respect to the volumes of hazardous substances to be addressed, the technologies to be used, and any performance requirements associated with those technologies; and 2) evaluation of the alternative regarding the evaluation criteria of implementability, effectiveness, and cost.

The content of this FFS and FRRP includes an identification and screening (initial and detailed) of remedial response options and technologies and the formulation of the remedial response alternative based on the combination of the potentially feasible options and technologies identified and retained in the screening process that are capable of meeting the remedial response goal. A detailed analysis of the alternative (identified) with respect to implementability, effectiveness, and cost is then conducted in accordance with MCP to prepare the FRRP.

4.1.1 Remedial Response Goal

The remedial response goal at the former Graves Texaco site is to reduce concentrations of petroleum hydrocarbon compounds in soil and ground water to below Method 1 risk-based standards. The purpose of this FFS is to evaluate the effectiveness of technologies that can be used to achieve this goal.

4.2 Identification and Screening of Remedial Response Technologies and Process Options

Focused remedial response alternatives were identified based on information obtained from the Phase II Comprehensive Site Assessment. This section of the FFS will focus on identifying the appropriate options for soil and ground water remediation at the site. The screening process was performed in two steps: 1) an initial screening to eliminate those technologies and process options which are not likely to be feasible or to eliminate significant risk; and 2) a detailed screening of the remaining technologies and process options. Based on the findings of the detailed screening, remedial response alternatives were formulated and evaluated.

4.3 Remedial Response Action Categories

Technologies and process options within the following remedial response action categories shall be considered for their applicability toward meeting the site remedial response objectives:

- No Further Action: No further remedial response action would be taken other than periodic monitoring of soil and ground water quality and water levels in site monitoring wells.

- Institutional Actions: Evaluation or minimization of exposure, through the use of site controls to restrict site access and inhibit future land usage.
- In-situ Treatment: Evaluation of in-situ technologies of soil and ground water treatment so as to hasten ground water remediation.
- Ex-situ Treatment: Evaluation of ex-situ technologies of soil and ground water treatment so as to hasten ground water remediation.

These remedial response categories are broad classes of remedies available to meet the remedial action objectives established for the site. Each general remedial response category defines a specific approach to remediate the media of concern. Two or more general remedial response categories may be used in combination to provide a comprehensive approach to site clean-up. An example of combining general response categories would be the use of a ground water recovery/treatment category to reduce the volume of contaminated ground water combined with in-situ treatment category to reduce the mass and mobility of residual constituents in the treated media.

4.4 Detailed Screening of Technologies and Treatment Options

Remedial response technologies and process options which were considered are described and evaluated further (e.g. relative to site applicability) in the following sections.

4.4.1 No Further Action

Description

No further remedial response action would take place under this option. It is assumed that the presence of any contaminated soil present at and above the water table and contamination in the ground water would remain in under this option. Any improvement in the quality of the media of concern at the site would be the result of natural degradation of the existing contamination.

A monitoring program is included as part of the No Further Action option. Groundwater monitoring would be performed semi-annually for a period of 10 years and would be designed to evaluate natural degradation processes. Institutional constraints (i.e., Activity and Use Limitation) would need to be placed on portions of the property.

Effectiveness

The effectiveness of this option would require institutional controls and would be effective in achieving a condition of no significant risk.

Implementation

The No Further Action option could be readily implemented. If any work were to be performed in contaminated areas, site soils would have to be monitored for contamination and properly managed. The area south of the building would be paved with bituminous asphalt, the integrity of which would be maintained with an Activity and Use Limitation. Existing monitoring wells are currently used to monitor site ground water conditions. Ground water data would be collected semi-annually from site monitoring wells to monitor temporal changes in site conditions.

Cost

Costs associated with implementing this alternative include semi-annual ground water sampling and semi-annual reporting requirements to the MADEP.

Screening

As required by the MCP, a remedial response alternative, when implemented, shall eliminate for any foreseeable period of time significant risk of harm to human health, safety, public welfare, and the environment posed by the site. Because of the potential for continued migration away from the site of gasoline in the dissolved phase, the option of "no additional remedial response action with monitoring", is not feasible in achieving a permanent solution in the foreseeable future.

4.4.2 Institutional Actions

Description

Institutional actions in this case would be to leave the site as it is and implement Activity and Use Limitations on the portions of the property where contaminated soil is present. Periodic monitoring of site monitoring wells would occur. No construction would be allowed on the site unless that work was performed under the direction of a Licensed Site Professional.

Effectiveness

This alternative would be effective in reducing risk at the site however there would be no control over the off site migration of contaminated ground water.

Cost

There is minimal cost of implementing this alternative.

Screening

Depending upon the success of other remedial alternatives, this option has been retained for future consideration in conjunction with other alternatives.

4.4.3 Soil Excavation

Description

Soil excavation in an ex-situ treatment option. Under this option, the top two or three feet of contaminated soil on the south side of the building would be removed and replaced with clean fill. The contaminated soil would be transported to a recycling facility for disposal. Contaminated soil on the north side of the building, which is present in the UST cavity at a depth of approximately eight feet below grade would remain in place. A bioremediation delivery system would be installed in the USY cavity, which would then would be backfilled with clean fill.

Effectiveness

This alternative would be used in conjunction with the bioremediation alternative and would immediately eliminate the dermal exposure pathway for soil on the south side of the building.

Implementation

This alternative is relatively easy to implement at the site. The excavated soil would be transported to a recycling facility on Martha's Vineyard for disposal.

Cost

The cost of implementing this technology is moderate. It also seamlessly interfaces with the installation of the bioremediation delivery system.

Screening

Based upon the above evaluation, soil excavation in conjunction in-situ bioremediation is a feasible option for further consideration.

4.4.4 In-situ Treatment Technologies

In-situ technologies considered in this FFS include conventional pump and treat technology, air sparge/soil vapor extraction and in-situ bioremediation.

