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Mailing Address: P.O. Box 1779
Norfolk, VA 23501-1779
Shipping Address: 929 Professional Place
Chesapeake, VA 23320

24 Hours: (757) 436-3000
1-800-989-4467
Fax: (757) 436-5266



October 25, 2002

Mr. Marc Gutterman
U.S. Army Corps of Engineers, Norfolk District
GeoEnvironmental Section
803 Front Street
Norfolk, Virginia 23510

Re: LANGLEY PAVEMENT AREA

Dear Mr. Gutterman:

IMS Environmental Services (IMS) is submitting the Soil Investigation Report for the referenced facility. Should you have any questions, please contact Mr. Rob Reali or myself at (757) 436-3000.

Sincerely,

IMS ENVIRONMENTAL SERVICES

A handwritten signature in cursive script that reads "Walter Bell".

Walter Bell
Project Manager

Enclosure

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SOIL INVESTIGATION REPORT

for

LANGLEY PAVEMENT AREA
LANGLEY AIR FORCE BASE
HAMPTON, VIRGINIA

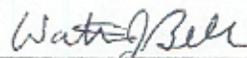
Prepared for

Mr. Marc Gutterman
United States Army Corps of Engineers, Norfolk District
GeoEnvironmental Section
803 Front Street
Norfolk, Virginia 23510

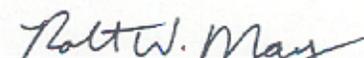
Submitted by

Mr. Walter J. Bell
IMS ENVIRONMENTAL SERVICES
929 Professional Place
Chesapeake, Virginia 23320
(757) 436-3000

Prepared By:


Walter J. Bell
Project Manager

Reviewed By:


Robert W. May, P.G.
Branch Manager

October 25, 2002

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1.0 INTRODUCTION

The U.S. Army Corps of Engineers (USACE), Norfolk District retained IMS Environmental Services (IMS) to conduct soil borings for a soil investigation at the proposed location for flight line pavement replacement at Langley Air Force Base, Hampton, Virginia. Langley Air Force Base is located at the north boundary of the city of Hampton, Virginia (Figure 1).

IMS was onsite August 12 and September 9-13, 2002 to conduct a soil-boring investigation of the site to evaluate the geophysical characteristics of the subsurface soils and prescreen the soil with a Flame Ionization Detector (FID) or Photoionization Detector (PID). In addition, IMS collected samples from suspect borings for analysis of the following adsorbed phase analytes:

- Total Petroleum Hydrocarbons – JP-4 Range Organics (TPH – JP-4)
- Total Petroleum Hydrocarbons – JP-8 Range Organics (TPH – JP-8)
- Benzene/Toluene/Ethylbenzene/Xylene (BTEX) aromatics

A site map, illustrating the locations of the soil borings and other pertinent onsite structures, is provided as Figure 2.

2.0 SOIL SAMPLING

As hydrocarbons migrate vertically through the vadose zone and horizontally via groundwater flow, a percentage of the hydrocarbons will become adsorbed to the soil particles. To sample adsorbed phase hydrocarbons, IMS collected soil borings using a truck mounted Geoprobe® direct-push sampling technology.

Borings were selected covering the extent of the proposed repavement area. Many borings were located by pushing the sample tube through the walls of pre-existing monitoring or observation wells at a slight angle from vertical to collect the soil immediately adjacent to the well. The remaining borings were located in newly designated locations that required a core cut through existing asphalt and concrete prior to boring. Figure 3 illustrates the locations of each boring in the proposed repavement area and presents the asphalt and concrete thickness encountered during the core cut employment. Table 1 summarizes the asphalt and concrete thickness at the site.

**TABLE 1: Concrete and Asphalt Thickness
Encountered on Site**

Soil Boring	Asphalt	Concrete
C-1	1	11.25
C-2	1	13.5
C-3	1-2	15
C-4	NA	NA
C-5	1	12
C-6	NA	NA
C-7	NA	NA
C-8	NA	NA
C-9	NA	NA
C-10	NA	NA
C-11	1.5	14
C-12	1	13.125
C-13	1.5	13.5
C-14	NA	NA
C-15	1.5	14
C-16	NA	NA
C-17	NA	NA
C-18	NA	NA
C-19	NA	NA
C-20	NA	NA
C-21	2	12
C-22	NA	NA
C-23	2	11.5
C-24	2	11
C-25	2	11
C-26	2	11
C-27	NA	NA
C-28	NA	NA
C-29	2	12
C-30	2	12
C-31	2	12
C-32	2	11
C-33	2.5	10.5
C-34	2	9.5
C-35	2	10.5
C-36	2	11.5
C-37	2	11
C-38	1.5	12.5
C-39	2	11.5
C-40	2.5	10.5
C-41	2	11.5

NA – Not Applicable, soil boring did not require core cut.

