Project Manual

Rec'd: 12/4/89

POST CLOSURE GROUNDWATER DETECTION MONITORING PROGRAM FOR THE PALMER STREET LANDFILL: WORK PLAN FOR SUPPLEMENTAL SITE ASSESSMENTS

Moench Tanning Company
Division of Brown Group, Inc.
Gowanda, New York

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MALCOLM PIRNIE

ENVIRONMENTAL ENGINEERS, SCIENTISTS & PLANNERS

MOENCH TANNING COMPANY
PALMER STREET LANDFILL

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1.0 INTRODUCTION

1.1 PURPOSE AND SCOPE OF DOCUMENT

This Supplemental Field Investigation Work Plan provides (a) a summary of conditions at the Moench Tanning Company, Palmer Street Landfill; (b) a description of field investigation tasks and the rationale behind these tasks; (c) a project schedule; (d) protocols/procedures for implementing field activities at the site; (e) Quality Assurance methods and procedures; and (f) Health and Safety procedures and guidelines. The document is organized as follows:

I. Work Plan (Sections 1 to 5) - provides project purpose, objectives, and scope of work, project schedule, and description of individual tasks which comprise the investigation.

II. Post Closure Ground Water Detection Monitoring Program for the Palmer Street Landfill: Conceptual Approach to Development (Appendix A) - a review of preliminary concepts which have been evaluated for this program.

III. Field Procedures (Appendix B) - provides detailed procedures and guidance for field investigation tasks.

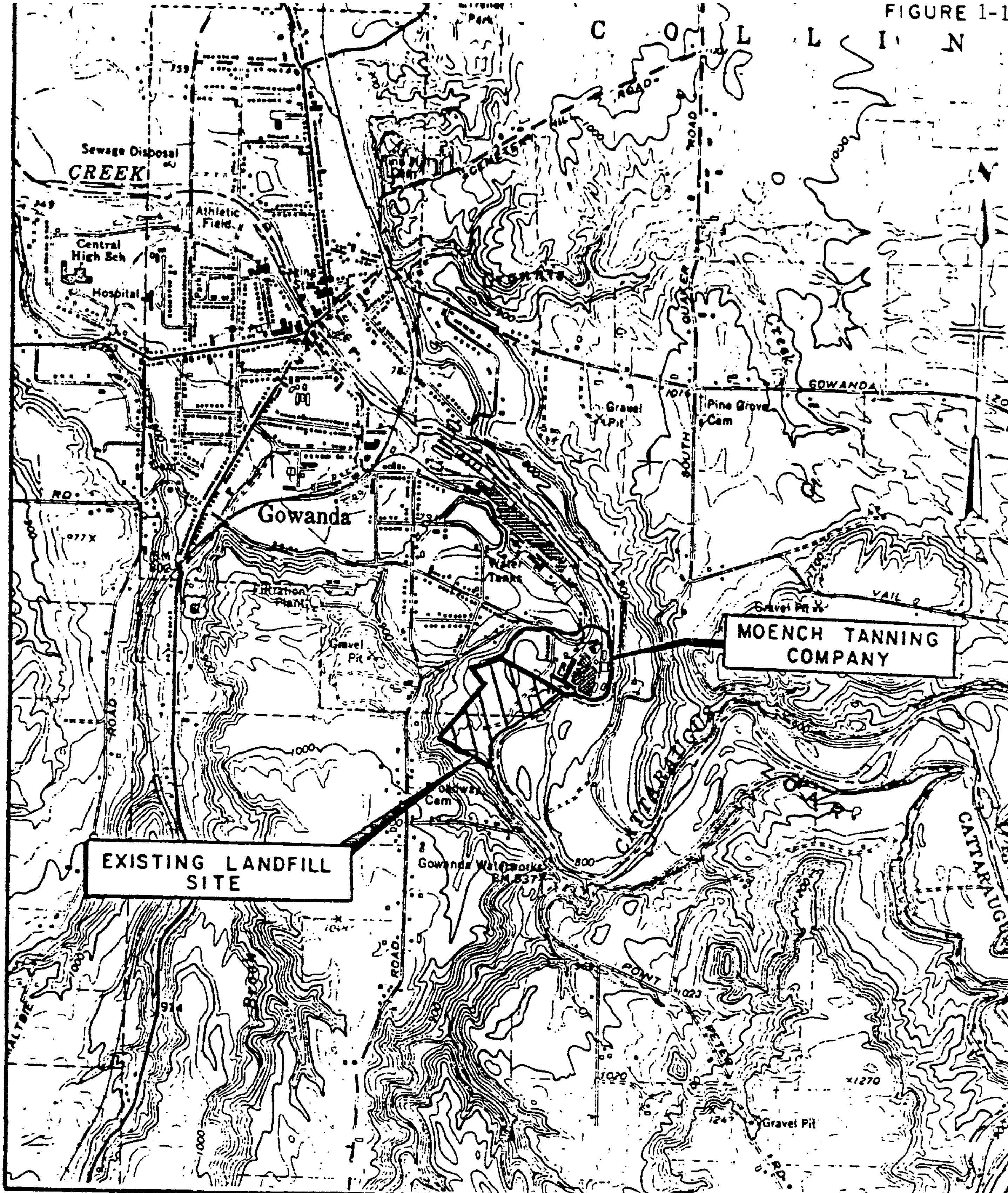
IV. Quality Assurance Plan (Appendix C) - provides the Quality Assurance program which will be followed to ensure data quality and validity.

V. Health and Safety Plan (Appendix D) - provides site specific guidelines and procedures in response to health and safety concerns at the site.

1.2 PROJECT DESCRIPTION AND OBJECTIVES

1.2.1 Project Description

Moench Tanning Company (Moench Tanning) operated the Palmer Street landfill contiguous to its tannery in Gowanda, New York from the late 1800s through July 1983 (see Figure 1-1 for Location Map). The site occupies approximately 21 acres and is bound on the west and south by a steeply-sloped wooded area, on the northwest by a swampy area and on the



NOTE:
TOPOGRAPHY TAKEN FROM 1963 GOWANDA, N.Y.
U.S.G.S. QUADRANGLE 7.5 MIN. SERIES
SCALE: 1" = 2000'

QUADRANGLE LOCATION

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SITE LOCATION MAP
PALMER STREET LANDFILL
GOWANDA, N.Y.

east by Cattaraugus Creek. The Tannery complex serves as the northeast boundary of the site.

An application for a permit to close the landfill under the requirements of 6NYCRR Part 373 was approved by the New York State Department of Environmental Conservation in September 1989. A post-closure, ground water detection monitoring program will be a condition of the post closure permit which will ultimately be developed for the site in accordance with the requirements of 40 CFR 264.98 and NYCRR Part 373.2.6.

As initially discussed in the Palmer Street Landfill Closure/Post Closure Plan of January 1989, the post-closure monitoring program will be developed in two phases. Phase I involves continued routine monitoring of the existing monitoring system; and further site assessment. This Supplemental Site Assessment Work Plan identifies objectives of the Phase I site assessment and the related tasks needed to conduct the assessment. The work is focused on specific issues related to the existing monitoring system; on further characterization of lower overburden (aquitard) units underlying the site; and on development of an early warning detection monitoring system within the lower overburden.

Phase II of the detection monitoring program (viz. long-term post-closure detection monitoring) will be initiated upon NYSDEC approval of the Phase I report. The details of the post-closure monitoring program will be presented to the NYSDEC for review/approval as part of the ongoing ground water monitoring assessment program. Although the details of the long-term post-closure detection monitoring program cannot be established until the further site assessment is completed, the current concept for post-closure monitoring has been established as follows:

- Routine monitoring of the shallow overburden ground water/leachate flow system throughout the closure and post-closure periods for periodic evaluation of cap performance and to determine when steady-state flow conditions and chemical equilibrium have been re-established;

- Routine monitoring of the lower overburden and/or bedrock ground water flow system for purposes of demonstrating compliance with 40 CFR Part 264.98 and 6NYCRR Part 373-2.6(i); and

- Establishment of an early warning/immediate detection system within the overburden aquitard.

1.2.2 Project Objectives

The objectives of the Supplemental Site Assessment are to:

1. recommend a detection monitoring strategy for the glacial till aquitard which underlies the site;

2. assess the integrity of existing deep overburden and bedrock monitoring wells;

3. assess the need for long-term, ground water monitoring in bedrock in the northeast corner of the site;

4. assess the potential for hydraulic connections between on-site, off-site wells, and Cattaraugus Creek;

5. install a bedrock monitoring well which is fully downgradient of the waste/fill and replace a damaged existing well;

6. recommend detection monitoring parameters; and

7. assess the need for additional investigations.

1.3 SITE DESCRIPTION

1.3.1 Previous Investigations

Site conditions are known from the results of four (4) previous investigations at the site. These investigations are reported in Malcolm Pirnie (1983, 1986, 1987 and 1989). The most recent document, Palmer Street Landfill: Evaluation of Alternative Cover Systems (Malcolm Pirnie, 1989) provides a comprehensive summary of geologic and hydrogeologic conditions; waste/fill characterization; and site water quality.

1.3.2 Site Geologic and Hydrogeologic Conditions

Geologic units occurring beneath the site, from youngest to oldest, include:

- waste fill;
- alluvium;
- glaciolacustrine silt and clay;
- glacial till;

- glaciofluvial sand and gravel; and
- bedrock.

Major geologic units are grouped according to their hydrogeologic properties (viz. hydraulic conductivity and porosity) as follows: (1) an unconfined, shallow water-bearing zone consisting of near surface waste/ fill mixed with alluvial silt, sand and gravel and an underlying layer of undisturbed alluvial materials; (2) a confining unit (aquitard) comprised of low permeable glaciolacustrine deposits overlying the altered bedrock and till; (3) saturated glaciofluvial sand and gravel deposits with aquifer potential; and (4) bedrock aquitard with local water-bearing bedding plane joints and vertical fractures. The correlation of geologic and hydrostratigraphic units is summarized in Table 1-1.

A summary of existing monitoring wells (designated MW) and existing piezometers (designated P) is provided in Table 1-2. Monitoring well/ piezometer locations are shown in Figure 1-2.

Shallow ground water flow is primarily from the topographic high located west of the landfill eastward toward Cattaraugus Creek. A component of shallow flow also moves off-site in a northerly direction near MW-7S. During major precipitation events, the water table rises and some discharge occurs in the shallow ditches and swales which cross the landfill. A water table isopotential map is shown in Figure 1-3.

A portion of the ground water moves downward through the confining unit to the glaciofluvial aquifer and the bedrock aquitard. Ground water flow in the bedrock is lateral toward the southwest under relatively steep hydraulic gradients. Flow through the granular lenses has not been established, but is likely toward the southwest based on the observed hydraulic heads in the bedrock. Ground water isopotentials in bedrock are shown in Figure 1-4. Isopotentials in the northeast portion of the landfill near Cattaraugus Creek are based on assumed ground water elevations.

A water balance has been performed for the Palmer Street Landfill to partition quantities of water which factor into the hydrologic recharge/discharge relationship. Figure 1-5 schematically illustrates the various component parameters and calculated values of the water balance.

