

**REPORT ON THE
SUBSURFACE INVESTIGATION
OF PETROLEUM CONTAMINATION
AT REYNOLDS & SON,
SOUTH BARRE, VERMONT**

VTDEC SITE #92-1337
GRIFFIN PROJECT #1934326

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Prepared for:

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I. INTRODUCTION

This report details the investigation of residual subsurface petroleum contamination at Reynolds & Son, Inc. in South Barre, Vermont. Included in this report is a description of drilling activities, supply well sampling results, a receptor risk assessment, conclusions of the investigation, and recommendations. This work has been conducted by Griffin International, Inc. (Griffin) for Reynolds & Son in response to a letter from the Vermont Department of Environmental Conservation (VTDEC) dated December 23, 1992.

II. SITE BACKGROUND

A. Site Description

Reynolds & Son is located on Bridge Street in South Barre, approximately 1,000 feet west of Route 14 (see Site Location Map in Appendix). The Stevens Branch of the Winooski River flows generally northward and is at least 300 feet east of the site at its nearest point. The Surficial Geologic Map of Vermont indicates the presence of till and bedrock exposures in the vicinity of Reynolds & Son. The site is situated in a hilly area and significant bedrock outcroppings are evident. Materials encountered at the site during this investigation consisted of fine sand and silt with a trace of gravel in several split-spoon samples.

The Reynolds & Son property was originally farmland. During the construction of the building, bedrock was blasted to prepare a level area for the siting of the Reynolds & Son building, and bedrock is reported to exist relatively close to the surface all across the site. The presence of bedrock was confirmed in the area of drilling to be between 13 and 20 feet below grade.

The area surrounding Reynolds & Son has a mixture of industrial, commercial and residential uses. Isabelle Electric Supply Corporation is located directly to the west, and residences are to the east and south of the site (see Area Map in Appendix). Drinking water for the area is supplied by private drilled bedrock wells.

B. Site History

On November 25, 1992, three 1,000-gallon underground storage tanks (USTs) were removed from the Reynolds & Son property. Griffin was present on this day to perform the tank pull inspection. During removal, the gasoline and waste oil tank were observed to be in good condition, but the diesel tank was in poor condition and had two holes. Soils in the tank pit were observed to be contaminated with gasoline and diesel fuel. A photoionization device (PID) was used to screen the soils in the gasoline/diesel tank pit area. PID readings of 150 to 220 parts per million (ppm) were measured. Groundwater was not encountered during the excavations, but bedrock was present at 11 feet below grade in the vicinity of the gasoline tank. The tanks were not replaced. Additional

information concerning the removal of these tanks is presented in Griffin's summary letter report dated November 27, 1992.

In response to the presence of petroleum contamination at the site, the VTDEC issued a letter dated December 23, 1992, requesting further investigation of the degree and extent of contamination.

III. INVESTIGATIVE PROCEDURES

A. Exploratory Soil Borings

In an effort to further determine the degree and extent of residual petroleum contamination at the site, Griffin proposed the installation of three groundwater monitoring wells in the vicinity of the former tank complex. Due to the presence of bedrock and the lack of groundwater encountered during the tank excavations, Griffin realized that the installation of viable groundwater monitoring wells may not be possible. On March 18, 1993, two attempts were made to install a well in the proposed MW-1 and MW-3 locations. One attempt was made in the proposed MW-2 location. A significant groundwater table was not observed in any of the five soil borings, and no monitoring wells were installed.

A hollow-stem auger drill rig was used to complete the five exploratory soil borings at the site. The Site Map in the Appendix shows the locations of these borings. This work was completed under the direct supervision of a Griffin hydrogeologist. Split-spoon samples were obtained from each borehole at five-foot intervals and screened for the presence of volatile organic compounds (VOCs) using a PID. Soil types and characteristics were logged for each five-foot sample. Boring logs in the Appendix detail this information for each borehole. Soils in each of the five borings consisted of brown silt, fine sand and silty fine sand.