Based on olfactory, visual, PID and FID observations in the field, certain samples were selected for analysis. Twenty-two soil samples collected from eighteen Geoprobe® borings were analyzed for TPH-JP-4 and TPH-JP-8 using EPA Method 8015M and BTEX using EPA Method 8260B. Some borings had two samples submitted, one each from the upper and lower horizons. All soil samples were packed in ice for shipment to Accutest Laboratories of Orlando, Florida, under a chain of custody. Soil samples were identified on the chain of custody by the letter "C" followed by the boring location number followed by the letter "A" (designating upper horizon) or "B" (designating lower horizon). Figure 2 presents the sample locations, adsorbed phase analytical concentrations and FID/PID readings. Table 2 summarizes the FID/PID readings and the adsorbed phase analytical results for the soil samples. The laboratory report is provided as Appendix A.

TABLE 2: Summary of Soil Analytical Results with FID/PID Readings

Sample ID	Parameter	Result	Units	RL	DF	Collected
C-3A 3'	PID	210	ppm	NA	NA	12-AUG-02
C-3A 2-4'	TPH (JP-8 Range)	49.4	mg/kg	10	1	12-AUG-02
C-3A 2-4'	TPH (JP-4 Range)	ND	mg/kg	10	1	12-AUG-02
C-3A 2-4'	Benzene	ND	ug/kg	5.8	1	12-AUG-02
C-3A 2-4'	Toluene	7.1	ug/kg	5.8	1	12-AUG-02
C-3A 2-4'	Ethylbenzene	ND	ug/kg	5.8	1	12-AUG-02
C-3A 2-4'	Xylene (total)	ND	ug/kg	17	1	12-AUG-02
C-3B 5'	PID	150	ppm	NA	NA	12-AUG-02
C-3B 4-6'	TPH (JP-8 Range)	52.9	mg/kg	11	1	12-AUG-02
C-3B 4-6'	TPH (JP-4 Range)	ND	mg/kg	11	1	12-AUG-02
C-3B 4-6'	Benzene	ND	ug/kg	6.2	1	12-AUG-02
C-3B 4-6'	Toluene	10.8	ug/kg	6.2	1	12-AUG-02
C-3B 4-6'	Ethylbenzene	ND	ug/kg	6.2	1	12-AUG-02
C-3B 4-6'	Xylene (total)	ND	ug/kg	19	1	12-AUG-02
C-5A 1.5'	PID	400	ppm	NA	NA	12-AUG-02
C-5A 2-3'	TPH (JP-8 Range)	27.6	mg/kg	9.7	1	12-AUG-02
C-5A 2-3'	TPH (JP-4 Range)	ND	mg/kg	9.7	1	12-AUG-02
C-5A 2-3'	Benzene	ND	ug/kg	5.4	1	12-AUG-02
C-5A 2-3'	Toluene	10.3	ug/kg	5.4	1	12-AUG-02
C-5A 2-3'	Ethylbenzene	ND	ug/kg	5.4	1	12-AUG-02
C-5A 2-3'	Xylene (total)	ND	ug/kg	16	1	12-AUG-02
C-7A 1-3'	PID	NA	ppm	NA	NA	12-AUG-02
C-7A 1-3'	TPH (JP-8 Range)	134	mg/kg	35	4	12-AUG-02
C-7A 1-3'	TPH (JP-4 Range)	ND	mg/kg	35	4	12-AUG-02
C-7A 1-3'	Benzene	ND	ug/kg	4.8	1	12-AUG-02
C-7A 1-3'	Toluene	ND	ug/kg	4.8	1	12-AUG-02
C-7A 1-3'	Ethylbenzene	ND	ug/kg	4.8	1	12-AUG-02
C-7A 1-3'	Xylene (total)	ND	ug/kg	15	1	12-AUG-02

(a) TPH calculated as total area, pattern consists of more than just JP-8.

