LINCOLN
APPLIED GEOLOGY, INC.
Environmental Consultants

March 19, 1998

Mr. Robert Haslam
Hazardous Materials Specialist
Sites Management Section
Vermont Department of
Environmental Conservation
103 South Main Street
Waterbury, VT 05671-0404

RE: Perry's Oil/Mayo Property, Hardwick (#94-1608) - Site Summary, Fracture Trace Analysis, and Specifications for a Drilled Bedrock Well

Dear Mr. Haslam:

Lincoln Applied Geology, Inc. (LAG) is pleased to present the findings relative to the proposed replacement of a drilled bedrock water supply on the Bruce and Cathy Mayo property on Route 14 in Hardwick, Vermont. The Mayo's (and other residences) currently receive treated potable water from a petroleum contaminated bedrock well (new well) on the Perry's Oil Service (POS) property located to the southeast.

Review of the historical data associated with the POS petroleum contamination and data collected by LAG during a field survey of surrounding bedrock structural features and a fracture trace analysis, indicates that the old and new wells on the POS property were contaminated by petroleum contaminants released to the shallow soils and ground water during operations at the POS facility. The contaminants entered the wells by vertically migrating along, around, and under each casing; and through shallow bedrock fractures under pumping conditions.

The bedrock structural data and fracture trace analysis indicates that there are two dominant structural "zones" consisting of bedding, fracture, and joint surfaces that trend to the north and east. These data suggest that contaminants from the source area migrated into the old well through the north-trending bedrock fractures and/or vertical migration along the borehole annulus, and then migrated into the new well via the east-trending bedrock fractures. In short, the data indicates that once contaminants enter the bedrock system, either directly or from the shallow sandy loam soils, they either migrate naturally or by induced effects along bedrock structures.

In response to the SMS request to locate a drilled bedrock well on the Mayo property, the data collected indicates that there is only a limited risk of petroleum contamination to the proposed well due to its (upgradient) location, the great distance from the contaminated old well (450 feet) and the petroleum source area (530 feet), the low water use demand on the well, the route of entry of contaminants into the bedrock aquifer, and the proposed extraordinary well construction methods to be used. It is our opinion that this well should provide a source of clean, potable water to the Mayo residence.

Revell Drive • Lincoln, Vermont 05443 • (802) 453-4384 • FAX (802) 453-5399

Perry's Oil Site History

The Perry's Oil Service (POS) file was reviewed by LAG at the Sites Management Section (SMS) on November 20, 1997. Correspondence included in the file indicates that the POS property (southeast of the Mayo property) has been a retail gasoline station since prior to 1968. The POS and Mayo properties are shown on **Figure 1**.

On August 3, 1993 two single wall steel underground storage tanks (USTs) were removed from the south side of the store building. The 4,000 gallon and 2,000 gallon gasoline USTs were estimated to be at least 25 years old and were described as being in fair to good condition with no evidence of leakage. Bedrock was encountered at a depth of 8.5 feet, and soil contaminant levels as assayed by photoionization detector (PID) ranged from 0.2 parts per million (ppm) to 8.7 ppm. Minor soil contamination found around the fill pipe during the UST removal was apparently caused by spillage while pumping UST waste liquids. No mention is made of the condition of the UST piping and/or the gasoline dispenser island that served the two USTs. Shortly thereafter a 20,000 gallon double wall polyethylene clad steel UST was installed on the west side of the store building to replace the two USTs. Bedrock was blasted in order to place the UST to the proper depth. The UST removal form and correspondence are included as **Appendix A**.

Water Supply Wells

The bedrock well ("old well") that once supplied water to the POS building, the Miller residence (east side of Route 14), Rowell's Body Shop, and the Appleby and Mayo properties (west side of Route 14) was drilled in November 1975 by Gordon Appleby. The old well is 150 feet deep, has a driller's yield of 40 gallons per minute, and is located on the east side of the POS store building. The depth to bedrock is very shallow at 4 feet, and only 10 feet of steel casing was installed (6 feet below the top of rock). The old and new wells, and the proposed location of the Mayo well are shown on **Figure 1**, and the old well driller's log is included in **Appendix B**.

Prior to November 1993, none of the water users ever noticed or reported any water taste or odor problems. In November 1993, after the two USTs had been removed and bedrock had been blasted for the new 20,000 gallon UST, the Mayo's noticed that their drinking water had a "strange odor". On May 10, 1994 Richard Spiese of the SMS conducted a visit to the Mayo residence and collected a water sample from their kitchen sink tap. Mr. Spiese's site visit summary letter is included as **Appendix C**. Water quality results showed that 53 parts per billion (ppb) of benzene and 843 ppb total volatile hydrocarbons (TVH) were present, indicating that the old well was contaminated with petroleum. Four point-of-entry water treatment (POET) systems were installed in the POS, Miller, Appleby, and Mayo buildings to treat water from the old well, and water quality testing of the old well POET systems continued through January 1996. Although concentrations of benzene, toluene, and xylenes declined, levels of MTBE increased

through January 1996. A summary of the historical water quality data from the old well is summarized and included in **Appendix C**.

While there is no information from the old well driller's log identifying the depth(s) of water-bearing fractures or zones, it is apparent that the contamination entered the well between the bottom of the casing (10') and the bottom of the well (150'). Since the old well served 5 residences and businesses, the wells' calculated maximum daily demand (MDD) pumping rate is 3.1 gpm, much less than the 40 gpm well driller's yield. This high yield well with a low MDD that is located in a ground water discharge zone likely resulted in only limited drawdown of the water within the well under active pumping conditions. Therefore this data suggests that the contaminants entered the well from below the casing but within the upper portion of the shallow bedrock aquifer.

POS hired H.A. Manosh Corporation to drill a new replacement bedrock well on their property on June 21, 1996 in an attempt to supply clean, potable water to the 5 water users. The "new well" is located about 220 feet northeast of the old well and southeast of the Mayo property. The new well is 348 feet deep, has a driller's yield of 32 gpm (slightly less than the old well), and contains 40.7 feet of steel well casing. The top of bedrock is 26 feet below grade, and the casing and driveshoe are grouted 12 feet into bedrock. The new well driller's log is included in **Appendix A**.

Water quality sampling of the new well has been performed since August 13, 1996, and the historical data is summarized and included in **Appendix B**. On January 2, 1997, 11 ppb MTBE was detected in the new well, and 9 ppb MTBE was detected on March 31, 1997. The presence of gasoline related contaminants in the new well strongly suggests that they migrated through interconnected bedrock fractures from the source area (gasoline USTs, piping, and dispenser island) toward the northeast and into the well. With the new well actively pumping ground water from bedrock fractures which intersect the well below the bottom of the casing at a depth of 38 feet, highly soluble and mobile dissolved gasoline contaminants (such as MTBE) in ground water were induced to flow through these fractures and contaminate the new well.

The new well driller's log identifies water-bearing zones at 130 - 131', 214 - 216', 242' - 248', and 328' - 348'. The data indicates that the contamination entered the well between the bottom of the casing (41') and the bottom of the well (348'). Since the new well also serves 5 residences and businesses, the wells' calculated maximum daily demand (MDD) remains at 3.1 gpm, again much less than the 32 gpm well driller's yield. As is probably the case with the old well, this high yield well with a low MDD located in a ground water discharge zone likely results in only limited drawdown of the water within the well under active pumping conditions. With the shallowest identified water-bearing zone at a depth of 130 feet, it is unlikely that the contaminants entered the well from this deeper portion of the bedrock aquifer. Instead, these data suggest that the contaminants entered the well from shallower (unidentified) fractures below the well casing but within the

upper portion of the bedrock aquifer.

