HYDROGEOLOGIC INVESTIGATION
of the
JOHN J. RILEY TANNING COMPANY INC.
228 SALEM STREET
WOBURN, MASSACHUSETTS

Date ?

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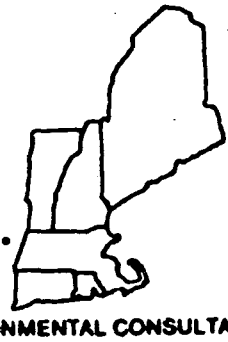

ENVIRONMENTAL CONSULTANTS

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1.0 Statement of Problem/Objective of Investigation

The John J. Riley Tanning Company is located in East Woburn approximately one mile west of the Aberjona River, north of and adjacent to Salem Street. The Boston and Maine (B&M) Railroad easement and tracks abut the Riley property to the east (Figure 1). Two production wells are located northeast of and are utilized by the tanning facility. Production Well #1, which is located west of the B&M Railroad easement on Riley property is not presently in use and is reported to be in poor condition (Riley, 1980). Production Well #2, which is located east of the B&M Railroad easement, is located on property owned by Beatrice Foods Company. The John J. Riley Company, Inc. maintains the water rights to Production Well #2, which provides up to 400,000 gallons of water for the tannery process daily.

Groundwater samples collected from Production Well #2 (PW#2) have been shown to contain significant levels of chlorinated volatile organic compounds. Groundwater collected from Production Well #1 (PW#1) has also exhibited chlorinated volatile organic contamination, although to a lesser extent. The source of the contaminant found in these wells is unknown. It has been suggested, however, that the source of contamination may be located on the John J. Riley property, which appears to be upgradient from both Production Wells (EPA, 1981).

The objective of this investigation is to determine the direction of groundwater flow on the John J. Riley property under typical pumping conditions at PW#2 and determine if groundwater contamination, if present, on the Riley property is contributing to the contamination of Production Wells #1 and #2.

The John J. Riley Tanning Company, Inc. property, which is the subject of this investigation, is situated on approximately 31 acres of land, bordered to the east by the Boston and Maine Railroad easement, to the west by Wildwood Street, to the north by property owned by Bioassay Systems, Inc., and to the south by Salem Street (Figure 1).

Topographic elevations at the Riley Site range between 113.1 National Geodetic Vertical Datum (NGVD) at the crest of a small drumlin north of Building #2 and along the northeastern edge of the property, and 48 NGVD at the well house for PW#1. Generally, topographic elevation declines from west to east. Surface drainage from the site is via an intermittant stream which flows from Wildwood Street east toward PW#1. Land elevations east of the Riley property and north of Salem Street is low, generally within the 100 year floodplain of the Aberjona River, and is under the protection of the Massachusetts Wetlands Protection Act, Chapter 131, Section 40 (Brady, 1983).

The Riley facility consists of a medium sized chrome-cowhide leather tannery of which the principle product is leather for footwear.

Two large buildings, which house the tannery, are located within the study area (Figure 1). A gray, one-story building (Building #1) which abuts Wildwood Street and the main parking lot, is used for washing tanned hides, streaking and buffing. The Machine Shop is also located at the northeast corner of Building #1. A second, two-story building (Building #2) encloses the beam house, tan coloring and finishing rooms, and a material storage area. A power plant, which houses two boilers, with a maximum output potential of 25,000 lbs. of steam per hour, is located north of the Machine Shop in Building #1. Three 15,000 gallon underground storage tanks are located west of and adjacent to the power plant. Administration and business offices are located in two woodframe buildings located at the southernmost end of the property along Salem Street. Finally, the brick pump house for PW#1 is located at the base of the slope at the eastern edge of the Riley property.

The Pump House for Riley's PW#2, which is located on property owned by Beatrice Foods, Inc. is located approximately 400' northeast of PW#1.

The Riley property is intersected by a Woburn City Sewer easement which extends approximately 600' north from Salem Street, and then northeast towards the B&M Railroad easement, where the Woburn City Sewer discharges to the Metropolitan District Commission Wilmington Trunk Sewer Main. The Riley Tannery has been discharging effluent into the Woburn City Sewer since approximately 1940 (Riley, 1983).

The northernmost portion of the Riley property, west of the gravelly drumlin identified in Figure 1 is presently grassland. This area, which was previously a sand and gravel pit, was excavated and filled with sewage sludge from the Riley Tanning process prior to 1975 (Riley, 1983). A semi-paved lot north of Building #1 and south of the grassland area is used for raw hide material and refuse storage. An empty barrel and pallet storage area is situated on a paved area northeast of the Power Plant (Figure 1).

A catch basin which receives all liquid and semi-liquid waste generated during the tanning process in located north of Building #2. Solids are permitted to settle out of the waste stream and the liquid fraction is discharged to the Woburn City Sewer System.

Effluent which is discharged to the Sewer System has been analyzed for parameters selected by the Metropolitan District Commission (MDC) (Appendix A). Solids which accumulate in the catch basin are dredged on a regular basis and landfilled on site. Currently, sludge is disposed of on the slope between the settling basin and the pump house for PW#1. Solids from the settling basin consist of soluable and insoluable hide material, hair, blood, dirt, manure, salt, lime, and miscellaneous salts which are precipitated out of the waste stream by high alkalinity (chrome hydroxide and ferrous hydroxide). Representative samples of landfilled sludge from the settling basin have been collected and submitted for an EPA EP toxicity test. Sewage sludge on the Riley site was determined to contain acceptable limits of hexavalent and total chromium, as established by the Environmental Protection Agency (EPA) and Massachusetts Department of Environmental Quality Engineering (DEQE) (Appendix A).

Dust from the buffing room, which is located in Building #1, is collected in a bag house and disposed of in a small lagoon located north of Building #1 and approximately 100' east of Wildwood Street (Figure 1).

Other solid wastes generated during the tanning process includes steel drums, which are sent to a barrel reclamation firm in Woburn, general trash, which is incinerated or removed from the site by a private trash collecting company, scrap metal, which is sent to the Stoneham Trading Company, and leather trimmings and shavings, which are sold to other manufacturing companies (Riley, 1983).

Sampling conducted by EPA between November 1980 and March 1981, and more recent sampling by John J. Riley personnel has shown that groundwater from PW#2 is contaminated with chlorinated volatile organic compounds. Levels of contaminants in water from PW#2 has on occasion exceeded 1000 ppb. In addition, lesser quantities of several chlorinated volatile organic compounds have been detected in PW#1 (Table 1).

The source of the contamination is unknown. Some of the contaminants present in PW#1 and PW#2 are also present in the City of Woburn's Municipal Production Wells G and H, which are located approximately 2000' northeast of Riley Production Well #2, and east of the Aberjona River (EPA, 1981).

This report will address, in part, the effect that groundwater quality at the Riley site may have on Production Well #2. It does not, however, address the relationship between contaminants in groundwater at Woburn Production Wells G and H and Riley Production Well #2.

TABLE 1

CONTAMINANTS DETECTED IN PRODUCTION WELL #1 and #2
1980 - 1983

Compound	Contaminants Detected (in parts per billion (ppb)) PW#2 A	PW#2 B	PW#2 C	PW#1 A
1,1,1 trichloroethane	133	ND	6.6-9.4	28
1,2 trans dichloroethene	116	10	15-25	12
tetrachloroethylene	28	240	3.1-6.8	ND
trichloroethene	1372	5	358-540	53
benzene	ND	ND	----------[1]	ND
chlorobenzene	ND	ND	ND	10
chloroform	ND	20	2.8-3.7	ND
toluene	ND	ND	----------[1]	ND

[1]Sample not analyzed for compound

KEY

A - Samples collected by Ecology and Environment, Inc. of Buffalo, NY between November 12, 1980 and March 2, 1981 for U.S. EPA Investigation of East and North Woburn. From the Report of Chlorinated Solvent Contamination of the Groundwater, East Central Woburn, Massachusetts. Final Report, March, 1982. U. S. EPA.

B - Samples collected by Ecology and Environment, Inc. on November 4 and 5, 1981 for U.S. EPA Investigation of Groundwater Contamination in Woburn, Massachusetts.

C - Samples collected by employees of John J. Riley Company during modified pump test of PW#2. August 8, 1983.

2.0 Method/Results of Investigation

In order to address the objectives of the study, Yankee Environmental Engineering and Research Services (YE^{2}ARS), Inc. implemented a phased investigation of the John J. Riley Company, Inc. Tannery. This section describes tasks of each phase of the investigation, the purpose of the tasks and summarizes the data obtained.

2.1 Review of Existing Data

The John J. Riley Tannery is located west of and adjacent to the Aberjona River Valley, which has been the subject of numerous hydrogeologic and environmental investigations. As a result, some limited data in groundwater quality, geology and land use data has been developed for the Riley property. In order to avoid the duplication of existing data during this study and to assist in the development of a hydrogeologic investigation of the site, YE^{2}ARS evaluated numerous documents. References reviewed, which are summarized in Table 2, provided seismic data, groundwater flow conditions east of the site, and groundwater quality data. In addition, a topographic base map of the study area was obtained from the City of Woburn Engineering Department. This map, which was completed by Harry Feldman Inc. in 1966 for the City of Woburn, with a scale of 1" = 100', will be used as a base map for this investigation.

2.2 Excavation of Test Pits

In order to assess surficial geologic conditions, the presence or absence of subsurface waste, and to determine depth to the water table, YE^{2}ARS excavated nine test pits on the Riley property. Test pit locations 1 - 9 are shown on Figure 2. Table 3 summarizes data obtained during the excavation of test pits. All test pits were excavated on August 23 by Arthur Pyburn & Sons Inc., General Contractors, under the supervision of YE^{2}ARS geologist. No soil samples were collected for chemical analysis during test pit excavation.

TABLE 2

REPORTS REVIEWED FOR
HYDROGEOLOGIC INVESTIGATION OF
JOHN J. RILEY TANNING COMPANY SITE

Ecology and Environment, Inc., May 6, 1981. Interim Report on the Geology and Groundwater of North and East Woburn, Massachusetts. EPA FIT Project.

Ecology and Environment, Inc., April 3, 1981. Interim Report on the Geology and Groundwater of North and East Woburn, Massachusetts. EPA, FIT Project.

Cook, D. K., 20 November - 17 December 1980. Site Inspection Reports for Severence Trucking Company, Inc., Aberjona Auto Parts, John J. Riley Company, Whitney Barrel Company, Atlantic Gelatin and Independant Tallow Company. EPA FIT Project.

U. S. Geologic Survey,, 1979 Photo Revisions. 1:25000 Topographic Sheets for the Boston North, Wilmington, Reading, and Lexington, Massachusetts Quadrangles.

Delaney, F. D., and Gay, F. B. Hydrogeology and Water Resources of the Coastal Drainage Basins of Northeastern Massachusetts from Castle Neck River, Ipswich to Mystic River, Boston. U. G. Geologic Survey Hydrologic Investigation Atlas No. 589 (1980).

Ecology and Environment, Inc., October 13, 1981. Report on the Groundwater Contamination by Trichlorethylene, East Woburn, Massachusetts. Interim Report. EPA FIT Project.

TABLE 3

DATA OBTAINED DURING EXCAVATION OF TEST PITS
AUGUST 23, 1983

(LOCATIONS OF TEST PITS ILLUSTRATED IN FIGURE 2)

TEST PIT NO.	LOCATION	STRATIGRAPHY	COMMENTS
1	North end of Site, South of Chain Length Fence, NW Edge of Drumlin	0-2' topsoil 2-9' gravel, large boulders 9'11" fine grey silt, sand, with gravel 11' compact silt and sand 11'3" bottom of excavation	Hole was dry.
2	Approximately 100' East of Wildwood, At Northern End of Site	0-1' topsoil 1-2' brown-beige fine sand 2-4' coarse sand, gravel 4-6' gravel and boulders 6-9' grey silt, sand, some cobbles 9-11' clean grey-brown medium sand 11'8" grey sand, cobbles (till) (bottom of excavation)	Hole was dry.
3	Approximately 200' Southeast of TP#2	0-4' brown, medium sand 4-7' medium sand mixed with black peat-like sludge 7-9' wet sludge, some gravel. 10'7" bottom of excavation	Area was identified as an abandoned sand and gravel pit, which was used for tannery waste disposal. Water at 9'7".

TABLE 3 continued

DATA OBTAINED DURING EXCAVATION OF TEST PITS
AUGUST 23, 1983

(LOCATIONS OF TEST PITS ILLUSTRATED IN FIGURE 2)

TEST PIT NO.	LOCATION	STRATIGRAPHY	COMMENTS
4	Excavated Area Approximately 150' East of Wildwood Street	0-3' topsoil, sand, gravel 3-7' black sludge 7-8 1/2" gravel, sharp stones, mixed with sludge 8 1/2" refusal	Water at 5 feet.
5	Stream Bed. North of Storage Area	0-3 1/2' loam, topsoil 3 1/2-4' sandy loam 4' refusal, very large boulders	Stream bed is dry. Area is being used as a vegetable garden.
6	Northern Edge of Hide Storage Area	0-10 1/2' misc. fill. includes sand, gravel, asphalt, chared timbers, brick, plastic, leather scraps, small amounts of tannery sludge. Woburn storm drain encountered at 5'. Excavation widened to complete hole.	Hole is dry.

TABLE 3 continued

DATA OBTAINED DURING EXCAVATION OF TEST PITS
AUGUST 23, 1983

(LOCATIONS OF TEST PITS ILLUSTRATED IN FIGURE 2)

TEST PIT NO.	LOCATION	STRATIGRAPHY		COMMENTS
7	North of Power Plant adjacent to Paved Area	0-2' 2-9'4"	orange-brown sand very large cobbles and boulders in fine sand	Hole is dry. Difficult to excavate.
8	East of Bag house	0-6'6"	very large cobbles, and boulder in fine sand	Hole is dry.
9	East of Catch Basin, Southwest of PW#1	0-7'	clean sand with coarse gravel, large cobbles	Hole is dry.