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TABLE 1-1

MOENCH TANNING COMPANY
PALMER STREET LANDFILL

CORRELATION OF GEOLOGIC AND HYDROSTRATIGRAPHIC UNITS

GEOLOGIC UNITS	HYDROSTRATIGRAPHIC UNITS
Mixed Alluvial Deposits and Waste	Shallow Water-Bearing Zone
Alluvial Deposits: Silt and Sand : Sand and Gravel	
Glaciolacustrine Deposits: Silt : Clay	Aquitard
Glacial Till: Clayey Silt with Sand and Gravel Inclusions	
Glaciofluvial Deposits	Sand and Gravel Aquifer
Bedrock	Bedrock Aquitard

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TABLE 1-2

MOENCH TANNING COMPANY
PALMER STREET LANDFILL

SUMMARY OF EXISTING MONITORING WELLS AND PIEZOMETERS

Well	Depth	Material in the Screened Interval
		Alluvial Deposits
MW-1 (1)	29.5	Sandy silt
MW-3	12.5	Silty sand and gravel
MW-5 (2)	16.5	Silty sand and gravel
MW-6	14.0	Silty fine sand, and silty sand and gravel
MW-7S	12.0	Silty sand and gravel
		Alluvial Deposits and Waste
P-1	17.0	Sludge/hair over silty sand and gravel
P-2	10.5	Mixed sludge, sand and gravel
P-3B	10.0	Mixed sludge, silty fine sand
P-4	13.0	Mixed sludge, sand and gravel
P-5A	11.7	Mixed sludge, sand and gravel
P-6	13.0	Mixed sludge, debris, and silty sand
P-7A	16.7	Mixed sludge, sand and gravel
P-8A	13.5	Mixed sludge, sand and gravel
MW-4	17.0	Sludge and mixed soil/debris
		Glacio-lacustrine Deposits
MW-2	30.0	Sandy silt and clay
MW-7	27.5	Clayey silt
		Glacio-fluvial Deposits
MW-3D	61.5	Sand, gravel, silt
MW-8	105.5	Sand and gravel
		Bedrock
MW-3DR	97.0	Siltstone and shale
MW-7D	39.0	Weathered siltstone and shale
MW-8D	122.0	Weathered siltstone and shale

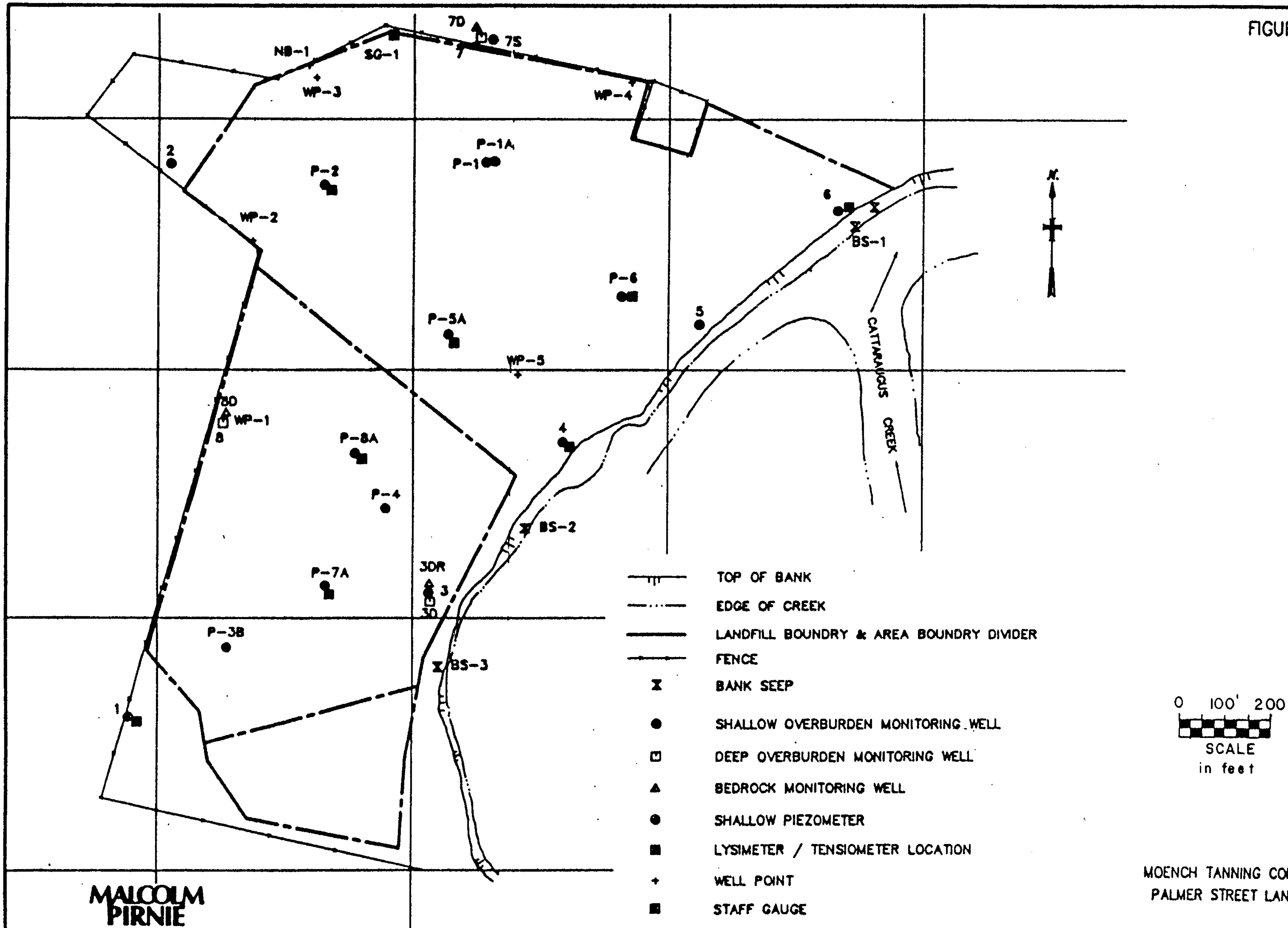
NOTES:

ND Not determined

(1) The screen straddles the alluvium/glacio-lacustrine contact.

(2) The screen extends upward into waste material, but the saturated zone occurs below the waste.

FIGURE 1-2



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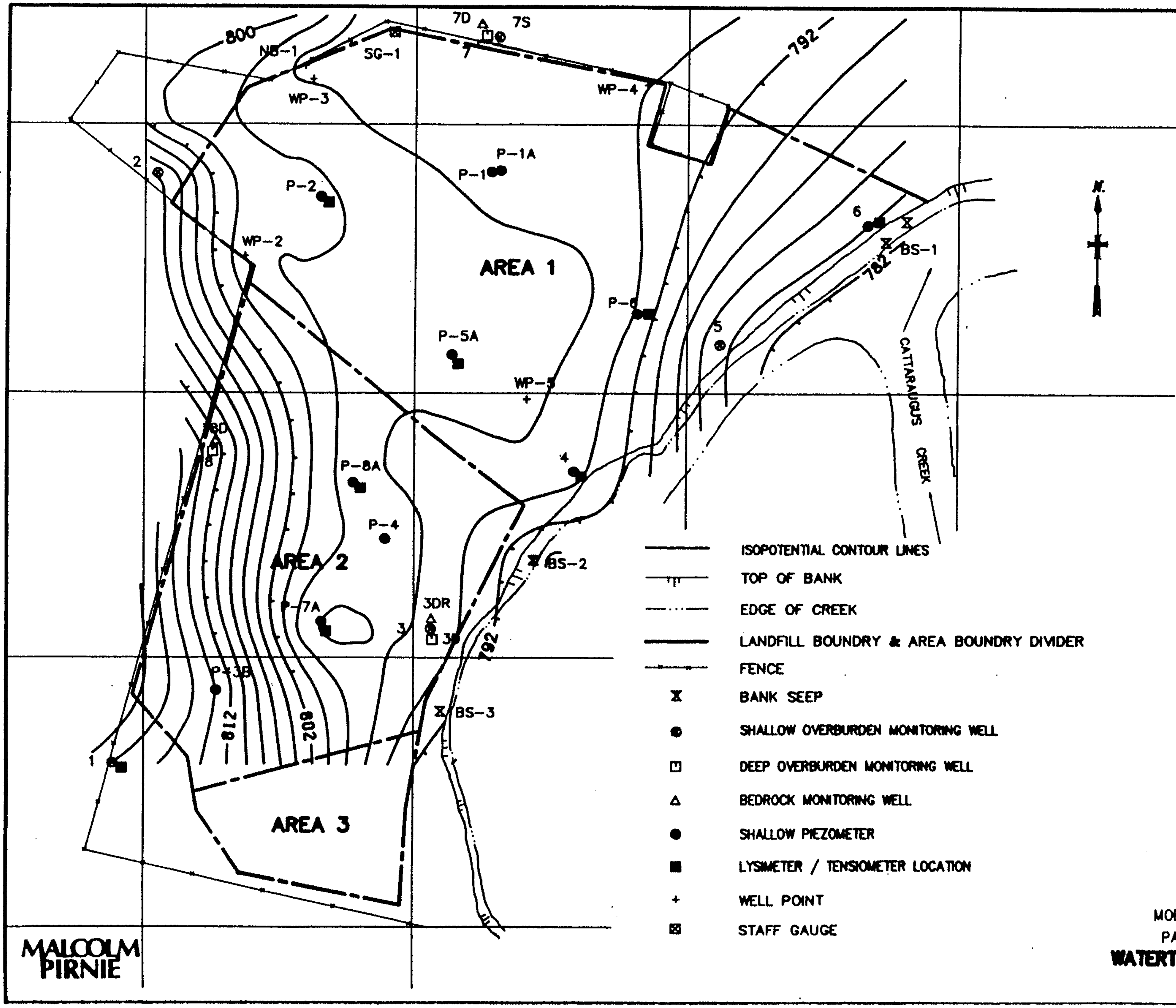
MOENCH TANNING COMPANY
PALMER STREET LANDFILL

MONITORING LOCATIONS

FIGURE 1-3



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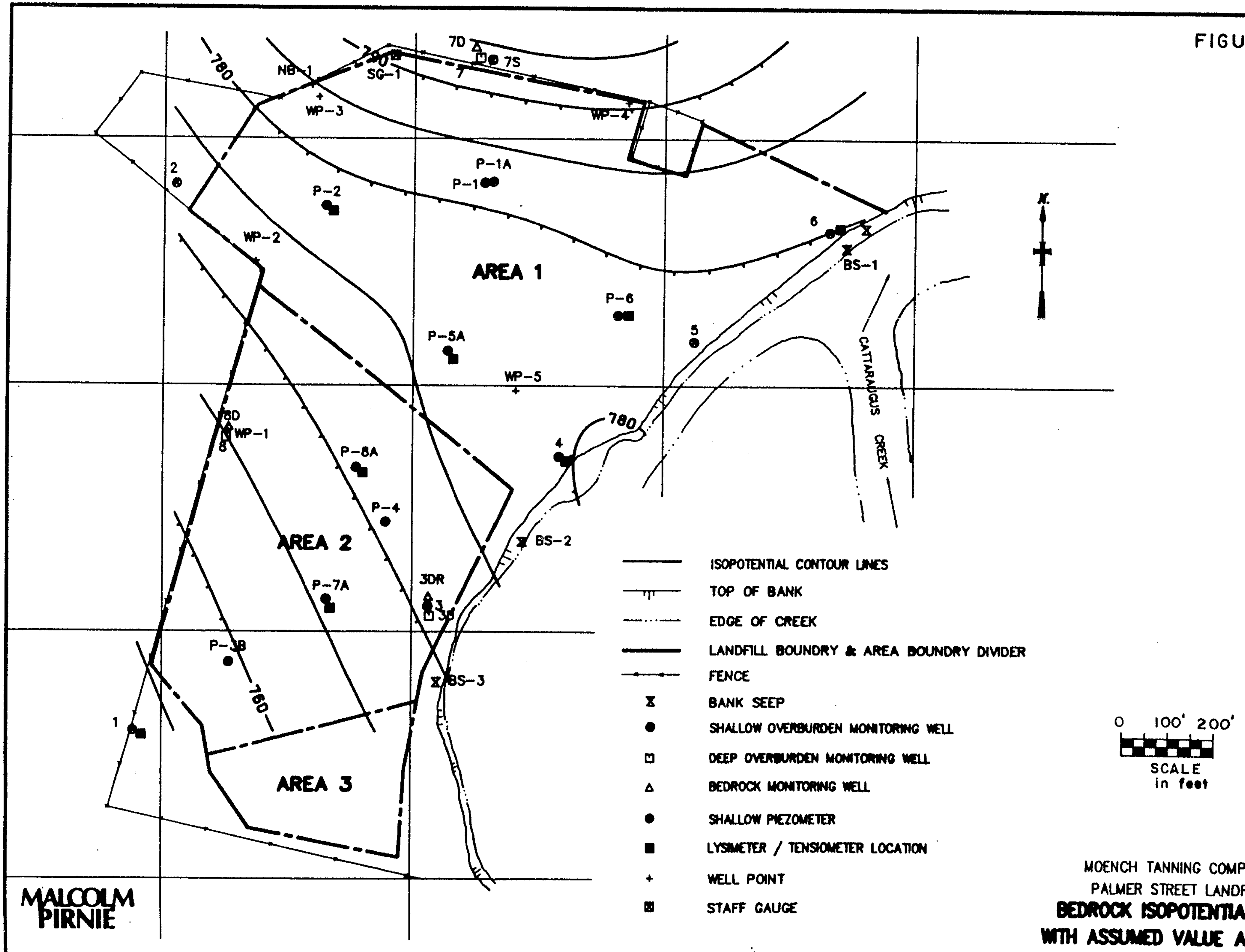
MOENCH TANNING COMPANY
PALMER STREET LANDFILL
WATERTABLE ISOPOTENTIAL MAP
OF 11-21-88