Contaminant Chronology

The following is a chronology of events related to the use and contamination of the old and new bedrock wells:

- The old well was drilled in November 1975 to a depth of 150 feet;
- There were no odor or taste problems associated with water from the old well from 1975 through November 1993;
- Two gasoline USTs (4,000 and 2,000 gallon capacities) were excavated and removed from the POS property on August 3, 1993;
- The two USTs had been sitting on or just above the top of bedrock at a depth of 8.5 feet;
- Ground water was not encountered during the UST removal, suggesting that there is no shallow ground water in unconsolidated soils at the source area but instead shallow ground water is in the bedrock fractures;
- Removal of the USTs disturbed the soils in the area;
- Very limited contamination of the soils were detected by PID, suggesting either minor contamination had occurred or the bulk of the contaminants had directly entered the underlying bedrock fractures;
- On August 4, 1993 bedrock was blasted for installation of the 20,000 gallon replacement UST, resulting in severe disturbance and increased fracturing of the bedrock,
- The Mayo's noticed a petroleum odor and taste to their water in November 1993 following the UST removal and bedrock blasting activities;
- On May 10, 1994 the SMS sampled the Mayo's water and detected 53 parts per billion (ppb) benzene and 843 ppb total volatile hydrocarbons (TVH);
- Shortly thereafter the SMS installed four water point-of-entry treatment (POET) systems in the POS building, and the Miller, Mayo, and Appleby residences;
- On May 24, 1996 the new well was drilled to a depth of 348 feet to replace the contaminated old well water supply;
- The old well was then shut off and removed from service, and the new well began pumping and supplying the businesses and residences with potable (but treated) water;
- On January 2, 1997 the new well contained 11 ppb MTBE; and
- It appears that cessation of ground water pumping from the old well and active pumping from the new well has caused petroleum contaminants in bedrock fractures to migrate into the new well via shallow fractures and open structural surfaces.

Contaminant Migration Route

There are no data from the old or new wells indicating at what depth, or by which route of entry dissolved petroleum contaminants entered these wells. However, data from the old and new well logs, historical water quality, geology, geographic location, and site history allow a reasonable reconstruction of the most probable contaminant migration route.

The data indicates that after removal of the USTs and blasting of bedrock for installation of the replacement UST, petroleum contaminants entered the old well. The excavation and blasting activities and continued pumping of ground water from the old well apparently caused dissolved petroleum contaminants beneath the source area to migrate into the old well via induced pumping effects. The presence of the former USTs atop shallow bedrock (8.5'), lack of shallow ground water in the overlying unconsolidated soils, and presence of shallow bedrock (4') at the old well suggest that contaminants directly entered bedrock fractures in the source area and then migrated through the fractures and entered the old well between the casing bottom (10') and well bottom (150'). Since the old well is located within a ground water discharge zone, ground water in the deeper portions of the fractured bedrock aquifer naturally flows vertically upward into the shallow portions of the bedrock aquifer or shallow unconsolidated soil aquifer (where present), where it ultimately flows and discharges into the Lamoille River. The lighter-than-water petroleum contaminants will normally remain in the shallow parts of the ground water aquifer unless they are induced to migrate deeper through active pumping of the well.

Review of the driller's well yield for the old well (40 gpm) and the water demand on the well indicates that the well yield is high and the demand is low. Assuming that 450 gallons of water per day (gpd) is used by each of the five water users (POS, Miller, Mayo, Appleby, and Rowell's), this results in an average daily demand (ADD) of 2,250 gpd or a low MDD pumping rate of 3.1 gpm. The high well yield and low MDD indicate that there would be only minor drawdown of the ground water level in the well under pumping conditions, thereby providing further evidence that the contaminants entered the old well via shallow bedrock fractures below the bottom of the well casing and not from deeper bedrock fractures.

Occasionally shallow aquifer related contaminants migrate vertically downward within the more permeable annular space between the exterior wall of the well casing and the borehole wall, where they leak past the casing bottom (driveshoe) and enter the well. Since the old well casing was not grouted into the bedrock, this downward leaky condition likely existed when the well was actively pumping. The data indicates that the old well was contaminated through this downward leaky hydraulic condition as well as by induced infiltration of contaminants from the shallow unconsolidated sediments directly into the bedrock fractures under active pumping conditions.

The means by which contamination entered the new well was probably quite similar to that of the old well. Following installation of the new well, the old well was shut off and the new well activated. This action eliminated the hydraulic control of the contaminant plume that had been established through active pumping of the old well. Once no longer under the hydraulic control of the old well, ground water and contaminants within the bedrock fractures connecting the old and new wells began to migrate toward the new well. Since the well yield of the new well (32 gpm) was only slightly less than the old well and the water demand remained the same (very low), drawdown in the well was minimal. Thus, the data indicates that the contaminants probably entered the new well through shallow aquifer fractures and/or downward leakage through fractures near the well casing.

Although the driller's log for the new well indicates that the significant identified water producing zones are at 130 to 131 feet, 214 to 216 feet, 242 to 248 feet, and 328 to 348 feet, the data indicates that it is more probable that the dissolved contaminants have migrated through the shallow bedrock fractures, past the grouted casing and driveshoe, and entered the well rather than entering the well at the much deeper identified producing zone of 130 to 131 feet.

Bedrock Structure Evaluation

Five bedrock outcrops were located within a 1,100 foot radius of the Mayo property on December 11, 1997. These outcrops are numbered 1 through 5 on **Figure 1**. The bedrock is mapped on the Centennial Geologic Map of Vermont (1961) as the Middle Ordovician age (480-460 million year old) Moretown member of the Mississquoi formation, a metamorphosed quartzite and quartz-plagioclase granulite. Spatial orientation data from bedrock structural features including bedding, fractures, and joints were used to evaluate whether dominant bedrock structures may have controlled the contaminant migration from the source area into the old and new wells. These data were also used to determine a suitable location where a drilled bedrock well could be placed on the Mayo's property which would minimize the risk of being contaminated from the identified contaminant plume to the south and southeast.

Twenty sets of structural bedrock data were collected and plotted on a compass rose included as **Figure 2**. These data indicate that there are two dominant "structural zones" of fractures, joints, and bedding present in the local bedrock. One structural zone trends north from 340 degrees to 32 degrees, and the other trends east from 77 degrees to 114 degrees (measured relative to magnetic north at 0 degrees). Within these structural zones the feature that is most dominant is the bedrock bedding that is north-trending. The locations of the contaminant source area, old well, new well, and proposed Mayo well were evaluated with regard to potential contaminant routes within the two bedrock structural zones.

The north-trending structural zone includes the source area, old well, and proposed

Mayo well. The new well lies outside both the north and east-trending structural zones as they relate to the source area. The old well is located about 90 feet north of the contaminant source area, close enough to readily become contaminated under induced pumping conditions following the UST excavation and bedrock blasting events. These data suggest that contamination of the old well occurred under pumping conditions due to migration of the contaminants through the north-trending shallow fractures between the source area and the old well. It is important to note that when the old well was actively pumping it may have served to control and contain the ground water contamination from migrating further in the shallow soils and the shallow bedrock fractures. Although the proposed Mayo well would be located within the north trending structural zone in relation to the source area and the old well, we have limited concern that this well could become contaminated due to the proposed extraordinary well construction measures to be employed and its location 530 feet north of the source area and 450 feet north of the old well.

