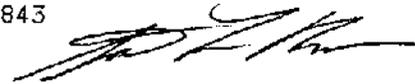


OCT 0 8 1988

Subsurface Hydrogeological Evaluation  
of  
Mike's Gulf Service Center Area  
Hardwick, VT

Prepared for: Tom Brochu  
P.O. Box 738  
Hardwick, VT 05843

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Date: October 3, 1988

Reviewed By: Stephen Revell



## I. Introduction

### A. Background History

On July 19, 1988 three underground petroleum storage tanks were removed from Mike's Gulf Service Center (MGSC). The tanks consisted of one 4,000 and two 3,000 gallon tanks. All three tanks were originally installed in 1956. The removal was supervised by Mr. Chuck Schwier of the Vermont Department of Environmental Conservation's Hazardous Waste Management Division. Mr. Schwier observed that all three tanks were in poor condition, and showing signs of corrosion, such as pitting and rust. Mr. Schwier noted that vapor levels in the soils associated with the tank excavation, measured with a photoionization device increased with depth. It was also noted that approximately 15' of the Lamoille river bed, behind the MGSC was stained brown by an active petroleum seep. Utilizing this data, Mr. Schwier requested that the MGSC retain a qualified consultant to conduct a limited hydrogeologic evaluation and risk assessment of the MGSC area. In August 1988, Tom Brochu of MGSC contracted Lincoln Applied Geology, Inc. (LAG) to perform the necessary work.

### B. Location

The MGSC is located in the west central section of Caledonia County in the town of Hardwick just east of the Route 15 and Route 14 intersection (see Figure 1). The property has historically been used as a service station and is presently being used for the same purpose. The property is bounded to the north by the Lamoille River; to the south by Route 15; to the east by a large, old wooden structured store complex; and to the west by a small town park. See Figure 2 for a detailed site map.

The site can topographically be described as a small plateau which drops 20 to 25' to the Lamoille River bed behind the MGSC. The elevation of the plateau is approximately 1,000' above sea level.

Precipitation falling on the site flows from the subject area as sheet flow from the front of the station towards Route 15 and the local storm drain, and from the rear and east side of the station towards the Lamoille River.

The MGSC and surrounding businesses are served by both public water and sanitary sewer. Both of these services enter the MGSC from Route 15.

## II. Scope of Investigation

### A. Objectives

Objectives of the study were:

- i. to define the subsurface hydrogeology of the study area,

A. Objectives Cont.

2. to define the presence of petroleum contamination beneath the study area,
3. to define the physical extent and magnitude of the petroleum contamination beneath the study area,
4. to evaluate the potential risk to the neighboring businesses and Lamoille River,
5. to evaluate and propose, if necessary, a means of remediating the contamination, and
6. to evaluate and propose a schedule for monitoring the site to ensure no further impacts are encountered.

B. Methodology Utilized to Accomplish Objectives

The definition of the subsurface hydrogeology and initial assessment of contamination associated with the study area has involved:

1. The placement and construction of three - two inch PVC monitoring wells.
2. The proper development of the monitoring wells to ensure the collection of representative water quality and water level data.
3. Collection and laboratory analyses of water samples taken from the three monitoring wells and three sample points along the Lamoille River.
4. The conduction of site surveys to relate monitoring well and river elevations to prepare a site map.
5. Collection of water level measurements to determine ground water table elevations and ground water flow directions.
6. The conduction of slug tests on all three monitoring wells to assist in the determination of ground water flow rates.
7. A visual survey of the Lamoille River one-half mile up gradient and one-eighth mile down gradient of the site to determine the impact of the seepage on the river.
8. The evaluation of all data collected.
9. The evaluation of potential risks to the nearby businesses and the Lamoille River.
10. The evaluation of the need for a remediation system.

## B. Methodology Utilized to Accomplish Objectives Cont.

The conduction of these tasks was initiated by the author, in August 1988 and have continued to date.

## III. Results of Investigation

All of the monitoring wells were installed by hollow stem auger methods on 8/15/88. A four inch hole was drilled to its depth of completion, while samples of soil were intermittently collected for olfactory evaluation for the presence of petroleum type contaminants. Following drilling, a two inch PVC, schedule 40, 0.20" well screen and riser pipe was installed and packed with an artificial silica sand pack which was immediately covered by a bentonite pellet seal.

The soils encountered on-site can generally be described as lensey, poorly sorted, glacial and recent alluvium overlying highly fractured slate. Figure 3a, b and c are detailed representations of the soil profile and well construction for MW-1, 2, and 3 respectively. (It should also be noted that evidence of an old cellar hole was encountered while excavating to remove the old tanks.)

Olfactory presence of petroleum was noted in all three monitoring wells. The odor associated with MW-1 and 2 was stale and typical of aged gasoline product. The odor associated with MW-3 was fresher than that of MW-1 and 2. An olfactory survey of the adjacent building's basement produced no noticeable odor.

Following well construction, the wells were developed by continuous pumping methods. The well development consisted of pumping each well in a non-turbulent fashion with a peristaltic pump until clear water was recovered. During development of the monitoring wells, at least, 10 well volumes of water were pumped from each. Following their development the monitoring wells were then allowed to fully recover. The results of well development indicate that well recharge (the yield of the unconsolidated materials) is low.

Following well development, the monitoring wells were allowed to fully recover for four days. At this time, a ground water elevation survey was performed. Seven days after the first ground water elevation survey, a second survey was performed. Figures 4 and 5 are the ground water elevation contour maps generated utilizing the data collected on 8/19/88 and 8/26/88 in conjunction with the relative well elevation survey performed on 8/16/88. The figures indicate that the gradient of the water table is approximately .060 ft./ft. from Route 15 through the site. This shallow ground water system, discharges directly to the Lamoille River. (See Table 1 for well elevations and ground water level data.)

On 8/26/88 a water quality survey was performed by LAG. Each of the three monitoring wells, along with three monitoring points along the Lamoille River were sampled. Each monitoring well was purged of, at least, 3 well volumes of ground water with a peristaltic pump before being sampled with a clean bailer. One stream grab sample was taken directly adjacent to

### III. Results of Investigation Cont.

the area of product/water seepage that had absorbent booms placed around it on 8/16/88. The other two stream samples were taken approximately 50' upstream and downstream of the seep area. The samples were taken directly to Aquatec Inc. for analysis. The analyses consisted of Aquatec's benzene, toluene, ethyl benzene, xylene (BTEX), aromatic, and aliphatic hydrocarbon's test procedure. The results of the analyses are found as Table 2. As can be seen, the three monitoring wells have varying degrees of contamination. The greatest amount of contamination is found in MW-3, the least is in MW-1. The stream samples show that: outside the boom area there is little to no contamination, while inside the boom area there are considerable amounts of hydrocarbon contamination. It should be noted that due to the rapid stream flow through the seepage area the level of BTEX, aromatics, and aliphatics should be low for the stream samples.

