*PREPARED FOR*

FILE COPY

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**BOND , SCHOENECK & KING**

**COLUMBIA MILLS SITE**
**MINETTO , NEW YORK**

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# WORK PLAN

**REMEDIAL INVESTIGATION / FEASIBILITY STUDY**

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MALCOLM PIRNIE

ENVIRONMENTAL ENGINEERS, SCIENTISTS & PLANNERS

*APRIL 1989*

*REVISED JULY 1989*

*REVISED OCTOBER 1989*

MALCOLM PIRNIE

MALCOLM PIRNIE, INC.
ENVIRONMENTAL ENGINEERS, SCIENTISTS & PLANNERS

October 11, 1989

Mr. Eric R. Obrecht
Project Manager
Central Technical Support Section
Bureau of Eastern Remedial Action
Division of Hazardous Waste Remediation
New York State Department of
Environmental Conservation
50 Wolf Road
Albany, New York 12233-7010

Dear Eric:

Attached is a revised copy of the Columbia Mill's Remedial Investigation/ Feasibility Study (RI/FS) Work Plan, which includes a revised Quality Assurance Project Plan (QAPP). Also attached is the schedule outlining RI/FS site activities planned for October and early November of this year which was faxed to you on October 5, 1989.

The enclosed copy of the RI/FS Work Plan incorporates the previous revisions which were forwarded to you on July 27, 1989 in response to your June 16, 1989 letter and your latest comments, as contained in your September 14, 1989 correspondence. Latest revisions to the work plan are contained on pages 4-7, 4-20, 5-9, 5-10, 5-13 and 5-16, and Figure 5-6 has been updated.

Revisions to the QAPP were forwarded to the NYSDEC on July 27, 1989 and August 22, 1989. Table 2-2 was revised and forwarded to you on September 25, 1989. All of the State's comments have been incorporated in the QAPP including the latest change in Table 2-3.

Drilling at Columbia Mills is scheduled to begin October 11, 1989. Soil gas work will also take place that week.

We will keep you informed of any changes. Feel free to call if you have any questions.

Very truly yours,

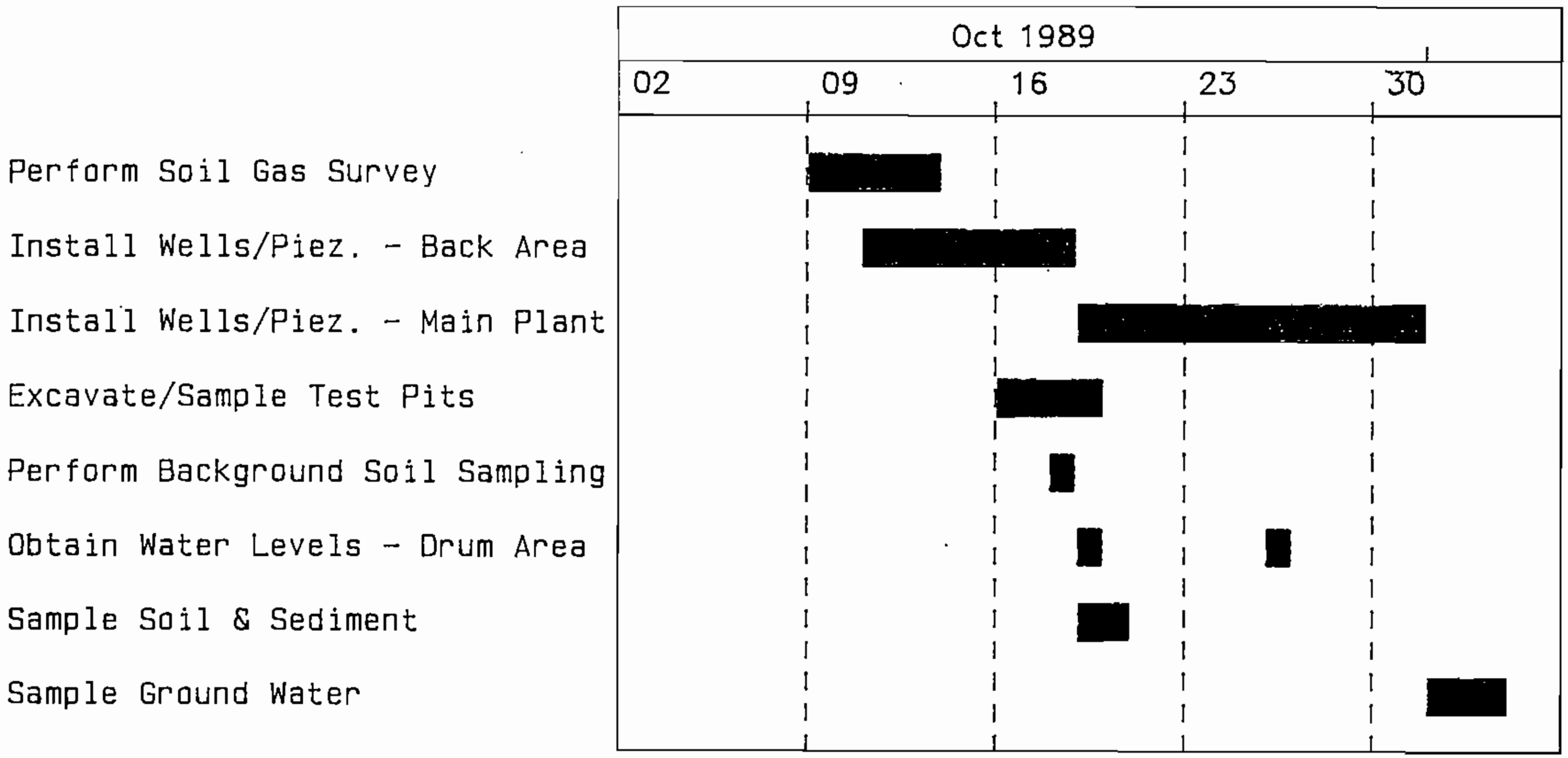
MALCOLM PIRNIE, INC.

Richard W. Klippel, P.E.
Senior Associate

slo
1069-04-1
attachments

# COLUMBIA MILLS
## REMEDIAL INVESTIGATION/FEASIBILITY STUDY
## SITE ACTIVITIES

TASKS




MALCOLM PIRNIE, INC.
OCTOBER 4, 1989

# WORK PLAN

FOR

COLUMBIA MILLS SITE
Minetto, New York

REMEDIAL INVESTIGATION/
FEASIBILITY STUDY

APRIL 1989
REVISED JULY 1989
REVISED OCTOBER 1989

MALCOLM PIRNIE, INC.
ENVIRONMENTAL ENGINEERS,
SCIENTISTS & PLANNERS
7481 Henry Clay Boulevard
Liverpool, New York 13088

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# 1.0 INTRODUCTION

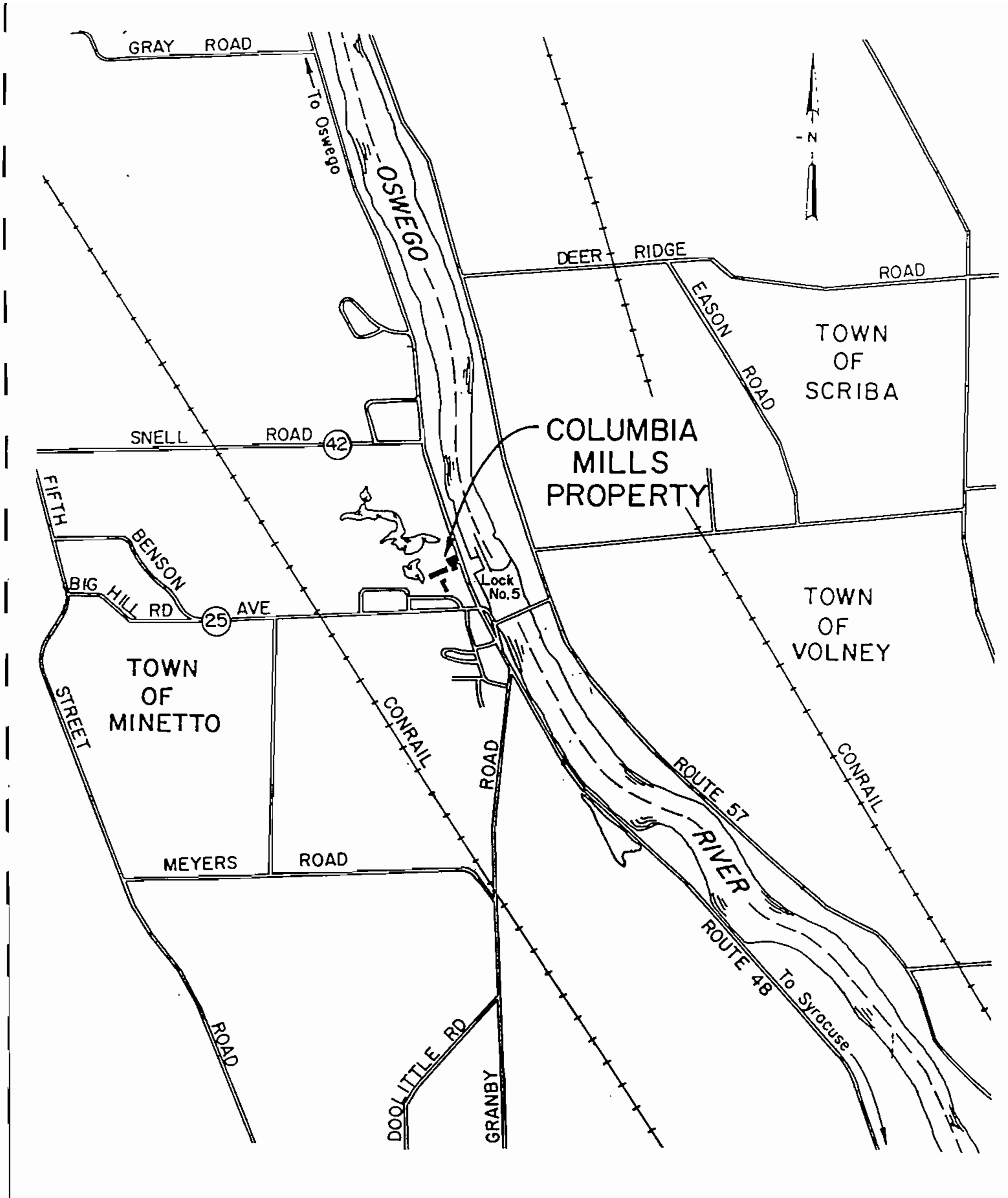
## 1.1 GENERAL

This Remedial Investigation/Feasibility Study (RI/FS) work plan has been developed for the Columbia Mills site (Registry #738012) located in Minetto, New York. The work plan has been based on information obtained during previous site investigations which were performed under the authorization of Bond, Schoeneck & King, attorneys for the former owners of the Columbia Mills site. The work plan has been developed based on United States Environmental Protection Agency (USEPA) guidance on RI/FS work plan preparation and New York State Department of Environmental Conservation (NYSDEC) guidance on selected portions of the RI/FS process.

This work plan for the Supplemental Remedial Investigation is submitted in compliance with paragraph II, page 4 of Order On Consent #A7-0161-88-12, dated February 20, 1989. A separate work plan for conducting Interim Remedial Measures at the site is submitted as a separate document.

## 1.2 SITE BACKGROUND

Columbia Mills, located in Minetto, New York (Figure 1-1) was a manufacturer of cloth and vinyl products from 1887 until the plant closed in 1976. After the plant ceased to operate, it was sold to Columin Development Corporation, who initiated salvage operations. During the salvage proceedings, asbestos (from pipe wrappings and other sources) was left exposed and buried in rubble and in remnants of the buildings left on the site. Due to economic reasons, the salvaging ended prematurely, and Columin defaulted on property taxes. Ownership of the site transferred jointly to the County of Oswego and the Town of Minetto.




MALCOLM PIRNIE

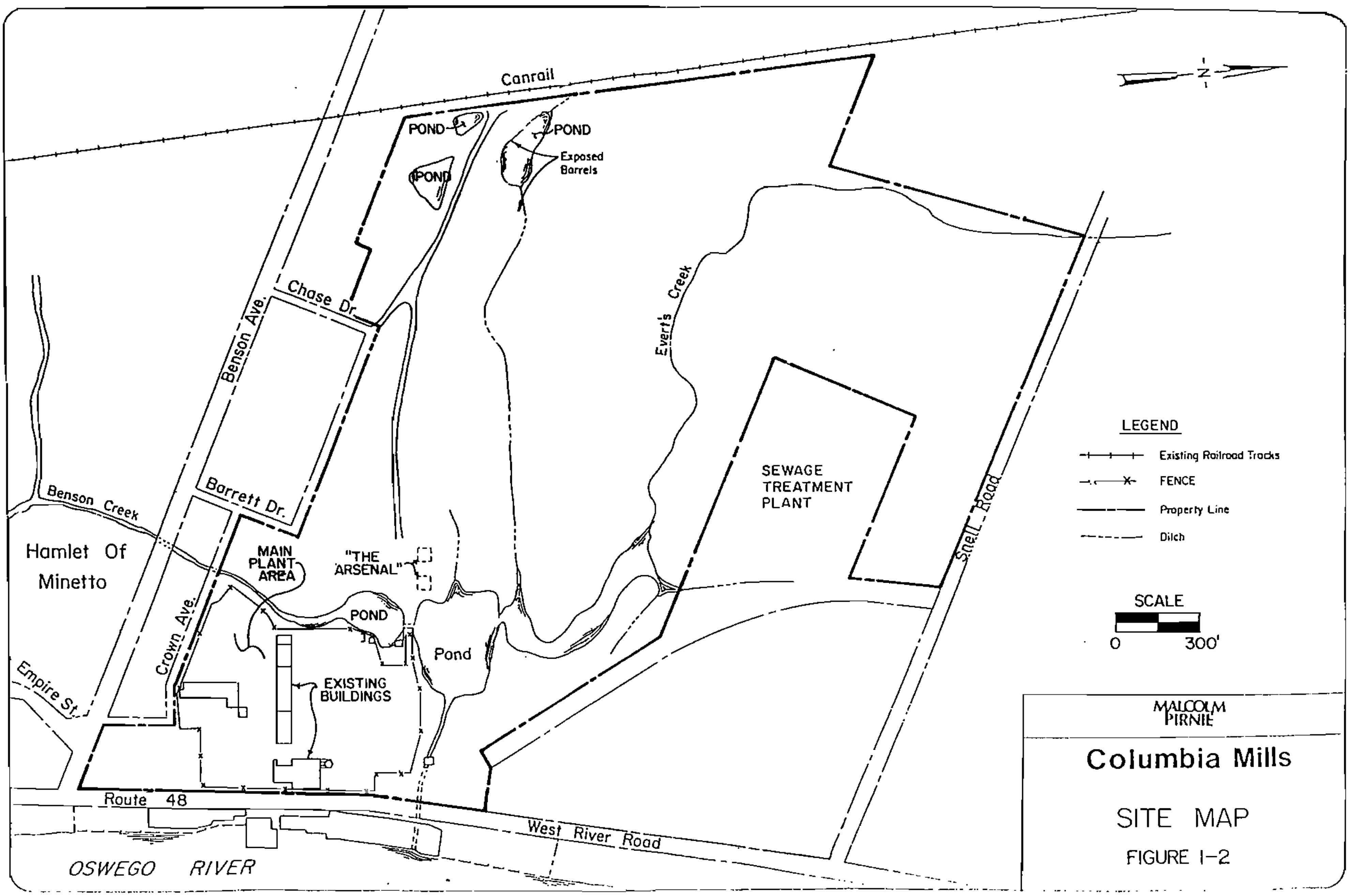
COLUMBIA MILLS
SITE LOCATION MAP

FIGURE 1-1

APRIL 1989

SCALE: 1" = 2000'

In its present state, the site consists of approximately 10 acres of standing structures, partially and completely demolished buildings and rubble and approximately 90 acres of undeveloped property, which includes several ponds, streams and the plant's former landfill (Figure 1-2).


Canrail
POND
POND
POND
Exposed Barrels
Chase Dr.
Benson Ave.
Barrett Dr.
Benson Creek
Hamlet Of Minetto
MAIN PLANT AREA
"THE ARSENAL"
POND
Pond
Crown Ave.
Empire St.
EXISTING BUILDINGS
Route 48
West River Road
OSWEGO RIVER
Evert's Creek
SEWAGE TREATMENT PLANT
Snell Road
N
LEGEND
Existing Railroad Tracks
FENCE
Property Line
Ditch
SCALE
0
300'
MALCOLM PIRNIE
Columbia Mills
SITE MAP
FIGURE 1-2

# 2.0 PROJECT OBJECTIVES AND RATIONALES

## 2.1 PURPOSE OF REMEDIAL INVESTIGATION/FEASIBILITY STUDY

The purpose of this RI/FS is to present a systematic approach to identify the following:

a. The site-specific remedial response objectives,

b. Applicable remedial technologies, and

c. The procedures needed to collect sufficient data to adequately evaluate the remedial action alternatives.

This approach leads to concurrent performance of the RI and FS portions of the report so that the FS data can be continuously evaluated and, if required, the RI activities modified accordingly.

The results of the RI/FS will be the selection of a preferred remedial action alternative which will achieve the cleanup criteria established and be cost-effective. The information contained in the RI/FS will be in sufficient detail to allow preparation of the conceptual design of the preferred remedial action alternative.

## 2.2 RI/FS PROCESS

The basic components of the RI/FS process were formulated under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) of 1980, commonly known as Superfund. Some modifications to this process resulted under the new provisions contained in the Superfund Amendments and Reauthorization Act (SARA) of 1986. The basic components of the RI/FS process, however, have remained the same. The RI continues to serve as the mechanism for collecting data for site and waste characterization, and for conducting treatability testing as necessary to evaluate the performance and cost of the treatment technologies. The FS continues to serve as the mechanism for the development, screening and detailed evaluation of potential remedial alternatives.

To be most effective, the RI and FS should be conducted in an interactive and iterative manner. Data collected during the RI influence the development of remedial alternatives in the FS which, in turn, affects data needs, the scope of treatability studies and additional field investigations. Two concepts are useful to understand the phased RI/FS. First, data can be collected in several stages. Initial data collection efforts are usually limited to developing a general understanding of the site; as the site is better characterized, subsequent site data collection can focus on filling data gaps. Second, this phased sampling approach encourages identification of key data needs early in the process to ensure that data collection is directed toward providing the necessary information to select a remedial action. In this way, the overall site characterization effort can be continually scoped to minimize the amount of data and maximize data quality. At the Columbia Mills site, the initial data collection phase and subsequent site data collection have been ongoing for several years.

Development of this work plan was based on the following USEPA Guidance documents relative to RI/FS preparation:

- Guidance on Remedial Investigations Under CERCLA, EPA/540/G-85/002, June 1985.
- Guidance on Feasibility Studies Under CERCLA, EPA/540/G-85/003, June 1985.
- Guidance For Conducting Remedial Investigations and Feasibility Studies Under CERCLA, OSWER Directive 9355,3-01, Draft, March 1988.

Further guidance was obtained from the existing USEPA regulations on the National Contingency Plan (NCP) (40 CFR Part 300) and the proposed revisions to the NCP (53 FR 51394-51520, December 21, 1988).

## 2.3 WORK PLAN RATIONALE

The work tasks included in this work plan are intended to provide information to fill data gaps that have been identified, to determine future data needs, to identify the quality of the data required and to determine what steps will be taken to satisfy the data requirements for the risk assessment and evaluation of the alternatives. The RI/FS will need to identify the migration and exposure routes and potential receptors for any contamination leaving the site. The following subsections present additional information regarding these items.

### 2.3.1 Possible Contaminant Migration Factors at the Columbia Mills Site Include:

- Infiltration of precipitation into contaminated subsurface soil and ultimately into the shallow ground water.
- Migration of contamination from the shallow aquifer into the bedrock aquifer in areas where the lodgement till layer is thin.
- Discharge of contaminated ground water into surface water bodies.
- Leaching of contaminants into surface water due to the disposal of contaminated material in the surface water.
- Migration of volatile organics through the vadose zone in the form of soil gas.
- Migration of contaminants via surface water and sediment movement.

### 2.3.2 Potential Exposure Routes

Possible exposure routes include dermal contact with contaminated soils, sediments and surface waters; ingestion of contaminated soils, sediment, surface water and ground water; inhalation of vapors, gases, volatile organics and contaminated dust; and inhalation of asbestos in the main plant area.

### 2.3.3 Potential Receptors

Potential receptors include fish and wildlife on site, nearby residents, surface water users, people using ground water for potable or non-potable uses or unauthorized personnel entering the property.

## 2.4 DEVELOPMENT OF PRELIMINARY REMEDIAL ACTION ALTERNATIVES

### 2.4.1 General

Remedial action objectives should be identified for each contaminated medium and a preliminary range of remedial action alternatives and associated technologies should be identified. The list of alternatives should be a general classification of potential remedial actions based on the initially identified potential routes of exposure and associated receptors. Alternatives for remediation are developed by assembling combinations of technologies, and the media to which they will be applied, into alternatives that address contamination on a site-wide basis or for an identified operable unit.

### 2.4.2 General Response Action

Based on previous investigation activities at the Columbia Mills site, the following remedial action objectives have been identified:

- Further define the nature of contamination (i.e. principal contaminants, transport media, horizontal and vertical extent).
- Identify the possible populations at risk and potential exposure levels (baseline risk assessment).
- Identify applicable or relevant and appropriate requirements (ARARs).
- Establish and screen response actions consistent with results of the baseline risk assessment.
- Evaluate remedial action alternatives and select a recommended alternative to meet site clean-up criteria.

General response actions that may be taken to satisfy the remedial action objectives can be considered in terms of the goals of abatement and restoration. Abatement as a goal refers to the application of methodologies which will aid in preventing contaminant migration into the various environmental medial (air, surface water, ground water). Restoration as a goal refers to the restoration of the various media to their normal quality, usually by removing or containing the source of contamination and renovating the contaminated media. Some of the abatement methodologies are more thorough in their approach to source abatement than others. The more thorough an abatement strategy is, the greater the possibilities are for relatively minor restoration measures. The effectiveness of a particular methodology in controlling contaminant migration is the principal measure of the viability of that methodology. However, other factors must be considered as well before decisions are made with regard to implementation of any methodology. These include minimization of immediate danger, the cost-effectiveness of possible remediation measures and how the methodology will work with other methodologies being utilized at the site.

Remedial methodologies can be broken down into three categories, as follows:

1. In-situ treatment methodologies.
2. Source removal methodologies.
3. Source control methodologies.

2.4.2.1 In-Situ Treatment Methodologies

In-situ treatment methods involve the reduction or elimination of the threat that certain wastes pose to water and air quality by altering the physical or chemical make-up of the wastes. Varieties of in-situ treatment technologies for contaminated soil include solution mining, neutralization/detoxification, and microbial degradiation. The development of each in-situ treatment is site and situation specific, depending very heavily on the type of waste to be treated. Waste types at the Columbia Mills site have been defined in previous investigations and are described in Section 3.0 of this work plan.

The metallic wastes in the drum disposal area have been shown to have minimal rates of migration. These migration rates may be even further reduced by chemical neutralization or fixation.

The volatile organics still present in the areas of the plant where tasks were removed could be remediated by vacuum extraction whereby the vapors are pumped from the vadose zone and captured on activated carbon.

2.4.2.2 Potential Source Removal Methodologies

One way to abate the sources of contamination at the site is to remove them by excavation. The excavated material can be handled by off-site disposal, whereby the waste is shipped to either a permitted hazardous waste facility or to a solid waste management facility depending on the hazardous or non-hazardous nature of the material. All excavated material would need to be replaced with clean soils to maximize future site utilization.

The excavated material could also be disposed of by on-site containment. This disposal method assumes that a secure facility could be constructed on another portion of the Columbia Mills site. The excavated portion of the site would be backfilled with clean soil to permit site reuse.

On-site incineration (by low temperature thermal treatment) could also be utilized to handle the excavated soil that is contaminated with organic material. The residue remaining after the process has destroyed the organic constituents could be either returned to the excavation areas or it could be used to cap other areas on-site. Suitable emission controls would have to be incorporated into the design.

Volatile organic contaminant removal can also be achieved by vacuum extraction of soil gas.

2.4.2.3 Potential Source Control Methodolgies

Abatement of contaminant migration can also be achieved by controlling the source of contamination. Methodologies for source abatement involving control of the waste source could conceivably require additional measures to restore ground water quality. However, by instituting thorough control regimes it is feasible that relatively minor measures, such as ground water monitoring, would be sufficient. The options applicable to the Columbia Mills site fall under the heading of physical containment of the wastes. Methods for physically containing the sources on the site include:

(1) Surface capping with low permeability materials to minimize the infiltration of precipitation through the waste and thus

greatly reduce the migration of contaminants into the underlying ground water. In order to effectively mitigate ground water contamination, the low permeability cap must be designed to prohibit run-on of surface water, avoid ponding on the cap surface, encourage run-off of precipitation falling on the surface and support vegetative cover that will maximize evapotranspiration.

(2) Lateral migration barriers (e.g., slurry walls) inserted into the site in a pattern that surrounds the waste deposits. To be effective these barriers should be anchored into an underlying layer of low permeability soil such as lodgement till. These physical barriers are often used in conjunction with a low permeability cap.

2.4.2.4 Ground Water Restoration Considerations

All of the abatement methodologies mentioned may also require restoration of ground water. Whether or not ground water restoration is required, the degree of restoration that is needed, and the type of treatment required are dependent on the level of the source abatement regimes instituted and the type of contaminants involved. Most ground water restoration methodologies include extraction of the ground water for treatment purposes. Whether the extraction is attained through pumping wells, collection trenches or other infiltration means is dependent on the hydrogeologic characteristics of the contaminated media at the site.

2.4.3 Remedial Action Alternatives

The following is a list of preliminary remedial action alternatives that may be applicable for the Columbia Mills site. Since the main source of wastes is the drum disposal area, the general classification of the alternative reflects the disposition of the wastes in the drum disposal area.

(1) No Action Alternatives.

(2) On-Site Containment Alternatives.

a) Excavate all waste and contaminated soil on-site for burial in a new permitted landfill which would be constructed in a suitable part of the western portion of the site. Ground water recovery and treatment would be required in the four former underground storage tank areas in the main plant area.

b) Excavate all waste and contaminated soil in the drum disposal area only and deposit the material in a new landfill constructed on site. The soil contaminated with volatile organics in the main plant area would be treated with vacuum extraction techniques. A mobile vacuum extraction system would be utilized to allow reuse of the same basic equipment in the four different areas. Ground water extraction and treatment would be implemented as necessary in the main plant area.

(3) <u>In-Place Containment Alternatives</u>

a) Excavate contaminated soil in the main plant areas, treat by aeration or by a low temperature thermal process to remove the volatile organics and utilize this soil (along with additional off-site material) to cap the waste areas in the drum disposal area. Ground water recovery and treatment in the main plant area would be required and the stream in the drum disposal area would need to be rerouted.

b) Use soil that has already been excavated from the four former underground storage tank areas to cap as much of the drum disposal area as possible, bring in additional cap material as necessary, reroute the stream in the drum disposal area and use vacuum extraction to treat the remaining in place soils in the main plant area. Ground water collection and treatment would be required in the main plant area.

(4) Off-Site Disposal Alternatives

a) Ship all contaminated soil and waste material on site to a hazardous waste landfill. Restore ground water quality through extraction and treatment.

b) Excavate contaminated soil and waste material in the drum disposal area and ship it to a secure hazardous waste disposal facility. Used vacuum extraction to treat soil in the main plant area that is contaminated with volatile organics and ground water collection and treatment to restore ground water quality.

c) Ship all contaminated soil and waste material on site to a non-hazardous waste disposal facility. Ground water collection and treatment would be required.

d) Excavate contaminated soil and waste material in the drum disposal area and ship it to a non-hazardous waste disposal facility. Use vacuum extraction to treat soil in the main plant area that is contaminated with volatile organics and ground water collection and treatment to restore ground water quality.

## 2.5 DATA NEEDS

The following data needs have been identified for the remedial action objectives. The data needs are further defined in the ensuing subsections.

- Nature of contamination
- Potential receptors, populations at risk and allowable exposure levels
- Applicable or relevant and appropriate requirements (ARARs)
- Screening of alternatives
- Data quality requirements

### 2.5.1 Nature of Contamination

The previous investigative activities at the site were aimed at identifying the nature and extent of site contamination. However, further data are required to complete the RI/FS process. The data required to further define the nature of contamination will be generated through performance of work tasks and will be used to:

- Identify the levels of contaminants present in each medium (soil, ground water, air, etc.)
- Further define the horizontal and vertical extent of contamination is the soil and ground water
- Determine the presence and extent of volatile organics migration via the unsaturated zone (soil gas).
- Further define the direction and rate of ground water flow in the shallow aquifer and in the upper portion of the bedrock aquifer.
- Further characterize the general subsurface geology, thereby determining (1) the thickness and areal extent of the lodgement till layer which separates the shallow and deep (upper bedrock) aquifer; and (2) the natural subsurface soils, and the occurrence of ground water and bedrock.
- Further characterize the extent of waste deposits in the drum disposal area.

### 2.5.2 Potential Receptors, Populations at Risk and Allowable Exposure Levels

A natural resources investigation will need to be conducted to assess potential fish and wildlife receptors. This information will be used to aid in further defining populations at risk near the site. Allowable exposure levels need to be defined to help identify potential receptors.

### 2.5.3 Applicable or Relevant and Appropriate Requirements

The following regulations need to be reviewed to determine if they are applicable to the site:

- Federal and State surface water quality standards
- Federal and State drinking water standards
- State ground water standards
- OSHA permissible exposure limits
- TSCA PCB cleanup levels

### 2.5.4 Screening of Alternatives

The following types of data are needed to screen the remedial action alternatives:

- Proven technologies for treatment and/or disposal of volatile organics
- Current cost data
- Estimated quantities of contaminants to be remediated
- Pilot or treatability study results
- Site geology and soils information

### 2.5.5 Data Quality Requirements

The quality requirements for each type of data needed in the RI/FS are summarized in Table 2-1.

TABLE 2-1

DATA QUALITY REQUIREMENTS
COLUMBIA MILLS RI/FS

| Data Needed | Data Quality Required |
|---|---|
| Contaminant identification/ concentration levels for air, soil, and ground water | See Section 2 of QAPP. |
| Soil gas | GC: Detection levels of 10% of lowest PEL for contaminants detected on site.<br>HNU: 1 ppm |
| Water level | ±0.01 foot. |
| Population information | Most recent census and field verification. |
| ARARs | Existing regulatory levels. |
| Acceptable risk clean-up criteria | ARARs when available; if ARARs are not available:<br>- non-carcinogens - no appreciable risk of significant adverse effect<br>- carcinogens - $10^{-4}$ to $10^{-7}$ lifetime excess cancer risk. |
| Treatment technology evaluation | Actual remedial action data, where available. |
| Estimated quantities of contaminated media | ±20% of actual volume. |
| Unit costs | Vendor quotations and actual costs from similar projects preferred. Compendium costs adjusted to current dollars. |
| Cost estimates | +50% - 30% all in current year dollars. |

## 3.0 PREVIOUS INVESTIGATIONS

Calocerinos & Spina, Consulting Engineers (C&S) was retained in 1984 by Oswego County to evaluate the potential for site reuse. During that preliminary investigation, several potential hazards were identified in the main plant area (the 10 acre section) and in the drum disposal area (the former landfill area in the 90 acre section), including the following. SITE REUSE STUDY

1. Underground storage tanks in the main plant area containing potential product or residue.
2. Rusted and mostly empty drums, and cinders, ashes and other plant wastes in the drum disposal area.
3. Abandoned drums and bags of chemicals in remnants of the buildings in the main plant area.
4. Due to the absence of site security measures to restrict site access such as secure fencing, the site itself was a potential hazard.

In order to evaluate potential contaminant sources in the main plant area and drum disposal area relative to human health and the environment, to improve site security measures, and to arrange for the removal of the drums and bags of chemicals in the main plant, C&S was authorized Bond, Schoeneck & King in 1985 to perform a Phase II site investigation.

Work tasks performed during the Phase II investigation included: PHASE II

1. Conducting geophysical surveys (electromagnetic terrain conductivity and magnetic)
2. Excavating test pits - DRUM AREA
3. Drilling shallow test borings and installing monitoring wells
4. Sampling and analysis of soil, ground water, surface water and sediment - DRUM AREA, PONDS
5. Air monitoring
6. Calculating a Hazard Ranking System (HRS) Score
7. Writing a report detailing the results of the Phase II investigation

Results of the Phase II investigation indicated that contamination of the soil, surface water and shallow ground water by organics had occurred in selected locations hydraulically downgradient of underground storage tanks in the main plant area. In addition, there was metals and organic contamination of the surface soil and metals contamination of surface water and sediment in the drum disposal area. The HRS score was calculated as 31.78 with component scores of 52.35 for ground water, 16.78 for surface water and 0 for the air route.

During the Phase II study, site security was improved and actions were undertaken to characterize and remove the abandoned containers of chemicals in the main plant area.

Following review of the Phase II report by the New York State Department of Environmental Conservation (NYSDEC), several meetings were held to discuss the status of the site and additional work tasks which should be performed. During these meetings it was decided that interim remedial actions would be continued, or undertaken, while additional work tasks were performed to obtain data to better define site contamination and migration and more accurately calculate the site HRS score.

The interim remedial actions included the completion of the removal of the packaged chemicals in the main plant area. Interim remedial actions also included removal of the underground storage tanks, the contents and associated contaminated soil below and around the tanks, and improving site security and limiting potential exposure to wastes in the drum disposal area.

The additional work tasks which were performed included:

1. Installation of three deeper wells on site which were used to collect data on bedrock ground water quality, deeper ground water movement and information for a recalculation of the site HRS score.
2. Performing a domestic water well inventory in the vicinity of the site to provide information on ground water usage for the HRS score recalculation.

3. Collecting samples from the tunnels and sewers, which are located primarily beneath the main plant area, to define the role of these subsurface conduits on shallow contaminant migration.
4. Collecting air samples in and downwind of the main plant area to determine if asbestos was being blown around in the main plant area and/or offsite.
5. Collecting additional soil, sediment, surface water and shallow ground water samples for analysis for an increased list of parameters to provide additional information on site contamination and contaminant migration.