(b) TPH calculated as total area, pattern appears to be oil related.

RL – Reporting Limit

DF – Dilution Factor

J Qualifier indicating estimated value.

ND – Parameter not detected.

NA – Not Applicable/Not Analyzed.

TABLE 2: Summary of Soil Analytical Results with FID/PID Readings (continued)

Sample ID	Parameter	Result	Units	RL	DF	Collected
C-7B 3-4'	PID	60	ppm	NA	NA	12-AUG-02
C-7B 3-4'	TPH (JP-8 Range)	101	mg/kg	40	4	12-AUG-02
C-7B 3-4'	TPH (JP-4 Range)	ND	mg/kg	40	4	12-AUG-02
C-7B 3-4'	Benzene	ND	ug/kg	6	1	12-AUG-02
C-7B 3-4'	Toluene	ND	ug/kg	6	1	12-AUG-02
C-7B 3-4'	Ethylbenzene	ND	ug/kg	6	1	12-AUG-02
C-7B 3-4'	Xylene (total)	ND	ug/kg	18	1	12-AUG-02
C-11A 2-4'	PID	25	ppm	NA	NA	12-AUG-02
C-11A 2-4'	TPH (JP-8 Range)	ND	mg/kg	10	1	12-AUG-02
C-11A 2-4'	TPH (JP-4 Range)	ND	mg/kg	10	1	12-AUG-02
C-11A 2-4'	Benzene	ND	ug/kg	5.9	1	12-AUG-02
C-11A 2-4'	Toluene	22.2	ug/kg	5.9	1	12-AUG-02
C-11A 2-4'	Ethylbenzene	ND	ug/kg	5.9	1	12-AUG-02
C-11A 2-4'	Xylene (total)	ND	ug/kg	18	1	12-AUG-02
C-11B 4-6'	PID	10	ppm	NA	NA	12-AUG-02
C-11B 4-6'	TPH (JP-8 Range)	ND	mg/kg	10	1	12-AUG-02
C-11B 4-6'	TPH (JP-4 Range)	ND	mg/kg	10	1	12-AUG-02
C-11B 4-6'	Benzene	ND	ug/kg	6	1	12-AUG-02
C-11B 4-6'	Toluene	17	ug/kg	6	1	12-AUG-02
C-11B 4-6'	Ethylbenzene	ND	ug/kg	6	1	12-AUG-02
C-11B 4-6'	Xylene (total)	ND	ug/kg	18	1	12-AUG-02
C-13-B 4'-6'	FID	300	ppm	NA	NA	09-SEP-02
C-13-B 4'-6'	TPH (JP-8 Range)	2910	mg/kg	520	50	09-SEP-02
C-13-B 4'-6'	TPH (JP-4 Range)	ND	mg/kg	520	50	09-SEP-02
C-13-B 4'-6'	Benzene	4.3 (J)	ug/kg	5.6	1	09-SEP-02
C-13-B 4'-6'	Toluene	53.4	ug/kg	5.6	1	09-SEP-02
C-13-B 4'-6'	Ethylbenzene	ND	ug/kg	5.6	1	09-SEP-02
C-13-B 4'-6'	Xylene (total)	ND	ug/kg	17	1	09-SEP-02
C-14-A 1'-2'	FID	120	ppm	NA	NA	09-SEP-02
C-14-A 1'-2'	TPH (JP-8 Range) (a)	24.7	mg/kg	9.2	1	09-SEP-02
C-14-A 1'-2'	TPH (JP-4 Range)	ND	mg/kg	9.2	1	09-SEP-02
C-14-A 1'-2'	Benzene	ND	ug/kg	5.1	1	09-SEP-02
C-14-A 1'-2'	Toluene	5.7	ug/kg	5.1	1	09-SEP-02
C-14-A 1'-2'	Ethylbenzene	ND	ug/kg	5.1	1	09-SEP-02
C-14-A 1'-2'	Xylene (total)	ND	ug/kg	15	1	09-SEP-02
C-18-A 0'-2'	FID	10	ppm	NA	NA	09-SEP-02
C-18-A 1'-2'	TPH (JP-8 Range) (a)	7.34 (J)	mg/kg	10	1	09-SEP-02
C-18-A 1'-2'	TPH (JP-4 Range)	ND	mg/kg	10	1	09-SEP-02
C-18-A 1'-2'	Benzene	ND	ug/kg	5.8	1	09-SEP-02
C-18-A 1'-2'	Toluene	12.3	ug/kg	5.8	1	09-SEP-02
C-18-A 1'-2'	Ethylbenzene	ND	ug/kg	5.8	1	09-SEP-02
C-18-A 1'-2'	Xylene (total)	ND	ug/kg	17	1	09-SEP-02

(a) TPH calculated as total area, pattern consists of more than just JP-8.