Utilizing the ground water quality data and the detailed site map a total hydrocarbon contour map was drawn (see Figure 6). The map shows the most contaminated portion of the plume lying in the area of MW-3, and the active stream seep.

On 8/16/88, a visual stream survey was performed. It was noted that unusual amounts of algal growth exist in the Lamoille River in the site area. This growth exists downstream of the site for, at least, one-eighth mile. The growth exists upstream about one-half mile and stops abruptly above the Hayes Service Center west of the MGSC site. It was also noted that large amounts of free petroleum product were entering the stream at this point in the river. Another area of mild hydrocarbon seepage was observed behind the Citgo station, which lies halfway between the MGSC and Hayes service center.

On 8/26/88 slug tests were performed on the three monitoring wells to assist in determining ground water flow rates through the site. The slug test consisted of injecting a theoretical five foot slug of water into the well. The initial rise in head and subsequent re-equilibration were monitored with a pressure transducer. The resulting graphs of the data are included as Appendix A. Using the methods of Bouwer and Rice (1976) an average hydraulic conductivity for MW-1 and 2 of 14 ft./day was calculated. A hydraulic conductivity for MW-3 of 6.3 ft./day was calculated. This data was used to derive the number of days it would take for contaminated water to flow from the tank area to the area of seepage. The average number of days required to flow this distance is 80 days. If the river level increases approximately 2' the time period needed could increase to approximately 158 days.

### IV. Conclusions

In view of the preceding report, the following conclusions regarding the petroleum contamination associated with the Mike's Gulf Service center (MGSC) are set forth:

#### IV. Conclusions Cont.

1. In the process of removing the old tanks associated with their retail petroleum distribution system, significant levels of petroleum vapor were encountered.
2. The three underground storage tanks that were removed showed evidence of corrosion and leakage.
3. A 15' section of the Lamoille River directly behind the MGSC is stained by petroleum seepage.
4. The MGSC site is underlain by poorly sorted sands, fine gravels, and silts which directly overly a highly weathered slate. There is also evidence of an old house foundation existing below the site.
5. A shallow unconfined aquifer exists below the MGSC site.
6. The results of two ground water elevation surveys indicate that ground water flows through the site from the south towards the north and the Lamoille River.
7. No free product has been observed in the monitoring wells.
8. The results of the 8/26/88 water quality survey indicate that substantial petroleum type contamination exists below the site. The majority of which is located adjacent to the Lamoille River.
9. Utilizing olfactory surveys and conclusions #7 and #8, it is further concluded that the petroleum problem is an old problem.
10. The results of the 8/26/88 water quality survey also indicate that the absorbent boom system associated with the active seep area greatly decreases the impact of the petroleum seepage.
11. Several other sources of petroleum seepage not associated with the MGSC are adversely impacting the Lamoille River.
12. The building directly adjacent to the MGSC site has no evidence of being impacted by the petroleum vapor present in the soil above the ground water.
13. The flow rate of ground water through the site ranges from 0.6 - 1.2 ft./day.
14. The source of contamination was stopped when the old tanks were removed.

#### V. Recommendations

It is my professional opinion that an active remediation system is not necessary at the MGSC site. My opinion is based on the following facts:

1. The source of contamination has been removed,
2. There has been no evidence of free product on the ground water,
3. The present absorbent boom system has decreased the impact of petroleum seepage into the Lamoille River to a negligible amount, and
4. There has been no evidence of petroleum vapors entering the adjacent structure.

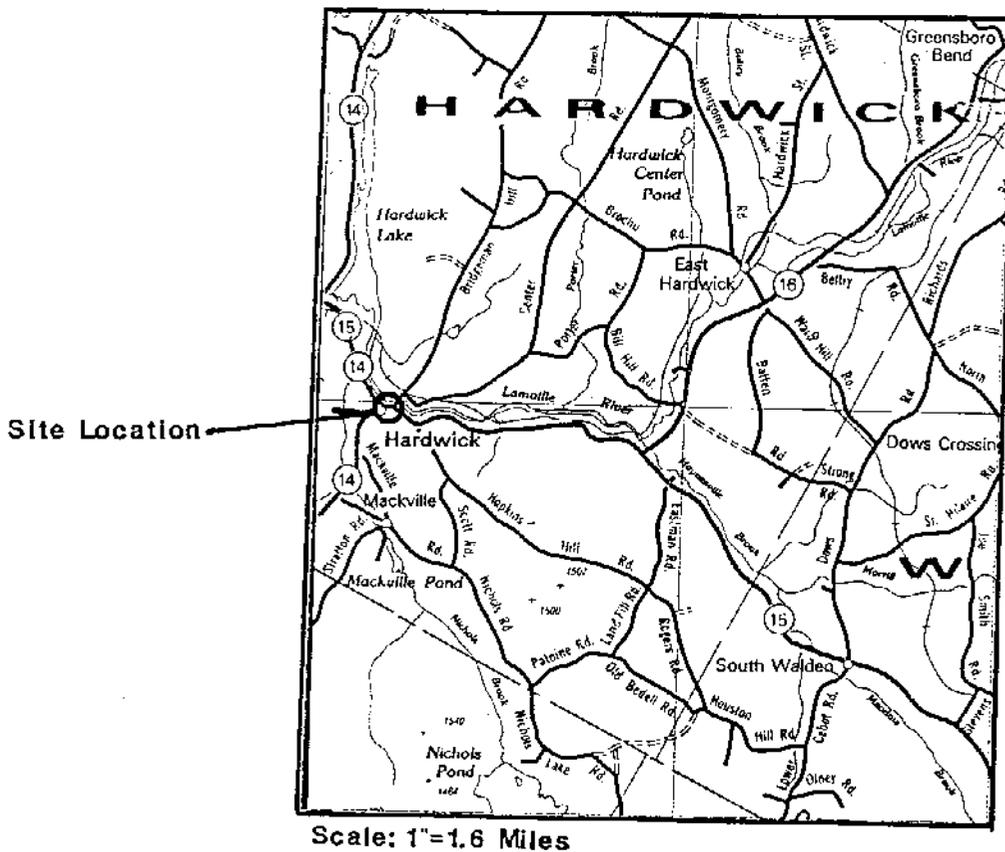
It is recommended that quarterly sampling of the following be performed for 6 months after receipt of this report:

