FOR ADJACENT PROPERTY
(CITY OF SEATTLE)

APPENDIX A

SCS ENGINEERS REPORT

CITY OF SEATTLE

SITE INVESTIGATION TO ASSESS SOIL CONTAMINATION AND LOCATE UNDERGROUND STORAGE TANKS

802 ROY STREET
PARKS DEPARTMENT SHOPS COMPLEX
SEATTLE, WASHINGTON

Prepared for:

City of Seattle
Department of Administrative Services
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Seattle, Washington 98104

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May 1992

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FIGURES

SECTION 1

INTRODUCTION

PURPOSE AND SCOPE

This report was prepared by SCS Engineers in response to a request by the City of Seattle to conduct a site characterization for the release of fuel product and an investigation to locate underground storage tanks at 802 Roy Street, Seattle, Washington. The location of the site is illustrated in Figure 1.

The scope of this investigation included conducting a soil vapor survey to assess the extent of petroleum hydrocarbon contamination in the soil and a geophysical survey in an attempt to locate underground tanks on the property.

BACKGROUND

In early 1992, the City of Seattle Parks Department notified the Department of Ecology of a leak in a fuel pump dispenser at their Roy Street Service Shops Complex. The fuel system reportedly tested tight in June 1991. According to City representatives, fueling operations at the site were suspended immediately after discovering fuel odors in the soil adjacent to the fuel pump.

Remaining fuel product in the only active underground tank at the site was subsequently removed. In February 1992, representatives from the City of Seattle and SCS Engineers met at the site to discuss an investigative approach that would provide an assessment of the leak and determine if any abandoned underground tanks exist on the property.

The following sections of this report include a description of the site, a summary and evaluation of soil vapor survey results, and an interpretation of the results of the geophysical survey.

