AGRA EARTH & ENVIRONMENTAL, INC.
PHASE II RELEASE INVESTIGATION
GOLD HILL LIQUOR AND GROCERY
FAIRBANKS, ALASKA

Submitted To:

Mr. Phil Carboy
Gold Hill Liquor and Grocery
3040 Parks Highway
P.O. Box 80701
Fairbanks, Alaska 99708

Submitted By:

AGRA Earth & Environmental, Inc.
600 University Avenue, Suite 5E
Fairbanks, Alaska 99709

James A. Sprinter for

Douglas J. Buteyn
Project Geologist

John B. Carnahan
Environmental Project Manager

MARCH 1995

32-01110-00

AGRA
Earth & Environmental

TABLE OF CONTENTS

PAGE

LIST OF FIGURES

LIST OF TABLES

TABLE OF CONTENTS (Continued)

APPENDICES

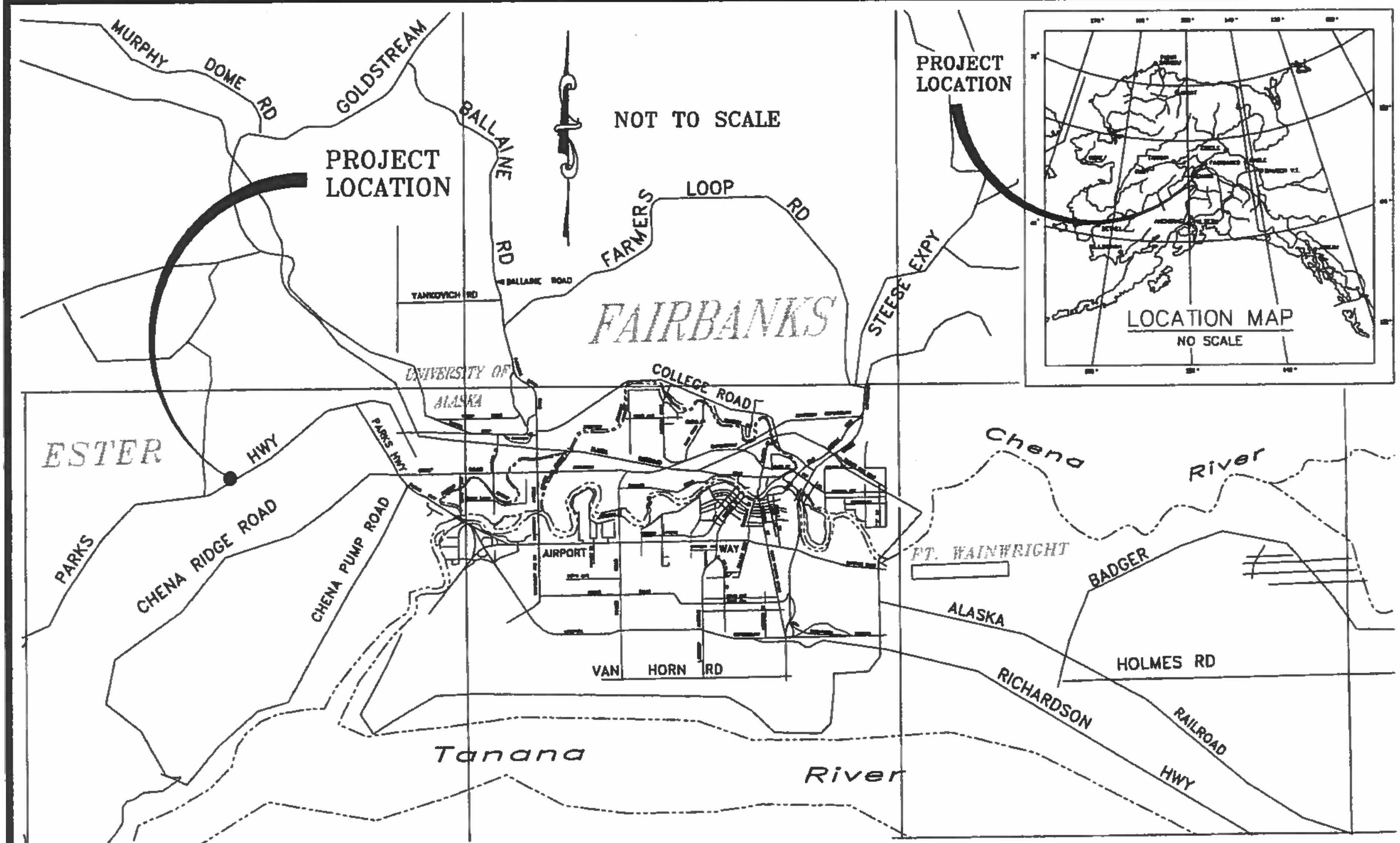
1.0 INTRODUCTION

This report summarizes the activities performed and findings obtained by AGRA Earth & Environmental, Inc. (AGRA) during a Phase II Release Investigation at the Gold Hill Store near Fairbanks, Alaska. The purpose of this work was to delineate the vertical and horizontal extent of petroleum hydrocarbon contamination in the soil and groundwater beneath the subject site. The contamination had previously been documented as originating from regulated gasoline USTs on the property. This work was partially funded by the Alaska Department of Environmental Conservation (ADEC) Underground Storage Tank Financial Assistance Program under Grant No. 150446021. The Phase II Release Investigation was conducted as Task 3 of AGRA's work plan under this grant.

The subject site, referenced as the Gold Hill Store, is located at 3040 George Parks Highway, approximately 7.5 miles west of downtown Fairbanks (Figure 1, page 2). The property is currently owned by Phil and Genevieve Carboy and is described as Tax Lot 926 in Section 9, Township 1 South, Range 2 West, Fairbanks Meridian, within the Fairbanks North Star Borough, Alaska. The property is a roughly square, approximately 2.3-acre site which is generally flat and level. In the northwest portion of the lot, the ground surface becomes progressively more uneven as it approaches the base of a steep bluff that marks the northern edge of the property. The bluff is a steep wall of loess deposits that rises approximately 150 feet above the valley floor. Uneven areas along the west side of the property appear to be tailings piles that are overgrown with vegetation. The property slopes generally to the south and runoff from the site is channeled into a drainage ditch that parallels the north side of the Parks Highway. Topographic map coverage of the site is provided by the U.S. Geological Survey Fairbanks (D-2 SW), 1:25,000, 7.5-minute quadrangle.