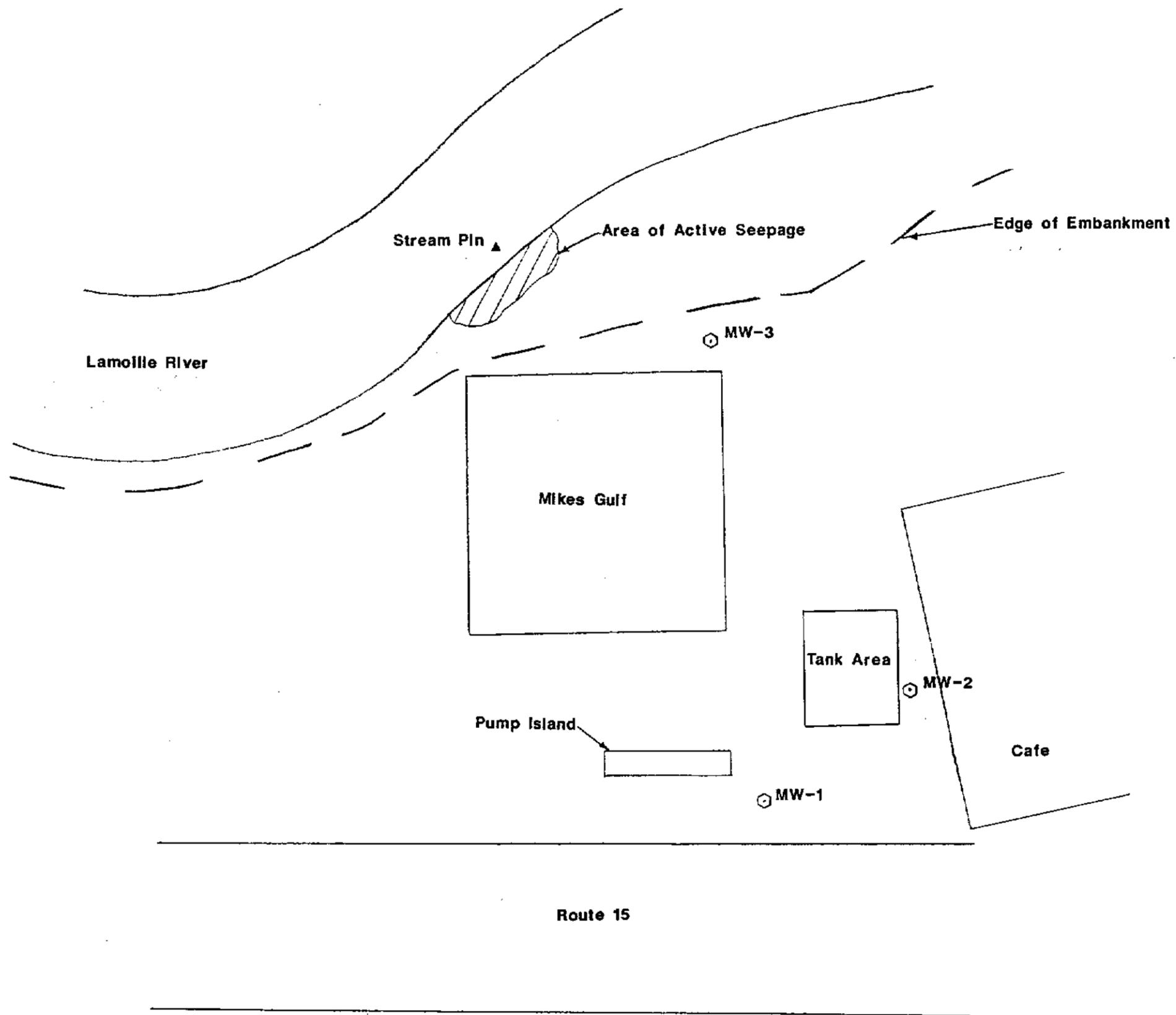
1. ground water and river elevations,
2. water quality for BTEX, aromatic, and aliphatics hydrocarbons, and
3. photoionization surveys of the basement in the adjacent buildings.

If the basement shows no evidence of fumes and BTEX presence declines over the next six months, it can be concluded that the potential for adverse impact in the adjacent building is negligible.

It is also recommended that the absorbent boom system be maintained as long as is feasible this fall and is re-installed, if needed, in the spring. The boom should remain in place as long as active seepage is occurring into the Lamoille River.

