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SEATTLE CITY LIGHT WORK ORDER #87-14

GEORGETOWN TANK SLUDGE AND SOIL TESTING

I. INTRODUCTION

On 12 October, 1987, Raven Systems & Research, Inc. undertook a project to determine the distribution of potential hazardous chemicals in and around fuel tanks at the Georgetown Steam Plant, specifically 1 700-gal. diesel tank, 3 12,000-gal. Bunker C tanks (all steel) and an 800,000-gal. Bunker C tank made of concrete. The large concrete fuel tank is northwest of the Georgetown Steam Plant. The tank occupies space at the north end of the west runway for King County Airport, and is targeted for demolition and/or removal. The circular sidewall is 12" thick at the top and 24" thick at the bottom, 15.7 feet high, of which about eight feet extends above the runway elevation. The concrete top is 101 feet in diameter and is supported internally by 32 concrete pilasters surrounding a large central column. Fuel was brought in by rail in the 1940's, and by truck in the 1950's and 60's. A large underground pipeline delivered the fuel to the plant. The purpose of the study was to define the distribution and quality of any leaked or spilled fuel from the tank or from the activities around the tank, and to examine the contents and environment of the other fuel tanks.

Tasks in this work order include:

	TASK	SAMPLE #
A.	Archived individual soil samples from four four bore holes around the berm. Samples taken every two feet of depth.	GX 1-4 @ 0' GX 6-9 @ 2' GX 11-14 @ 4' GX 21-24 @ 8' GX 26-29 @ 10' GX 31-34 @ 12' GX 36-39 @ 14' GX 41-44 @ 16'
B.	Composite soil samples at each 2 feet of depth comprised of four subsamples (one from each bore hole) through sixteen feet.	GX 5, 10, 15, 20, 25, 30, 35, 40, 45
C.	Core of concrete in the interior of the tank wall (one only)	GX 51, 52 duplicates

TASK	SAMPLE #
D. Residual Bunker oil in the bottom of the concrete tank	GX 53,54 duplicates
E. Individual samples of surface soil near fuel tanks and diesel tank	GX 61-64
F. Diesel oil	GX 65
G. Sludge in the three fuel tanks	GX 66, 67, 68
H. Oily sand at 21 feet of bore hole #1	GX 99

In the concrete tank, most of the Bunker C type fuel was removed. Of the remaining 5-6" deep fuel residue on the bottom, the PCB concentration was found to be 1.3-2 ppm of Aroclor 1260 [Raven Work Order #87-9, July, 1987]. A previous lab analysis reported 3 ppm.

In this study, the berm around the tank, the tank residual fuel and the concrete tank wall were sampled for examination of hazardous materials. Selected samples were subjected to PCBs, polynuclear aromatic hydrocarbons [PAH], toxic screens by thin layer chromatography [TLC], oil and grease, and EP Toxicity metals analyses. Oil and grease was not analyzed in oil samples. PAHs were not analyzed in dry sand samples. Fuel was examined for halogenated hydrocarbons.

A similar analysis scheme was applied to residues in and soils around the three underground fuel tanks and the diesel oil tank at the southwest corner of the steam plant. Analytical methods were chosen to indicate where the materials in question fit in the WDOE Dangerous Waste Classification scheme or other regulatory agency criteria.

II. SAMPLING METHODOLOGY

A. Container and Sampling Equipment

All samples were placed in 270 ml wide-mouth glass containers that had been pre-cleaned. The metal screw cap lids were lined with aluminum foil such that the dull side was in contact with the sample.

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The pre-cleaning procedure involved scrubbing with a special petrochemical dissolving soap [HarborMaster Products, Inc., Edmonds, Washington]. The terminal end of the brush applied had sufficient bristles to scrub the seam where the side connects with the bottom. A final rinsing with pesticide grade iso octane was undertaken to remove any invisible greases and detergent residues.

Scoops and collection pans are laboratory grade stainless steel. Digging tools, augers and drilling bits are high carbon tool steel. Tools were cleaned with the aforementioned detergent and rinsed with iso-octane. The tools were buffed free of rust before arriving at the site.

B. Field Observations

Data on the collection process and observations of the physical nature of the sample were kept in the bound field log book. The format for this book is chronological.