Although a supplemental Phase II report was originally intended to be prepared at the conclusion of the expanded Phase II investigation, it was determined that, since the reporting requirements would be similar, a Remedial Investigation (RI) report would be prepared in lieu of the Supplemental Phase II report. Based on this decision, additional sampling and analyses were requested by the NYSDEC and New York State Department of Health. The additional sampling and analysis included collection of ground water, surface water, sediment and soil samples for analysis for the compounds on the Target Compound List.

The results of the interim remedial actions and the post-Phase II investigation were presented in a draft RI report which was submitted to the NYSDEC and the NYSDOH in October 1988. The results are summarized in the following paragraphs. RI REPORT

Over 100 containers of chemicals in the main plant area were cataloged, tested for basic chemical parameters and repacked in preparation for transport and disposal. The containers were removed from the site in the fall of 1987 and taken to an approved disposal facility.

During the summer of 1988, eight underground storage tanks were removed from the site for disposal at an approved facility. The underground storage tanks were removed from three separate areas in the main plant area. During excavation in a fourth area, where storage tanks were reportedly utilized, no tanks were found, but strong organic odors were detected. Soil and water samples were collected from the excavation for analysis.

Contaminated soil from two of the three other underground storage tank areas was staged in piles located in a separate area of the site for sampling, analysis and potential treatment or disposal. Samples were also obtained from the walls and bottoms of the excavations in the three former tank areas where tanks had been removed.

The results of the analysis indicated that soil contaminated with organic compounds including toluene, methyl ethyl ketone and/or ethyl benzene was present in all four excavation areas. Three of the five soil piles contained low levels of organics, while the other two piles contained slightly higher levels of organic constituents (total organic compounds less than 100 ppm).

During June 1988, the accessible part of the most contaminated portion of the drum disposal area was covered with a six-inch soil blanket, and large trees were cut down and positioned to block access points into this part of the site.

Three deep monitoring wells were installed in March 1987. During the drilling process it was noted that the relatively low permeability lodgement till layer, which underlies the shallow aquifer on site, is thin in certain areas of the site. Results of the analysis performed on ground water samples collected from a deep well installed in a downgradient location from one of the underground storage tank areas revealed the presence of low levels of organics, and metals (in sufficient concentration to contravene Class GA ground water standards). Apparently, contamination has migrated through the relatively thin lodgement till layer below the underground storage tank area.

No significant contamination has been detected in samples collected from the deep monitoring well installed downgradient of the drum disposal area.

Sixteen domestic water wells that are used for drinking water purposes were located within the domestic water well survey area. There were 178 dwellings surveyed and the response received totalled 154 (87 percent). The wells range in depth from eight to 75 feet below land surface. Sixteen wells in the area are used for water supply purposes, although none of the 16 wells could be considered to be located hydraulically downgradient of site contaminant areas.

Based on the deep ground water data, ground water quality analyses of samples from shallow wells on site and the domestic well inventory, the site HRS score was revised to 47.70, an increase from the score calculated during the Phase II investigation. This elevated score results from the presence of numerous wells in the area but, the scoring formula does not reflect the fact that such wells are hydraulically upgradient of the site.

No organics were detected in the storm sewer water samples and relatively low metals concentrations were detected in the tunnel sediment samples. Polychlorinated biphenyls (PCBs) were detected at high levels in the soil collected in the basement of the Boiler House, but no PCBs were detected in the tunnel sediment sample that was collected in a downgradient location from the basement area. Therefore migration of PCBs from the basement area sampled is considered negligible.

PCBs were detected in one surface sample collected outside the Boiler Room. The source of this contamination is not known.

During August 1987, approximately 200 samples were collected from the main plant area for analysis to evaluate the extent of asbestos-containing materials (ACM) on site. Asbestos was found throughout the main plant area. ACM was present in pipe insulation, wire insulation, transite board, roofing materials, boiler insulation, debris piles, soil samples and floor sweepings. Two areas of major contamination are the tunnels and the Boiler House. Air sampling was also conducted to monitor for asbestos. The results indicated asbestos in the air was less than 0.005 fibers/cc. This work was conducted by a separate contractor working for Columbia Mills.

The following conclusions, which supplement the information presented in the preceding paragraphs, were drawn in the draft RI and are warranted based on the Phase II and post-Phase II investigations.

1. The principal medium for shallow ground water flow consists of fill, lacustrine sand and silt and ablation till deposits which form a fairly continuous surficial unit underlying the site.
2. Lodgement till, of relatively low permeability, underlies the shallow aquifer below the site.
3. Although the lodgement till appears to comprise a continuous unit across the site, the thickness of this unit is variable. The lodgement till is relatively thin in certain areas of the main plant and drum disposal areas. The effectiveness of this unit as a barrier to the downward migration of contaminants is dependent on its thickness and continuity.
4. Generally, shallow ground water flow is from west to east towards the Oswego River, but, in the main plant area, subsurface conduits (tunnels, sewers, etc.) influence local flow directions.
5. Although a small component of ground water flow is occurring across the lodgement till layer, the majority of shallow ground water flow is more horizontal through the more permeable surficial deposits.
6. Deep ground water flow, in the upper portion of the bedrock aquifer, is from west to east to the Oswego River.
7. The horizontal ground water seepage velocity of the shallow zone was calculated as approximately 100 feet per year, while the seepage velocity of the bedrock aquifer was calculated to be 50 feet per year.
8. NYSDEC Class GA ground water standards or guidance values have been contravened at all wells on site, except deep well B-2, on at least one occasion. However, the only wells where compounds have been detected at levels that exceed the standards or guidance values on two or more occasions are B-2, B-6 and B-7.

9. Organics and metals have consistently exceeded standard or guidance values in ground water from shallow well B-2, which was located near five underground storage tanks. This well was destroyed during removal of the tanks and associated contaminated soil.

10. Wells B-6 and B-7, located near and in the drum disposal area, respectively, exceeded several metals standards on two occasions. On both occasions ground water collected at the wells was not filtered, therefore, the analysis was for total metals.

11. Surface water and sediment samples collected from the ponds in the drum disposal area generally have higher metals concentrations than samples collected from the stream locations.

12. Metals concentrations in the surface water and sediment generally decrease with distance from the drum disposal area ponds to the last sample location before exiting the site (near building No. 21); however, samples obtained at the location have contained significant concentrations of metals in the surface water and sediment in the past indicating that metal contaminants may have migrated to the Oswego River at times in the past.

13. The most recent analyses (April 1989) indicate that no metals were detected at high levels in surface water collected near Building No. 21, nor were organics detected in surface water at this location above detection limits. Sediment was not sampled on this date.

14. Both metals and organics are high in sediment and surface water near underground storage tank Area No. 1, located at the northwest corner of the main plant area.

15. Although concentrations of metals in the streams generally decrease with distance from the ponds in the drum disposal area, some metals contaminants (lead and chromium(T)) may be migrating from additional sources, located east of those ponds, to the downgradient streams.

16. Some contaminated soil still remains in the vicinity of the four former underground storage tank locations.

The NYSDEC and NYSDOH reviewed the draft RI report and determined that additional RI work is necessary to define the extent of contamination emanating from various source areas at the site.

# 4.0 EXISTING SITE CONDITIONS

## 4.1 GEOLOGY AND HYDROGEOLOGY

### 4.1.1 Regional Geology

Bedrock underlying Oswego County is composed of gently-dipping sedimentary rock. The groups of rocks occur in broad bands that generally trend east-west across the county. The layers of rock dip regionally to the south-southwest at approximately 25 to 50 feet per mile. The oldest rocks (Upper Ordovician) occur in the northern part of the county. Bedrock formations are progressively younger with distance southward. The youngest bedrock formations in the county are Middle Silurian age.

The topography and soils of Oswego County have been greatly influenced by repeated advances and retreats of glacial ice. The ice age began approximately 300,000 years ago. The last ice sheet retreated from the area about 12,000 years ago.

The predominant glacial deposit in the county is glacial till. The till consists of a mixture of clay, silt, sand and gravel. The till was deposited directly on the land surface as material was carried along at the bottom of the glacier.

The discharge of water from melting glacier fronts transported coarse grained material. Lakes, formed and fed by melting ice, were the depositional areas for fine grained sediments. Remnants of the glacial lakes occur in many parts of the county. Streams flowing during and after glaciation deposited alluvium and formed alluvial fans in many areas.

### 4.1.2 Regional Hydrogeology

Ground water is found in the bedrock underlying the county and in the unconsolidated deposits overlying bedrock. Ground water occurs in the openings between the individual grains that make up the unconsolidated deposits. The amount of ground water that is able to be stored in the unconsolidated material is a measure of its porosity. The porosity is largely controlled by the uniformity, or degree of sorting, of the deposit. The porosity is an indicator of how much water can be stored in a deposit, but not of how much water can be withdrawn from it. The amount of water that can be withdrawn is largely controlled by the size of the particles in the deposit, and is a measure of the specific yield. In general, deposits of glacial till have low porosity and low specific yield. Conversely, sand and gravel deposits represent the best ground water yielding deposits in the county due to the high porosity and high specific yield.

Compared to the unconsolidated deposits, the bedrock has relatively uniform physical and water-bearing properties. The present porosity of the bedrock is secondary porosity, the result of fractures that developed due to stresses that were applied to the rock. The specific yield of the bedrock is controlled by the amount and width of the water-bearing fractures. The upper surface of the bedrock is usually highly fractured, but fracture density often decreases with depth. Generally, bedrock is a better source of ground water than till or clay and silt, but a poorer source than either sand and gravel or mixed unconsolidated deposits.

Water in saturated, surficial unconsolidated deposits usually occurs under water table conditions. Water in buried unconsolidated deposits and in bedrock generally occurs under artesian pressure.

Ground water is constantly moving from recharge areas toward discharge areas, that is, the water table roughly mirrors surface water drainage patterns, moving from topographically high areas to low areas (marshes, streams, rivers, etc.). However, under confining pressures (artesian) ground water can flow contrary to natural topographic flow directions.

### 4.1.3 Site Geologic and Hydrogeologic Assessment

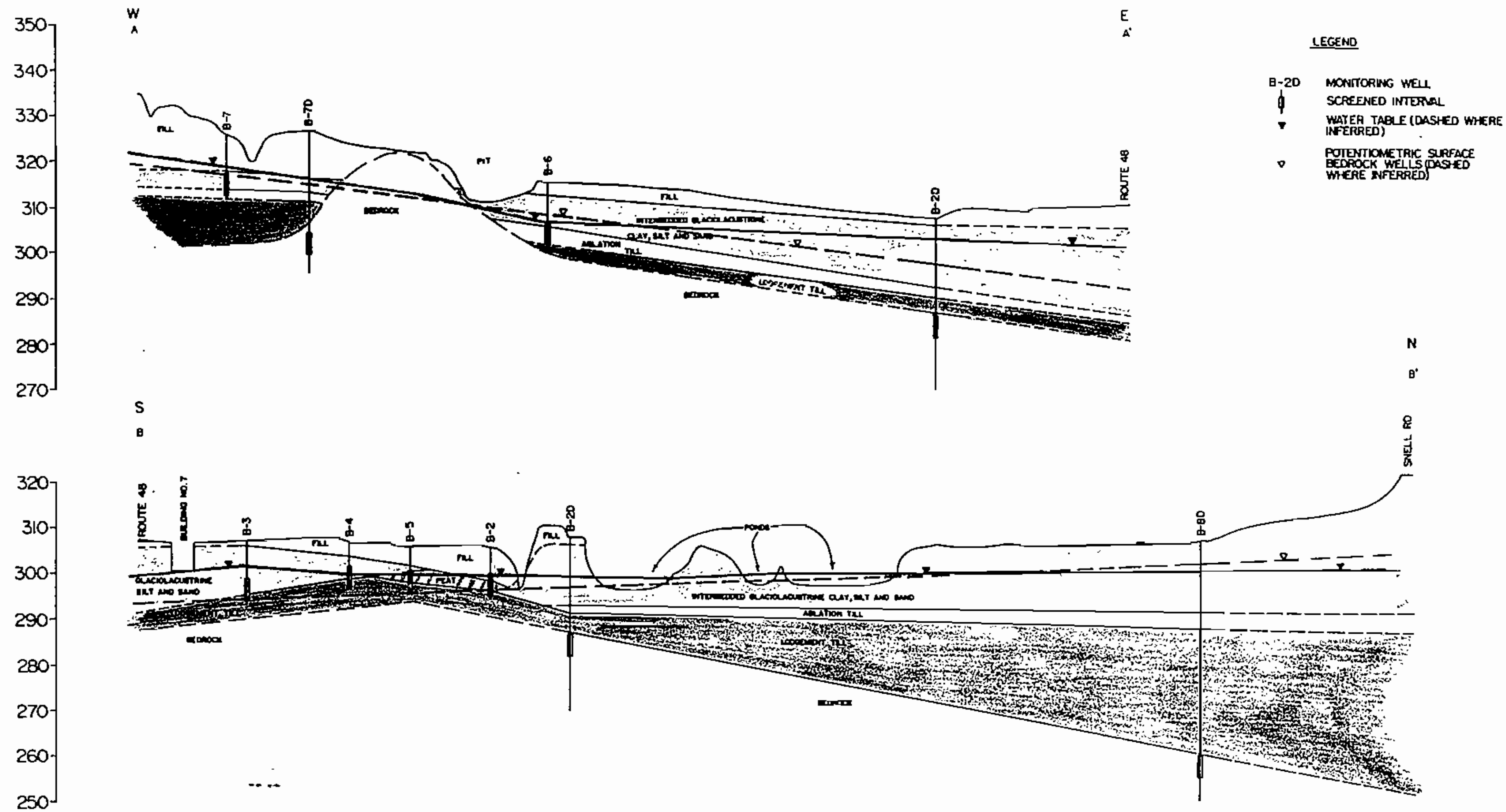
#### 4.1.3.1 Site Geology

Based on information obtained during the drilling at the site, the thickness of the unconsolidated deposits beneath land surface varies from 20 feet in the vicinity of the drum disposal area (B-7D), to 20.7 feet in the plant area (B-2D), to 46 feet near the Minetto Waste Water

Treatment Plant (B-8D). These horizons correspond to the occurrence of the top of bedrock. According to information obtained during the remedial investigation test pits, bedrock is shallower in other areas of the site. Bedrock occurs at a depth of less than one foot below land surface in the area east of B-7D and south of the stream that discharges from Pond 1. The unconsolidated deposits consist of, in descending order, discontinuous miscellaneous fill, glaciolacustrine sand and silty sand, interbedded glaciolacustrine sand and clay, ablation till and lodgement till. In certain areas of the site, the ablation till is absent. The interrelationship of the geologic units underlying the site is illustrated on the hydrogeologic cross-sections presented as Figure 4-1. The plan-view locations of the cross-sections are shown on Figure 4-2.

Bedrock of the Medina Group (Lower Silurian) occurs below the unconsolidated deposits. The Medina Group consists of hard, massive red and green sandstone interbedded with red and green siltstone and shale. The apparent dip of the top of bedrock below the site is roughly northward. Structural deformation of the bedrock, or some type of glacial scouring process which has caused erosion of the bedrock surface, may be responsible for the lower bedrock elevation near the Waste Water Treatment Plant.

The thickness of glacial lodgement till (which directly overlies bedrock) varies as a consequence of the variation in elevation of the top of bedrock. As glaciers overrode the area, subsequent to the structural deformation or the scouring process, they deposited glacial lodgement till. In general, lodgement till was deposited in greater thicknesses in areas where the bedrock was topographically lower. The lodgement till averages about four feet thick in the plant and drum disposal areas, while it is 27 feet thick near the Waste Water Treatment Plant. The thickness of the lodgement till is important due to its relatively low permeability and its ability to be an effective barrier to potential downward vertical migration of contaminants.




WATER LEVELS BASED ON MEASUREMENTS
RECORDED ON AUGUST 18,1987

MALCOLM PIRNIE

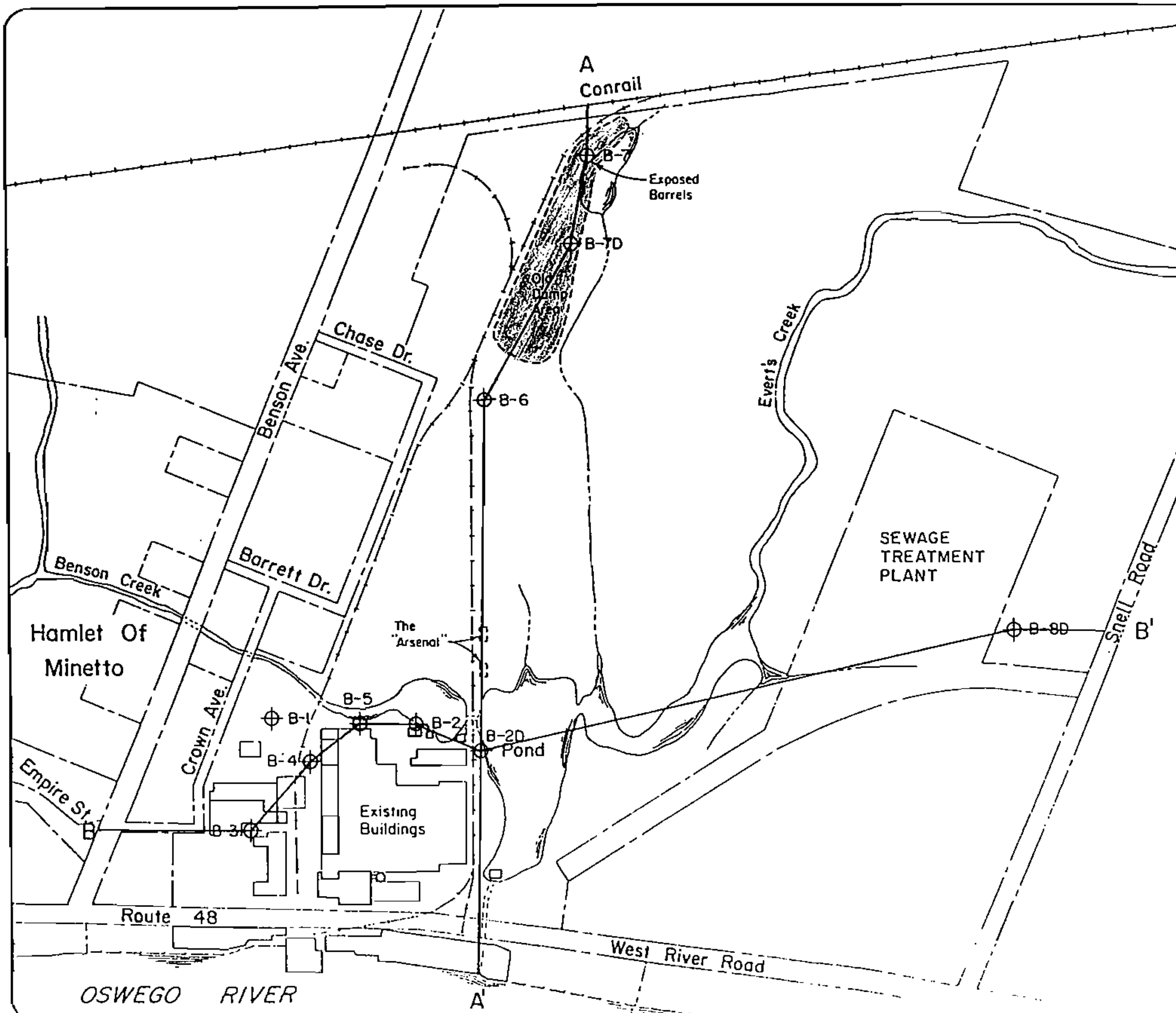
REVISIONS

COLUMBIA MILLS

HYDROGEOLOGIC CROSS SECTIONS A-A' AND B-B'

DATE APRIL 1989

FIGURE 4-1




MALCOLM PIRNIE

## Columbia Mills

### MONITORING WELL LOCATIONS

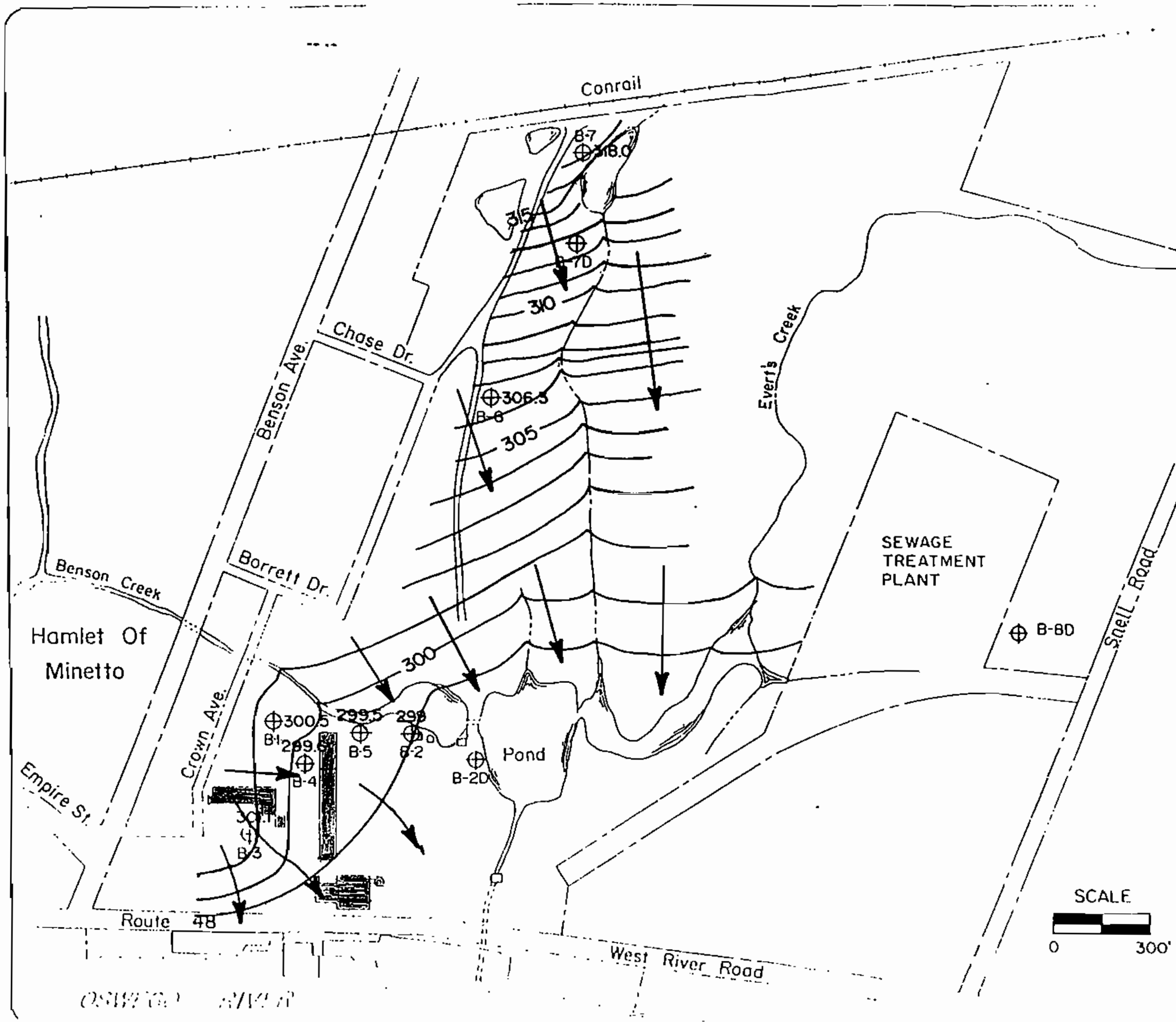
FIGURE 4-2

#### 4.1.3.2 Ground Water Movement in Shallow Zone

The principal medium for shallow ground water flow consists of the fill, lacustrine sands and silts and ablation till deposits which form a fairly continuous surficial unit at the site. Recharge to this zone is from infiltration of precipitation through the unsaturated zone to the water table. Horizontal flow into the site is from the south and west. The lodgement till underlying the surficial unit has a much lower permeability and retards downward flow. Although the thickness of the lodgement till varies across the site, it appears to comprise a continuous unit. Therefore, the majority of shallow ground water flow is horizontal through the more permeable surficial deposits. Shallow ground water discharges to the marshes, creeks and ponds within the site and to the Oswego River. Figure 4-3 presents the configuration of the water-table surface and the direction of ground water flow in the shallow zone. The water-table map is based on water levels recorded at the seven shallow monitoring wells on site on August 18, 1987. Monitoring well data are presented on Table 4-1 and the monitoring well locations are shown on Figure 4-2. The water level elevations are listed on Table 4-2. Generally, shallow ground water flow is from west to east towards the Oswego River.

In the eastern portion of the site, in the main plant area, ground water flow is influenced by a multitude of natural and man-made factors. The effects of these factors ar superimposed on the west-to-east regional flow towards the Oswego River. The magnitude of the effects are increased by the shallow nature of the deposits. Man-made influences on shallow ground water flow include permeable back-fill materials along buried conduits (sewers, pipes), basements and the system of tunnels beneath the buildings which lead to the Oswego River. Ground water is directed along the linear features at a higher flow rate due to the higher permeability in the vicinity of the features.

Slug tests were performed at the shallow monitoring wells to estimate the permeability of the surficial materials, and to attempt to estimate shallow ground water flow rates. Although the mean horizontal




MALCOLM PIRNIE

Columbia Mills

WATER TABLE MAP
AUGUST 18, 1987

FIGURE 4-3

TABLE 4-1

COLUMBIA MILLS MONITORING WELL DATA

| MONITORING WELL | LAND SURFACE ELEVATION | STICK UP (feet) | MEASURING POINT ELEVATION | TOTAL well DEPTH (Feet Below Land Surface) |
|---|---|---|---|---|
| B-1 | 308.5 | 2.8 | 311.3 | 10 |
| B-2 | 305.6 | 2.1 | 307.7 | 12 |
| B-2D | 308.2 | 2.1 | 310.3 | 26.9 |
| B-3 | 307.2 | 1.7 | 308.9 | 13 |
| B-4 | 306.8 | 1.9 | 308.7 | 10 |
| B-5 | 305.9 | 1.6 | 307.5 | 10 |
| B-6 | 315.7 | 1.9 | 317.6 | 14 |
| B-7 | 328.1 | 2.5 | 328.6 | 13.5 |
| B-7D | 326.9 | 2.2 | 329.1 | 27.4 |
| B-8D | 307.8 | 1.7 | 309.5 | 51.4 |

Note: Elevations are relative to feet above mean sea level.

TABLE 4-2

COLUMBIA MILLS
WATER LEVEL ELEVATIONS
SHALLOW AND DEEP MONITORING WELLS

| MONITORING WELL | MEASURING POINT ELEVATION (Top of well) | | DATES: 11/22/85 | 4/3/87 | 4/29/87 | 6/25/87 | 8/18/87 | 10/19/87 | 1/18/88 | 4/1/88 |
|---|---|---|---|---|---|---|---|---|---|---|
| B-1 | 311.3 | | 307.1 | 304.7 | 303.3 | 302.1 | 300.5 | 302.5 | 303.1 | 304.4 |
| B-2 | 307.7 | | 304.9 | 303.9 | 302.8 | 302.4 | 299 | 301.9 | 302.5 | 298.6 |
| B-2D | 310.3 | | N.A. | 299.9 | 299.3 | 298.6 | 296.6 | 298.3 | 298.6 | 298.3 |
| B-3 | 309.3 | Land: 302.2 | 306.7 .5 | 305.3 1.9 | 303.6 3.6 | 302.5 4.7 | 301.1 6.1 | 303.3 | 303.2 | 304.9 |
| B-4 | 308.9 | | 303.5 | 302.6 | 301.0 | 300.5 | 299.6 | 300.5 | 305.2 | 302.2 |
| B-5 | 307.9 | | 305.2 | 304.0 | 303.5 | 302.3 | 299.5 | 302.2 | 302.7 | 301.6 |
| B-6 | 317.8 | | 313.5 | N.A. | 313.5 | 306.2 | 306.3 | 307.8 | 310.4 | 311.8 |
| B-7 | 328.6 | | 321.7 | 319.4 | 319.3 | 318.8 | 318 | 318.4 | 319.1 | 319.2 |
| B-7D | 329.1 | | N.A. | 318.5 | 317.9 | 317 | 315 | 315.9 | 317.3 | 318.5 |
| B-8D | 309.5 | | N.A. | 306.0 | 305.4 | 304.3 | 300.9 | 303.7 | 304.6 | 305.5 |
| POND NORTH OF MAIN PLANT | | | | | | | | | 295.6 | |
| POND WEST OF MAIN PLANT | | | | | | | | | 302.5 | |

permeability of the shallow unconsolidated deposits was calculated to be $1 \times 10^{-3}$ cm/sec, the system of conduits and tunnels serve to collect, and transmit shallow ground water at a high flow rate along a nearly direct pathway to the discharge point at the Oswego River.

The average ground water seepage velocity (VS) between contaminant sources and these conduits was calculated using the mean horizontal permeability of the shallow aquifer ($1 \times 10^{-3}$ cm/sec), a typical horizontal hydraulic gradient and an estimate of the effective porosity.

A. Mean horizontal permeability (K) of the fill = $1 \times 10^{-3}$ cm/sec.

B. A typical horizontal hydraulic gradient (dh/dl) (between wells B1 and B4) in the vicinity of the buildings = 0.03.

C. An estimate of the effective porosity ($n_e$) of permeable, granular fill materials = 0.3.

The shallow, horizontal ground water seepage velocity was calculated during the Phase II investigation (using a variation of Darcy's Law) to be:

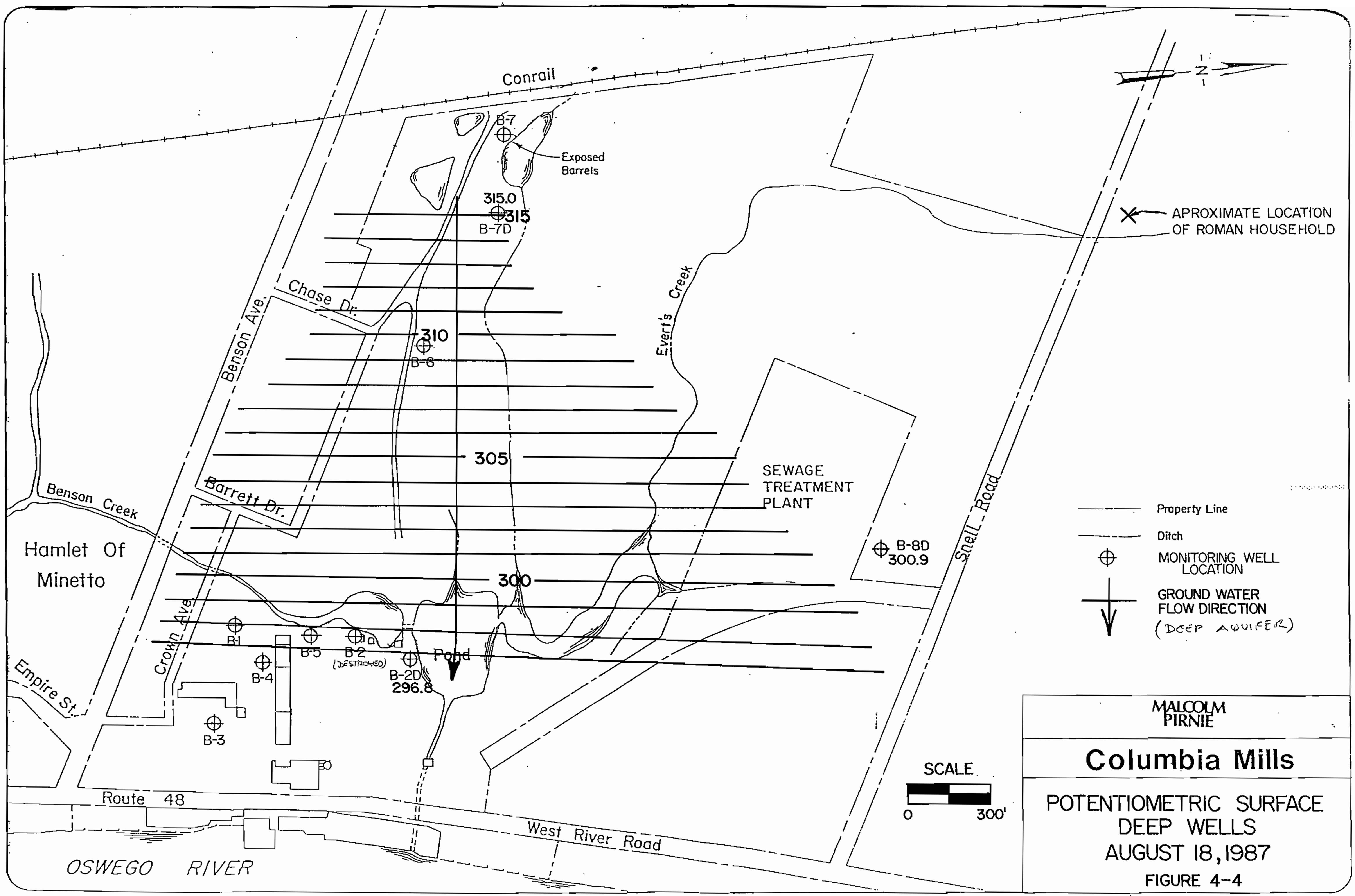
$$VS = \frac{K}{n_e}\frac{dh}{dl} = \frac{(1 \times 10^{-3} \text{ cm/sec})}{0.3}(0.03) = 1 \times 10^{-4} \text{ cm/sec}$$

or approximately = 100 ft/year

#### 4.1.3.3 Ground water Movement in Deep Zone

Ground water in the upper portion of the bedrock aquifer underlying the site flows in an easterly direction toward the Oswego River. The ground water flow direction within this zone is illustrated on Figure 4-4. The potentiometric surface shown on Figure 4-4 is based on water levels recorded at the three deep wells on site on August 18, 1987. The water level elevations are shown on Table 4-2.