FIGURE 1-4



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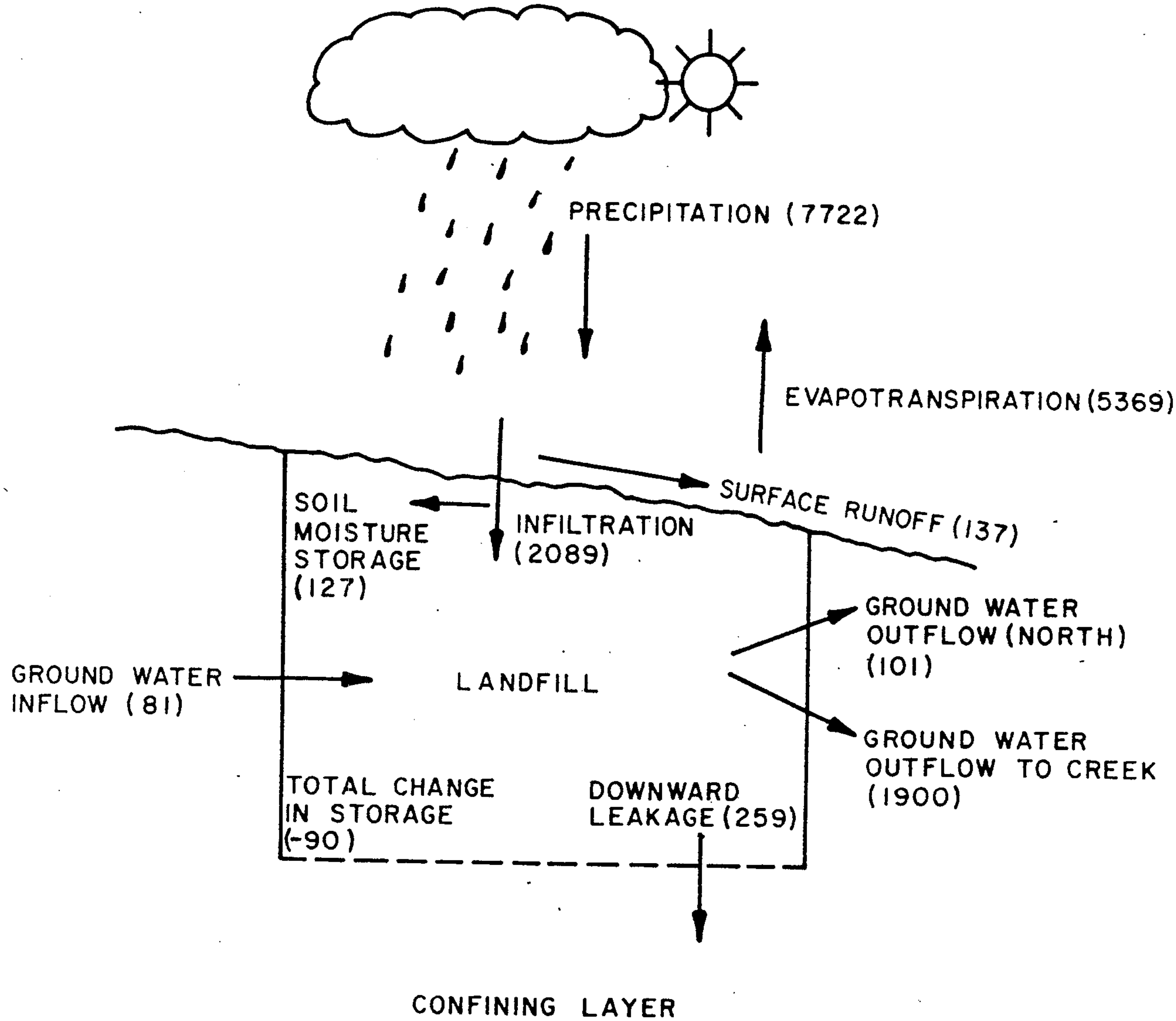
PALMER STREET LANDFILL
BEDROCK ISOPOTENTIAL MAP WITH ASSUMED VALUE AT MW-6



NOTE: AVERAGE ANNUAL VALUES EXPRESSED IN CUBIC FEET / DAY.

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PALMER STREET LANDFILL

LANDFILL WATER BALANCE (AVERAGE WATER TABLE CONDITIONS)

Details of the water balance calculations are provided in Malcolm Pirnie (1989).

1.3.3 Site Water Quality

Based on the full record of ground water monitoring at the site, the parameters of interest include arsenic, barium, lead, and chromium. Certain volatile aromatic organics were detected in waste/fill piezometers during the 1988 field investigation (Malcolm Pirnie 1989).

Comparison of site water quality to standards and guidelines indicates:

- Concentrations of trace metals of interest are generally elevated in the leachate, with mean barium, and chromium concentrations exceeding, and mean arsenic and lead concentrations below NYSDEC Class "GA" Ground Water Quality Standards.
- Ground water discharge to Cattaraugus Creek is elevated in barium and chromium, and slightly elevated in arsenic and lead concentrations. Only mean barium concentrations exceed NYSDEC Class "GA" Ground Water Quality Standards.
- Ground water discharge across the northern landfill boundary is elevated in barium and chromium concentrations. The mean concentrations of all trace metals are below NYSDEC Class "GA" Ground Water Quality Standards.
- Trace metal concentrations in surface water immediately downgradient from the site are significantly below NYSDEC Class "C" Surface Water Quality Standards.

Volatile organics which are present in leachate from the waste/fill piezometers have not been detected in downgradient shallow monitoring wells. Volatile organic analyses for the bedrock ground water have been inconclusive.

1.3.4 Site Impacts

Identified contaminant pathways include (a) lateral movement of leachate through the shallow subsurface with ultimate discharge to Cattaraugus Creek via ditches or directly along the creek bank; (b) downward movement of leachate through the overburden aquitard into underlying geologic formations which are hydraulically continuous with the regional aquifer; and (c) overland runoff and mechanical transport of waste particles.

Contaminated ground water either discharges to Cattaraugus Creek or moves downward through the overburden aquifer to the regional flow system. A dilution calculation for the deep flow system indicates that contaminants-of-interest (excluding barium which is naturally elevated in this portion of Western New York) would not be detectable at the nearest known withdrawal point (viz. the Moench production wells). In addition, concentrations of the various contaminants-of-interest as measured immediately downstream of the landfill are lower than Ambient Water Quality Criteria and it is unlikely that existing contaminant loadings to Cattaraugus Creek from the landfill are having an impact on the fresh water aquatic organisms present in the creek.

2.0 PROJECT APPROACH

This section outlines the approach to be followed in this site assessment in meeting the project objectives as listed in Section 1.2.2. The assessment rationale is presented in Appendix A.

2.1 DETECTION MONITORING FOR THE LOWER OVERBURDEN

Assessment of an early warning detection methodology for the aquitard. This would include:

- completing an exploratory boring;
- installing a nest of four (4) wells or lysimeters, depending on the presence or absence of saturated conditions;
- evaluating the hydraulic properties of the aquitard, and determining the rate and flux of contaminant movement (if saturated); and
- developing a long-term monitoring strategy which will provide timely detection of any mobile contaminant constituents.

Field observations from previous boring programs indicate that the aquitard may not be saturated at all depths; therefore, an exploratory boring is proposed in order to better establish site-specific conditions. The exploratory boring should be located near existing piezometer P-6, and should extend to the top of bedrock, an estimated depth of about 30 feet. Aquitard thickness is estimated to be 16 feet at location P-6, which is considered a suitable thickness for the installation of monitoring devices at discrete depth intervals. Information to be obtained from the exploratory boring includes the following:

- Lithology and soil texture (i.e., presence of sand lenses or fractures that may transmit ground water seepage);
- % moisture to establish a moisture profile with depth;
- concentration of total arsenic, barium, chromium, and lead in the aquitard material again to establish a concentration profile with depth;

- laboratory determination of vertical hydraulic conductivity at select depth intervals;

- water level measurements to establish a vertical hydraulic gradient profile;

- analysis of tritium in ground water and in pore water of the aquitard materials to establish age of the water with increasing depth;

- analysis of total and soluble arsenic, barium, chromium, and lead in ground water collected from select depth intervals to establish a concentration profile with depth.

An evaluation of alternative monitoring methods for the lower overburden is discussed in Appendix A.

2.2 EXISTING WELL INTEGRITY

Assessment of the integrity of existing deep overburden and bedrock wells will include:

Surging didn't work - made things wors

- redevelopment of each deep well by pumping at the natural recovery rate of the individual well;

- monitoring the progress of well development;

- evaluating alternate well purging and sampling procedures, if required; and

- evaluating the need for replacing or retrofitting existing monitoring wells.

2.3 MONITORING OF NORTHEAST CORNER

Assessment of the need for long-term, ground water monitoring in bedock in the northeast corner of the site will entail:

- install a piezometer in bedrock near existing well MW-6;

- updating the bedrock isopotential map to incorporate additional water level information; and

- evaluation the need for long-term monitoring near MW-6.

2.4 ASSESS HYDRAULIC CONNECTIONS

In support of the above program, ground water levels will be monitored continuously in select deep overburden and bedrock wells. Water level hydrographs will be compared with Cattaraugus Creek stream flow data, production well pumping records (for Moench wells), and continuous records of local barometric pressure, to determine if deep overburden or bedrock water bearing zones are hydraulically connected to the production well fields, or to Cattaraugus Creek.

2.5 ADDITIONAL/REPLACEMENT MONITORING WELLS

The following wells will be installed to supplement the existing monitoring network:

- a bedrock monitoring well at existing well location MW-1, downgradient of existing wells MW-3DR and MW-8D;
- a deep overburden well at MW-1, if a saturated zone of sand and gravel is encountered in the aquitard at that location, which could be correlated with known sand and gravel units at either MW-8 or MW-3D; and
- new well at MW-2 to replace this well (has filled with sand).

2.6 ASSESS MONITORING PARAMETERS

A site specific list of monitoring parameters will be developed. Issues which will need to be addressed include:

- basis for the potential elimination of volatile organic components from the monitoring program; and
- reduction of the list of trace metals which are currently being routinely monitored.

3.0 TASK DESCRIPTIONS

The following sections describe the various tasks that will be performed to develop a long-term detection monitoring network at the Palmer Street Landfill. These descriptions present the rationale and scope of each work task. Detailed step-by-step protocols/procedures for implementing the identified tasks are presented in the Field Procedures Plan (Appendix B), the Quality Assurance Plan (Appendix C), and Health and Safety Plan (Appendix D). A summary of project tasks in the sequence discussed in Section 3.0 is provided in Table 3-1.

3.1 SOIL BORINGS AND WELL INSTALLATION

Proposed soil borings and monitor installations are summarized in Table 3-2. All proposed boring locations are referenced to existing monitor locations that are shown in Figure 1-2. Daily activities during the field program will be documented in Daily Drilling Report forms, and a Project Field Book (see Appendix B2.16) B2.15

3.1.1 Lower Overburden Monitor Nest

A monitor nest will be installed in the glacial till at piezometer location P-6, in order to define lower overburden conditions and to evaluate a feasible early detection, monitoring strategy in the lower overburden. Figure 3-1 illustrates the relationship of the proposed monitor nest to the waste/fill/alluvium (shallow water bearing zone), and to the top of bedrock (regional water bearing zone). The monitor nest is designed to monitor downward seepage of leachate through the low permeability aquitard material. Monitors will be installed at select depth intervals through the lower overburden, which has an estimated thickness of 16 feet at location P-6. The lowest monitored zone will be the till/bedrock contact and will provide additional water level and water quality data for this zone.