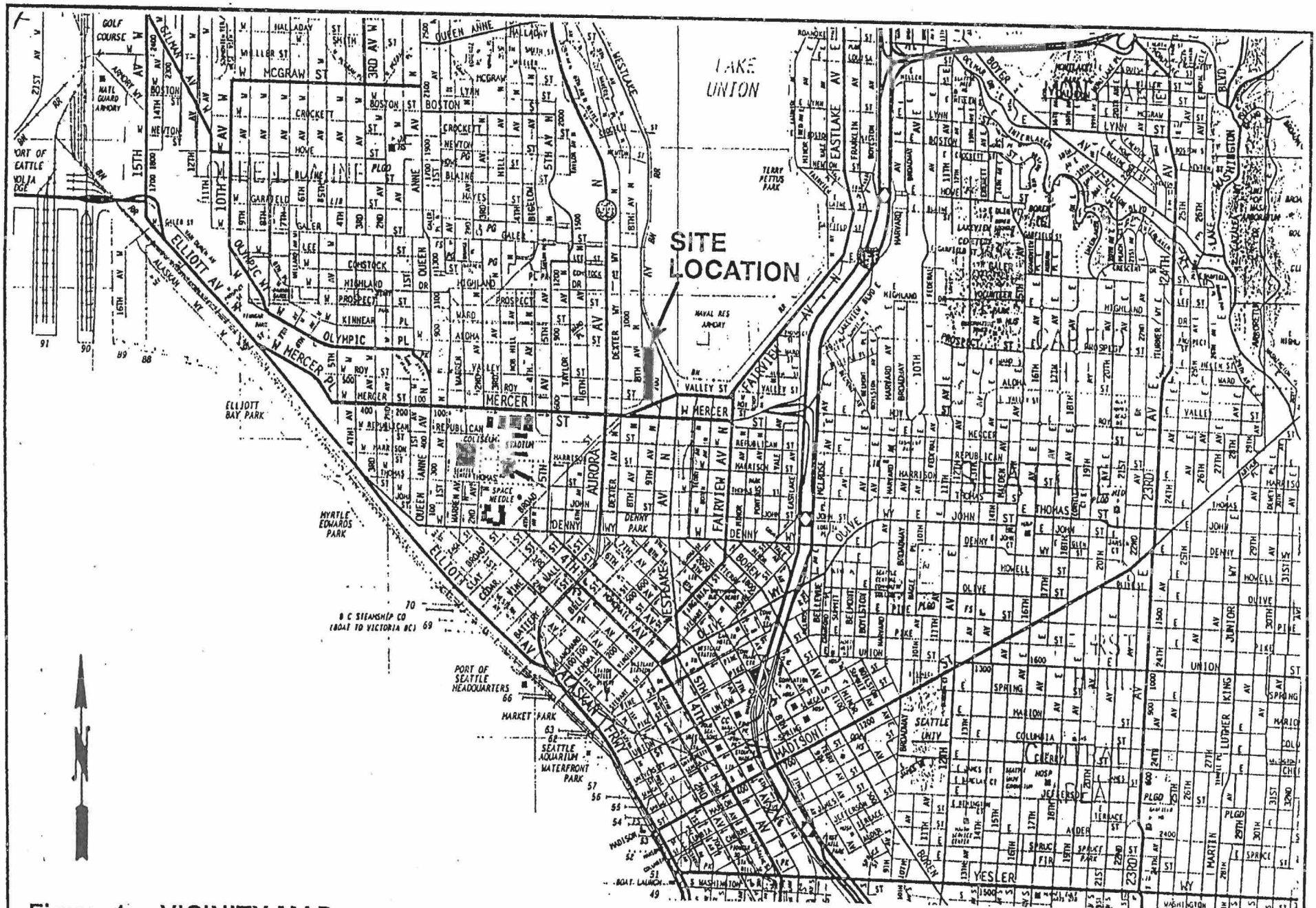

Figure 1 VICINITY MAP

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SECTION 2

SITE DESCRIPTION

This investigation was conducted at the City of Seattle Parks Department Shops Complex located at 802 Roy Street in Seattle, near the south end of Lake Union. A site map of the facility is illustrated in Figure 2.

The Roy Street Shops Complex is situated on about a one acre parcel of property that includes an administrative office building and adjoining service shop, a truck bay area on the west side of the main building and a ten stall vehicle parking area on the east side of the building. The main vehicle parking area and fueling service area is located adjacent to the north end of the service shop building.

The site is bordered by Aloha Street to the north, Roy Street to the south, 8th Avenue to the west, and an alley to the east. The property was filled and graded flat many years ago; however, the general topography slopes to the east, towards Lake Union.

The entire parking area is covered with asphalt, except for the fuel service station and a washing area on the northwest corner of the service shop, both areas of which are covered with concrete. Storm water runoff discharges into surface drains on the property and in the adjacent streets. No underground public service utilities were identified on the property.

The existing fueling system consists of one 2,700-gallon unleaded gasoline tank, one fuel pump, and a service island. The tank dimensions are six feet diameter by approximately 12 feet in length. According to an engineering drawing provided by the City, the existing tank was formerly used as a lard cooking unit and was intended to be fabricated for use as a gasoline storage tank. The drawing is dated January 24, 1944 and was prepared for Puget Power & Light Company.

Another drawing, also prepared for Puget Power & Light Company, indicates existing conditions as of June 1955. This drawing shows that the tank is located approximately 20 feet from the north end of the building. The bottom of the tank rests on an inverted concrete saddle at a depth of 14 feet. A vent line extends from the tank to the north wall of the service building. These plans also indicate the presence of a 550-gallon gasoline tank at the northwest corner of the service shop.

This 550-gallon abandoned UST was located at the site during a recent visit. A fill cap and a vent line were observed in the northwest corner of the service shop. The tank bottom is eight feet below the ground surface and is currently empty. Small particles of rust and a gasoline odor were detected on the bottom of a tape which was inserted into the tank. An engraved metal tag tied around the fill pipe reads "Do not fill- tank leaks".

A December 1967 engineering drawing, prepared for City of Seattle Department of Lighting shows approved plans for the installation of a 4,000-gallon diesel fuel tank and piping system at the site. The tank location is adjacent to an Oil Storage Building (existing storage shed), approximately 60 feet north of the main service building on the west side of the property.