(b) TPH calculated as total area, pattern appears to be oil related.

RL – Reporting Limit

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J Qualifier indicating estimated value.

ND – Parameter not detected.

NA – Not Applicable/Not Analyzed.

TABLE 2: Summary of Soil Analytical Results with FID/PID Readings (continued)

Sample ID	Parameter	Result	Units	RL	DF	Collected
C-19-A 0'-2'	FID	29	ppm	NA	NA	09-SEP-02
C-19-A 1'-2'	TPH (JP-8 Range)	277	mg/kg	100	10	09-SEP-02
C-19-A 1'-2'	TPH (JP-4 Range)	ND	mg/kg	100	10	09-SEP-02
C-19-A 1'-2'	Benzene	ND	ug/kg	300	1	09-SEP-02
C-19-A 1'-2'	Toluene	ND	ug/kg	300	1	09-SEP-02
C-19-A 1'-2'	Ethylbenzene	ND	ug/kg	300	1	09-SEP-02
C-19-A 1'-2'	Xylene (total)	ND	ug/kg	910	1	09-SEP-02
C-24-A 1'-4'	FID	325	ppm	NA	NA	12-SEP-02
C-24-A 1'-2'	TPH (JP-8 Range) (b)	201	mg/kg	190	20	12-SEP-02
C-24-A 1'-2'	TPH (JP-4 Range)	ND	mg/kg	190	20	12-SEP-02
C-24-A 1'-2'	Benzene	88.4	ug/kg	5.7	1	12-SEP-02
C-24-A 1'-2'	Toluene	22.5	ug/kg	5.7	1	12-SEP-02
C-24-A 1'-2'	Ethylbenzene	21.2	ug/kg	5.7	1	12-SEP-02
C-24-A 1'-2'	Xylene (total)	38.7	ug/kg	17	1	12-SEP-02
C-25-A 1'-4'	FID	303	ppm	NA	NA	12-SEP-02
C-25-A 1'-2'	TPH (JP-8 Range)	ND	mg/kg	10	1	12-SEP-02
C-25-A 1'-2'	TPH (JP-4 Range)	ND	mg/kg	10	1	12-SEP-02
C-25-A 1'-2'	Benzene	ND	ug/kg	6	1	12-SEP-02
C-25-A 1'-2'	Toluene	19.9	ug/kg	6	1	12-SEP-02
C-25-A 1'-2'	Ethylbenzene	2.6 (J)	ug/kg	6	1	12-SEP-02
C-25-A 1'-2'	Xylene (total)	ND	ug/kg	17	1	12-SEP-02
C-29-A 1'-4'	FID	193	ppm	NA	NA	12-SEP-02
C-29-A 1'-2.5'	TPH (JP-8 Range)	ND	mg/kg	9.8	1	12-SEP-02
C-29-A 1'-2.5'	TPH (JP-4 Range)	ND	mg/kg	9.8	1	12-SEP-02
C-29-A 1'-2.5'	Benzene	ND	ug/kg	5	1	12-SEP-02
C-29-A 1'-2.5'	Toluene	14.3	ug/kg	5	1	12-SEP-02
C-29-A 1'-2.5'	Ethylbenzene	ND	ug/kg	5	1	12-SEP-02
C-29-A 1'-2.5'	Xylene (total)	ND	ug/kg	16	1	12-SEP-02
C-32-A 1'-2.5'	FID	531	ppm	NA	NA	13-SEP-02
C-32-A 1'-2.5'	TPH (JP-8 Range)	ND	mg/kg	9.8	1	13-SEP-02
C-32-A 1'-2.5'	TPH (JP-4 Range)	ND	mg/kg	9.8	1	13-SEP-02
C-32-A 1'-2.5'	Benzene	ND	ug/kg	6	1	13-SEP-02
C-32-A 1'-2.5'	Toluene	15.1	ug/kg	6	1	13-SEP-02
C-32-A 1'-2.5'	Ethylbenzene	ND	ug/kg	6	1	13-SEP-02
C-32-A 1'-2.5'	Xylene (total)	ND	ug/kg	17	1	13-SEP-02
C-35-A 1'-2.5'	FID	302	ppm	NA	NA	13-SEP-02
C-35-A 1'-2.5'	TPH (JP-8 Range)	ND	mg/kg	8.9	1	13-SEP-02
C-35-A 1'-2.5'	TPH (JP-4 Range)	ND	mg/kg	8.9	1	13-SEP-02
C-35-A 1'-2.5'	Benzene	ND	ug/kg	5	1	13-SEP-02
C-35-A 1'-2.5'	Toluene	16.8	ug/kg	5	1	13-SEP-02
C-35-A 1'-2.5'	Ethylbenzene	ND	ug/kg	5	1	13-SEP-02
C-35-A 1'-2.5'	Xylene (total)	ND	ug/kg	16	1	13-SEP-02