The first attempt to install MW-1 (soil boring SB-1A) was conducted on the southern edge of the gasoline/diesel tank pit. PID readings of 200 ppm and 260 ppm were observed in the 0'-1' and 4.5'-6.5' split-spoon samples, respectively. Bedrock was encountered at approximately 13 feet below grade in SB-1A. All soil samples from this borehole were dry, and the borehole was backfilled to grade.

The second attempt to install MW-1 (SB-1B) was approximately fifteen feet southeast of SB-1A. A slight petroleum odor was detected in the three samples from grade to 11.5'. A moderate odor (PID reading of 50 ppm) was observed in the sample from 14.5'-16.5'. This deepest soil sample, taken from just above the encountered bedrock at 17', was moist but clearly not saturated. Therefore, a monitoring well was not installed in this location and the boring was backfilled to grade.

The only attempt to install MW-2 (SB-2A) was located in the presumed downgradient direction from the former underground storage tank complex. The maximum PID reading in this boring was 2 ppm for the sample from the 14.5'-16.5' sample interval. Bedrock was encountered at approximately 19.5' below grade and every soil sample was dry. Therefore, a monitoring well was not installed in this location.

Two soil borings were completed in an attempt to install MW-3 (SB-3A and SB-3B). No petroleum contamination was observed in either boring. Bedrock was encountered at 13' and 20' below grade in SB-3A and SB-3B, respectively. No groundwater was present in either boring so no monitoring well was installed. Both borings were backfilled to grade.

B. Supply Well Sampling

On January 11, 1993, the Reynolds & Son drinking water supply well was sampled and analyzed for volatile organic compounds (VOCs) by EPA Method 8240 and for Total Petroleum Hydrocarbons (TPH) by EPA Method 418.1. MTBE, a gasoline constituent, was the only compound detected from the 8240 analysis. It was detected at a concentration of 24.7 parts per billion (ppb). The Vermont Health Advisory Level for MTBE in drinking water is 40 ppb. TPH was not detected in the 418.1 analysis.

Due to the presence of MTBE in the Reynolds & Son supply well, it was determined that the supply well at the adjacent residence should be sampled as well. On January 20, 1993, the Lavigne supply well was sampled and analyzed by the same methods as above for Reynolds & Son. TPH and VOCs were not detected in the samples from the Lavigne supply.

On March 9, 1993, a technician from the Hazardous Materials Management Division (HMMD) Technical Services Section (TSS) obtained water samples from the Reynolds & Son supply well and the Lavigne supply well. The samples were analyzed for VOCs by EPA Method 8240. MTBE was detected at 21 ppb in the sample from the Lavigne's well and <10 ppb in the Reynolds & Son sample.

As a result, the VTDEC requested that both of these wells be sampled every two weeks to track the MTBE levels in the drinking water. In addition, the nearby Isabelle Electric Supply Corporation supply well would need to be sampled at that time.

On March 29, the three bedrock supply wells were sampled and analyzed for petroleum hydrocarbons by EPA Method 8020. MTBE was detected in the Reynolds & Son well, the Lavigne well, and the Isabelle well at 11.2, 27.4 and 4.8 ppb, respectively.

Most recently, on April 12, the supply wells were sampled again. MTBE was detected at 16 ppb in the samples from the Reynolds & Son and Lavigne supply wells. No contaminants were detected in the sample from the Isabelle well. The laboratory reports and a table showing these sampling results are included in the Appendix.

IV. RECEPTOR RISK ASSESSMENT

Sensitive receptors at this site include the drinking water supply wells for Reynolds & Son, the Lavigne residence, Isabelle Electric Supply Corp., and potentially other water supply wells in the area. The supply wells presently contaminated are all bedrock wells and it is anticipated that any other supply wells found in this area will also be drilled into the bedrock.