The site is currently operating as a liquor and grocery store. The site was also a retail gasoline station until late July 1994, when the gasoline USTs and associated fuel dispensers were decommissioned. The potentially contaminated soil excavated during the UST closure was stockpiled in a lined and bermed storage cell on the northeast portion of the property. The southeastern portion of the property is presently leased to the Fairbanks North Star Borough and is used as a solid waste collection facility. A map showing the major features of the property is provided as Figure 2 (page 3).

Field work for this investigation, including monitoring well installation, well development, and groundwater sample collection, was conducted between November 8 and December 22, 1994. Drilling and well construction services were provided by Airborne Exploration, Inc. of Fairbanks. All other phases of work were performed by AGRA personnel.



• FROM FAIRBANKS NORTH STAR BOROUGH GENERAL VICINITY MAP.

PHASE II RELEASE INVESTIGATION

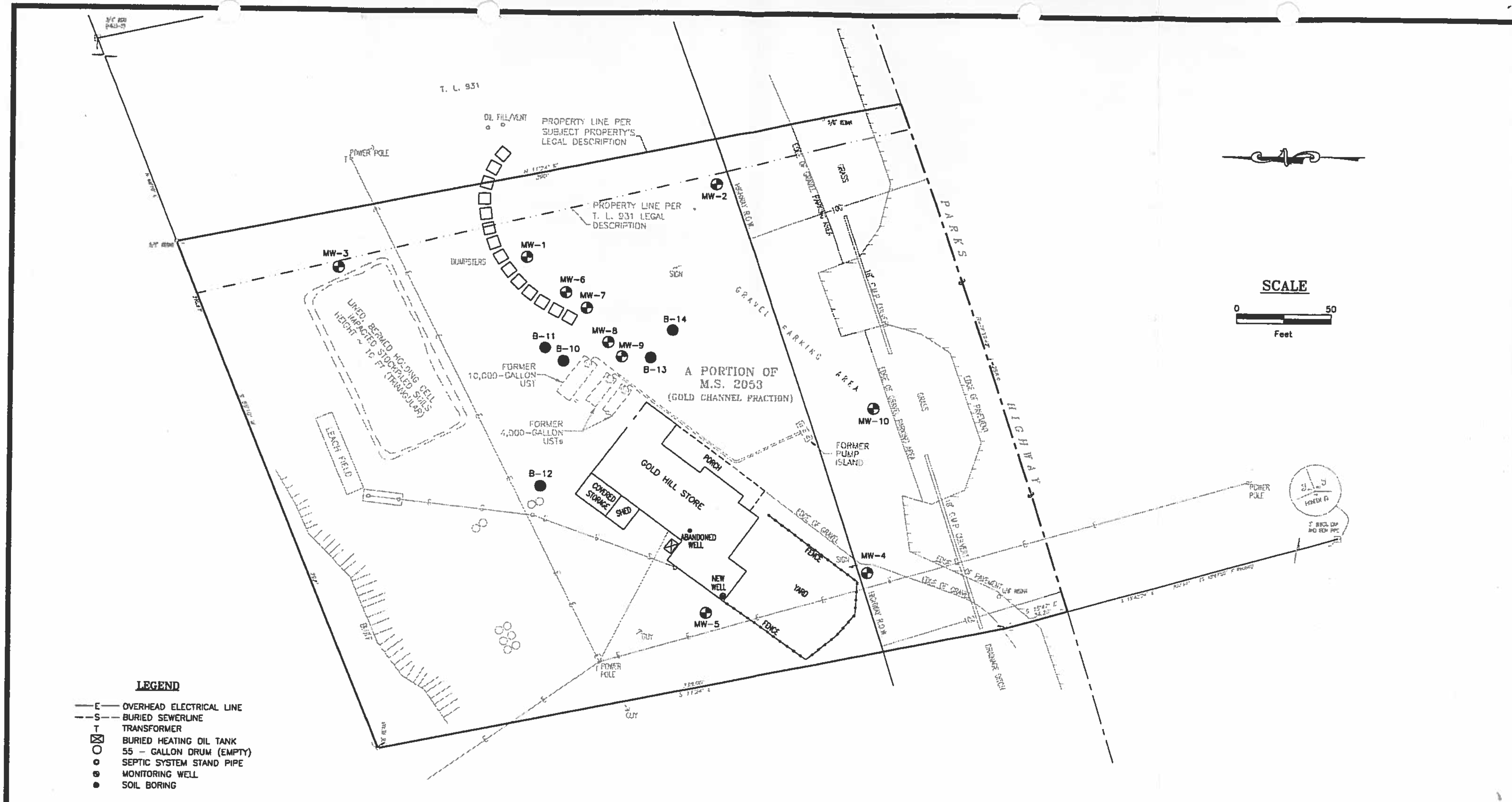
AGRA EARTH & ENVIRONMENTAL, INC.
600 University Avenue
Suite 5E
Fairbanks, Alaska 99709

PROJ #	32-01110-00
DESIGN	DJB
DRAWN	PTS/F1110VIC
DATE	08/31/94
SCALE	NOT TO SCALE
REVISED	01/24/95

SITE LOCATION MAP

GOLD HILL STORE
3040 PARKS HIGHWAY
TL 926, SEC 9, T1S, R2W
FAIRBANKS, AK

FIGURE 1



FROM SURVEY BY STUTZMANN ENGINEERING ASSOC. INC.