The 1967 plans also show a different configuration for the existing fuel pump island than the older drawings. The 1967 drawing shows the pump island as it now exists. It is situated in a northeast-southwest position and is oblique to the underground tank. The 1944/1955-updated drawing shows a pump island parallel to the tank, between the tank and the service shop. The drawing indicates that the old pump island was located where the fuel line valve box presently exists.

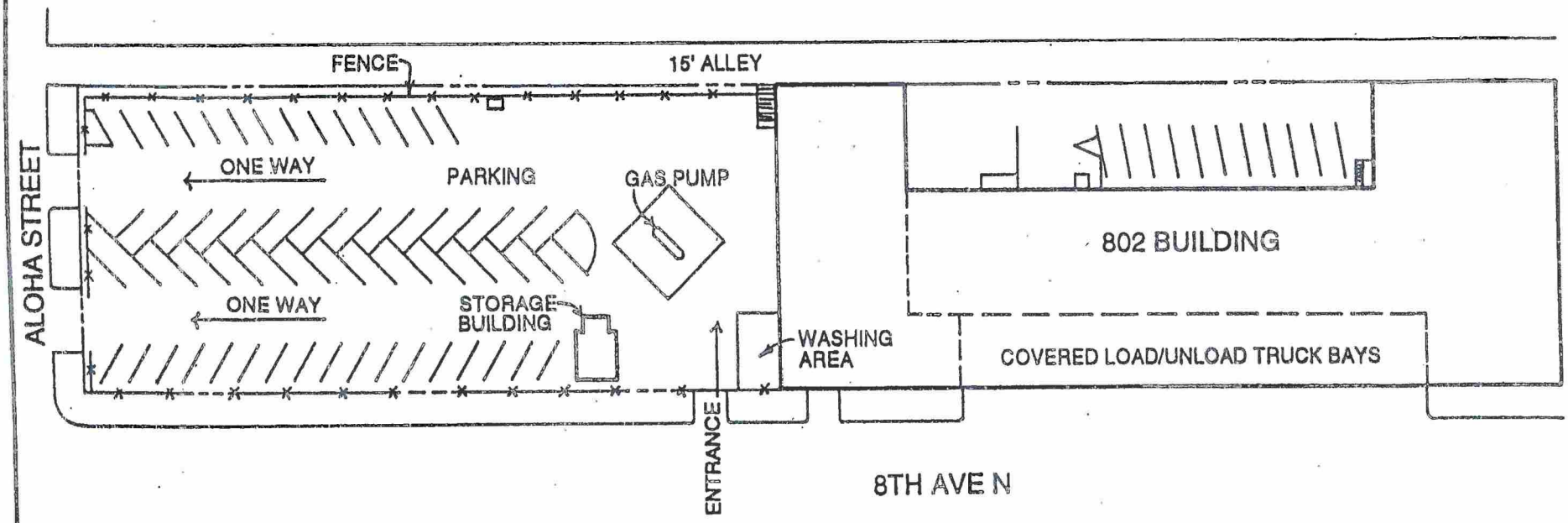


Figure 2 SITE PLAN

SCS ENGIN S

SECTION 3

GEOPHYSICAL SURVEY

A geophysical survey was conducted at the site on April 28, 1992 in attempt to locate all active and any abandoned underground fuel storage tanks. The survey was performed by Terra Associates, Inc. under the observation of an SCS geologist. A letter report describing the investigation was prepared by Terra Associates and is provided in Appendix A.

Ground penetrating radar (GPR) was used to conduct the geophysical survey. Magnetometer instrumentation was also attempted but was unsuccessful because of the interference produced by adjacent buildings, fences, and the presence of reinforcing steel in the concrete.

Three general areas were traversed in the south end of the parking lot. As described in Terra's Geophysical Report (Appendix A) the areas covered include the northwest corner of the service shop building (Area A), around the storage shed (Area B), and an area extending from the fuel pump island to the east property line (Area C).