The Stevens Branch of the Winooski River is also a potential receptor, however the apparent lack of a significant overburden aquifer suggests that the threat to this river is minimal. Petroleum contamination appears to have seeped downward beneath the tank area, and the lack of a water table in the overburden has allowed the migration of this contamination directly into the bedrock formation.

V. CONCLUSIONS

Based on the result of this investigation, Griffin has developed the following conclusions:

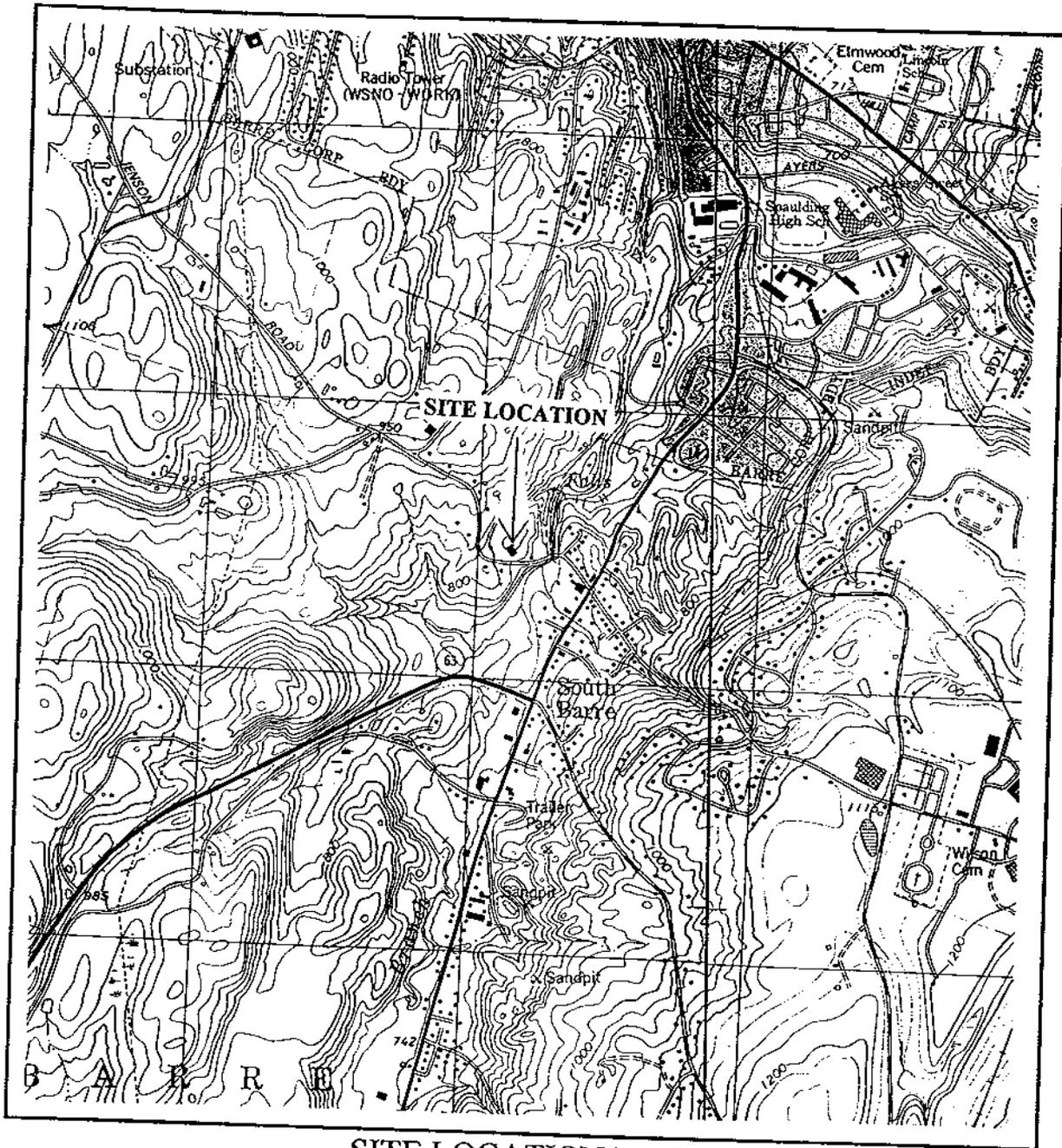
1. Soils observed during this investigation consisted primarily of silty fine sands.
2. Bedrock was confirmed to be between 13 and 20 feet below grade in the area of investigation. Bedrock is reported to exist relatively close to the surface all across the site.
3. No groundwater was encountered during the drilling of the five soil borings. Therefore, no monitoring wells were installed. There does not appear to be a significant overburden aquifer in the vicinity of the former UST area.
4. Significant volatile organic compounds were detected in soil borings 1A and 1B. PID readings between 50 and 260 ppm were measured in the samples obtained from SB-1A, and between 4 and 50 ppm in SB-1B. The extent of petroleum contamination does not appear to extend very far laterally from the former tank pit area.
5. Three nearby bedrock supply wells appear to have been impacted by the petroleum contamination at the Reynolds & Son property: (1) the Reynolds & Son well, (2) the Lavigne's residential well, and (3) the Isabelle Electric Supply Corporation well. MTBE is the only petroleum compound that has been detected to date in these wells. This compound has been detected at concentrations which are below the Vermont Health Advisory Level for drinking water of 40 ppb. There is no consistent trend upward or downward in the levels of MTBE in the supply wells.