(a) TPH calculated as total area, pattern consists of more than just JP-8.

(b) TPH calculated as total area, pattern appears to be oil related.

RL – Reporting Limit

DF – Dilution Factor

J Qualifier indicating estimated value.

ND – Parameter not detected.

NA – Not Applicable/Not Analyzed.

TABLE 2: Summary of Soil Analytical Results with FID/PID Readings (continued)

Sample ID	Parameter	Result	Units	RL	DF	Collected
C-37-A 1'-2.5'	FID	565	ppm	NA	NA	13-SEP-02
C-37-A 1'-2.5'	TPH (JP-8 Range)	140	mg/kg	39	4	13-SEP-02
C-37-A 1'-2.5'	TPH (JP-4 Range)	ND	mg/kg	39	4	13-SEP-02
C-37-A 1'-2.5'	Benzene	ND	ug/kg	6	1	13-SEP-02
C-37-A 1'-2.5'	Toluene	53.5	ug/kg	6	1	13-SEP-02
C-37-A 1'-2.5'	Ethylbenzene	8.9	ug/kg	6	1	13-SEP-02
C-37-A 1'-2.5'	Xylene (total)	ND	ug/kg	17	1	13-SEP-02
C-38-A 1'-2.5'	FID	382	ppm	NA	NA	13-SEP-02
C-38-A 1'-2.5'	TPH (JP-8 Range)	ND	mg/kg	9.6	1	13-SEP-02
C-38-A 1'-2.5'	TPH (JP-4 Range)	ND	mg/kg	9.6	1	13-SEP-02
C-38-A 1'-2.5'	Benzene	ND	ug/kg	6	1	13-SEP-02
C-38-A 1'-2.5'	Toluene	3.1 (J)	ug/kg	6	1	13-SEP-02
C-38-A 1'-2.5'	Ethylbenzene	ND	ug/kg	6	1	13-SEP-02
C-38-A 1'-2.5'	Xylene (total)	ND	ug/kg	17	1	13-SEP-02
C-38-B 2.5-4'	FID	1300	ppm	NA	NA	13-SEP-02
C-38-B 4'-8'	FID	130	ppm	NA	NA	13-SEP-02
C-38-B 2'-6'	TPH (JP-8 Range)	ND	mg/kg	11	1	13-SEP-02
C-38-B 2'-6'	TPH (JP-4 Range)	ND	mg/kg	11	1	13-SEP-02
C-38-B 2'-6'	Benzene	ND	ug/kg	7	1	13-SEP-02
C-38-B 2'-6'	Toluene	26.3	ug/kg	7	1	13-SEP-02
C-38-B 2'-6'	Ethylbenzene	ND	ug/kg	7	1	13-SEP-02
C-38-B 2'-6'	Xylene (total)	ND	ug/kg	21	1	13-SEP-02
C-39-A 1'-2.5'	FID	596	ppm	NA	NA	13-SEP-02
C-39-A 1'-2.5'	TPH (JP-8 Range)	10.1	mg/kg	9.1	1	13-SEP-02
C-39-A 1'-2.5'	TPH (JP-4 Range)	ND	mg/kg	9.1	1	13-SEP-02
C-39-A 1'-2.5'	Benzene	ND	ug/kg	5	1	13-SEP-02
C-39-A 1'-2.5'	Toluene	21.4	ug/kg	5	1	13-SEP-02
C-39-A 1'-2.5'	Ethylbenzene	6.4	ug/kg	5	1	13-SEP-02
C-39-A 1'-2.5'	Xylene (total)	ND	ug/kg	15	1	13-SEP-02
C-40-A 1'-2.5'	FID	384	ppm	NA	NA	13-SEP-02
C-40-A 1'-2.5'	TPH (JP-8 Range)	ND	mg/kg	9	1	13-SEP-02
C-40-A 1'-2.5'	TPH (JP-4 Range)	ND	mg/kg	9	1	13-SEP-02
C-40-A 1'-2.5'	Benzene	ND	ug/kg	5	1	13-SEP-02
C-40-A 1'-2.5'	Toluene	2.6 (J)	ug/kg	5	1	13-SEP-02
C-40-A 1'-2.5'	Ethylbenzene	2.7 (J)	ug/kg	5	1	13-SEP-02
C-40-A 1'-2.5'	Xylene (total)	ND	ug/kg	14	1	13-SEP-02
C-41-A 1'-4'	FID	100	ppm	NA	NA	13-SEP-02
C-41-A 1'-3'	TPH (JP-8 Range) (a)	12.2	mg/kg	9.7	1	13-SEP-02
C-41-A 1'-3'	TPH (JP-4 Range)	ND	mg/kg	9.7	1	13-SEP-02
C-41-A 1'-3'	Benzene	ND	ug/kg	5	1	13-SEP-02
C-41-A 1'-3'	Toluene	45.3	ug/kg	5	1	13-SEP-02
C-41-A 1'-3'	Ethylbenzene	ND	ug/kg	5	1	13-SEP-02
C-41-A 1'-3'	Xylene (total)	ND	ug/kg	15	1	13-SEP-02