### GENERAL SITE LOCATION MAP





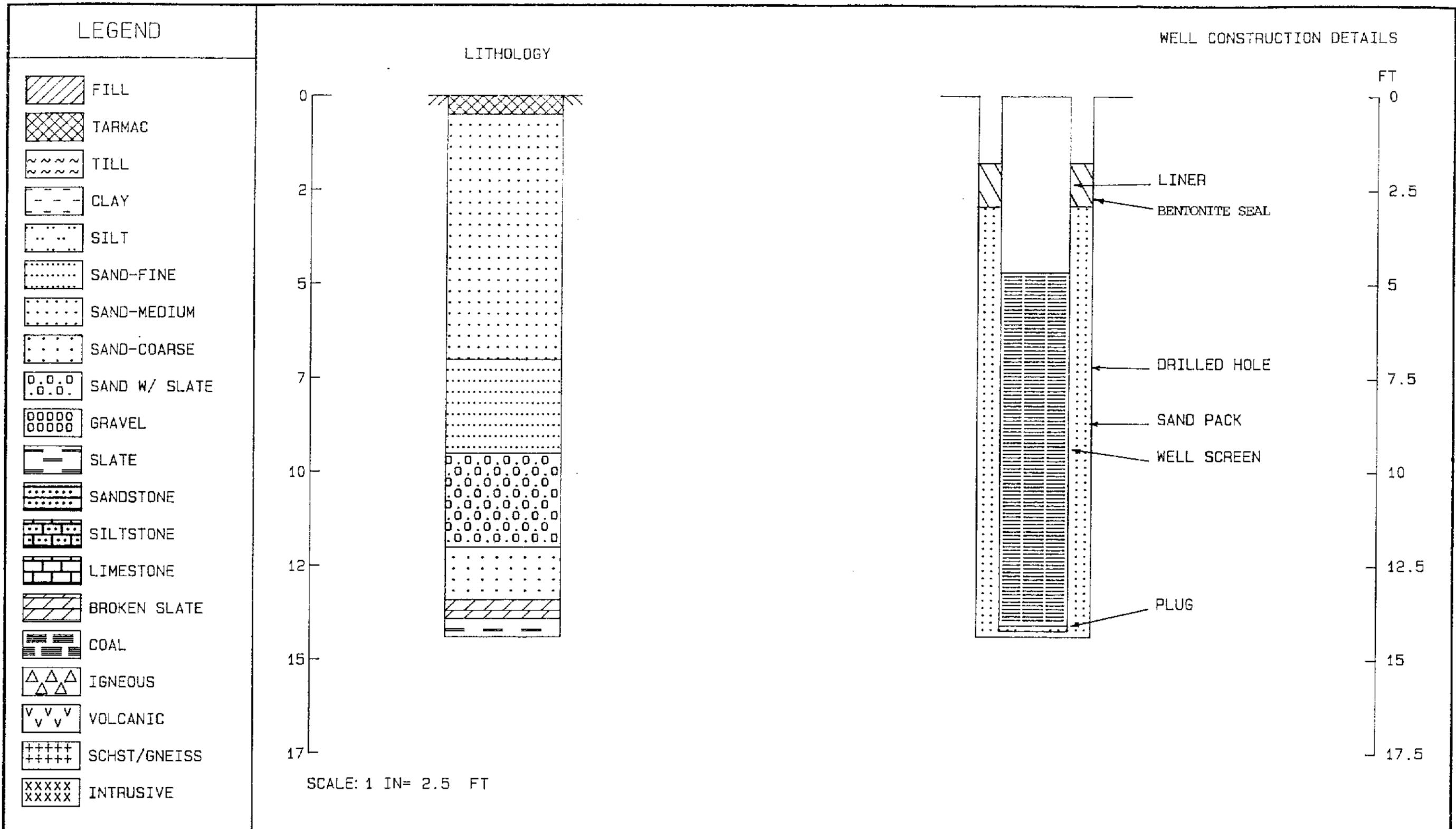
Approx. True North ↑

Legend:

⊙ MW-2      2" Monitoring Well

Figure 2

<b>MIKES GULF STATION</b>	
Scale: 1"=20'	Drawn by: S.L.
<b>Detailed Site Map</b>	
Date: 8/88	Problem: Petroleum Seepage Into Lamolle River