6. Adsorbed petroleum in soils above the bedrock represents a continuous source of bedrock contamination. Removal of the overburden contamination would result in a gradual reduction of bedrock groundwater contamination as it is diluted and dispersed by clean groundwater.

VI. RECOMMENDATIONS

Based on the above conclusions, Griffin makes the following recommendations:

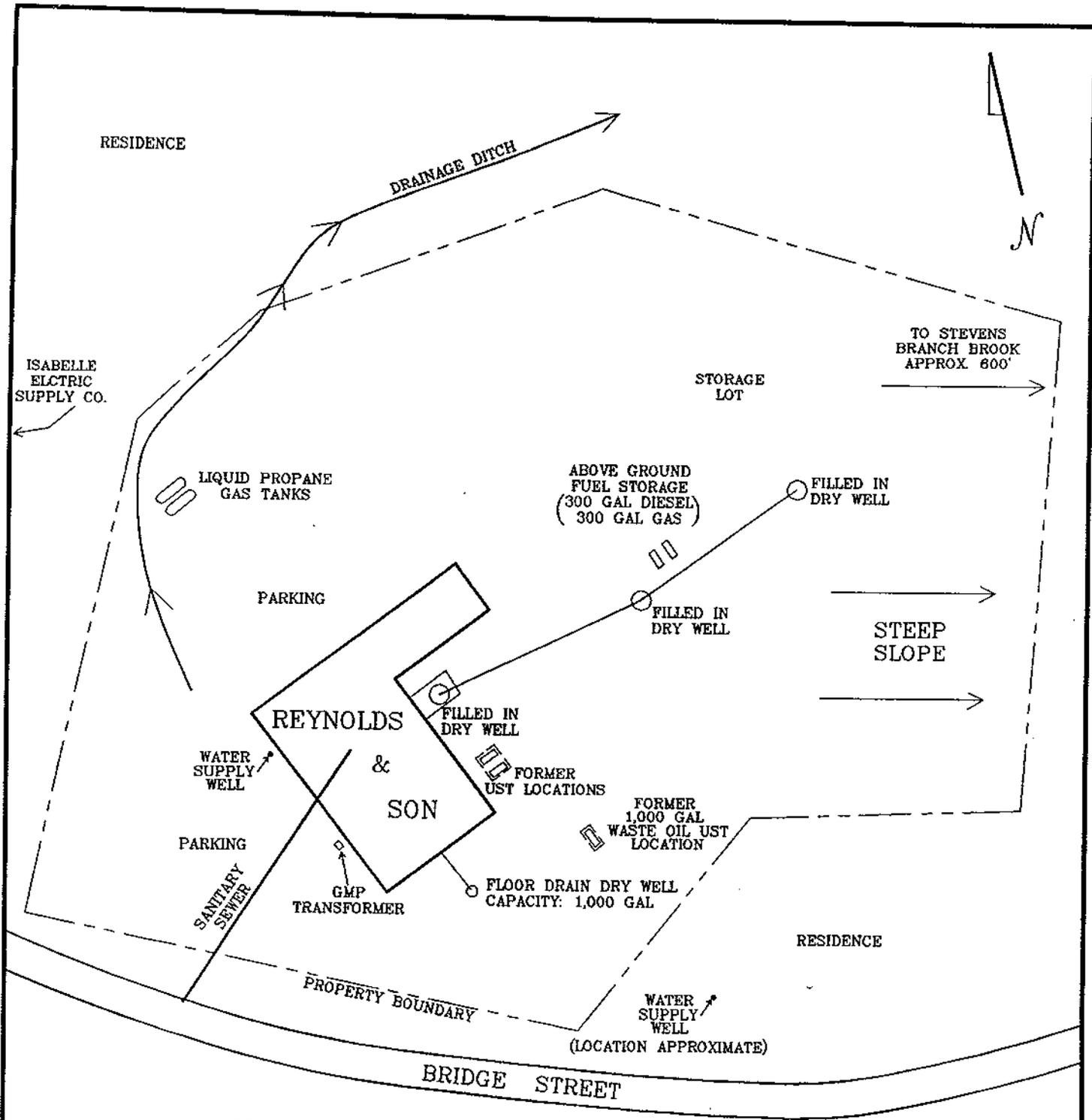
1. Continue sampling the Reynolds & Son, Lavigne, and Isabelle supply wells every two weeks to track contamination levels. This sampling frequency should be reduced if contamination is not detected over several sampling periods or if clear trends can be established.
2. Determine the location of additional nearby supply wells that may be impacted by the contamination. These wells should be sampled once initially to determine if they have been impacted. Supply well samples should be analyzed for BTEX and MTBE by EPA Method 602. The closest known supply well in the area (not presently being sampled) is reported to exist between two residences across Bridge Street to the south.
3. The well construction details for each relevant supply well in the area should be determined if possible. Information on the nature of each well should reveal well type (bedrock or gravel), well depth, the year it was drilled, the nature of the deposits encountered during drilling, approximate yield, etc... A brief search of State files may need to be conducted.
4. To remove the adsorbed petroleum contamination from the soils above the bedrock and to increase the rate of biodegradation, Griffin recommends the installation of a soil vapor extraction system. This system would consist of several soil vapor extraction wells (or soil vent points) and combustion of the extracted contaminated soil vapors by catalytic oxidation. Griffin also recommends that the area in the vicinity of the former UST pit be paved. This will have two effects: (1) the effectiveness (radius of influence) of the soil vapor extraction system will potentially be increased, and (2) the pavement cap will reduce the amount of groundwater seepage through the contamination thereby reducing the rate at which the contamination moves downward into the bedrock formation. This system should be installed as soon as possible due to the supply well contamination in the area.