The results of the survey were generally inconclusive. The instrumentation failed to detect the 550-gallon tank known to exist in Area A, reportedly because of the presence of concrete and rebar. A zone of poor reflectivity and faint hyperbolic response was detected near a suspected tank location in Area B, between the existing fuel island and the storage shed. The Geophysical Report indicates that a tank backfilled with concrete or wet, non-reflective clay soils could possibly exist at this location.

A partial image of the recently inactivated 2,700-gallon underground gasoline tank was identified in Area C. A complete image of the tank was masked by interference from the reinforced concrete pad. The tank appears to be oriented in east-west direction, as shown on the engineering drawings discussed in Section 2.

The results of the geophysical survey indicated that the site is probably underlain by an assortment of fill debris over native fine-grained soils. Wet soil conditions may exist at shallow depths along the east property boundary. No other active or abandoned tanks were identified on the property using GPR methodology.

SECTION 4

SOIL VAPOR SURVEY

A soil vapor survey was conducted at the site by SCS Engineers on April 28, 1992. A total of 62 locations were tested for the presence of volatile organic vapors in the shallow subsurface soil at the site. The locations and results of the survey are illustrated in Figure 3.

At each test location, a one-half-inch diameter hole, approximately one to three feet in depth, was constructed using a portable drill and a hand-driven bar punch. A portable photoionization analyzer (HNu meter), which was calibrated to a direct reading for benzene (a constituent of gasoline), was used to test for volatile organic vapors in the soil at each test location. The meter probe was inserted into each hole and a reading was then recorded.

The test locations were selected based on the location of the fuel dispenser leak and the known or suspected presence of underground tanks. Areas that showed as subsurface anomalies or possible tank locations using GPR methodology were also tested during the soil vapor survey.

Several transect lines are shown in Figure 3 which illustrate the area traversed. Test locations were usually spaced five to ten feet apart, except for around the fuel island where each test location was separated by a distance of 15 feet.

Soil vapor test results ranged from no detection to 140 ppm. The results indicate that the property does not appear to be extensively impacted by gasoline spills or fuel leaks. Readings around the fuel island and existing underground tank ranged from less than 5 ppm to 30 ppm. Volatile organic vapors in this area are likely from infiltration of product drippings from refueling activities, routine vehicle service, or traffic in the yard.

The highest levels of volatile vapors were recorded near the abandoned 550-gallon underground tank and the area at the gate entrance on 8th Avenue, about 20 to 30 feet north of the tank. Volatile organic vapors were recorded up to 140 ppm on the east side of the tank and up to 100 ppm near the main gate. The high vapor readings appeared to be isolated and were limited to within about 10 feet in any one direction.

Soil vapor readings around the GPR anomaly in Area B, southeast of the storage shed, suggest that the soil is not significantly impacted by lighter fraction petroleum hydrocarbons, such as gasoline. This was the approximate location of a 4,000-gallon diesel tank, shown on the 1967 engineering drawing.

Six locations were also tested along the east property boundary for volatile vapors. This area was selected for testing to assess the possibility of any off-site migration of contamination because of the eastward slope of the surrounding topography. The readings ranged from <1 to 8 ppm, which are very low and insignificant levels of volatile organic vapors.

One important consideration of this soil vapor survey is that the photoionization meter used to detect volatile organic vapors is calibrated to benzene, which is a constituent in gasoline. However, the meter is less sensitive to other fuel products such as diesel and motor oil, which ordinarily do not contain benzene. Therefore, if fuel contamination other than from gasoline is present in the soil at the site, it may not have been readily detected.