2.3 Installation of Monitoring Wells

Although hydrologic data is available for land located east of the Riley property and west of the Aberjona River, no hydrologic data has been developed for the site to date. In order to determine the direction of groundwater flow, depth to bedrock, subsurface geologic conditions, and provide groundwater quality monitoring locations, YE^{2}ARS installed six monitoring wells on the John J. Riley property. Monitoring well locations are identified in Figure 2. Wells were installed between September 12 and October 17, 1983 by Geo-Metrics, Inc. under the supervision of YE^{2}ARS geologist.

All wells were constructed with a 2" nominal PVC casing and screened over the entire length of the saturated thickness of soils penetrated. With the exception of B-6b, all wells were installed to bedrock. Depth to bedrock was confirmed by coring and sampling two to five feet of bedrock material. Detailed logs of subsurface soils were recorded during monitoring well installation. Soil samples were collected with a split-barrel sampler every five feet unless otherwise noted. The well specifications and drilling methods utilized during the investigation is presented in Appendix B. Well logs for each well are included in Appendix C.

Finally, YE^{2}ARS monitored ambient air and soil samples during the installation of B-1 and B-2 with an HNU Systems Organic Vapor Analyzer (OVA). No significant concentrations (greater than 20 ppm) of volatile organic vapors were detected during the installation of these wells.

2.4 Topographic Survey of Locations of Monitoring Wells, Test Pits and Other Locations

In order to construct an accurate groundwater contour map and bedrock elevation map of the site, YE^{2}ARS contracted Dana Perkins Associates of Reading, Massachusetts to survey elevations and distances between selected monitoring wells, test pits and other features.

Approximately 20 points were surveyed and plotted on an overlay to the topographic base map of the site. Surveyed elevations are identified in Figure 2. A description of the work completed by Dana Perkins Associates at the John J. Riley Tannery is presented in Appendix D.

Although elevations and distances between test pits, monitoring wells and other features are accurate, many of the features depicted in Figures 1 and 2 (such as the location of Wildwood Avenue) are approximate and based on property maps obtained at the City of Woburn Engineering Department.

2.5 Measurement of Water Level Elevations in Monitoring Wells and Test Pits

In order to map groundwater contour elevations at the Riley site, YE^{2}ARS collected depth to groundwater measurements from all monitoring wells and test pits located on site. Water level measurements from monitoring wells B-1, B-2, B-3c, B-4 and B-5 were collected with a Soil Test Automatic Water Level Indicator on both October 11 and 12, 1983. Water level measurements which were taken on October 11, 1983 were taken approximately five hours after PW#2 was shut down. Water level measurements taken on October 12, 1983 were taken while PW#2 was pumping at a typical rate (averaging 400,000 gallons per day). A water level measurement from B-6b was collected on October 23, 1983 with an Interface Probe manufactured by Oil Recovery Systems, also during normal pumping at PW#2. Water level measurements from test pits were collected during excavation of test pits on August 23, 1983. Table 4 summarizes water table elevations recorded for all monitoring points.

2.6 Groundwater Sampling

To determine if groundwater quality on the Riley property is contributing to the contamination of PW#2, it was necessary to determine if chlorinated volatile organics, such as those present in PW#2, are present in groundwater at the Riley site. YE^{2}ARS collected groundwater

TABLE 4

SUMMARY OF WATER LEVEL MEASUREMENTS
FROM
MONITORING WELLS AND OTHER LOCATIONS

Well Location	Ground Surface Elevation (NGVD)	Depth to Groundwater				Groundwater Elevation (NGVD
		10/11/83	10/12/83	10/23/83	8/23/83	
B-1	69.6	52' 10 5/8"	25' 10 5/8"			43.77
B-2	79.1	29' 11"	29' 8"			49.44
B-3c	90.8	37' 2 1/2"	37' 2 1/2"			53.6
B-4	86.7	18' 7 3/4"	18' 7 3/4"			68.06
B-5	73.6	3' 9 1/2"	3' 10"			69.7
B-6b	90[1]			40' 7"		49.52
PW#1	55.4 (From top of Well House)	11.49 (From top of Well House)	11.91 (From top of Well House)			43.49
Test Pit #3	78[1]				9'7"	68.42

[1] Ground Surface Elevation Approximate

samples at B-1, B-2, B-4, B-5, and PW#1 for chemical analysis. Prior to sampling each well, YE^{2}ARS calculated the approximate volume of water present in each well column, and bailed the equivalent of three well volumes of water from each well. Wells were permitted to equilibrate after bailing. A sample from PW#1 was collected from a discharge pipe located on the east side of the pump house, after water from PW#1 was pumped for five minutes (until clear).

Samples were collected in 40 ml vials with septum and delivered to Cambridge Analytical Associates in Watertown, Massachusetts for chlorinated volatile organic analysis. For a more complete description of sampling procedures utilized and Cambridge Analytical Associates (CAA) report on the sample analysis, see Appendix E. Table 5 summarizes the results of the analysis of water collected on the Riley site.

3.0 Evaluation of Results

3.1 Geology

Observations made during the excavation of test pits and the installation of monitoring wells indicate that unconsolidated glacial deposits between 10 and 60 feet thick, mantle a crystalline bedrock surface at the Riley site. Glacial deposits consist of a layer of poorly sorted coarse sand, gravel, cobbles and boulders with very little silt, ranging between 8 feet thick at Well B-5 and 34 feet at B-1, overlying a sequence of more uniform sand and gravel, in some instances exhibiting clay and silt varves with some occasional boulders.

As described in Section 2, tannery sludge has been mixed with soil and landfilled at the northwest portion of the site. A black, sludge resembling peat, with occasional ripraf, and hair was observed during the excavation of test pits 2, 3, 4, and 6. Samples collected during the installation of Wells B-4 and B-5 also include some tannery sludge in samples collected up to 17 feet deep.

Glacial sediment appear to thicken uniformly from west to east, as illustrated in Figure 3.

TABLE 5

CHLORINATED VOLATILE ORGANIC ANALYSIS OF GROUNDWATER SAMPLES[1]
COLLECTED FROM WELLS ON JOHN J. RILEY TANNING COMPANY SITE
WOBURN, MASSACHUSETTS[3]
OCTOBER 12, 1983

	concentration ug/l (ppb)[2]				
	PW#1	B-1	B-2	B-4	B-5
trans, 1,2-dichloroethene	.4	ND	.7	ND	ND
chloroform	ND	ND	ND	1.7	.8
trichloroethene	.4	ND	ND	ND	ND
chlorobenzene	ND	ND	.7	20	ND

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[1] EPA Method 601. Methods for Organic Chemical Analysis of Municipal and Industurial Wastewater EPA 600/3-82-057. EPA/EMSL, Cincinnati, Ohio.

[2] Concentrations less than 0.1 ug/l (ppb) are not detected.

[3] Analysis completed by Cambridge Analytical Associates, Watertown, Massachusetts.

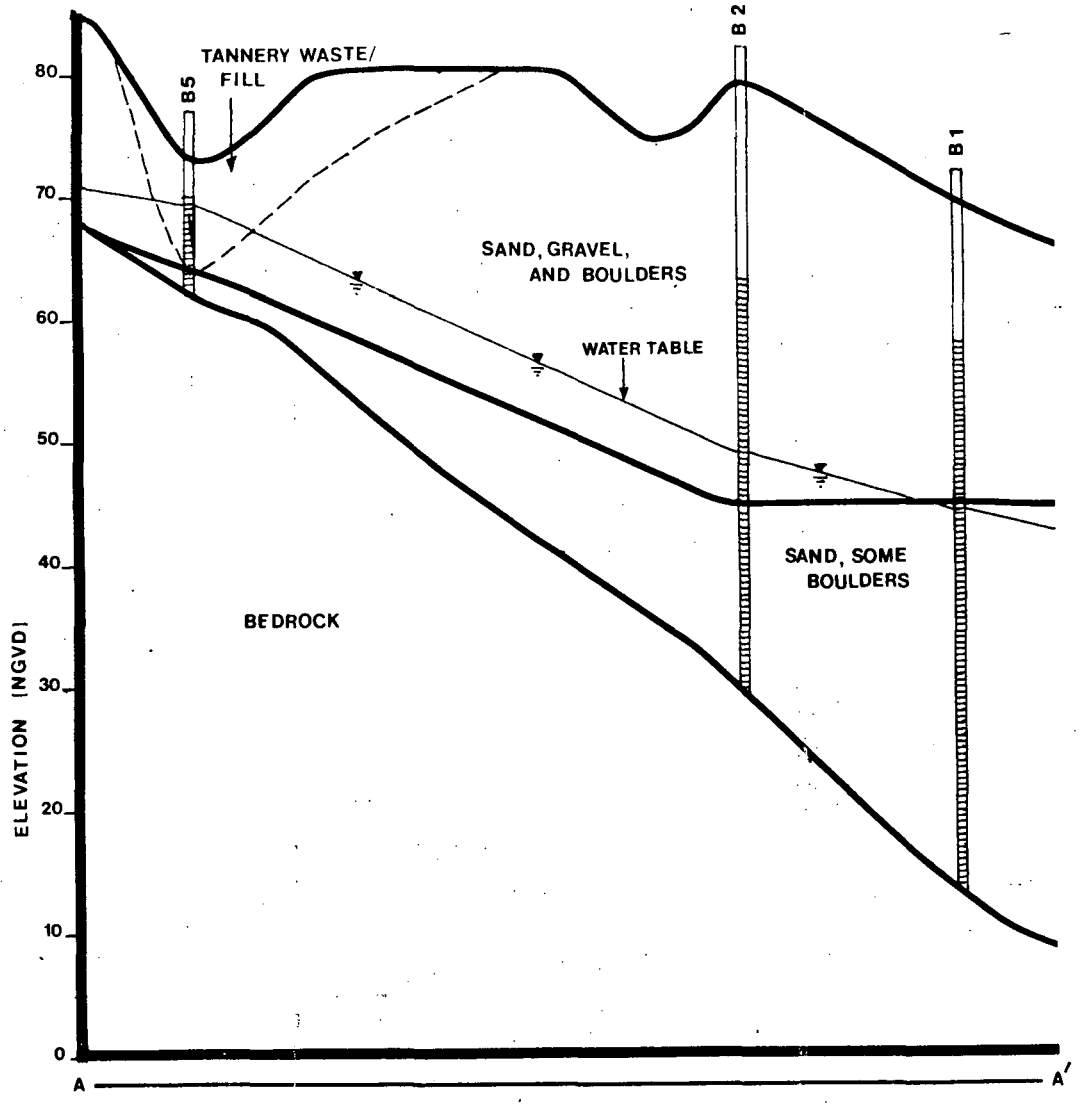

FIGURE 3. IDEALIZED GEOLOGIC CROSS SECTION VERTICAL SCALE EXAGGERATED (SEE FIGURE 4)

SCALE: 1' = 100'	APPROVED BY	DRAWN BY MH
DATE: 11/8/83		

JOHN J. RILEY TANNING COMPANY INC.
228 SALEM STREET, WOBURN, MASSACHUSETTS

HYDROGEOLOGIC INVESTIGATION	DRAWING NUMBER 3

Depth to bedrock ranges from 62.6 feet above the NGVD at Well B-5 to approximately 10 feet above MGVD at PW#1. A contour diagram of the bedrock surface underlying the Riley site (Figure 4) suggests that the study area is located within a shallow buried glacial stream valley which discharged to the east.

3.2 Hydrology

Soil samples collected during monitoring well construction and observation made during excavation of test pits indicate that glacial soils present at the Riley site are moderately to highly permeable. Surficial sediments consisting of poorly sorted coarse sand, gravel and boulder material which overly most of the site can be expected to exhibit permeabilities ranging between 10^4 and 10^2 $ft^3/f^2/day$ (ft/day) (USDI, 1981). This material was observed to be well drained in areas not used for sludge disposal. The more uniform sand and gravels observed at depth and in contact with bedrock were found to be saturated throughout the site, but appear to be more compact and slightly less permeable than the overlying sediments. Some compact silt and clay lenses, observed in samples of the uniform sand and gravel taken at B-3c, suggest that low to moderately permeable soils are preent at depth on the Riley site.

Finally, sand and gravels mixed with tannery sludge were found to be generally saturated. Although no permeability tests were conducted during this investigation, permeabilities of the tannery sludge refuse are expected to be similar to naturally occuring peat and organic matter (10^{-2} to 10^{-3} $ft^3/ft^2/day$) (ft/day).

Based on groundwater elevation and surface elevations measured, YE^2ARS constructed a groundwater contour elevation map of the Riley site (Figure 5). Groundwater elevation measurements are summarized in Table 4. Groundwater contour elevations indicate that groundwater flow direction is generally west to east across the site under typical

pumping conditions. The direction of local groundwater flow will, however, be effected by changes in surface topography and the configuration of the bedrock surface.

For example, the bedrock surface contour map (Figure 4) shows a slight trough which slopes from B-4 towards B-2. Groundwater migrating along the bedrock surface may be expected to travel from B-4 in the direction of B-2. Similarly, shallow groundwater may be expected to flow radially away from the drumlin identified in Figure 1.

Additionally, drawdown data previously collected by Riley personnel indicate that the total drawdown at PW#1 when pumping PW#2 at a rate of 530/gallons/minute is approximately 1 1/2 feet over a 24 hour period, indicating that flow conditions at PW#1 are influenced by pumping at PW#2 (Hanley, 1983). It is not known if flow at other monitoring wells installed by YE^{2}ARS are influenced by pumping at PW#2. Groundwater contour elevations, which were measured under typical pumping conditions, do not suggest however that the predominant direction of groundwater flow on the Riley site is effected significantly by pumping at PW#2.

3.3 Groundwater Contamination

A total of four chlorinated organic compounds were identified in samples collected from monitoring wells located on the Riley property.

Trichloroethene (trichloroethylene), trans 1,2 dichloroethene (1,2 trans dichloroethylene) and chloroform, contaminants which are present in PW#2 (See Table 1), were identified in samples collected by YE^{2}ARS at the Riley site. In addition, chlorobenzene was detected in two wells on the Riley property, but has not been found in groundwater sampled at PW#2.