PHASE II RELEASE INVESTIGATION AGRA EARTH & ENVIRONMENTAL, INC. 600 University Avenue Suite 5E Fairbanks, Alaska 99709	PROJ # 32-01110-00 DESIGN DJB DRAWN PTS/F1110SIT DATE 09/02/94 SCALE AS SHOWN REVISED 01/24/95	SITE MAP GOLD HILL STORE 3040 PARKS HIGHWAY TL 926, SEC 9, T1N, R2W, F.M. FAIRBANKS, AK FIGURE 2

2.0 BACKGROUND

AGRA's original involvement with this project consisted of a subsurface investigation performed on the adjacent property to the east. That investigation documented that groundwater north of the drinking water well on the property was impacted by gasoline range petroleum hydrocarbons (GRPH). Benzene has subsequently been detected in water samples from the drinking water well. In order to investigate potential sources of the contamination, and the potential impact to the water well, ADEC requested a subsurface release investigation at the Gold Hill property.

The initial subsurface release investigation at the Gold Hill site was performed by AGRA in May 1994. The results of that investigation were presented in AGRA's report *Release Investigation, Gold Hill Store, Fairbanks, Alaska*, dated June 1994. The investigation consisted of drilling four soil borings: one near the former fuel dispenser island (boring SB-1), one adjacent to the former regulated USTs (boring SB-2), one near the southeastern property corner (boring SB-3), and one in front of the solid waste dumpsters (boring SB-4). The latter two locations were between the USTs and the water well on the adjacent property to the east. Boring SB-4 was converted to monitoring well MW-1. The analytical results from that investigation are reproduced in Table 1.

TABLE 1
Analytical Results - May 1994 Release Investigation

Sample Number	Depth	GRPH	Benzene	Toluene	Ethylbenzene	Xylenes	Total BTEX
Soil Sample Results (mg/kg)							
SB-1/S-3		0.503	0.025	0.026	0.025	0.104	0.180
SB-1/S-4		0.600	0.030	0.030	0.030	0.060	0.150
SB-2/S-3		769	0.431	9.17	13.3	86.1	109.001
SB-2/S-4		6110	69.1	556	238	1,012	1,875.1
SB-3/S-3		8.73	0.057	0.402	0.131	0.532	1.122
SB-3/S-4		5.56	0.033	0.245	0.030	0.475	0.783
MW-1/S-1		0.600	0.030	0.044	0.030	0.092	0.196
MW-1/S-2		3.46	0.045	0.651	0.249	0.930	1.875
MW-1/S-3		881	0.827	40.7	37.0	162	240.527
MW-1/S-4		18,200	194	141	792	2,284	3,411
Water Sample Results (µg/L)							
MW-1		192,000	20,500	42,300	9,660	3,710	109,560

GRPH: Gasoline Range Petroleum Hydrocarbons by EPA Method 8015 Modified
BTEX: Benzene, Toluene, Ethylbenzene, Xylenes by EPA Method 8020

Except for the samples collected from boring SB-3, all of the soil samples contained analyte concentrations in excess of the most stringent ADEC cleanup standards. The groundwater sample from well MW-1 contained BTEX concentrations that exceed state and/or federal limits for the stated compounds. In addition, 0.2 feet of free phase product (primarily gasoline range) was measured floating on the water table in well MW-1.

Additional work at the site has included a Phase I environmental site assessment prepared in September 1994, and a ground penetrating radar (GPR) survey conducted in August 1994. The Phase I investigation reviewed the historical use of the subject site and immediate vicinity to assess the potential for other sources of the subsurface contamination. Although some potential sources of petroleum hydrocarbons were identified, none were located either topographically or hydrologically upgradient of the Gold Hill Store property. Historically, the subject site was a portion of a large placer gold mining claim. The purpose of the GPR survey was to attempt to map the presence of groundwater overlying the bedrock beneath the site to assess the possibility that the groundwater was localized in channels carved into the bedrock by the former dredging operations. No such channels were identified by that study and a relatively continuous groundwater surface was interpreted across the areas investigated. Coincident with the GPR study was the installation of monitoring well MW-2 in the approximate location of soil boring SB-3. Groundwater was encountered in MW-2 at approximately 13 feet below the ground surface. The GPR study is included with this report as Appendix A.

3.0 SCOPE OF WORK

The scope of work for this investigation was described in AGRA's *Work Plan for Additional Soil and Groundwater Investigation, Gold Hill Store, Fairbanks, Alaska*, dated October 1994. The work plan was approved by the ADEC in early November 1994. The objective of the investigation was the delineation of the subsurface contamination in the soil and groundwater beneath the Gold Hill Store property. As described in the work plan, three tasks were planned to accomplish this objective. These tasks included:

- Laboratory analysis of soil samples collected from five soil borings in the vicinity of the former USTs to assess the extent of subsurface soil contamination;
- Laboratory analysis of soil samples collected during the installation of four additional monitoring wells on the site; and
- Laboratory analysis of groundwater samples from six monitoring wells to evaluate the extent of the plume of impacted groundwater and the potential for plume migration to the drinking water well on the adjacent property.

The four new monitoring wells were to be located near the property boundaries, both upgradient and downgradient of the former USTs, to allow assessment of groundwater quality, flow direction, and gradient across the entire property. To allow for future feasibility testing of remedial processes, two additional tasks were included in the scope of work. These tasks included:

- Installing three soil vapor extraction (SVE) test wells within the zone of contaminated soil around the former USTs; and

- Installing a single air sparging test well within the plume of impacted groundwater.

The work plan included the SVE and air sparging tests as part of the Phase II investigation. However, a need has arisen for compilation of the soil and groundwater data collected during the well installation. As a result, this report has been prepared prior to conducting the remedial feasibility tests.

4.0 FIELD METHODS

All field work was conducted in accordance with the approved work plan. Sample collection and handling was performed in accordance with AGRA's Quality Assurance Program Plan (QAPP). The QAPP has been approved by ADEC and is on file in the Northern Region Office in Fairbanks. The field portion of this investigation included the drilling of soil borings and installation of monitoring wells, well development, and groundwater sampling. The methods used for each of these tasks are described in the following sections.