4.4.4.1 Ground Water Pump and Treat System

Description

Ground water extraction and treatment consists of installing a number of ground water recovery wells in the saturated zone where contaminated ground water is present on the north side of the building and on the east side of Uncas Avenue. Because of the relatively shallow depth of ground water across the site, the extraction wells could be manifolded together and connected to a suction lift pump rather than using individual submersible pumps in each well. The discharge would be passed through shallow air stripping trays and liquid phase carbon prior to discharge.

Effectiveness

This technology is very effective in removing dissolved phase contamination in ground water. Given the moderate to high permeability of the soil, a pilot test and ground water modeling would be required to optimize the spacing the design pumping rate of the treatment system. This alternative would not however remove contamination from the eight-foot unsaturated zone beneath the gasoline-UST cavity and the water table. To avoid placing an Activity and Use Limitation on this portion of the property, this soil would either have to be excavated or treated in some other fashion (i.e., in-situ bioremediation).

Implementation

Site accessibility does not present any difficulties in locating and installing the extraction wells on the north side of the building. Off-site recovery wells however would be difficult to connect to the treatment trailer. A temporary utility trench would need to be dug beneath Uncas Avenue. Discharge of treated ground water is a more difficult problem to surmount. Since there are no sewers for storm runoff or municipal waste, treated ground water would have to be discharged to a leach field located on the south side of the building. Because of the close proximity of the recovery wells to the leach field, the potential for "short circuiting" between the recovery wells and the leach field would need to be evaluated as a part of the pilot test.

Cost

The capital and operation and maintenance costs for a ground water extraction system would be high. The major capital costs would be in construction related activities (i.e., drilling, treatment plant construction and utility work). In addition, a pilot pumping test study would need to be performed to identify the radius of influence and optimum pumping rate for the extraction wells and the degree of hydraulic connection with the leach field.

Screening

Based on the above evaluation, a ground water extraction and treatment system is not practical for the site.

4.4.4.2 Soil Vapor Extraction

Description

Soil vapor extraction consists of installing a number of vapor extraction wells (VE) in the unsaturated zone where contaminated soil is present on the north side of the building and on the other side of Uncas Avenue. The VE wells would be manifolded together and connected to a vacuum pump. The discharge would be passed through a condensate tank and then through vapor phase carbon prior to discharge to the atmosphere.

Effectiveness

Given the moderate to high permeability of the soil and the close proximity of a number of buildings, a pilot study would be required to determine the optimum number and spacing of VE wells. Vapor extraction is an effective technology for removing organic vapors in the unsaturated zone. The technology would be used in conjunction with air sparging to deal with contamination in ground water.

Implementation

Site accessibility does not present any difficulties in locating and installing the vapor extraction wells on the north side of the building. A temporary utility trench would need to be dug for piping and electrical wiring to install the system on the east side of Uncas Avenue. The performance of the vapor recovery system would be evaluated semi-annually, or more frequently, to determine whether the goals and standards of the design criteria are being met.

Cost

The capital and operation and maintenance costs for a vapor extraction system would be moderate to high. The major capital costs would be in construction related activities (i.e., drilling, treatment plant construction and utility work). In addition, a pilot study would need to be performed to identify the radius of influence for the VE wells.

Screening

Based on the above evaluation, an active vapor recovery system is a feasible option for the recovery of additional residual contamination when coupled with air sparging.

4.4.4.3 Air Sparging

Description

Air sparging is a technology often used in conjunction with soil vapor extraction and is applied to sites where contaminated ground water is present. The technique involves installing sparge wells in the saturated overburden (i.e., in the top ten feet of the water column) within the plume and pumping air into them, thereby causing a mass transfer of contaminants from the aqueous phase to the vapor phase. The vapor, which is present in the air bubbles that rise to the surface of the water table, are then allowed to escape to the unsaturated zone or are collected with vapor extraction wells. Because of the close proximity of other dwellings to the plume where sparging would occur, control of fugitive vapors beyond the capture radius of the VE wells could be difficult to manage and migration of vapors into basements could possibly occur. Consequently, this alternative used in conjunction with vapor extraction has been eliminated from further consideration.

4.4.4.4 In-Situ Bioremediation

Description

In-situ bioremediation is a process whereby residually contaminated subsurface soils and shallow ground water are inoculated with bacteria especially formulated to biologically breakdown residual petroleum hydrocarbons adsorbed to soil. A weak (i.e., 2 to 3%) hydrogen peroxide solution is periodically injected to maintain adequate levels of dissolved oxygen in the ground water. Bioremediation also occurs in the saturated zone as the water table fluctuates seasonally and as ground water migrates both horizontally and vertically away from the point of application.

Effectiveness

Bioremediation is a proven technology and works especially well for petroleum hydrocarbons. Given the depth of contamination, less than 15 feet, neutralizing residual contamination in this manner is an attractive alternative. The system would be passive with periodic inoculations occurring on a weekly basis at initially and then on a monthly basis thereafter. Inoculation would occur on the Graves Texaco property as well as on the other side of Uncas Avenue. Because the technology is passive, no piping would be required to pass beneath the roadway. In addition, there would be no treatment and disposal requirements as with the other treatment technologies that have been presented. Neither would there be any power costs or operation and maintenance costs associated with equipment that would be required by other technologies.

Implementation

Application of the bacteria would occur in two areas; on the north side of the building where multi-level horizontal piping would be installed in the former tank cavities and dispenser islane on the north side of the building. Up to 25 vertical inoculation wells would be installed adjacent to the building and the Laundromat and on either side of Uncas Avenue. All of these areas are accessible for installation of the delivery system. The vertical injection wells would be installed to a depth of 18 feet below grade. Horizontal arrays would be installed in the UST cavities and dispenser island at two depths, just above the water table (i.e., 13 feet) and then at a depth of seven feet below grade. The contaminated soil removed from this zone would be placed back into the excavation before installing the shallower delivery system. The system could be installed within two or three weeks. Once the delivery system is installed, the bacterial culture or hydrogen peroxide solution would then be mixed into the appropriate aqueous solution and injected into the ground. To evaluate the performance of the treatment alternative, quarterly sampling of target monitoring wells for VPH compounds would be conducted. In addition, quarterly sampling for remedial additives would be performed in one upgradient and one downgradient monitoring well.