3.1.1.1 Exploratory Boring

An exploratory boring (P-6D) will be completed to the upper bedrock zone at P-6 in order to better define aquitard conditions and select the

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TABLE 3-1

MOENCH TANNING COMPANY
PALMER STREET LANDFILL

SUMMARY OF PROJECT TASKS

Task No.	Description
1	Soil Borings and Well Installation
2	Well Development
3	Well Testing
4	Continuous Water Level Monitoring
5	Geotechnical Soil Testing
6	Isotope (Tritium) Sampling
7	Metals Analyses in Soil
8	Water Quality Sampling
9	Assessment of Detection Monitoring Parameters
10	Data Compilation
11	Assessment Report

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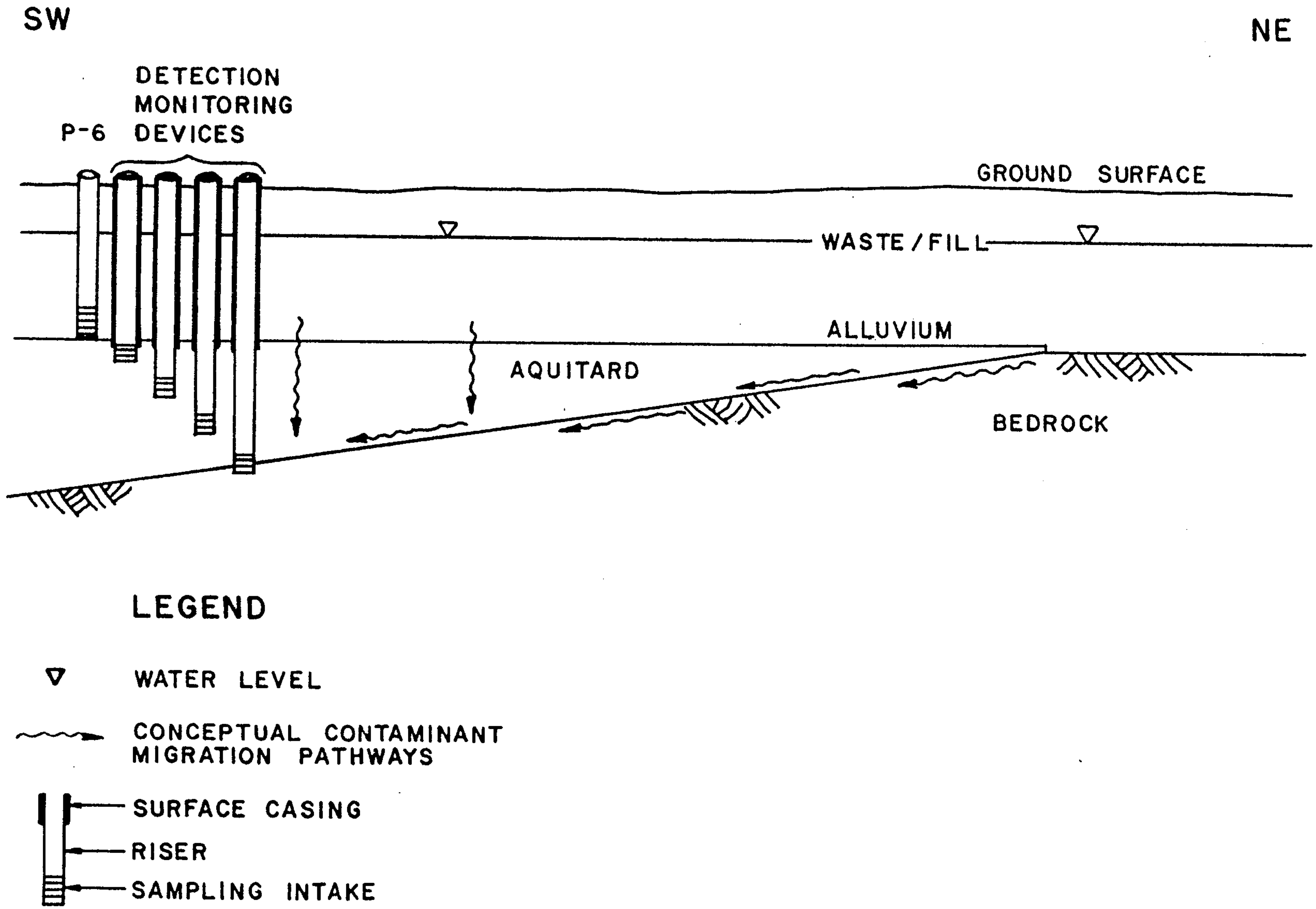
TABLE 3-2

MOENCH TANNING COMPANY
PALMER STREET LANDFILL

SUMMARY OF SOIL BORINGS AND MONITOR INSTALLATIONS

Location	Monitor Completion Zone	Approximate Drilling Footage (ft)
MW-1D	Bedrock	150
MW-2	Glaciolacustrine Deposits	30
MW-6D	Bedrock	30
Lower Overburden Monitor Nest		
P-6A	Glacial Till	18
P-6B	Glacial Till	22
P-6C	Glacial Till	26
P-6D	Till-Bedrock Contact	32
	Total Proposed Drilling Footage	308

FIGURE 3-1



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MODEL OF CONTAMINANT MIGRATION TO BEDROCK AND CONCEPTUAL DETECTION MONITORING SYSTEM screened intervals for the lower overburden monitor nest. The boring will be advanced with 6¼-inch I.D. hollow stem augers through the waste/fill to a depth of approximately one (1) foot into the top of the till. A permanent eight (8) to ten (10) inch O.D. overburden casing will be grouted into place in the top of the till following the procedures in Appendix B2.7. Overburden casing will prevent downhole contamination. Sampling will be restricted to conforming the top of till, which is known from existing boring data.

The borehole will be advanced through the overburden casing to refusal within the upper bedrock zone using 4¼-inch I.D. hollow stem augers. Soil sampling will be performed by split-spoon sampling in accordance with the method described in Appendix B2.3. Sampling will be performed continuously in one (1) foot increments and, if recoveries are low, a three (3) inch diameter split spoon will be used instead of the normal inch diameter spoon to ensure that there is sufficient sample for analysis.

After a visual description of the sample according to the soil classification scheme in Appendix B2.4, each sample will be subdivided and placed into separate containers following procedures in Appendix B4.1. Soil samples will be submitted for % moisture determination; analyses of trace metals (see Section 3.7), and analysis of tritium in pore water (see Section 3.6). Due to the combined sample volume requirements for the proposed tests, soil samples will not be retained in storage after the project. Each split spoon will be decontaminated prior to each use, according to Appendix B3.6. A maximum of ten (10) samples will be submitted for determination of pore water tritium, and a maximum of twenty (20) samples will be submitted for total metal analyses. The exploratory boring will be described with respect to vertical profiles of lithology, % moisture, total metals, and pore water tritium.

3.1.1.2 Piezometer Installation

Following a review of the lithologic log and the % moisture content data at P-6D, three (3) additional monitoring intervals will be selected within the overburden aquitard. Based on an aquitard thickness of 16 feet, piezometers are proposed to be installed at depths of approximately 16' to 18', 20' to 22', 24' to 26'. In addition, the exploratory boring will be completed as a piezometer in the upper bedrock zone (approximately 30' to 32' deep). Each boring will be completed through an overburden casing grout into the top of till. The actual screened intervals may vary from these identified above. Each piezometer will consist of a one (1) inch inside diameter flush threaded, SCH 40 PVC screen and riser. Screens will be one (1) foot in length with 0.006 inch slots. The borehole annulus will be backfilled with No. 1 sand no further than one (1) foot above the screen, thereby providing a maximum monitoring interval of two feet. The piezometer I.D. and short monitoring interval were selected based on the anticipated slow water level recovery in the aquitard material. Centralizers will be used to center the screen within the augers. The remainder of the annular space will be backfilled with bentonite-cement grout or powdered bentonite slurry. A lockable cap will be fitted on each overburden casing. The applicable protocols for piezometer installation are described in Appendix B2.8, and B2.9.

3.1.1.3 Optional Lysimeter Installation

If the piezometers remain dry after installation, an alternate monitoring strategy for the lower overburden will be considered. Pressure-vacuum lysimeters are suitable for collecting pore water which is under tension saturated conditions, (e.g., less than atmospheric pressure). Field observations of dry sand lenses (1-5 cm) within moist till suggest that unsaturated conditions are present within portions of the aquitard. Lysimeters can be used to collect soil pore water by creating a vacuum within the sampling vessel and drawing pore water toward and into the vessel through the porous section of the lysimeter. Two types of material are typically used in lysimeter construction: ceramic and poly(tetrafluoroethylene) (PTFE). Lysimeter performance in an early detection monitoring program for the lower overburden would have to be evaluated with respect to three (3) factors as follows:

a) soil suction values and % soil moisture in the formation must be within the operating range of the lysimeter;

b) unsaturated hydraulic conductivity, the prevailing soil moisture (%) and the resulting sample collection time; and

c) chemical interference with the material of construction.

Lysimeters constructed of PTFE may be required to obtain representative samples. The alternate ceramic construction material, may selectively screen or adsorb trace metals in the pore water. Ceramic lysimeters, however, are capable of collecting pore water from soils having a lower moisture content, than will PTFE lysimeters (e.g., the operating range of a ceramic lysimeter is greater than that of a PTFE lysimeter). A field test of both types, involving installation, sampling, and laboratory analysis, would be required to select the proper material.

Lysimeter Evaluation Program

The work sequence for evaluating pressure-vacuum lysimeters as an early detection monitoring methodology would be as follows:

a) Observe water level recovery in the piezometer for a period of one (1) week to determine if the aquitard will yield water;

b) Drill out the shallowest dry piezometer with 4¼-inch augers, and clean out the borehole; advance the borehole one (1) foot deeper with a large, diameter split spoon if possible to eliminate borehole skin effects.

c) Install a ceramic pressure-vacuum lysimeter in the split spoon borehole.

d) Advance a new borehole to the same depth, through overburden casing and install a PTFE lysimeter.

e) Sample each lysimeter once for total and soluble arsenic, barium, chromium, and lead.

f) Evaluate ceramic vs PTFE lysimeter performance with respect to volumes collected; required collection times; and analytical variability. Select the most appropriate lysimeter material.

g) Install the selected lysimeter type in each dry piezometer, and sample for pore water and analyze for trace metals.

Lysimeters constructed of PTFE must be installed with a transfer vessel if sampling at depths greater than 20 feet. Ceramic lysimeter can be installed and sampled to 50 feet without need of a transfer vessel. Transfer vessels are connected to the porous sampling element via a one way valve, which prevents the sample from being forced outward through the porous element while under pressure during sampling. Representative samples for volatile organics analyses cannot be obtained from pressure-vacuum lysimeters.

Lysimeter Evaluation Scheduling

If lysimeter installation is needed, detailed installation and sampling procedures for the pressure-vacuum lysimeters will be provided in the Site Assessment Report. The piezometer evaluation period, and shipping logistics for the lysimeter materials requires that the lysimeter evaluation be conducted as a separate field investigation.

3.1.2 Additional Monitoring Wells and Piezometers

A bedrock monitoring well (MW-1D) will be installed at existing well location MW-1 in order to monitor the regional ground water flow in a location that is fully downgradient of the waste/fill. Existing downgradient deep wells MW-3DR and MW-8D are upgradient of a small portion of the waste/fill.

A bedrock piezometer (MW-6D) will be installed at existing well location MW-6 in order to evaluate bedrock ground water flow in the vicinity of the bedrock exposures in Cattaraugus Creek. The bedrock ground water isopotential map will be revised based on measured head values at MW-6; and the need for additional bedrock monitoring wells near the Creek will be evaluated.

Existing monitoring well MW-2 has been damaged and partly rehabilitated, but is currently partially filled with sand. Well MW-2 will be replaced.

3.1.2.1 Drilling and Geologic Sampling

In anticipation of difficult drilling conditions, the boring for MW-1D will be advanced through the overburden to bedrock with a cable tool drilling rig. The proposed drilling method involves alternately advancing a split spoon sampler, cleaning out the borehole by bit and bailer and driving four (4) inch steel casing. Drilling and sampling procedures using cable tool drilling methods are described in Appendix B2.2. Continuous split spoon samples will be collected; visually classified according to Appendix B2.4; and retained in clean one (1) quart jars for future reference. A small soil sample from each sampling interval will

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be collected from the shoe of the split spoon; sealed in a numbered moisture tin, and submitted for the laboratory determination of moisture content. Moisture tin numbers will be recorded in the field logs. After the four inch casing is seated into the top of rock (approximately two feet), the cable tool rig will be demobilized and a rotary drilling rig will set up over the casing to collect from 10 to 20 feet of NX rock core. All rock core will be logged according to the procedures in Appendix B2.5 and B2.6 and stored in wooden core boxes.