The new well is located about 375 feet northeast of the source area, and about 290 feet east-northeast of the old well as shown on **Figure 1**. Although it is located outside the north-trending structural zone as related to the source area and the old well, it is located within the east-trending structural zone related to the old well. These data suggest that the new well became contaminated from dissolved contaminants migrating (under pumping conditions) through the east-trending bedrock fractures connecting the old well with the new well. We have limited concern that the proposed Mayo well could become contaminated from contaminants present in the new well since it is not located within either the north or east-trending structural zones related to the new well; it lies 450 feet northwest of the new well; its water demand would be very low (0.6 gpm), and the proposed extraordinary well construction measures should prevent its contamination.

Aerial Photo Lineaments

Two sets of aerial photographs (dated April 29, 1963 and May 21, 1974) were evaluated to determine the presence of regional and local lineaments or fracture traces detected by visual means. The orientations of 28 lineaments were then plotted on a compass rose included as **Figure 3**. Review of these data indicate that there are no clearly defined lineament "zones". Instead, the lineaments are oriented throughout the compass rose. However, the aerial photos do show relatively prominent lineaments that correspond with north-trending bedrock ridges (strike of bedding and fractures) generally oriented at 341 to 38 degrees (relative to true north at 0 degrees).

Summary of Bedrock and Lineament Data

Although the aerial photos show widely oriented lineaments as compared to the two structural zones delineated by bedrock outcrop structural analyses, these data do indicate that there are well defined bedrock structural features that appear to have strongly

controlled contaminant migration from the POS petroleum source area into the old well, and then into the new well. A combination of: permeable shallow aquifer soils; lack of a confining unit between the shallow aquifer and the bedrock aquifer; dominantly north-trending bedrock structures; inadequate well construction methods (i.e. minimum well casing lengths and lack of grouting casing into bedrock); relatively close proximity to the contaminant source area; the UST removal and bedrock blasting activities which severely disturbed the soils and bedrock; and contaminant migration into the wells under pumping conditions have all contributed to contamination of the old and new bedrock wells.

As long as the POET systems remain in use on the new well and are properly maintained and monitored, then the new well can be used to supply the POS building, Miller trailer, Appleby residence, and Auto Body Shop with potable water. The Mayo's have decided to drill a bedrock well on their property to supply potable water to their residence. There should be no problems associated with potential contamination of the proposed Mayo well as long as the new well remains actively pumping and contains the contaminant plume. If the old well has not been properly abandoned already, then this should be done to eliminate a conduit for the vertical migration of petroleum contaminants within the bedrock aquifer.

Proposed Mayo Bedrock Well

On December 11, 1997 a potential suitable location for a drilled bedrock well on the Mayo property was evaluated. As stated previously, the data collected indicates that there is a limited risk of petroleum contamination from the POS property impacting the proposed Mayo well due to the great distance (450 feet) from the known plume, upgradient location of the Mayo property, and the proposed extraordinary well construction measures to be employed.

As shown on **Figure 4**, the proposed location for the well (site A) is north of the Mayo house and west of the garage near the base of the slope. This is the only location that will meet the required minimum separation distances outlined in the Vermont Water Supply Rule - Chapter 21. The proposed well location is about 25 feet from the northwest property boundary, 25 feet from the garage building, 100 feet upgradient of the replacement septic disposal field (and 115 feet from the existing septic field), and much greater than 100 feet to the Appleby and Keogh downgradient septic disposal fields. The Mayo septic tank is also greater than 90 feet downgradient of the proposed well.

Since well site A is located near the base of a steep slope, excavation of soils will be necessary in order to maintain the 100 foot separation distance from the replacement septic disposal field and to maneuver the drill rig in position. Once the well is drilled and completed, the original soil can be backfilled and the slope grade restored after a steel casing extension is placed on the well to bring it a minimum of 1.5 feet above grade.

The proposed well will be drilled to a depth of 300 feet. A 12-3/4" tophole will be drilled to the top of bedrock, and then an 8" air hammer will be used to drill through bedrock to a depth of 100 feet. The borehole will be filled with sufficient neat cement grout to completely fill the annular space between the borehole wall and the exterior of the 6" steel casing when the casing is installed. A temporary plug will be installed in the bottom driveshoe of 102 feet of 6" steel casing (19 lbs/ft). The casing (fully threaded and welded couplings) will be lowered into the borehole and driven into the bedrock, causing displacement of the grout to the surface.

The next day (after the grout has cured) the temporary driveshoe plug will be drilled out and the well completed to a depth of 300 feet. Throughout the well drilling and installation process, the driller shall keep a detailed log of the geologic materials encountered, depths and zones where ground water is encountered, and their estimated yields. After the well is completed, a water yield test will be conducted while developing the well with compressed air for two hours. The necessary casing extension will then be placed atop the well and welded in place prior to returning the slope to its original grade.

An appropriately sized submersible pump, piping, and electrical wiring will be installed in the well and extended to the residence basement where a pressure tank, switches, and other necessary equipment will be properly installed and connected to the house plumbing. Water samples will then be collected and analyzed for total coliform bacteria, arsenic, nitrate, chloride, sodium, iron, manganese, odor, and volatile organic compounds (EPA Method 524.2) as suggested in the Vermont Water Supply Rule.

We look forward to assisting you and the Mayo's with accurately siting the proposed well, coordinating the drilling, and conducting water quality sampling, if necessary. Please call me at 802-453-4384 if you have any questions or comments.

Sincerely,
Lincoln Applied Geology, Inc.

William D. Norland
Hydrogeologist

Enclosures
cc: Bruce and Cathy Mayo

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Lincoln Applied Geology, Inc
Environmental Consultants
Revell Drive • Lincoln, Vermont 05443 • (802) 453-4384 • FAX (802) 453-5399

Appendix B

Driller's Well Logs
for Old Well and New Well

WELL OWNER Gordon Applebee (Name) Craftsbury Rd. (Mailing Address)

WELL DRILLER Wilio (250) (Name) Hardwick (Mailing Address)

PROPOSED USE OR USES (Check):
☐ Domestic ☐ Agriculture ☐ Business Establishment ☐ Municipal ☐ Industrial
☐ Other (specify use):

CASING DETAILS (Inside)	YIELD TEST	WATER LEVEL (From land surface if possible)
Length: 10 5. Feet	☐ Bailed or ☐ Pumped or ☐ Compressed Air	Hours
Diameter: Inches		GPM
Kind:	Well Cap	Static: Feet
Weight: lbs./p/ft.		During Yield Test: Feet
☐ New ☐ Used	Yield: 40 GPM	DRILLING EQUIPMENT ☐ Cable Tool ☐ Rotary ☐ Air Percussion ☐ Other (specify)

1050. –
50. –
46.60
1146 60
2.89
1149 49

TOTAL DEPTH OF WELL 150'7." FEET TOWN WELL IS LOCATED IN: Hardwick
(Make sketch of well location on reverse side of sheet)

— WELL LOG —

Depth From Ground Surface	Give description of formations penetrated, such as: peat, silt, sand, gravel, clay, hardpan, shale, limestone, granite, etc. Include size of gravel (diameter) and sand (fine, medium, coarse) color of material, structure (loose, packed, cemented, hard). For example; 0 ft. to 27 ft. fine, packed, yellow sand; 27 ft. to 134 ft. gray granite.
0 ft. to 4 ft.	Fill
4 ft. to 150 ft.	Shale
ft. to ft.	
ft. to ft.	
ft. to ft.	