The rate at which the ground water flows in the bedrock is dependent on the size and abundance of fractures which give the rock its secondary porosity. According to core samples of the rock that were obtained during drilling of the bedrock test borings, the bedrock is massive with relatively few fractures. The fractures that were seen


Conrail
B-7
Exposed Barrels
315.0
315
B-7D
Chase Dr.
Benson Ave.
310
B-6
Evert's Creek
305
SEWAGE TREATMENT PLANT
Barrett Dr.
Benson Creek
Hamlet Of Minetto
300
B-8D
300.9
Snell Road
Crown Ave.
B-1
B-5
B-2
(DESTROYED)
B-4
B-2D
296.8
Pond
Empire St.
B-3
Route 48
West River Road
OSWEGO RIVER
N
APROXIMATE LOCATION OF ROMAN HOUSEHOLD
Property Line
Ditch
MONITORING WELL LOCATION
GROUND WATER FLOW DIRECTION
(DEEP AQUIFER)
SCALE
0
300'
MALCOLM PIRNIE
Columbia Mills
POTENTIOMETRIC SURFACE DEEP WELLS
AUGUST 18, 1987
FIGURE 4-4

were filled with clay and silt. The RQD calculated for the core samples averaged 85 percent. The RQD is equivalent to the cumulative length of unbroken core pieces greater than four inches in length divided by the length of the core run. It is expressed as a percentage. In general, the higher the RQD percentage, the lower the fracture content in the rock.

The average seepage velocity for the deep zone was estimated based on the average horizontal hydraulic conductivity (K = 5 x $10^{-4}$ cm/sec), the average hydraulic gradient between B-7D and B-2D (dh/dl = 0.01) and an estimated effective porosity ($n_e$ = 0.1). Calculated seepage velocity for the shallow bedrock aquifer is 5 x $10^{-5}$ cm/sec or approximately 50 feet per year. This rate is one half the rate calculated for flow in the shallow zone beneath the site.

## 4.2 SITE CONTAMINATION

### 4.2.1 Shallow and Deep Ground Water

A summary of ground water sampling and analyses that have been performed to date is presented on Table 4-3. The compounds that were detected during these analyses are listed, according to whether the NYSDEC Class GA ground water standard or guidance value has been exceeded, on Table 4-4. The compounds that were detected in the samples collected during April 1988, for analysis for the Target Compound List (TCL) parameters, are listed on Table 4-5.

Contravention of Class GA ground water standards or guidance values has occurred at all wells on site except B-7D on at least one occasion. Several of the exceedences are one-time exceedences of standards or guidance values for organic compounds which were detected when lower detection limits were employed using Method 601/602 GC analysis. The one-time contravention list includes deep well B-8D, which is located hydraulically downgradient of the Waste Water Treatment Plant.

TABLE 4-3

COLUMBIA HILLS
GROUND WATER SAMPLING AND ANALYSIS

PHASE II

| DATE | LOCATION | LABORATORY | ANALYTICAL METHOD(S) OR PARAMETERS |
|---|---|---|---|
| October 1985 | Seven Shallow Wells * | CompuChem Laboratories | USEPA 624 |
| October 1985 | B-6 and B-7 | C & S Environmental Laboratory | Cd, Cr(H), Cr(T), Cu, Pb, Ni, Ag, Zn |
| April 1987 | All Wells ** | Upstate Laboratories, Inc. | USEPA 601/602; Cd, Cr(H), Cr(T), Cu, Pb, Ni, Ag, Zn |
| August 1987 | All Wells | Upstate Laboratories, Inc. | USEPA 624; Cd, Cr(T), Cu, Pb, Ni, Ag, Zn |
| October 1987 | All Wells | Upstate Laboratories, Inc. | USEPA 624 |
| October 1987 | B-2, B-2D, B-6, B-7, B-7D, B-8D | " " " | Cd, Cr(H), Cr(T), Cu, Pb, Ni, Ag, Zn |
| October 1987 | B-1, B-3, B-4, B-5 | " " " | Cd, Cr(T), Cu, Pb, Ni, Ag, Zn |
| April 1988 | B-1, B-2, B-2D, B-3, B-7, B-7D | WESTON Analytics | Target Compound List |

POST-PHASE II

DISC. NOTED

Notes: April 1987 and August 1987 - Metals samples were unfiltered (Total)
October 1985 and October 1987 - Metal Samples were filtered (Dissolved)

* - Includes B-1, B-2, B-3, B-4, B-5, B-6, and B-7

** - Includes B-1, B-2, B-2D, B-3, B-4, B-5, B-6, B-7, B-7D, and B-8D

TABLE 4-4
COLUMBIA MILLS
SUMMARY OF GROUND WATER ANALYSES
VOLATILE ORGANICS AND METALS

NOTE: 4/88 DATA IS ON TABLE 4-5.

| MONITORING WELL | COMPOUND DETECTED (BELOW STANDARD OR GUIDANCE VALUE) | VALUE (ug/l) | DATE | COMPOUND DETECTED (ABOVE STANDARD OR GUIDANCE VALUE) | VALUE (ug/l) | DATE | CLASS GA GW STANDARD OR GUIDANCE VALUE (ug/l) |
|---|---|---|---|---|---|---|---|
| 1 | | | | 1,1-Dichloroethylene | 2 | 04/28/87 | 0.07 (G) |
| | 1,1,1-Trichloroethane | TR<1 | 04/28/87 | | | | 50 (G) |
| 2 | | | | Toluene | 190000 | 10/07/85 | 50 (G) |
| | | | | Toluene | 1500 | 04/28/87 | 50 (G) |
| | | | | Toluene | 23000 | 08/18/87 | 50 (G) |
| | | | | Toluene | 29000 | 10/19/87 | 50 (G) |
| | | | | Total Xylenes | 100 | 04/28/87 | 50 (G) |
| | Ethylbenzene | 25 | 04/28/87 | | | | 50 (G) |
| | | | | Cadmium | 18 | 10/19/87 | 10 (S) |
| | | | | Lead | 600 | 04/28/87 | 25 (S) |
| | | | | Lead | 500 | 08/18/87 | 25 (S) |
| 2D | Toluene | 16 | 04/28/87 | | | | 50 (G) |
| | Toluene | 5 | 08/18/87 | | | | 50 (G) |
| | 1,1,1-Trichloroethane | TR<1 | 04/28/87 | | | | 50 (G) |
| | | | | Cadmium | 12 | 10/19/87 | 10 (S) |
| 3 | Toluene | 1.9 | 10/07/85 | | | | 50 (G) |
| | Toluene | 8 | 04/28/87 | | | | 50 (G) |
| | Toluene | 5 | 08/18/87 | | | | 50 (G) |
| | | | | 1,1,2,2-Tetrachloroethane | 13 | 10/07/85 | 0.2 (G) |
| 4 | Toluene | TR<1 | 04/28/87 | | | | 50 (G) |
| | Toluene | 3 | 08/18/87 | | | | 50 (G) |
| | 1,1,1-Trichloroethane | 1 | 04/28/87 | | | | 50 (G) |
| | | | | Lead | 100 | 08/18/87 | 25 (S) |
| 5 | Toluene | 14 | 04/28/87 | | | | |
| | Ethylbenzene | 9 | 04/28/87 | | | | 50 (G) |
| | Ethylbenzene | 31 | 10/19/87 | | | | 50 (G) |
| | Chloroform | 1 | 04/28/87 | | | | 100 (S) |
| | 1,1,1-Trichloroethane | 1 | 04/28/87 | | | | 50 (G) |
| | | | | Total Xylenes | 69 | 04/28/87 | 50 (G) |
| | | | | 1,1-Dichloroethylene | 14 | 04/28/87 | 0.07 (G) |
| 6 | Toluene | 5 | 08/18/87 | | | | 50 (G) |
| | Chlorofrom | 11 | 04/28/87 | | | | 100 (S) |
| | 1,1,1-Trichloroethane | 2 | 04/28/87 | | | | 50 (G) |
| | | | | 1,1-Dichloroethylene | 4 | 04/28/87 | 0.07 (G) |
| | | | | Lead | 200 | 04/28/87 | 25 (S) |
| | | | | Lead | 100 | 08/18/87 | 25 (S) |

FLUCTUATES

METALS UNFILTERED

DRUM AREA

TABLE 4-4 (con d)
COLUMBIA MILLS
SUMMARY OF GROUND WATER ANALYSES
VOLATILE ORGANICS AND METALS

| MONITORING WELL | COMPOUND DETECTED (BELOW STANDARD OR GUIDANCE VALUE) | VALUE (ug/l) | DATE | COMPOUND DETECTED (ABOVE STANDARD OR GUIDANCE VALUE) | VALUE (ug/l) | DATE | CLASS GA GW STANDARD OR GUIDANCE VALUE (ug/l) |
|---|---|---|---|---|---|---|---|
| 7 | Methylene chloride | 2.6 | 10/07/85 | | | | 50 (G) |
| | Chloroform | 7 | 04/28/87 | | | | 100 (S) |
| | | | | 1,1-Dichloroethylene | TR<1 | 04/28/87 | 0.07 (G) |
| | | | | Cadmium | 110 | 04/28/87 | 10 (S) |
| | | | | Cadmium | 120 | 06/18/87 | 10 (S) |
| | | | | Copper | 2500 | 04/28/87 | 1000 (S) |
| | | | | Lead | 55000 | 04/28/87 | 25 (S) |
| | | | | Lead | 58000 | 08/18/87 | 25 (S) |
| | | | | Zinc | 22000 | 06/18/87 | 5000 (S) |
| 7D | Chloroform | 6 | 04/28/87 | | | | 100 (S) |
| 8D | 1,1,1-Trichlorethane | 2 | 04/28/87 | | | | 50 (G) |
| | Trichloroethylene | 1 | 04/28/87 | | | | 10 (S) |
| | | | | 1,1-Dichloroethylene | 3 | 04/28/87 | 0.07 (G) |

DRUM AREA

METALS ARE UNFILTERED

TABLE 4-5
COLUMBIA MILLS
TCL ANALYSIS - 04/11/88
GROUND WATER
Malcolm Pirnie - Syracuse

| PARAMETER | NYSDEC (note 7) | MW-1S | MW-2S | MW-2D | MW-3S | MW-7S | MW-7D |
|---|---|---|---|---|---|---|---|
| Benzene | nd | <5 | 24 J | <5 | <5 | <5 | <5 |
| Toluene | 50 (G) | <5 | 20,000 | 1 | <5 | <5 | <5 |
| Ethylbenzene | 50 (G) | <5 | 11 J | <5 | <5 | <5 | <5 |
| Xylenes(total) | 50 (G) | <5 | 110 | <5 | <5 | <5 | <5 |
| Unknown | - | 8 | - | - | - | - | - |
| Unknowns | - | - | - | - | Note 2 | - | - |
| 2-Methylphenol | n.a. | <10 | 21 | <10 | <10 | <10 | <10 |
| 4-Methylphenol | n.a. | <10 | 22 | <10 | <10 | <10 | <10 |
| Naphthalene | 10 (G) | <10 | 4 J | <10 | <10 | <10 | <10 |
| Phenanthrene | 50 (G) | <10 | 3 J | <10 | <10 | <10 | <10 |
| Fluoranthene | 50 (G) | <10 | 1 J | <10 | <10 | <10 | <10 |
| Pyrene | 50 (G) | <10 | 1 J | <10 | <10 | <10 | <10 |
| Unknowns | - | - | - | - | Note 3 | - | - |
| Silver | 50 (S) | <10 | <10 | 17.3 | 10.4 | <10 | <10 |
| Aluminum | n.a. | <200 | 398 | <200 | <200 | <200 | <200 |
| Arsenic | 25 (S) | 19.7 | <10.0 | 14.4 | <10.0 | <10.0 | <10.0 |
| Barium | 1,000 (S) | 234 | 400 | 513 | <200 | <200 | 238 |
| Calcium | n.a. | 96,500 | 103,000 | 76,200 | 66,200 | 51,600 | 56,300 |
| Iron | 300 (S) | 6,690 | 15,700 | 580 | 580 | 580 | 580 |
| Magnesium | 35,000 (G) | 8,140 | 9,800 | 25,600 | 8,880 | 7,110 | 15,900 |
| Manganese | 300 (S) | 3,420 | 4,250 | 1,310 | 3,640 | 2,310 | 116 |
| Sodium | n.a. | <5,000 | 14,700 | 48,700 | 43,200 | 6,230 | 12,900 |
| Lead | 25 (S) | <5.0 | 10.8 | <5.0 | <5.0 | <5.0 | <5.0 |
| Antimony | 3 (G) | <60.0 | <60.0 | <60.0 | 64.1 | <60.0 | <60.0 |
| Zinc | 5,000 (S) | 72.9 | 48.9 | 51.5 | 86.7 | 86.7 | 86.7 |
| Cyanide, total | 200 (S) | <10.00 | 152 | <10.00 | 29.2 | 153 | <10.00 |

METALS ARE FILTERED

NOTES
1. All results in ug/l.
2. 15 VOA unknowns ranging in concentration from 5 to 89 ug/l.
3. 2 BNA unknowns of concentration equal to 12 and 15 ug/l.
4. J = present, but below detection limit; nd = not detected.
5. Metals samples were filtered in the field.
6. Only those organics and metals that were detected are include on this table.
7. NYSDEC class GA standards (S) or guidance (G) values.

Contamination of wells B-2, B-6 and B-7 has occurred on more than one occasion at levels that exceed standards and guidance values. Volatile organics and metals are the contaminants of concern at well B-2, while metals are the principal concern at wells B-6 and B-7. The metals contamination observed at all three wells was detected when samples were analyzed for total metals as opposed to dissolved metals. Well B-2 was destroyed during interim remedial efforts.

Organic and metals contamination has been detected at deep well B-2D, while organic contamination has been observed at all other wells in the main plant area (i.e., shallow wells B-1, B-3, B-4 and B-5). The source of contamination at these wells is attributed to former underground storage tanks that were located in different areas of the main plant.

The lodgement till layer, below the shallow saturated zone, is relatively thin near B-2D and is projected to be thin near B-2. Due to the thinness of this layer, contamination has migrated from the shallow zone to the upper portion of the bedrock aquifer. However, the principal routes of contaminant migration from point sources in the main plant area are via shallow horizontal ground water flow through the unconsolidated deposits overlying the lodgement till unit and through more permeable backfill around man-made conduits including pipes, sewers and tunnels.

Due to the relative immobility of the metals contaminants in the drum disposal area, few metals have been detected in shallow ground water collected at wells B-6 and B-7, and no metals have been detected at significant levels at deep well B-7D which is located hydraulically downgradient of the main drum disposal area.

During October 1987, a domestic well located on Snell Road (Roman's Well) was sampled and analyzed for compounds on the EPA Method 624 list and for several metals including cadmium, lead and hexavalent chromium. The results of this analysis are included as Appendix D. The results indicated that all compounds except zinc were below the detection limit. Zinc was detected at 0.041 ppm.

Revised Text (2)

Since the location of this well results in the ground water sampled being hydraulically separated from the site, this well should classify as an upgradient well location.

All homes located hydraulically downgradient of the site are served by a public water supply.

4.2.2 Surface Water and Sediment

Surface water and sediment samples have been collected at various locations in the ponds and streams located on the Columbia Mills property. The samples have been collected and analyzed during the preliminary site investigation, during the Phase II investigation and during the initial remedial investigation. Table 4-6 lists the samples that have been collected during these investigations according to sample date, sample location, analytical method and laboratory performing the analysis.

One surface water sample was collected from the pond located to the west of well B-2 during the preliminary site investigation in June 1984. The sampling location is shown on Figure 4-5. The sample was analyzed for the compounds on the USEPA Methods 601/602 lists. According to the analytical results, 34,300 ppb of toluene, 72 ppb benzene and 50 ppb total xylenes were detected. B-2 POND

Five surface water and sedime[illegible] ie PONDS 1&3
Phase II investigation in August [illegible] ls
located in the drum disposal area [illegible] on
Figure 4-5. Samples were submitte[illegible] nd
for metals analysis.

THE SOURCE OF THIS PROBLEM SEEMS TO HAVE BEEN VST-1 TANKS (WHICH HAS BEEN ALLEVIATED IN SUMMER '88).

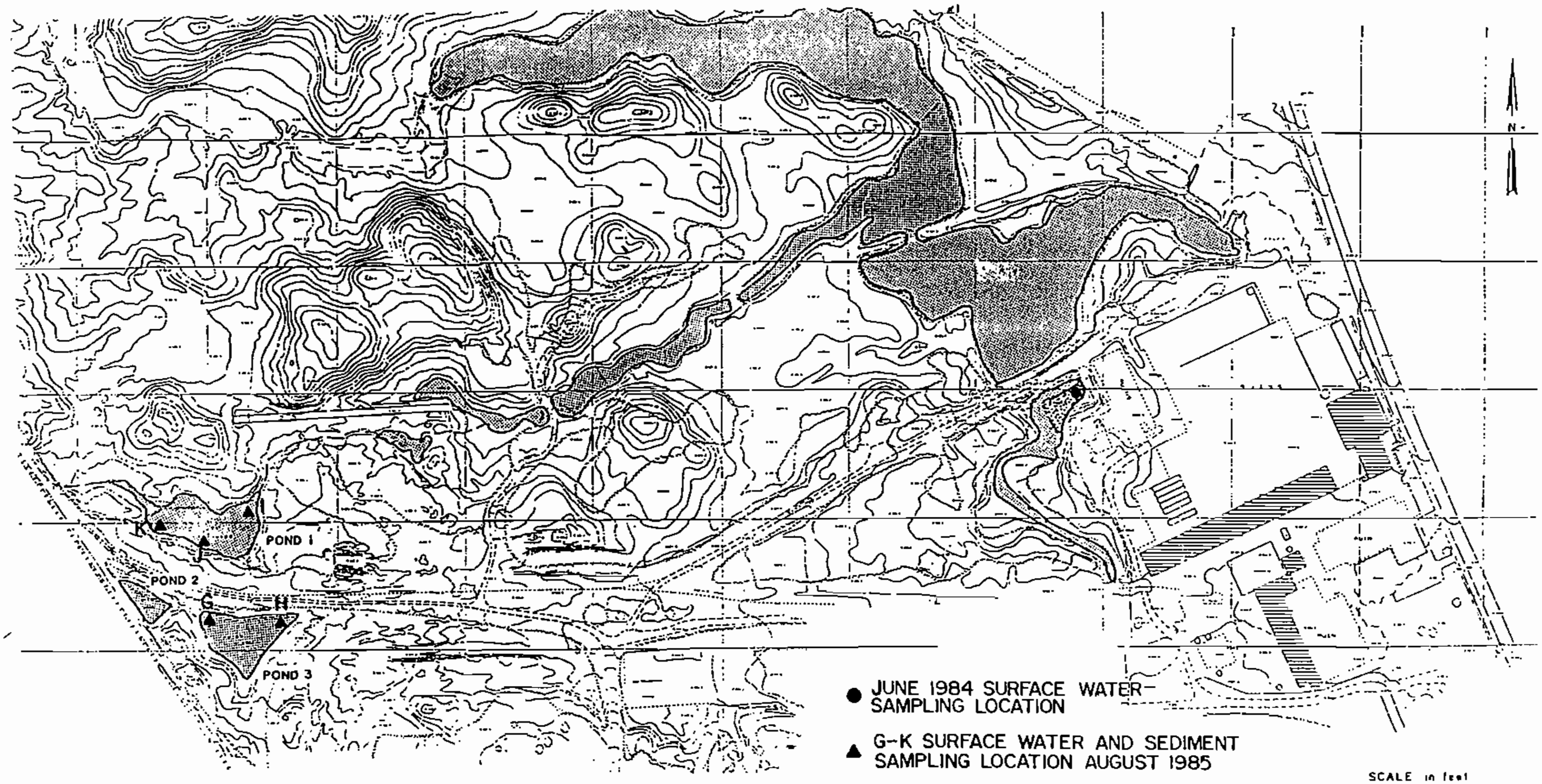
The results of the metals [illegible] 7.
Samples G and H (both sediment an[illegible] om
Pond 3, located south of the rail [illegible] re
collected from Pond 1, located n[illegible] er
Ponds 2 nor 3 have distinct disc[illegible] hy
with well defined drainage both in [illegible] he
concentration of metals in the sur[illegible] 1

Revised Text

TABLE 4-6
COLUMBIA MILLS
SURFACE WATER AND SEDIMENT
SAMPLING AND ANALYSIS

| | DATE | SAMPLE TYPE & SAMPLE LOCATION | ANALYTICAL METHODS OR PARAMETERS | LABORATORY |
|---|---|---|---|---|
| INITIAL SURVEY — | June 1984 | Water (1) - pond west of well B-2. | USEPA 601 & 602 | CS Environmental |
| PHASE II — | August 1985 | Water (5) and sediments (5) - ponds 1 & 3 in drum disposal area. | USEPA 624; Cd, Cr(h), Cr, Cu, Pb, Ni, Ag, Zn | CompuChem - organics<br>CS Environmental - metals |
| POST-PHASE II ↓ | April 1987 (WET SEASON) | Water (5) - ponds 1,2,3 in drum disposal area. | Cd, Cr(h), Cr, Cu, Pb, Ni, Ag, Zn | Upstate |
| | | Sediment (5) - ponds 1,2,3 in drum disposal area. | USEPA 601 & 602; Cd, Cr(h), Cr, Cu, Pb, Ni, Ag, Zn | Upstate |
| | | Water (5) - Streams along discharge path from ponds 1,2,3. | USEPA 601 & 602; Cd, Cr(h), Cr, Cu, Pb, Ni, Ag, Zn | Upstate |
| | | Sediment (5) - streams along discharge path from ponds 1,2,3. | Cd, Cr(h), Cr, Cu, Pb, Ni, Ag, Zn | Upstate |
| | August 1987 (DRY SEASON) | Water (2) - pond 3 in drum disposal area. | Cd, Cr, Cu, Pb, Ni, Ag, Zn | Upstate |
| | | Water (3) - streams. | USEPA 624; Cd, Cr, Cu, Pb, Ni, Ag, Zn | Upstate |
| | | Sediment (13) - ponds 1,2,3 in drum disposal area. | Cd, Cr, Cu, Pb, Ni, Ag, Zn | Upstate |
| | | Sediment (5) - streams | Cd, Cr, Cu, Pb, Ni, Ag, Zn | Upstate |
| | April 1988 | Water (1) - west of sluice gate exiting pond north of main plant. | TCL parameters | WESTON Analytics |
| | | Sediment (3) - at confluence of stream exiting pond 1 and pond 1 and in ponds north and west of main plant | TCL parameters | WESTON Analytics |

NOTE: Metals analyses were for total metals, except for chromium (hexavalent as denoted by Cr(h)).




| MALCOLM PIRNIE | REVISIONS | COLUMBIA MILLS<br>MINETTO, NEW YORK | SURFACE WATER AND SEDIMENT SAMPLING LOCATIONS<br>JUNE 1984 AND AUGUST 1985 | DATE APRIL 1989<br>FIGURE 4-5 |
|---|---|---|---|---|

TABLE 4-7
COLUMBIA MILLS
METALS ANALYSIS
SURFACE WATER AND SEDIMENT SAMPLES
PHASE II INVESTIGATION

| | CADMIUM | CHROMIUM (total) | CHROMIUM (hex) | COPPER | LEAD | NICKEL | SILVER | ZINC |
|---|---|---|---|---|---|---|---|---|
| SURFACE WATER | | | | | | | | |
| G | LT 0.01 | LT 0.01 | LT 0.004 | 0.01 | 0.11 | 0.02 | LT 0.03 | 2.3 |
| H | LT 0.01 | LT 0.01 | LT 0.004 | LT 0.01 | 0.08 | 0.01 | LT 0.03 | 0.04 |
| I | 0.06 | 0.11 | 0.009 | 0.10 | 0.6 | 3 | LT 0.03 | 77 |
| J | 0.53 | 2.0 | 0.010 | 0.80 | 3.5 | 7 | LT 0.03 | 330 |
| K | 0.08 | 0.39 | 0.010 | 0.53 | 0.9 | 2 | LT 0.03 | 62 |
| SEDIMENT | | | | | | | | |
| G | 2 | 40 | LT 0.04 | 14 | 150 | 9 | LT 0.3 | 960 |
| H | 6 | 88 | LT 0.04 | 160 | 13,000 | 60 | 0.3 | 3,200 |
| I | 5 | 20 | LT 0.04 | 20 | 82 | 130 | 0.3 | 2,300 |
| J | 3 | 32 | LT 0.04 | 14 | 210 | 110 | LT 0.3 | 1,800 |
| K | 0.7 | 7.8 | LT 0.04 | 7.5 | 21 | 23 | LT 0.3 | 380 |

NOTE: 1. All sediment sample results expressed in mg/kg.
2. All surface sample results in ug/l.

TABLE 4-8
SURFACE WATER AND SEDIMENTS — PHASE II
VOLATILE ORGANIC ANALYSIS

METHOD USEPA 624

| | WATER G | WATER H | WATER I | WATER J | WATER K | SEDIMENT G | SEDIMENT H | SEDIMENT I | SEDIMENT J | SEDIMENT K |
|---|---|---|---|---|---|---|---|---|---|---|
| Chloromethane | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL |
| Vinyl chloride | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL |
| Chloromethane | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL |
| Bromomethane | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL |
| Acrolein | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL |
| Acrylonitrile | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL |
| Methylene chloride | 3.0 B | 4.5 B | 1.0 | 2.4 | 1.4 | BDL | BDL | BDL | BDL | BDL |
| Trichlorofluoromethane | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL |
| 1,1-Dichloroethylene | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL |
| 1,1-Dichloroethane | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL |
| t-1,2-Dichloroethylene | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL |
| Chloroform | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL |
| 1,2-Dichloroethane | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL |
| 1,1,1-Trichloroethane | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL |
| Carbon tetrachloride | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL |
| Bromodichloromethane | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL |
| 1,2-Dichloropropane | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL |
| t-1,3-Dichloropropene | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL |
| Trichloroethylene | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL |
| Benzene | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL |
| c-1,3-Dichloropropene | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL |
| 1,1,2-Trichloroethane | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL |
| Dibromochloromethane | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL |
| Bromoform | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL |
| 1,1,2,2-Tetrachloroethylene | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL |
| 1,1,2,2-Tetrachloroethane | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL |
| Toluene | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL |
| Chlorobenzene | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL |
| Ethylbenzene | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL |
| 2-Chloroethyl vinyl ether | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL |

NOTE: 1. BDL = below detection limit.
2. Water samples in ug/l; sediment in ug/kg.
3. Sediment detection limits = 100 for acrolein & acrylonitrile; 10 for others.
Water detection limits = 10 for acrolein & acrylonitrile; 1 for others.
4. B = also found in blank; value shown corredted for concentration in blank.

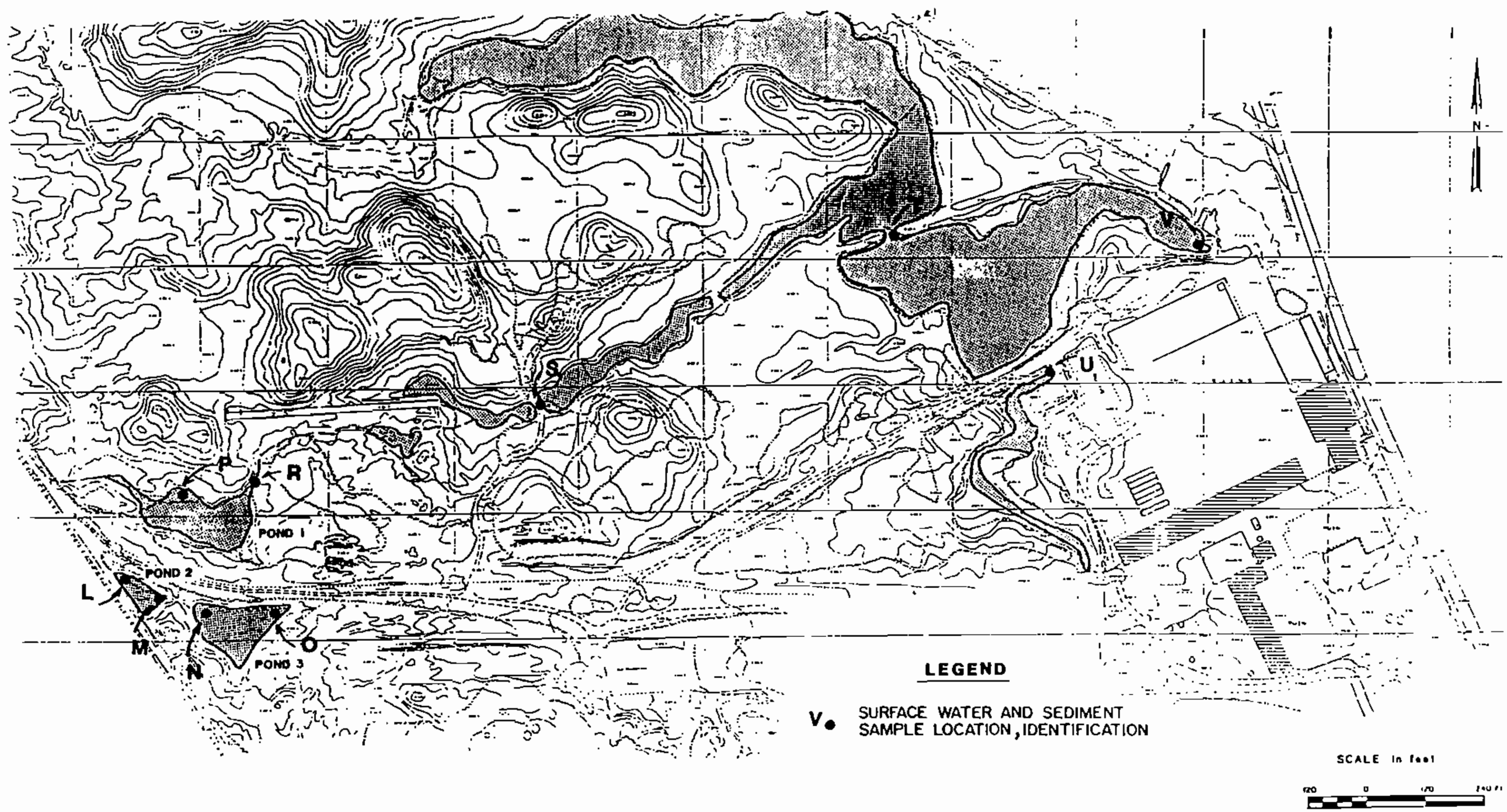
were elevated relative to those samples collected in Pond 3 (other than for silver which was consistently below detection limits). Concentrations of metals in the sediment samples are generally higher in those collected from Pond 3 relative to those from Pond 1. One possible explanation for this occurrence is that the lack of discharge from the area south of the tracks may serve to concentrate contaminants in the sediments, whereas the flushing action north of the tracks tends to suspend more sediments, and contaminants, in the surface water.

The results of the volatile organic analyses for the surface water and sediments collected in Ponds 1 and 3 are listed on Table 4-8. Methylene chloride was the only parameter detected in either the surface water samples or the sediment samples.

Surface water and sediment samples have been collected from the ponds and streams located on site as part of the remedial investigation. Samples were collected during April 1987, a seasonally wet period, and during August 1987, a seasonally dry period. The two 1987 sampling events were chosen to provide data for an evaluation of contaminant concentration and migration under the seasonally different conditions. The 1987 samples were analyzed for metals and/or organics, as shown on Table 4-6. Additional samples were collected in April 1988 in locations where major confluences between ponds and streams occur. The 1988 samples were analyzed for the TCL parameters.

Ten surface water and sediment samples were collected on April 28, 1987 at the locations shown on Figure 4-6. Sample points L, M, N, O and P represent five locations where samples were taken from ponds 1, 2 and 3 in the drum disposal area. These samples were collected as source samples to see if, or how much, contamination was already present in the ponds. Sample points R, S, T, U and V represent locations where five surface water and sediment samples were collected at downstream locations. These samples were taken to evaluate contaminant migration and to identify potential additional sources of contamination.

Dry weather samples were collected on August 19, 1987 at the locations shown on Figure 4-7. During the sampling, there were only five surface water samples collected. The samples were collected at

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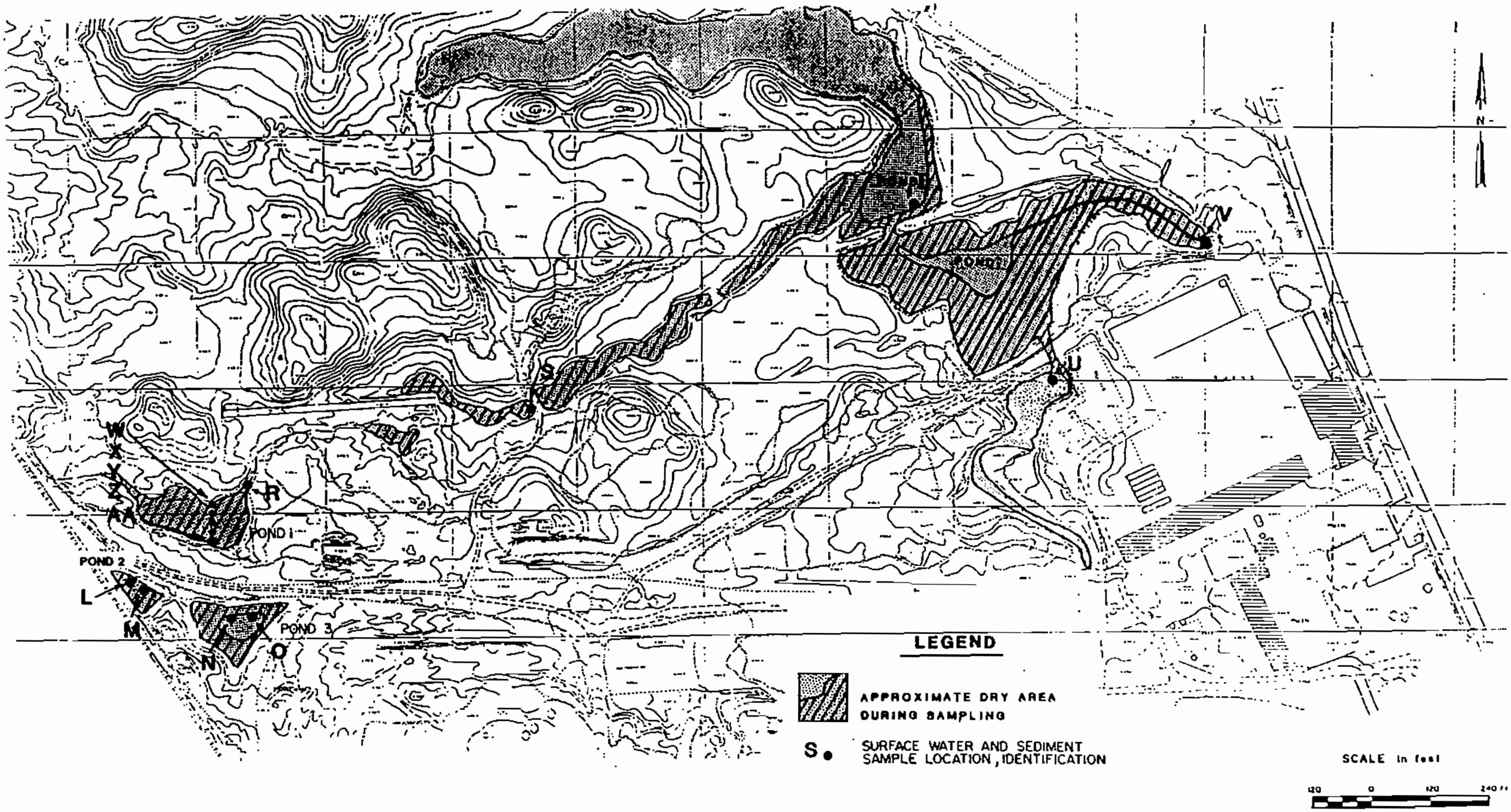
SURFACE WATER AND SEDIMENT SAMPLING LOCATIONS 4-28-87

APRIL 1989

FIGURE 4-6

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MINETTO, NEW YORK

SURFACE WATER AND SEDIMENT SAMPLING LOCATIONS 8-19-87

DATE APRIL 1989
FIGURE 4-7

points N and O (pond samples) and at points T, U and V (stream discharge samples). All other surface water sampling locations were dry at this time.