Following coring operations, a permeability test will be conducted in the corehole using a pressure packer. This test involves sealing off the corehole with an inflatable packer system and either forcing water under high pressure and at a near constant rate into the surrounding bedrock or pressurizing the formation with an inert gas. At least two (2) intervals will be tested. Observations of elapsed time and either the volume pumped at different pressure or the rate of water level recovery (after pressure released) are recorded. The data obtained provides a means of estimating the permeability of the rock, and also the openness of fractures and joints. Packer test procedures involving water injection are detailed in Appendix B2.13. Subsequent to packer testing, the corehole will be reamed with a 3-7/8 inch roller bit to facilitate construction of a bedrock monitoring well.

The bedrock boring adjacent to MW-6 will be advanced to bedrock using 6¼-inch I.D. hollow stem augers. Permanent 8 or 10-inch black steel overburden casing will be grouted into the upper few feet of rock according to the procedures in Appendix B2.7. Overburden sampling will not be performed since the stratigraphy of this area is well defined. The boring will be further advanced with an NX core barrel to obtain from 10 to 20 feet of rock core. Rock core will be described according to the procedures in Appendix B2.5 and B2.6. Packer permeability tests will be performed as described previously for boring MW-1D. Subsequent to packer testing, the corehole will be reamed with a 3-7/8 inch roller bit to facilitate the installation of a piezometer.

The boring for replacement well MW-2 will be advanced with 6¼-inch hollow stem augers. Continuous split spoon sampling, with % moisture sample collection will be performed to determine the highest yielding water bearing interval for setting a five to ten foot length of screen.

3.1.2.2 Monitoring Well and Piezometer Installation

Bedrock wells and piezometers will be installed according to the procedures in Appendix B2.10. Two (2) inch flush joint SCH 40 PVC screen and riser, with five (5) or ten (10) feet of 10 slot screen will be installed in bedrock borings. Screened intervals will be selected by the Malcolm Pirnie field geologist on the basis of core description and packer testing results. Each borehole annulus will be backfilled to no more than two (2) feet above the screen with No. 2 silica sand. Well MW-1D will be backfilled to the surface with a powdered bentonite slurry. Well MW-6D will be sealed with a minimum of three (3) feet of bentonite pellets; followed by a one (1) foot secondary sand consisting of No. 1 silica sand to prevent grout intrusion into the bentonite; followed by cement bentonite grout to the surface. The overburden casings will be fitted with lockable covers.

Replacement overburden well MW-2, will be installed through the augers as described in Appendix B2.9. Well materials will consist of two-inch flush threaded SCH 40 PVC with 5 to 10 feet of screen; 6 slot screen; and No. 1 silica sand.

3.1.3 Drilling Equipment Decontamination

To prevent cross-contamination between boring locations, the drilling rig and all drilling accessories will be thoroughly decontaminated before arriving on-site and between all drilling sites. A pressurized steam cleaner will be utilized for purposes of decontamination of the drilling rig and accessories. Split-spoon samplers will be brushed cleaned of soil and steam cleaned between samples, or chemically decontaminated as per Appendix B3.6, as appropriate.

3.2 WELL DEVELOPMENT

3.2.1 New Monitoring Wells/Piezometers

All new monitoring wells/piezometers will be developed by pumping or bailing to remove any introduced sediment. As a general rule, water levels will not be drawn below the top of the sand pack during development. If the well screen straddles the water table, this rule will not apply, however, care will be taken not to exceed the natural recovery rate of the well. In all cases, the effectiveness of the development measures will be closely monitored to keep the volume of discharged water to the minimum necessary to obtain sediment-free samples. A Model 16800 Portalab Turbidimeter (Hach Company) will be used to monitor development effectiveness. A turbidity reading of <50 NTU will be used as a guide for discontinuing well development. Field measurements for pH, conductivity and temperature will also be recorded during well development. Development progress will be documented on the "Well Development/Purging Record" presented in Appendix B2.11.

Various well development methods, which may be used, are described in Appendix B2.11. The method selected will depend on monitor-specific considerations, including depth to water level and well productivity.

3.2.2 Existing Monitoring Wells Evaluation

Existing deep overburden and bedrock monitoring wells, MW-3D, 8, 8D, and 7D, have exhibited either elevated sample turbidity which affects the analytical results for total metals, and/or elevated pH. Both parameters will affect the validity of any interpretation of long-term monitoring data. The integrity of these wells as detection monitoring points will therefore, be evaluated.

The approach for evaluating each well includes the redevelopment of each well by continuous pumping for a full 8 hour day at the natural recovery rate of the individual well. Natural recovery rates are on the order of 0.2 to 0.25 gallons per minute. Success has been achieved redeveloping MW-8 using this approach. A purge pump, which can function unsupervised, will be used to allow development to proceed at the same time as other field tasks.

Field parameters of pH, specific conductivity, temperature, and turbidity will be monitored periodically during development. If it is not possible to permanently improve sample turbidity and/or reduce pH, alternate purging and sampling procedures will be evaluated. Specific criteria used in evaluating these procedures may include purging rate, total gallons purged, the period between purging and sampling, and the effects on chemistry of sampling with a pump rather than a bailer. Purging and sampling procedures that are specific to individual wells would be included in the sampling and analysis plan for long-term detection monitoring.

3.3 WELL TESTING

In-situ hydraulic conductivity tests will be performed on each redeveloped well (MW-8, MW-8D, MW-7D, and MW-3D); on the four (4) aquitard piezometers (P-6A, P-6B, P-6C, and P-6D); and on the replacement well MW-2. The tests will be conducted by displacing water in the well/piezometer and monitoring the rate at which the water level recovers to static conditions. The recovery pattern can be analyzed to provide an estimate of hydraulic conductivity. A detailed description of the proposed slug testing procedure is provided in Appendix B2.12.

During testing, data will be collected manually or by use of a down hole pressure transducer linked to a data logger. Manual measurements will be recorded on a slug test record form. Water level recovery vs time data for unconfined ground water conditions will be analyzed by the method of Bouwer and Rice (1976, 1989). Confined ground water conditions will be analyzed by the method of Cooper et al. (1967) or Hvorslev (1951).

3.4 WATER LEVEL MONITORING

3.4.1 New Monitoring Wells/Piezometers

Water levels in all newly installed monitoring wells and piezometers will be measured using a water level indicator. Initially, measurements will be taken at least once daily following well installation, while staff are in the field, until the well has recovered to anticipated static conditions. Subsequently, measurements of all on-site wells will be taken on one separate occasion. Water levels will also be measured prior to the ground water sampling and before-and-after well development. Procedures for taking water level measurements are contained in Appendix B2.14.

3.4.2 Continuous Water Level Monitoring

During previous field investigations (see Malcolm Pirnie, 1989) water level fluctuations were observed in deep overburden and bedrock monitoring wells that appeared to correlate with periods of pumping at the

Tannery and Village production wells. The possible hydraulic connection between on-site wells and the production wells will be evaluated as part of this program. Water levels in eight (8) on-site well pairs (MW-1/1D, MW-3D/3DR, MW-6/6D, and MW-8/8D) will be monitored continuously using four (4) data loggers with two pressure transducers per data logger. Water levels will be electronically recorded at one (1) hour intervals for a period of 30 days.

Water level hydrographs will be prepared from the well data, and compared to production well pumping records; Cattaraugus Creek stream flow data (available from the USGS stream gauging station at Gowanda); and continuous records of barometric pressure. As assessment will be made regarding hydraulic connection between the Creek, the aquifer tapped by the production wells and the water bearing units underlying the site.

3.5 GEOTECHNICAL SOILS TESTING

Gradation curves and Atterberg Limits will be determined for samples from the screened intervals of replacement well, MW-2 and the aquitard piezometers, and for samples from four (4) intervals from the deep bedrock boring (MW-1D). Moisture content will be determined for each split spoon from continuously sampled soil borings. An attempt will be made to collect an undisturbed sample from the dense till in the aquitard piezometer borings using a Shelby Tube or Denison tube sampler. Undisturbed soil sampling procedures are described in Appendix B2.15. One (1) undisturbed permeability test will be performed if sufficient undisturbed sample can be collected from the till. Soils testing is summarized in Table 3-3.

3.6 ISOTOPE (TRITIUM) SAMPLING

Selected monitoring wells will be sampled for tritium analyses to assist in the evaluation of ground water flow.

3.6.1 General Principles

Tritium (^3H) is a radioactive isotope of hydrogen with a half life of 12.3 years. Tritium is measured in Tritium Units (T.U.), where 1 T.U.

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TABLE 3-3

MOENCH TANNING COMPANY
PALMER STREET LANDFILL

SUMMARY OF SOILS TESTING

Test Method	ASTM Procedure	MW-1D	Aquitard Piezometers	MW-2
Moisture Content	D2216-80	80	17	15
Seive Analyses	D422-63	4	4	1
Hydrometer Analyses	D421-53	4	4	1
Atterberg Limits	D4318-84	4	4	1
Undisturbed Permeability	(1)		1(2)	

NOTES:

(1) Analyses with permeameter as per current literature.

(2) To be performed only if an undisturbed sample can be collected from the dense till.

equals 1 tritium atom in 10^{18} hydrogen atoms. Following 1953, tritium levels in precipitation increased dramatically as a result of above ground testing of thermonuclear bombs. Through the 1950s and 1960s, tritium levels reached thousands of T.U. Levels have been declining slowly since 1964, following a ban on atmospheric testing of thermonuclear devices. In 1985, the levels in precipitation from Ottawa, Ontario ranged from 12 to 61 T.U. In contrast, pre-1953 levels of tritium in precipitation have been estimated to range from 5 to 20 T.U. (Freeze and Cherry 1979).

Tritium concentrations in ground water are not appreciably affected by interactions with geologic materials (Desaulniers et al, 1981). Consequently, considering the time elapsed since the early 1950s and the half-life of tritium, ground waters recharged by pre-1953 precipitation with tritium of 20 T.U. now will have tritium levels below about 3 T.U. Detection of tritium above these levels indicates that part or all of the ground water was recharged since 1953.

3.6.2 Application

Tritium levels in pore water and ground water will be determined to provide qualitative data regarding

a) the rate of recharge to water bearing zones within and underlying the lower overburden; ;and

b) the potential for hydraulic connection with Cattaraugus Creek.

Tritium analyses will assist in evaluating the effectiveness of the lower overburden as an aquitard.

3.6.2.1 Pore Water Analyses

Tritium levels will be determined in pore water from the lower overburden at exploratory boring P-6D. Split spoon samples will be collected at one foot intervals, for a maximum of 10 samples to be analyzed for tritium. Samples will be shipped to the Environmental Isotope Laboratory (EIL) at the University of Waterloo, (Waterloo, Ontario Canada) for sample preparation and analyses.

Pore water will be extracted from the soil matrix by azeotropic distillation, and analyzed for tritium by direct liquid scintillation counting. The distillation procedure involves heating the soil sample and liquid toluene a boiling flash, which is connected to a condenser and distilling receiver. A gaseous mixture of toluene and soil water is produced in the boiling flask; and cooled to two immiscible liquids in the condenser. Each liquid collects in the distilling receiver, where the more dense water phase is drawn off through a stopcock. Azeotropic distillation is described by Hendry (1983) and EIL (1989a).

Analytical precision for direct tritium analyses at the EIL is ±8 T.U. Minimum sample volume requirements for direct tritium analyses is 15 ml. An analytical precision for tritium of ±0.8 T.U. can be achieved using an electrolytic enrichment process (EIL, 1989b), but minimum sample volumes are 250 ml. Tritium enrichment requires seventeen times the volume of soil sample (at constant % moisture) than does direct counting. Because the analytical uncertainty for direct counting analyses of old ground water (low tritium) may overlap with the tritium levels in modern ground water, it may be necessary to use enriched tritium analyses to obtain interpretable data. The laboratory will begin with direct tritium analyses of pore water from upper soil samples. When detection limits are encountered, enriched analyses will be used. Distillation will be performed on one or more successive soil samples (in the vertical sequence) until the sample volume required for enriched analysis is obtained. Therefore, tritium values may be averaged over greater than one (1) foot intervals.