DATE WELL STARTED 4/6 DATE WELL COMPLETED

Bits Used # 24837 Footage 142 Daily Footage 150

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8" Bit 18718 8

DRILLERS HOURS 10 HELPERS HOURS 10

NOV 11 1975

WELL NO. / TAG NO. _____ (For Driller's Use)

This report must be completed and submitted to the Department of Environmental Conservation 103 South Main Street (10N), Waterbury, VT 05676 no later than 60 days after completion of the well.

State of Vermont
Dept. of Environmental Conservation
103 South Main Street (10N)
Waterbury, Vt. 05676
WELL COMPLETION REPORT

DEPARTMENT USE ONLY

E.C. _____ U.S.G.S. _____

Field Location ☐ Map area _____

Latitude _____ ° ' " Elev. _____

Longitude _____ ° ' " Topo. _____

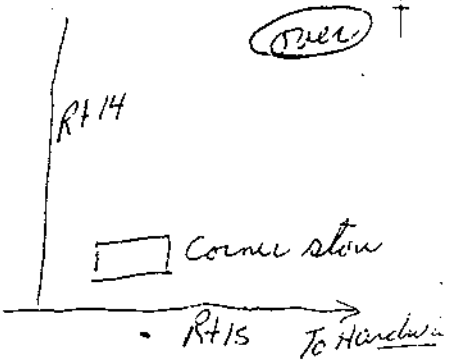
Scale: 62,500 ☐, 25,000 ☐, 24,000 ☐

Location map attached to WCR _____ Data in Town Files ☐ _____

1. WELL OWNER Vona Bissett (Name) PO Box 1250 Hardwick Vt. 0584- (Permanent Mailing Address)
   OR
   WELL PURCHASER _____ (Name) Same (Permanent Mailing Address)
2. LOCATION OF WELL: TOWN Hardwick SUBDIVISION _____ LOT NO. _____
3. DATE WELL WAS COMPLETED 5/24/96
4. PROPOSED USE OF WELL: ☐ Domestic, ☐ Other Commercial
5. REASON FOR DRILLING WELL: ☐ New Supply, ☑ Replace Existing Supply, ☐ Deepen Existing Well, ☐ Test or Exploration, ☐ Provide Additional Supply, ☐ Other _____
6. DRILLING EQUIPMENT: ☐ Cable Tool, ☑ Rotary with A-P, ☐ Other _____
7. TYPE OF WELL: ☑ Open Hole in Bedrock, ☐ Open End Casing, ☐ Screened or Slotted; ☐ Other _____
8. TOTAL DEPTH OF WELL: 348 feet below land surface.
9. CASING FINISH: ☑ Above ground, Finished, ☐ Above ground, Unfinished, ☐ Buried, ☐ In Pit, ☐ Removed, ☐ None used, ☐ Other _____
10. CASING DETAILS: Total length 40'8" ft. Length below L.S 38' ft Dia. 6 in. Material Steel Wt. 19 lb./ft
11. LINER OR INNER CASING DETAILS: Length used _____ ft Diameter _____ in. Material _____ Weight _____ lb./ft
12. METHOD OF SEALING CASING TO BEDROCK: ☑ Drive Shoe, ☑ Grout - type II, Drilled 10 5/8 in. hole 12 ft in Bedrock
    ☐ Other Cement - 5% Bentonite
13. SCREEN DETAILS: Make and Type _____, Material _____, Length _____ ft, Diameter _____ in.
    Slot Size _____, Depth to top of screen in feet below land surface _____ ft., Gravel pack if used, Gravel Size or Type _____
14. YIELD TEST: ☐ Bailed, ☐ Pumped, ☑ Compressed Air, for 3+ Hours at 32 Gallons per minute
    Measured by ☑ Bucket, ☐ Orifice pipe, ☐ Weir, ☐ Meter ☐ Permanent Airline installed
15. STATIC WATER LEVEL: _____ feet below land surface, Date or Time measured _____, Overflows at _____ G P M
16. WATER ANALYSIS: Has the water been analyzed? ☐ Yes ☑ No, If Yes, Where _____
17. SPECIAL NOTES: _____
18. WELL LOG

Depth from Land Surface: Feet	Feet	Water Bearing	Formation Description	Sketch
Ground Surface	26		Wet Gravel + Boulders	
26	130		Green bedrock	
130	131		Brown Vein	
131	214		Green bedrock	
214	216		Brown vein	
216	242		Light Gray bedrock	
242	248		Brown Vein	
248	328		Med. Gray bedrock	
328	348		Green with lots of Quartz	

19. SITE MAP
Show permanent structure such as buildings, septic tanks, and/or other land marks and indicate not less than two distances to the well. Indicate local street name and subdivision lot number.



20. TESTED YIELD
If the yield was reduced or different aquifers during drilling, list below.

Feet	Gallons Per Minute
130-131	5 gpm
214-216	10 gpm
242-248	10 gpm
328-348	5 gpm

WELL DRILLED BY: H. A. Manosh Corp

DOING BUSINESS AS: H. A. Manosh Corp (Company or Business Name)

REPORT FILED BY: L. Rowe (Authorized Signature)

DATE OF REPORT: May 29, 96 WELL DRILLERS LIC. NO. 8

GPM increased at mid the above

Appendix C

May 12, 1994 Memorandum regarding contamination of May Water Supply

M E M O R A N D U M

TO: Mayo Residence File (site #94-1608)

THROUGH: Chuck Schwer, Supervisor, Sites Management Section CS

FROM: Richard F. Spiese, Sites Coordinator RFS
Sites Management Section

DATE: May 12, 1994

SUBJECT: Possible Contaminated Water Supply, Hardwick

On May 10, 1994, I stopped by the Mayo Residence in Hardwick to sample their water supply. The Mayos believed that their water supply may have been contaminated by the Perry Oil Services, Inc., Rt. 14 and 15, gasoline station.

The Mayos get their water from a well which is located across Rt. 14 on the gas station property. One other house, a body shop, and a trailer also get their water from this well. A brief history of the site is as follows:

> The USTs at this site were replaced at this facility on 8/4/93. Perry Oil had to blast in order to get into bedrock and place the new UST at this site. The Mayos believed that they first started to notice a strange odor in their water in November, 1993. The Mayos lived in this house for five years, but Ms. Mayo lived in the other house on this water system (her father's house) for 30 years.

On May 10, I sampled the Mayo's tap in their kitchen using standard tap sampling techniques. The odor from the Mayo's tap was not clearly gasoline or fuel oil, but on the other hand it could have been either. The odor could also have been an organic (septage) or mineral (sulfur) smell. The smell in their water was just not distinct. I informed Ms. Mayo that once we got the results to the EPA Method 8240 sample, we would decide the next course of action, and get them the results.