4.1 SOIL BORINGS AND SAMPLE COLLECTION

The drilling and well installation portion of this investigation was conducted between November 8 and November 15, 1994. Temperatures during that time period ranged from -5°F to 15°F. Two well types were installed as part of this project. Monitoring wells were placed to enable continued groundwater quality observations, and test wells were installed for future site characterization testing. A total of 13 soil borings were drilled during this project of which eight borings were completed as monitoring or test wells. Three monitoring wells (MW-4, MW-5, and MW-9) and the air sparging test well (MW-6) were constructed using two-inch diameter well casing. The remaining two monitoring wells and the two SVE test wells were constructed using four-inch diameter casing. All drilling was accomplished using a truck-mounted Mobile B-47HD drilling rig equipped with either six-inch or eight-inch outside diameter hollow-stem augers. The latter were used for drilling the borings which were converted to four-inch diameter wells.

4.1.1 Soil Borings and Monitoring Well Construction

The 13 borings included five soil borings in the vicinity of the former regulated USTs and eight monitoring wells spaced across the property. The soil borings were numbered sequentially as borings B-10 through B-14. The monitoring and test wells were numbered sequentially as MW-3 through MW-10. As proposed in the work plan, one monitoring well (MW-10) was to be located within the Right-of-Way (ROW) for the Parks Highway. Prior to installing this well, AGRA contacted the Alaska Department of Transportation & Public Facilities (ADOT&PF) and obtained a permit for this purpose. A copy of the permit is included with this report as Appendix B. The well and soil boring locations are shown on Figure 2.

All of the borings were advanced until refusal by competent bedrock. In general, competent bedrock was encountered at a depth of approximately 20 feet below the ground surface and was confirmed by sample collection. Soil samples were collected at nominal five-foot intervals during drilling using a 3-inch outside diameter (OD) split-spoon sampler. The sampler was driven in advance of the auger using a 340-pound hammer on a 30-inch drop. Bedrock refusal was indicated when 60 blows of the hammer advanced the sampler less than six inches. A geologist from AGRA was on site to collect the samples, log the subsurface geology in each boring, and record the geotechnical and well construction details. A geologic log for each of the 13 borings is provided in Appendix C.

Upon reaching final depth, each boring was either abandoned or converted to a monitoring or test well. Boring abandonment consisted of removing the auger from the boring and backfilling with the drill cuttings. Bentonite chips were mixed with the cuttings in the upper few feet of each boring to seal the boring and minimize infiltration of surface water. All wells were constructed using Schedule 40 PVC well casing. In general, the casing was installed to 20 feet and consisted of 15 feet of well screen and 5 feet of blank casing. The annulus was backfilled with 10-20 grade silica sand to two feet above the well screen, or approximately three feet below grade. The remaining backfill included at least two feet of bentonite chips finished with concrete. A portion of the wells were capped with watertight flush-mounted monuments. The remaining wells will be completed with protective steel riser monuments to be installed in Spring 1995.

Monitoring wells MW-3, MW-4, MW-5, and MW-10 were installed near the margins of the property to allow assessment of groundwater quality across the entire site. Well MW-6 was installed as the air sparging test well, and wells MW-7, MW-8, and MW-9 were installed as SVE test wells. The construction details for these wells are as described above with the exception of the air sparging well MW-6. This well was screened only through the bottom three feet of the well casing. Clean drill cuttings were used as backfill above the bentonite seal in this well. Well construction details for the eight wells are included on the geologic logs in Appendix C.

During the drilling and construction of the monitoring wells, the drill cuttings were temporarily stored adjacent to each boring on the ground surface. Upon completion of well construction, the drill cuttings were transferred to the bed of a truck, which was lined with visquene, and transported to a temporary storage area on the northern portion of the property. The cuttings were shoveled out of the truck onto an impermeable liner and covered with visquene. The storage area for the cuttings is located adjacent to the containment cell for the soil removed during the UST excavation. The soils will be relocated to within the containment cell when weather permits removal of the holding cell cover.

4.1.2 Sample Collection and Equipment Decontamination

Sampling protocol included the collection of both field screening and analytical soil samples at five-foot intervals in each boring, beginning at a depth of approximately five feet below grade. Upon removal of the split-spoon sampler from the boring, the sampler was opened, and the analytical samples were collected. The field screening sample was collected immediately after obtaining the analytical sample. During the sample collection process, the soil in the sampler was characterized and examined for obvious indications of the presence of petroleum hydrocarbons. The soil characteristics and sample information were then recorded on the geologic log.

The analytical samples were collected using a stainless steel trowel to transfer the soil from the split-spoon sampler to laboratory-prepared sample jars. The jars were filled to capacity to minimize headspace and then capped with a teflon-lined lid. Each jar was labeled with the sample number, the date and time of collection, and the analytical method requested. The numbering scheme for the samples included the boring or well number followed by a sequence number, reflecting the order in which the sample was collected. While on site, the jars were stored in a chilled cooler. Each evening, the samples were transferred to a refrigerator for storage until submitted to the laboratory.

Collection of the field screening samples consisted of filling a clean, sealable plastic bag approximately one-third full of soil. The screening samples were labeled using the same number as the analytical sample, and the sample number was written directly on the bag using an indelible marker. Sample analysis consisted of screening the headspace gas inside the bag for volatile organic compounds using an Environmental Instruments Model 580D Organic Vapor Meter (OVM). Prior to screening, each sample was warmed for 20 to 30 minutes inside the field vehicle. The samples were screened by inserting the probe of the OVM into a small opening at the top of the sample bag and allowing the headspace gas inside the bag to be pumped through the instrument. The OVM provides a digital display, in parts per million (ppm), of the concentration of volatile organic compounds in the headspace gas. For each sample, the maximum reading observed on the display was recorded as the headspace gas concentration for that sample.

Following sample collection, any residual soil in the sampler was discarded to the pile of soil cuttings adjacent to the boring. The stainless steel spoon and the split-spoon sampler were then decontaminated. The decontamination process included washing with a laboratory-grade soap solution, rinsing with potable water, and triple rinsing with distilled water. Decontaminated sampling equipment was stored on a clean surface inside the field vehicle until its next use.