Two contaminants detected in samples collected at PW#2 are present in groundwater from PW#1, located on Riley property. One of these contaminants, trans 1,2 dichloroethene is also present in another upgradient on-site monitoring well, B-2, but is not present in water sampled from wells upgradient of B-2, suggesting that the Riley property is the probable source of that contamination at PW#1. Trichloroethene, which is a major contaminant at PW#2 is also present in trace quantities (0.4 ppb) at PW#1. The absence of trichloroethene in all other wells sampled on the Riley property suggest, however, that the source of that contaminant is not the Riley property. Historical pumping of PW#1, or pumping during sampling may have induced contaminants from the vicinity of PW#2 towards PW#1.

Chlorobenzene was detected in groundwater samples collected from B-4 and B-2. Chlorobenzene has been detected historically in PW#1 in trace quantities (less than 10 ppb) (Table 1). Groundwater flow directions and sampling data indicate that the Riley property or an upgradient area northwest of B-4 is the source of chlorobenzene detected in B-4, B-2 and PW#1. Historical sampling data shows that PW#2 has not been contaminated with chlorobenzene, which may indicate that groundwater quality at PW#2 may not be affected by groundwater quality at PW#1 under typical pumping conditions.

The volatile organic compound chloroform was detected in the two most upgradient wells at the Riley site, B-4 and B-5 in concentrations less than 2 ppb. Chloroform was not detected in any of the downgradient wells located on site (B-1, B-2 and PW#1). Although chloroform has been detected in trace quantities at PW#2 (2.8 - 3.7 ppb), the absence of the compound in wells located downgradient of B-4 and B-5 suggest that the Riley site is not the source of chloroform detected at PW#2.

Groundwater flow at the Riley site under normal pumping conditions has been shown to flow west to east. Water level measurements taken at PW#1 during pumping and nonpumping conditions indicate that PW#1 is within the pumping of influence of PW#2. Chlorinated volatile organic compounds present at PW#1 could, therefore, contribute to the contamination at PW#2 under pumping conditions. Levels of trichloro-

ethene and trans 1,2 dichloroethene detected at PW-1 are however significantly less than those detected at PW#2. If chlorinated contaminants at PW#2 were the result of contamination at the Riley site, a significant concentration of those substances would be expected at PW#1, which is the most downgradient well on the Riley site and most proximate to PW#2.

The absence of significant concentrations of any of the compounds contaminating PW#2 in groundwater from PW#1 or from any other well on the Riley site indicates that the Riley sit is not the principal source of contaminants detected at PW#2.

4.0 Summary/Conclusions

1. The geology of the Riley site is characterized by moderate to highly permeable glacial sediments, ranging between 11' and 60' thick overlying a crystalline bedrock surface which slopes from the west to the east. Landfilling of tannery waste has occurred on portions of the site north of the semi-paved storage area, and northeast of the catch basin, along a slope southwest of PW#1.

2. Existing data indicates that groundwater flow at PW#1 is influenced by pumping at PW#2. Contaminants present at PW#1 may therefore contribute to the contamination of PW#2 under pumping conditions. Groundwater contours illustrated in Figure 5, which represent groundwater elevations under typical pumping conditions of PW#2 do not indicate that groundwater upgradient of PW#1 is influenced toward PW#2. Flow direction appears to be west to east over the entirety of the study area.

3. Chlorinated volatile organic compounds were detected in monitoring wells installed by YE^{2}ARS on the Riley site. B-1 which is located southwest of PW#1 was found to be free of chlorinated volatile organic contamination. PW#1, B-2, B-4 and B-5 contained trace amounts of four different compounds, three of which have been identified in samples collected at PW#2. None of the wells exhibited more than two contaminants .

Analysis of groundwater flow and contaminant distribution on the Riley site suggests that contaminants present on the Riley site would be detected at PW#1, and probably Wells B-1 or B-2 prior to entering the influence of pumping well PW#2.

Only two substances were identified in PW#1, both of which are present in PW#2; Trichloroethene (trichloroethylene) and trans 1,2 dichloroethene (trans 1,2 dichloroethylene) were present in concentrations of less than 1 ppb. Concentrations of these contaminants in PW#1 are significantly less than those detected in PW#2, suggesting that groundwater contamination at the Riley site is not contributing significantly to the contamination of PW#2.

In addition, only one of these substances, trans 1,2 dichloroethene was shown to be present at monitoring locations other than PW#1. It is possible, therefore, that a portion of the contaminants present at PW#1 are due to contamination downgradient of the well, which may be influenced toward PW#1 during pumping of that well prior to sample collection.

5.0 REFERENCES

Cook, D. K., 20 November - 17 December 1980. Site Inspection Reports for Severence Trucking Company, Inc., Aberjona Auto Parts, John J. Riley Company, Whitney Barrel Company, Atlantic Gelatin and Independant Tallow Company. EPA FIT Project. Buffalo, New York.

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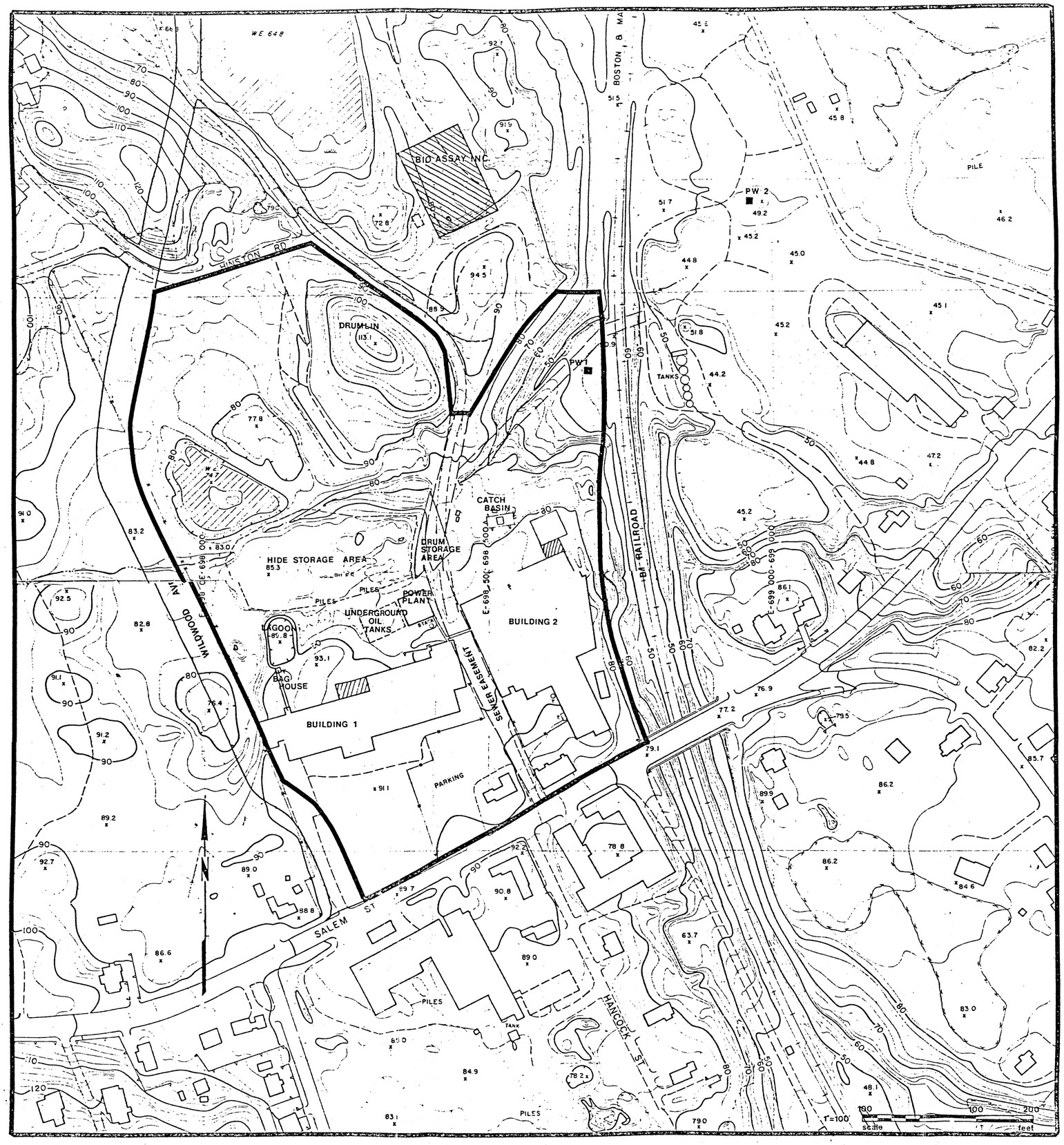
Riley, John J., October 1983. Personal Communication with M. Hanley, Yankee Environmental Engineering and Research Services, Inc., Concerning Discussion of Historical Land Use at Riley Tanning Company Inc., 228 Salem Street, Woburn, Massachusetts. President, John J. Riley Tanning Company Inc., Woburn, Massachusetts.

U. S. Department of the Interior, 1981. Ground Water Manual. A Water Resources Technical Publication. U. S. Government Printing Office. Denver, Colorado.



LEGEND

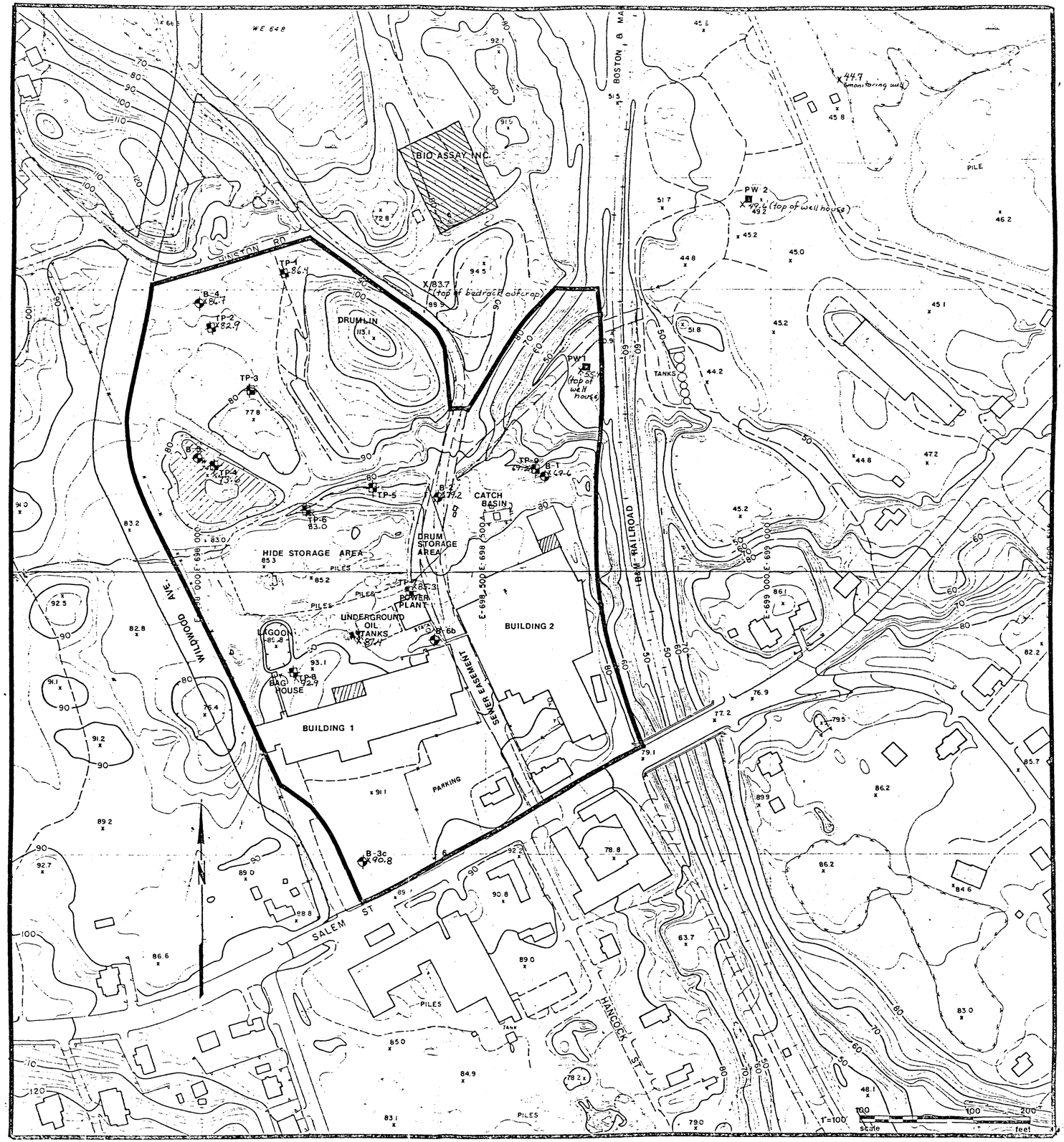
- PERIMETER OF STUDY AREA
- INTERMITTANT STREAM
- ADDITIONS, NEW BUILDINGS
- VARIOUS STORAGE AREAS
- SEWER EASEMENT
- PW 1 — PRODUCTION WELL

FIGURE 1. SITE PLAN

SCALE: 1"=100'	APPROVED BY	DRAWN BY MH
DATE: 11/7/83		

JOHN J. RILEY TANNING COMPANY, INC.
228 SALEM STREET, WOBURN, MASSACHUSETTS

HYDROGEOLOGIC INVESTIGATION — DRAWING NUMBER 1



LEGEND

- PERIMETER OF STUDY AREA
- INTERMITTANT STREAM
- ADDITIONS, NEW BUILDINGS
- VARIOUS STORAGE AREAS
- SEWER EASEMENT
- PW 1 — PRODUCTION WELL
- B 1 — MONITORING WELL
- TP 3 — TEST PIT
- X 49.6 — SURVEYED ELEVATION

NOTES: HORIZONTAL CONTROL ESTABLISHED IN GROUND BY LOCATING EXISTING BUILDINGS AND OVERLAY WORK PRINT.