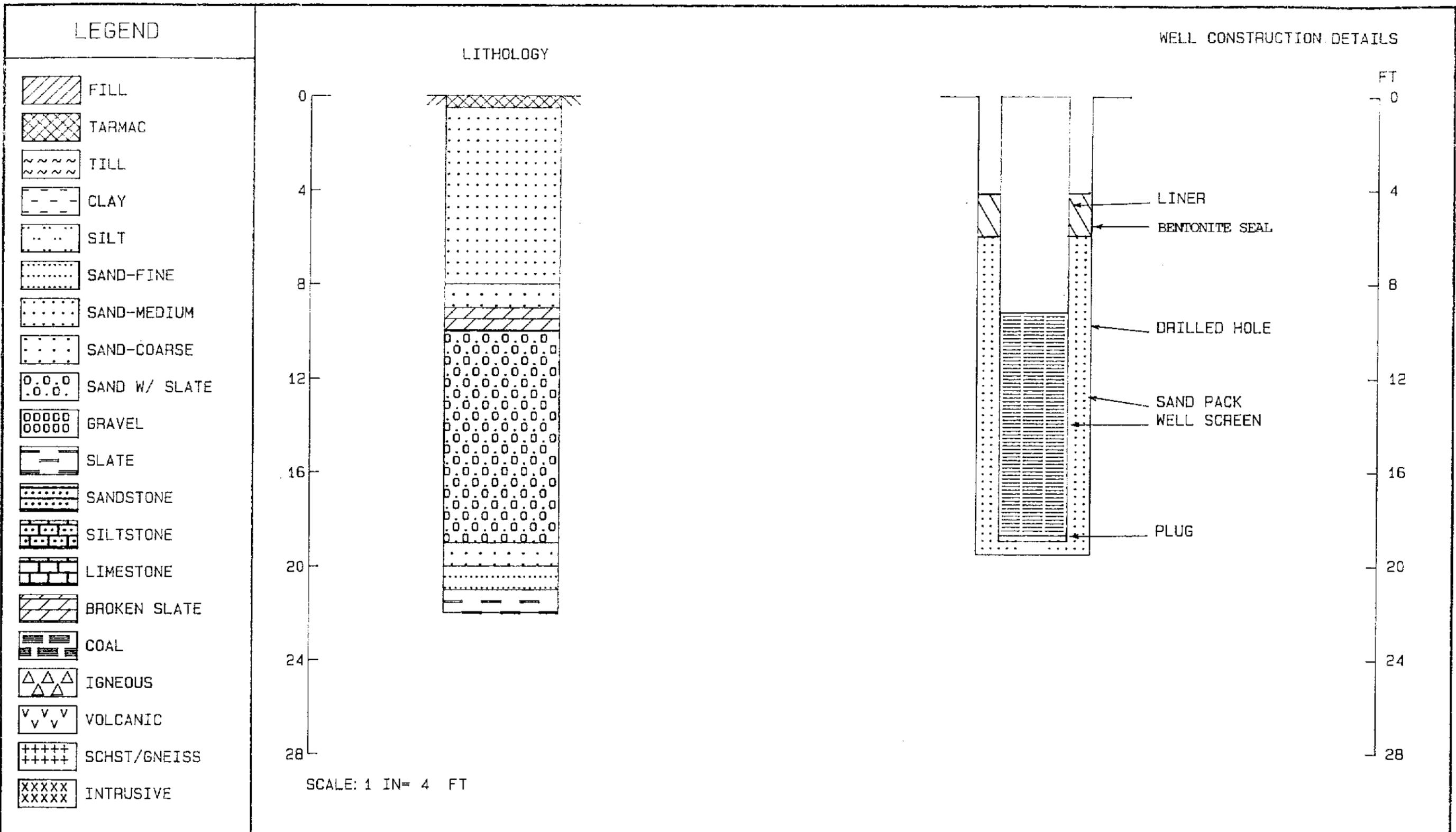


PROJECT: MIKES GULF  
 FILE: LAG/88  
 LOCATION: HARDWICK

MONITORING WELL #1

LINCOLN APPLIED GEOLOGY

FIGURE: 3a

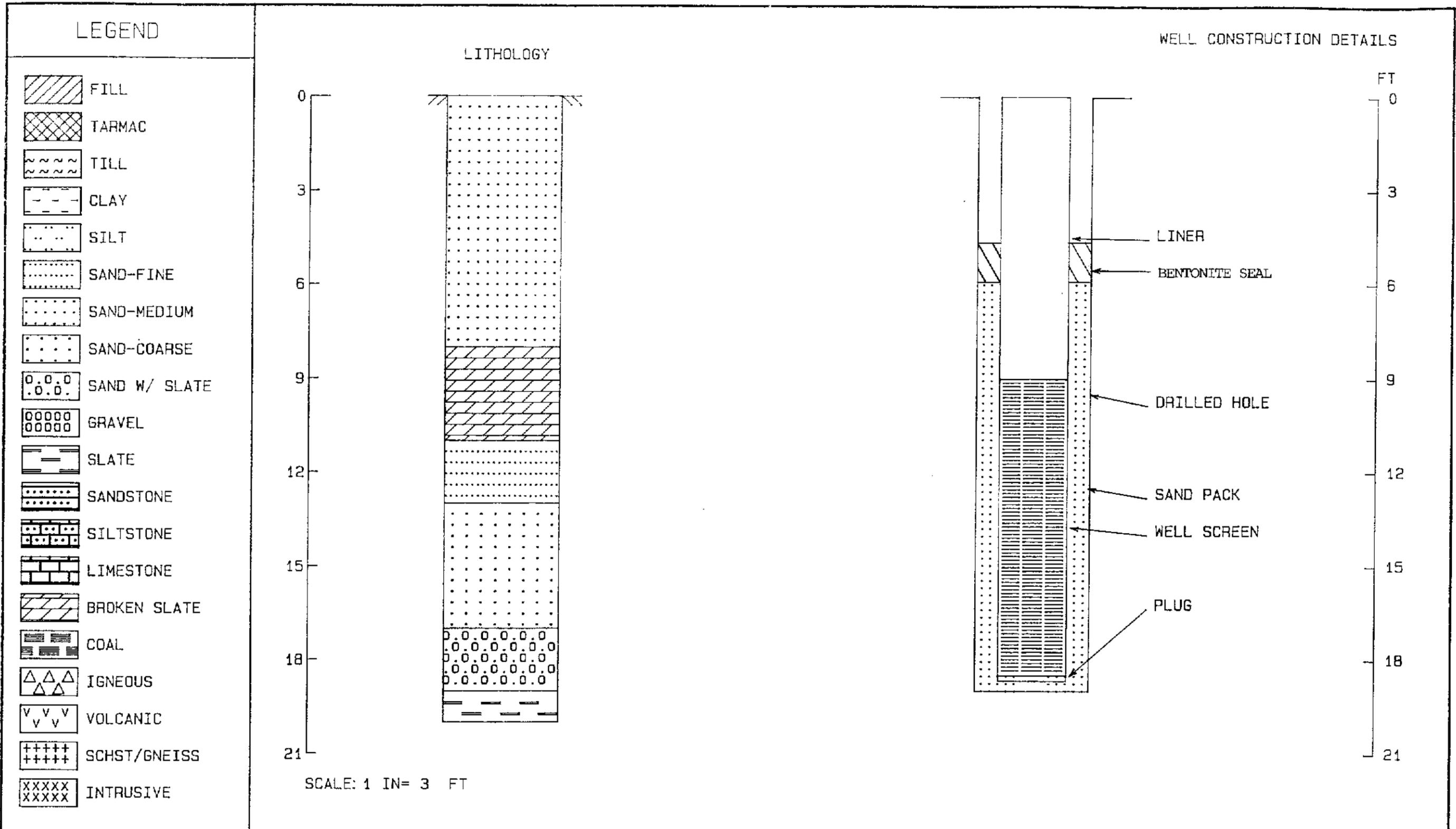


PROJECT: MIKES GULF  
 FILE: LAG/88  
 LOCATION: HARDWICK

MONITORING WELL #2

LINCOLN APPLIED GEOLOGY

FIGURE: 3b

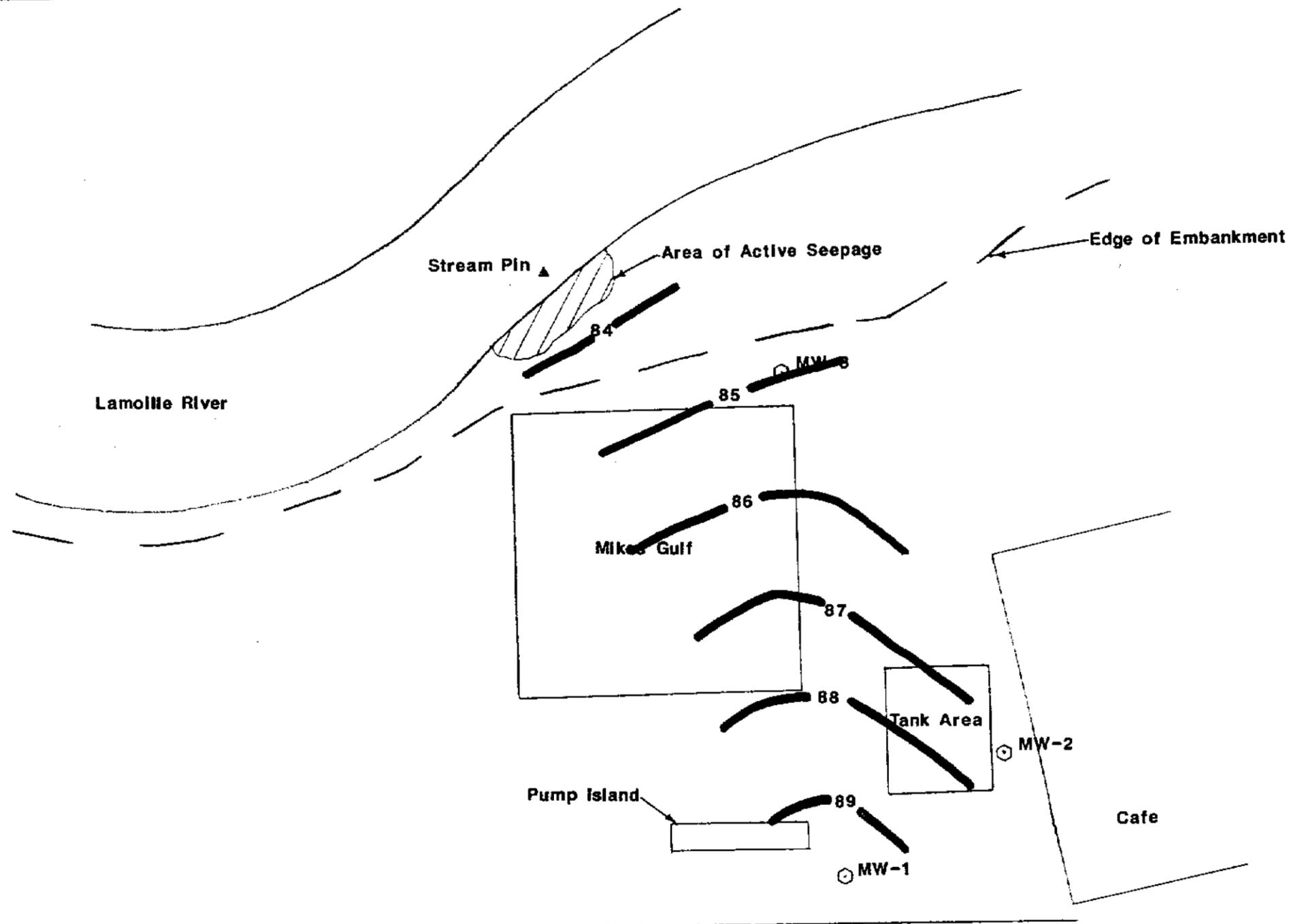


PROJECT: MIKES GULF  
 FILE: LAG/88  
 LOCATION: HARDWICK

MONITORING WELL #3

LINCOLN APPLIED GEOLOGY

FIGURE: 3c

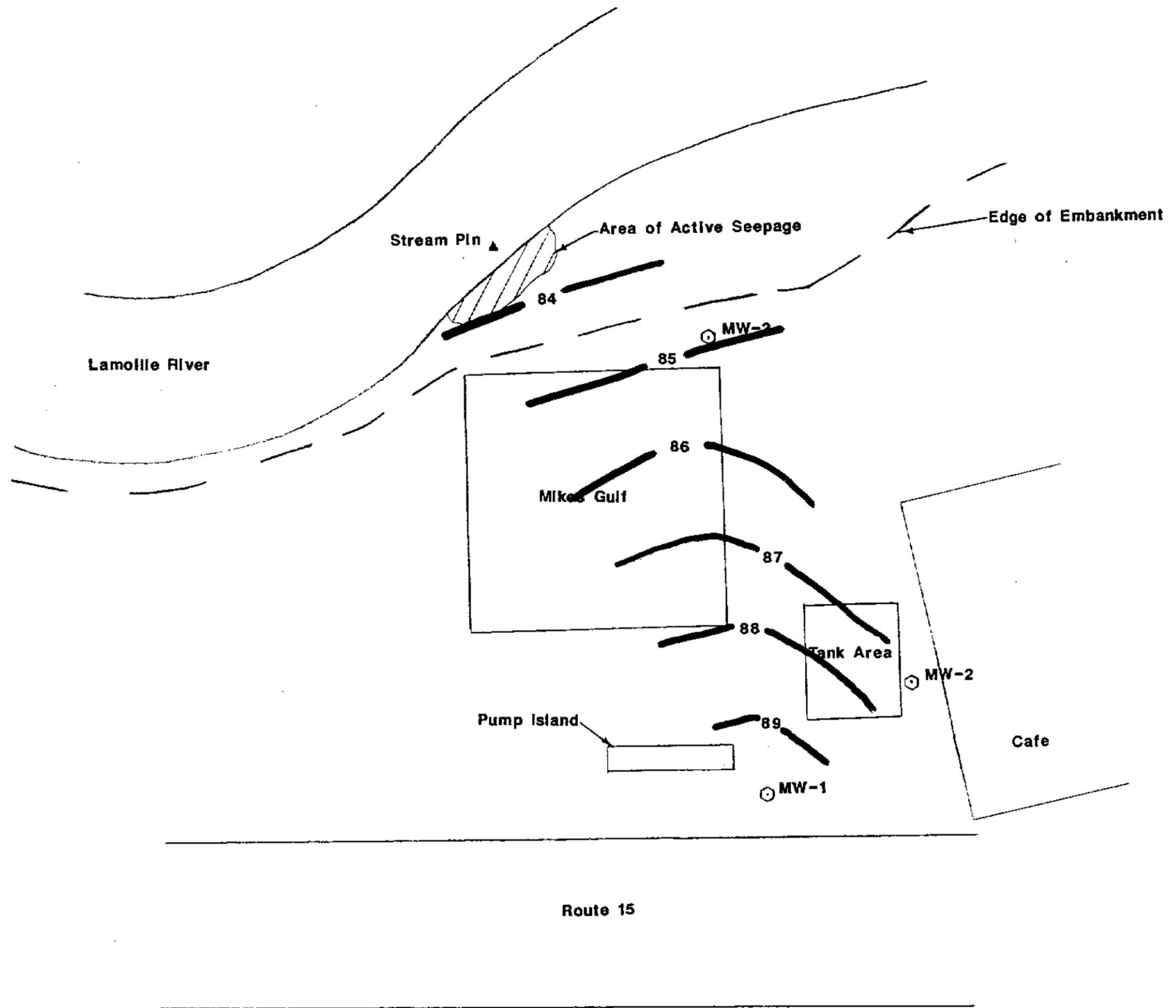


↑  
Approx. True North

Legend:  
 ⊙ MW-2      2" Monitoring Well  
 — 87 —      Contour Line

Figure 4

<b>MIKES GULF STATION</b>	
Scale: 1"=20'	Drawn by: S.L.
Ground Water Contour Map for 08/19/88	
Date: 8/88	Problem: Petroleum Seepage Into Lamolle River



Approx. True North

Legend:  
 ○ MW-2      2" Monitoring Well  
 — 87 —      Contour Line

Figure 5

<b>MIKES GULF STATION</b>	
Scale: 1"=20"	Drawn by: S.L.
<b>Ground Water Contour Map for 08/26/88</b>	
Date: 8/88	Problem: Petroleum Seepage Into Lamolite River