Sediment samples collected during the dry weather event included the same locations as during the wet weather sampling with the exception of point P. Point P was replaced by samples taken at points W, X, Y, Z and AA to obtain a horizontal profile of sediment in the bottom of Pond 1. At locations X and Z, additional samples were collected at depths of one and two feet below the sediment surface in the pond to determine the depth of contamination in the pond.

All 1987 surface water and sediment samples were analyzed for metals including cadmium, chromium (hexavalent), chromium (total), copper, lead, nickel, mercury and zinc. Surface water and sediment samples collected at points R, S, T, U and V were analyzed according to USEPA Method 624 for volatile organic priority pollutants (Table 4-6).

Tables 4-9 and 4-10 present the results of metals analyses performed on surface water and sediment samples collected during the wet and dry sampling events in 1987, respectively. The results of the analysis performed on the surface water samples indicate the presence of cadmium, copper and zinc during both conditions. Zinc was detected at the highest concentrations, ranging from 20 ppm at point O (pond 3), to 0.006 ppm at point U (stream location) during dry weather sampling. Cadmium and copper were present at relatively lower concentrations (not exceeding 0.7 ppm). Lead was present in Pond 3 at 0.2 ppm and 0.7 ppm during dry weather only. The concentrations of the remaining metals, including chromium (hexavalent), chromium (total), nickel and silver, were all below detectable limits.

Of the eight metals parameters tested for surface water, only copper and zinc were present at any of the stream sample locations.

The results of sediment samples for metals analysis indicate a much wider range of concentrations for all metals tested except chromium (hexavalent), which was the only parameter below detectable limits. Silver was present only once, at point P, at a concentration of 4 ppm. Zinc and lead were detected in the highest concentrations (greater than

TABLE 4-8
COLUMBIA MILLS
WET WEATHER SAMPLING
APRIL 1987

SURFACE WATER

| SAMPLE LOCATION | HEX CHROMIUM | TOTAL CADMIUM | TOTAL CHROMIUM | TOTAL COPPER | TOTAL LEAD | TOTAL NICKEL | TOTAL SILVER | TOTAL ZINC |
|---|---|---|---|---|---|---|---|---|
| L | <0.01 | <0.005 | <0.05 | <0.02 | <0.1 | <0.03 | <0.05 | 0.27 |
| M | <0.01 | 0.007 | <0.05 | <0.02 | <0.1 | <0.03 | <0.05 | 0.040 |
| N | <0.01 | <0.005 | <0.05 | <0.02 | <0.1 | <0.03 | <0.05 | 0.074 |
| O | <0.01 | <0.005 | <0.05 | <0.02 | <0.1 | <0.03 | <0.05 | 0.061 |
| P | <0.01 | 0.005 | <0.05 | <0.02 | <0.1 | <0.03 | <0.05 | 0.89 |
| R | <0.01 | <0.005 | <0.05 | <0.02 | <0.1 | <0.03 | <0.05 | 0.11 |
| S | <0.01 | <0.005 | <0.05 | <0.02 | <0.1 | <0.03 | <0.05 | 0.35 |
| T | <0.01 | <0.005 | <0.05 | <0.02 | <0.1 | <0.03 | <0.05 | 0.011 |
| U | <0.01 | <0.005 | <0.05 | <0.02 | <0.1 | <0.03 | <0.05 | 0.011 |
| V | <0.01 | <0.005 | <0.05 | 0.03 | <0.1 | <0.03 | <0.05 | 0.009 |

Results expressed in ppm.

SEDIMENT

| SAMPLE LOCATION | HEX CHROMIUM | TOTAL CADMIUM | TOTAL CHROMIUM | TOTAL COPPER | TOTAL LEAD | TOTAL NICKEL | TOTAL SILVER | TOTAL ZINC |
|---|---|---|---|---|---|---|---|---|
| L | <5 | 9.2 | 57 | 590 | 3000 | 42 | <1.0 | 7800 |
| M | <5 | 1.0 | 20 | 13 | 120 | 2.7 | <1.0 | 94 |
| N | <5 | 0.63 | 13 | 9.2 | 58 | 4.6 | <1.0 | 100 |
| O | <5 | 1.2 | 200 | 57 | 1300 | 24 | <1.0 | 690 |
| P | <5 | 0.93 | 2.6 | 5.7 | 20 | 2.0 | 4.0 | 41 |
| R | <5 | 2.1 | 42 | 70 | 250 | 8.6 | <1.0 | 37 |
| S | <5 | 14 | 15 | 30 | 73 | 14 | <1.0 | 33 |
| T | <5 | 16 | 15 | 32 | 81 | 15 | <1.0 | 41 |
| U | <5 | 3.5 | 20 | 68 | 160 | 64 | <1.0 | 1100 |
| V | <5 | 0.24 | 5.9 | 36 | 55 | 4.3 | <1.0 | 87 |

Results expressed in mg/kg (or ppm).

1,000 ppm) while concentrations of copper and chromium (total) were detected at relatively high concentrations (greater than 100 ppm) in some locations. The remaining parameters, including cadmium, nickel and silver, are present at relatively lower and more consistent levels. The samples collected with depth at points X-X2 and Z-Z2 indicate concentrations of metals at these locations generally decrease with depth, but still contain concentrations above detectable limits at a depth of two feet.

Table 4-11 and 4-12 present the results of the 1987 volatile organic analysis for surface water and sediment samples at stream locations R, S, T, U and V. Of the thirty-two organic parameters included in the analysis, only three parameters: chloroform, 1,1-dichloroethylene and 1,1,1-trichloroethane were detected in the surface water samples. None were detected in the sediment samples. Chloroform was present at locations R, S, U and V in concentrations ranging from one to three ppm. A trace amount of 1,1,1-trichloroethane was present at point R, and one ppm at point S. 1,1-Dichloroethylene was present at a concentration of eight ppm at point U. These three parameters were all detected during the wet weather conditions (sampled April 28, 1987). During the dry weather sampling, only points T, U and V were sampled (the remaining locations were dry). The results revealed all parameters tested to be below detectable limits.

Three sediment samples and one surface water sample were collected on April 11, 1988 at the locations shown on Figure 4-8. The samples were obtained for analysis for parameters included on the TCL. The sediment samples labeled SED-3 and SED-1 were obtained to provide information on contaminants on the TCL that might have migrated from Pond 1 and from underground storage tank Area No. 1, respectively. Sample SED-2 was obtained to allow for assessment of contamination that could have migrated from sources located downgradient of Pond 1. The surface water sample was collected from near Building No. 21 to provide information on contaminants on the TCL that could be migrating via surface water to the Oswego River. This location (SW-1) is hydraulically downgradient of essentially all surface water on site.

TABLE 4-11
COLUMBIA MILLS-SURFACE WATER SAMPLES
VOLATILE ORGANICS

| SAMPLING LOCATION | DATE SAMPLED | Chloro-methane | Bromo-methane | Vinyl chloride | Chloro-ethane | Methyl-ene chloride | Trichloro-fluoro-methane | 1,1-Di-chloro-ethylene | t-1,2-Di-chloro-ethylene | 1,1-Di-chloro-ethane | Chloro-form | 1,2-Di-chloro-ethane | 1,1,1-Tri-chloro-ethane | Benzene | Carbon tetra-chloride | 1,2-Di-chloro-propane | Bromodi-chloro-methane | Tri-chloro-ethylene |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| R | 04/28/87 | <1 | <1 | <1 | <1 | <5 | <1 | <1 | <1 | <1 | 2 | <1 | TR<1 | <1 | <1 | <1 | <1 | <1 |
| | 08/11/87 | | | | | | | | | | | | | | | | | |
| S | 04/28/87 | <1 | <1 | <1 | <1 | <5 | <1 | <1 | <1 | <1 | 2 | <1 | 1 | <1 | <1 | <1 | <1 | <1 |
| | 08/11/87 | | | | | | | | | | | | | | | | | |
| T | 04/28/87 | <1 | <1 | <1 | <1 | <5 | <1 | <1 | <1 | <1 | <1 | <1 | <1 | <1 | <1 | <1 | <1 | <1 |
| | 08/11/87 | <3 | <3 | <3 | <3 | <3 | <3 | <3 | <3 | <3 | <3 | <3 | | <3 | <3 | <3 | <3 | <3 |
| U | 04/28/87 | <1 | <1 | <1 | <1 | <5 | <1 | 8 | <1 | <1 | 3 | <1 | <1 | <1 | <1 | <1 | <1 | <1 |
| | 08/11/87 | <3 | <3 | <3 | <3 | <3 | <3 | <3 | <3 | <3 | <3 | <3 | | <3 | <3 | <3 | <3 | <3 |
| V | 04/28/87 | <1 | <1 | <1 | <1 | <5 | <1 | <1 | <1 | <1 | 1 | <1 | <1 | <1 | <1 | <1 | <1 | <1 |
| | 08/11/87 | <3 | <3 | <3 | <3 | <3 | <3 | <3 | <3 | <3 | <3 | <3 | | <3 | <3 | <3 | <3 | <3 |

| SAMPLING LOCATION | DATE SAMPLED | c-1,3-Di-chloro-propene | t-1,3-Di-chloro-propene | 1,1,2-Tri-chloro-ethane | Toluene | Dibromo-chloro-methane | Tetra-chloro-ethylene | 2-Chloro-ethyl-vinyl ether | Chloro benzene | Ethyl-benzene | Bromo-form | 1,1,2,2-Tetra-chloro-ethane | 1,2-Di-chloro-benzene | 1,3-Di chloro-benzene | 1,4-Di-chloro-benzene | Total Xylenes |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| R | 04/28/87 | <1 | <1 | <1 | <1 | <1 | <1 | <1 | <1 | <1 | <1 | <1 | <1 | <1 | <1 | <1 |
| | 08/11/87 | | | | | | | | | | | | | | | |
| S | 04/28/87 | <1 | <1 | <1 | <1 | <1 | <1 | <1 | <1 | <1 | <1 | <1 | <1 | <1 | <1 | <1 |
| | 08/11/87 | | | | | | | | | | | | | | | |
| T | 04/28/87 | <1 | <1 | <1 | <1 | <1 | <1 | <1 | <1 | <1 | <1 | <1 | <1 | <1 | <1 | <1 |
| | 08/11/87 | <3 | <3 | <3 | <3 | <3 | <3 | <3 | <3 | <3 | <3 | <3 | <3 | <3 | <3 | <3 |
| U | 04/28/87 | <1 | <1 | <1 | <1 | <1 | <1 | <1 | <1 | <1 | <1 | <1 | <1 | <1 | <1 | <1 |
| | 08/11/87 | <3 | <3 | <3 | <3 | <3 | <3 | <3 | <3 | <3 | <3 | <3 | <3 | <3 | <3 | <3 |
| V | 04/28/87 | <1 | <1 | <1 | <1 | <1 | <1 | <1 | <1 | <1 | <1 | <1 | <1 | <1 | <1 | <1 |
| | 08/11/87 | <3 | <3 | <3 | <3 | <3 | <3 | <3 | <3 | <3 | <3 | <3 | <3 | <3 | <3 | <3 |

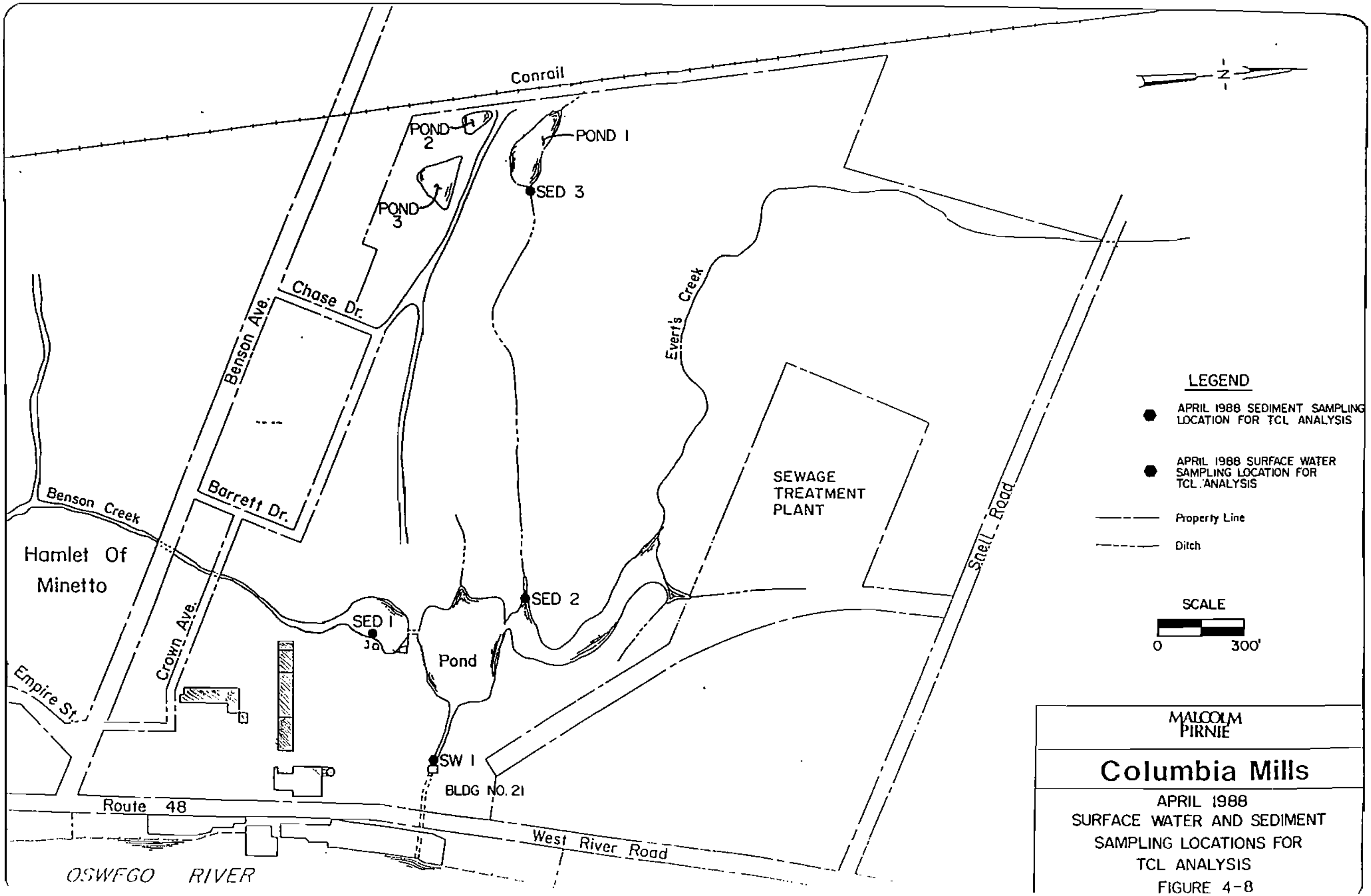
NOTES: 1. All results expressed as ppb.
2. 04/28/87 - wet weather samples.
3. 08/11/87 - dry weather samples.

TABLE 4-12
COLUMBIA MILLS-SEDIMENT SAMPLES
VOLATILE ORGANICS

| SAMPLING LOCATION | DATE SAMPLED | Chloro-methane | Bromo-methane | Vinyl chloride | Chloro-ethane | Methyl-ene chloride | Trichloro-fluoro-methane | 1,1-Di-chloro-ethylene | t-1,2-Di-chloro-ethylene | 1,1-Di-chloro-ethane | Chloro-form | 1,2-Di-chloro-ethane | 1,1,1-Tri-chloro-ethane | Benzene | Carbon tetra-chloride | 1,2-Di-chloro-propane | Bromodi-chloro-methane |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| R | 04/28/87 | <20 | <20 | <20 | <20 | <100 | <20 | <20 | <20 | <20 | <100 | <20 | <20 | <20 | <20 | <20 | <20 |
| S | 04/28/87 | <20 | <20 | <20 | <20 | <100 | <20 | <20 | <20 | <20 | <100 | <20 | <20 | <20 | <20 | <20 | <20 |
| T | 04/28/87 | <20 | <20 | <20 | <20 | <100 | <20 | <20 | <20 | <20 | <100 | <20 | <20 | <20 | <20 | <20 | <20 |
| U | 04/28/87 | <20 | <20 | <20 | <20 | <100 | <20 | <20 | <20 | <20 | <100 | <20 | <20 | <20 | <20 | <20 | <20 |
| V | 04/28/87 | <20 | <20 | <20 | <20 | <100 | <20 | <20 | <20 | <20 | <100 | <20 | <20 | <20 | <20 | <20 | <20 |

| SAMPLING LOCATION | DATE SAMPLED | Tri-chloro-ethylene | c-1,3-Di-chloro-propene | t-1,3-Di-chloro-propene | 1,1,2-Tri-chloro-ethane | Toluene | Dibromo-chloro-methane | Tetra-chloro-ethylene | 2-Chloro-ethyl-vinyl ether | Chloro benzene | Ethyl-benzene | Bromo-form | 1,1,2,2-Tetra-chloro-ethane | 1,2-Di-chloro-benzene | 1,3-Di chloro-benzene | 1,4-Di-chloro-benzene | Total Xylenes |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| R | 04/28/87 | <20 | <20 | <20 | <20 | <20 | <20 | <20 | <20 | <20 | <20 | <20 | <20 | <20 | <20 | <20 | <20 |
| S | 04/28/87 | <20 | <20 | <20 | <20 | <20 | <20 | <20 | <20 | <20 | <20 | <20 | <20 | <20 | <20 | <20 | <20 |
| T | 04/28/87 | <20 | <20 | <20 | <20 | <20 | <20 | <20 | <20 | <20 | <20 | <20 | <20 | <20 | <20 | <20 | <20 |
| U | 04/28/87 | <20 | <20 | <20 | <20 | <20 | <20 | <20 | <20 | <20 | <20 | <20 | <20 | <20 | <20 | <20 | <20 |
| V | 04/28/87 | <20 | <20 | <20 | <20 | <20 | <20 | <20 | <20 | <20 | <20 | <20 | <20 | <20 | <20 | <20 | <20 |

NOTES: Results expressed as ppb.
04/28/87 - Wet weather samples.




MALCOLM PIRNIE

**Columbia Mills**

APRIL 1988
SURFACE WATER AND SEDIMENT SAMPLING LOCATIONS FOR TCL ANALYSIS
FIGURE 4-8

TABLE **4-13**
COLUMBIA MILLS
TCL ANALYSIS - 04/11/88
SEDIMENT SAMPLES

| PARAMETER | SED-1 | SED-2 | SED-3 |
|---|---|---|---|
| Chloromethane | 73 | <27 | <48 |
| 2- Butanaone | 52 | <27 | <48 |
| Benzene | 23 | <14 | <24 |
| Toluene | 8,400 | 4 J | <24 |
| Ethylbenzene | 38 | <14 | <24 |
| Xylenes (total) | 180 | <14 | <24 |
| Dimethyl sulfide | 120 | - | - |
| Phenol | <1,000 | 830 J | <2,000 |
| 4-Chloro-3-methylphenol | <1,000 | 490 J | <2,000 |
| Phenanthrene | 880 J | 430 J | <2,000 |
| Fluoranthene | 1,600 | 500 J | <2,000 |
| Pyrene | 1,400 | 460 J | 400 J |
| Benzo(a)anthracene | 770 J | <900 | <2,000 |
| bis(2-Ethylhexyl)phthalate | <1,000 | 740 J | 710 J |
| Chrysene | 1,100 J | 320 J | <2,000 |
| Benzo(b)fluoranthene | 1,600 | <900 | <2,000 |
| Carboxylic acid | - | 3,400 | 2,400 |
| Unknowns | Note 3 | Note 3 | Note 3 |
| Hexanedioic acid | - | 4,200 | - |
| 4,4'-DDE | 33 J | 13 J | 40 J |
| 4,4'-DDD | 13 J | 6.4 J | 43 J |

NOTES
1. All results in ug/kg.
2. J = present, but below detection limit.
3. Several BNA unknowns were found:

| LOCATION | NO. OF UNKNOWNS | CONCENTRATION RANGE (ug/kg) |
|---|---|---|
| SED-1 | 5 | 5,600 - 7,400 |
| SED-2 | 4 | 4,300 - 8,700 |
| SED-3 | 4 | 5,100 - 17,000 |

TABLE **4-14**
COLUMBIA MILLS
TCL ANALYSIS - 04/11/88
SEDIMENT SAMPLES

| PARAMETER | SED-1 | SED-2 | SED-3 |
|---|---|---|---|
| Aluminum | 10700 | 4920 | 6130 |
| Arsenic | 7.7 | <3.2 | <6.8 |
| Barium | 288 | 87.9 | <166 |
| Calcium | 4980 | 3730 | 4620 |
| Cadmium | <2.6 | <1.8 | 23.2 |
| Chromium (T) | 21.3 | 23.5 | 18.4 |
| Copper | 193 | 63.3 | 181 |
| Iron | 20500 | 6830 | 12300 |
| Manganese | 645 | 192 | 408 |
| Nickel | 24.8 | 21.5 | <33.1 |
| Lead | 203 | 606 | 61.5 |
| Selenium | 3.6 | 2.1 | 4.7 |
| Vanadium | 206 | <18.0 | <41.4 |
| Zinc | 505 | 662 | 2000 |

NOTES
1. All results in mg/kg.

The results of the TCL analysis indicate that no organic compounds were detected at levels above detection limits during the analysis of the surface water sample, nor were any metals detected at high levels. The results of the three sediment sample analyses are summarized on Tables 4-13 and 4-14. Table 4-13 summarizes the organic compounds that were detected at one or more of the sediment sampling locations. Relatively high levels of organics, including toluene (8,400 ppb), and several PAHs were detected at SED-1, near underground storage tank Area No. 1. Toluene was also present, but at a level below the detection limit, at SED-2. No noteable organic compounds were detected at SED-3. The highest metals concentrations, except lead, zinc and chromium (T), were also detected at SED-1 (Table 4-14). Lead and chromium (T) were detected at the highest levels at SED-2. Zinc was detected at a relatively high level, and at the highest level of the three samples, at SED-3. All other metals were higher at SED-3 than SED-2. SW-1

Based on the results of the 1987 analyses and the 1988 TCL analyses, the following conclusions regarding contaminant migration in surface water and/or sediment can be made. CONCLUSIONS

Samples collected in the pond locations in the drum disposal area (both surface water and sediment) generally have higher metals concentrations than samples from the stream locations. Results indicate that metals concentrations are generally decreasing at each location further downstream from the ponds to the last sample location downstream near Building No. 21, however, samples obtained at this location did contain concentrations of metals in the surface water and sediment above detectable limits during 1987, indicating that some metals contaminants may have migrated to the Oswego River at times in the past.

The most recent analyses (April 1988) indicate that no metals were detected at high levels in surface water collected from the sampling location near Building No. 21, nor were organics detected at this location above detection limits. Sediment was not sampled at this location during 1988.

Both metals and organics are relatively high in sediment and surface water near underground storage tank Area No. 1.

Although concentrations of metals in the sediment generally decrease with distance from Pond 1, some metals contamination (lead and chromium (T)) may be migrating from additional sources located east of Pond 1, to the downgradient streams.

4.2.3 Soil

4.2.3.1 Main Plant Area

Five soil samples were collected in the main plant area during the preliminary site investigation (June 1984). The sampling locations were chosen in the vicinity of chemical storage areas (see Figure 4-9) where the potential for finding contamination was considered greatest. The samples were analyzed for compounds included on the USEPA Methods 601 and 602 lists. The results of the analysis performed on the soil samples are summarized on Table 4-15.

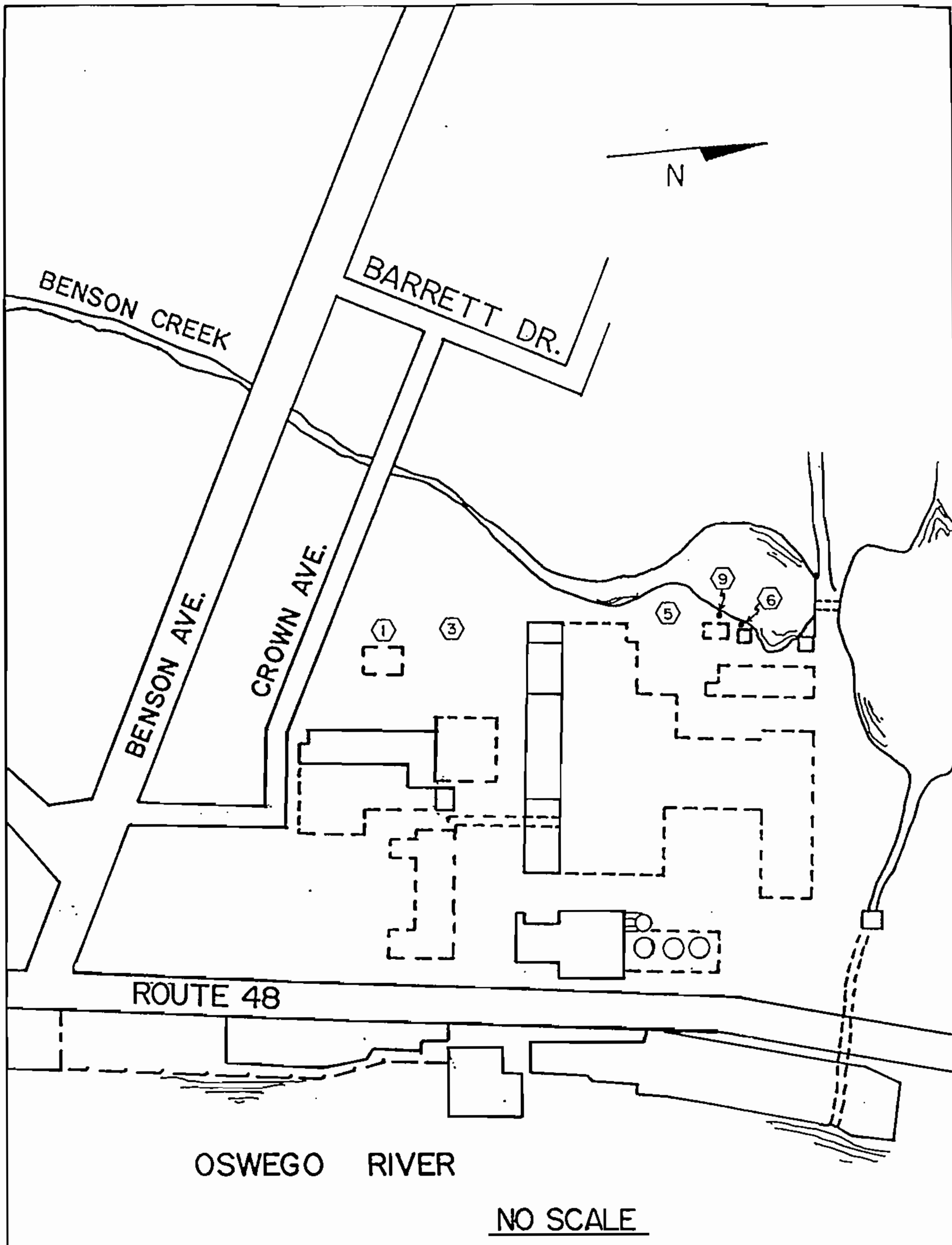
According to these early analytical results, benzene was found at all five sampling locations. However, it should be noted that toluene and/or methyl ethyl ketone have been identified as the product contained in the underground storage tanks that were formerly located in these areas.

Toluene and ethylbenzene were detected at soil sample location 5. Toluene was also detected at location 9.

An investigation into the underground storage tanks (UST) at the site resulted in the sampling and analysis of soil in the main plant area. The UST investigation occurred in four separate areas where tanks were reportedly abandoned. These areas are shown on Figure 4-10.

When necessary, soil below and around the tanks was excavated for potential disposal at an approved facility. The excavation of soil in the vicinity of the tanks was contingent upon organic vapor analysis with an HNU photoionization instrument. Contaminated soils, as determined by HNU screening based on predetermined levels of total organic vapor concentrations, were staged in a segregated area of the Columbia Mills site for additional sample collection and analysis.

Soil samples were also collected from the sides and bottom of each excavation area after the excavation area had reached its full extent. These samples were submitted for analysis for benzene, toluene, xylenes and ketones.




MALCOLM PIRNIE

COLUMBIA MILLS
SOIL SAMPLING LOCATIONS
JUNE 1984

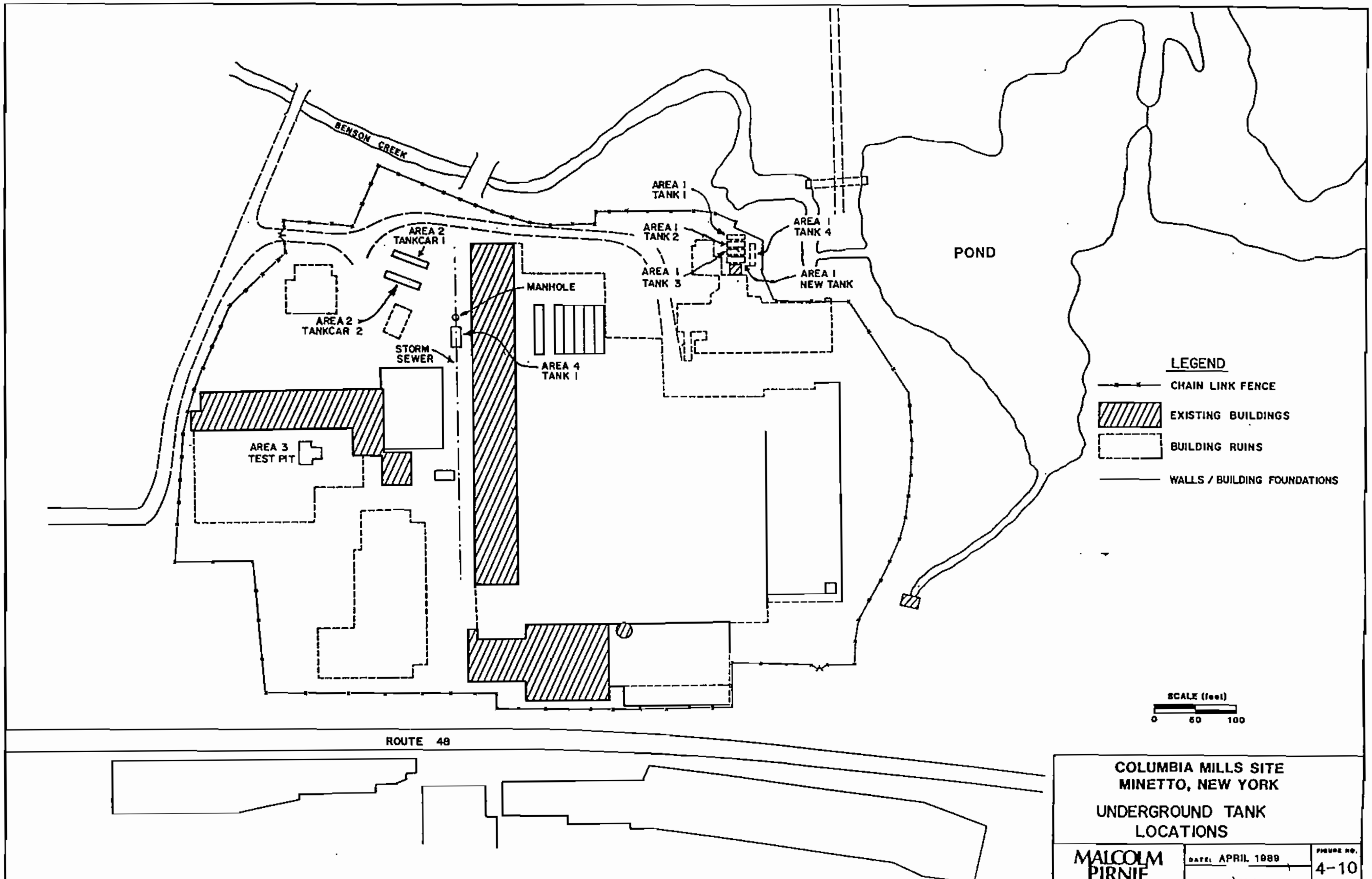
MALCOLM PIRNIE, INC.