Field preparation of split spoon soil samples for pore water extraction involves wrapping a representative portion of soil in polyethylene film and storing separately in tight sealing glass jars. Samples must not be exposed to the atmosphere unnecessarily in order to avoid isotopic exchange and desiccation. Sampling protocols are described in Appendix B4.1.

A profile of pore water tritium vs. depth will be presented for the exploratory boring. Tritium levels will provide information on the age of ground water (pre-1953 or post-1953) which is currently moving through the lower overburden.

3.6.3 Ground Water

Electrolytically enriched tritium analyses will be performed on ground water samples from :

a) four (4) aquitard piezometers and one (1) shallow overburden piezometer at location P-6;

b) four (4) bedrock wells (MW-1D, MW-3DR, MW-8D, and MW-7D);

c) three (3) deep overburden wells (MW-3D, MW-8, and MW-7); and

d) one (1) sample of drilling water;

e) one (1) sample from Cattaraugus Creek; and

f) one (1) sample from Moench Tanning production wells.

Based on the low hydraulic conductivity of the lower overburden, vertical seepage rates may be very low, and potential impacts of the landfill on the bedrock limited. However, aquitard heterogeneities and spatial variations in recharge conditions may promote more rapid movement of tritiated water. Tritium analysis will assist in evaluating the effectiveness of the lower overburden as a confining unit.

Sampling methodology for tritium includes: standard well purging; filling a 1 liter amber glass bottle (having an airtight lid); and shipment to the laboratory. Detailed sampling procedures are given in Appendix B3.2. Analyses will be performed at the University of Waterloo (Canada) isotope lab. Laboratory Quality Assurance, Quality Control procedures are described in EIL (1989).

3.7 SOILS ANALYSIS BY INAA

Contaminant penetration of the lower overburden may also be detected by direct analysis of the till and its pore water for the parameters of interest. Approximately twenty soil samples will be submitted to Becquerrel Laboratories, Inc. of Buffalo, NY for the analysis of 34 metallic elements (Table 3-4) by Instrumental Neutron Activation Analysis (INAA). In the INAA method, a sample of material is radiated in a flux of neutrons. Most of the elements comprising the sample become radioactive and will emit characteristic radiation, which can be analyzed

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TABLE 3-4

MOENCH TANNING COMPANY
PALMER STREET LANDFILL

SUBSURFACE SOIL CHARACTERIZATION PARAMETERS BY INNA[1]

Element	Detection Limit	
Gold	2	ppb
Antimony	0.1	ppm
Arsenic	0.5	ppm
Barium	50	ppm
Bromine	2	ppm
Cadmium	2	ppm
Cerium	5	ppm
Cesium	0.5	ppm
Chromium	20	ppm
Cobalt	5	ppm
Europium	1	ppm
Hafnium	1	ppm
Iridium	50	ppb
Iron	0.2	%
Lanthanum	2	ppm
Lutetium	0.2	ppm
Molybdenum	1	ppm
Nickel	10	ppm
Rubidium	5	ppm
Samarium	0.2	ppm
Scandium	0.2	ppm
Selenium	5	ppm
Silver	2	ppm
Sodium	0.02	%
Tantalum	0.5	ppm
Tellurium	10	ppm
Terbium	0.5	ppm
Thorium	0.2	ppm
Tin	100	ppm
Tungsten	1	ppm
Uranium	0.2	ppm
Ytterbium	2	ppm
Zinc	100	ppm
Zirconium	200	ppm

NOTE:

(1) Instrumental Neutron Activation Analysis

quantitatively to determine elemental concentrations. All 34 elements are analyzed jointly. Analysis of lead is not amendable to INAA. Therefore, lead will be analyzed by standard spectroscopic methods (Method 7420 in USEPA, 1986). Quality assurance procedures for INAA will determine comparibility and precision through the analyses of one (1) split sample by spectrographic methods (Method 7000 series, USEPA, 1986), and one (1) split sample by INAA.

Between 30 and 100 grams of sample (dry weight and stone free) are required for sample preparation and analysis. Samples will be obtained from each one foot, split-spoon sampling interval in the overburden at boring location P-6D. Sampling protocols are described in Appendix B4.1.

Objectives of the soils characterization by INAA are to establish a vertical concentration profile for total arsenic, barium, chromium, and lead. The profile may show evidence for the presence (or absence) of a contamination front below the waste/fill. In addition, solids sampling is one of the various early warning detection methodologies evaluated in Appendix A. The concentration profile may serve as a base condition against which contaminant profiles from future sampling events could be compared.

3.8 WATER QUALITY SAMPLING

3.8.1 Number and Location of Samples

Ground water will be sampled from (a) two (2) new bedrock wells (MW-1D and MW-6D); and (b) five (5) wells in the lower overburden piezometer nest (including P-6, 6A, 6B, 6C, and 6D). Replacement well MW-2 will be sampled as a part of the next routine quarterly monitoring event following well installation and development. Analytical results will be used to assess actual contaminant migration through the lower overburden and along the till-bedrock contact at location P-6; and in the bedrock ground water regime at MW-1D and MW-6D.

3.8.2 Analytical Protocols

Analysis will be performed by a state approved laboratory and will follow all appropriate USEPA/NYSDEC protocols. The analytical parameters, analytical methods, and method detection limits are specified in

Table 3-5. An independent compliance review of the analytical data will be performed by Malcolm Pirnie. Detailed procedures used to collect, process and handle the samples are presented in Appendices B3.1a, B3.1b, B3.3, and B3.4.

3.8.3 Sampling Protocols

Sampling will occur no sooner than one week following the end of well development and after all wells have equilibrated. All monitoring wells will be purged (in conformance with Appendix B3.1a) prior to sampling to remove stagnant water from the casing. Purging will continue until: (a) at least 3 well volumes are removed; (b) field parameters such as conductivity, temperature, and pH stabilize; or (c) the well purges to dryness (i.e., top of sand pack). Where the well purges to dryness, the well will be allowed to recover to a level sufficient for sampling. Measurements to be taken in the field during purging and prior to sampling include pH, Eh, temperature, specific conductance and turbidity. Field instrumentation will be calibrated and maintained according to procedures in Appendix B3.5.

3.8.4 Quality Assurance/Quality Control

One (1) equipment blank and one (1) blind duplicate will be analyzed during ground water quality monitoring. The parameters for these QC samples will be identical to those monitored for ground water samples. In addition, one (1) trip blank will be included with each daily shipment of samples. Trip blanks will be analyzed for volatile organics as monitored for the ground water samples during any given monitoring event.

Trip blanks will be prepared by the laboratory and will accompany sample bottles into the field to be returned to the lab with the samples collected. One (1) trip blank will be analyzed for each day that samples are collected in the field. Preparation of trip blanks by the laboratory will involve the placement of analyte-free distilled laboratory water into appropriate precleaned sample bottles.

An analytical data validation review will be performed by Malcolm Pirnie to assess compliance of the data with quality control acceptance criteria (i.e., sampling protocols, sample holding times, and accuracy and precision of data). The data validation review will access conformance

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TABLE 3-5

MOENCH TANNING COMPANY
PALMER STREET LANDFILL

ANALYTICAL PARAMETERS AND METHODOLOGY

Parameter	Method(1)
VOLATILE HALOGENATED ORGANICS	~~8010~~ 8240 GC/MS
Bromodichloromethane	
Bromoform	
Bromomethane	
Carbon Tetrachloride	
Chlorobenzene	
Chloroethane	
2-Chloroethyl vinyl ether	
Chloroform	
Chloromethane	
Dibromochloromethane	
1,2-Dichlorobenzene	
1,3-Dichlorobenzene	
1,4-Dichlorobenzene	
1,1-Dichloroethane	
1,2-Dichloroethane	
1,1-Dichloroethylene	
trans-1,2-Dichloroethylene	
1,2-Dichloropropane	
cis-1,3-Dichloropropene	
trans-1,3-Dichloropropene	
Methylene chloride	
1,1,2,2-Tetrachloroethene	
Tetrachloroethylene	
1,1,1-Trichloroethane	
1,1,2-Trichloroethane	
Trichloroethylene	
Trichlorofluoromethane	
Vinyl chloride	
VOLATILE AROMATIC ORGANICS(2)	~~8020~~ 8240 GC/MS
Benzene	
Ethylbenzene	
Toluene	
m-Xylene	
o-Xylene	
p-Xylene	
Methyl Ethyl Ketone	

TABLE 3-5 (Continued)

MOENCH TANNING COMPANY
PALMER STREET LANDFILL

ANALYTICAL PARAMETERS AND METHODOLOGY

Parameter	Method[1]
METALS (Total and Soluble)[3]	
Arsenic	7060
Barium	6010
Chromium	6010
Lead	7421

NOTES:

(1) All analyses shall be performed in accordance with USEPA SW-846, Third Edition, November, 1986.

(2) Including Methyl Ethyl Ketone

(3) Filtration of samples for soluble metals analysis shall be performed by the ENGINEER in the field at the time of sample collection.

of the sampling and analytical program with all components of the Quality Assurance Plan presented in Appendix C.

3.9 ASSESSMENT OF DETECTION MONITORING PARAMETERS

The current parameters of interest include the trace metals, arsenic, barium, chromium, and lead; as well as selected volatile aromatic hydrocarbons. The aromatic hydrocarbons detected in shallow wells completed within the waste/fill are very likely associated with one or both of the natural gas pipelines that formerly crossed through the waste disposal areas. A noticeable gas odor, and bubbling gas seeps were present in the vicinity of the pipelines. Relocation of the gas pipelines, and natural degradation processes should, over a period of time, reduce concentrations of the aromatic hydrocarbons in ground water to below detection. Criteria for the elimination of monitoring requirements for parameters associated with the natural gas will be developed for the monitoring program.

The inclusion of each trace metal in the monitoring program will be evaluated with respect to historical ground water data, waste/fill and background soil analyses.

3.10 DATA COMPILATION

All data generated in the field will be presented in standard forms that are included with the appropriate procedures in Appendix B. Additional data will be compiled as follows:

a) continuous water level, stream flow, pumping and barometric pressure data will be tabulated and presented graphically;

b) existing hydrogeologic cross-sections and subsurface contour plots will be modified to incorporate new data;

c) a revised bedrock isopotential map will be prepared;

d) graphic plots of parameter vs depth will be prepared for data from exploratory boring P-6D.

3.11 ANALYSIS AND REPORTING

The assessment report will summarize the results of the investigations and evaluate the need for further assessment. Specific issues the assessment report will address include:

a) the hydraulic properties of the lower overburden including the rate and flux of contaminant movement;

b) an early warning detection monitoring strategy for the lower overburden;

c) recommendations regarding the integrity of existing monitoring wells for long-term monitoring;

d) the need for long-term monitoring in bedrock in the northeast portion of the site;

e) potential hydraulic connections to off-site wells;

f) parameters for long-term detection monitoring; and

g) the need for additional site assessment.

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APPENDIX A

POST CLOSURE GROUND WATER
DETECTION MONITORING PROGRAM
FOR THE PALMER STREET LANDFILL
CONCEPTUAL APPROACH TO DEVELOPMENT

MALCOLM PIRNIE

MOENCH TANNING COMPANY
DIVISION OF BROWN GROUP, INC.
GOWANDA, NEW YORK

POST CLOSURE GROUND WATER DETECTION MONITORING PROGRAM FOR THE PALMER STREET LANDFILL

WORK PLAN FOR SUPPLEMENTAL SITE ASSESSMENTS

NOVEMBER 1989

MALCOLM PIRNIE, INC.
S-3515 Abbott Road
P. O. Box 1938
Buffalo, New York 14219

0605-12-2

POST CLOSURE GROUND WATER DETECTION MONITORING PROGRAM FOR THE PALMER STREET LANDFILL: CONCEPTUAL APPROACH TO DEVELOPMENT

Moench Tanning Company
Division of Brown Group, Inc.
Gowanda, New York

August 1989

Project No. 0605-12-2

1.0 INTRODUCTION

This report outlines an approach to the development and implementation of a long-term, post-closure, ground water detection monitoring program for the Palmer Street Landfill site. A post-closure, ground water monitoring program will be a condition of the post-closure permit which will ultimately be required for the site in accordance with the requirements of 40 CFR Part 264.98 and NYCRR Part 373.2.6.