C. Sampling Strategy

In accordance with EPA SW-846, sampling strategy was chosen from sections most analogous to the nature of the site. These sections are "waste piles" [1.4.3] and "landfills" [1.4.4]. Individual decisions were required for each site with the purpose of the study in mind. In this study, the sand/silt/soil samples were hand-augered, either with a four-blade post hole auger, or with a 1 1/2" diameter screw auger. Subsamples from the four holes around the berm as shown in Figure 1 were taken every two feet. Subsamples from each depth were combined to form composites of four. Sample sites from the other tanks are shown in Figure 2. The soil samples near the tanks were zero to one foot deep vertical composites of soil and sand. Fuels and oils were sampled with an aluminum thief. The concrete wall of the large tank was cleaned by chipping, then bored with a series of 5/8" diameter holes in a circular pattern 6" deep. The result was a core of concrete. The 3" to 6" deep

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section of the core comprised the sample whose volume was ~9.5 cubic inches. The core was broken in half to provide a duplicate. A physical description of all the samples can be found in Table IV.

D. Sample Collection

Method 8080 in the EPA SW-846 manual describes the protocol for handling of organochlorine pesticides and polychlorinated biphenyls. Compliance with these instructions necessitated using glass containers and specified conditions for refrigeration. All samples in our case were delivered to the laboratory in time to comply with the maximum seven days storage for extraction and thirty days for complete analysis. The samples subjected to metal analysis were also stored in glass, as conditions specified by ASTM part 23, p. 72-91 [1973] were met.

III. ANALYSIS

A. PCBs

Samples, stored no longer than five days at 4° C, were extracted with methanol and pre-treated with an iso-octane sulfuric acid procedure to remove heavy petroleum residues that interfere with the PCB determination [clean-up modification of USEPA Method 3540 with the sonicator option]. The samples were analyzed by a modification of the packed column gas chromatography procedure described in Method 8080. Detection and confirmation of positive signals was accomplished with a Hewlett-Packard 5890 gas chromatograph using a HP-1 column. This column is a state-of-the-art commercial column evolved from those designated in Method 8080. Detection limit was 0.01 ppm for PCBs.

B. Metals

EP toxicity as specified in USEPA SW-846 Methods 1310 and 7000 was proposed.

The analysis for metals, based on atomic absorption spectroscopy, has a detection limit two and one-half orders of magnitude lower

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than the WDOE dangerous waste threshold concentration for each metal in general. For instance, as seen on Table II, cadmium concentrations weren't detected below 0.005 ppm. The EP Tox maximum concentration for materials not to be classified as dangerous waste for landfills is 1 ppm.

C. PAH Analysis

WDOE [WAC 173-303] regulations state that a stepwise analysis can be used to classify a crude sample as extremely hazardous waste based on the PAH content. There is no dangerous waste classification for PAHs. The formal chemical analysis of all the constituents on the EPA list for PAH would be prohibitively expensive. In the WDOE scheme, residue from the first step that is greater than one weight percent must be treated with further steps. The fourth step of the procedure allows reporting by weight percent the portion of the crude sample containing the 4, 5, 6-membered ring compounds that have been determined the most dangerous in terms of chronic toxicity. The procedure discards the less toxic alkaline, acidic, and aliphatic hydrocarbons from the sample by the following scheme:

Fraction #1 - Percent of Petroleum Ether extractables in 2N HCl - any alkaline components removed in this step.

Fraction #4 - Petroleum ether extract with 2N NaOH- removes all acidic compounds, leaving neutral compounds.

Fraction #6 - Neutral compound sample is dried with sodium sulfate and run through a silica gel column. The petroleum ether eluate contains aliphatic hydrocarbon fraction. A benzene elution recovers the aromatic portion that is considered most toxic.

Since a 10 gram crude sample can be weighed to 0.0001 gram, the dried extract can theoretically contain 0.001 gram and be weighed with sufficient precision to provide a sensitivity of 0.01% and a

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detection limit of 0.001%. WDOE specifies 1% maximum not to be classified as extremely hazardous waste. It was on this basis that the oily soil/sand samples were not analyzed further than the first step, as shown in the left column in Table I.