Cost

The cost of implementing this technology is moderate when compared with the vapor extraction/air sparge or ground water extraction alternative.

Screening

Based upon the above evaluation, in-situ bioremediation in conjunction with soil excavation on the south side of the building is a feasible option for further consideration.

4.5 Summary of Retained Remedial Technologies

The technologies, which have been retained based on the evaluations conducted in this FFS are:

General Response Action	Technology/Option
1. Soil Removal	Off Site Soil Recycling
2. In-situ bioremediation	Subsurface inoculation of bacteria/Monitoring
3. Institutional Controls	Activity and Use Limitation

This evaluation has concluded that because of the difficulty of capturing contaminated ground water that has migrated off site, soil excavation on the south side of the building in conjunction with in-situ bioremediation on the north side of the building and on the other side of Uncas Avenue is the most feasible option to enhance remediation at the site. Implementation of this combination of alternatives will immediately remove the complete dermal exposure pathway that exists on the south side of the building. Restoration to background is also possible with this alternative. Implementation of the institutional control has been retained for future consideration pending additional sampling.

4.6 Formulation and Evaluation of Remedial Response Alternative

Based upon the above analysis, excavation of a limited amount of soil on the south side of the building and in-situ bioremediation on the north side of the building has been selected for implementation at the former Graves Texaco Station in Oak Bluffs. The remedial response alternative consists of excavation and replacing with clean fill approximately 400 cubic yards of soil on the south side of the building and installing a bioremediation delivery system on the north side of the building and on the east side of Uncas Avenue. These areas will be inoculated with bacterial culture and/or a weak (2 to 3%) hydrogen peroxide solution. Ground water quality will be monitored quarterly during the treatment process and additional bacteria or peroxide solution will be added as needed. This appears to be the most feasible and economical remediation option that can be immediately implemented.

5.0 Phase IV Remedy Implementation Plan

5.1 South Side Soil Excavation

The top three feet of soil in the impacted areas will be excavated from the south side of the building and replaced with clean fill. The estimated volume of soil that will be removed is 200 C.Y. The area where excavation will occur is shown on Figure 6. The soil will be pre-characterized and pre-approved at the recycling facility to prior initiating work. Using this approach, little or no soil will be stockpiled on site where there is limited room for soil storage.

5.2 Description of the Bioremediation Delivery System

In-situ bioremediation will occur on the north side of the building and on either side of Uncas Avenue. The locations where the delivery systems will be installed are depicted on Figure 6. Specifically, the delivery system will consist of the following:

- Horizontal arrays would be installed in the UST cavities and the dispenser island at two depths, just above the water table and then at a depth of seven feet below grade. The clean fill that was placed in the tank cavities will be removed and temporarily stockpiled near the excavation. The contaminated soil beneath the clean fill will be excavated to a depth of approximately 13 feet and stockpiled separately. A series of horizontal perforated piping will be installed in the base of the excavation and the contaminated soil will be replaced in the cavity. A second set of horizontal pipes will be placed above the contaminated soil upon which the clean fill will be placed.

- Up to 18 vertical inoculation wells would be installed adjacent to the building and the Laundromat and on either side of Uncas Avenue. The vertical injection wells would be installed to a depth of 20 feet below grade with 10 feet of well screen, which would straddle the water table.

The horizontal arrays, which consist of one-inch perforated Schedule 40 PVC piping, will be installed on, and covered with, a bed of crushed stone. The horizontal arrays will be connected to vertical riser pipes that extend to the land surface. They will be secured with bolt-down steel covers.

The vertical injection wells will be constructed of 10 feet of four-inch diameter Schedule 40 PVC well screen and 10 feet of solid riser pipe. The wells will extend approximately seven feet into the water table and the well screens will straddle the ground water interface so that the inoculate can infiltrate into the unsaturated zone as well as the shallow portion of the saturated overburden. The wells will be secured with bolt-down steel covers.

5.3 Placement of Bacteria

Following installation of the piping, the bacterial culture will be batch mixed on site. Inoculations will occur once a week for the first two months and than once a month thereafter. The initial inoculation will consist of approximately 6,000 gallons of microbe solution. Lesser quantities will be used in subsequent inoculations but will depend upon soil moisture conditions and interim sampling results. The volume of inoculate represents approximately 15% of the available pore space in the five foot unsaturated zone over the impacted area between the building and the opposite side of Uncas Avenue (5,400 sq.ft.). This represents a volume of 27,000 cu.ft. Assuming a porosity of 25%, the pore space is 6,750 cu.ft. Assuming a 20% moisture content, the available pore space is 5,400 cu.ft. (40,392 gallons).

The bacteria that will be used in this application are non-pathogenic and non-opportunistic Type 1 bacteria. The inoculation solution consists of the bacteria (B), Miracle Grow (MG) and Brewer's Yeast (BY). They will be mixed at a ratio of 9:3:1 (B:MG:BY). Bioremediation Cleanup, Inc. (BCI) of Worcester, Massachusetts will perform bioremediation activities.

Depending upon the dissolved oxygen content in ground water, a weak (2-3%) hydrogen peroxide solution would be intermittently injected into the delivery system.

The effectiveness of the treatment will be verified by obtaining soil and groundwater samples from within the impacted area both during and after bioremediation treatment has been completed.

5.4 Duration of Construction

It is estimated that soil excavation on the south side of the building and the soil excavation and piping installation will be accomplished within four weeks. The initial inoculation will occur immediately following installation of the delivery system. The effectiveness of the treatment will be monitored during the quarterly sampling of the upgradient and downgradient monitoring wells as well as target wells in the impacted area.

5.5 Target Ground Water Sampling

To evaluate the progress of remediation activities, two monitoring wells that have exhibited high contamination levels will be periodically sampled. MW-2 and MW-A, will be purged and sampled on a quarterly basis for VPH compounds without target analytes.