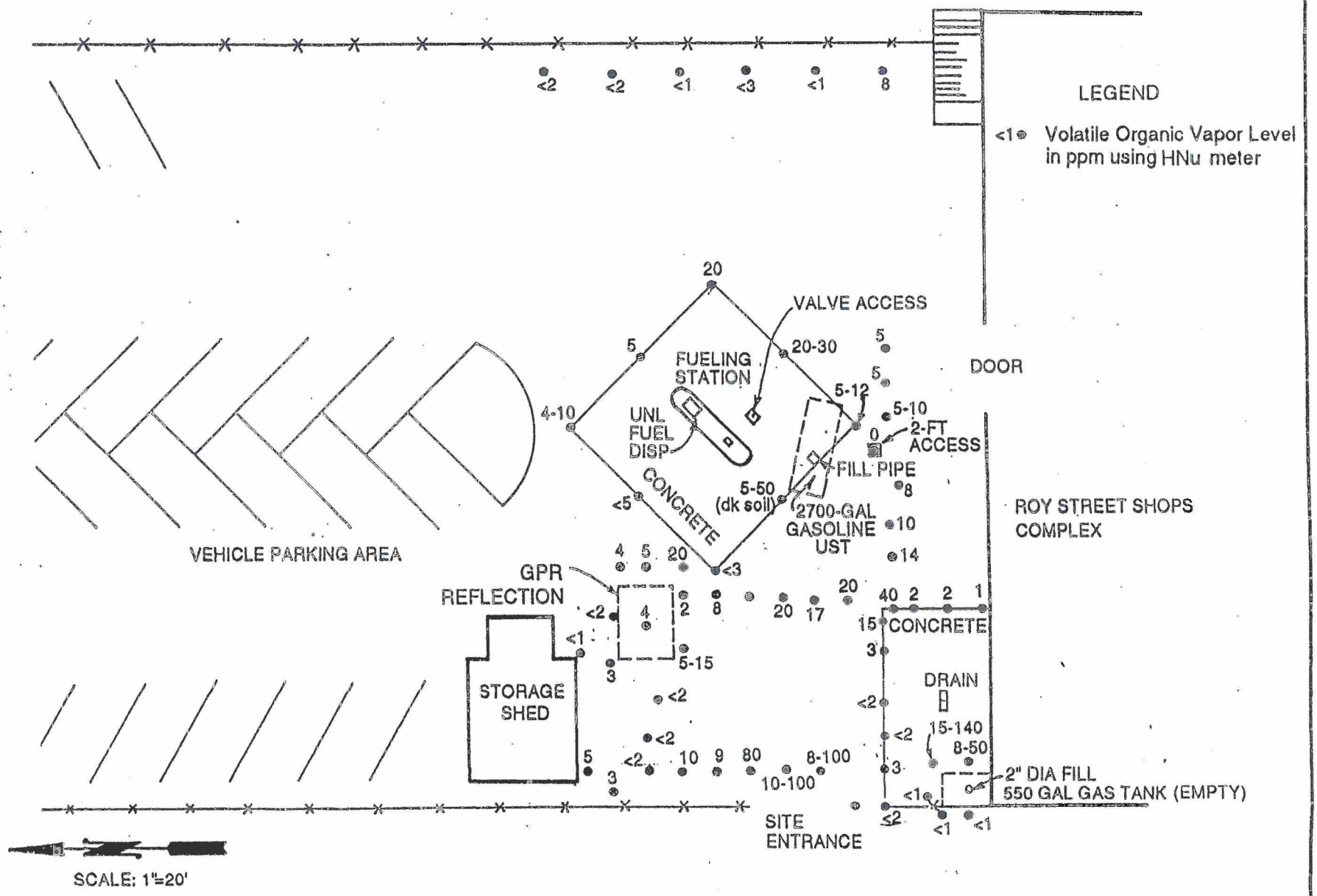


Figure 3 SOIL VAPOR TEST RESULTS

SECTION 5

CONCLUSIONS

Our findings indicate that two underground tanks are present on the property; and that a third tank is suspected. The tanks located during this investigation include the 2,700-gallon tank that was temporarily inactivated and a 550-gallon abandoned gasoline tank.

The geophysical survey conducted on April 28, 1992, provided data that indicated the possible presence of a third tank between the storage shed and the fuel island. Available engineering drawings illustrate the presence of a 4,000-gallon underground diesel tank that may have been previously installed at this location.

Our soil vapor survey indicated that the leak discovered at the fuel pump dispenser is likely very localized. The survey did not detect any significant volatile vapors at the edge of the concrete around the fuel pump service area, or around the 2,700-gallon gasoline tank.

The soil vapor survey indicated the presence of moderately high volatile vapors on the east side of the abandoned 550-gallon tank and near the center of the main gate entrance. This is an indication that subsurface soils in these areas could be contaminated with petroleum hydrocarbons.