BENCHMARK USGS DATUM - ABERJONA RIVER #5, NORTHWEST OF SALEM STREET, SOUTHWEST END OF BRIDGE OVER THE ABERJONA RIVER AT INNER BASE OF FENCE. CHISELED SQUARE. ELEVATION = 47.96.

SURVEY WORK COMPLETED 10/3/83.
DANA F. PERKINS ASSOC., INC.
READING, MASSACHUSETTS.

FIGURE 2: LOCATION OF TEST PITS, MONITORING WELLS, AND OTHER FEATURES

SCALE: 1"=100'	APPROVED BY	DRAWN BY MH
DATE: 11/8/83		

JOHN J. RILEY TANNING COMPANY, INC.
228 SALEM STREET, WOBURN, MASSACHUSETTS

HYDROGEOLOGIC INVESTIGATION	DRAWING NUMBER 2

LEGEND

- PERIMETER OF STUDY AREA
- INTERMITTANT STREAM
- ADDITIONS, NEW BUILDINGS
- VARIOUS STORAGE AREAS
- SEWER EASEMENT
- PW1 10.0 — PRODUCTION WELL, APPROXIMATE ELEVATION OF BEDROCK SURFACE (NGVD)
- B1 11.6 — MONITORING WELL, APPROXIMATE ELEVATION OF BEDROCK SURFACE (NGVD)
- BEDROCK OUTCROP
- 40 — BEDROCK CONTOUR ELEVATION IN FEET ABOVE NATIONAL GEODETIC VERTICAL DATUM (NGVD)
- A——A' — GEOLOGIC CROSS-SECTION (FIGURE 3)

NOTES: DEPTH TO BEDROCK DATA OBTAINED DURING MONITORING WELL INSTALLATION.

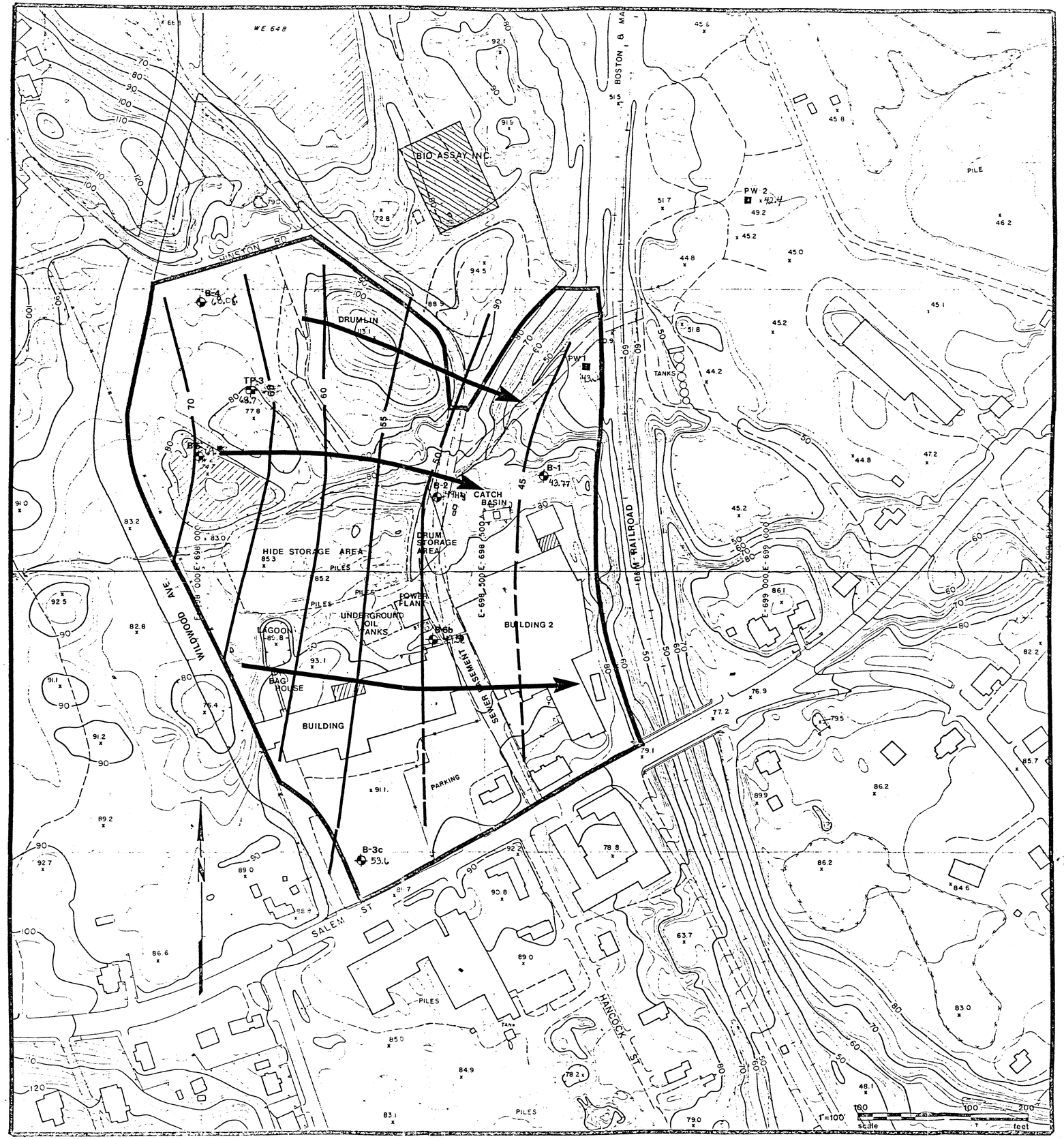
SURVEY WORK COMPLETED 10/8/83.
DANA F. PERKINS ASSOC., INC.
READING, MASSACHUSETTS

FIGURE 4. BEDROCK CONTOUR MAP

SCALE: 1"=100'	APPROVED BY	DRAWN BY MH
DATE: 11/8/83		

JOHN J. RILEY TANNING COMPANY, INC.
228 SALEM STREET, WOBURN, MASSACHUSETTS

HYDROGEOLOGIC INVESTIGATION — DRAWING NUMBER 4



LEGEND

- PERIMETER OF STUDY AREA
- INTERMITTANT STREAM
- ADDITIONS, NEW BUILDINGS
- VARIOUS STORAGE AREAS
- SEWER EASEMENT
- PW1 43.0 — PRODUCTION WELL, GROUNDWATER CONTOUR ELEVATION (NGVD)
- B1 43.7 — MONITORING WELL, GROUNDWATER CONTOUR ELEVATION (NGVD)
- DIRECTION OF GROUNDWATER FLOW
- 60 — GROUNDWATER CONTOUR IN FEET ABOVE NATIONAL GEODETIC VERTICAL DATUM (NGVD)

NOTES: DATES OF GROUNDWATER ELEVATION [illegible] NOTED IN TABLE 4

FIGURE 5. GROUNDWATER CONTOUR MAP

SCALE: 1"=100'	APPROVED BY	DRAWN BY MH
DATE: 11/8/83		

JOHN J. RILEY TANNING COMPANY, INC.
228 SALEM STREET, WOBURN, MASSACHUSETTS

HYDROGEOLOGIC INVESTIGATION — DRAWING NUMBER 5

APPENDIX A

Chemical Analysis of Effluent from
John J. Riley Tanning Company Inc.

to

City of Woburn Sewer System
May 2, 1979

and

Report of Analysis for
EP Toxicity Test of
Landfilled Tannery Waste
from
John J. Riley Tanning Company Inc.
July 15, 1983

Analysis of Effluent Parameters

JOHN J. RILEY CO., WOBURN, MA.

Sampling Date: May 2, 1979

Effluent Temperature: 22°C

EFFLUENT PARAMETERS (mg/l)

Time[1]	Proportion of Total Daily Flow %	pH	BOD_5	COD	Grease
4 A.M.	5.18	12.7	1,710	15,600	1,400
5	9.82	12.7	2,100	6,200	11,000
6	6.73	11.8	1,920	5,100	2,200
7	10.96	11.7	1,410	3,800	9,100
8	11.02	12.5	2,310	7,000	6,100
9	8.77	10.5	3,930	4,600	7,100
10	10.73	11.0	2,520	6,000	1,900
11	7.06	12.1	2,370	5,500	1,100
12	5.71	12.1	3,000	6,600	1,700
1 P.M.	5.39	9.4	1,650	3,200	2,200
2	9.13	7.2	2,340	5,000	2,000
3	4.55	6.8	2,310	4,900	2,200
4	2.95	6.2	1,890	4,100	1,400
5	0.50	6.8	2,130	4,000	2,400
6	0.40	7.0	990	2,000	1,400
7	1.07	4.8	1,410	3,800	1,800
8	0.01	6.3	390	800	2,100
9	0.01	6.6	630	500	2,400
10	0.01	6.7	240	800	2,100
11	0.0	6.9	150	800	1,800
12	0.0	7.0	270	600	1,400
1 A.M.	0.0	7.1	270	800	1,000
2	0.0	7.1	270	1,200	1,000
3	0.0	7.1	240	900	1,000
	100%				
Flow Weighted Average Values	(mg/l)	10.8	2,290	5,800	4,500
	(lb/1000 lb of hide)	10.8	70	177	137
Industry Average[2]	(lb/1000 lb of hide)		95	260	19

[1] Indicates hour that sampling began. Samples collected on the hour and every 15 minutes thereafter.

[2] Taken from the Development Document for the Leather Tanning and Finishing Industry. EPA-440 (1-74-016-9) March, 1974.

EFFLUENT PARAMETERS CONTINUED (mg/l)

May 2, 1979

Time	TS	TSS	Sulfide	TOTAL Cr	Pb	Cd
4 A.M.	21,500	12,800	520	12	0.0	0.01
5	10,700	2,900	240	11	0.0	0.01
6	9,500	3,900	120	197	0.0	0.00
7	7,700	3,000	100	133	0.0	0.00
8	11,800	4,500	180	86	0.0	0.00
9	6,800	3,100	100	97	0.0	0.00
10	9,200	3,500	140	103	0.0	0.00
11	9,000	3,000	200	36	0.0	0.00
12	12,100	3,000	300	25	0.0	0.00
1 P.M.	7,200	2,000	80	49	0.0	0.00
2	14,400	2,700	60	24	0.0	0.00
3	2,100	2,700	60	4	0.0	0.00
4	18,500	1,400	60	27	0.0	0.00
5	12,100	1,800	60	40	0.0	0.00
6	7,900	2,000	20	32	0.0	0.00
7	5,700	700	60	17	0.0	0.00
8	12,500	500	20	12	0.0	0.00
9	2,600	200	100	6	0.0	0.00
10	2,000	200	60	5	0.0	0.00
11	1,900	200	60	4	0.0	0.00
12	1,800	200	60	3	0.0	0.00
1 A.M.	2,000	200	40	3	0.0	0.00
2	2,000	300	40	3	0.0	0.00
3	2,100	300	60	2	0.0	0.02
(mg/l)	10,400	3,600	160	69	0.0	<0.01
(lb/1000 lb of hide)	317	110	5	2		
" "	525	140	8.5	4.3		

CHEMICAL ANALYSES

JOHN J. RILEY CO., WOBURN, MA.

24-Hour Composite Samples

Effluent Parameters mg/l

	Sampling Dates 3/5-3/6/81	Sampling Dates 3/11-3/12/81
COD	5913	5022
BOD	2240	1017
TS	10516	10840
TSS	1835	2340
TDS	8681	8500
Chlorides	2169	3179
Sulfides	182	200
Grease	2498	1371
Cr Total	24.5	41.0
Cr(VI)	0	0
Pb	0.3	1.3
Cd	0	0

Sea Plantations Environmental Services, Ltd.

Engineering and Environmental Consultants

John J. Riley Co.
228 Salem Street
Woburn, MA 01801

ATTENTION: Richard Jones

Date: June 17, 1981

Project No.:

Reference: Special - Hourly

Sampling date: 5/20/81

LABORATORY REPORT

TIME	SAMPLE #	BOD 5-Day mg/l	COD mg/l	Total Susp. Solids mg/l	Sulfide mg/l	Oil & Grease mg/l	Chlorides mg/l	Total Chrom. mg/l	Lead mg/l	Cadmium mg/l	Total Solids mg/l	% of Total Flow 30 min Before & After
4AM	05126	1320	2080	440	0.8	40	610	9.0	0.6	0.13	2560	3.64
5AM	05127	2760	7170	1020	18.4	60	1800	0.8	0.8	0.17	10,060	7.93
6AM	05128	1920	6336	900	15.2	70	750	1.3	0.2	0.07	7660	7.69
7AM	05129	2520	5423	1620	15.2	590	3270	334	0.1	0.16	13,770	9.08
8AM	05130	1440	2240	1920	13.6	570	1160	352	0.6	0.16	7290	10.14
9AM	05131	2580	5245	4320	17.6	2610	3060	202	0.7	0.18	15,880	8.29
10AM	05132	2460	5742	1300	12.0	2140	1160	176	0.8	0.21	9600	7.82
11AM	05133	1440	2262	1880	2.4	250	1260	30	0.4	0.11	6430	7.50
12N	05134	1380	1392	1080	8.0	446	5000	59	2.4	0.18	10,100	7.53
1PM	05135	2100	3828	2620	0.8	556	9940	53	5.0	0.18	21,210	8.74
2PM	05136	1800	3040	1560	6.4	180	5850	29.9	1.6	0.12	9330	9.02
3PM	05137	1680	1740	1140	14.4	2470	3500	19.2	0.4	0.17	8510	5.89
4PM	05138	1260	2958	900	0.8	1220	4430	10.9	0.2	0.07	10,220	3.01
5PM	05139	540	1218	400	4.0	380	850	16.9	1.7	0.06	3820	3.32
COMPOSITE BASED ON % OF TOTAL FLOW 30 MINS BEFORE & AFTER THE HOUR		1915	3867	1670	10.3	820	3025	113.1	1.2	0.15	10,340	

Incorrect. Test method failure. See report dated 10/30/81 using new method

80 mg/l

6/17/81
Date

Supervisor, Testing Services Laboratory

29 Congress Street, Salem, Massachusetts 01970 Telephone: (617) 745-4560

EP Toxicity Report
Landfilled Tannery Waste

Cambridge Analytical Associates
222 Arsenal Street / Watertown, Massachusetts 02172 / (617)923-9376

FORMAL REPORT OF ANALYSIS

PREPARED FOR: Yankee Environmental Engineering and Research Services, Inc.
27 Salem Street
Woburn, MA 01801

ATTN: Bob Young

CUSTOMER ORDER NUMBER:

CAMBRIDGE ANALYTICAL ASSOCIATES, INC.