The principal purpose of the monitoring program is to provide a mechanism for initiating corrective actions if the impairment of ground water or surface water is imminent or apparent. In order to limit the scope of the corrective actions, the monitoring program should be designed to provide early warning of contaminant movement.

In preparation of this program, it became apparent that it will be necessary to better define the hydrogeologic and chemical characteristics of the overburden aquitard, which underlies the site. This geologic unit retards the downward movement of contaminants from the landfill to the regional aquifer. Information on the thickness, continuity, textural uniformity, and hydraulic conductivity of the aquitard material is very limited. Any detection monitoring program would have to address the mechanisms by which the contaminants could move through the aquitard and the rate and flux of such movement.

The approach outlined herein consists of two phases as initially discussed in the Palmer Street Landfill Closure/Post-Closure Plan. Phase I would involve continued routine monitoring and further site assessment. Phase II is development of the final program which would be initiated upon issuance of the post-closure permit.

In addition to continued routine monitoring which Malcolm Pirnie is currently conducting on Moench Tanning's behalf, it is recommended that the four (4) assessment items described below be included.

1. Development of an appropriate methodology for the early warning detection of contaminant migration through the aquitard;
2. Evaluation of existing deep overburden and bedrock monitoring wells for long-term compliance monitoring;

3. Evaluation of the need for additional deep overburden and bedrock compliance monitoring wells; and

4. Establishment of detection monitoring parameters.

The conceptual approach outlined herein will be used to prepare a Phase I site assessment work plan for submission to the NYSDEC in November 1989, as required in the recently completed Closure/Post-Closure Plan. Each assessment item is discussed below.

2.0 ASSESSMENT ITEM I: EARLY WARNING DETECTION METHODOLOGY

Malcolm Pirnie has evaluated several strategies that may be used to implement the detection monitoring program. Each monitoring strategy is discussed in Section 2.3.

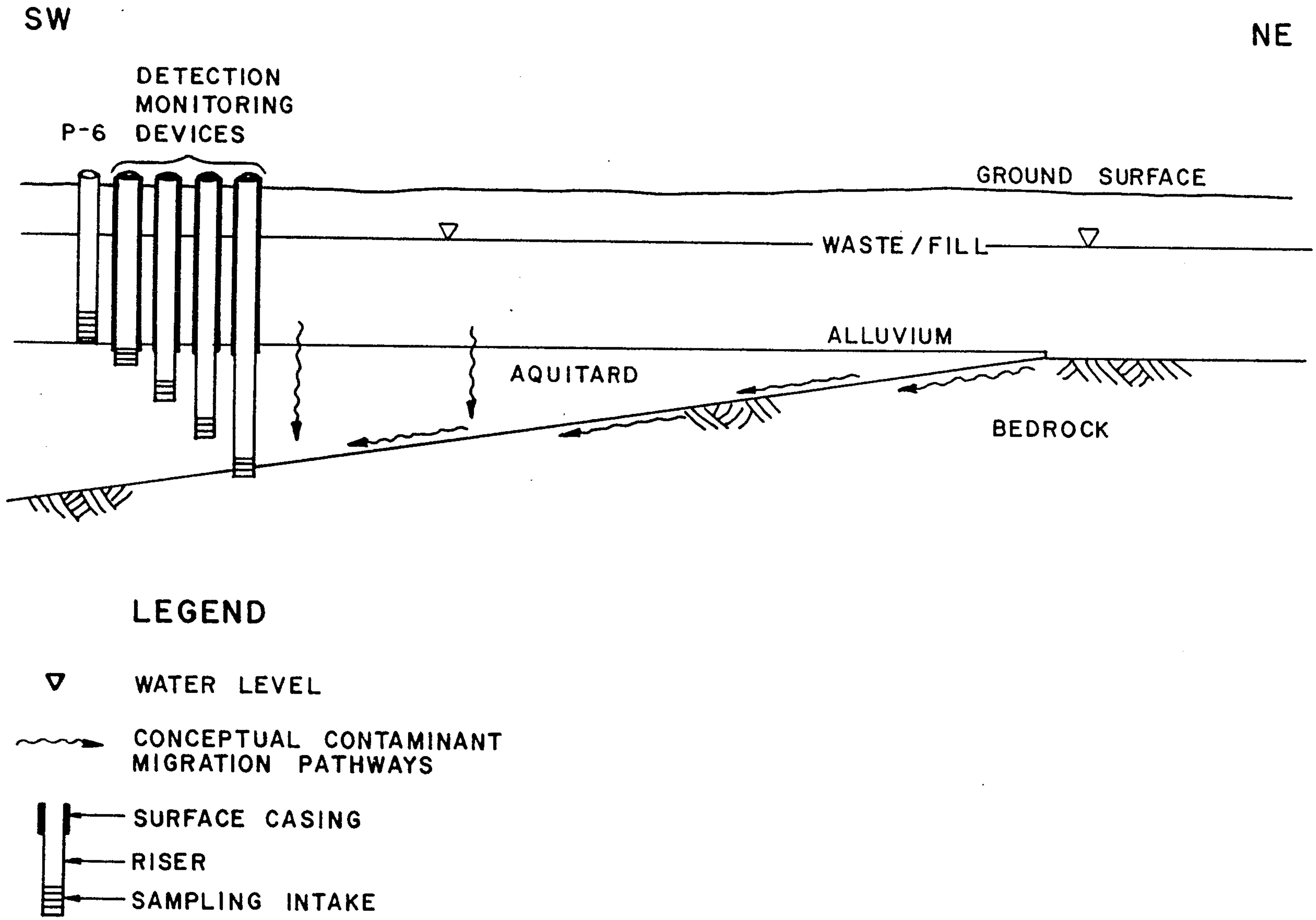
2.1 POTENTIAL CONTAMINANT MIGRATION PATHWAYS

A conceptual contaminant migration model for the Palmer Street Landfill is diagrammed in Figure 1. The silt-clay aquitard unit which underlies the waste fill pinches out at the northeastern portion of the landfill, and increases in thickness to the southwest. Potential contaminant migration may occur as downward ground water seepage through the aquitard, or as flow along the bedrock/overburden interface where the aquitard is absent in the northeast. Based on existing well data, the bedrock itself serves as an aquitard, except near the overburden interface where it is fractured. The objective of any detection monitoring system at the landfill is to provide early detection of contaminant migration within this conceptual framework.

The selection of an appropriate contaminant detection methodology for the aquitard will depend on its hydrogeologic and chemical characteristics. For example, the extent of contaminant penetration into the aquitard is a function of the hydraulic gradient, porosity, hydraulic conductivity, and water saturation of the aquitard material. Monitoring strategies have been evaluated for both saturated and unsaturated conditions. Those which have merit for saturated conditions include:

1. Monitoring of contaminant penetration in the aquitard at select depths using a multi-level sampling device in a single boring.

FIGURE 1



MALCOLM PIRNIE

MODEL OF CONTAMINANT MIGRATION TO BEDROCK AND CONCEPTUAL DETECTION MONITORING SYSTEM

2. Monitoring using a single-level sampling device in multiple boreholes completed to varying depths.

Monitoring strategies evaluated for unsaturated conditions include:

1. Collection of soil samples obtained from select depths and analysis for indicator parameters.

2. Monitoring using lysimeters completed at select depths.

2.2 EXPLORATORY BORING

Field observations from previous boring programs indicate that the aquitard may not be saturated at all depths; therefore, an exploratory boring is proposed in order to better establish site-specific conditions. The exploratory boring should be located near existing piezometer P-6, and should extend to the top of bedrock, an estimated depth of about 30 feet. Aquitard thickness is estimated to be 16 feet at location P-6, which is a suitable thickness for the installation of monitoring devices at select depth intervals. Information to be obtained from the exploratory boring includes the following:

- Lithology and soil texture (i.e. presence of sand lenses or fractures that may allow ground water seepage);
- % moisture to establish a moisture profile with depth;
- concentration of total arsenic, barium, chromium, and lead in the aquitard material again to establish a concentration profile with depth;
- laboratory determination of vertical hydraulic conductivity from select depth intervals;
- water level measurements to establish a vertical hydraulic gradient profile;
- analysis of tritium in ground water to establish age of the water with increasing depth;
- analysis of total and soluble arsenic, barium, chromium, and lead in ground water collected from select depth intervals to establish a concentration profile with depth.

Data from the exploratory boring should be evaluated to determine the water bearing properties of the aquitard material. If saturated conditions are found, the rate and flux of contaminant movement should be estimated.

All borings advanced through the waste must be cased off from the waste prior to drilling into the aquitard material. This is critical in order to prevent downhole migration of contaminants during drilling.

Samples can be obtained by either a Denison sampler or an MD overburden core barrel made by Acker Drilling Products. Standard split-spoon soil sampling has proven to be ineffective in the hard glacial till underlying the landfill. Sampling for moisture content and total metals analyses in soil should be at one (1) foot intervals. Installation of a multilevel sampler or completion of additional boreholes with instrumentation (described in the following section) would be required to determine if the aquitard material can yield water for chemical analysis, tritium, and hydraulic head (or gradient) determinations.

The seepage rate through the aquitard material can be determined from Darcy's Law calculations; and, independently, from tritium concentrations. Analyses of the soil for trace metals would help detect a contaminant migration front, if present.

2.3 EVALUATION OF MONITORING METHODS

Two monitoring methods were considered for saturated conditions, 1) the Waterloo Multilevel Sampler, sold by Solinst Canada Ltd., and 2) narrow diameter monitoring wells in multiple boreholes. Two monitoring methods were evaluated for unsaturated conditions, 1) monitoring with lysimeters (pore water samplers), and 2) solids sampling and analysis. The latter two methods are proposed only if the till fails to yield sufficient water for sampling/analysis.

Each method was evaluated under the same base conditions, as follows:

- The aquitard is 16 feet thick at Location P-6, and would be monitored in four (4) zones vertically spaced 2 to 3 feet apart.

- The lowest monitored zone is specified as the till/bedrock contact.

The advantages/disadvantages of each method are discussed below.

2.3.1 Waterloo Multilevel Sampler

The Sampler consists of a single string of four (4) sampling ports connected by 2" diameter riser sections. Each sampling port is 3/4" diameter stainless steel tubing that is factory fitted into the wall of a short length of 2" PVC pipe. Polyethylene tubing (3/4" I.D.) connects to the stainless steel port and extends up the riser to the surface. Riser sections can be any length. Annular space opposite sampling ports is backfilled with silica sand. Annular space opposite riser sections is backfilled with bentonite, in order to isolate individual sampling ports.

The Sampler can be assembled on-site so that sampling ports will monitor narrow zones of interest determined by subsurface sampling. Only one borehole and one permanent steel casing is needed. Water level recovery rates and purging volumes are minimized due to the small sample tubing diameter. Cost is approximately two-thirds that of installing four separate wells.

Disadvantages include the following:

- Recommended sampling collection method is to use a gas drive pump, which lifts slugs of water to the surface with nitrogen gas. If used incorrectly or if water yields are minimal, as expected, the gas can effect dissolved volatile organic compounds and trace metals present in the ground water. Alternative sample collection devices may not work due to the narrow sample tube diameter. Although it is less expensive to install a multi-level sampler, the lower cost may not justify the risk of compromising samples.

- Bentonite seals along the riser sections may leak, allowing hydraulic connection between the sampling ports. This may lead to false positive monitoring data which can trigger unwarranted corrective action.

- Not possible to conduct in situ hydraulic conductivity testing on the sampling ports.

2.3.2 Single Piezometers:

Installation of single piezometers involves initially setting permanent casings through the waste fill into the underlying aquitard and then advancing the borehole through the casing. A one-inch diameter well with two feet of screen can then be installed in each boring. The screened interval would then be backfilled with silica sand, and the remaining annular space backfilled with bentonite. One-inch wells would be proposed rather than standard two-inch wells because water level recovery rates are estimated to be about four (4) times faster.

The single piezometers can be sampled with a bailer, the preferred sampling method specified by NYSDEC. The potential for leakage of contaminants between monitored zones is minimized.

The major disadvantage is a higher installation cost.