The halogenated hydrocarbons recovered in Fraction #1 were analyzed by Method 325.3 (Chloride) and Method 340.2 (Fluoride) as in EPA-625/6-74-003 as specified by WAC 173-303. Detection limits are 80 ppb for chloride and 10 ppb for fluoride. If the total residue weight percent is less than 0.01 ppm, then the sample is below the WDOE dangerous waste classification for halogenated hydrocarbons.

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TABLE I
ORGANIC RESULTS AT GEORGETOWN STEAM PLANT

SAMPLE #	LOCATION	DEPTH FEET	MATRIX	OIL&GREASE ppm	TLC PAHs ppm	TLC HYDROCARBONS	PCB ppm	WDOE PAH est. ppm
*GX-5	berm	0	fill	70	<5	50	ND	<14
GX-10	berm	2	fill	30	<5	50	ND	<6
GX-15	berm	4	fill	150	<5	50	ND	<31
GX-20	berm	6	fill	160	<5	50	ND	<33
*GX-25	berm	8	fill	460	<5	50	ND	<94
GX-30	berm	10	fill	220	<5	50	ND	<45
*GX-35	berm	12	fill	260	<5	50	ND	<53
GX-40	berm	14	fill	3,660	200	250	ND	<747
*GX-45	berm	16	fill	20	<5	<50	ND	<4
*GX-52	wall	0.5	concrete	100	<5	---	ND	<20
*GX-53	tank	bottom	bunker oil	---	10,000	---	--	---
Backyard								
GX-61	S. tank	0-1.1	soil	1,810	50	---	ND	<370
GX-62	M. tank	0-1.2	soil	8,240	100	---	ND	<1680
*GX-63	N. tank	0-1.2	soil	35,690	100	---	ND	<7280
*GX-64	diesel	0-2	soil	130	50	---	ND	<27
GX-65	diesel	---	oil	---	2,000	---	7.5	---
*GX-66	N. tank	---	sludge	---	5,000	---	8.2	---
GX-67	M. tank	---	sludge	---	10,000	---	ND	---
GX-68	S. tank	---	sludge	---	20,000	---	ND	---
GX-99	trench bore hole	21	oil/sand	60,000	---	---	ND	<12240
WDOE	**threshold**			**---**	**10,000**	**---**	**50**	**10000**
King Co.	**land fill threshold**			**40,000**	**---**	**---**	**---**	**---**

* samples analyzed for EP Tox metals

** Estimated from the ratio of fraction #6 PAH in the Bunker C residue applied to the oil and grease in the soil sample.

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TABLE II
ANALYSES OF METALS

SAMPLE #	MATRIX	EP TOX METAL CONCENTRATION [ppm]: Cd	Pb	Ag	Cu	Ni	Ba	Cr	As	Se	Zn	Hg	% H_2O
GX-5	fill	<0.005	<0.050	<0.016	<0.011	<0.150	<0.100	<0.050	<0.500	<0.100	0.18	<0.005	8.96
GX-25	fill	<0.005	<0.050	<0.016	<0.033	<0.150	<0.100	<0.050	<0.500	<0.100	0.17	<0.005	9.72
GX-35	fill	<0.005	0.050	<0.016	<0.011	<0.150	<0.100	<0.050	<0.500	<0.100	<0.05	<0.005	15.48
GX-45	fill	<0.005	<0.05	<0.016	<0.011	<0.150	<0.100	<0.050	<0.500	<0.100	<0.05	<0.005	11.54
GX-52	concrete	<0.019	0.302	<0.016	0.022	1.09	<0.100	<0.050	<0.500	<0.100	<0.05	<0.005	6.01
GX-53	oil	<0.005	<0.050	<0.016	<0.011	<0.150	<0.100	<0.050	<0.500	<0.10	<0.05	<0.005	---
GX-63	soil	<0.005	0.086	<0.016	<0.011	<0.150	<0.100	<0.050	<0.500	<0.10	0.08	<0.005	11.93
GX-64	soil	0.023	<0.050	<0.016	<0.011	<0.150	<0.100	<0.050	<0.500	<0.10	1.51	<0.005	4.96
GX-66	sludge	<0.005	0.086	<0.016	<0.033	<0.150	<0.100	<0.050	<0.500	<0.100	0.09	<0.005	---
EP TOX MAXIMUM		1.0	5	5	NA	NA	100	5	5	1.0	NA	0.2	NA