4.2 MONITORING WELL DEVELOPMENT

Development of the eight monitoring wells installed as part of this investigation was conducted on December 14, 1994. As planned, development was to consist of alternately surging and purging each well using a bailer as a surge block and a gasoline-powered pump to purge each well. However, due to a malfunction in the pump, the purging was done by hand using a bailer. Prior to initiating well development at each well, the bailer was lowered into the well to obtain a sample of the upper one to two feet of water in the well casing. This sample was visually examined for the presence of free-phase product or visible sheen and tested for obvious hydrocarbon odor. Although no free-phase product was observed, the water in wells MW-6, MW-7, MW-8, and MW-9 exhibited a strong hydrocarbon odor and/or visible sheen.

In general, the water removed from each well was extremely silty and showed no decrease in silt content throughout the development process. At the time of development, each of the wells contained between three to five feet of water. The casing volume was calculated using a uniform water column depth of five feet and an effort was made to remove a minimum of three times the calculated casing volume during well development. The well development process, including any pertinent observations at each well, is summarized in Table 2.

TABLE 2
Summary of Well Development

Well Number	Casing Diameter (in)	Gallons of Water in Casing	Purged Volume (gal)	Number of Surge/Purge Cycles	Comments
MW-3	4	3.3	20	4	Very silty, no decrease in silt content during purging.
MW-4	2	0.8	5	-	Bailed dry after approximately two gallons removed.
MW-5	2	0.8	5	-	Bailed dry after approximately two gallons removed.
MW-6	2	0.8	10	3	Strong odor; no change in silt content during purging.
MW-7	4	3.3	7	2	Strong odor; considerably less silt than other wells.
MW-8	4	3.3	15	3	Strong odor; no change in silt content during purging.
MW-9	2	0.8	10	3	Strong odor; no change in silt content during purging.
MW-10	4	3.3	15	3	Very silty, no decrease in silt content during purging.

Purge water not exhibiting signs of hydrocarbon contamination was discarded on the ground surface around each wellhead. The purge water exhibiting a noticeable hydrocarbon odor was placed into a 55-gallon drum. The drum was labeled with AGRA's company name and phone number, the date of collection, and the nature of the contents. Before leaving the site, the drum cover was replaced and secured. The drum was stored at the site adjacent to the store building.

4.3 GROUNDWATER SAMPLE COLLECTION

AGRA personnel returned to the site on December 21, 1994, to collect groundwater samples from the monitoring wells. The sample collection process included measurement of the depth to water and total depth in each well, calculation of the volume of water in each well, and purging of at least three well volumes of water using a disposable bailer. Following the purging of each well, a sample of the groundwater in the well was transferred to laboratory-prepared sample containers using the bailer. The samples were labeled with the well number, the date and time of collection, and the requested analytical method. The samples were stored in a chilled cooler while on site and then transferred to a refrigerator for storage until submitted to the laboratory.

To allow calculation of water table elevation, gradient, and groundwater flow direction, a level survey was performed on the wells by AGRA personnel on December 22, 1994. For the survey, a temporary benchmark (TBM) was established at the site and assigned an arbitrary elevation of 100 feet. Each of the wells was then surveyed relative to the TBM to establish a top-of-casing elevation as well as the elevation of either the ground surface next to the well or the top of the well monument. The survey data and the measurements obtained during sample collection efforts are summarized below in Table 3.

TABLE 3
Monitoring Well Data
December 21, 1994

Well Number	Top of Casing Elevation (ft)	Depth to Water (ft)	Water Table Elevation (ft)	Casing Volume (gal)	Volume Purged (gal)
MW-1	96.71	13.58	83.13	1.0	5
MW-2	96.33	15.18	81.15	3.2	5
MW-3	98.15	15.27	82.88	3.1	9
MW-4	100.35	15.94	84.41	0.3	1
MW-5	97.44	12.57	84.87	0.5	1.5

TABLE 3 (Continued)
Monitoring Well Data
December 21, 1994

Well Number	Top of Casing Elevation (ft)	Depth to Water (ft)	Water Table Elevation (ft)	Casing Volume (gal)	Volume Purged (gal)
MW-6	97.40	13.95	83.45	1.1	not sampled
MW-7	97.69	14.10	83.59	3.8	not sampled
MW-8	97.60	13.90	83.70	4.0	12
MW-9	97.53	13.98	83.55	1.0	not sampled
MW-10	96.86	13.77	83.09	2.8	9

During the sampling process, a visible sheen and strong odor were exhibited by the water in wells MW-1 and MW-8. Monitoring wells MW-2 and MW-10 were purged dry with hand bailing. Wells MW-6, MW-7, and MW-9 were not sampled based on their proximity to well MW-8.

5.0 SUBSURFACE CHARACTERISTICS

The observations and measurements made while conducting the activities described in Section 4.0 allow a description of many of the physical characteristics of the subsurface environment beneath the Gold Hill Store property. This characterization includes the subsurface lithology, the groundwater within those sediments, and the nature of the bedrock interface.

In general, the subsurface environment beneath the site consists of approximately 20 feet of sediments overlying schistose bedrock. The upper 12 to 15 feet of sediments are comprised of gravelly sands which exhibit a general increase in the degree of sorting with depth. Between the gravelly sands and bedrock is approximately five to eight feet of a very fine silt with a relatively high plasticity. At the time of drilling, the water table roughly corresponded with the upper surface of the silt. The bedrock/silt interface likely acts as the lower limit of the aquifer. Based on the samples of bedrock collected during drilling operations, only the most weathered, upper layer of the bedrock contains water. Samples of the more competent bedrock appeared dry in the split-spoon sampler. This is similar to the observations made during the drilling activities completed for the preliminary release investigation.