Other possible sources in the area include two auto body/mechanic shops; one across Rt. 14 from the gas station and the other about 400 yards up valley from the station, and a junkyard which is also about 400 yards up valley from the station but across Rt. 14 from the shop. Farming in the area includes only the haying of fields.

I will follow up on this problem once I receive the sampling results from the lab.

rfs/594m1.Mayo

Appendix D

Old Well and New Well Water Quality Database

influent

Donas - Hardwick 1608 "old well"

date	benzene	toluene	ethyl-benzene	xylenes	MTBE	(other) TUH	(other) 1,1,2,2-Tetrachloroethane
5/10/94	53	ND	ND	<5	ND	843	ND
7/18/94	ND	→	→	→	→	ND	ND
9/2/94	ND	ND	ND	6	ND	ND	5
9/14/94	ND	→	→	→	→	→	→
10/10/94	ND	→	→	→	→	→	
2/10/95	15	ND	ND	ND	9	ND	
3/22/95	12	ND	ND	ND	12	ND	
4/20/95	12	ND	ND	ND	27	ND	
5/24	ND	ND	ND	ND	19	ND	
7/~~28~~/95	11	2	ND	2	58	234	
7/28	ND	→	→	→	43	ND	
8/31	6	ND	ND	1	63		
11/17	5	ND	ND	ND	74		
1/31/96	2	~~ND~~ ND	ND	ND	65		
1/12/96	ND	ND	ND	ND	55		
new well	drilled	5/24/96					

D + H collected sample / Seibert analyzed

Replacement Well "New Well"

WATER QUALITY SUMMARY SHEET

date	benzene	toluene	ethyl-benzene	xylenes	MTBE	
8/13/96	ND	→	→	→	→	
10/22/96	ND	→	→	→	→	
1/2/97	ND	→	→	→	11	
3/31/97					97	
6/19/97	ND	→	→	→	→	

CONCENTRATIONS LISTED IN PARTS PER BILLION

Appendix A

UST Closure Reports for former Hall's Handy Mart (Perry's Oil Service)

GRIFFIN INTERNATIONAL INC

August 4, 1993

Mr. Marc Coleman
State of Vermont
Department of Environmental Conservation
Management and Prevention Section
103 South Main Street/West Building
Waterbury, VT 05676-0404

Re: UST Closure Inspection, formerly Hall's Handy Mart, Hardwick, VT

Dear Mr. Coleman:

On August 3, 1993, I conducted a tank closure inspection on 2 Underground Storage Tanks (UST), one 4,000 gallon unleaded gas and one 2,000 gallon super unleaded gas, at the former Hall's Handy Mart, located at the intersection of Rt's 14 and 15 in Hardwick, VT. Enclosed are the completed State of Vermont tank pull forms, a site location map and site photographs.

The subject UST's had been in service for approximately 25 plus years, though the exact date of installation could not be ascertained from personnel on site. Both UST's were being removed as part of routine replacement, with the current tank pit not being utilized for the installation of the new tank. A new 20,000 gallon divided tank is to be installed in a different location.

Prior to the two tanks being removed from the tank pit, the remaining product and water in the tanks was pumped into 55 gallon drums. The total waste pumpage generated from the tank cleaning and product removal totaled approximately 300 gallons. All waste generated from this site will be transported and disposed of by Pollution Solutions of Vermont. The cleaning and disposal of the tanks was conducted by Martin's Meter and Tank Service. Excavation of the tanks was performed by Gravel Construction Company of Wolcott.

2B Dorset Lane • Williston, VT 05495 • 802-879-7708

Based on data collected and visual observations during the investigation, I have arrived at the following conclusions:

1) Both UST's were in fair to good condition, with no evidence or signs of leakage.

2) The low level of contamination detected around the fill pipe of the 2,000 gallon tank was apparently the result of a small observed spill during the UST waste pumpage/removal and is not anticipated to have any significant or adverse affect on the environment or any surrounding sensitive receptors.

3) Bedrock was encountered at a depth of 8.5 feet, with no contamination present.

4) Further investigation at this site does not appear to be warranted.

If you have any questions regarding this report, feel free to give me a call.

Sincerely,

Don Tourangeau
Inspector

Encl.

cc. Martin's Meter and Tank
Mr. Dona Bessette

VERMONT DEPARTMENT OF ENVIRONMENTAL CONSERVATION
UNDERGROUND STORAGE TANK PROGRAM
103 SOUTH MAIN STREET
WATERBURY, VERMONT 05671-0404
(802) 244-8702

Date of Removal: 8/3/93 Date of Assessment: 8/3/93
Person & Company Doing Assessment: Don Toobangeau / Griffin International, Inc
Telephone Number: (802) 879-7708

Business Name Where Tank(s) Located: Nulls Handy Mart (former name)
Number of Employees: 0
Street Address & Town/City: AT's 1445, Hardwick

Owner of Tank(s): Raymond Lacoss
Address:
Town/City: Wolcott, Vt. Contact Person: Raymond Lacoss
Phone Number: Unknown

UST Facility ID Number: #1740

Tank #	Product	Size	Condition
1	S. Unleaded	2000 Gal	Fair-Good
2	Reg. Unleaded	4000 Gal.	Good
3			
4			

Reason for Tank Removal (check one): ☐ abandoned ☑ routine replacement ☐ tank or piping leaking ☐ liability

Replacement Tank(s)? ☑ yes ☐ no Number of Replacement Tanks: 1

DEC UST Permit(s) Obtained? ☑ yes ☐ no

DEC-Permitted Tank(s) Still On-Site? ☐ yes ☑ no Number of Tanks: ____

Out of Service Tank(s) On-Site? ☐ yes ☑ no Number of Tanks: ____

Heating Oil Tank(s) On-Site? ☐ yes ☑ no No. of Tanks: 0 Size(s): ____

Any Waste Pumpage? ☑ yes ☐ no Estimated Volume: 300 Gallons.
Transported By: Pollution Solutions of Vermont

Size of Excavation (ft²): 364 Depth: 8' Soil Type: Sandy loam
Concentrations Detected with PID: Peak = 8.7 Average = 0.2
Type of PID: Hnu Model PI 101
Number of Readings (please put locations on attached drawing): 6 in Pit
Calibration Info. (date, time, type of gas): 8/3/93 09:05 Iso.

Free Phase Product Encountered? ☐ yes ☒ no Approx. Amount: 0
Cont. Soils Stockpiled? ☐ yes ☒ no Amount (yd³): 0
Cont. Soils Backfilled? ☐ yes ☒ no Amount (yd³): 0

Groundwater Encountered? ☐ yes ☒ no Depth to Groundwater: Unknown
Monitoring Wells Installed? ☐ yes ☒ no Number: ____ Screen Depth: ____

On-Site Drinking Well? ☑ yes ☐ no [if yes: ☑ rock ☐ gravel ☐ spring]
Public Water Supply Well(s) Within ½ Mile? ☐ yes ☒ no
Distance to nearest: 1½ miles
Private Water Supply Well(s) Within ½ Mile? ☑ yes ☐ no How Many? ____

Samples Collected for Laboratory Analysis? ☐ yes ☒ no How Many? ____
[check all that apply: ☐ soil ☐ groundwater ☐ drinking water]