5.6 Remedial Additives Sampling

Two wells, MW-11 and MW-13, will be sampled on a quarterly basis for the presence of bioremediation additives (i.e., total nitrogen series and dissolved oxygen) per the requirements set forth in Section 40.0046 of the MCP. Sampling will be performed at the beginning of bioremediation activities and then quarterly thereafter until the conclusion of the project. The total nitrogen series consists of NO3, NO2, TKN, NH3 and total phosphorous, pH and dissolved oxygen. It is not anticipated that Massachusetts Water Quality Criteria will be exceeded.

5.7 Post Remediation Sampling

Post excavation soil samples will be collected on the south side of the building prior to placing clean fill in the excavation. The samples will be analyzed for EPH compounds with target analytes and lead.

At the conclusion of bioremediation activities, soil samples will be collected in the UST cavity for VPH compounds with target analytes. Depth-composite soil samples will be collected at a sufficient number of locations in the UST cavities to assess post remediation soil conditions. Groundwater in site monitoring wells that have been impacted will also be sampled for VPH compounds with target analytes. This data will provide information that will be used to support a Response Action Outcome.

6.0 Evaluation of Remedial Response Alternative

The following evaluation of the proposed remedial response alternative focuses on the implementability, effectiveness, and anticipated costs for conducting site remediation and addresses the requirements set forth in the MCP.

6.1 Implementability

This criterion includes such items as: the ability to construct components of the selected alternative; accessibility to the site; space limitations; time required for implementation; and the ability to obtain approvals from appropriate agencies for permits and licenses. Additional items of consideration within this selection criteria include:

- Ease of undertaking additional remedial actions, if necessary;
- Ability to monitor the effectiveness of the alternative;
- Coordination with other agencies;
- Availability of off-site treatment, storage, and disposal services and capacity;
- Availability of necessary equipment and specialists; and
- Timing of new technology under consideration.

6.1.1 Space Limitations

There are no restrictions to either excavation soil on the south side of the building or to the installation of bioremediation system. Care will need to be taken in certain areas where underground piping exists for public utilities. This piping will be field located prior to the commencement of excavation activities.

6.1.2 Ability to Monitor Effectiveness

The effectiveness of the selected alternative can be readily monitored by collecting soil samples after the top three feet of soil are excavated on the south side of the building. Sampling existing on-site monitoring wells and periodically collecting soil samples in the UST cavities and quarterly sampling of target monitoring wells will be used in the bioremediation treatment area.

6.1.3 Availability of Necessary Utilities

No utilities will required to operate the bioremediation treatment system, which is completely passive All that will be needed is a batching tank, a pump and hose, all of which are being supplied by the remediation contractor.

6.1.4 Land Uses

The foreseeable use of the property and surrounding areas will remain residential and commercial.

6.1.5 Permits

A street opening permit may be required for the implementation of this alternative.

6.1.6 Project Duration

Remediation of the plume is expected to take three to five years. Since the goal of this remedial project is to mitigate the future off-site migration of ground water in excess of the S-1/GW-2/GW-3 standards, the project will continue until this has been achieved.

6.1.7 Summary

Soil excavation on the south side of the building and enhanced remediation of soil and ground water on the north side of the building using in-situ bioremediation is a viable combination of alternatives that can be readily implemented.

6.2 Effectiveness

This criterion discusses the effectiveness of the proposed remedial response alternative and includes such items as: reliability of technologies and controls, residual contamination, residual risk, potential for future releases, and risks during implementation and remedial alternative permanency.

6.2.1 Reliability of Technologies and Controls

Soil excavation and in-situ bioremediation are established and reliable technologies. In-situ bioremediation has been widely used in New England over the past eight years. Use of the technology in other parts of the country has been ongoing for many more years. It is a passive and effective means of reducing petroleum hydrocarbons in soil and ground water. The relative effectiveness of the alternative to eliminate foreseeable risk by active bioremediation will be monitored through the sampling of on-site monitoring wells.

6.2.2 Residual Contamination

According to the manufacturer, upon implementation of bioremediation treatment and after an adequate residency period, a majority of the residual product within the soil structure will be removed.

6.2.3 Potential for Future Releases

There is no potential for future releases identified at the site. The sources of the current and prior releases have been removed and no underground storage tanks are in use on the site.

6.2.4 Implementation Risks

Implementation of this alternative will require minimum worker exposure. Soil removal on the south side of the building will be performed with an excavator as will the work that will be performed in the UST cavities. Once the contaminated soil is removed from the tank cavities, a layer of crushed stone will be placed in the UST cavity to aid in dispersing the inoculate. To mitigate any potential risks, adherence to proper health and safety protocols will be required during all remedial activities.