FIGURE 4-9

TABLE **4-15**
COLUMBIA MILLS
SUMMARY OF ANALYTICAL RESULTS
SOIL SAMPLES - MAIN PLANT AREA
JUNE 1984

| SAMPLE NUMBER | BENZENE | TOLUENE | ETHYLBENZENE |
|---|---|---|---|
| 1 | 173 | LT 1 | LT 1 |
| 3 | 5.3 | LT 1 | LT 1 |
| UST-( 5 | 13,150 | 9 | 7 |
| 6 | 6,870 | LT 1 | LT 1 |
| 9 | 12 | 15 | LT 1 |

NOTE: All results expressed in mg/kg.
LT = less than.




COLUMBIA MILLS SITE
MINETTO, NEW YORK

UNDERGROUND TANK LOCATIONS

MALCOLM PIRNIE

DATE: APRIL 1989

FIGURE NO. 4-10

AREA 1: 2 empty, 2 90% toluene 200; 400 gal
AREA 2: 2 tanks, 90% toluene
90% mek
Area 4: 1 tank empty formerly cont. - gasoline

TANKS

Five tanks were removed from Area 1, two tanks were removed from Area 2 and one tank was removed from Area 4. No tanks were found in Area 3, however, strong organic vapor odors and HNU readings in the range of 100 to 200 ppm were detected in this excavation area. The location of the test pit that was excavated in Area 3 is shown on Figure 4-10. According to maps that were produced during operation of the Columbia Mills facility, three 500-gallon benzene tanks were located in this area. The results of the analysis performed on soil and ground water collected from Area 3 indicate that 11,000 parts per billion (ppb) toluene, 4,800 ppb ethylbenzene, 59,000 ppb total xylenes and traces of methyl ethyl ketone (MEK) and methyl isobutyl ketone were detected in the soil; and, 540,000 ppb toluene and 70,000 ppb ethylbenzene were detected in the water.

Since the compounds detected in the subsurface soil and ground water in the excavation area were different than the benzene that was reportedly stored in this area, but included some of the same compounds that had been detected in the tanks in Area 2, it was not clear where the source of the contamination was. A soil gas survey was performed during April 1988 to provide information on the potential source of the contamination and information on migration of the contaminants from Area 3. The results of the soil gas survey will be discussed in a separate subsection of this work plan.

Toluene and methyl ethyl ketone were detected in the soil collected from the sides and the bottom of the excavation pit in Area 1. Toluene ranged from below detection limits (BDL) to 83,000 ppb. Methyl ethyl ketone ranged from BDL to 2,300 ppb. Xylenes were also detected at one sample location at a concentration of 280 ppb.

During excavation in Area 2, it became evident that the two tanks in that area had been anchored into place inside a concrete-block vault. It was also evident that one or both of the tanks had leaked since HNU readings at levels greater than 200 ppm were commonly obtained as the soil was screened during removal. Soil samples were collected from the interval between land surface and the top of the walls (approximately four feet below land surface), and from soil located below the sides of the tanks. All bottom samples and all top samples, except one, contained low levels (580 to 6,600 ppb) of methyl ethyl ketone.

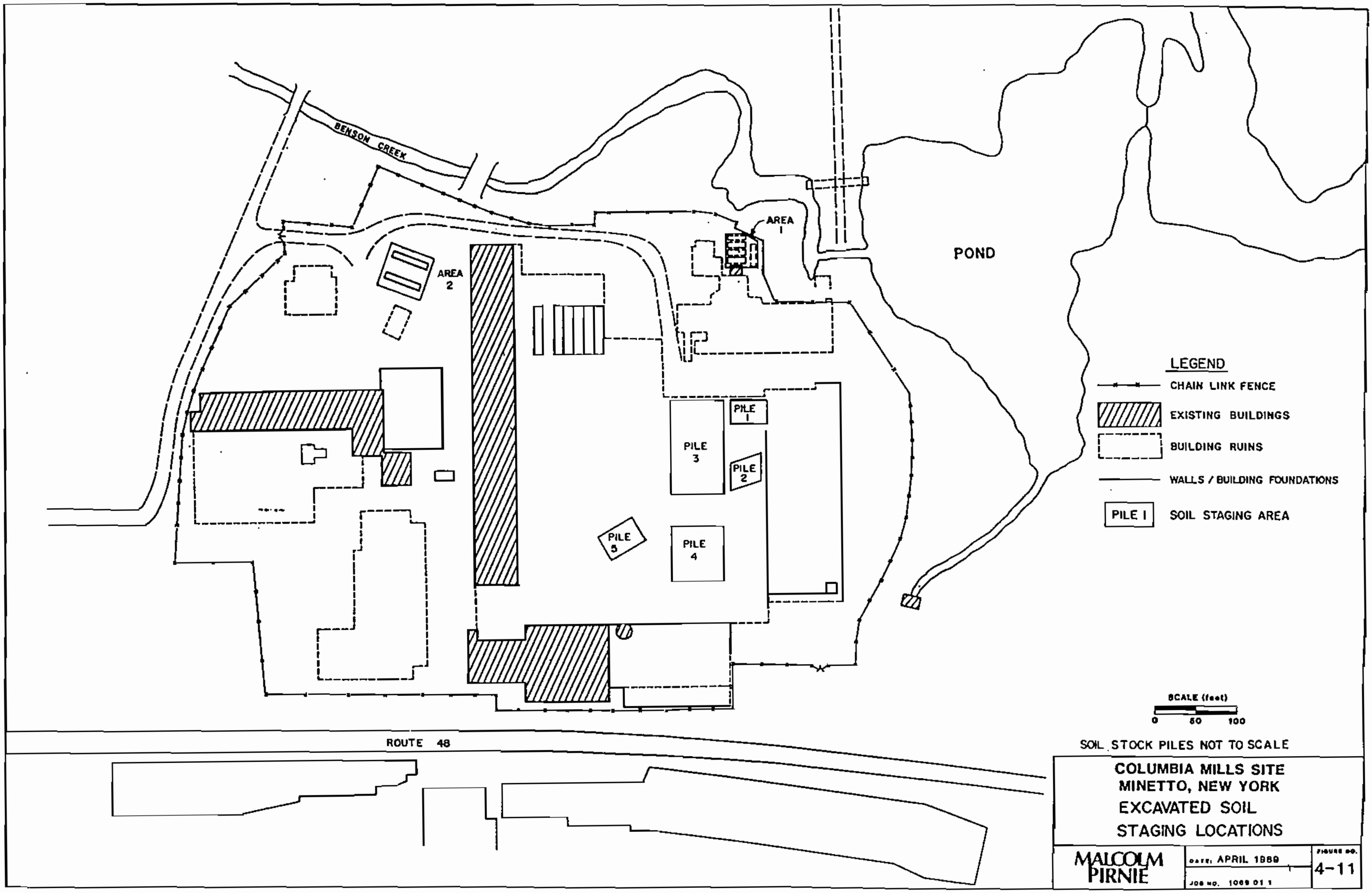
A 500-gallon gasoline tank was removed from Area 4. Five soil samples (one from each side and one from the bottom) were collected from the excavation area. Low levels of methyl ethyl ketone were detected in four of the five samples. The concentrations ranged from 490 to 5,900 ppb. The remaining sample contained 39 ppb toluene. The source of the compounds in this area is not attributed to leakage from the 500-gallon tank, since this tank contained gasoline. It seems more likely that the contaminants detected in this area are the result of migration of methyl ethyl ketone and toluene in the shallow part of the saturated zone from Area 2 (or other nearby sources) toward the storm sewer. The specific gravity of MEK is 0.81 and the specific gravity of toluene is 0.87; therefore, these compounds are lighter than water and would have a tendency to remain in the shallow part of the saturated zone.

Soil excavated from Area 1 or Area 2 that was determined to be contaminated (by visual means and/or by HNU reading) was staged into five piles at the approximate locations shown on Figure 4-11. No soil from Area 4 was staged in these locations since the HNU readings obtained from the soil from this area always registered below the predetermined trigger level of 10 ppm. A combined total of more than 1000 cubic yards of soil was excavated from Areas 1 and 2. The source of the soil that is staged in each pile is indicated below.

Pile #1 - Soil from Areas 1 and 2
Pile #2 - Soil from Areas 1 and 2
Pile #3 - Soil from Area 1
Pile #4 - Soil from Area 2
Pile #5 - Soil from Area 1

SOIL PILES

After the excavation process in both areas was completed, each pile was divided into four quadrants and one sample was obtained from each quadrant at a depth of from two to three feet below the top of the


BENSON CREEK
AREA 1
AREA 2
POND
PILE 1
PILE 2
PILE 3
PILE 4
PILE 5
ROUTE 48
LEGEND
CHAIN LINK FENCE
EXISTING BUILDINGS
BUILDING RUINS
WALLS / BUILDING FOUNDATIONS
PILE I SOIL STAGING AREA
SCALE (feet)
0 50 100
SOIL STOCK PILES NOT TO SCALE
COLUMBIA MILLS SITE
MINETTO, NEW YORK
EXCAVATED SOIL
STAGING LOCATIONS
MALCOLM PIRNIE
DATE: APRIL 1989
JOB NO. 1069 01 1
FIGURE NO.
4-11

piles. The four samples from each pile were composited into one sample and submitted for analysis for volatile organics (USEPA 601/602), PCBs, cyanide reactivity, sulfide reactivity and ketones. Compounds that were detected above detection limits are listed on Table 4-16.

Soil Pile Results

According to the analytical results, soil in Pile #1 and Pile #4 are essentially free of organic contamination. A low level of tetrachloroethylene (34 ppb) was detected in the soil composited from Pile #2. Toluene was detected in Pile #3 and Pile #5 at concentrations of 16,000 ppb (16 ppm) and 1,300 ppb (1.3 ppm), respectively. Also detected in Piles #3 and #5 was methyl ethyl ketone at levels of 2,800 ppb and 2,900 ppb, respectively. The only other volatile organic compound that was detected above detection limits was methyl isobutyl ketone in soil obtained from Pile #5. Both Pile #3 and Pile #5 are comprised of soil that originated in Area 1. a plan to address the soil contained in the piles will be presented in an Interim Remedial Measures Work Plan. The Interim Remedial Measures Work Plan will also address the soil contaminated with organics in the vicinity of the Area 3 test pit.

#### 4.2.3.2 Drum Disposal Area

One surface soil sample was collected from the drum disposal area during June 1984 as part of the sampling program conducted at the site during the preliminary assessment. The sampling location is shown on Figure 4-12. The soil sample was analyzed for five metals. The results of the analysis indicated that relatively high concentrations of chromium (4,200 mg/kg) and lead (5,000 mg/kg) were present at that sample location. Lower concentrations of cadmium (31 mg/kg), cobalt (20 mg/kg) and nickel (69 mg/kg) were also detected.

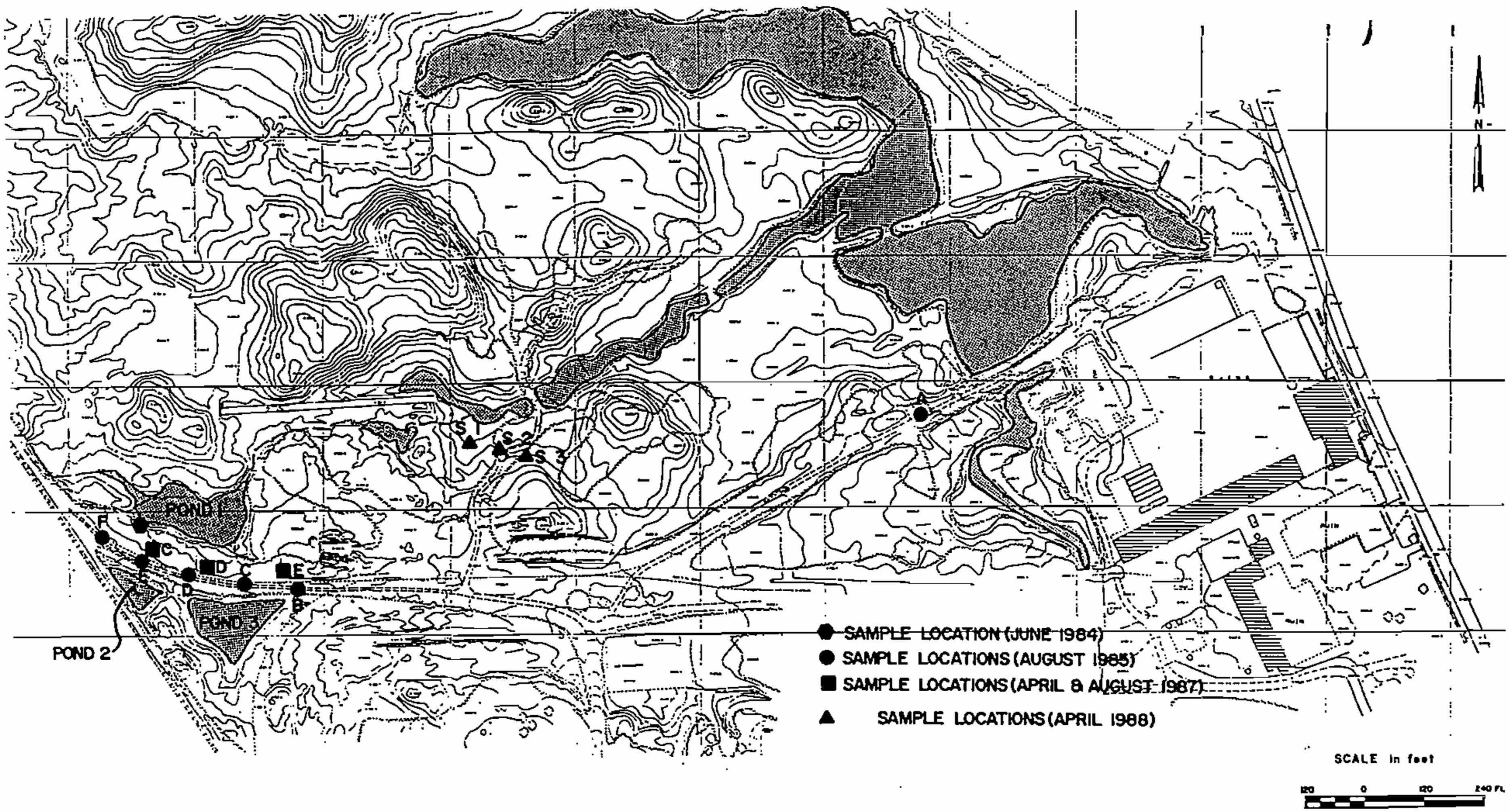
Surface soil samples were collected from five locations in the drum disposal area on August 27, 1985 as part of the Phase II investigation. An additional soil sample was collected from the arsenal area on the same date. The sampling locations are shown on Figure 4-12. The samples were submitted for analysis in accordance with USEPA Method 624.

TABLE 4-16
COLUMBIA MILLS

ANALYTICAL RESULTS
SOILS IN COVERED PILES

| | REACTIVE SULFIDE (ppm) | REACTIVE CYANIDE (ppm) | METHYL ETHYL KETONE (ppb) | METHYL ISOBUTYL KETONE (ppb) | TETRA-CHLORO-ETHYLENE (ppb) | TOLUENE (ppb) |
|---|---|---|---|---|---|---|
| Pile #1 | 250 | 2.1 | LT 30 | ND | LT 30 | LT 30 |
| Pile #2 | 150 | 18 | LT 30 | ND | 34 | LT 30 |
| Pile #3 | 130 | 2.3 | 2,800 | ND | LT 300 | 16,000 |
| Pile #4 | 460 | LT 1.0 | LT 30 | ND | LT 30 | LT 30 |
| Pile #5 | LT 20 | 3.9 | 2,900 | 320 | LT 20 | 1300 |

ND = Not Detected
LT = Less Than




| MALCOLM PIRNIE | REVISIONS | COLUMBIA MILLS<br>MINETTO, NEW YORK | SURFACE SOIL SAMPLE<br>COLLECTION LOCATIONS | MALCOLM PIRNIE, INC.<br>DATE APRIL 1989<br>FIGURE 4-12 |
|---|---|---|---|---|

Additional soil samples from location A and location D were submitted for analysis for the remainder of the organic priority pollutants. Soil samples from the same six locations were also submitted for analysis for cadmium, chromium (total), chromium (hexavalent), copper, lead, nickel, silver and zinc. The results of the metals analysis, shown on Table 4-17, indicated that a wide range of concentrations were detected for all metals except chromium (hexavalent) and silver, which occurred in relatively consistent concentrations in the six surface soils tested. Chromium (hexavalent) occurred in concentrations below the detectable limit (0.04 mg/kg in all six samples. The concentrations of silver ranged from 0.3 mg/kg (Samples A, B and F) to 0.6 mg/kg (Sample E) and averaged 0.4 mg/kg.

The concentrations of the remaining metals (cadmium, chromium(T), copper, lead, nickel, zinc) varied considerably, but were segregated into two groups with concentrations of similar magnitude. The surface soils collected at locations A and B constituted the first group and contained concentrations that are relatively lower than the second group, which are the surface soils collected at locations C, D, E and F.

Lead and zinc were detected in the highest concentrations, while the concentrations of copper, chrimium (T), nickel and cadmium were also detected at relatively high levels in some samples.

The results of the USEPA Method 624 analysis performed on the six soil samples indicated that no volatile compounds were detected other than methylene chloride. Several organic compounds were detected in the soil samples collected at locations A and D, based on the USEPA Methods 608 and 625 analyses. The compounds detected by the analyses are shown on Table 4-18. Only a few compounds were detected in the arsenal area soil sample (A), however, many were detected in the drum disposal sample (D).

As part of the remedial investigation, additional surface soil samples were collected from the drum disposal area. Three grab samples were collected during April 1987, at the locations shown on Figure 4-12, for analysis for EP-Toxicity metals. During August 1987, three soil samples were composited from the areas surrounding the grab-sample

TABLE 4-17
COLUMBIA MILLS
SURFACE SOIL SAMPLE RESULTS
ANALYSIS FOR METALS
AUGUST 1985

| LOCATION | CADMIUM | CHROMIUM (TOTAL) | CHROMIUM (HEX) | COPPER |
|---|---|---|---|---|
| A | 1 | 11 | LT 0.04 | 5.6 |
| B | 0.3 | 12 | LT 0.04 | 18 |
| C | 15 | 1,000 | LT 0.04 | 540 |
| D | 52 | 807 | LT 0.04 | 10,000 |
| E | 65 | 921 | LT 0.04 | 135 |
| F | 23 | 1,000 | LT 0.04 | 75 |

| | LEAD | NICKEL | SILVER | ZINC |
|---|---|---|---|---|
| A | 100 | 2.7 | 0.3 | 60 |
| B | 130 | 8 | 0.3 | 78 |
| C | 40,000 | 75 | 0.5 | 13,000 |
| D | 35,000 | 280 | 0.5 | 12,000 |
| E | 32,000 | 1,250 | 0.6 | 24,000 |
| F | 65,000 | 125 | 0.3 | 69,000 |

NOTE: All results expressed as mg/kg.

TABLE **4-18**
COLUMBIA MILLS
TEST PITS AND SURFACE SOILS COLLECTED IN
THE ARSENAL AND DRUM DISPOSAL AREAS
COMPOUNDS DETECTED (USEPA METHODS 608 AND 625)

| PARAMETER | SURFACE SOIL D | TEST PIT K | TEST PIT B | SURFACE SOIL A |
|---|---|---|---|---|
| bis(2-Ethylhexyl)phthalate | 14,000 | | | 1,900 |
| Di-N-butylphthalate | 1,700 | | | |
| Fluoranthene | 1,200 | 1,300 | | |
| Benzo(b)/(k)fluoranthene | 1,200 | 1,200 | 220 | |
| Pyrene | 1,000 | 1,100 | | |
| Chrysene | 870 | 850 | 210 | |
| Benzo(a)pyrene | 850 | 730 | | |
| 2-Ethyl-1-hexanol | 810 | 1,000 | | 6,000 |
| Benzo(a)anthracene | 800 | 760 | | |
| Phenanthrene | 620 | 1,200 | | |
| 2-Methylphenol | 470 | | | |
| Heptanol | 390 | | | |
| Toluene | 370 | | | |
| Acetic acid, butyl ester | 350 | | | |
| Decane | 300 | | | |
| 2-Tridecanone | 280 | | | |
| Hexadecanoic acid, methyl ester | 150 | 230 | | |
| Nonanedoic acid | | 4,800 | | |
| Octanoic acid | | 1,200 | | |
| Indeno(1,2,3-c,d)pyrene | | 500 | | |
| Benzo(g,h,i)perylene | | 500 | | |
| 1,3-Cyclopentadiene | | 440 | | |
| Benzo(e)pyrene | | 430 | | |
| 4-Methyl-2-heptanone | | 270 | | |
| Anthracene | | 250 | | |
| Octamethylcyclotetrasiloxane | | | 1,400 | |
| Decamethylcyclotetrasiloxane | | | 260 | |
| Benzene acetic acid | | | | 600 |
| 4-Hydroxy-3-methoxy benzaldehyde | | | | 180 |
| 1,2-Benzinedicarboxylic acid, butyl-2-methylpropyl ester | 11 | | | |
| 1-Propene-1,2,3-tricarboxylic acid, tributyl ester | 550 | | | |

NOTE: All results expressed in ug/kg.

locations. These samples were also analyzed for metals on the EP-Toxicity list. During April 1988, three soil samples were collected in locations between the edge of the newly discovered drum disposal area and the stream that drains Pond 1 (Figure 4-12). These samples were collected to aid in a determination of whether the migration of contaminants from the drums to the stream was occurring. The samples were analyzed for the compounds on the Target Compound List (TCL). Additional soil samples that were collected during April 1988 in the drum disposal area included 14 surface soil samples from locations surrounding the drum disposal area for analysis for lead, and two surface soil samples from the drum disposal area for analysis for combustion byproducts (USEPA Methods 625: Semivolatiles and 608: PCBs/pesticides). The sampling locations are shown on Figure 4-13.

The results of the analysis performed on the soil samples collected during April and August 1987 are summarized on Table 4-19. The results indicate that the concentrations for most metals were generally higher in the grab samples than in the composite samples. The exceptions were barium, cadmium and chromium at location D, mercury at all three locations and selenium at location E. Silver was not detected at levels above the detection limit at any of the locations. The highest lead and chromium concentrations were detected at location E.

An additional sample was obtained during August 1987 from a partially-filled drum in the drum disposal area. The sample was obtained when odors were noticed while in the vicinity of the drum during August 1987 sampling. The sample was analyzed for EPA Method 624 organics and library search for the 10 largest peaks on the GC/MS scan. The results indicated that the volatile material in the drum was greater than 90 percent toluene.

The results of the analysis performed on the three soil samples collected during April 1988 (for the TCL parameters) are summarized on Tables 4-20 and 4-21. Toluene and several polynuclear aromatic hydrocarbons (PAHs) were detected at soil sample locations S-1 and S-2. Bis(2-Ethylhexyl)phthalate was detected at the S-3 location. Two insecticides, DDT and DDE, and several unknown base/neutrals and acids (BNAs), were also detected during the analysis.

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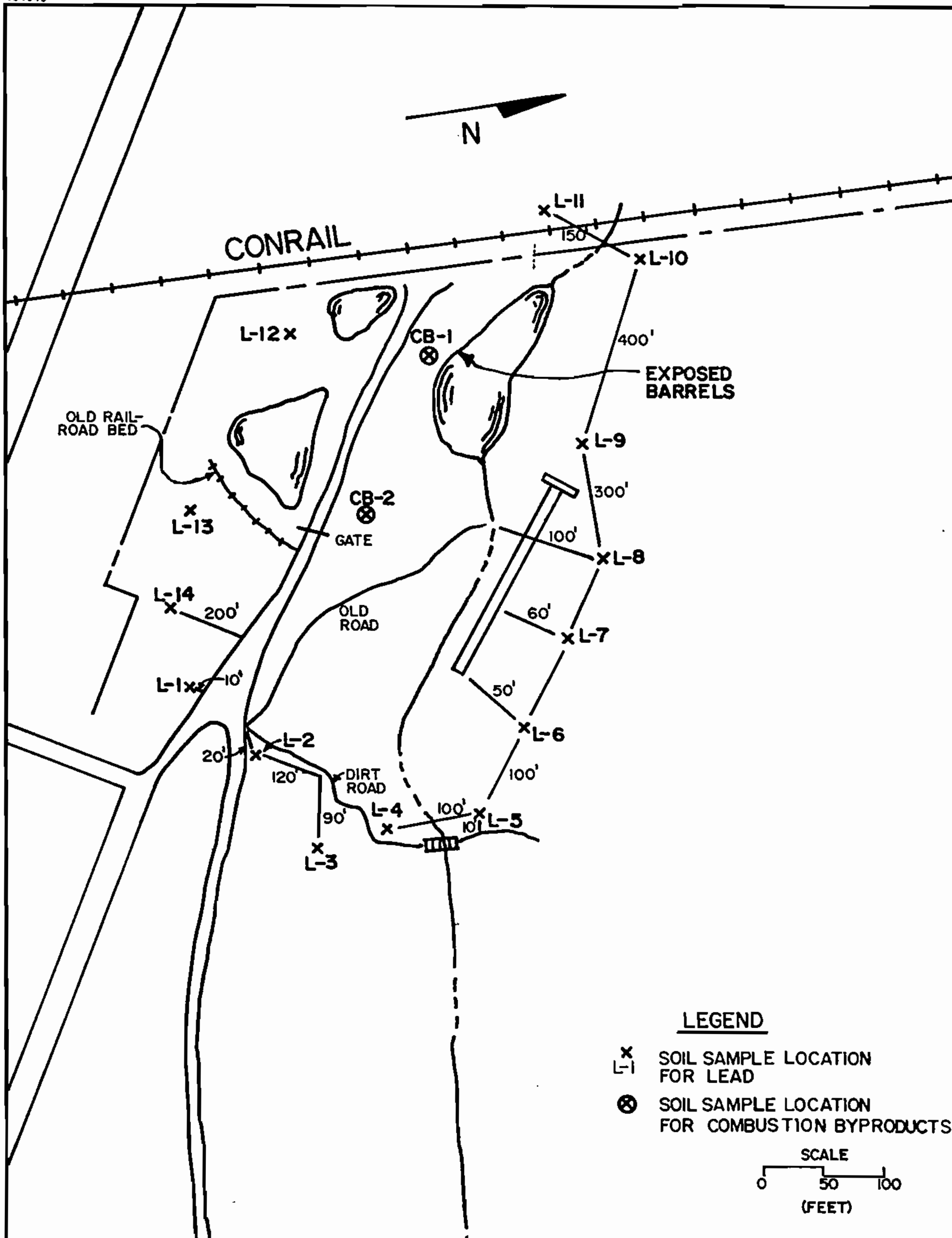



MALCOLM PIRNIE

COLUMBIA MILLS
SOIL SAMPLING IN DRUM DISPOSAL AREA FOR
LEAD AND COMBUSTION BYPRODUCTS
APRIL 1988

MALCOLM PIRNIE, INC.

FIGURE NO.
4-13

TABLE **4-19**
COLUMBIA MILLS - MINETTO, NEW YORK
SOIL - EP TOXICITY

| SAMPLE LOCATION | SAMPLE DATE | ARSENIC | BARIUM | CADMIUM | CHROMIUM | LEAD | MERCURY | SELENIUM | SILVER |
|---|---|---|---|---|---|---|---|---|---|
| C | 4/29/87 | 0.004 | 3.1 | 0.020 | <0.05 | 0.7 | <0.0004 | <0.001 | <0.05 |
| | 8/18/87 | 0.002 | 0.9 | 0.018 | <0.05 | 0.2 | 0.0018 | <0.001 | <0.05 |
| D | 4/29/87 | 0.001 | <0.3 | <0.005 | <0.05 | <0.1 | <0.0004 | <0.001 | <0.05 |
| | 8/18/87 | <0.001 | 0.7 | 0.014 | 0.11 | <0.1 | 0.0005 | <0.001 | <0.05 |
| E | 4/29/87 | 0.012 | 13 | 0.55 | 0.89 | 230 | <0.0004 | <0.001 | <0.05 |
| | 8/18/87 | <0.001 | 0.6 | 0.016 | <0.005 | <0.1 | 0.0006 | 0.002 | <0.05 |

ALL RESULTS EXPRESSED IN PPM.

TABLE **4-20**
COLUMBIA MILLS
TCL ANALYSIS - 04/11/88
ORGANICS DETECTED - SURFACE SOIL SAMPLES

| PARAMETER | SOIL-1 | SOIL-2 | SOIL-3 |
|---|---|---|---|
| Toluene | 7 | 2 J | <7 |
| Phenanthrene | <500 | 94 J | <500 |
| Fluoranthene | 150 J | 150 J | <500 |
| Pyrene | 180 J | 140 J | <500 |
| bis(2-Ethylhexyl)phthalate | 320 J | 1,100 | 300 J |
| Carboxylic acid | - | - | 710 |
| Unknowns | Note 3 | Note 3 | Note 3 |
| 4,4'-DDE | 3.8 J | 12 J | <110 |
| 4,4'-DDT | <110 | 16 J | <110 |

PAH's

NOTES
1. All results in ug/kg.
2. J = present, but below detection limit.
3. Several BNA unknowns were found:

| LOCATION | NO. OF UNKNOWNS | CONCENTRATION RANGE (ug/kg) |
|---|---|---|
| SOIL-1 | 2 | 9,500 - 14,000 |
| SOIL-2 | 2 | 4,200 - 5,900 |
| SOIL-3 | 2 | 6,500 - 8,500 |

TABLE **4-21**
COLUMBIA MILLS
TCL ANALYSIS - 04/11/88
SURFACE SOIL SAMPLES

| PARAMETER | SOIL-1 | SOIL-2 | SOIL-3 |
|---|---|---|---|
| Silver | <2.4 | <2.1 | <2.5 |
| Aluminum | 11,600 | 6,310 | 11,500 |
| Arsenic | <2.8 | 2.7 | 2.6 |
| Barium | 50.8 | 60.9 | 167 |
| Beryllium | <1.2 | <1.1 | <1.2 |
| Calcium | <1,210 | <1,070 | <1,230 |
| Cadmium | <1.2 | <1.1 | <1.2 |
| Cobalt | <12.1 | 10.7 | <12.3 |
| Chromium (T) | 9.2 | 11.5 | 10.6 |
| Copper | 9.2 | 16.6 | 11.2 |
| Iron | 14,200 | 12,800 | 14,600 |
| Mercury | <0.14 | <0.13 | <0.14 |
| Potassium | <1,210 | <1,070 | <1,230 |
| Magnesium | 1,270 | <1,070 | 1,730 |
| Manganese | 169 | 254 | 333 |
| Sodium | <1,210 | <1,070 | <1,230 |
| Nickel | <9.7 | <8.6 | 11.4 |
| Lead | 12.9 | 73.6 | 31.9 |
| Antimony | <14.67 | <12.8 | <14.7 |
| Selenium | <1.4 | <0.97 | <1.3 |
| Thallium | <2.8 | <1.9 | <2.5 |
| Vanadium | 18 | 11.6 | 18 |
| Zinc | 41.3 | 79.8 | 89.6 |

NOTES
1. All results in mg/kg.

The results of the lead analysis performed on the 14 surface soil samples collected from around the drum disposal area and the base/neutral extractables performed on the two soil samples in the drum disposal area, are listed on Table 4-22.

Although lead was detected at all sampling locations, ranging from 8.9 ppm to 130 ppm, the values detected are within the common range of lead in natural soils. The common range of lead in natural soils is from 2 ppm to 200 ppm. The average concentration of lead found in natural soils is 10 ppm. The average concentration found in the 14 samples was 39 ppm.

Several PAHs and two phthalates were detected in the combustion byproduct samples. Three mg/kg of phenol was detected in sample CB-2 and 0.3 mg/kg of PCB Aroclor 1254 was detected in sample CB-1.

### 4.2.4 Additional Sampling in the Main Plant Area

#### 4.2.4.1 PCB Sampling

Samples have been collected for polychlorinated biphenyl (PCB) analysis from the Boiler Room (Building No. 8), from the Power Supply Relay Building (Building No. 10A) and from several locations around the perimeter of Building No. 8 and between the foundations for the former oil storage tanks (Figure 4-14).

The locations of sample collection in the Boiler Room are shown on Figure 4-15. The concentrations of PCBs in the soil samples collected on the west side of the room within the curbed area, including the soil near the drum, are higher than those collected throughout the rest of the room. PCBs were detected in each of the soil samples collected. The circuit breaker and drum samples did not contain PCBs. The results are shown on Table 4-23.

Of the 10 PCB-sampling locations shown on Figure 4-14, PCBs were detected at only one sample location (PCB-2). The results are listed on Table 4-24.