(a) TPH calculated as total area, pattern consists of more than just JP-8.

(b) TPH calculated as total area, pattern appears to be oil related.

RL – Reporting Limit DF – Dilution Factor

J Qualifier indicating estimated value. ND – Parameter not detected. NA – Not Applicable/Not Analyzed.

3.0 DISCUSSION

The borings conducted at the sites of pre-existing observation/monitoring wells are shown on Figure 2 with the symbol for the well. Of these, C-7, C-14, and C-18 were selected for analysis.

Three samples in Table 2 (C-14A, C-18A, and C-41A) are denoted with the comment, "TPH calculated as total area, pattern consists of more than just JP-8." This indicates that petroleum products matching the JP-8 fingerprint existed in the sample; but other heavier components existed as well. All analytical results were combined, however, so that the data for JP-8 in these particular samples reflect the combined JP-8 and heavier products.

The analytical result for C-24A is denoted with the comment, "TPH calculated as total area, pattern appears to be oil related." This indicates that detected petroleum in the sample did not appear to be a JP product. The analysis indicated a product similar to motor oil. However, the contract laboratory calculated the TPH area (201 mg/kg) in order to report an indication of the petroleum hydrocarbons in the sample.

Evaluation of the analytic data indicates that concentrations of hydrocarbons exist throughout the site. The TPH parameter was fingerprinted by the lab for JP-4 and JP-8. JP-4 was not identified in any sample submitted for analysis. Of the twenty-two soil samples submitted for analysis, JP-8 was identified in twelve samples (except C-24A discussed above) representing ten boring locations. One JP-8 result (C-13B) was as high as 2910 mg/kg. The remaining analyses detected concentrations below 277 mg/kg (C-19A) ranging down to minimum detection limits.

BTEX analytes are present in nineteen samples representing sixteen boring locations. Of the BTEX analytes, Toluene is the most prevalent on the site ranging between 55.5 ug/kg and minimum detection limits. Ethylbenzene is detected in five samples ranging from 21.2 ug/kg to concentrations near the reporting limit. Benzene is indicated in two samples (88.4 ug/kg and an estimated value below detection limits) and xylene in one sample (38.7 ug/kg). Sample C-24A is the only sample with all four BTEX analytes and contains the higher Benzene and Ethylbenzene and Xylene concentrations.