6.2.5 Remedial Alternative Permanency

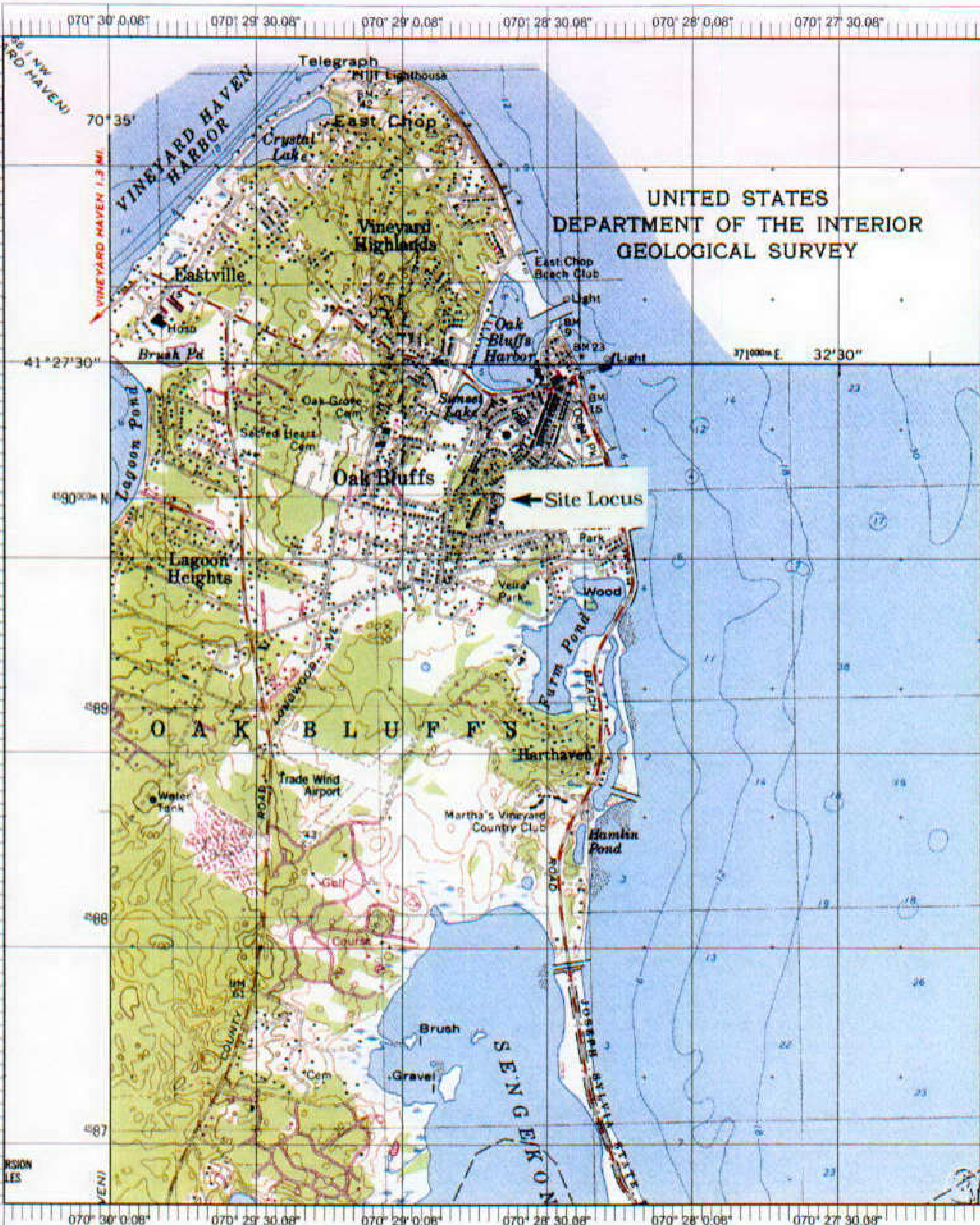
The permanency of this remedial alternative will be achieved when VPH/EPH concentrations in soil and ground water are below Method 1 Standards.

7.0 Limitations

The services described in this report were performed consistent with generally accepted professional consulting principles and practices. No other warranty, express or implied, is made. These services were performed consistent with our agreement with our client. This report is solely for the use and information of our client and their successors and assigns, advisors, counsel, lenders and prospective lenders, and prospective buyers and lenders. To the extent that any additional parties intend to rely upon this report, they may do so only upon a written request to and approval from D'Amore Associates, Inc., which approval shall not be reasonably withheld.