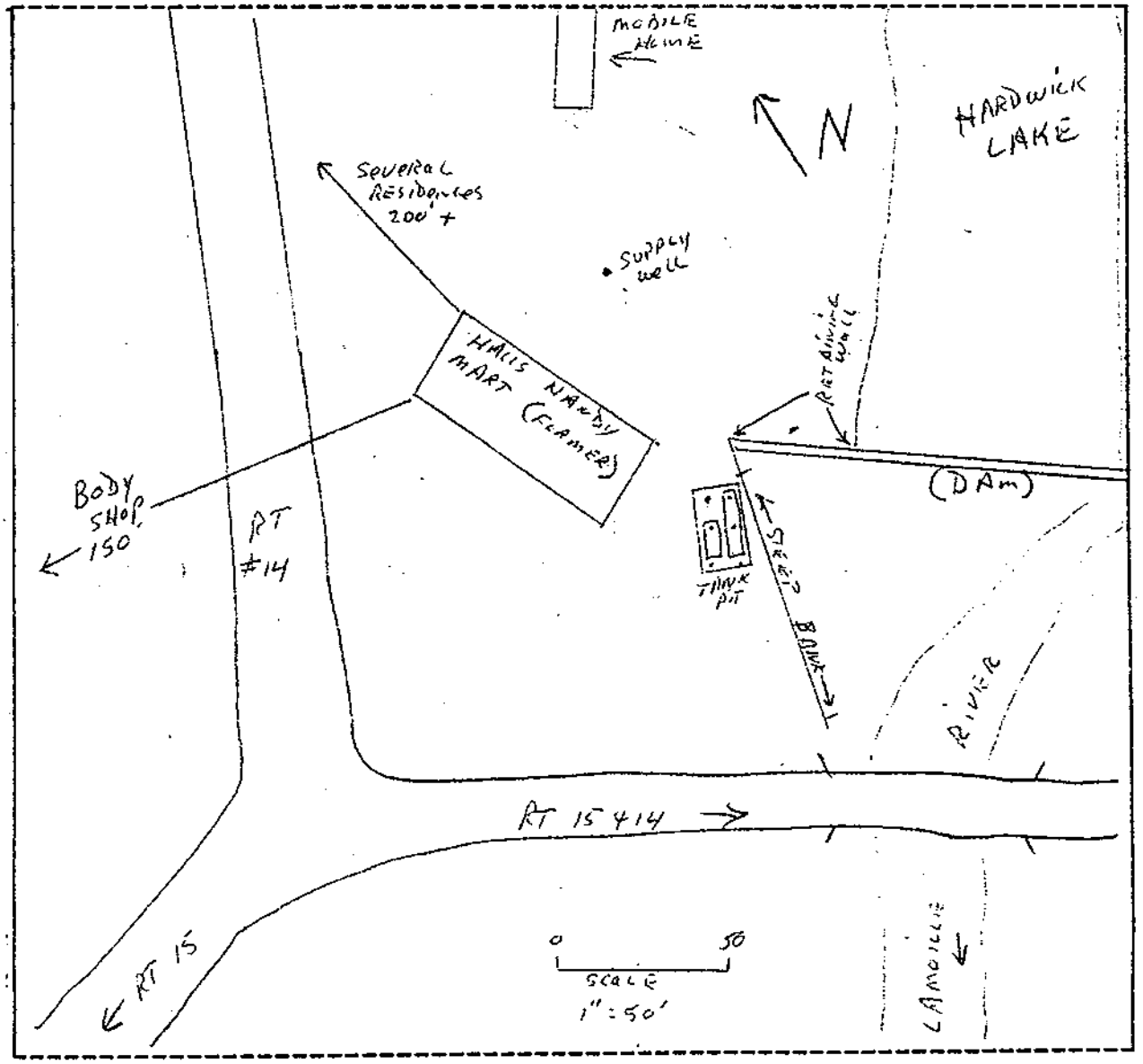
VERMONT DEPARTMENT OF ENVIRONMENTAL CONSERVATION
UNDERGROUND STORAGE TANK PROGRAM
TANK PULL FORM

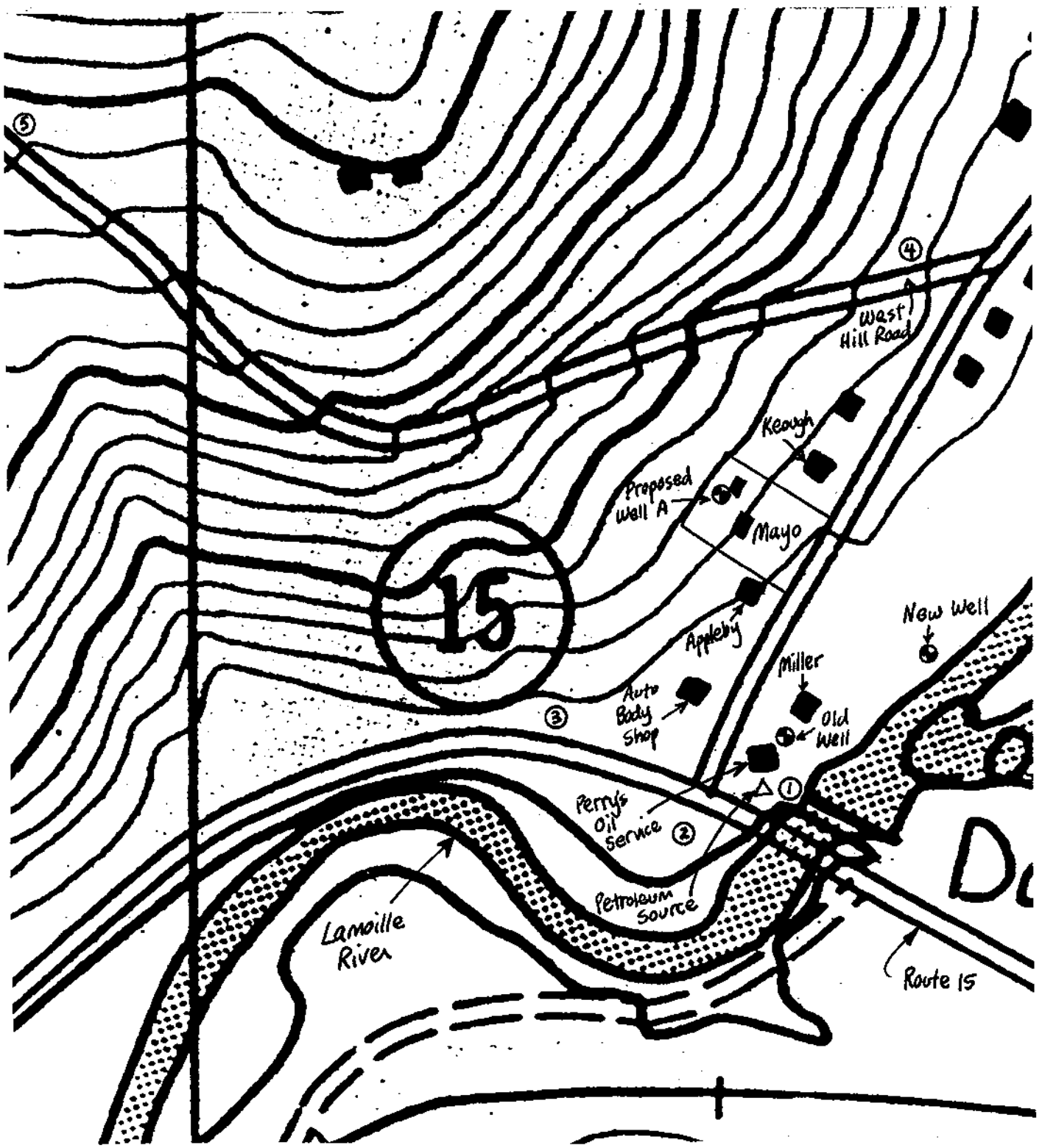
TODAY'S DATE: 8/3/93 INSPECTOR: DON TOURANGEAU

DATE OF REMOVAL: 8/3/93 BUSINESS NAME: HALLS HANDY MART

SITE DIAGRAM

Show location of all tanks and distance to permanent structures, sample points, areas of contamination and any pertinent site information. Indicate North arrow and major street names or route number.