PROJECT Mike's Gulf Service Center

JOB NO. LAG/09/88

LOCATION Hardwick, VT

SHEET 1 OF 1



DATA POINT	REFERENCE ELEVATION	Water Table Elevation Data							
		DATE	8/19/88	8/26/88					
MW-1	100.00		89.77	89.82					
Mw-2	100.58		87.38	87.34					
MW-3	101.71		84.99	84.90					
Stream Pin	84.00		83.31	83.39					

Notes: 1) Elevation datum assumed.  
 2) "Reference Elevation" is elevation of top of PVC well casing at each data point.



# aquatec

**ENVIRONMENTAL SERVICES**

 75 Green Mountain Drive, So. Burlington, VT 05403  
 TEL. 802/658-1074

## ANALYTICAL REPORT

 Lincoln Applied Geology  
 RD 1, Box 128-B  
 Bristol, VT 05443

Attn: Mr. Steve LaRosa

Date: 9/8/88

Project No: 88400

ETR No: 14774

Sample(s) Received On: 8/26/88

Page 1 of 1

Standard analyses were performed in accordance with Methods for Analysis of Water and Wastes, EPA-600/4/79-020, Test Methods for Evaluating Solid Waste, SW-846, or Standard Methods for the Examination of Water and Wastewater. All results are in mg/l unless otherwise noted.