Opinions and recommendations contained in this report apply to conditions existing when services were performed and are intended only for the client, purposes, locations, time frames, and project parameters indicated. We are not responsible for the impacts of any changes in environmental standards, practices, or regulations subsequent to performance of services. We do not warrant the accuracy of information supplied by others, or the use of segregated portions of this report.

FIGURES



<Default> - 1 Markers, Length = 0 feet

SITE LOCUS - 041° 29' 39.1" N, 070° 28' 40.4" W

Name: EDGARTOWN
Date: 10/24/100
Scale: 1 inch equals 2000 feet

Location: 041° 29' 20.2" N 070° 28' 41.2" W
Caption: Figure 1
Site Locus Map
Graves Texaco, Oak Bluffs

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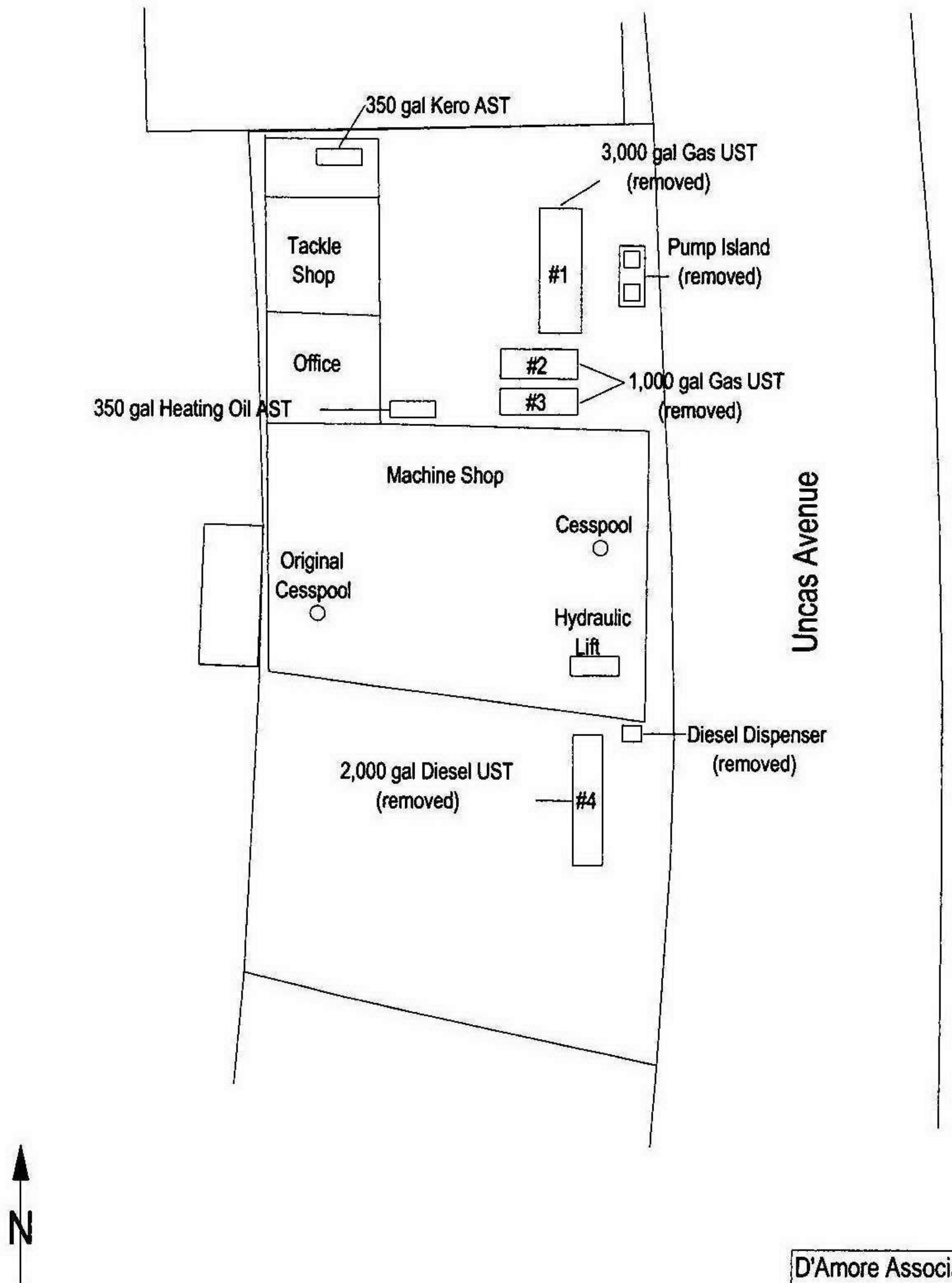