LEGEND

- Bedrock Well
- Buildings
- △ Petroleum Source
- ② Bedrock Outcrops

FIGURE 1

LINCOLN APPLIED GEOLOGY, INC.
Environmental Consultants

LOCATIONS OF PROPERTIES, BEDROCK WELLS, PETROLEUM SOURCE, AND BEDROCK OUTCROPS

PERRY'S OIL SERVICE/MAYO PROPERTY
SITE # 94-1608
HARDWICK, VERMONT

Date:	Job Type:	Scale:
MAR '98	Petroleum Contamination	1" = 250'

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Bedrock Structural Features

(294) 59 Fracture / Joint Strike and Dip

(78) 90 Vertical Fracture / Joint

(16) 77 Bedding Strike and Dip

Strike Orientations are relative to Magnetic North

Dip is in degrees below horizontal

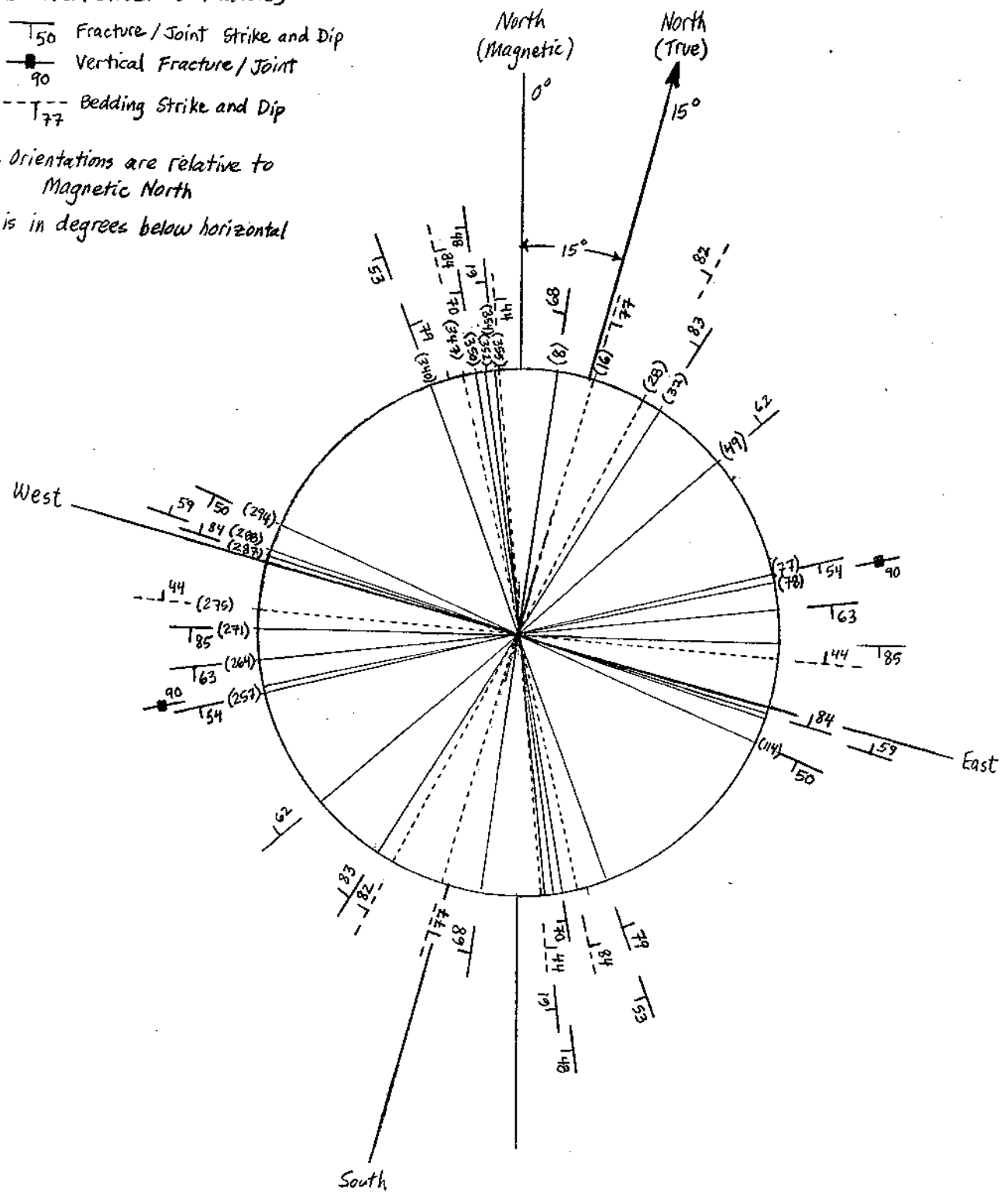

FIGURE 2

LINCOLN APPLIED GEOLOGY, INC. Environmental Consultants	BEDROCK STRUCTURAL FEATURES COMPASS ROSE	PERRY'S OIL SERVICE/MAYO PROPERTY SITE # 94-1608 HARDWICK, VERMONT		
		Date: MAR '98	Job Type: Petroleum Contamination	Scale: NTS