2.3.3. Lysimeter

Pressure-vacuum lysimeters are suitable for collecting pore water which is under tension saturated conditions, eg. less than atmospheric pressure. Field observations of dry sand lenses (1-5 cm) within moist till suggest that unsaturated conditions are present within portions of the aquitard. Lysimeters were utilized effectively for sampling pore water in waste material above the water table.

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A lysimeter would be installed in a single borehole, each with its permanent steel casing. The borings would be advanced to the same depths as the borings for single piezometers. Each lysimeter cup would be set into silica flour, and backfilled with bentonite to the surface. If the wells remain dry after installation, then an alternate approach is to drill out the constructed wells and install lysimeters in the previously drilled boreholes. The lysimeter may be installed one (1) foot deeper than the base of the wells to eliminate borehole skin effects, which would inhibit the seepage of water to the lysimeter.

Based on testing performed for the Summer, 1988 investigation lysimeters constructed of polytetrafluoroethylene (PTFE) may be required to obtain representative samples. The alternate construction material is a ceramic, which may selectively screen or adsorb trace metals in the pore water. Ceramic lysimeters, however, will collect pore water from soils having a lower moisture content, than will PTFE lysimeters. A field test of both types, involving installation, sampling, and laboratory analysis, should be conducted to select the proper material. A compromise may be required between the ability to collect pore water and also obtain representative samples.

Costs would be comparable or slightly more than the single piezometer option.

Disadvantages are as follows:

- Lysimeters will collect water from fine porous material, and may also collect water from fractures, if any are present. Yet the fracture may serve as the primary conduits. The composition of water in the fractures and small pores may be different. Data variability can occur depending on the proportion of of the sample contributed by fracture flow on a specific sampling event.

- Samples cannot be collected when soils are dry to the point that pore water suction is great enough to allow air to enter cups when applying vacuum. This may be a serious limitation in the aquitard and can only be evaluated after installation.

- A phased installation approach would be needed to evaluate the performance of ceramic vs. PTFE lysimeters in the dense aquitard material.

- Sampling/analyses for volatile organics can be performed only with very specialized sampling apparatus.

2.3.4 Solids Sampling

Contaminant penetration of the aquitard material may also be detected by direct analysis of the till with its pore water for the contaminants of interest. For this option a single boring is needed for each sampling event, possibly on a bi-annual schedule. Each boring must be cased off from the waste material. The initial sampling and analysis would establish a vertical concentration profile of total arsenic, barium, chromium, and lead. This contaminant profile can act as a base condition against which contaminant profiles from later sampling events would be compared. Increased concentrations over time at specific depths could be attributed to contaminant migration from the upper water-bearing zone through the aquitard for the point at which the sample is collected.

An initial profile may be developed by analysis of soil samples at one foot intervals. Analysis of total arsenic, barium, chromium can be performed cost effectively by instrumental neutron activation analysis.

Analysis for lead must be performed with standard spectroscopic methods at a higher cost.

Disadvantages are as follows:

- The precise same location cannot be resampled, and the uncertainty due to the spatial variability between adjacent borings cannot be eliminated. Consequently, delineating changes through time in constituents of interest is difficult.

- Each sampling event requires the need to contract with a drilling firm to obtain soil samples. Sampling costs will far exceed analytical costs.

- Sampling requires repeated penetration of the landfill cap; and the movement of heavy equipment over the cap surface. Each boring must be grouted to the surface.

2.4 RECOMMENDATIONS

The recommended approach is outlined below:

1. Define geological conditions, certain water-bearing properties, and chemical characteristics of the aquitard in an exploratory borehole.

2. Drill three (3) additional borings and install individual piezometers in all borings.

3a. Determine hydraulic head and hydraulic conductivities; Sample and analyze for selected trace metals, and tritium.

3b. Install lysimeters in the same borings if the wells remain dry. Sample and analyze for selected trace metals and tritium.

4. Evaluate the aquitard characteristics and analytical data. Determine whether there is evidence of contaminant penetration of the aquitard at that location. Evaluate the suitability of the monitoring method.

3.0 ASSESSMENT ITEM II: EXISTING WELL INTEGRITY

Existing deep overburden and bedrock monitoring wells, MW-3D, 8, 8D, and 7D, have exhibited either elevated sample turbidity which affects the analytical results for total metals), and/or elevated pH. Both parameters will affect the validity of any interpretation of long-term monitoring

4.2 SOUTHWESTERN LOCATION

The existing network of bedrock wells does not monitor bedrock beneath the southwestern corner of the landfill (downgradient of MW-3DR and MW-8D). Therefore, consideration should be given to installing an additional monitoring well in the vicinity of existing well MW-1 to adequately monitor ground water in bedrock. If a saturated zone of sand and gravel is encountered in the aquitard at that location which could be correlated with known sand and gravel units at either MW-8, or MW-3D, it is recommended that an additional deep overburden monitoring well be installed in this zone. Based on existing data, drilling depth for the new bedrock well could be approximately 150. A deep overburden well may be 130 feet deep.

4.3 EXISTING WELL MW-2

Existing monitoring well MW-2 has filled with sand and needs to be rehabilitated or replaced.

4.4 SUPPORTING DATA COLLECTION

In support of the above program, ground water levels should be monitored continuously in all deep overburden and bedrock wells. Water level hydrographs would be compared with Cattaraugus Creek stream flow data, production well pumping records (for Moench wells), and continuous records of local barometric pressure, to determine if deep overburden or bedrock water bearing zones are hydraulically connected to the production well fields, or to the Creek.

New deep overburden and bedrock monitoring wells should be sampled for total and soluble arsenic, barium, chromium, and lead; and for volatile organics.

5.0 ASSESSMENT ITEM IV: DETECTION MONITORING PARAMETERS

The current parameters of interest include the trace metals, arsenic, barium, chromium, and lead; as well as selected volatile aromatic hydrocarbons. The aromatic hydrocarbons detected in shallow wells completed within the waste/fill are very likely associated with one or both of the natural gas pipelines that formerly crossed through the waste disposal areas. A noticeable gas odor, and bubbling gas seeps were present in the vicinity of the pipelines. Relocation of the gas pipelines, and natural degradation processes should, over a period of time, reduce concentrations of the aromatic hydrocarbons in ground water to below detection. Criteria for the elimination of monitoring requirements for parameters associated with the natural gas should be developed for the monitoring program.

The inclusion of each trace metal in the monitoring program will be evaluated with respect to historical ground water data, waste/fill and background soil analyses.

6.0 CONCLUSIONS AND RECOMMENDATIONS

Initially, Phase I of the detection monitoring program development should include the following:

1. Assessment of an early warning detection methodology for the aquitard. This would include:

   - completing an exploratory boring;
   - installing a nest of four (4) wells or lysimeters, depending on aquitard conditions;
   - evaluating the hydraulic properties of the aquitard, and determining the rate and flux of contaminant movement (if saturated); and
   - recommending a long-term monitoring method.

2. Assessment of the integrity of existing deep overburden and bedrock wells, including:

   - redevelopment of each deep well by pumping at the natural recovery rate of the individual well;
   - monitoring the progress of well development;
   - evaluating alternate well purging and sampling procedures, if required;
   - making recommendations for replacing or retrofitting existing monitoring wells, if necessary.

3. Replace or install additional monitoring wells as follows:

   - Install a piezometer in bedrock near MW-6
   - Install an additional bedrock monitoring well at MW-1.
   - Evaluate the need for an additional overburden well at MW-1.
   - Revise the bedrock isopotential map and evaluate the need for long-term monitoring of bedrock near MW-6.
   - Replace or rehabilitate existing well MW-2.
   - Continuously monitor water levels in all deep wells to evaluate potential hydraulic connections with off-site wells or the creek.
   - Sample newly-installed wells for selected trace metals and volatile organics.

4. Assessment of detection monitoring parameters:

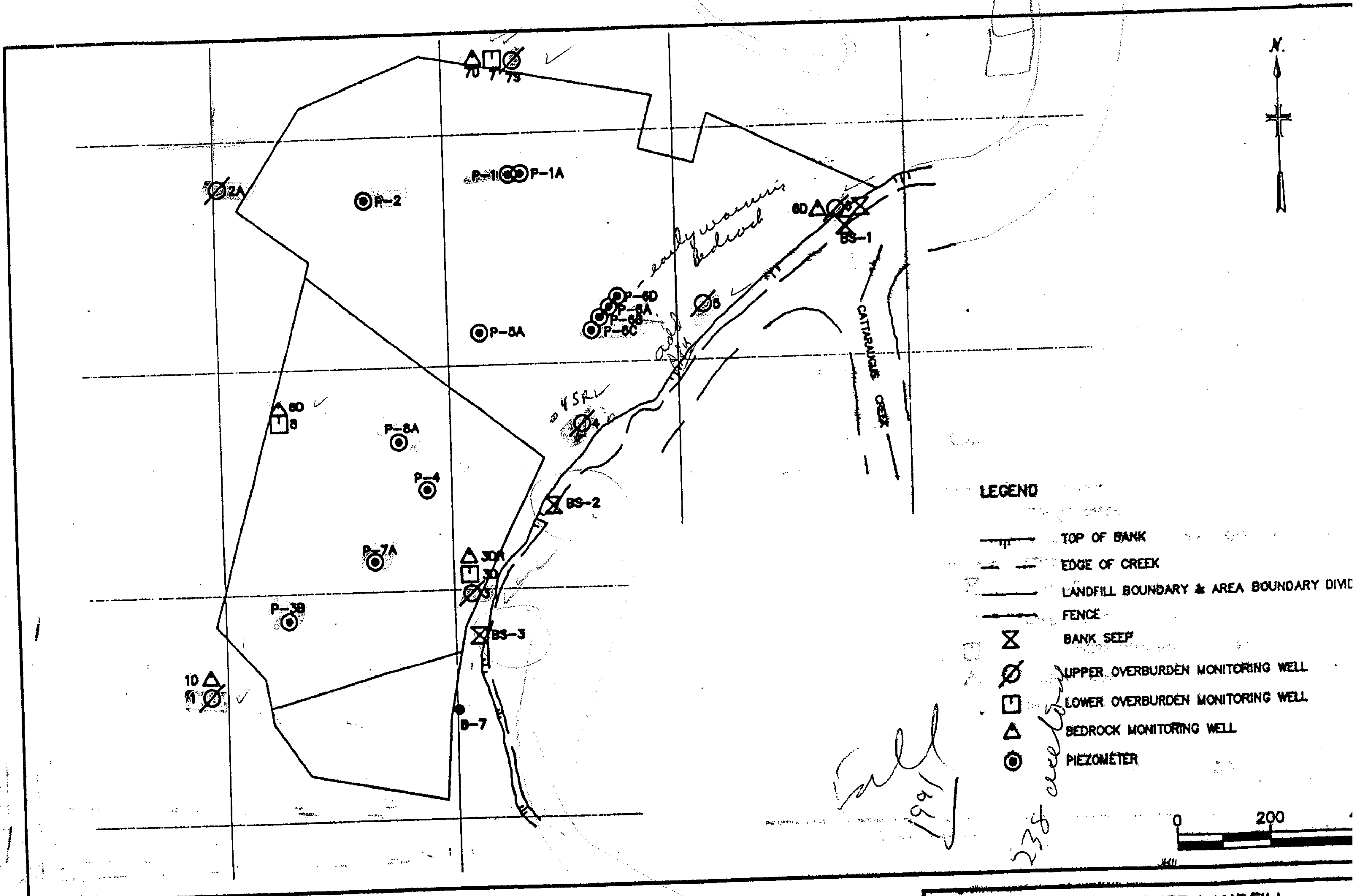
   - Develop criteria for the elimination of volatile organics from the monitoring program.
   - Evaluate the need to monitor each trace metal.

Phase I assessment results will be used to:

1. Prepare an assessment report summarizing the results of the investigations and evaluating the need for further assessment;
2. Prepare a work plan for further assessment within the scope of Phase I, if necessary;

3. Identify any additional work (e.g. installation of additional monitoring wells or piezometers required to establish a long-term post-closure monitoring system; and

4. Recommend a long-term post-closure monitoring program and prepare a Sampling and Analysis Plan which addresses sample locations, analytical parameters to be monitored, frequency of monitoring, and evaluation procedures.



PALMER STREET LANDFILL
POST CLOSURE INVESTIGATION

SITE MAP

MOENCH TANNING COMPANY

MALCOLM PIRNIE