Scale: 1' = 25'

Source: Modif1ed from plan prepared by Saunders Assoc.

D'Amore Associates, Inc.

Figure 2
Site Plan
Graves Texaco, Oak Bluffs

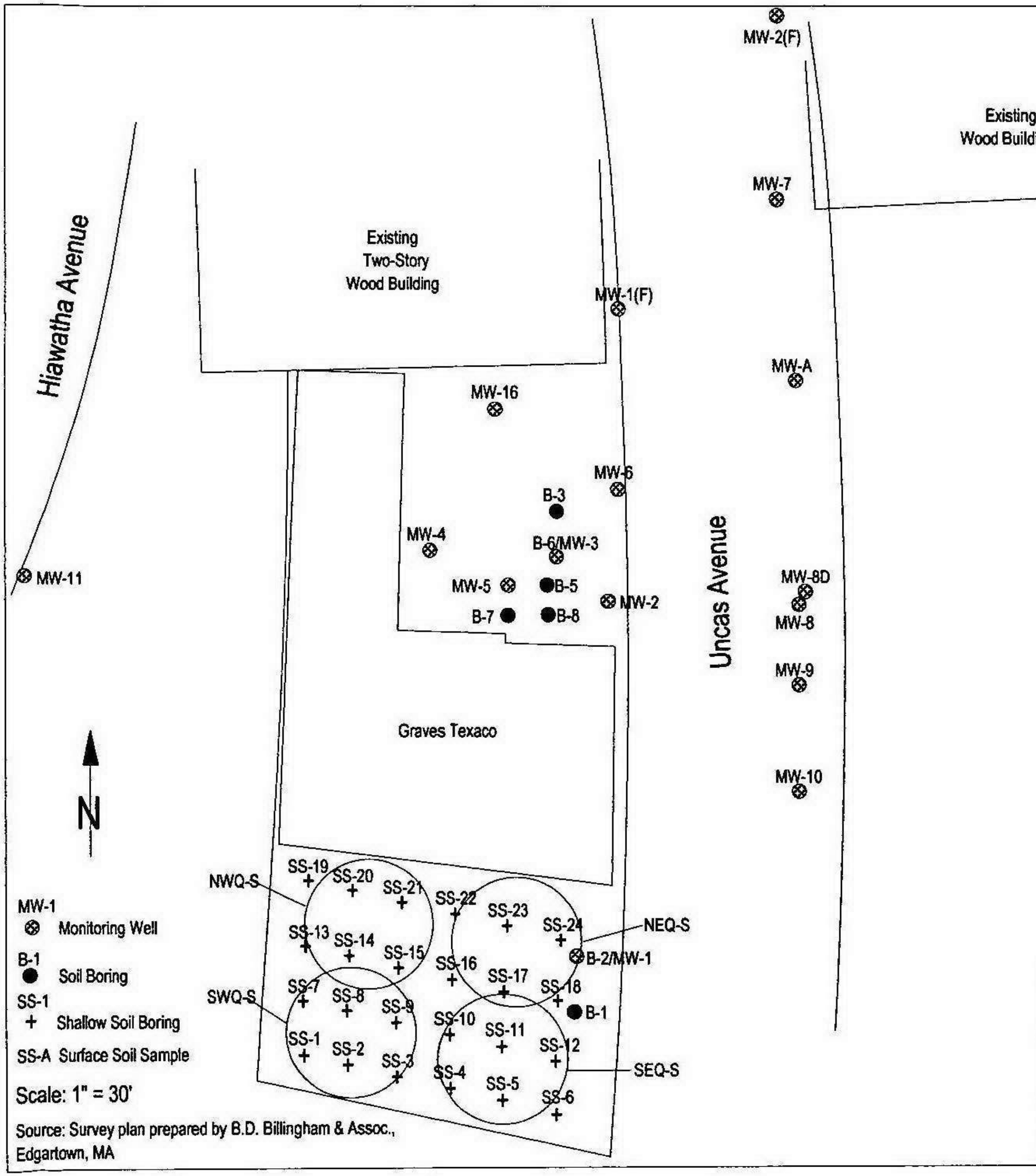

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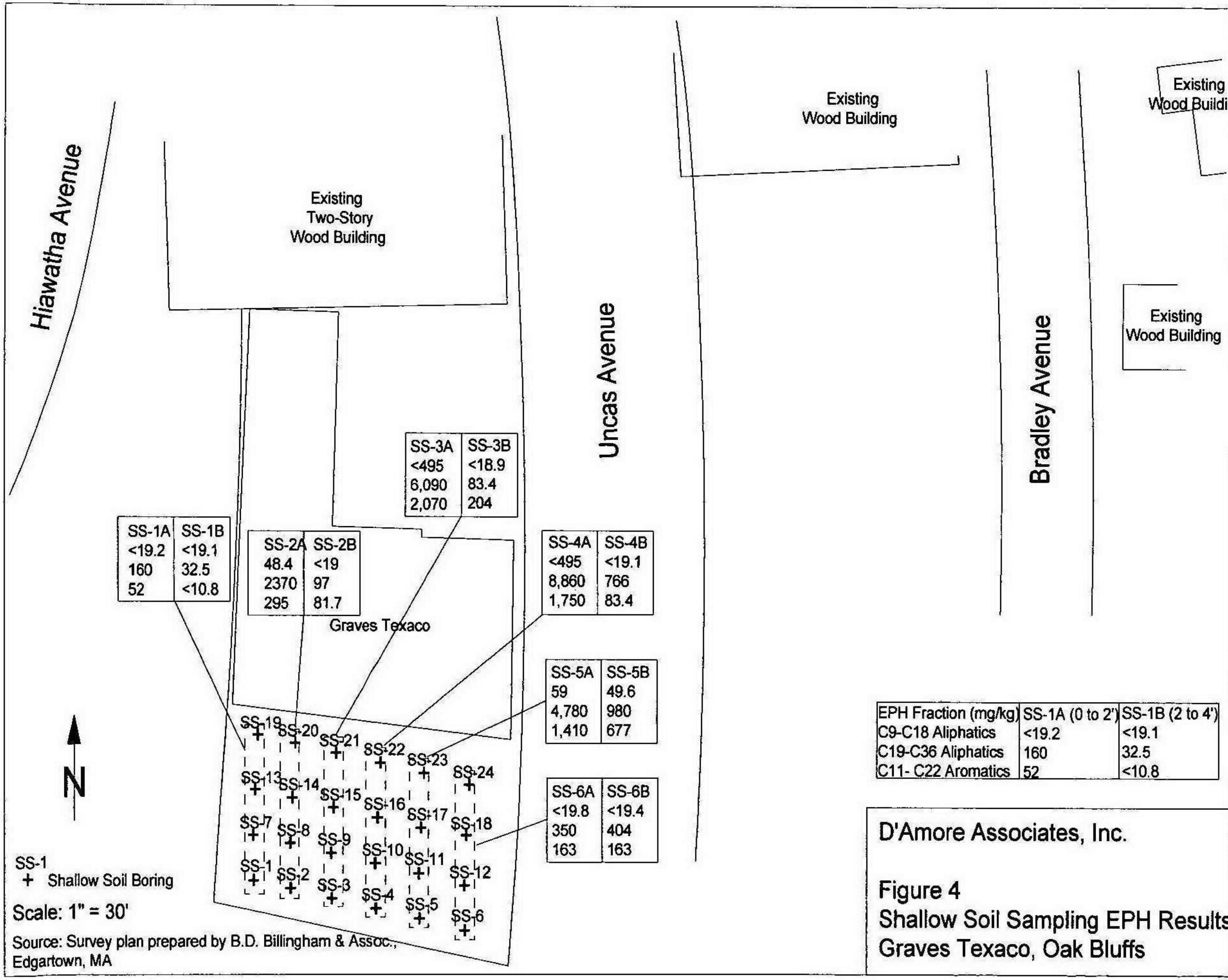
Figure 3
Soil Sampling and SoilBoring/
Monitoring Well Locations
Graves Texaco, Oak Bluffs



EPH Fraction (mg/kg)	SS-1A (0 to 2')	SS-1B (2 to 4')
C9-C18 Aliphatics	<19.2	<19.1
C19-C36 Aliphatics	160	32.5
C11- C22 Aromatics	52	<10.8

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Figure 4
Shallow Soil Sampling EPH Results
Graves Texaco, Oak Bluffs