No significant vapors were detected in any other areas of the property, including the area possibly occupied by a 4,000-gallon underground diesel tank. It should be noted however, that the vapor meter was calibrated to benzene- a constituent of gasoline. If diesel fuel contamination is present, it would not be readily detectable using this method.

SECTION 6

RECOMMENDATIONS

Based on the results of this investigation, we recommend the following:

- Locate and repair the leak at the fuel pump dispenser and maintain all records of any repairs. Conduct a tank tightness test to determine if the problem has been corrected as a result of the repair.

- We are not recommending any further investigation for soil contamination below the fuel dispenser because our findings indicate that the leak did not result in a significant problem. However, in order to provide a more definitive assessment of the possibility of fuel migration, we suggest installing two or three soil borings east of the service island.

- Proceed to abandoned and decommission the 550-gallon UST in accordance with State regulations. Since there is evidence of soil contamination adjacent to the tank, we recommend to excavate the tank only if it does not involve disrupting or otherwise undermining the foundation to the service shop building. The soil adjacent to the tank should be tested for BETX (benzene, ethylbenzene, toluene, and xylene) and total lead contamination, since the tank previously stored gasoline.

- Excavate a shallow test pit at the main gate to inspect for subsurface soil contamination. Collect and test several soil samples from the excavation to document levels of petroleum hydrocarbon (BETX and TPH) contamination.

- Excavate the area just south of the storage shed to determine if an abandoned UST is present. If present, proceed to properly abandon and decommission the tank in accordance with State regulations.

APPENDIX A

GEOPHYSICAL SURVEY REPORT
TERRA ASSOCIATES, MAY 7,1992

TERRA ASSOCIATES, Inc.
Consultants in Geotechnical Engineering, Geology
and
Environmental Earth Sciences

May 15, 1992
Project No. T-2030

Mr. Rick Alvord
SCS Engineers
2950 Northup Way
Bellevue, Washington 98004

Subject: Geophysical Investigation
Roy Street Shops Complex
802 Roy Street
Seattle, Washington

Dear Mr. Alvord:

As requested, Terra Associates has completed a geophysical investigation at the Roy Street Shops Complex in Seattle. The purpose of our work was to locate underground storage tanks in the north parking lot of the complex using geophysical techniques. The survey was performed using Ground Penetrating Radar (GPR) equipment subcontracted from Williamson and Associates of Seattle. Due to the presence of metal fencing, metal sheds and overhead power lines, it was not feasible to use magnetic instrumentation for our survey.

EXPLORATION

Our field work was performed on April 28, 1992. The City of Seattle provided blueprints showing the locations of three underground storage tanks. We established arbitrary exploration grids across the southern portion of the north parking lot, around areas where the tanks were expected. These grids were initially surveyed on five foot centers. When possible targets were encountered, or where tanks were expected, additional transects were performed on 2.5 foot centers to obtain greater detail.

The equipment used during this survey was a GSSI System 3 Ground Penetrating Radar (GPR) with a 500 mHz antenna. The GPR reflects electromagnetic (EM) waves using an antenna, which transmits and receives EM pulses. Waves reflected back from subsurface features are immediately processed and displayed on a graphic recorder. The EM reflections typically occur at boundaries separating materials with different electrical properties. A continuous profile of subsurface features can be obtained by pulling the antenna along the transect of interest. Reflections from targets, such as pipes or other round objects, appear as hyperbolic features. Flat surfaces produce high amplitude reverberations. The hyperbolic shape associated with round objects appears because the antenna has a fairly broad radiation pattern within the ground. The antenna "sees" the object before and after it has moved over it, which results in a longer, slanted reflection path on both sides of the target.

All data was acquired on a 60 nanosecond scale graphically displayed as 1.0 to 1.5 feet per division.

Three general areas were explored in the southern portion of the north parking lot. Area A is located immediately north of the northwest corner of the existing complex. Area B is around a storage shed, north of Area A. Area C was around and east of the existing pump island. The exploration grids, mapped reflection depths, and pertinent site features are shown on the attached Site Plan.