REPORT NUMBER: 83-572

DATE PREPARED: July 29, 1983

TABLE OF CONTENTS

1. INTRODUCTION

This report summarizes results of chemical analyses performed on samples received by CAA on July 15, 1983. Analytical methods employed for these analyses are described in Section 2 and results are presented in Section 3. The last section contains quality control data and certifications supporting the analytical results.

2. ANALYTICAL METHODS

Analytical methods utilized for sample analysis are summarized in Table 1. For analysis of EP toxicity, a 100 gram sample was extracted according to methods specified by EPA (1980). The leachate was then analyzed for metals according to methods of EPA (1979).

3. RESULTS

Results of analyses are presented in Table 2.

Table 1

SUMMARY OF ANALYTICAL METHODS

Constituent	Method Reference	Method Description
Extraction	EPA 1980 (1)	EP Test
Metals		
-As	Method 206.2 (2)	Graphite furnace atomic absorption
-Ba	Method 208.1 (2)	Flame atomic absorption
-Cd	Method 213.1 (2)	Flame atomic absorption
-Cr (total)	Method 218.1 (2)	Flame atomic absorption
-Cr (hexavalent)	Method D1687-80 (3)	Colorimetric; diphenyl carbizide
-Pb	Method 239.2 (2)	Graphite furnace atomic absorption
-Hg	Method 245.1 (2)	Cold-vapor atomic absorption
-Se	Method 270.2 (2)	Graphite furnace atomic absorption
-Ag	Method 272.1 (2)	Flame atomic absorption
Cyanide	Method 335.2 (2)	Distillation; colorimetric
Sulfide	Method 376.1 (2)	Titrimetric

(1) U.S. EPA. 1980. Hazardous Waste and Consolidated Permit Regulations - Appendix II - EP Toxicity Test Procedure. Federal Register 45(98): 33127-33128.

(2) U.S. EPA. 1979. Methods for Chemical Analysis of Water and Waste. EPA 600/4-79-020. EPA/EMSL, Cincinnati, Ohio.

(3) ASTM, 1980. Annual Book of ASTM Standards. Part 31 - Water. ASTM, Philadelphia, Pennsylvania.

Table 2

RESULTS OF CHEMICAL ANALYSES

Constituent	Maximum Contamination Level	Client ID:	O	N		B
		CAA ID:	8305791	8305792		8305793
METALS (ppm)						
As	5.0		<0.005	<0.005;	<0.005[a]	<0.005
Ba	100		<0.1	<0.1;	<0.1[a]	<0.1
Cd	1.0		<0.005	0.008;	<0.005[a]	<0.005
Cr (total)	5.0		0.35	<0.1;	<0.1[a]	0.27
Cr (hexavalent)	5.0		0.17	<0.1		<0.1
Pb	5.0		0.10	0.11;	0.11[a]	1.2
Hg	0.2		<0.0002	<0.0002;	<0.0002[a]	<0.0002
Se	1.0		<0.005	<0.005;	<0.005[a]	<0.005
Ag	5.0		<0.01	<0.01;	<0.01[a]	<0.01
Cyanide (ppm, wet weight)	--		0.66	6.5		--
Sulfide (ppm, wet weight)	--		<5	<5		--

[a]Duplicate analyses performed.

Table 3

QUALITY CONTROL DATA
SPIKE RECOVERIES AND CHECK STANDARDS

Constituent	Client ID	CAA ID	Concentration (ppm) Theoretical Value	Observed Value	Recovery (%)
As	O	8305791	0.100	0.114	114
	N	8305792	0.100	0.081	81
	B	8305793	0.100	0.103	103
Ba	O	8305791	1.00	1.13	113
	N	8305792	1.00	1.08	108
	B	8305793	1.00	1.08	108
Cd	O	8305791	0.100	0.096	96
	N	8305792	0.100	0.098	98
	B	8305793	0.100	0.099	99
Cr (total)	O	8305791	1.79	1.61	90
	N	8305792	0.50	0.46	92
	B	8305793	1.64	1.51	92
Cr (hexavalent)	B	8305793	0.250	0.267	107
Pb	O	8305791	2.50	2.44	98
	N	8305792	2.50	2.48	99
	B	8305793	2.50	2.54	102
Hg	O	8305791	0.100 ug	0.106 ug	106
	N	8305792	0.100 ug	0.102 ug	102
	B	8305793	0.100 ug	0.106 ug	106
Se	O	8305791	0.100	0.087	87
	N	8305792	0.100	0.085	85
	B	8305793	0.100	0.109	109
Ag	O	8305791	0.500	0.497	99
	N	8305792	0.500	0.503	101
	B	8305793	0.500	0.503	101

4. QUALITY ASSURANCE DOCUMENTATION

4.1 Quality Control Data

Quality control data associated with these analyses are summarized in Table 3. These results consist of recoveries of spikes from analyte solutions.

4.2 Certification

This work has been checked for accuracy by the following staff personnel:

Director, Inorganic
Chemistry Laboratory

Keith A. Hausknecht

Keith A. Hausknecht

APPENDIX B

Specifications for Soil Sampling, Drilling, and Installation of Monitoring Wells

at the

John J. Riley Tanning Company
228 Salem Street
Woburn, Massachusetts

SERVICE AGREEMENT AND QUOTATION
FOR
SOIL SAMPLING, DRILLING
AND
INSTALLATION OF MONITORING WELLS
WOBURN, MASSACHUSETTS
JOHN J. RILEY COMPANY INCORPORATED
228 SALEM STREET

Section 1 - General

Yankee Environmental Engineering and Research Services, Inc. (hereafter, YE^{2}ARS), of 27 Salem Street, Woburn, Massachusetts has been hired by the John J. Riley Company Inc. to conduct a hydrogeologic investigation of their tanning facility at 228 Salem Street in Woburn, Massachusetts.

This investigation will require soil boring, soil sampling and the installation of groundwater monitoring wells.

Section 2 - Information to Subcontractor

The Scope of Work indicates that approximately six monitoring wells will be installed and several additional test borings will be advanced on property owned and used by the John J. Riley Company Inc.

The John J. Riley Company Inc., a tannery, is located in the town of Woburn, Massachusetts, south of Route 128 on Salem Street. The location of the John J. Riley Company Inc. tannery is indicated on the attached USGS topographic map. Low levels of volatile organic contamination has been detected in monitoring wells located east of the tannery on adjacent property.

Data developed during YE^{2}ARS investigation will be used to determine the direction of groundwater flow on the John J. Riley Tannery Site, and assess groundwater quality. The approximate location of the proposed wells and borings are indicated on the attached map. The precise locations of the wells and borings will be determined by YE^{2}ARS personnel prior to the commencement of drilling. All boring and well locations will be reviewed by the site owner to insure that underground utilities will not be encountered during drilling. It is anticipated that all well and boring locations will be accessible for a truck-mounted drilling rig.

Existing site data has been reviewed to determine if any potentially hazardous substances have been disposed of on the Site. In addition, nine test pits were excavated to assess subsurface geologic conditions and the presence of tannery wastes.

Although tannery sludge, which exhibits objectionable odors, but is not hazardous, has been landfilled on some portions of the Site, YE^{2}ARS staff does not anticipate that large quantities of tannery waste will be encountered during drilling.

In addition, low levels of volatile organic compounds have been detected in groundwater samples collected from wells located east, and presumably downgradient of the site. There is a possibility that volatile organic compounds, such as those present in contaminated groundwater east of the site, may be encountered during drilling. YE^{2}ARS anticipates that volatile organic contaminant levels in groundwater or soil, if encountered, will not be significant.

As a precautionary measure, however, YE^{2}ARS personnel will monitor soil and ambient air during borehole advancement for volatile organic compounds and will inform the subcontractor if respiratory protection is required.

Questions with respect to the technical work and contract procedures should be directed to the attention of YE^{2}ARS technical manager, M. Margret Hanley.

Section 3 - Site Geology

USGS data and existing boring logs indicate that the study area is characterized by 15 to 50 feet of silt, sand, some gravel, and boulders overlying crystalline bedrock. Portions of the study area have been developed and some resultant fill or rip-rap may be encountered during drilling. Anticipated depths to groundwater vary from 10 to 25 feet.

Section 4 - Scope of Work

4.0 Scope of Work

The work to be performed includes the furnishings of all material, labor, and equipment necessary for access to boring locations, for soil boring, and for the construction and installation of groundwater monitoring wells.

All monitoring wells and boreholes will be drilled with a 3 3/4 inch inside diameter hollow stem auger or drive casing.

4.1 Soil Sampling

Soil samples will be collected during drilling with a 24-inch split-barrel sampler having a 2-inch outside diameter (OD). Unless otherwise specified by YE^{2}ARS, drilling will be carried to refusal. For the purposes of this investigation, refusal will be defined as the driving resistance of 2 inches or less per 100 blows for a 140-pound hammer falling 30 inches. In addition, 2-5 feet of bedrock coring may be done to insure that refusal is at the bedrock surface.

The subcontractor will obtain representative samples of soil at the beginning of every change of stratum and at intervals of 5 feet. Samples will be representative of the material encountered and will be collected with a 2-inch OD sample spoon with a 140 pound weight free-falling 30 inches. The driving resistance will be recorded for each 6-inch increment sampled with the split-spoon.

If requested by YE^{2}ARS personnel, the split-spoon sampler will be cleaned by the subcontractor before each sample is taken. The cleaning process will consist of rinsing the split-spoon sampler with clean wash water. YE^{2}ARS personnel may require that sampling equipment be decontaminated with methanol in addition to clean wash water All cleaning material will be provided by the subcontractor.

Representative portions of each split-spoon sample well be preserved in round, screw-top, airtight, clear-glass jars. Size of jars will be 8 ounces or larger for 2-inch-diameter samples. The specimens will be placed in the jars as soon as they are taken in order to preserve the original moisture content. The jars will be tightly capped and will be suitably boxed, marked, and identified with legible labels as directed by YE^{2}ARS. These labels and jars, provided by the subcontractor, will show the date, well location number, sample number, depth at which the sample was taken, record of number blows for each 6-inch drive increment, and length of sample recovery.

Samples of bedrock will be collected and placed in an 8 ounce jar and labelled. One sample jar of rock fragments per well will be collected by the subcontractor.

In general, all drilling coring and sampling operations will conform to American Society for Testing and Materials (ASTM) standards unless otherwise designated.

4.2 Monitoring Well Construction and Installation

Construction of the wells will be in accordance with standard procedures. The well construction is subject to change as subsurface conditions warrant as determined in the field by YE^{2}ARS. The monitoring well casing will be PVC with a nominal diameter of 2 inches. The pipe will extend 2.0 feet above ground level. The pipe will have threaded flush joints and be equivalent to Schedule 80 ASTM standards. The casing will terminate in a factory-slotted PVC well screen with a slot size of 0.010 inches. Screens will be continuously slotted or slotted in three rows placed at 120° intervals around the circumference of the pipe. Threaded PVC bottom plugs will be used for each well installation.

4.3 Backfilling

If bedrock is cored, open boreholes in bedrock will be backfilled with formation material until the bottom of hole is coincident with the depth of bedrock.

The annular space of the monitoring wells above bedrock will be backfilled with a suitable grade of Ottawa sand or similar medium-grain clean sand to a level approximately one foot above the top of the screen.

All backfilling should be done in 2-foot increments or less as augers or drive casing are withdrawn to keep the hole from collapsing around the well screen before the sand chamber is established.

A 2-foot seal of bentonite pellets or slurry as determined necessary by YE^{2}ARS will be placed above the sand chamber and will be firmly tamped into place. Special care will be exercised to obtain an adequate, bentonite seal as casing or augers are withdrawn.

4.4 Well Security

To provide well security, a 3 or 4-inch nominal diameter steel casing 5 feet in length will be placed around the PVC casing and set into a 2-foot depth of concrete. The top of the steel casing will extend above the inner casing and will be fitted with a cap. The security casing and cap will be provided by the subcontractor.

4.5 Well Development/Completion

Upon completion of the monitoring well installation, the well is to be developed by flushing with clean water from the bottom of the well until the fluid runs clear. YE^{2}ARS will determine when the well is properly developed. The monitoring well must pass a 1-inch stainless steel bailer.

4.6 Reports

Upon completion of the work, soil samples and well logs containing the following information will be submitted to the YE^{2}ARS office within 5 working days of completion of field work:

a. Location
b. Start and completion dates
c. Boring/well number
d. Depth of static water table
e. Soil classification and depths
f. Blow counts
g. Driller's remarks
h. Sample depths and types
i. Screen depths
j. Filter depths
k. Seal depths
l. Monitoring well material used and lengths per well
m. Driller's names

Section 5 - Clean-Up

At YE^{2}ARS descretion, the driller may be required to clean drilling equipment (split-spoon, auger, etc.) with a pressurized steam cleaner and detergent or methanol before proceeding to the next well. The subcontractor shall collect contaminated solvents, wash water, and related materials in 55 gallon drums to be provided by the site owner.

Prior to the mobilization of the drill rig on site, the rig and all associated equipment shall be thoroughly cleaned to remove all oil, grease, mud, tar, etc. This cleaning process will consist of 1) high pressure hot water claning of the drilling equipment 2) rinsing the equipment with methanol and 3) a high pressure hot-water final rinse. The subcontractor must provide all equipment necessary for this cleaning process which may include clean water, methanol and a mobile hot water, high-pressure washer.

Unless otherwise specified by YE^{2}ARS technical manager, all sampling equipment must be cleaned between samples with clean water rinse in order to minimize contamination. If requested, the augers, cutting bits and drill rods shall be cleaned with pressurized water and rinsed with methanol and and clean water.* Special attention must be given to the thread section of the casing, and drill rods. Petroleum based lubricants shall not be used to prevent binding. The subcontractor will be responsible for providing a means for collecting contaminated solvents and related materials.