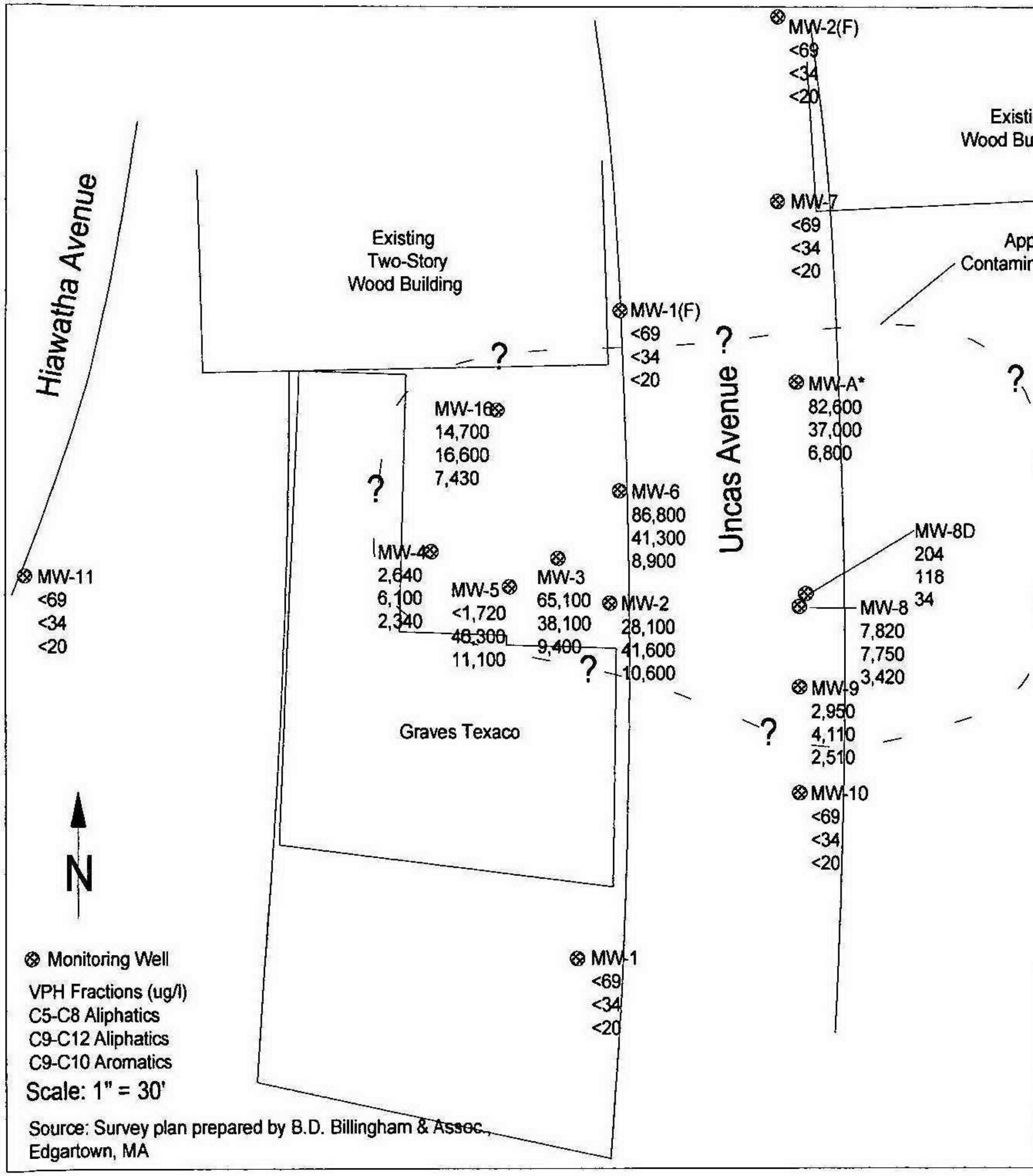

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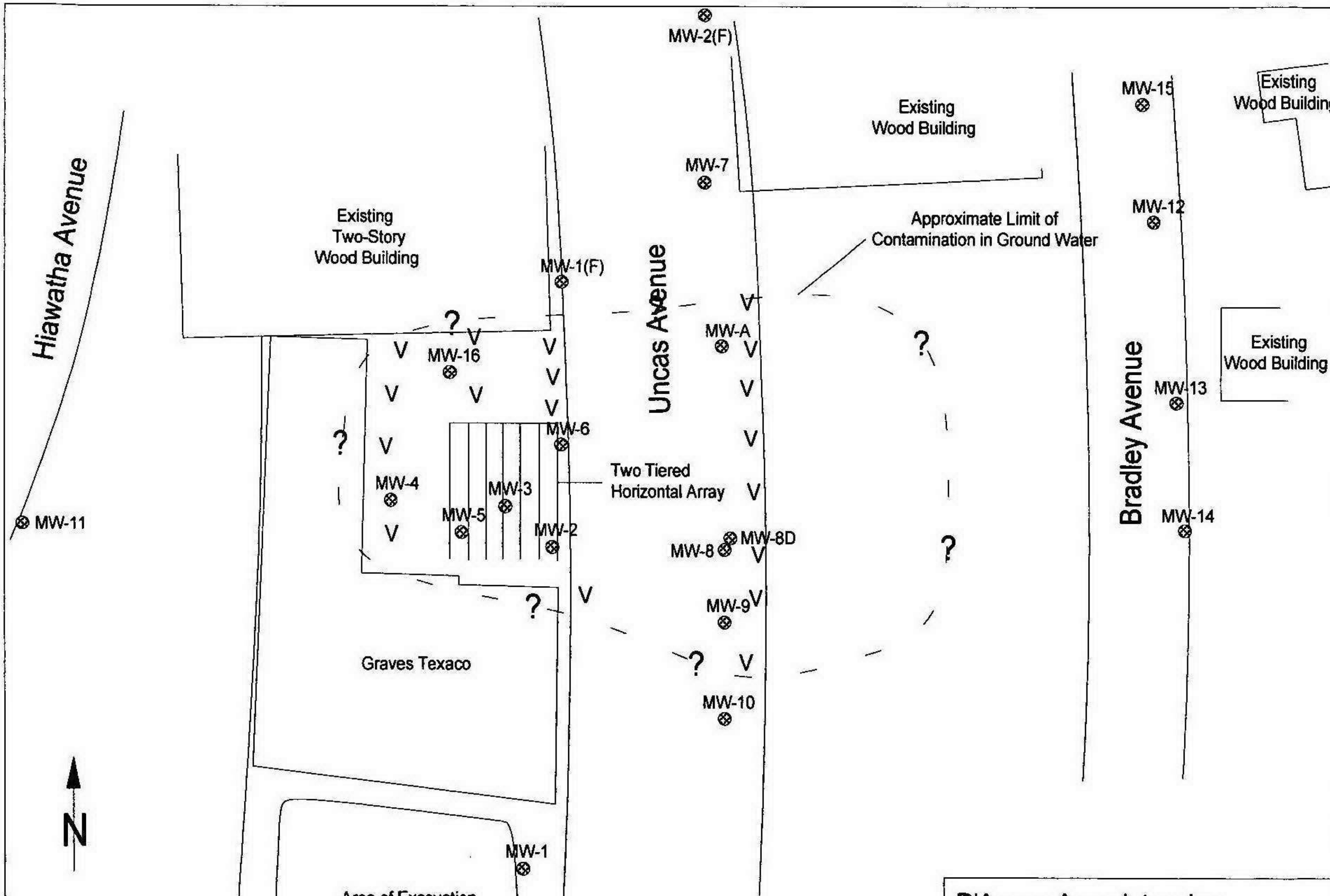
Figure 5
VPH Distribution in Ground Water
Graves Texaco, Oak Bluffs



⊗ Monitoring Well

V - Vertical Inoculation Well

Scale: 1" = 30'

Source: Survey plan prepared by B.D. Billingham & Assoc., Edgartown, MA

D'Amore Associates, Inc.

Figure6
Excavation and Inoculation Locations
Graves Texaco, Oak Bluffs