Area A

Area A is surfaced with a steel reinforced concrete slab. A filler cap and vent pipe are visible at the southwest corner of Area A. Based on tape measurements obtained through the filler cap, it was determined that the tank was installed at least four feet below the ground surface. Due to the concrete slab and rebar, the penetration depth of the GPR was reduced to less than four feet. This was not deep enough to image the tank, despite its apparent location.

Area B

Area B was paved with asphalt, except for a small concrete pad extending east from a storage shed. Two shallow pipelines were imaged south and east of the shed at a depth of about one foot. One image corresponded with a known water line.

A very shallow reflective point, about six inches below the surface, was imaged at grid location 6N, 0E. In general, the area where the tank was expected to be, displayed very poor reflectivity. A faint, hyperbolic reflection was detected four feet down at 6N, 10E. This is near the east end of a tank shown on the as-built plan. The zone immediately east of the poorly reflective area is highly reflective, indicating a sharp change in subsurface conditions. It appears that the Area B tank was backfilled with a non-reflective, or absorbing, material such as concrete or wet clay.

Area C

Area C covers the south half of the existing pump island area and extends north and east to a chemical storage pen. This area was paved, except for the pump island zone, which had a reinforced concrete pad.

As in Area A, the concrete pad limited the penetration depth of the GPR. However, a hyperbolic reflector characteristic of a tank was detected just outside the limits of the pad at 10N, 12E. In addition, a two foot deep reflector was encountered along the 20E grid alignment between ON and 15N. This shallow reflector aimed towards a tank vent, which was visible on the side of the existing shops building. Based on the partial tank image, the location of the filler cap, and the vent alignment, it appears this tank was installed as shown on the as-built, with its long axis oriented east-west.

Further survey of Area C encountered old and new, shallow piping. A reflective zone was also mapped between gridline 60E and 70E. This area of high amplitude reflection appears to be a drainage pipe alignment surrounded by very wet soils.

SUMMARY

In general, the survey encountered highly variable soil conditions. The parking lot area appears to be constructed on variable fill soils placed over native, fine-grained soils. The fills often contained reflective constituents, suggesting the presence of debris, such as concrete chunks. The native soils demonstrate poor reflectivity characteristics. If used for tank backfill, they may mask the underlying tank. In addition, the reinforced concrete pads reduced the penetration depths of GPR. We were unable to image a tank in Area A, despite evidence of its depth and location. Lack of reflection in parts of Area B indicates that a tank may have been backfilled with concrete or with wet, non-reflective clay soils. Although we obtained only a partial image of a tank in Area C, it appears to be aligned in an east-west direction. Finally, wet soil conditions predominate along the east side of the parking area, although no evidence of seepage was noted through the adjacent rockery below.