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Aerial Photos Lineaments

(67) ——— Strike

Strike orientations are relative to Magnetic North

1963 and 1974 Aerial Photographs -

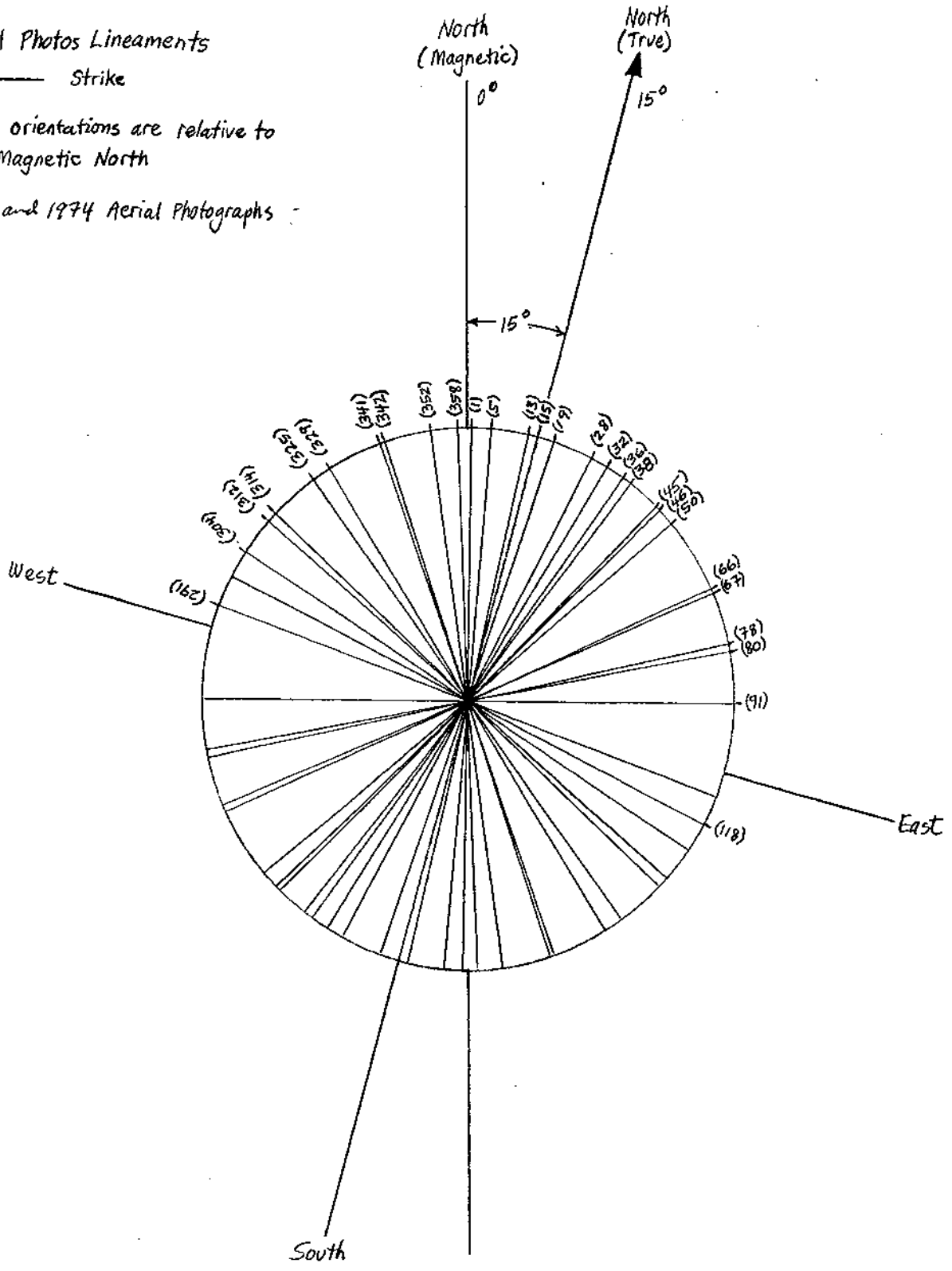

FIGURE 3

LINCOLN APPLIED GEOLOGY, INC. Environmental Consultants	AERIAL PHOTOS LINEAMENTS COMPASS ROSE	PERRY'S OIL SERVICE/MAYO PROPERTY SITE # 94-1608 HARDWICK, VERMONT	
		Date: MAR '98	Job Type: Petroleum Contamination
			Scale: NTS

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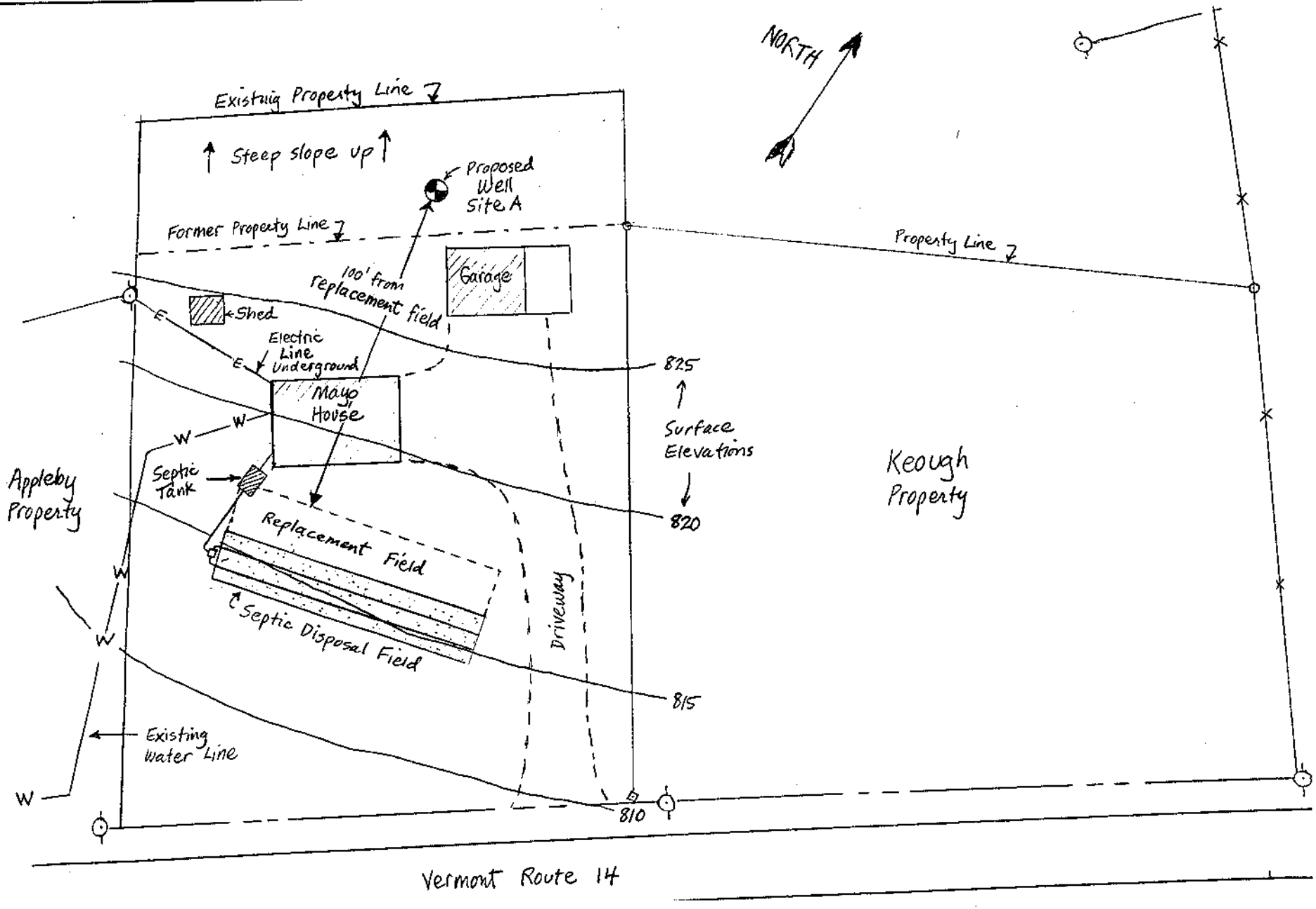

FIGURE 4

SOURCE: WALTER L. URIE, CONSTRUCTION ENGINEER, MORRISVILLE, VT. 06/03/88

LINCOLN APPLIED GEOLOGY, INC.
Environmental Consultants

MAYO PROPERTY, SEPTIC DISPOSAL SYSTEM, BUILDINGS, AND PROPOSED WELL SITE A

PERRY'S OIL SERVICE/MAYO PROPERTY
SITE # 94-1608
HARDWICK, VERMONT

Date:	Job Type:	Scale:
MAR '98	Petroleum Contamination	1" = 40'

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