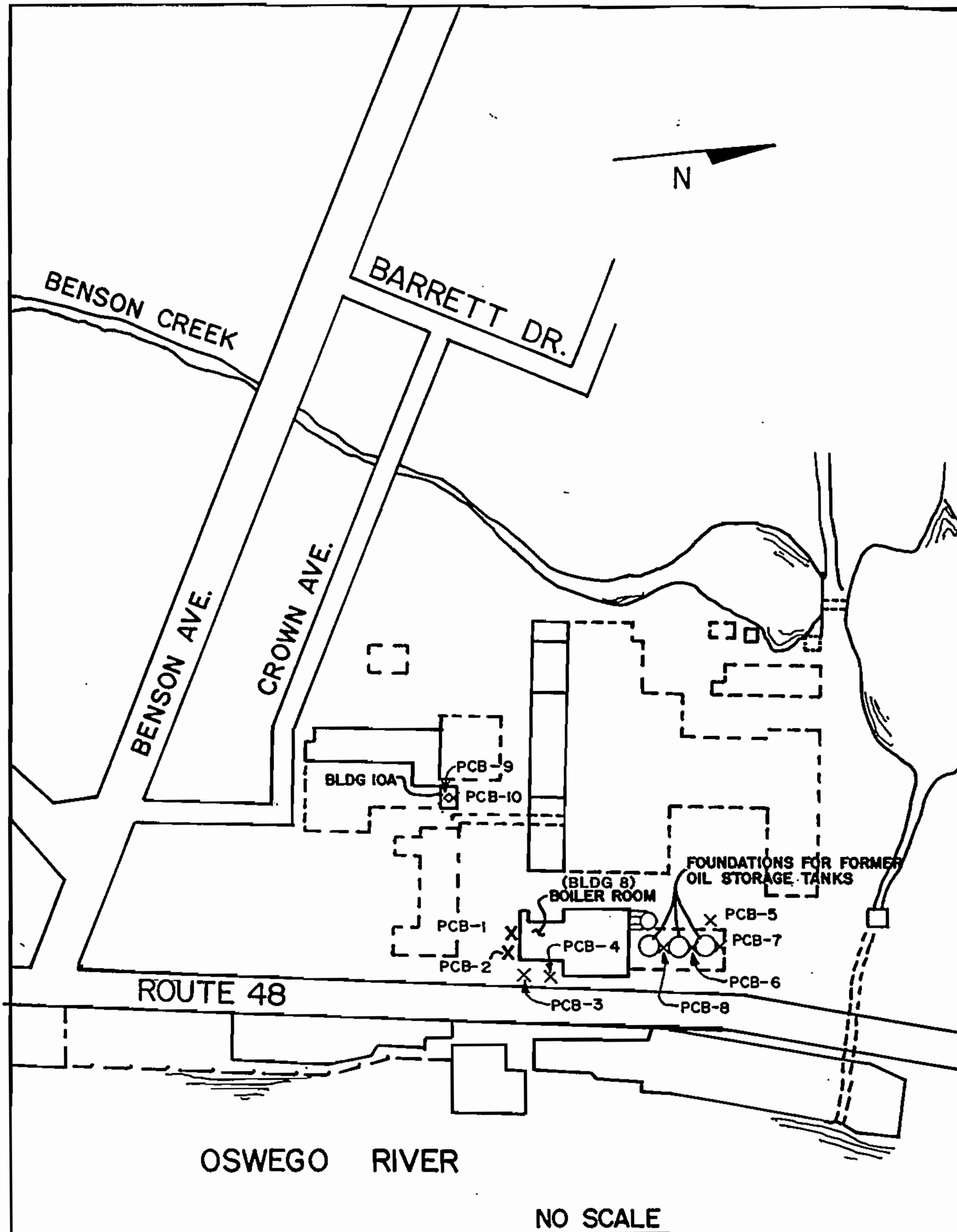
## TABLE **4-22**
## COLUMBIA MILLS
## SUMMARY OF ANALYTICAL RESULTS
## SURFACE SOIL SAMPLES

### LEAD ANALYSES

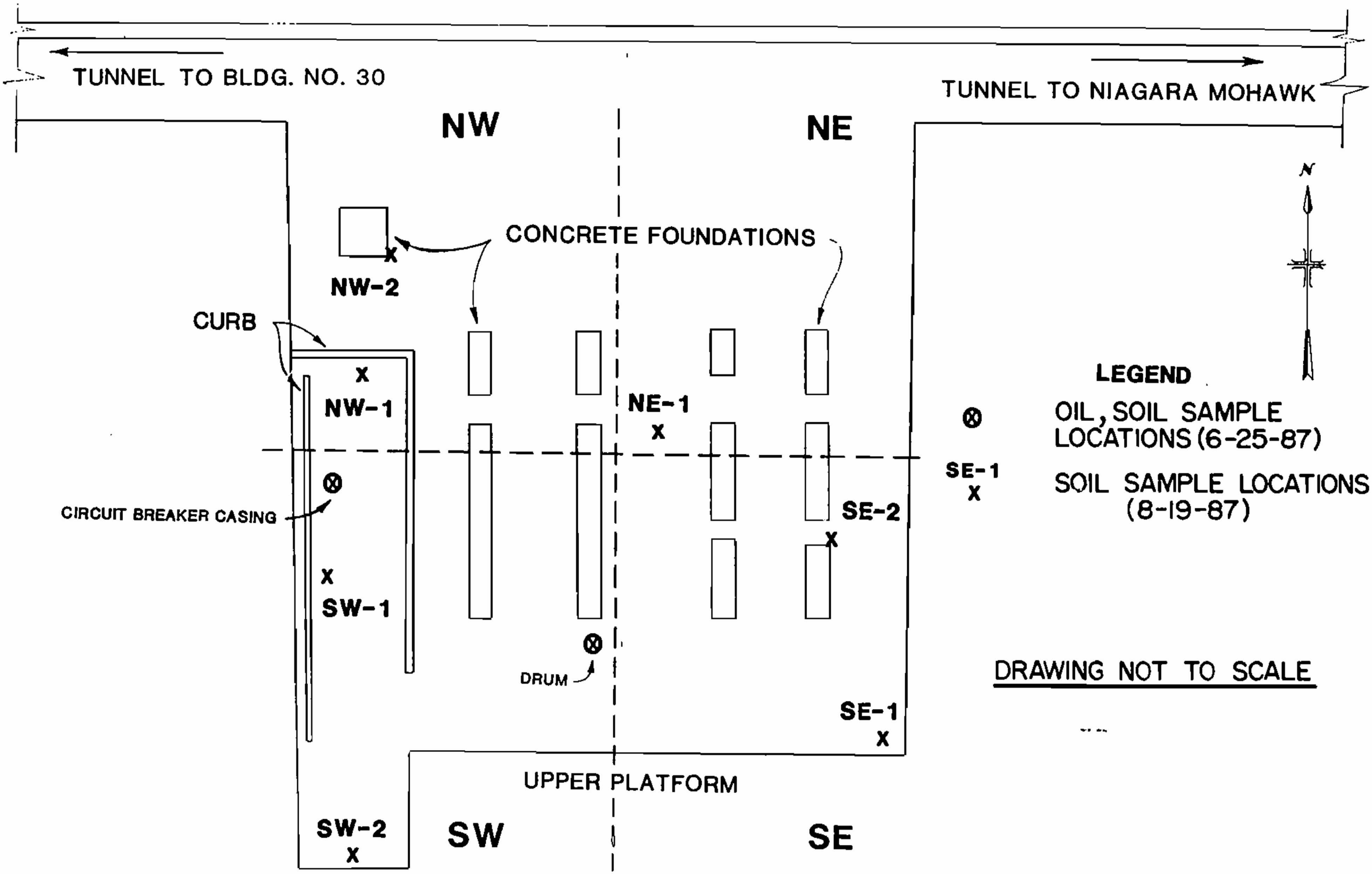
| SAMPLE ID | TOTAL LEAD (ppm) |
|---|---|
| L-1 | 100 |
| L-2 | 130 |
| L-3 | 31 |
| L-4 | 17 |
| L-5 | 12 |
| L-6 | 8.9 |
| L-7 | 53 |
| L-8 | 36 |
| L-9 | 29 |
| L-10 | 41 |
| L-11 | 19 |
| L-12 | 25 |
| L-13 | 23 |
| L-14 | 23 |

### BASE/NEUTRAL EXTRACTABLES

| | CB-1 (mg/kg) | CB-2 (mg/kg) |
|---|---|---|
| Acenaphthylene | 1 | <1 |
| Phenanthrene | <1 | 1 |
| Dibutyl phthalate | 8 | 18 |
| Fluoranthene | <1 | 4 |
| Pyrene | <1 | 9 |
| Aroclor 1254 | 0.3 | <0.1 |
| Phenol | <1 | 3 |
| bis(2-Ethylhexyl)-phthalate | 17 | 280 |




| MALCOLM PIRNIE | SAMPLE LOCATIONS FOR PCB ANALYSIS COLLECTED APRIL 13, 1988 | MALCOLM PIRNIE, INC. FIGURE 4-14 |
|---|---|---|




MALCOLM PIRNIE

BOILER ROOM SAMPLE LOCATIONS

MALCOLM PIRNIE, INC

FIGURE 4-15

TABLE **4-23**

BOILER ROOM-PCBs

| SAMPLE LOCATION | DATE SAMPLED | PCB CONCENTRATION |
|---|---|---|
| SOIL - near curcuit breaker casing | 06/25/87 | 43,000 (mg/kg - wet weight) |
| OIL - in circuit breaker casing | 06/25/87 | <2 (mg/l) |
| SOIL - near drum | 06/25/87 | 280 (mg/kg - wet weight) |
| OIL - in drum | 06/25/87 | <2 (mg/l) |
| SE-1 | 08/19/87 | 33 |
| SE-2 | 08/19/87 | 5 |
| NE-1 | 08/19/87 | 33 |
| NW-1 | 08/19/87 | 74 |
| NW-2 | 08/19/87 | 12 |
| SW-1 | 08/19/87 | 530 |
| SW-2 | 08/19/87 | 110 |

NOTE: Results expressed as mg/kg dry weight except where noted

All PCBs reported are Aroclor 1242

TABLE **4-24**
COLUMBIA MILLS
SAMPLES FOR PCB ANALYSIS
APRIL 1988

| SAMPLE ID | PCBs | PCBs |
|---|---|---|
| PCB-1 | <2 | <2 |
| PCB-2 | 33 | 28 |
| PCB-3 | <2 | <2 |
| PCB-4 | <2 | <2 |
| PCB-5 | <2 | <2 |
| PCB-6 | <2 | <2 |
| PCB-7 | <2 | <2 |
| PCB-8 | <2 | <2 |
| PCB-9 | <2 | <2 |
| PCB-10 | <2 | <2 |

All results in mg/kg dry weight

#### 4.2.4.2 Tunnels and Storms Sewers

The storm sewers and tunnels on site were visually inspected to estimate flows, and sampled to provide data for a determination of contaminant transport from the plant through the tunnels and sewers to the Oswego River. Water samples were collected (during August 1987) from the storm sewer at the two locations shown on Figure 4-16. The first sample (SD1), was taken from a manhole located between Barrett Drive and Chase Drive. The second sample (SD2), was collected in the tunnel that joins Building No. 30 to Building No. 7, where the storm sewer flows perpendicular to the tunnel, beneath a metal grating on the tunnel floor. The samples were submitted for analysis for the parameters included on the USEPA Method 624 list. Results of the analysis indicated that all parameters were below detectable limits.

Two sediment samples were collected from the tunnel that runs from Building No. 30, through the Boiler Room and under Rt. 48 to the Niagara Mohawk Building (Figure 4-17). The samples were collected during August 1988 and were comprised of solids that settled in the overflow drains on the north side of the tunnel floor.

Analysis for PCBs at location T1 and T2 revealed concentrations below detectable limits. Analysis for metals showed all parameters tested to be higher for T1 than T2, except chromium (hexavalent) which was below detection limits at both locations (Table 4-24). Therefore, based on these results, no contaminants are believed to be exiting through the tunnel to the Oswego River.

#### 4.2.4.3 Soil Gas Survey

A soil gas survey was performed during April 1988 to provide information on the source of contamination that was detected in the test pit in Area 3, and information on migration of the contaminants from Area 3. The locations where soil gas readings were obtained with an HNU meter are shown on Figure 4-18. Also shown on Figure 4-18 are the locations where additional soil gas sampling was performed for analysis with a portable gas chromatograph (GC).

Revised Text (2)

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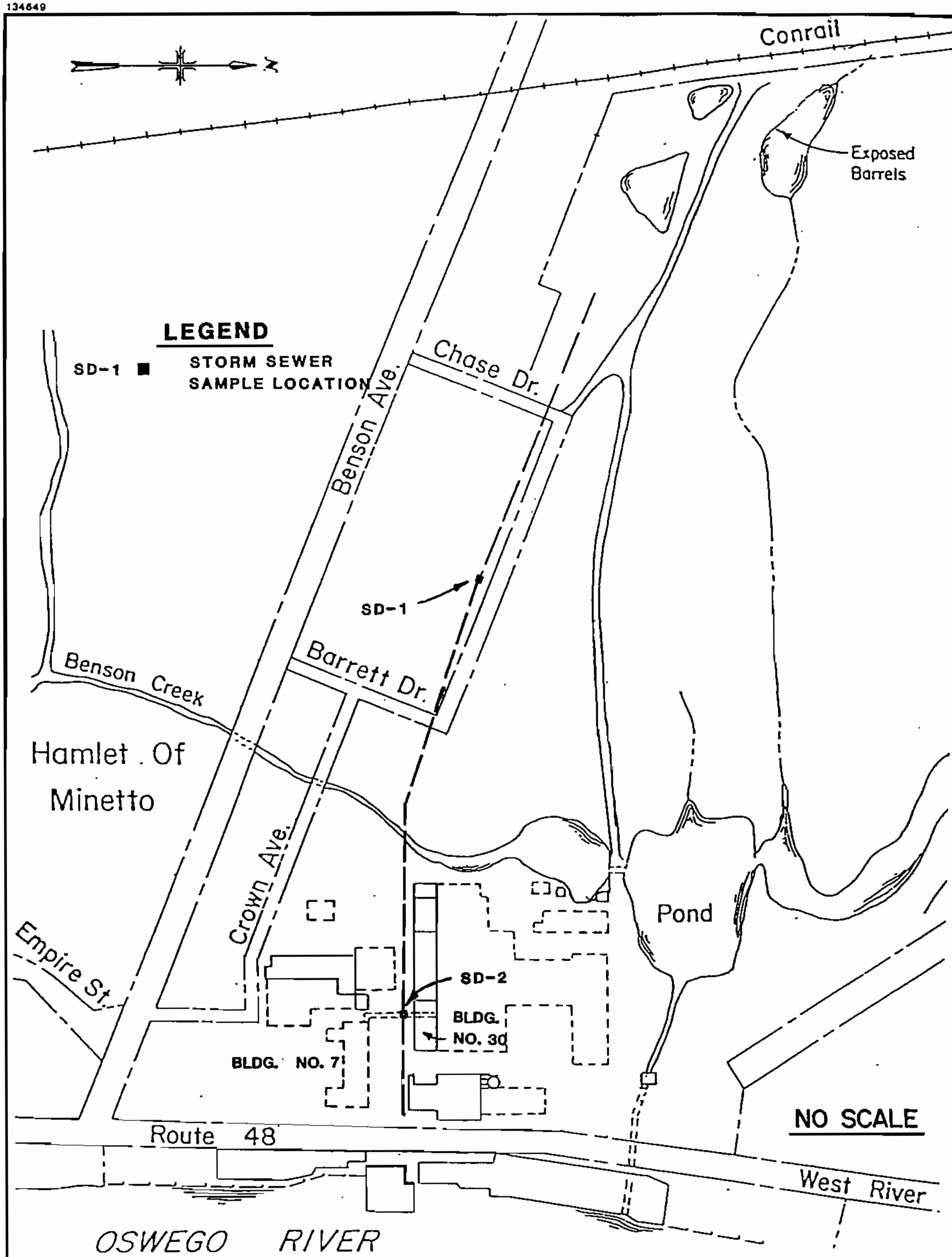


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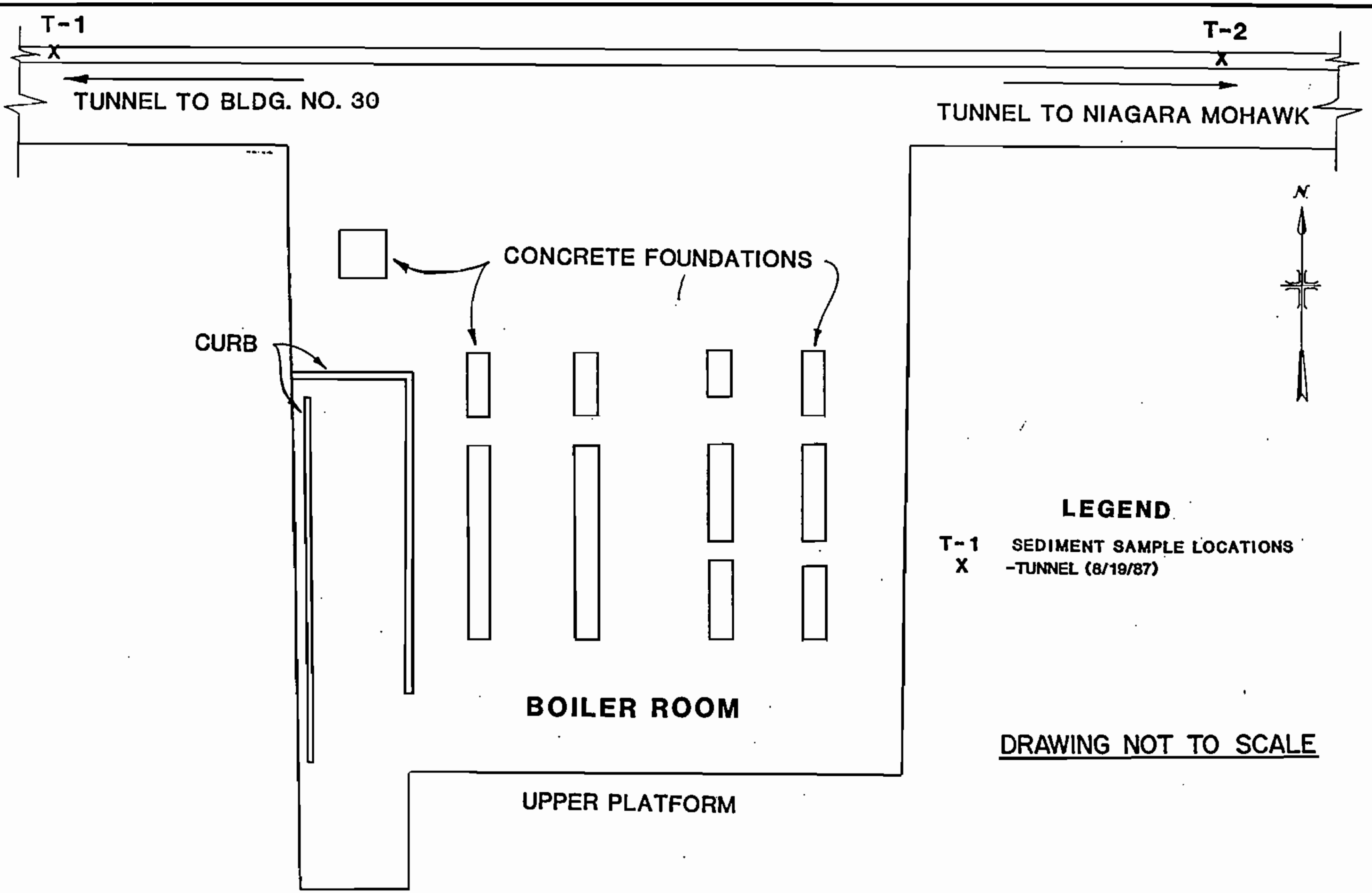
**STORM SEWER SAMPLE LOCATIONS**

MALCOLM PIRNIE, INC.

FIGURE 4-16

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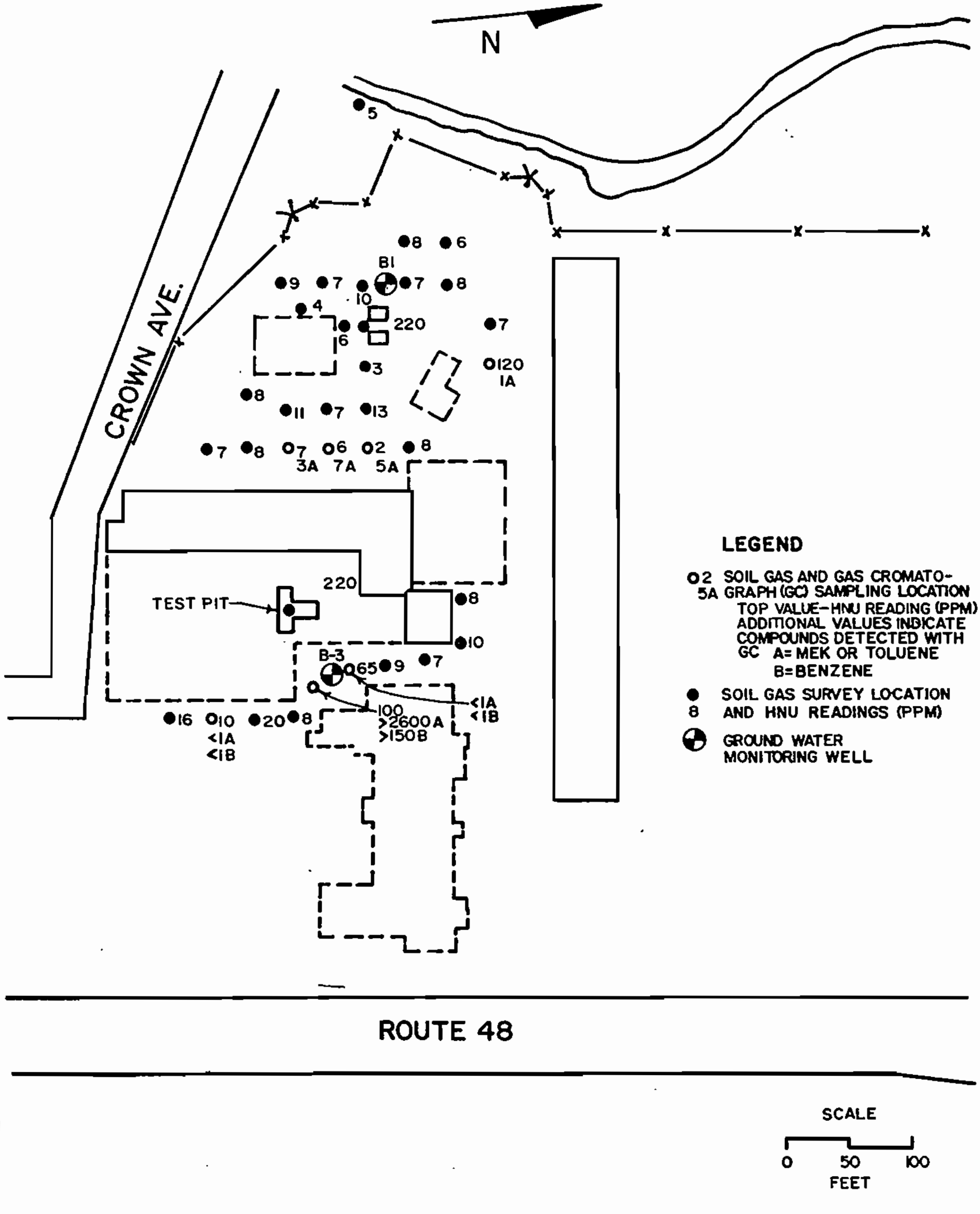
TUNNEL SEDIMENT SAMPLE LOCATIONS
COLLECTED AUGUST 1987

MALCOLM PIRNIE, INC.

FIGURE 4-17




MALCOLM PIRNIE

COLUMBIA MILLS MINETTO, NEW YORK
SOIL GAS SURVEY

MALCOLM PIRNIE, INC.

FIGURE NO.
4-18

The HNU readings obtained during the survey ranged from 2 ppm to 220 ppm. The 220 ppm level was recorded twice, in the soil gas pipe installed in the test pit in Area 3 and in the location nearest to the two 10,000-gallon tanks in Area 2. Elevated readings were also obtained at a location between Area 2 and the storm sewer (120 ppm) and at two locations near shallow ground water monitoring well B-3, shown on Figure 4-18. The readings obtained at the locations near well B-3 were 100 ppm and 65 ppm.

According to the soil gas survey results, it would appear that migration of contaminants from Area 2 is occurring in a direction to the north or northeast toward the storm sewer.

Although a 220 ppm reading was obtained a few feet south of the tanks in Area 2, this location turned out to be located within the vault area surrounding the tanks. Therefore, higher HNU readings at this location would not necessarily be indicative of contaminant migration.

Migration of contaminants from Area 3 is apparently occurring, at a minimum, in a direction to the east-northeast toward monitoring well B-3. The relatively low HNU values recorded in a north-south trend along the west side of Building No. 11 would seem to indicate that the source of contamination detected in Area 3 is not the tanks in Area 2. It seems likely that the source of contamination in Area 3 is from leaking underground storage tanks that were once stored in Area 3 and were subsequently removed. The location of the concrete pad over the former tank location has inhibited infiltration of precipitation and probably reduced the spread of contamination from the area.

Air samples were obtained at seven of the soil gas survey locations for analysis with the portable GC. Benzene, toluene and MEK were introduced into the GC using an air sampling valve. The compounds were then separated on an SE-30 packed column. Under the conditions used, MEK and toluene coeluted. All compounds eluting at the retention time of toluene or MEK were reported as toluene. Benzene was able to be clearly separated from MEK and toluene. The results of the air sampling and analysis have been plotted at their respective sampling locations on Figure 4-18. The results indicate that low levels of MEK/toluene, and less than 1 ppm benzene, were detected at all soil gas survey locations except soil gas location SG27. At soil gas survey location SG27, located next to ground water monitoring well B-3, there were 100 ppm of total organic compounds detected with the HNU. The GC analysis at this location detected an extremely high level of organic material. The reported value of 2600 ppm for toluene /MEK is an estimate, since the detector utilized was no longer linear in that region, the actual value may be much higher. Fourteen separate peaks eluted during the sample run, but, since only benzene, MEK and toluene were included in the test, the remaining compounds were unknown.

#### 4.2.4.4 Air

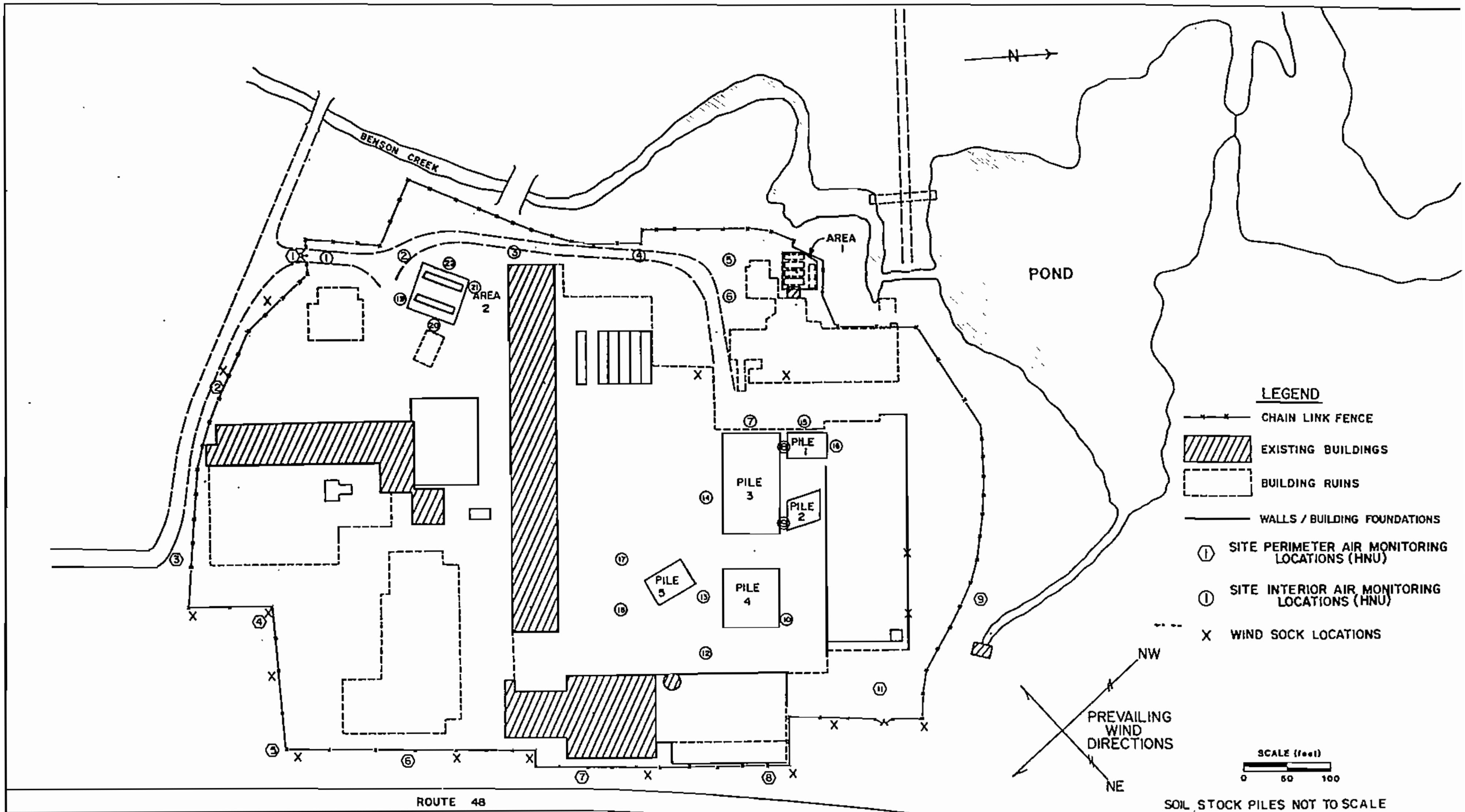
Air monitoring has been conducted on site during the Phase II investigation and during the remedial investigation. The extent of the Phase II air investigation included utilizing a TLV Sniffer to obtain readings upwind of the main plant site (for background purposes), at various locations within the main plant area and downwind of the site. The purpose of the survey was to detect potential gaseous releases to the atmosphere from sources within the main plant area, and to determine the extent of the release downwind from the source. Additional air monitoring was performed during the drilling of Phase II test borings in accordance with the Site Health and Safety Plan. The air monitoring performed during the remedial investigation included collecting air samples for analysis for asbestos content in locations downwind form the main plant site, utilizing an HNU meter to monitor the volatile organic content in the atmosphere in the vicinity of and downwind from excavation areas and soil piles during the removal of underground storage tanks and associated contaminated soil, utilizing a portable GC to obtain analytical results of air samples collected during the underground storage tank work and monitoring the air in the vicinity of the boreholes and test pits during site work in accordance with the Site Health and Safety Plan.

Following the installation of well B-2, during the Phase II investigation, organic odors were detected for a short period of time. The odors diminished to background levels shortly after the well installation was completed. No other significant organic vapors were detected in any other area of the site during the Phase II investigation.

Air monitoring with the HNU meter was performed along the perimeter of the site and in locations in the site interior during removal of the UST and soil near the tanks. These locations are shown Figure 4-19. Wind socks were placed in locations throughout the site to monitor the wind direction. The prevailing wind directions during the excavation work were from the northwest and northeast. In general, the wind conditions were mild during the work period.

The results of the air monitoring during the underground storage tank work can be summarized as follows.

1. HNU readings at the property fenceline never exceeded 10 ppm during work operations.
2. Peak instantaneous HNU readings at the perimeter locations were equal to or less than 4 ppm, with the exception of perimeter locations 1 (7 ppm) and location 2 (5 ppm) on July 28, 1988.
3. High temperatures and mild to moderate wind conditions enhanced vertical volatilization as opposed to organic vapors being blown off site.
4. HNU readings in the soil pile areas were:
    a. Less than or equal to 5 ppm at distances of approximately 10 feet from the piles in upwind locations when work was in progress.
    b. Around 10 ppm at distances of approximately 10 feet from the piles in downwind locations when no work was in progress.
    c. In the range of 150 to 1200 ppm at distances of 10 feet downwind from the soil piles when work was in progress.
5. Stockpiled soil that was exposed to the sun usually dried-out within a few minutes and had readings of less than 10 ppm.




COLUMBIA MILLS SITE
MINETTO, NEW YORK
AIR MONITORING LOCATIONS
DURING UNDERGROUND STORAGE
TANK WORK

MALCOLM PIRNIE

DATE: APRIL 1989

FIGURE NO. 4-19

## 4.3 WASTE QUANTITY

### 4.3.1 Drum Disposal Area

Based on information from the excavation of test pits, drilling logs and site reconnaissance, it is estimated that approximately 114,300 cubic yards of waste material and contaminated soil exist in the drum disposal area. This volume estimate will be refined during additional investigatory work tasks that are planned in the supplemental RI.

### 4.3.2 Main Plant Area

Approximately 1,000 cubic yards of soil were excavated and stockpiled during the UST removal process. It is estimated that approximately 600 cubic yards of contaminated soil have been left in place in Area 3. It is also estimated that approximately 500 cubic yards contaminated soil remain in Area 1, 200 cubic yards remain in Area 2 and 150 cubic yards remain in Area 4. These values will also be refined by performance of work tasks in the supplemental RI.

# 5.0 REMEDIAL INVESTIGATION PLAN

## 5.1 INTRODUCTION

The remedial investigation work plan for the Columbia Mills site is designed to provide sufficient data to perform a baseline risk assessment and to conduct a feasibility study that will meet the remedial action objectives. The RI is composed of the following work tasks which were developed based on the NYSDEC and NYSDOH comment letter following review of the draft RI report.

- Two-Stage Soil Gas Survey
- Test Drilling; Piezometer and Monitoring Well Installation
- Waste Quantity Determinations
- Natural Resources Investigation
- Air Sampling Program
- Sampling and Analysis of Soil and Ground Water
- Data Evaluation and Validation
- Baseline Risk Assessment
- Refine Remedial Action Goals

At the completion of these tasks, the draft remedial investigation report will be updated to include the additional information generated during this phase of the RI. The report will be submitted to the NYSDEC for review and comment.

In addition to this remedial investigation work plan, the NYSDEC and the NYSDOH have requested that interim remedial measures be instituted at the site to address:

1. The contaminated soils near UST Area 3;
2. Aeration of the soils staged from excavation in the UST areas; and,
3. Removal of the PCB contaminated soil in the Boiler Room (Building No. 8).

The interim remedial measures will be addressed in a separate work plan.

Prior to the performance of field activities, the following documents will be submitted for approval.