Section 6 - Safety

All subcontractors may be required to wear hard hats within the John J. Riley Company Inc. facility. Decontamination of equipment may require that the contractor wear rubber gloves and safety goggles.

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* YE^{2}ARS anticipates that drilling equipment will require decontamination on two separate occasions during the drilling project.

During borehole advancement, YE^{2}ARS will monitor ambient air and split-spoon samples for volatile organic compounds. YE^{2}ARS will inform the drilling subcontractor if respiratory protection (i.e. NIOSH approved air-purifying respiratory face mask with protection levels up to 1000 ppm total volatile organics) is required.

If YE^{2}ARS determines that organic vapor concentrations in ambient air exceed levels above the design specifications of the air purifying repiratory equipment used by the subcontractor, the subcontractor will be directed to cease operations at that borehole and withdraw from the area.

Section 7 - Service Agreement Particulars

The subcontractor will, on his own time and at his own expense procure all permits, licenses, and certificates (birth certificate or proof of identification) that may be required of him by law for the execution of the work hereunder. The subcontractor will comply with all federal, state and local laws, ordinances, rules and regulations relating to the performance of the work hereunder.

The owner of the Site will determine the location of all public and private utilities in advance of the drilling program. During the progress of the work, the subcontractor will cooperate with the owners of utilities and permit their representatives access to the work area to determine if their utilities are being endangered in any way.

At the completion of field operations, it will be the responsibility of the subcontractor to restore the site as nearly as possible to its original condition.

Should boulders or other obstructions be encountered, the subcontractor will attempt to redrill at an alternate location selected by YE^{2}ARS personnel. If it is necessary to move a drilling location to a new site, the new location will be designated by a new boring number, and the boring location will be marked in the field by YE^{2}ARS personnel. Where a reasonable depth is not obtained due to boulders or other obstructions, the subcontractor will be paid for the depth reached for all drilling attempts.

Upon completion of the field work, complete drilling logs of all borings, together with complete sets of soil and rock samples, will be delivered at the expense of the subcontractor to the office of YE^{2}ARS located at 27 Salem Street, Woburn, Massachusetts, Attention: Ms. M. Margret Hanley.

Section 8 - Project Particulars

The quantities and items stated on the attached bid sheet are YE^{2}ARS best approximation of the scope of work. YE^{2}ARS does not guarantee that the bid quantities are correct or that stated tasks will be performed. YE^{2}ARS reserves the right to vary the quantities or delete items in their entirety, and the Subcontractor will not be entitled to any extra payment due to such amended quantities or deleted items. It must be stated, however, that at this time every item discussed in the work plan is expected to be performed under this contract.

Fixed Prices quoted will remain valid for a period of 90 days from the receipt by YE^{2}ARS of this service agreement for work performance as described in this specification package.

A letter accompanying the Fixed Price Quotation Sheet and Service Agreement will also include:

a. An estimate of the number of days required to complete the drilling and construction of the wells.

b. The earliest date the subcontractor can commence work on site.

c. Proof of minimum insurance coverage.

The Service Agreement quotation items will include all services, labor, equipment, transportation, material, and supplies needed to complete the work. Payment of these items will be provided in the compensation for drilling and well installation and will also include obtaining, packaging, marking, and submitting soil samples and recording and submitting data incidental to each item. Any down time incurred by the subcontractor other than a delay at the request of YE^{2}ARS will not be a payment item.

No other payments for any specified or indicated work nor for any work implied therefrom will be made. No payment will be made for drilled holes abandoned without authorization of YE^{2}ARS, for drilling holes for which satisfactory samples and data are not submitted, or for wells which do not allow passage of a 1 inch diameter bailer.

Prior to the start of field operations, the subcontractor will designate his foreman or representative who will be the only individual authorized to discuss work schedules and related matters with YE^{2}ARS personnel.

Information gathered during this investigation is confidential and will not be discussed with any individual other than YE^{2}ARS technical manager, M. Margret Hanley.

Section 9 - Quotation Items

Item 1. Mobilization and Demobiliation

This item will carry all charges incidental to equipment set-up and removal, in order that the charges need not be distributed among the more variable items of the contract. This item will be paid at the contract lump sum price for mobilization and demobilization and will include the furnishing of personnel, machinery, tools, and all other equipment necessary to carry on and complete the work properly. All material or equipment furnished under this item will remain the property of the subcontractor and will be maintained, cared for, and disposed of by him.

Item 2. Decontamination

This item will include any costs incurred by the subcontractor for the decontamination of equipment and supplies, including all charges for labor and hourly rates for equipment down time necessary to decontaminate drilling equipment when requested by YE^{2}ARS personnel.

Item 3. Soil Borings with Sampling

This work will be paid for at the respective contract unit prices per linear foot of drilling/soil sampling. This work will be measured for payment by the actual number of vertical linear feet drilled for each accepted hole between the ground surface at the hole and the bottom of the accepted well or the bottom of the last soil sample taken, whichever is deeper. This item will include the furnishing of a complete well log as outlined in the specifications and necessary sample containers. This item will also include any split-spoon sampler decontamination requested by YE^{2}ARS.

Item 4. Bedrock Coring and Sampling

This item will be paid for at the respective contract unit prices per linear foot of bedrock coring. Coring methods will be determined by YE^{2}ARS technical manager in the field. This item will also include the collection of one representative sample of rock/per well by the subcontractor.

Item 5 and 6. Monitoring Well Casing and Screen

This item will be paid at the respective unit prices per linear foot for installed material only of the type as specified in the Scope of Work.

Item 7. Installation of Monitoring Wells

This item will include all costs and time for installation, backfilling and grouting between the bottom of the well screen and the ground surface. This item includes all backfilling materials specified such as sand, bentonite pellets or slurry, concrete or other impermeable materials.

Item 8. Installation of Well Protection and Well Development

This item will include all costs for material and time necessary to fabricate and install the required well protection at each well location.

This item will also include all time and necessary equipment to properly develop each monitoring well. Wells will be developed until deemed acceptable by YE^{2}ARS.

APPENDIX C

Well Logs of Monitoring Wells
Installed Under the Supervision of YE^{2}ARS, Inc.
September - October 1983

at the

John J. Riley Tanning Company
228 Salem Street
Woburn, Massachusetts

and

Well Log of John J. Riley Company
Production Well #1

DATE START 9-12-83
DATE FINISH 9-15-83
WEIGHT OF HAMMER 140 300
HEIGHT OF FALL 30" 24"

GROUND WATER OBSERVATION

DATE	TIME	DEPTH
10-12	AM	25'10"

SAMPLER OD 2" ID 1 3/8"
TYPE OF RIG CME 45

GEO-METRICS, INC.

SUBSURFACE EXPLORATIONS

LONG POND ROAD
P.O. BOX 288
DANVILLE, NH 03819

CLIENT
Yankee Environmental Eng. and Research Services, Inc.

SHEET 1 of 2

PROJ. NO
LOCATION Woburn, Mass
LINE & STA
OFFSET
GROUND ELEVATION
HOLE NO. 1

CASING SAMPLER CORE BARREL

	CASING	SAMPLER	CORE BARREL
TYPE	Pipe	SS	Hy core
SIDE ID	37/8"	1 3/8"	2 1/8"

Sample Depths	Type of Sample	Blows Per 6" On Sampler From 0-6	To 6-12	To 12-18	To 18-24	Moist.	Profile Change Depth Elev.	Field Identification Of Soils Remarks	Sample No	Sample Pen
							Gs			
4-6	ss	8	9	10	10	D			1	24
9-11	ss	18	26	15	14	D		Brown medium to coarse sand and gravel, with cobbles and boulder	2	24
14-16	ss	32	20	32	41	D			3	24
18-20	ss	30	21	25	40	D			4	24
							24			
24-26	ss	16	35	30	44	W		Gray silt and sand some gravel with occasional boulders	5	24
							29			
29-31	ss	27	29	37	14	W		Gray-brow fine silty sand and gravel occasional boulders	6	24
							34			
34-36	ss	12	20	23	20	W		Brown medium sand becoming gray-brown medium sand	7	24
39-41	ss	16	28	36	38	W			8	24

Proportions used trace = 0-10%, little = 10-20%, some = 20-35%, and 35-50%.

Driller L. Knox
Helper K. Knox
Soil Engineer
Drilling Inspector

SAMPLE TYPE
C = Cored W = Washed
SS = Split Spoon
UP = Undisturbed Piston
TP = Test Pit

COHESIONLESS DENSITY
0- 4 very loose
4-10 loose
10-30 compact
30-50 dense

COHESIVE CONSISTENCY
0- 2 very soft
2- 4 soft
4- 8 medium
8-15 stiff
15-30 very stiff

TOTAL FOOTAGE
Earth Boring ft 58.5'
Rock Coring ft
Hole No 1

DATE START 9-12-83

DATE FINISH 9-15-83

WEIGHT OF HAMMER 140 300

HEIGHT OF FALL 30" 24"

GROUND WATER OBSERVATION

DATE	TIME	DEPTH
10-12	AM	25'10"

SAMPLER OD 2" ID 1 3/8"

TYPE OF RIG CME 45

GEO-METRICS, INC.

SUBSURFACE EXPLORATIONS

LONG POND ROAD
P.O. BOX 288
DANVILLE, NH 03819

CLIENT
Yankee Environmental Eng. and Research Services, Inc.

SHEET 2 of 2

PROJ. NO

LOCATION Woburn, Mass.

LINE & STA

OFFSET

GROUND ELEVATION

HOLE NO. 1

CASING SAMPLER CORE BARREL

	CASING	SAMPLER	CORE BARREL
TYPE	Pipe	SS	Hy core
SIDE ID	4 7/8"	1 3/8"	2 1/8"

Sample Depths	Type of Sample	Blows Per 6" On Sampler From 0-6	To 6-12	To 12-18	To 18-24	Moist.	Profile Change Depth Elev.	Field Identification Of Soils Remarks	Sample No	Sample Pen
							42	See page #1		
44-46	ss	24	43	50	72	W		Brown medium sand trace clay and silt with occasional boulders	9	24
49-51	ss	5	17	51	43	W			10	24
							52			
54-56	ss	27	70	150		W		Fine yellow sand, trace silt and clay with occasional boulders.	11	15
							58.5			
								Cored rock 58.5-61.5 Rec. 1'		
								Cored rock 61.5-63.5 Rec. 10"		
								Installed observation well at 58' using 45' screen and 15' solid pipe.		
								Backfill 63.5'		
								1 protective casing		

Proportions used trace = 0-10%, little = 10-20%, some = 20-35%, and = 35-50%.

Driller L. Knox
Helper K. Knox
Soil Engineer
Drilling Inspector

SAMPLE TYPE
C = Cored W = Washed
SS = Split Spoon
UP = Undisturbed Piston
TP = Test Pit

COHESIONLESS DENSITY
0- 4 very loose
4-10 loose
10-30 compact
30-50 dense

COHESIVE CONSISTENCY
0- 2 very soft
2- 4 soft
4- 8 medium
8-15 stiff
15-30 very stiff

TOTAL FOOTAGE
Earth Boring ft 58.5'
Rock Coring 5 ft
Hole No 1

DATE START 9-19-83

DATE FINISH 9-22-83

WEIGHT OF HAMMER 140 300

HEIGHT OF FALL 30" 24"

GROUND WATER OBSERVATION

DATE	TIME	DEPTH
10-12	AM	29'11"

SAMPLER OD 2" ID 1 3/8"

TYPE OF RIG CME 45

GEO-METRICS, INC.

SUBSURFACE EXPLORATIONS

LONG POND ROAD
P.O. BOX 288
DANVILLE, NH 03819

CLIENT
Yankee Environmental Eng. and Research Services, Inc.

SHEET 1 of 2

PROJ. NO

LOCATION Woburn, Mass.

LINE & STA

OFFSET

GROUND ELEVATION

HOLE NO. 2

CASING SAMPLER CORE BARREL

	CASING	SAMPLER	CORE BARREL
TYPE	Pipe	SS	Hy core
SIDE ID	47/8"	1 3/8"	2 18"

Sample Depths	Type of Sample	Blows Per 6" On Sampler From 0-6	To 6-12	To 12-18	To 18-24	Moist.	Profile Change Depth Elev.	Field Identification Of Soils Remarks	Sample No	Sample Pen
							Gs			
4-6	ss	2	5	4	6	W		Medium silty sand and gravel with occasional cobbles and boulders.	1	24
9-11	ss	13	30	20	15	W			2	24
14-16	ss	34	21	19	13	D	18		3	24
19-21	ss	30	20	19	21	M		Gray-brown silty sand and gravel with occasional boulders and fine sandy silt layers	4	24
24-26	ss	20	22	26	110	M	29		5	24
30-32	ss	21	40	44	50	W		Coarse silty sand and gravel with occasional boulders.	6	24
35-37	ss	19	29	35	108	W	35		7	24
								Fine brown silty sand and boulders		

Proportions used trace = 0-10%, little = 10-20%, some = 20-35%, and = 35-50%.

Driller L. Knox
Helper K. Knox
Soil Engineer
Drilling Inspector

SAMPLE TYPE
C = Cored W = Washed
SS = Split Spoon
UP = Undisturbed Piston
TP = Test Pit

COHESIONLESS DENSITY
0- 4 very loose
4-10 loose
10-30 compact
30-50 dense

COHESIVE CONSISTENCY
0- 2 very soft
2- 4 soft
4- 8 medium
8-15 stiff
15-30 very stiff

TOTAL FOOTAGE
Earth Boring ft 48.7'
Rock Coring 2 ft
Hole No. 2

ATE START 9-19-83

ATE FINISH 9-22-83

VEIGHT OF HAMMER	140	300
EIGHT OF FALL	30"	24"

GROUND WATER OBSERVATION

DATE	TIME	DEPTH
10-12	AM	29'11"

AMPLER OD 2" ID 1 3/8"

YPE OF RIG CME 45

GEO-METRICS, INC.