Parameter	88079	88080	88081	88082	88083	88084	88085
Following Results are in $\mu\text{g/l}$					<i>mw1</i>	<i>mw2</i>	<i>mw3</i>
Benzene	<1	170	<1	<1	28	630	8600
Toluene	<1	140	<1	1.2	3.3	1500	4600
Ethylbenzene	<1	9.7	<1	<1	<1	<1	1200
Xylenes	<1	71	<1	<1	36	1800	3600
Other Aromatic Hydrocarbons as o-Xylene	<10	60	<10	<10	32	3400	3300
Aliphatic Hydro- carbons as Hexane	<10	320	<10	<10	170	13,000	21,000

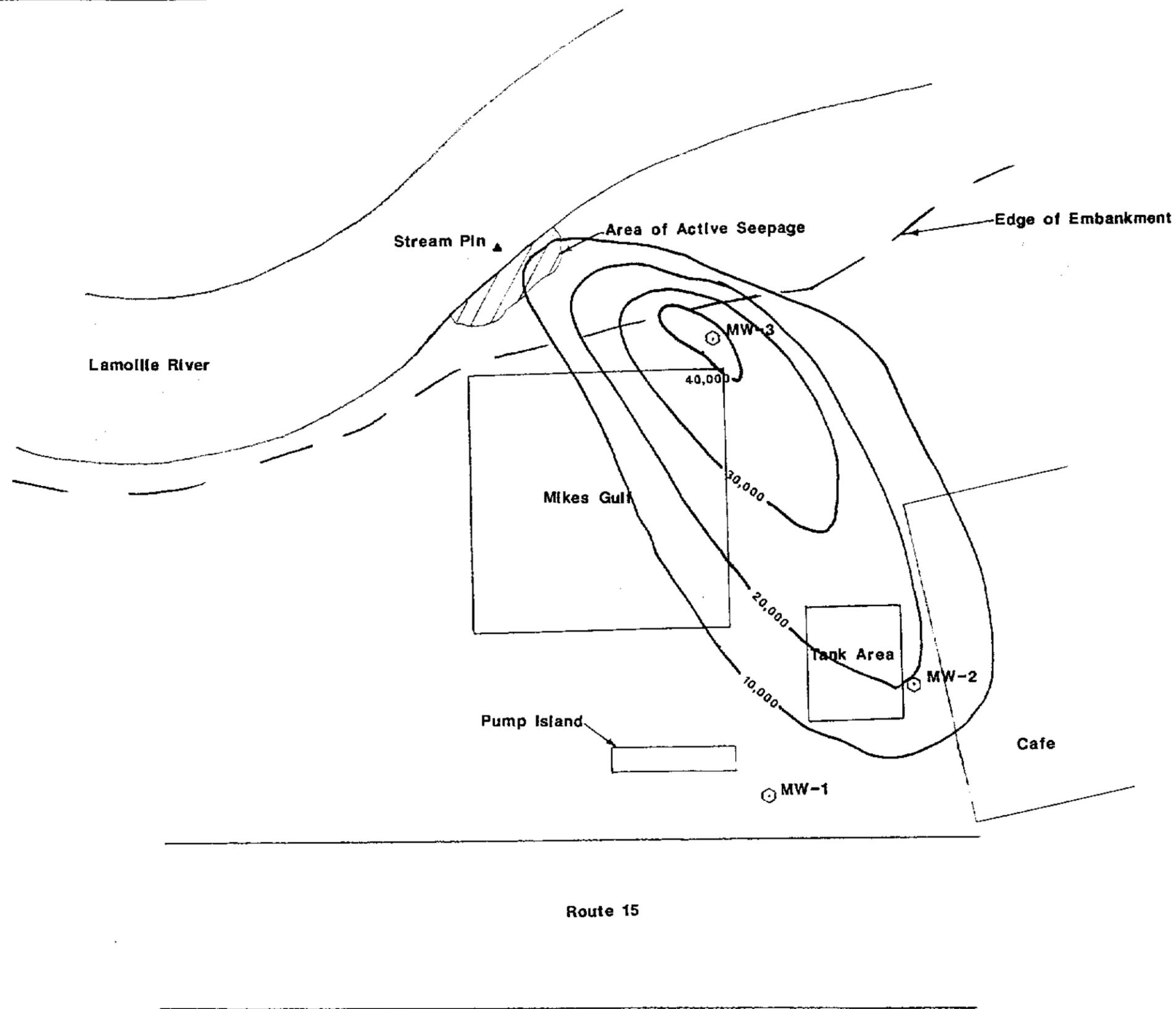
Lab No.

Sample Description

88079. Water sample labeled blank, collected 8/26/88.  
 88080. Water sample labeled boom area, collected 8/26/88.  
 88081. Water sample labeled upstream, collected 8/26/88.  
 88082. Water sample labeled downstream, collected 8/26/88.  
 88083. Water sample labeled MW-1, collected 8/26/88.  
 88084. Water sample labeled MW-2, collected 8/26/88.  
 88085. Water sample labeled MW-3, collected 8/26/88.

Submitted By:

Aquatec Inc.