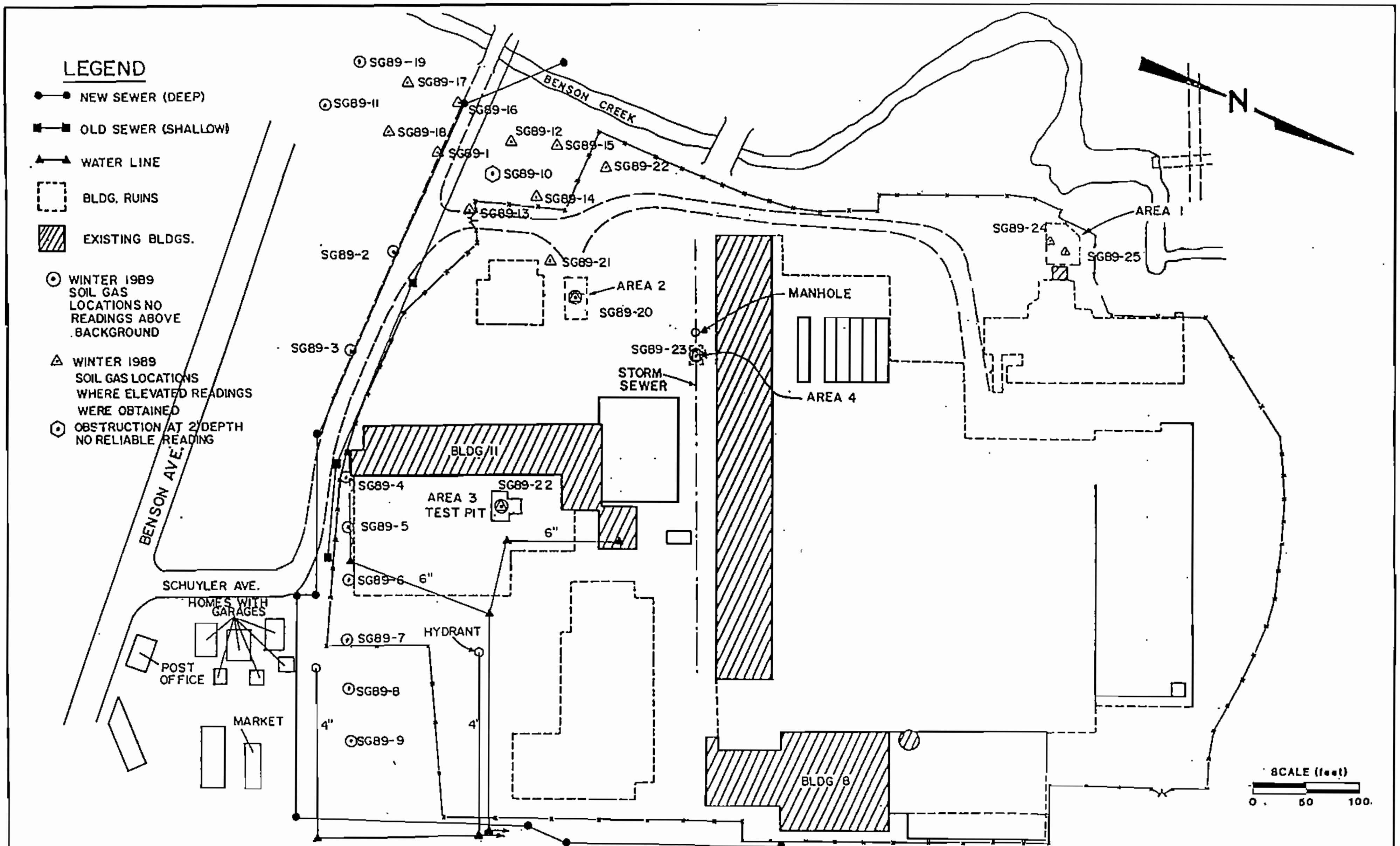
- Site specific health and safety plan (HSP) for both the remedial investigation and the interim remedial measures investigation.
- Quality assurance project plan (QAPP) to cover both investigations.

Draft copies of the HSP and QAPP are included in this work plan as Appendix A and Appendix B, respectively.

## 5.2 SOIL GAS SURVEY

The soil gas survey consists of two stages. The first stage, which has been completed, involved an investigation to determine if contamination was migrating toward nearby residences via soil gas beneath the frozen soil cap during the winter months. The second stage involves tracking contaminant plumes emanating from contaminated ground water in the main plant area and will be performed during the summer months. Results from both stages of the survey will be used to select shallow ground water monitoring well locations.

A plan to conduct the first stage of the soil gas survey was submitted to and approved by the NYSDEC during March 1989. Soil gas was then sampled and analyzed in the field using an HNU photoionization meter and a portable GC (March 1989). The soil gas sampling locations are shown on Figure 5-1. At several of these locations, soil gas was also drawn through charcoal filters to permit subsequent laboratory analysis by GC/MS. The GC/MS analysis was performed to verify and quantify compounds that were tentatively identified in the field, and to identify unknown peaks that

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SOIL GAS SURVEY LOCATIONS-WINTER 1989

MALCOLM PIRNIE, INC.

FIGURE 5-1

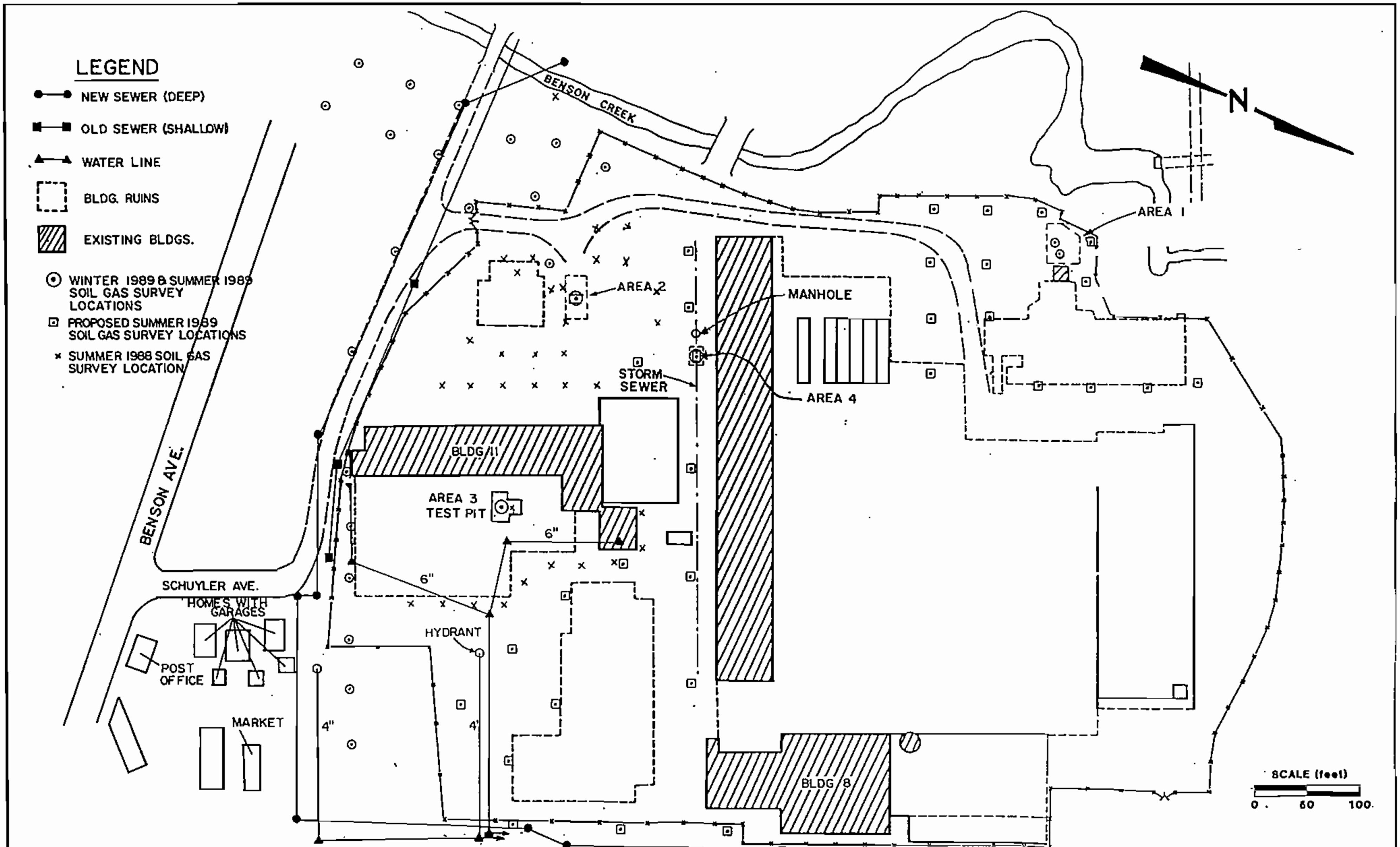
were obtained. The results of the GC/MS analysis were not available at the time of preparation of this work plan.

The same soil gas locations where samples were collected in March 1989 will be resampled during the Summer of 1989. The summer survey will also incorporate several new sampling locations in the main plant area, as shown on Figure 5-2. The new sampling locations have been selected to allow for the collection of soil gas data that will aid in shallow monitoring well placement. Soil gas survey locations are concentrated around former UST locations and the storm sewer. Additional soil gas sampling locations may be added during the performance of the survey, if necessary. The decision for adding soil gas collection locations will be made by the MPI representative in the field, in conjunction with any NYSDEC or NYSDOH representative that may be present.

To facilitate collection of the soil gas samples, a two-inch O.D. soil auger will be used to drill to a depth of approximately three feet below land surface. A slotted two-inch O.D. galvanized steel pipe, with sampling ports for an HNU and a portable GC, will then be inserted into the drill hole. The construction of the galvanized steel pipe is illustrated on Figure 5-3. The three-foot sample collection depth has been selected to conform to the Winter 1989 sampling depth, and to permit utilization of the probes during the winter months if future sampling is required.

Once the soil gas sampling probes have been installed, a calibrated, battery-operated air pump will be used to purge a volume of air equal to two times the sample probe volume from the probe. An HNU organic vapor detector will then be connected to the soil gas probe and the volatile organic content of the soil gas will be monitored. If HNU values register above background levels, a syringe will be inserted through the septum on the sample probe and a soil gas sample will be withdrawn for analysis with a portable GC unit. Calibration procedures for the HNU unit are given in the Quality Assurance Project Plan (QAPP) in Appendix B.

A Model 511A Thermo Electron portable GC and a trained operator will be provided by Upstate Laboratories, Inc., Syracuse, New York to check the soil gas content for compounds that have been detected in the vicinity of UST Areas 1, 2, 3 or 4. The compounds that have been detected in these

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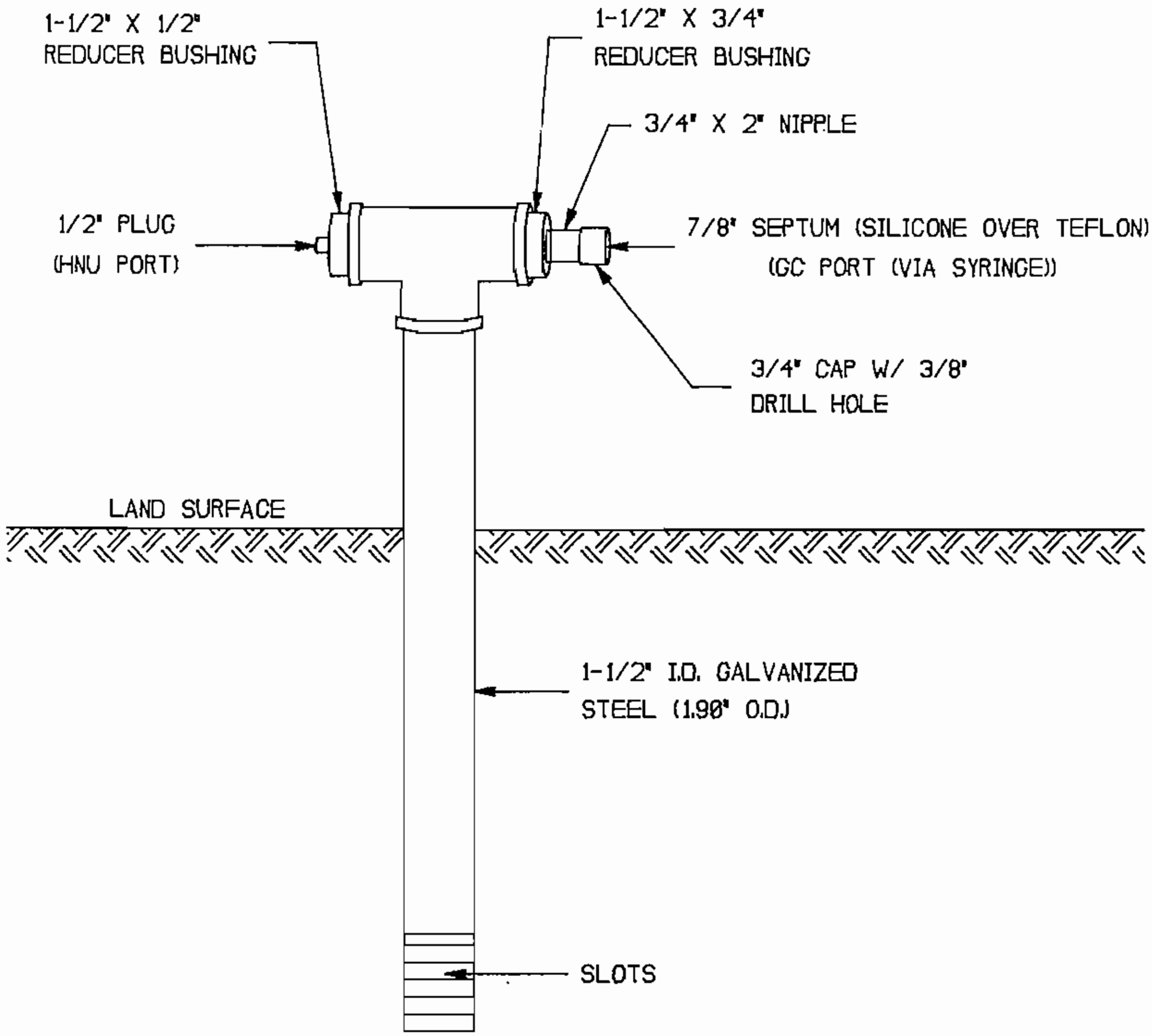
PROPOSED SOIL GAS SURVEY LOCATIONS-SUMMER 1989

MALCOLM PIRNIE, INC.

FIGURE 5-2




NOT TO SCALE

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TYPICAL GALVANIZED STEEL SOIL GAS PROBE

FIGURE 5-3

areas include xylenes, toluene, ethylbenzene, methyl ethyl ketone, methyl isobutyl ketone, benzene, 1,1,1-trichloroethane, 1,1-dichloroethylene and 1,1,2,2-tetrachloroethane. If the March 1989 analytical results indicate that additional volatile organic compounds are present in the vicinity of the main plant area, those compounds will be included in the analysis. A detection limit of 5 to 10 ppb will be attainable for the non-chlorinated volatile organics listed above. A detection limit of 100 ppb will be attainable for the chlorinated hydrocarbons.

## 5.3 MONITORING WELLS AND PIEZOMETERS

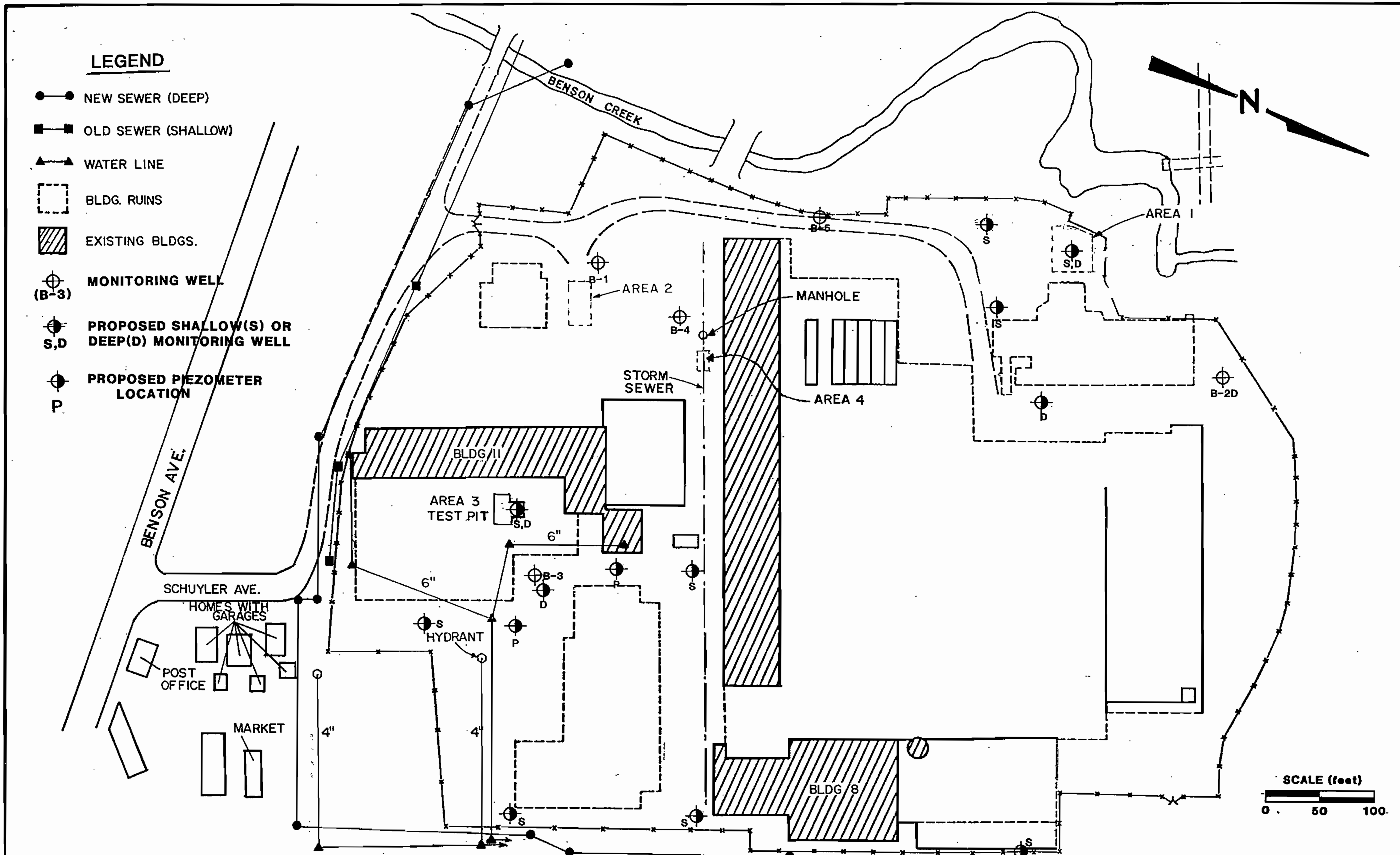
### 5.3.1 General Well Placement Rationale in the Main Plant Area

A. UST Area 1

It is anticipated that several shallow (water table) and deep (upper bedrock) ground water monitoring wells will be installed in the main plant area to allow for the collection of ground water samples for chemical analysis. Preliminary monitoring well locations are proposed as shown on Figure 5-4. The final number of monitoring wells that will be installed, and the final locations for the wells, will be determined based on soil gas survey results. The soil gas survey will be completed early in the RI process to enable installation of the wells in a expeditious manner.

As shown on Figure 5-2, three shallow wells and two deep wells are proposed in the vicinity of UST Area 1. One of the shallow wells is a replacement well for monitoring well well B-2S, which was destroyed. A deep monitoring well will be installed adjacent to this well to permit sampling of the upper bedrock aquifer in this area and to enable an estimation of the vertical hydraulic gradient. The additional shallow and deep wells will be used to delineate ground water contaminant plumes and map the configuration of the potentiometric surface in these two zones. A staff gauge will be installed in the main pond to enable coordination of the shallow ground water elevations with the pond water elevation.

Revised Text




MALCOLM PIRNIE

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**PROPOSED MONITORING WELL LOCATIONS - MAIN PLANT AREA**

MALCOLM PIRNIE, INC.

FIGURE 5-4

B. UST Area 3

Three shallow wells and two deep wells, along with several piezometers, are proposed in the vicinity of the test pit in Area 3. The shallow and deep monitoring wells will be used for water quality and water level purposes. The piezometers (one inch I.D.) will be installed to aid in mapping the water table. A monitoring well cluster will be installed in the test pit in Area 3 and a deep well will be installed adjacent to B-3 to complete the cluster in that location. The shallow well near the storm drain north of Area 3 will be installed in the bedding material. Information obtained from this well will be used to assess migration of contaminated ground water within the permeable bedding material. If elevated organic vapor levels are detected while drilling the boreholes for the piezometers, shallow monitoring wells will be installed instead of the piezometers.

C. Route 48 Boundary

Three (3) shallow wells will be placed at strategic points along the main plant area eastern boundary paralleling Route 48 in order to evaluate the potential impacts of buildings and conduits on shallow ground water flow and contaminant migration from the plant. The locations of these wells are shown on Figure 5-4. The southernmost well will be located in an area adjacent to the foundation of the former administration building and near the water lines entering the site and will attempt to measure any contaminant migration through the bedding material for these lines or along the building foundation. The central well will be installed adjacent to the storm sewer leaving the site and will evaluate ground water and contaminant migration in the sewer bedding. The northernmost well will be located so as to be hydraulically downgradient of the site of former oil storage tanks which were used to store boiler fuel. This location may have to be moved to the north depending upon the extent of buried interferences in the area shown.

Revised Text

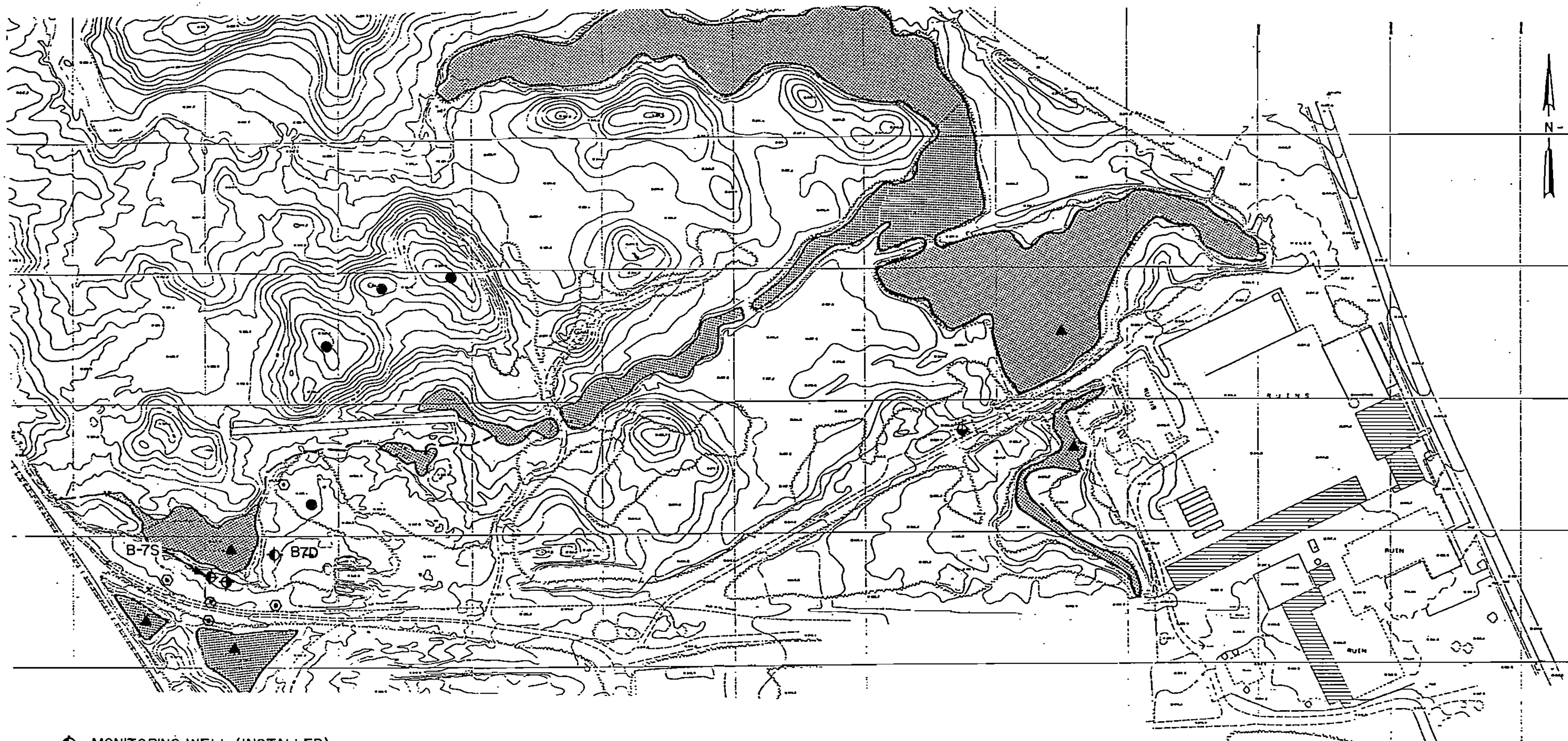
### 5.3.2 General Well Placement Rationale in the Drum Disposal Area and Arsenal Area

A. Drum Disposal Area

One well cluster and several piezometers will be installed in the drum disposal area. The well cluster, including both a deep and shallow well, will be installed adjacent to existing monitoring well B-7S, as shown on Figure 5-5, to monitor the water level and the water quality at this location. Several one-inch I.D. piezometers will also be installed in this area to provide information on the configuration of the water table, thereby allowing an assessment of shallow ground water flow patterns in this portion of the site. Staff gauges will be installed in the ponds to aid in the assessment of shallow ground water flow. If, based on ground water flow patterns, it appears that shallow ground water is flowing in directions that may be allowing potential unmonitored ground water contaminant migration (in directions other than toward the ponds), additional (shallow) monitoring wells will be installed. The decision on the location of such additional shallow wells will be made by MPI representatives and will be cleared with the NYSDEC.

Additional piezometers will also be installed in the hill located to the north-northeast of the drum disposal area to allow an assessment of the suitability of this area for use as an on-site secure landfill. The boreholes for these three piezometers will extend to the top of bedrock. Once the boreholes reach the top of rock, they will be backfilled with drilling cuttings to allow for the construction of the piezometers so that the middle of the screened portion approximately corresponds to the water table elevation. Samples of each different unconsolidated deposit will be obtained for grain size distribution analysis (GSDA) or Atterberg limit, whichever is applicable. A Shelby-tube sample will also be obtained from the lodgement till layer if it is present in this area. The Shelby-tube sample will be submitted to a soils laboratory for a determination of the saturated vertical hydraulic conductivity of this unit.

Revised Text




- MONITORING WELL (INSTALLED)
- STAFF GAUGE IN POND
- PIEZOMETER LOCATION (BOREHOLE TO BEDROCK)
- PIEZOMETER LOCATION
- PROPOSED MONITORING WELL CLUSTER LOCATION
- PROPOSED SHALLOW WELL OR MONITORING WELL CLUSTER

SCALE in feet

120 0 120 240 Ft.

| MALCOLM PIRNIE | REVISIONS | | | | DES ........ DWN ........ CKD ........ | COLUMBIA MILLS MINETTO, NEW YORK | PROPOSED MONITORING WELLS AND PIEZOMETERS IN THE DRUM DISPOSAL AREA | MALCOLM PIRNIE, INC. DATE APRIL 1989 FIGURE 5-5 |
|---|---|---|---|---|---|---|---|---|
| | NO. | BY | DATE | REMARKS | | | | |

One of the boreholes for a piezometer in the drum disposal area will also extend to the top of rock. The location selected for the deeper drilling is shown on Figure 5-5. Information obtained during the drilling process will be used to help in waste thickness determinations. A Shelby-tube sample will be collected from each naturally occurring unconsolidated deposit below the waste at this location to permit laboratory determination of the saturated vertical hydraulic conductivity below the waste. This information will be used during the remedial action alternative screening process, specifically to evaluate the possibility of capping the waste in place. Atterberg limits and/or GSDA will be performed on each different unconsolidated deposit penetrated during the drilling process. Once the borehole has reached the top of rock, it will be backfilled with cement/bentonite grout to a level that will permit installation of the water table monitoring piezometer. The grout will be allowed to set-up over a period of about 24 hours.

B. Arsenal Area

A minimum of one monitoring well will be installed in the arsenal area in the approximate location shown on Figure 5-5. The well will be located such that it is hydraulically downgradient of the area utilized in the past for materials storage. The boring will be advanced to the depth of any confining layer and depending upon the subsurface material and ground water conditions encountered, either a shallow well or a shallow/deep well cluster will be installed. The decision on one or two wells will be made by the on-site MPI geologist in conjunction with DEC's on-site representative.

### 5.3.3 Drilling Methods and Monitoring Well Installation

#### 5.3.3.1 Shallow Monitoring Wells and Piezometers

Hollow-stem augers (4 1/4-inch I.D.) will be utilized to drill the boreholes for installation of the shallow monitoring wells and the piezometers. Split-spoon samplers will be used to sample continuously from land surface to the total depth of the wells. Based on previous drilling and well installation at the site, it is estimated that the shallow wells and piezometers will be approximately 10 to 15 feet in total depth. These

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estimated depths do not include the piezometers to be installed in the hill located north-northeast of the drum disposal area, and the one deeper piezometer in the drum disposal area, since these piezometers may be considerably deeper. Portions of each split-spoon sample will be tested for the presence of volatile organics utilizing the method in the QAPP (Appendix A). The remainder of the samples will be jarred, labeled and retained for potential analysis. All soil samples collected will be described by an MPI hydrogeologist.

To prevent the possibility of cross-contamination between boreholes, the drilling rig and all drilling accessories will be thoroughly decontaminated before arriving on site and between drilling sites. A pressurized steam cleaner will be used to decontaminate the drilling rig and its accessories. All split-spoon samplers will be decontaminated with either the steam cleaner or with a detergent-water-hexane wash between usage.

Upon completion, each of the shallow boreholes will be converted to a ground water monitoring well or a piezometer. The actual depth of each well or piezometer will be determined in the field at the discretion of the MPI hydrogeologist on site. The NYSDEC, if available on-site, will participate in the decision-making process.

It is anticipated that each shallow monitoring well will be constructed in the following manner. Figure 5-6 illustrates the typical shallow monitoring well construction.

1. Five feet of two-inch I.D. Stainless Steel slotted screen (0.006 inch slots) will be utilized.
2. Two-inch I.D. black steel riser will extend from the screened interval to the top of the well.
3. Select sand (size 1Q ROK) will be packed in the annular space between the well and the borehole to approximately two feet above the top of the screened interval.
4. A minimum of two feet of bentonite will be emplaced above the sand pack to act as a well seal.

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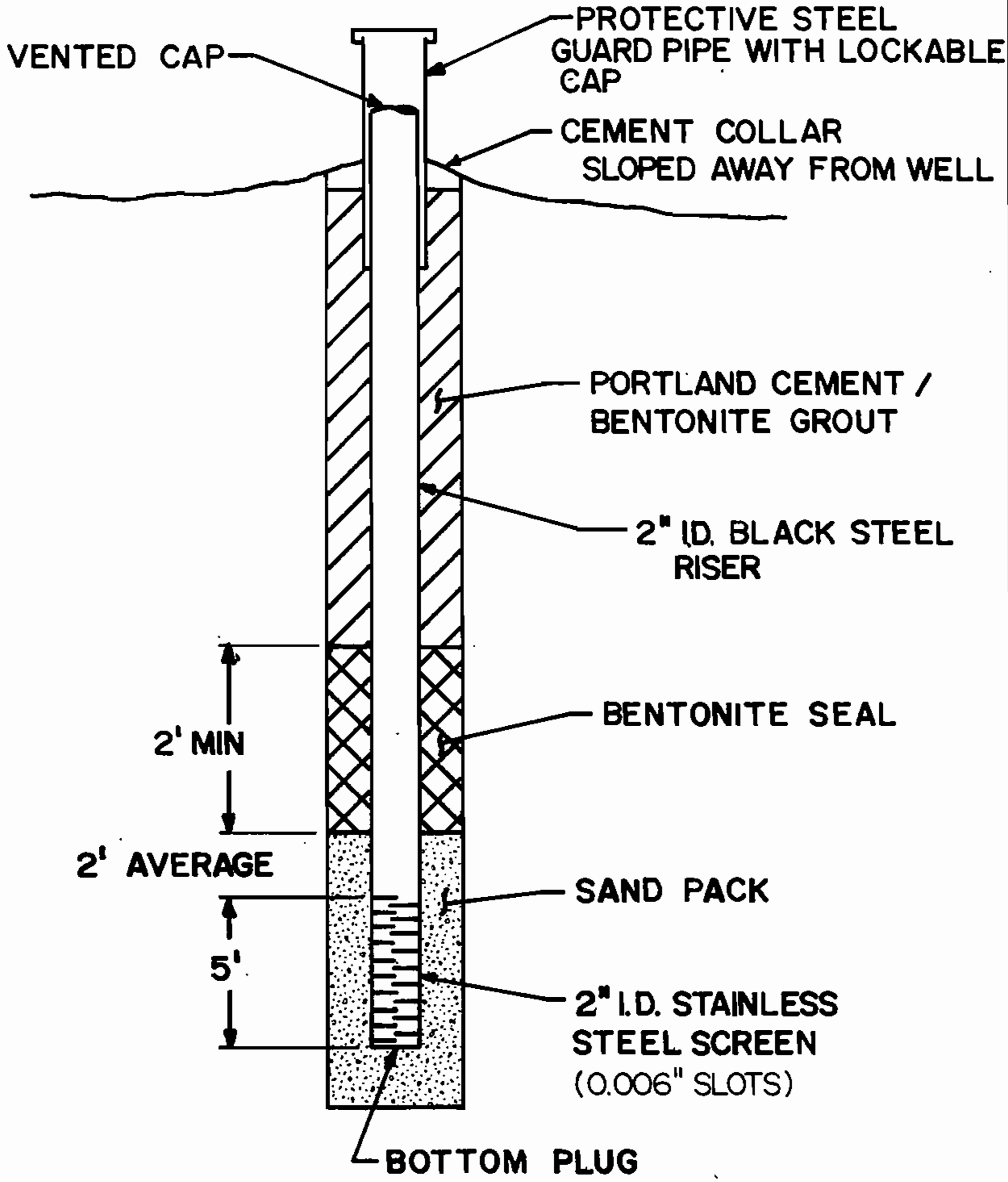



| MALCOLM PIRNIE | TYPICAL SHALLOW MONITORING WELL | MALCOLM PIRNIE, INC.<br>FIGURE 5-6 |
|---|---|---|

5. A Portland Cement/bentonite grout will be used to fill the remaining annulus to land surface. The proportions of the mixture will be 3-5 pounds bentonite per 94 pound bag of cement plus 6.5 gallons water, depending on field consistency.
6. A four-inch I.D. protective, steel guard pipe with a lockable cap will be lowered over the well casing and cemented into place (w/sloped collar).