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TABLE III
COMPARISON OF TLC RESULTS FOR FUELS

Comparison of DOE and TLC methods of estimating PAH* content of environmental samples:

Sample #	Type	DOE [ppm]	TLC [ppm]
GX-53	bunker oil	204,000	10,000
GX-65	diesel	156,000	2,000
GX-66	sludge	95,000	5,000
GX-67	sludge	89,000	10,000
GX-68	sludge	159,000	20,000

* The WDOE threshold for extremely hazardous waste classification is <1% (or 10,000 ppm).

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TABLE IV
PAH ANALYSIS [WDOE WASTE REGULATION]

Sample #	Type	Fraction #1	Bound Halogens as Chloride	Bound Halogens as Fluoride	Fraction #4	Fraction #6	2-,3- Ring PAH
GX-53	Bunker C	88.5%	<0.000008%	<0.000001%	65.2%	20.4%	0
GX-65	Diesel	94.5%	<0.000008%	<0.000001%	74.2%	15.6%	0
GX-66	Sludge	74.3%	<0.000008%	<0.000001%	53.5%	9.5%	0
GX-67	Sludge	46.6%	<0.000008%	<0.000001%	30.2%	8.9%	0
GX-68	Sludge	95.6%	<0.000008%	<0.000001%	53.1%	15.9%	0

Fraction #1 is percentage of crude sample without alkaline components

Fraction #4 is percentage of crude sample without alkaline components and acidic components

Fraction #6 is percentage of crude sample without alkaline, acidic and aliphatic hydrocarbons and contains the 2 to 6 membered rings. Since the 2- and 3-ring species were not detected, this number represents the 4-, 5-, 6-ring PAHs that above 1% are "Extremely Hazardous Waste."

THRESHOLDS:

WDOE threshold for halogenated hydrocarbons is <0.01% for dangerous waste classification, and <0.1% for extremely hazardous waste classification.

The threshold for PAH is <1% for extremely hazardous waste classification. There is no dangerous waste designation.