SUBSURFACE EXPLORATIONS

LONG POND ROAD
P.O. BOX 288
DANVILLE, NH 03819

CLIENT

Yankee Environmental Eng. and Research Services, Inc.

SHEET 2 of 2

PROJ. NO

LOCATION Woburn, Mass.

LINE & STA

OFFSET

GROUND ELEVATION

HOLE NO. 2

CASING SAMPLER CORE BARREL

	CASING	SAMPLER	CORE BARREL
TYPE	Pipe	SS	Hy Core
SIDE ID	37/8"	1 3/8"	2 1/8"

Sample Depths	Type of Sample	Blows Per 6" On Sampler From 0-6	To 6-12	To 12-18	To 18-24	Moist.	Profile Change Depth Elev.	Field Identification Of Soils Remarks	Sample No	Sample Pen
40-42	ss	11	22	28	31	W	42	See page # 1.	8	24
								Coarse silty sand and gravel with occasional boulders.		
47-48	ss	70	130			W	48.7'		9	12
								Cored bed rock 48.7'-50.7' Rec.2'		
							50.7			
								Installed well using 33' screen and 18' solid Pvc.		
								Backfill 50.7'		
								1 protective casing		

Proportions used trace = 0-10%, little = 10-20%, some = 20-35%, and = 35-50%.

Driller

Helper

Soil Engineer

Drilling Inspector

SAMPLE TYPE
C = Cored W = Washed
SS = Split Spoon
UP = Undisturbed Piston
TP = Test Pit

COHESIONLESS DENSITY
0- 4 very loose
4-10 loose
10-30 compact
30-50 dense
50 + very dense

COHESIVE CONSISTENCY
0- 2 very soft
2- 4 soft
4- 8 medium
8-15 stiff
15-30 very stiff

TOTAL FOOTAGE
Earth Boring ft
Rock Coring ft
Hole No

ATE START 10-23-83

ATE FINISH 10-23-83

EIGHT OF HAMMER 140 300

EIGHT OF FALL 30" 24"

GROUND WATER OBSERVATION

DATE	TIME	DEPTH
10-23	comp.	dry

AMPLER OD 2" ID 1 3/8"

YPE OF RIG CME 45

GEO-METRICS, INC.

SUBSURFACE EXPLORATIONS

LONG POND ROAD
P.O. BOX 288
DANVILLE, NH 03819

CLIENT

Yankee Environmental Eng. and Research Services, Inc.

SHEET 1 of 1

PROJ. NO

LOCATION Woburn, Mass.

LINE & STA

OFFSET

GROUND ELEVATION

HOLE NO. 3A

CASING SAMPLER CORE BARREL

	CASING	SAMPLER	CORE BARREL
TYPE	Pipe	SS	Hy core
SIDE ID	37/8"	1 3/8"	2 1/8"

ip. il. rt.	Sample Depths	Type of Sample	Blows Per 6" On Sampler From 0-6	To 6-12	To 12-18	To 18-24	Moist.	Profile Change Depth Elev.	Field Identification Of Soils Remarks	Sample No	Sample Pen
								Gs			
								3'	Gray brown coarse sand, gravel and boulders.		
								5'	Cored boulder 2'		
									Abandoned boring		
0											
0											
0											
0											

Proportions used trace = 0-10%, little = 10-20%, some = 20-35%, and = 35-50%.

Driller L. Knox
Helper K. Knox
Soil Engineer
Boring Inspector

SAMPLE TYPE
C = Cored W = Washed
SS = Split Spoon
UP = Undisturbed Piston
TP = Test Pit

COHESIONLESS DENSITY
0- 4 very loose
4-10 loose
10-30 compact
30-50 dense

COHESIVE CONSISTENCY
0- 2 very soft
2- 4 soft
4- 8 medium
8-15 stiff
15-30 very stiff

TOTAL FOOTAGE
Earth Boring 3 ft
Rock Coring 2 ft.
Hole No. 3A

ATE START 10-23-83

ATE FINISH 10-23-83

/EIGHT OF HAMMER 140 300

FIGHT OF FALL 30" 24"

GROUND WATER OBSERVATION

DATE	TIME	DEPTH
10-23	comp.	dry

AMPLER OD 2" ID 1 3/8"

YPE OF RIG CME 45

GEO-METRICS, INC.

SUBSURFACE EXPLORATIONS

LONG POND ROAD
P.O. BOX 288
DANVILLE, NH 03819

CLIENT

Yankee Environmental Eng. and Research Services, Inc.

SHEET 1 of 1

PROJ. NO

LOCATION Woburn, Mass.

LINE & STA

OFFSET

GROUND ELEVATION

HOLE NO. 3B

CASING SAMPLER CORE BARREL

	CASING	SAMPLER	CORE BARREL
TYPE	Pipe	SS	Hy core
SIDE ID	37/8"	1 3/8"	2 1/8"

Sample Depths	Type of Sample	Blows Per 6" On Sampler From / To 0-6	6-12	12-18	18-24	Moist.	Profile Change Depth Elev.	Field Identification Of Soils Remarks	Sample No	Pen
							Gs	Gray-brown coarse sand, gravel, and boulders.		
							4			
								Cored boulders 4-7		
							7			
								Abandoned boring		

Proportions used trace = 0-10%, little = 10-20%, some = 20-35%, and = 35-50%.

Driller L. Knox
Helper K. Knox
Soil Engineer
Drilling Inspector

SAMPLE TYPE
C = Cored W = Washed
SS = Split Spoon
UP = Undisturbed Piston
TP = Test Pit
T = Undisturbed Thinwall

COHESIONLESS DENSITY
0- 4 very loose
4-10 loose
10-30 compact
30-50 dense
50 + very dense

COHESIVE CONSISTENCY
0- 2 very soft
2- 4 soft
4- 8 medium
8-15 stiff
15-30 very stiff

TOTAL FOOTAGE
Earth Boring 4 ft.
Rock Coring 3 ft.
Hole No. 3B

DATE START 9-26-83

DATE FINISH 9-29-83

WEIGHT OF HAMMER 140 300

HEIGHT OF FALL 30" 24"

GROUND WATER OBSERVATION

DATE	TIME	DEPTH
10-12	AM	37.3'

SAMPLER OD 2" ID 1 3/8"

TYPE OF RIG CME 45

GEO-METRICS, INC.

SUBSURFACE EXPLORATIONS

LONG POND ROAD
P.O. BOX 288
DANVILLE, NH 03819

CLIENT

Yankee Environmental Eng. and Research Services, Inc.

SHEET 1 of 2

PROJ. NO

LOCATION Woburn, Mass.

LINE & STA

OFFSET

GROUND ELEVATION

HOLE NO. 3 C

CASING SAMPLER CORE BARREL

	CASING	SAMPLER	CORE BARREL
TYPE	Pipe	SS	Hy core
SIDE ID	37/8"	1 3/8"	1 3/8"

Sample Depths	Type of Sample	Blows Per 6" On Sampler From 0-6	To 6-12	To 12-18	To 18-24	Moist.	Profile Change Depth Elev.	Field Identification Of Soils Remarks	Sample No	Sample Pen
							Gs			
10-12	ss	7	26	54	72	D		Gray brown coarse sand, gravel, cobbles and boulders.	1	24
15-17	ss	37	85	70	60	D			2	24
20-22	ss	19	19	15	15	D			3	24
25-27	ss	13	16	19	28	D	28		4	24
30-32	ss	16	21	24	29	M		Fine sand with thin silty clay layers	4	24
35-37	ss	22	24	52	84	W			5	24
							39	Refusal @ 39'		
								Cored to 42'		

Proportions used trace = 0-10%, little = 10-20%, some = 20-35%, and = 35-50%.

Driller L. Knox

Helper K. Knox

Soil Engineer

Drilling Inspector

SAMPLE TYPE
C = Cored W = Washed
SS = Split Spoon
UP = Undisturbed Piston
TP = Test Pit

COHESIONLESS DENSITY
0- 4 very loose
4-10 loose
10-30 compact
30-50 dense

COHESIVE CONSISTENCY
0- 2 very soft
2- 4 soft
4- 8 medium
8-15 stiff
15-30 very stiff

TOTAL FOOTAGE

Earth Boring	ft. 39'
Rock Coring	3 ft.
Hole No.	3C

DATE START 9-26-83

DATE FINISH 9-29-83

WEIGHT OF HAMMER 140 300

HEIGHT OF FALL 30" 24"

GROUND WATER OBSERVATION

DATE	TIME	DEPTH
10-12	AM	37.3'

SAMPLER OD 2" ID 13/8"

TYPE OF RIG CME 45

GEO-METRICS, INC.

SUBSURFACE EXPLORATIONS

LONG POND ROAD
P.O. BOX 288
DANVILLE, NH 03819

CLIENT

Yankee Environmental Eng. and Research Services, Inc.

PROJ. NO

LOCATION Woburn, Mass.

LINE & STA

OFFSET

GROUND ELEVATION

HOLE NO. 3C

CASING SAMPLER CORE BARREL

	CASING	SAMPLER	CORE BARREL
TYPE	Pipe	SS	Hy core
SIDE ID	37/8"	1 3/8"	13/8"

Depth Sel. Surf.	Sample Depths	Type of Sample	Blows Per 6" On Sampler From 0-6	To 6-12	To 12-18	To 18-24	Moist.	Profile Change Depth Elev.	Field Identification Of Soils Remarks	Sample No	Sample Pen
								42	Cored 39'-42'		
									Installed well using 19' screen and 22' solid PVC. Back fill 42' 1 protective casing		
10											
20											
30											
40											

Proportions used trace = 0-10%, little = 10-20%, some = 20-35%, and 35-50%

Driller L. Knox

Helper K. Knox

Soil Engineer

Drilling Inspector

SAMPLE TYPE

C = Cored W = Washed
SS = Split Spoon
UP = Undisturbed Piston
TP = Test Pit
T = Undisturbed Thinwall

COHESIONLESS DENSITY

0- 4 very loose
4-10 loose
10-30 compact
30-50 dense
50 + very dense

COHESIVE CONSISTENCY

0- 2 very soft
2- 4 soft
4- 8 medium
8-15 stiff
15 30 very stiff

TOTAL FOOTAGE

Earth Boring ft 39'

Rock Coring 3 ft

Hole No. 3C

DATE START 9-30-83

DATE FINISH 10-4-83

WEIGHT OF HAMMER 140 300

HEIGHT OF FALL 30" 24"

GROUND WATER OBSERVATION

DATE	TIME	DEPTH
10-12	AM	18.66'

SAMPLER OD 2" ID 1 3/8"

TYPE OF RIG CME 45

GEO-METRICS, INC.

SUBSURFACE EXPLORATIONS

LONG POND ROAD
P.O. BOX 288
DANVILLE, NH 03819

CLIENT

Yankee Environmental Eng. and Research Services, Inc.

SHEET 1 of 1

PROJ. NO

LOCATION Woburn, Mass.

LINE & STA

OFFSET

GROUND ELEVATION

HOLE NO. 4

CASING SAMPLER CORE BARREL

	CASING	SAMPLER	CORE BARREL
TYPE	Pipe	SS	Hy core
SIDE ID	37/8"	1 3/8"	1 3/8"

Sample Depths	Type of Sample	Blows Per 6" On Sampler From 0-6	To 6-12	To 12-18	To 18-24	Moist.	Profile Change Depth Elev.	Field Identification Of Soils Remarks	Sample No	Sample Pen
							Gs			
4-6	ss	1	2	2	1	D		Brown coarse to fine sand, gravel, and boulders.	1	24
9-9.2	ss	100				D	10		2	3
14-14.5	ss	110				D		Fine gray sand and gravel with occasional cobbles and boulders.	3	6
							18			
19-21	ss	30	36	55	32	W			4	24
24-26	ss	10	27	20	21	W		Fine yellow silty sand and gravel.	5	24
							28	Refusal at 28'		
							29	Cored 28'-29'		
								Installed well using 18' screen and 12' solid PVC. Backfill 28' 1 protective casing		

Proportions used trace = 0-10%, little = 10-20%, some = 20-35%, and = 35-50%

Driller L. Knox
Helper K. Knox
Soil Engineer
Drilling Inspector

SAMPLE TYPE
C = Cored W = Washed
SS = Split Spoon
UP = Undisturbed Piston
TP = Test Pit

COHESIONLESS DENSITY
0- 4 very loose
4-10 loose
10-30 compact
30-50 dense

COHESIVE CONSISTENCY
0- 2 very soft
2- 4 soft
4- 8 medium
8-15 stiff
15-30 very stiff

TOTAL FOOTAGE
Earth Boring 28 ft
Rock Coring 1 ft
Hole No. 4

DATE START 10-5-83

DATE FINISH 10-6-83

WEIGHT OF HAMMER	140	300
HEIGHT OF FALL	30"	24"

GROUND WATER OBSERVATION

DATE	TIME	DEPTH
10-13	AM	3.75'

SAMPLER OD 2" ID 1 3/8"

TYPE OF RIG CME 45

GEO-METRICS, INC.

SUBSURFACE EXPLORATIONS

LONG POND ROAD
P.O. BOX 288
DANVILLE, NH 03819

CLIENT
Yankee Environmental Eng. and Research Services, Inc.

SHEET 1 of 1

PROJ. NO

LOCATION Woburn, Mass.

LINE & STA

OFFSET

GROUND ELEVATION

HOLE NO. 5

CASING SAMPLER CORE BARREL

	CASING	SAMPLER	CORE BARREL
TYPE	Pipe	SS	hy Core
SIDE ID	37/8"	1 3/8"	1 3/8"

Sample Depths	Type of Sample	Blows Per 6" On Sampler From 0-6	To 6-12	To 12-18	To 18-24	Moist.	Profile Change Depth Elev.	Field Identification Of Soils Remarks	Sample No	Sample Pen
							Gs	Brown sand and gravel (fill)		
							4			
4-6	ss	54	28	14	15	W		Black to gray silt and organic matter some fill	1	24
							9.5			
9-9.5	ss	1	100			W			2	6
							11	Fine yellow silty sand & boulders		
							13	Cored 11-13' Recovered boulders		
								Installed observation well using 7' screen and 6' solid PVC.		
								Backfill 13'		
								1 Protective casing		

Proportions used trace = 0-10%, little = 10-20%, some = 20-35%, and = 35-50%.