Of particular note is the fact that the bedrock/silt interface and the silt/sand interface were encountered at an elevation approximately 5 feet higher in wells MW-4 and MW-5, drilled along the western margin of the property, than in the other borings. In addition, the zone of saturated soil exhibited the same change in elevation and the apparent water table remained roughly coincident with the upper surface of the silt. How abrupt this change in elevation is could not be determined within the scope of this investigation. However, it does appear to occur within a horizontal distance of less than 100 feet.

Although groundwater elevation measurements taken during the sampling event on December 21, 1994, indicate an elevated water table exists along the western edge of the property, the measurements also show the change in elevation is not as significant as was observed during drilling operations. The overall change in elevation amounts to between one to two feet rather than the approximately 5 feet observed during installation of the wells. From this, it appears that elevational changes in the sand/silt interface have a greater effect on the capillary fringe than associated changes in the bedrock/silt interface have on the static water table. Capillary forces within the silt may be sufficient to saturate the entire unit regardless of the relative elevation of the water table.

6.0 ANALYTICAL RESULTS

The soil and groundwater samples selected for laboratory analysis were submitted to Superior Precision Analytical, Inc. of Martinez, California. This laboratory is approved by the ADEC for organic analyses. All of the analytical samples were submitted for analysis for GRPH by EPA Method 8015 Modified and for benzene, toluene, ethylbenzene, and total xylenes (BTEX) by EPA Method 8020 (soil) or EPA Method 602 (water). The samples were submitted under chain-of-custody procedures in accordance with AGRA's QAPP. The analytical results for the soil and groundwater samples are summarized on Tables 4 and 5, respectively. Copies of the analytical reports are provided with this report in Appendix D.

All of the soil samples collected from the 13 soil borings were field-screened using the OVM. The field screening results for this project ranged from 0 ppm to 5408 ppm. For each boring, the two samples exhibiting the highest OVM readings were selected for analysis with the exception of samples from well MW-9. Although samples from this boring were field screened, none were submitted for analysis on the basis of the proximity of this well to well MW-8 and boring B-13.

It should be noted that the OVM provides a semi-quantitative indication of the presence of volatile petroleum hydrocarbons in the screened samples. However, the concentration of volatiles in the headspace gas of the sample bag is the result of many different factors acting in combination. As a result, the OVM results do not always correspond directly with the laboratory analytical results. On this project, the correlation between the OVM results and both the GRPH and BTEX results is very low. Consequently, the OVM results should not be used to infer GRPH and/or BTEX concentrations in samples not submitted for laboratory analysis.

TABLE 4
Gasoline Range Petroleum Hydrocarbons and BTEX Compounds in Soil

Boring Number	Field Sample Number	Laboratory Number	Depth (feet)	Headspace Gas Concentration (ppm)	GRPH (mg/kg)	Benzene (mg/kg)	Toluene (mg/kg)	Ethylbenzene (mg/kg)	Xylenes (mg/kg)	Total BTEX (mg/kg)
Regulatory Limit					50	0.1	na	na	na	10
B-10	B10-01	—	4.5 - 6	1.3	—	—	—	—	—	—
	B10-02	—	9.5 - 11	2.0	—	—	—	—	—	—
	B10-03	80019-01	14.5 - 16	1549	18	2.6	2.6	1.2	1.1	7.5
	B10-04	80019-02	19.5 - 20.5	119	<DL(1)	<DL(0.005)	<DL(0.005)	<DL(0.005)	<DL(0.005)	<DL(0.005)
B-11	B11-01	—	4.5 - 6	2.7	—	—	—	—	—	—
	B11-02	—	9.5 - 11	8.9	—	—	—	—	—	—
	B11-03	80019-03	14.5 - 16	1214	25	4.1	4.3	0.32	1.6	10.32
	B11-04	80019-04	19.5 - 20	124	71	1.1	2.4	1.3	5.8	10.6
B-12	B12-01	—	4.5 - 6	2.0	—	—	—	—	—	—
	B12-02	80019-05	9.5 - 11	2.0	<DL(1)	<DL(0.005)	<DL(0.005)	<DL(0.005)	<DL(0.005)	<DL(0.005)
	B12-03	80019-06	14.5 - 16	2.0	<DL(1)	<DL(0.005)	<DL(0.005)	<DL(0.005)	<DL(0.005)	<DL(0.005)
B-13	B13-01	—	4.5 - 6	2.0	—	—	—	—	—	—
	B13-02	80019-07	9.5 - 11	5408	480	<DL(0.05)	2	3.2	40	45.2
	B13-03	80019-08	14.5 - 16	308	6	0.51	0.88	0.094	0.62	2.104
	B13-04	—	19.5 - 21	87	—	—	—	—	—	—
B-14	B14-01	—	4.5 - 6	2.6	—	—	—	—	—	—
	B14-02	—	9.5 - 11	1.1	—	—	—	—	—	—
	B14-03	80019-09	14.5 - 16	212	13	2.2	2.9	0.26	1.3	6.66
	B14-04	80019-10	19.5 - 21	100	<DL(1)	<DL(0.005)	<DL(0.005)	<DL(0.005)	<DL(0.005)	<DL(0.005)
MW-3	MW3-01	—	4 - 5.5	1.1	—	—	—	—	—	—
	MW3-02	80019-11	9 - 10.5	1.9	<DL(1)	<DL(0.005)	<DL(0.005)	<DL(0.005)	<DL(0.005)	<DL(0.005)
	MW3-03	80019-12	14 - 15.5	1.1	<DL(1)	<DL(0.005)	<DL(0.005)	<DL(0.005)	<DL(0.005)	<DL(0.005)
	MW3-04	—	20 - 21	0.3	—	—	—	—	—	—
MW-4	MW4-01	—	4.5 - 6	0.0	—	—	—	—	—	—
	MW4-02	80034-01	9.5 - 11	0.0	<DL(1)	<DL(0.005)	<DL(0.005)	<DL(0.005)	<DL(0.005)	<DL
	MW4-03	80034-02	14.5 - 16	0.0	<DL(1)	<DL(0.005)	0.009	<DL(0.005)	0.072	0.081