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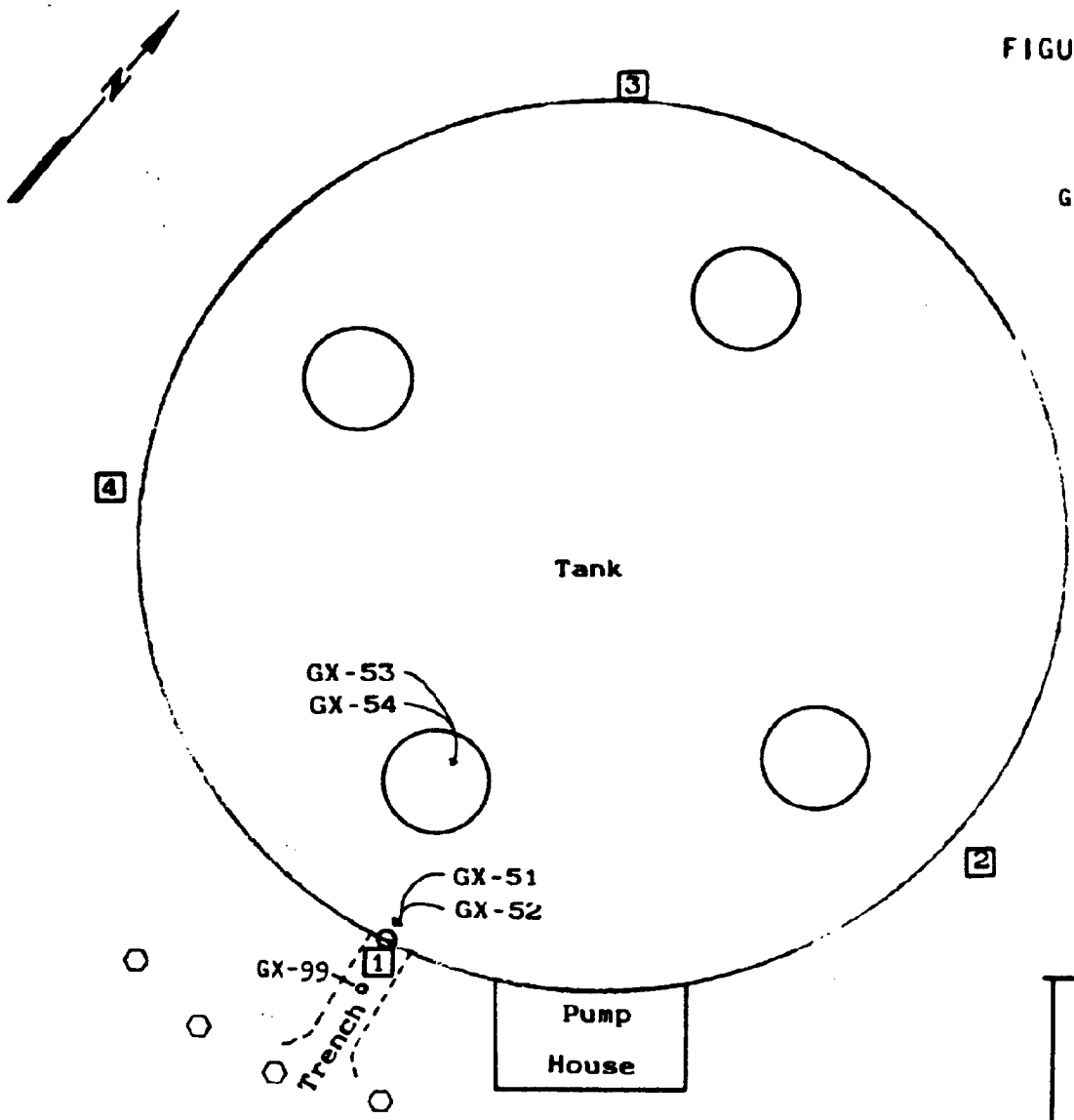
TABLE V
SAMPLE DESCRIPTIONS

SAMPLE #	TYPE	DESCRIPTION
GX-5	comp	Light brown surface silt with vegetation roots
GX-10	comp	Fill sand: Hole 3, a clay layer at 1'; Hole 2, a clay layer at 2'; Hole 3, full of ants at 3.5'.
GX-15	comp	Light brown fill sand
GX-20	comp	Fill sand, light brown medium as opposed to coarse. Hole 2 had gray sand at 7.5'; Hole 3 had soft sand at 7'.
GX-25	comp	Light brown fill sand
GX-30	comp	Hole 1 had a small amount of pea gravel above darker-colored soil, and odor of Bunker C; Hole 2 had a 1-2' diameter boulder.
GX-35	comp	Hole 1 contributed darker soil with odor of Bunker C; Hole 4 had pure dark sand.
GX-40	comp	dark brown sand, oily from Hole 1 subsample
GX-45	comp [3]	Hole 1 oily sand not included; composite was dark brown silty sand
GX-51	concrete	Ordinary looking old, clear, hard concrete; a 50-50 weight % mixture of powder and water had a pH of 9, indicating some lime was used in the pour mixture.
GX-52	duplicate	Same as above
GX-53	oil	Black concrete tank Bunker C residue
GX-54	duplicate	Same as above
GX-61	surface soil	Fine brown sand

SAMPLE #	TYPE	DESCRIPTION
GX-62	surface soil	Brown sand interspersed with pea gravels
GX-63	surface soil	Black soil under broken asphaltic blacktop; odor of petroleum
GX-64	surface soil	Fine gray-brown sand supporting blackberry brambles
GX-65	diesel	Dark brown oil, not as clear as pure diesel, 0.55' deep
GX-66	sludge	Black viscous oil 1' deep
GX-67	sludge	Thin layer of thick black oil over water 1.1' deep
GX-68	sludge	Thick black oil 8" deep
GX-99	sand	Medium, as opposed to coarse dark brown sand mixture, contains sufficient oil to be pasty

SCL GEORGETOWN CONCRETE FUEL TANK

FIGURE 1



GX-5,10 20
25,30,40,45:
Horizontal
Composites
from boreholes
1,2,3,4
at 2' depth

LEGEND:

Manhole

Soil Boring

Vibracore Boring

Concrete Sample

Sampling date:

soils 9 Oct '87

concrete 14 Oct '87

0 10 20 30 40 50

feet

RAVEN SYSTEMS and RESEARCH, INC

SCALE shown

DATE 1 Dec. '87

APPROVED BY

DRAWN BY LSG

REVISED JD Feb

SCL - Georgetown Fuel Tank
Soil Borings - Concrete Tank Area

LA TERRE ENVIRONMENTAL CONS.