Driller L. Knox
Helper K. Knox
Soil Engineer
Drilling Inspector

SAMPLE TYPE
C = Cored W = Washed
SS = Split Spoon
UP = Undisturbed Piston
TP = Test Pit

COHESIONLESS DENSITY
0- 4 very loose
4-10 loose
10-30 compact
30-50 dense
50+ very dense

COHESIVE CONSISTENCY
0- 2 very soft
2- 4 soft
4- 8 medium
8-15 stiff
15-30 very stiff

TOTAL FOOTAGE
Earth Boring ft 11'
Rock Coring 2 ft.
Hole No. 5

ATE START 10-6-83

ATE FINISH 10-6-83

EIGHT OF HAMMER 140 300

IGHT OF FALL 30" 24"

GROUND WATER OBSERVATION

DATE	TIME	DEPTH
10-6	comp.	dry

MPLER OD 2" ID 1 3/8"

PE OF RIG CME 45

GEO-METRICS, INC.

SUBSURFACE EXPLORATIONS

LONG POND ROAD
P.O. BOX 288
DANVILLE, NH 03819

CLIENT

Yankee Environmental Eng. and Research Services, Inc.

SHEET 1 of 1

PROJ. NO

LOCATION Woburn, Mass.

LINE & STA

OFFSET

GROUND ELEVATION

HOLE NO. 6A

CASING SAMPLER CORE BARREL

TYPE Pipe SS

SIDE ID 3 7/8" 1 3/8"

Sample Depths	Type of Sample	Blows Per 6" On Sampler From 0-6	To 6-12	To 12-18	To 18-24	Moist.	Profile Change Depth Elev.	Field Identification Of Soils Remarks	Sample No	Sample Pen
							Gs	Sand, gravel, boulders, concrete		
							5	Abandoned boring		
								Moved boring		

Proportions used trace = 0-10%, little = 10-20%, some = 20-35%, and = 35-50%

Driller L. Knox

Helper K. Knox

Soil Engineer

Drilling Inspector

SAMPLE TYPE
C = Cored W = Washed
SS = Split Spoon
UP = Undisturbed Piston
TP = Test Pit

COHESIONLESS DENSITY
0- 4 very loose
4-10 loose
10-30 compact
30-50 dense

COHESIVE CONSISTENCY
0- 2 very soft
2- 4 soft
4- 8 medium
8-15 stiff
15-30 very stiff

TOTAL FOOTAGE
Earth Boring 5 ft.
Rock Coring ft.
Hole No 6A

ATE START 10-7-83

ATE FINISH 10-7-83

EIGHT OF HAMMER 140 300

FIGHT OF FALL 30" 24"

GROUND WATER OBSERVATION

DATE	TIME	DEPTH
10-14	AM	41'

MPLER OD 2" ID 1 3/8"

PE OF RIG CME 45

GEO-METRICS, INC.

SUBSURFACE EXPLORATIONS

LONG POND ROAD
P.O. BOX 288
DANVILLE, NH 03819

CLIENT

Yankee Environmental Eng. and Research Services, Inc.

SHEET 1 of 2

PROJ. NO

LOCATION Woburn, Mass.

LINE & STA

OFFSET

GROUND ELEVATION

HOLE NO. 6

CASING SAMPLER CORE BARREL

	CASING	SAMPLER	CORE BARREL
TYPE	Pipe	SS	Hy core
SIDE ID	3 7/8"	1 3/8"	1 3/8"

Sample Depths	Type of Sample	Blows Per 6" On Sampler From 0-6	To 6-12	To 12-18	To 18-24	Moist.	Profile Change Depth Elev.	Field Identification Of Soils Remarks	Sample No	Sample Pen
							Gs-2	5" Black top		
								Yellow brown to gray fine to coarse sand, gravel, cobbles, and boulders		
10-12	ss	8	10	27	21	D			1	24
14-16	ss	118	46	29	24	D			2	24
19-21	ss	21	15	56	21	D			3	24
25-27	ss	15	15	18	15	D		*Note: No samples from 27'. Samples either wash or refusal on boulders.	4	24

Proportions used trace = 0-10%, little = 10-20%, some = 20-35%, and = 35-50%.

Driller L. Knox
Helper K. Knox
Soil Engineer M. Hanley
Drilling Inspector

SAMPLE TYPE
C = Cored W = Washed
SS = Split Spoon
UP = Undisturbed Piston
TP = Test Pit

COHESIONLESS DENSITY
0- 4 very loose
4-10 loose
10-30 compact
30-50 dense

COHESIVE CONSISTENCY
0- 2 very soft
2- 4 soft
4- 8 medium
8-15 stiff

TOTAL FOOTAGE
Earth Boring in 42'
Rock Coring 3'
Hole No 6

DATE START 10-7-83

DATE FINISH 10-7-83

WEIGHT OF HAMMER	140	300
HEIGHT OF FALL	30"	24"

GROUND WATER OBSERVATION

DATE	TIME	DEPTH
10-14	AM	41'

SAMPLER OD 2" ID 1 3/8"

TYPE OF RIG CME 45

GEO-METRICS, INC.

SUBSURFACE EXPLORATIONS

LONG POND ROAD
P.O. BOX 288
DANVILLE, NH 03819

CLIENT

Yankee Environmental Eng. and Research Services, Inc.

SHEET 2 of 2

PROJ. NO

LOCATION Woburn, Mass.

LINE & STA

OFFSET

GROUND ELEVATION

HOLE NO. 6

CASING SAMPLER CORE BARREL

	CASING	SAMPLER	CORE BARREL
TYPE	Pipe	SS	Hy core
SIDE ID	37/8"	13/8"	1 3/8"

Sample Depths	Type of Sample	Blows Per 6" On Sampler From / To 0-6	6-12	12-18	18-24	Moist.	Profile Change Depth Elev.	Field Identification Of Soils Remarks	Sample No	Sample Pen
							42	See page # 1		
								Cored boulders 41'-44'		
								Fine Yellow-brown silty sand and gravel with occasional layers of cobbles and boulders.		
							50			
								End of boring		
								Installed observation well using 20' of screen and 30' of solid PVC casind.		
								Back fill 50'		
								installed one roadway box		

Proportions used trace = 0-10%, little = 10-20%, some = 20-35%, and = 35-50%

Driller L. Knox
Helper K. Knox
Soil Engineer M. Hanley
Drilling Inspector

SAMPLE TYPE
C = Cored W = Washed
SS = Split Spoon
UP = Undisturbed Piston
TP = Test Pit

COHESIONLESS DENSITY
0- 4 very loose
4-10 loose
10-30 compact
30-50 dense
50 + very dense

COHESIVE CONSISTENCY
0- 2 very soft
2- 4 soft
4- 8 medium
8-15 stiff
15-30 very stiff

TOTAL FOOTAGE
Earth Boring ft. 47'
Rock Coring 3 ft.
Hole No. 6

March 5, 1945

John J. Riley Co.
228 Salem Street
Woburn, Mass.

Gentlemen:

We are submitting herewith a log of test and observation wells as driven by us recently on your property near your present pumphouse.

Test Well #1

0 - 2'	Loam
2'-15'	Brown medium sand
15'-20'	Gray fine sand to rock
	Tight - did not pump freely.

Test Well #2

0 - 3'	Mud and loam
3'-18'	Medium sand and gravel
18'-23'	Coarse gravel
23'-38'	Sand and gravel to rock
	Pumped free - 60 G.P.M.
	Observation Well at 37'
	This well tested for both capacity and drawdown.

P.W. #1

It is in our opinion that at location #2 we could develop you, with one of our large diameter gravel filter wells, 500 G.P.M. with a safe drawdown andwould run a preliminary test on this well at the above rated capacity for a period of forty-eight hours to determine the actual drawdown on this well.

D. L. MAHER CO.

LOG OF TEST WELL

Log of Well for ..... Test No. 2

Address .....

Well located at ..... in ..... County, State of .....

Date Drilling started ..... Date Test Hole Completed .....

Total depth to bottom of Well ..... Diameter Test Hole .....

Water stands when not pumping ..... feet ..... inches from the surface of the ground.

EACH STRATUM	DEPTH OF STRATA	FORMATION FOUND EACH STRATUM
3		
—		
15		

Did Well Clear Up?

How Long?

Time Pumped?

Drawdown Ft. In

Capacity

Time Required for Recovery?

Was Well Pulled?

Observation ? What Depth?

Was Observation Well Pulled?

Map of Location

Remarks and opinion of Test

Driller

Helpers

Well # 1.

APPENDIX D

Specifications for Topographic Survey of Test Pits, Monitoring Wells and other Features on the John J. Riley Tanning Company Site 228 Salem Street Woburn, Massachusetts

DANA F. PERKINS & ASSOC., INC.
Consulting Engineers

September 26, 1983

Ms. M. Margaret Hanley
Yankee Environmental Engineering
and Research Services, Inc.
27 Salem Street
Woburn, Massachusetts 01801

Re: J. J. Riley Tanning Company
Salem Street, Woburn, MA

Dear Ms. Hanley:

This correspondence is to confirm our meeting last week(September 16, 1983) at the site to discuss the survey requirements required by your firm. It is our understanding from the work print you gave us that there are approximately 17 to 20 points to be located with elevation. These points are test pit, boring or well locations as shown. In addition an elevation of a bedrock outcrop on the Bio Assay property is also required (as noted).

The scope of survey services will include the following:

1. Establish bench mark datum on U.S.G.S. datum.

2. Establish horizontal control on site by locating existing buildings, etc. as shown on the work print and preparing a scaled work plan overlay.

3. Elevations of the ground at test pit, borings and ledge outcrop location will be established. The elevation of concrete roofs of the well houses will also be established. All elevations will be to the nearest 0.1 foot.

4. A mylar of the working plan will be given to us by your firm in order for us to add the locations and elevations as noted above. (This will be the finish drawing with note relative to field work data by Dana F. Perkins & Assoc., Inc.)

It is our understanding that all points will be identified and clearly marked prior to the field crew location. It is also our understanding that you will have some tree clearing between the well #1 and well #2 line of sight completed to minimize delay of our survey time.

As expressed to you during our meeting last Friday, we have estimated the cost of the survey work based on one day of field time. Your assistance during the set-up phase of the control lines with the crew would be appreciated so we don't miss any information you need. Based on our best judgement of the manpower requirements to complete the survey work as noted, we have established an upper limit of $1000.00. It is planned to have the field crew at the site Thursday, September 29th at 7:30 AM to complete the field survey work. The mylar updated drawing should be available within two to three working days after completion of the field work.

It was a pleasure to meet with you last Friday and we look forward to working with you to complete this project to your satisfaction.

Very truly yours,

DANA F. PERKINS & ASSOC., INC.

Donald E. Martinage, P.E.

DEM/hmk

APPENDIX E

Description of Sampling Procedures

and

Report of Analysis of Groundwater Samples
Collected from Monitoring Wells
John J. Riley Tanning Company
228 Salem Street
Woburn, Massachusetts
October 12, 1983

Appendix E. Description of Sampling Procedures

Groundwater samples were collected from four monitoring wells installed under the direction of YE^{2}ARS staff on the John J. Riley Tanning Company site, and the Riley Production Well #1.

Prior to sampling, groundwater elevations were measured at each well. At each monitoring well, a minimum of three static volumes of water were bailed and the well was permitted to equilibrate prior to sampling. Production Well #1 was pumped for five minutes to purge the well of standing water (the exact pumping rate is unknown).

The samples from monitoring wells were bailed using a copper bailer. Production Well #1 was sampled from a discharge pipe located at the west side of the pump house at Production Well #1. Two full 40 ml septum vials were filled with groundwater from each well for chemical analysis. Bailing equipment was decontaminated with methanol between sampling.

Samples were labeled and stored on ice until delivered to Cambridge Analytical Associates of Watertown, Massachusetts for chemical analysis.

Cambridge Analytical Associates
222 Arsenal Street / Watertown, Massachusetts 02172 / (617)923-9376

October 25, 1983

Ms. M. Margaret Hanley
Yankee Environmental Engineering
and Research Services, Inc.
27 Salem Street
Woburn, MA 01801

Dear Margaret:

On October 12, 1983 Cambridge Analytical Associates received 5 samples for volatile organics analysis by EPA Method 601. These analyses were completed on October 17, 1983. The attached data are the results of these tests.

Should you have any questions, please do not hesitate to contact me.

Sincerely,

Ed Lawler

Edward A. Lawler
Senior Analytical Chemist

CAMBRIDGE ANALYTICAL ASSOCIATES, INC.

Table 1. Concentrations of Volatile Organic Compounds (Method 601[1])

Client: Yankee — Report No.: 83-887

Date Samples Received: October 12, 1983 — Reported by:

Date Analysis Completed: October 17, 1983 — Checked by:

Compound	Sample ID: / CAA ID:	Concentration ug/l (ppb)[2] JJR #1 8308582	JJR B-2 8308583	Prod. Well 1 8308584
		B-1	B-2	PW #1
chloromethane				
dichlorodifluoromethane				
vinyl chloride				
chloroethane				
methylene chloride				
trichlorofluoromethane				
1,1-dichloroethene				
1,1-dichloroethane				
trans-1,2-dichloroethene			0.7	0.4
chloroform				
1,2-dichloroethane				
1,1,1-trichloroethane				
carbon tetrachloride				
bromodichloromethane				
1,2-dichloropropane				
trans-1,3-dichloropropane				
trichloroethene				0.4
dibromochloromethane				
1,1,2-trichloroethane				
cis-1,3 dichloropropene				
2-chloroethylvinyl ether				
bromoform				
1,1,2,2-tetrachloroethane				
tetrachloroethene				
chlorobenzene			2.3	

[1]U.S. EPA. 1982. Methods for Organic Chemical Analysis of Municipal and Industrial Wastewater. EPA 600/4-82-057. EPA/EMSL, Cincinnati, Ohio.

[2]Concentrations less than 0.1 ug/l are not detected and are left blank.