AGRA Earth & Environmental

TABLE 4 (Continued)
Gasoline Range Petroleum Hydrocarbons and BTEX Compounds in Soil

Boring Number	Field Sample Number	Laboratory Number	Depth (feet)	Headspace Gas Concentration (ppm)	GRPH (mg/kg)	Benzene (mg/kg)	Toluene (mg/kg)	Ethylbenzene (mg/kg)	Xylenes (mg/kg)	Total BTEX (mg/kg)
Regulatory Limit					50	0.1	na	na	na	10
MW-5	MW5-01	—	4.5 - 6	0.0	—	—	—	—	—	—
	MW5-02	80034-03	9.5 - 11	0.0	1	0.017	0.089	0.027	0.11	0.243
	MW5-03	80034-04	14.5 - 16	0.0	<DL(1)	0.010	0.036	0.009	0.037	0.092
MW-6	MW6-01	—	4.5 - 6	0.0	—	—	—	—	—	—
	MW6-02	—	9.5 - 11	1.0	—	—	—	—	—	—
	MW6-03	80034-05	14.5 - 16	34	14	2.1	0.053	0.014	0.087	2.254
	MW6-04	80034-06	19 - 20.5	7.0	1	0.032	0.10	0.029	0.12	0.281
MW-7	MW7-01	—	5 - 6.5	2.7	—	—	—	—	—	—
	MW7-02	—	8.5 - 10	9.0	—	—	—	—	—	—
	MW7-03	80034-07	13.5 - 15	761	4700	50	370	140	560	1120
	MW7-04	80034-08	20 - 21.5	35.4	16	0.63	0.91	0.72	2.5	4.76
MW-8	MW8-01	—	3.5 - 5	9.4	—	—	—	—	—	—
	MW8-02	—	8.5 - 10	10.1	—	—	—	—	—	—
	MW8-03	80034-09	13.5 - 15	213	39000	480	3600	1000	4600	9680
	MW8-04	80034-10	20 - 21.5	276	39	0.18	1.3	0.5	2.4	4.38
MW-9	MW9-01	—	4 - 5	9.2	—	—	—	—	—	—
	MW9-02	—	9 - 10	4.8	—	—	—	—	—	—
	MW9-03	—	14 - 15	534	—	—	—	—	—	—
	MW9-04	—	19 - 20	1084	—	—	—	—	—	—
MW-10	MW10-01	—	3.5 - 5	0.0	—	—	—	—	—	—
	MW10-02	—	8.5 - 10	0.0	—	—	—	—	—	—
	MW10-03	80090-01	13.5 - 15	0.0	<DL(1)	<DL(0.005)	<DL(0.005)	<DL(0.005)	<DL(0.005)	<DL
	MW10-04	80090-02	18 - 19.5	0.0	<DL(1)	<DL(0.005)	<DL(0.005)	<DL(0.005)	<DL(0.005)	<DL

AGRA
Earth & Environmental

A total of ten samples were submitted from the five soil borings near the former USTs. Of these, six contained detectable concentrations of all analytes and four contained non-detectable concentrations of all analytes. Within the group of six samples, the reported concentrations of GRPH ranged from 13 mg/kg to 480 mg/kg. The maximum value is almost seven times higher than the second highest reported value of 71 mg/kg. Other results included a reported range of 0.51 mg/kg to 4.1 mg/kg benzene, and 2.1 mg/kg to 45.2 mg/kg total BTEX. In general, the reported concentration of benzene was similar in magnitude to the other BTEX compounds. The one exception to this was sample B13-02 which contained 40 mg/kg total xylenes but no detectable benzene. This sample also contained the maximum reported GRPH concentration.

Fourteen samples were submitted from the eight borings that were converted to monitoring wells. Based on the analytical results, wells MW-6, MW-7, and MW-8 are located within the zone of contaminated soil and wells MW-3, MW-4, MW-5, and MW-10 are outside that zone. Well MW-8 contained the highest reported concentrations for all analytes including 39,000 mg/kg GRPH, 480 mg/kg benzene, and 9,680 mg/kg total BTEX. Although collected only 20 feet from well MW-8, the reported concentrations for the samples from well MW-7 were generally a full order of magnitude lower than those reported for well MW-8 for all analytes. In well MW-6, located 30 feet from well MW-8, the only analyte exceeding cleanup standards was benzene, with a reported concentration of 2.1 mg/kg in one sample.

The results for the soil samples from the remaining wells ranged from non-detectable concentrations of all analytes (wells MW-3 and MW-10) to low levels of some or all analytes (wells MW-4 and MW-5). The bedrock sample from well MW-4 was reported to contain 0.009 mg/kg toluene and 0.072 mg/kg xylenes. More significantly, the samples from well MW-5, located within 15 feet of the drinking water well that serves the Gold Hill property, contained detectable concentrations of all analytes. However, none of the reported concentrations exceeds cleanup standards.

The analytical results for the groundwater samples indicate hydrocarbon impacts where expected (wells MW-1 and MW-8) and no impacts where none were expected based on soil sample analytical results. The most significant exception to this is well MW-2, the closest monitoring well to the drinking water well on the adjacent property. From these results, it would appear that the contaminant plume associated with the groundwater may be areally less extensive than was originally thought. Also of significance is the fact that, despite the soil sample results, the water sample from monitoring well MW-5 contains non-detectable concentrations of all analytes. Although no free-phase product was observed during this groundwater sampling event, the analyte concentrations reported for wells MW-1 and MW-8 are high enough to suggest that free-phase product may eventually equilibrate in each of these wells. Table 5 summarizes the groundwater analytical data.