DRAWING NUMBER 87-14-1

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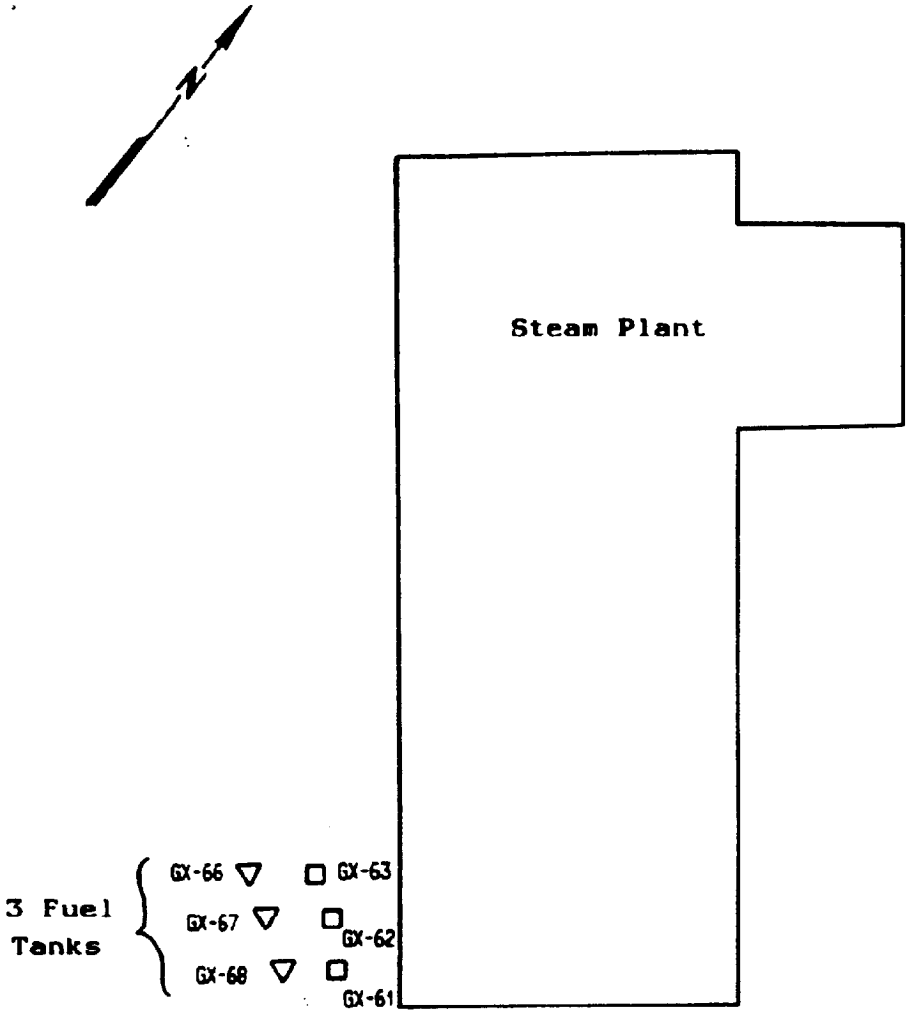
BURIED TANKS

FIGURE 2



LEGEND:

▽ Filler Cap

□ Soil Sample

RAVEN SYSTEMS and RESEARCH, INC		
SCALE shown	APPROVED BY MEH	DRAWN BY LSG
DATE 1 Dec. '87		REVISED JD
SCL - Georgetown Buried Tanks Soil Samples		
LA TERRE ENVIRONMENTAL CONS.		DRAWING NUMBER 87-14-2

0 20 40 60 80 100

feet

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