Approx. True North

Legend:  
 ○ MW-2      2" Monitoring Well  
 — 20,000 —      Contour Line

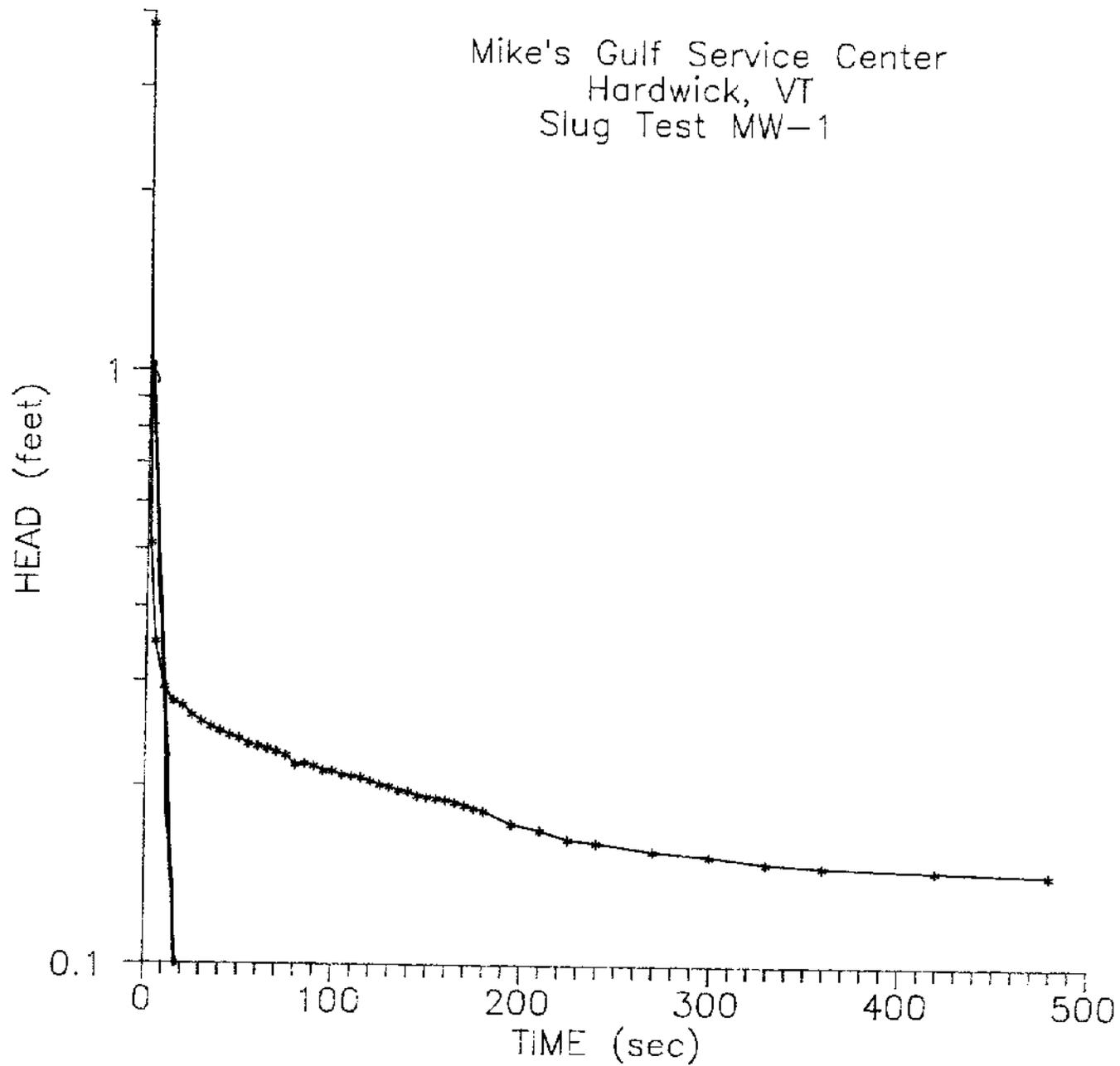
**Figure 6**

<b>MIKES GULF STATION</b>	
Scale: 1"=20"	Drawn by: S.L.
Total Hydrocarbon Contour Map for 08/26/88  (ppb)	
Date: 8/88	Problem: Petroleum Seepage Into Lamolite River

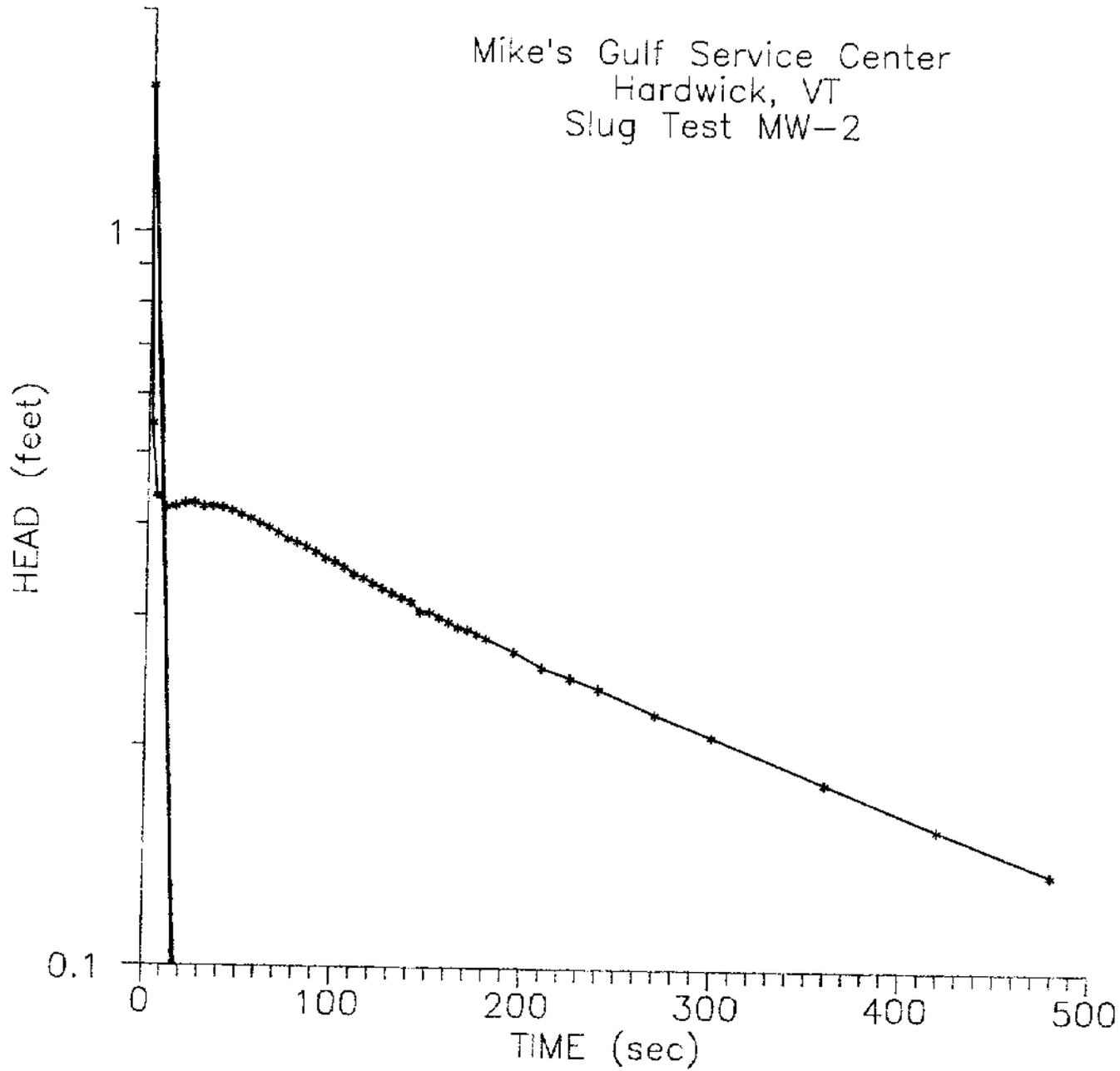
Appendix A

Slug Test Results

Mike's Gulf Service Center  
Hardwick, VT  
Slug Test MW-1



Mike's Gulf Service Center  
Hardwick, VT  
Slug Test MW-2



Mike's Gulf Service Center  
Hardwick, VT  
Slug Test MW-3