TABLE 5
Gasoline Range Petroleum Hydrocarbons and BTEX Compounds in Water
December 21, 1994

Well Number	Lab Number	GRPH (µg/L)	Benzene (µg/L)	Toluene (µg/L)	Ethylbenzene (µg/L)	Xylenes (µg/L)	BTEX (µg/L)
Regulatory Limit		---	5	2,000	700	10,000	---
MW-1	50234-01	340,000	25,000	25,000	14,000	57,000	121,000
MW-2	50234-02	<DL(50)	<DL(0.5)	<DL(0.5)	<DL(0.5)	<DL(0.5)	<DL
MW-3	50234-03	<DL(50)	<DL(0.5)	<DL(0.5)	<DL(0.5)	<DL(0.5)	<DL
MW-4	50234-04	<DL(50)	<DL(0.5)	<DL(0.5)	<DL(0.5)	<DL(0.5)	<DL
MW-5	50234-05	<DL(50)	<DL(0.5)	<DL(0.5)	<DL(0.5)	<DL(0.5)	<DL
MW-8	50234-06	560,000	61,000	80,000	7,100	33,000	181,100
MW-10	50234-07	<DL(50)	<DL(0.5)	<DL(0.5)	<DL(0.5)	<DL(0.5)	<DL
DUP-1	50234-08	560,000	63,000	82,000	6,500	33,000	184,500
Trip Blank	50234-09	<DL(50)	<DL(0.5)	1.0	<DL(0.5)	0.6	1.6

— Indicates regulatory limit not established.
<DL Indicates analyte not detected above method detection limit. Detection limit shown in parentheses.

7.0 CONCLUSIONS

The objective of this Phase II Release Investigation was to delineate the extent of soil and groundwater contamination beneath the Gold Hill Store property. To that end, a total of 13 soil borings were advanced on the property and eight monitoring and test wells were constructed. Soil and groundwater samples from these borings and/or monitoring wells were submitted for laboratory analysis for GRPH and BTEX. On the basis of the observations made during the field investigation and the analytical results, the following conclusions are offered.

- The majority of the soil impacted by the activities associated with the former USTs lies within the area bordered by the Gold Hill Store and soil borings B-11, B-12, and B-14. Approximately 1,100 cubic yards of soil have been excavated from within the confines of this defined area and are stockpiled on site. Soil samples from boring B-12 were reported to contain only non-detectable concentrations of all analytes tested. Although soil samples from both borings B-11 and B-14 contained GRPH and/or BTEX concentrations above ADEC Level A cleanup criteria, the reported concentrations are low enough to suggest that both borings are close to the margin of the contaminated soil.

- Most of the soil contamination on the Gold Hill Store property appears to be confined to the silt layer immediately above the bedrock. Within most of the soil borings drilled during this investigation, no visual or olfactory indications of the presence of petroleum hydrocarbons were noted until the silt layer was reached. The only exceptions to this were borings B-13 and B-14 in which petroleum hydrocarbons were noted within the lower portion of the gravelly sand at 10 feet and 15 feet below surface grade, respectively. The sample collected from this layer in boring B-13 produced the highest overall OVM reading. In boring B-14, this layer of soil was noted to exhibit only a slight petroleum-type odor.

- Analysis of the ratio of xylenes to benzene is often used to indicate the relative age of petroleum hydrocarbon contamination. In general, the ratio increases with the age of the product. Such analysis at this site provides some interesting results. The xylenes to benzene ratio within the silt layer varies significantly across the site. Within the five borings located around the former USTs, the ratio is generally less than 1. However, the average ratio is about 10 in the silt samples collected from the SVE test wells (MW-7 and MW-8). The ratio in the lower samples collected from well MW-1 is much higher still. The xylenes to benzene ratio in the bedrock samples ranges from 4 to 13. In combination with the proximity of the test wells to the former USTs, these ratios seem to support the assumption that product migration through the silt, both laterally and vertically, is quite slow. Well MW-6 is again an anomaly. Despite its location between two wells with relatively high ratios, the silt sample from this well has the lowest overall ratio of xylenes to benzene.

- The impacted groundwater plume appears to be limited to the general vicinity of wells MW-1 and MW-6 through MW-9. Within this area, the potential exists that free-phase product may be found in any of these wells. The analytical data from well MW-6, located between wells MW-1 and MW-8, would seem to indicate two isolated areas of potential free-phase product. However, the data collected at this time are insufficient to fully characterize the nature of the potential free-phase hydrocarbon plume. In addition, there is insufficient data to delineate the extent of the dissolved plume to the east and southeast of well MW-1.

- Groundwater elevation measurements from the ten on-site monitoring wells in December indicate a southeasterly flow direction for groundwater beneath the site. However, the location of the impacted soil and groundwater, as indicated by the monitoring wells, suggests that there may be a more easterly component to groundwater flow at other times of the year. Observations made during the winter months indicate that groundwater appears to be confined to the silt layer. The lack of evidence of contamination within the overlying sand, even within the most heavily impacted area, suggests that this may be true throughout most of the year. Based on its physical characteristics, the permeability and hydraulic conductivity of the silt are assumed to be quite low. Although this limits the migration rate of the contaminant plume, it may also complicate in situ treatment of the impacted soil and groundwater.

Within the scope of this investigation, the limits of the impacted soil have been identified to the north, east, and south of the former USTs. The building on the site prohibits an accurate assessment of the western extent of the petroleum impacts. The extent of the impacted groundwater has been only roughly defined. Again, the building prevents accurate delineation to the west, and the data collected to date indicate that impacted groundwater extends eastward of well MW-1. The need to more closely delineate the eastern limit of the plume may be precluded by the fact that the water well on the adjacent property is already known to be impacted by benzene.

8.0 LIMITATIONS

This Phase II Release Investigation Report has been prepared for the sole use of Phil and Genevieve Carboy and their designated agents or representatives. The contents of this report should not be used by any other party without the express written consent of the Carboys. The findings are relevant for the dates on which the work was conducted and should not be relied upon to represent conditions at later dates.

The observations and findings presented in this report are professional opinions based on the information gained from a small number of soil samples collected from a limited number of locations on the site. The measured concentrations of the tested analytes may not be representative of concentrations in unsampled portions of the property. The analytical methods used were selected based on the known past usage of the former USTs on the property. Additional analytes not tested for during this investigation may or may not be present. No warranty or guarantee is expressed or implied.