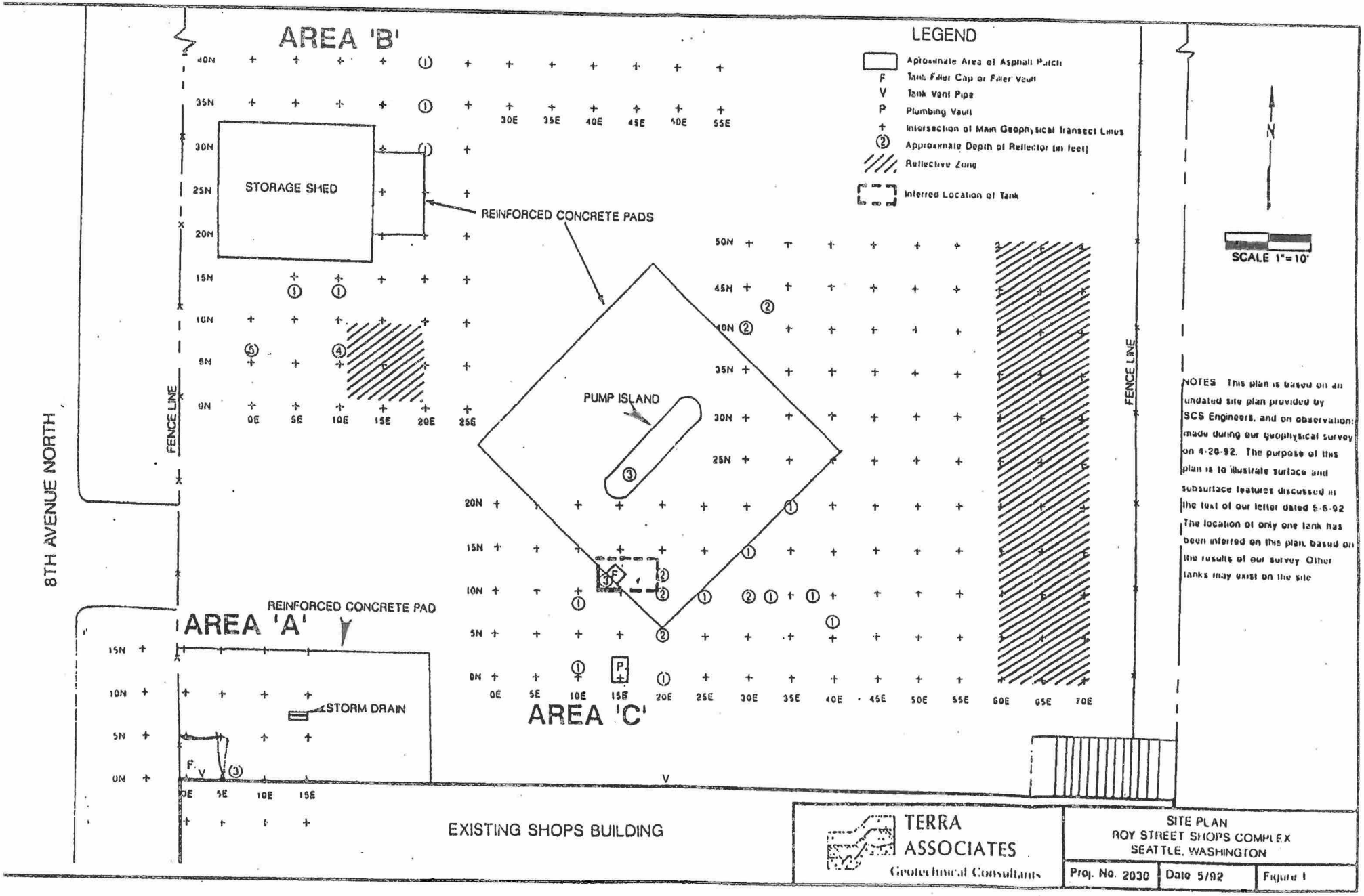
It has been a pleasure to be of service to you on this project. If you have any questions regarding our data or observations, please call.

Sincerely yours,

TERRA ASSOCIATES, INC.

Theodore J. Schepper, P.E.
Principal Engineer

DHG/TS:tm


AREA 'B'
AREA 'A'
AREA 'C'
STORAGE SHED
REINFORCED CONCRETE PADS
REINFORCED CONCRETE PAD
PUMP ISLAND
STORM DRAIN
FENCE LINE
FENCE LINE
8TH AVENUE NORTH
EXISTING SHOPS BUILDING
LEGEND
Approximate Area of Asphalt Patch
F Tank Filler Cap or Filler Vault
V Tank Vent Pipe
P Plumbing Vault
Intersection of Main Geophysical Transect Lines
Approximate Depth of Reflector (in feet)
Reflective Zone
Inferred Location of Tank
N
SCALE 1"=10'
NOTES This plan is based on an undated site plan provided by SCS Engineers, and on observations made during our geophysical survey on 4-28-92. The purpose of this plan is to illustrate surface and subsurface features discussed in the text of our letter dated 5-6-92. The location of only one tank has been inferred on this plan, based on the results of our survey. Other tanks may exist on the site.
TERRA ASSOCIATES
Geotechnical Consultants
SITE PLAN
ROY STREET SHOPS COMPLEX
SEATTLE, WASHINGTON
Proj. No. 2030
Date 5/92
Figure 1