4.0 CONCLUSIONS AND RECOMMENDATIONS

Excavated soil should be screened during excavation for petroleum impact utilizing FID/PID technology. Petroleum impacted soil should be segregated, stockpiled, sampled, and then processed at an approved disposal/recycling facility. Possible disposal methods include thermal destruction or landfarming; both of which are available in the Hampton Roads area.

FIGURES

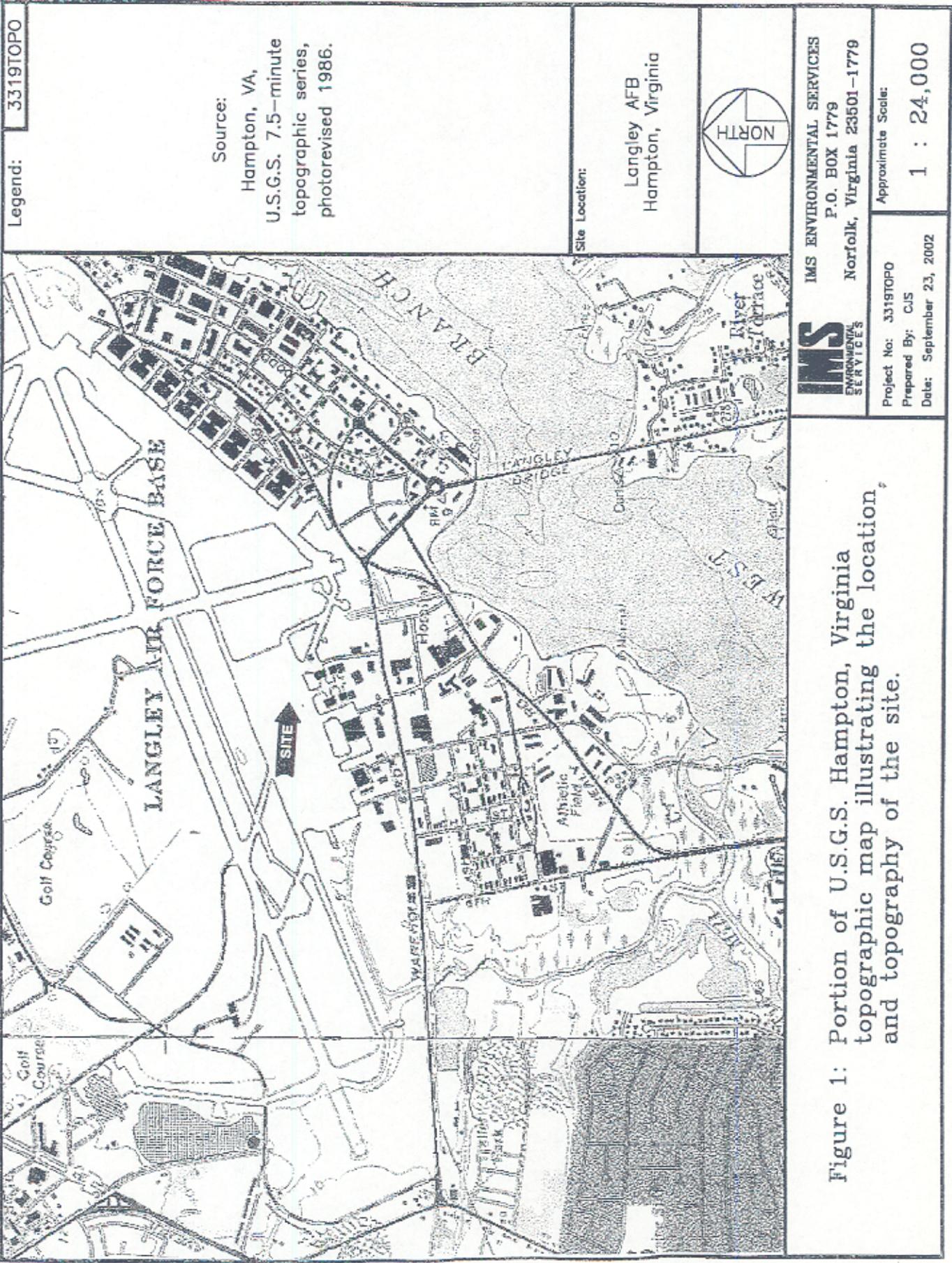


Figure 1: Portion of U.S.G.S. Hampton, Virginia topographic map illustrating the location, and topography of the site.