**SITE LOCATION MAP
REYNOLDS & SON, INC.
SOUTH BARRE, VERMONT**

SOURCES:
USGS BARRE WEST, VT (Photorevised 1988)
Scale - 1:24,000

USGS BARRE EAST, VT (Photorevised 1988)
Scale - 1:24,000



NOTE:
 BASE MAP INFORMATION FROM
 SURVEY BY SURVEYOR'S INC.
 MAY 1972

AREA MAP

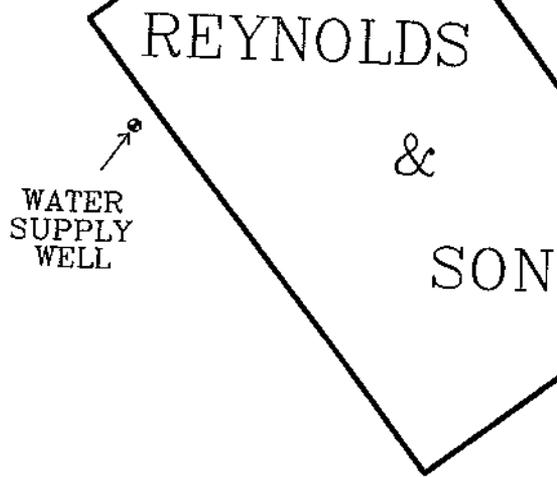
REYNOLDS & SON, INC
SOUTH BARRE, VERMONT

GRIFFIN PROJECT #1934326
 DRAWN: 12/17/92

0 50 100 200

SCALE IN FEET

GRIFFIN INTERNATIONAL, INC.



WATER SUPPLY WELL
(Approx. Location)



SITE MAP

REYNOLDS & SON, INC.
SOUTH BARRE, VERMONT

GRIFFIN PROJECT #1934326
DRAWN: 4/6/92

0 25 50 100
SCALE IN FEET

GRIFFIN INTERNATIONAL, INC.

**Groundwater Quality Summary
Reynolds & Son, Inc.
South Barre, Vermont**

Reynolds & Son Supply Well

PARAMETER	Date of Sample Collection				Vermont Drinking Water Standards
	1/11/93	3/9/93	3/29/93	4/12/93	
Benzene	ND	ND	ND	ND	5.0*
Chlorobenzene	ND	ND	ND	ND	100**
1,2-DCB	ND	ND	ND	ND	-
1,3-DCB	ND	ND	ND	ND	-
1,4-DCB	ND	ND	ND	ND	-
Ethylbenzene	ND	ND	ND	ND	680**
Toluene	ND	ND	ND	ND	2,420**
Xylenes	ND	ND	ND	ND	400**
Total BTEX	ND	ND	ND	ND	-
MTBE	24.7	<10	11.2	16.0	40**
BTEX+MTBE	24.7	<10	11.2	16.0	-

5/10 6/27
7.1 ND TP

Lavigne Supply Well

PARAMETER	Date of Sample Collection				Vermont Drinking Water Standards
	1/20/93	3/9/93	3/29/93	4/12/93	
Benzene	ND	ND	ND	ND	5.0*
Chlorobenzene	ND	ND	ND	ND	100**
1,2-DCB	ND	ND	ND	ND	-
1,3-DCB	ND	ND	ND	ND	-
1,4-DCB	ND	ND	ND	ND	-
Ethylbenzene	ND	ND	ND	ND	680**
Toluene	ND	ND	ND	ND	2,420**
Xylenes	ND	ND	ND	ND	400**
Total BTEX	ND	ND	ND	ND	-
MTBE	ND	21	27.4	16.	40**
BTEX+MTBE	ND	21	27.4	16.	-

5/10 6/27
NS 25.1 TP

Isabelle Supply Well

PARAMETER	Date of Sample Collection				Vermont Drinking Water Standards
	1/20/93	3/9/93	3/29/93	4/12/93	
Benzene	NS	NS	ND	ND	5.0*
Chlorobenzene			ND	ND	100**
1,2-DCB			ND	ND	-
1,3-DCB			ND	ND	-
1,4-DCB			ND	ND	-
Ethylbenzene			ND	ND	680**
Toluene			ND	ND	2,420**
Xylenes			ND	ND	400**
Total BTEX			ND	ND	-
MTBE			4.8	ND	40**
BTEX+MTBE			4.8	ND	-

5/10 6/27
NS ND

All Values Reported in ug/L (ppb)
* - Maximum Contaminant Level
** - Health Advisory Level

ND - None Detected
NS - Not Sampled