The piezometers will be constructed of one-inch PVC pipe and will be emplaced into each borehole after the total depth has been reached, or in the case of the four deeper boreholes after backfilling to the appropriate elevation has occurred. The bottom five feet of the pipes will be slotted. The top of the piezometers will be capped.

5.3.3.2 Deep Monitoring Wells

The drilling methods and monitoring well construction details that will be utilized to install the bedrock monitoring wells will be substantially modified from those used for installation of the shallow wells.

The modifications are necessary to prevent the possibility of providing a conduit by which potential contaminants in the overburden may migrate via the borehole to the potentially uncontaminated bedrock aquifer.

The boreholes will be advanced through the overburden to the contact between the overburden and competent bedrock by means of six-inch I.D. steel casing. Split-spoon samplers will be used to collect continuous soil samples from land surface through the overburden to the top of bedrock. In the case where the deep well is part of a well cluster where a shallow well will be installed, no split spoon samples will be collected at the shallow well location due to the availability of the deep borehole samples. Portions of the samples obtained will be subjected to organic vapor analysis with an HNU organic vapor analyzer (as described in the QAPP). The remainder of the soil samples collected will be jarred, labeled and

Revised Text (2)

retained. All samples collected will be described in accordance with the classification system described in Appendix A of this work plan. All split-spoon samplers will be decontaminated between usage.

Once the borehole has been advanced to the top of competent rock, a 5 7/8-inch roller bit will be telescoped inside the six-inch casing and will be used to advance the borehole two feet further into the rock. A four-inch I.D. steel casing will then be lowered inside the six-inch casing to the bottom of the 5 7/8-inch roller-bit borehole. A thick bentonite slurry (Volclay) will be used to fill the annulus between the borehole and the four-inch steel casing to land surface as the six-inch casing is removed. After the four-inch casing is properly emplaced, a double-tube, swivel-type core barrel will be used to obtain core samples (NX) of the next 10 feet of bedrock. Air, supplied by a compressor, will serve as the drilling "fluid". Description of the core samples, including the Rock Quality Designation (RQD), will be made by the MPI hydrogeologist.

Subsequent to coring, the boreholes will be reamed with a 3 7/8-inch roller bit. It is necessary to ream the boreholes to the larger diameter to accommodate the monitoring wells and their associated select backfill. Roller bit drilling will continue to a depth of 10 feet below the top of competent bedrock. The monitoring wells will be constructed of five feet of two-inch I.D. stainless steel screens (0.01 inch slots) and two-inch I.D. black steel riser. The riser pipe will extend from the top of the screened interval to approximately two feet above land surface. Prior to monitoring well construction, a packer permeability test will be performed in the 5-foot interval of bedrock corresponding to the intended screened interval of the well. The permeability test results will be used to calculate the horizontal hydraulic conductivity of the bedrock in the vicinity of the well. Sand will be emplaced in the borehole to support the well so that the top of the screened portion of the well corresponds to the top of competent bedrock.

The annulus between the 2-inch well and the borehole will be backfilled with select sand (size 2Q ROK) to approximately, but no less than, two feet above the top of the screened interval. The top of the sand

Revised Text (2)

pack will be continuously monitored during the backfilling process with a measuring tape fitted with a weighted tamper at the end. Thick bentonite slurry (Volclay) will be pumped into the annular space from the top of the sand pack to land surface. A 6-inch lockable steel guard pipe will be emplaced over the 4-inch steel casing. The guard pipe will be secured into place with a conical cement pad which will slope away from the pipe. In order to prevent the possibility of cement contamination, this will be the only place that cement is used during the well installation process. A typical monitoring well construction diagram (based on double-casing techniques) is illustrated on Figure 5-7.

The drilling rig and all drilling accessories, along with the split-spoon samplers will be decontaminated between use, as previously described.

5.3.3.3 Well Development

As each well installation is completed, the well will be developed by bailing until:

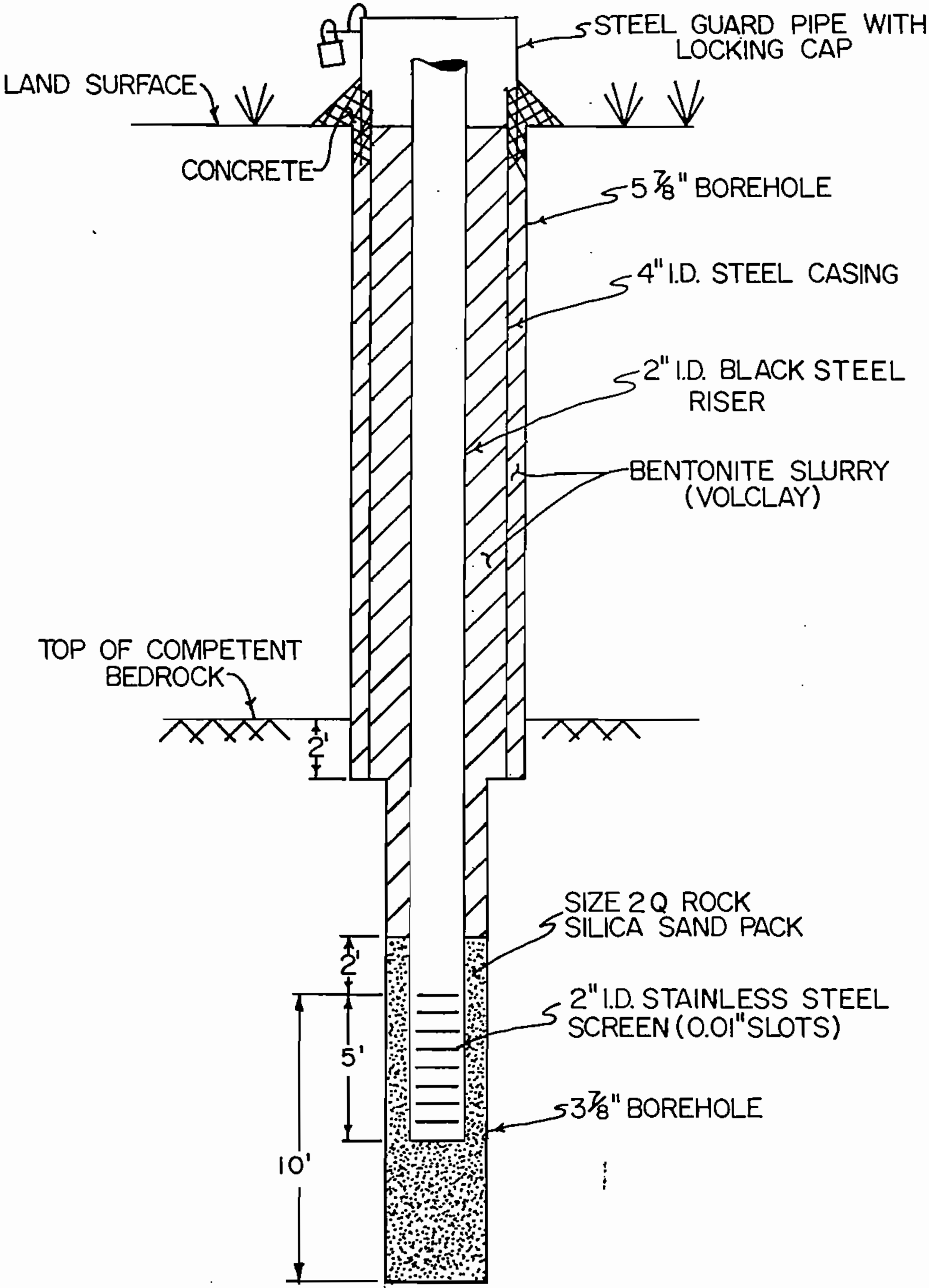
1. All drilling cuttings are removed;
2. Any drilling fluids that were added are removed; and,
3. If possible, to a turbidity level of less than 50 NTU.

However, since the wells will be screened in a formation(s) that is relatively fine-grained, development to the 50 NTU level may not be possible.

The decision flow chart shown on Figure 5-8 will be used to determine the steps to be taken during well development. The NYSDEC representative will be consulted during the well development process.

5.3.3.4 Disposition of Drill Cuttings and Development/Purge Water

In accordance with the proposed NYSDEC Technical and Administrative Guidance Memorandum on the disposal of drill cuttings (Appendix C), all drill cuttings will be disposed of within 20 feet of their respective boreholes. All development and purge water will also be disposed of near the wells.




NOT TO SCALE

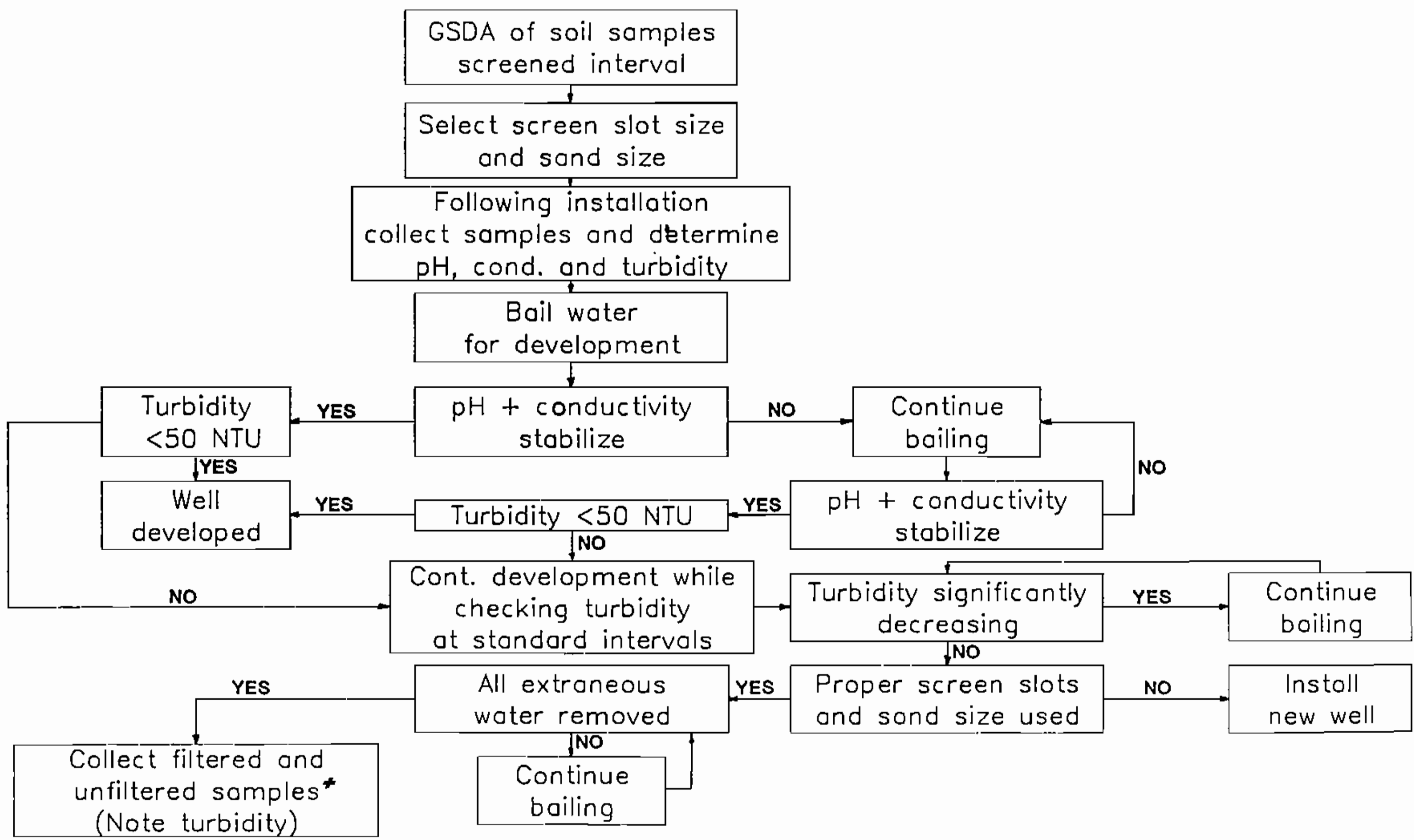
MALCOLM PIRNIE

TYPICAL DOUBLE-CASED MONITORING WELL

MALCOLM PIRNIE, INC.

FIGURE 5-7

# FIGURE 5-8
# COLUMBIA MILLS RI/FS
## DECISION FLOW CHART: WELL INSTALLATION AND DEVELOPMENT




* ANALYZE UNFILTERED SAMPLE FIRST : IF THE UNFILTERED SAMPLE EXCEEDS A R A R's ANALYZE THE FILTERED SAMPLE
IF THE UNFILTERED SAMPLE MEETS A R A R's DO NOT ANALYZE THE FILTERED SAMPLE.

5.3.3.5 Water Level Measurements

Subsequent to well development, water levels in the shallow and deep wells will be measured and recorded on a monthly basis for a period of approximately six months. These data will be used to map the configuration of the water table and the potentiometric surface of the deeper aquifer.

5.3.3.6 Well Surveying

The land surface and the top of the well casing elevations for each well and each piezometer will be surveyed by licensed surveyor. All surveyed elevations will be tied to a USGS datum. The wells will be surveyed to enable correlation of water levels and subsurface units.

5.3.3.7 Permeability Tests

Falling- or rising-head permeability tests (slug tests) will be performed at each shallow monitoring well to permit calculation of the saturated horizontal hydraulic conductivity of the soils in the vicinity of the screened interval. The procedure for this type of test is provided in the QAPP (Appendix B). As discussed earlier, packer permeability tests will be performed at the deep wells. The procedure for this test is also given in Appendix B.

## 5.4 WASTE QUANTITY DETERMINATIONS

Waste boundaries in the drum disposal area were approximated in the draft RI (see Figure 3-10 of that report) based on test pits that were excavated in that area. The test pits that were excavated during the Phase II investigation and during the preliminary RI are shown on Figure 5-9. Additional test pits will be excavated in the drum disposal area in order to provide information on the extent of the waste and its thickness and extent and the occurrence of bedrock in this area. Information obtained from test drilling for monitoring wells and piezometers in this area will also be used to refine the waste quantity estimations. Several long, narrow test pits will be excavated in the drum disposal area in the approximate locations shown on Figure 5-9. The test pits will be excavated

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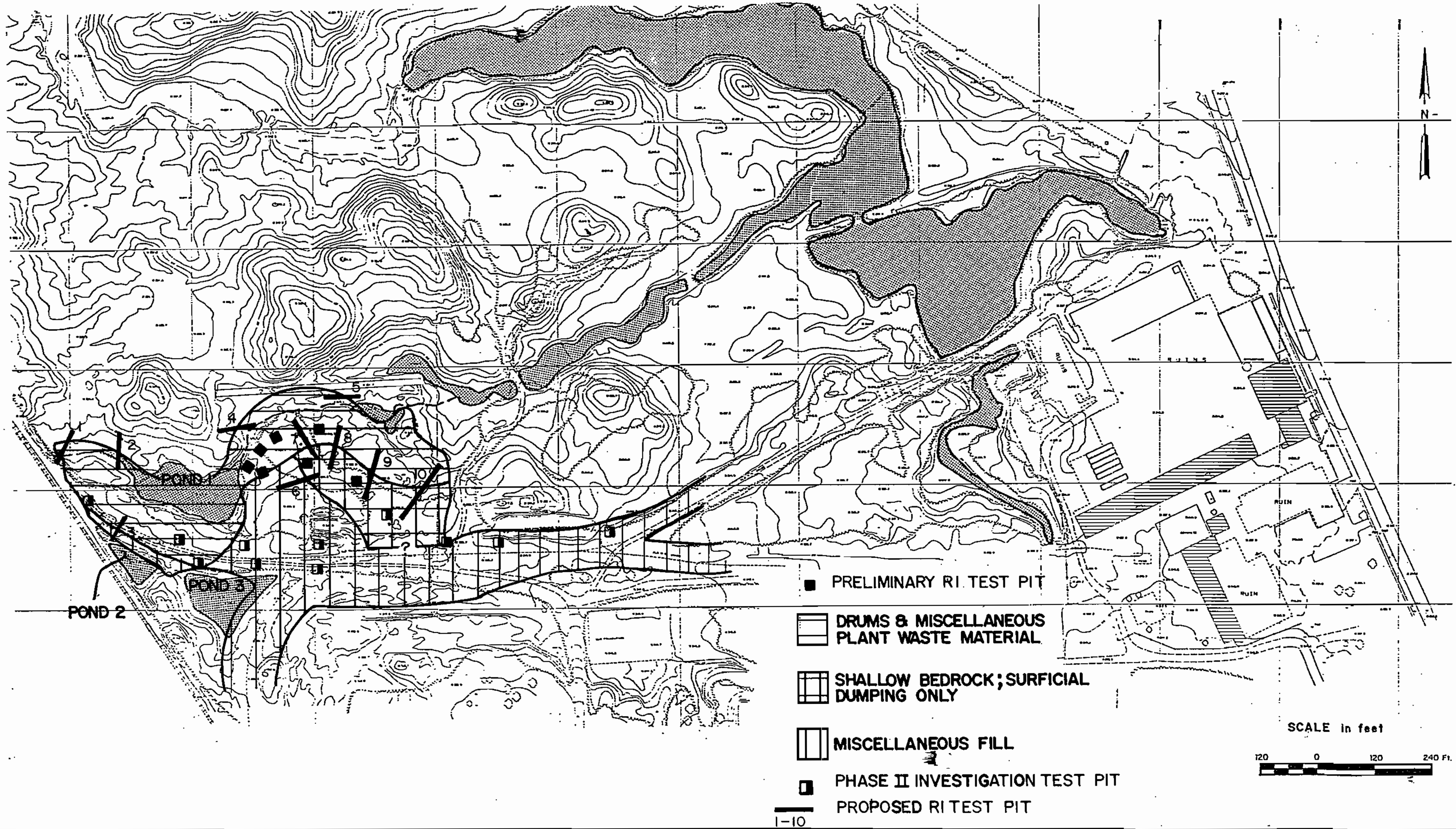


| MALCOLM PIRNIE | REVISIONS (NO. / BY / DATE / REMARKS) | DES / DWN / CKD | COLUMBIA MILLS<br>MINETTO, NEW YORK | PROPOSED TEST PITS IN<br>DRUM DISPOSAL AREA | MALCOLM PIRNIE, INC.<br>DATE APRIL 1989<br>FIGURE 5-9 |
|---|---|---|---|---|---|

by backhoe to a depth corresponding to the lower limit of the waste, to the water table or to bedrock, whichever is encountered first. The test pits will be approximately one bucket's width, or about two feet wide. The length of the test pits will be determined in the field by the MPI hydrogeologist and the on-site NYSDEC representative.

During the test pit excavation process, 10 discrete soil samples will be collected, approximately one from each new test pit, and subjected to analysis for EP-toxicity metals analysis and analysis for inorganics to determine the leaching characteristics of the soil.

The results of the soil gas survey will be used to better quantify volumes of contaminated soil in the vicinity of the UST areas in the main plant area.

## 5.5 NATURAL RESOURCES INVESTIGATION

A natural resources investigation will be performed at the Columbia Mills site to assess the vegetation covertypes and their associated fish and wildlife receptors. The investigation will be a "Habitat Based Assessment" (HBA) type of evaluation. As provided in guidance from the NYSDEC, the HBA will include the following components: (1) covertype map; (2) aquatic and terrestrial species assessment; and (3) fish and wildlife ARAR identification.

### 5.5.1 Covertype Map

A covertype map will be prepared using aerial photography, United States Geological Survey topographic maps and Soil Conservation Service maps. The map will show major vegetative communities, aquatic communities, and any significant habitats or areas of special concern. The specific covertypes and vegetative species will be verified by a limited amount of field checking. The vegetative communities will be described in the updated RI report, in addition to being shown on the map.

Revised Text (2)

5.5.2 Aquatic and Terrestrial Species Assessment

The second step of the HBA will be to determine the various aquatic and terrestrial species which would be associated with the types of habitats identified on the covertype map. This assessment will be performed using standard natural history references and any information provided by Regional NYSDEC offices of the United States Fish and Wildlife Service.

5.5.3 ARAR Identification

All fish and wildlife related ARAR's will be identified to complete the HBA. The following regulations will be consulted to determine the relevant ARAR's:

1. Freshwater Wetlands Act
2. Regulated Streams (Article 15 ECL. 6 NYCRR Part 608)
3. Navigable Waterbodies (Same as above)
4. Natural Heritage Program
5. NYS Water Quality Standards/Guidance Values

All regulated, classified, or significant habitats identified at the site, or downstream will be shown on the covertype map and discussed in the updated RI report.

5.5.4 Wildlife Risk Assessment

Once the previous tasks are completed and all data on habitats and species are collected, along with the appropriate ARARs, Malcolm Pirnie personnel will prepare a preliminary endangerment assessment report which shall evaluate the potential for acute, subacute and chronic impacts on the fish and wildlife in the area. After review by the NYSDEC Fish and Wildlife personnel, MPI and NYSDEC personnel will meet to discuss the findings and determine the need for any additional work in this area, such as tissue samples, etc.

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## 5.6 ENVIRONMENTAL SAMPLING

The following sections describe, in general, the sampling programs that will be conducted. Specific sampling procedures can be found in the QAPP (Appendix B).

### 5.6.1 Ground Water Sampling

A total of 24 ground water samples will be collected, one from each newly installed and existing well. If the total number of new wells is adjusted, so will the corresponding number of ground water samples be adjusted. Each well will be purged from four to ten well volumes (or to dryness) by hand bailing. The samples will also be obtained via the bailers. Dedicated bailers will be used at each well. Quality control samples for the ground water samples will include one trip blank/day (volatile organic compounds only) and two field duplicates.

The ground water samples will be analyzed for a select list of organic and inorganic parameters. The list of parameters along with detailed information regarding sampling and analytical requirements is included in Section 2 of the QAPP (Appendix B). The select inorganic and organic parameter list has been compiled based on previous analytical results from the site. Both filtered and unfiltered samples will be collected from each well for metals analysis.

Based on the results of the first round of sampling, a second round of ground water samples may be obtained at the wells. 3

### 5.6.2 Soil and Sediment Sampling

#### 5.6.2.1 Drum Disposal Area

Three grab soil samples will be collected in the drum disposal area for analysis for polychlorinated dibenzo-p-dioxins and polychlorinated dibenzofurans (combustion by-products). The analytical methods that will be utilized are specified in Section 2 of the QAPP.

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The soil samples will be collected from locations in the drum disposal area where ash material is evident on the land surface. The sampling locations will be determined in the field by an MPI representative (and a NYSDEC representative, if available) and will be staked to permit future identification of the sampling locale.

5.6.2.2 Main Plant Area (Tank Area #1)

Once the soil gas work is completed, approximately five (5) wells will be installed in this area as referenced in Section 5.3.1. Borings from these wells will be screened using head-space analysis with an HNU meter. Samples showing the highest levels of organic contamination will be analyzed for the organics and inorganics listed on Table 2-3 of the QAPP.

In addition, a total of five (5) soil and five (5) sediment samples will be collected in the area between Tank Area #1 and the creek. A row of five soil samples will be collected from the soil halfway between the fence and the creek. Sediment samples will also be obtained from the stream in the area that is subject to recharge by ground water from the vicinity of UST 1. The sample locations are shown on Figure 5-10. Table 2-2 in the QAPP has been revised to include the soil samples for analysis for the inorganics listed on Table 2-3 of the QAPP. The sediment samples will be analyzed for the inorganics and organics listed on Table 2-3 of the QAPP.

5.6.2.3 Stream Sediments

Previous sampling has identified excessive levels of metals in the sediments near the outlet of Pond #1 (location Sed 3) and the entrance of the stream into the large pond (location Sed 2). The stream runs for a total distance of approximately 1300 feet between these two points. A total of ten (10) sediment samples will be collected along the stream bed at intervals of 100 feet to determine the extent of sediment contamination in the stream bed (see Figure 5-11). These samples will be analyzed for the inorganics on Table 2-3 of the QAPP. Since only low amounts of organics were found in past organic analyses, no further organic analyses will be performed and the relative metals content of the sediments will be used as a basis for remedial planning.

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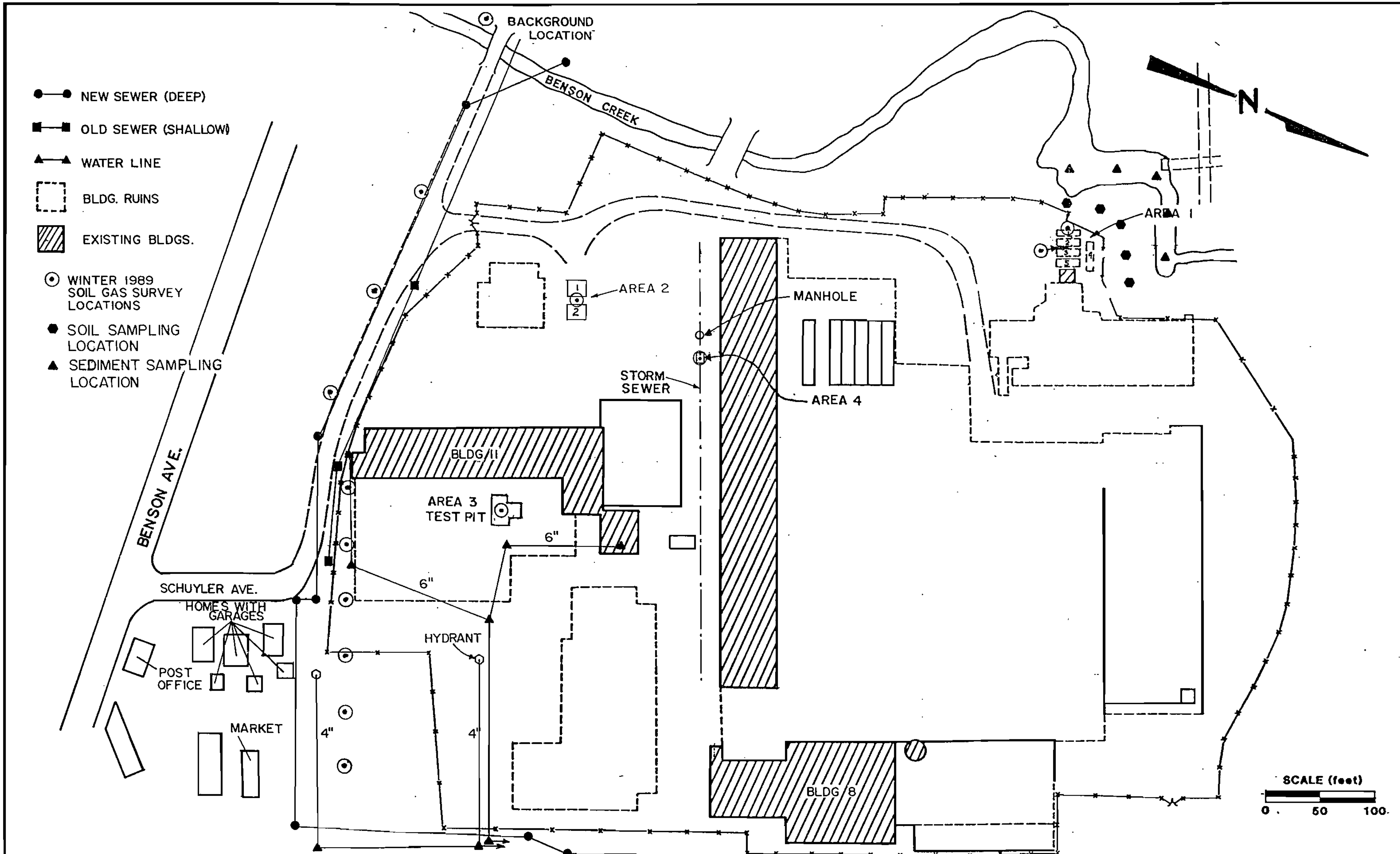


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PROPOSED SOIL AND SEDIMENT SAMPLING LOCATIONS NEAR UST AREA 1

MALCOLM PIRNIE, INC.

FIGURE 5-10

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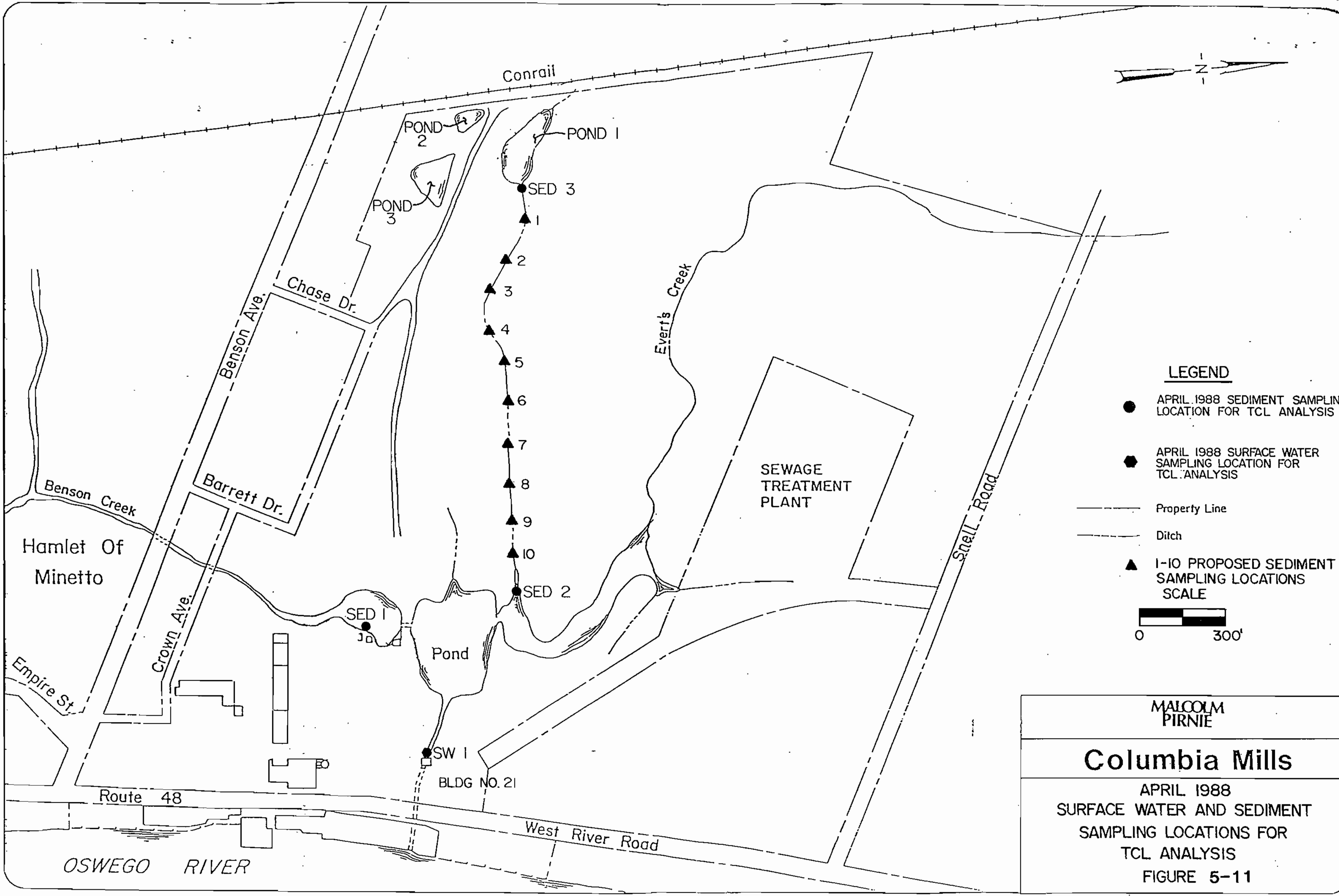


Columbia Mills

APRIL 1988
SURFACE WATER AND SEDIMENT
SAMPLING LOCATIONS FOR
TCL ANALYSIS
FIGURE 5-11

5.6.2.4 Background Soils

Two (2) samples of soil will be collected in two separate uncontaminated portions of the Columbia Mills property and analyzed for TCL parameters to establish background contaminant levels in the soils. These locations will be established by Malcolm Pirnie in conjunction with NYSDEC's on-site representative at the time that soil sampling is conducted at the site.

5.6.3 Air Sampling Program

A. Organics

An air sampling program will be conducted in the main plant area to supplement previous sampling performed during the Phase II and preliminary remedial investigations.

The program will include head space analysis with a portable GC on grab soil samples collected from areas of known contamination.

The portable GC to be utilized will be able to detect non-chlorinated volatile hydrocarbons that have been detected in these areas at a level above 5 to 10 ppb. Toluene and methyl ethyl ketone will be able to be separated on the GC. The results of these analyses will be coupled with previous analytical results obtained from soil samples collected in the main plant area to develop a Baseline Emissions Estimate. The Baseline Emissions Estimate will be prepared in accordance with the methods outlined in the USEPA document 450/1-89-002 "Estimation of Baseline Air Emissions at Superfund Sites".

Air sampling will also be performed during all remedial activities in areas where volatile organics have been detected. The procedures to be utilized for this sampling are summarized in the USEPA document 450/1 89-003 "Estimation of Air Emissions from Cleanup Activities at Superfund Sites".

B. Particulate Matter

Real time monitoring for particulates will be performed at the work site and at the downwind plant boundary during any investigating activities which result in blowing dirt or dust; including test pit excavations or

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other dirt moving activities. Such work will be performed, when possible, at times when wind velocities are low and moisture conditions are best, however, scheduling conflicts may not always allow such latitudes. Section 3.5.5 of the QAPP references the method used for such monitoring and the action levels to be utilized.

5.6.4 Soil Gas Sampling

Approximately 55 soil as samples will be obtained during the Summer 1989 soil gas survey. The total number will increase if the survey is expanded during its performance.

The soil gas sampling procedure is described in Section 5.2 of this workplan. Specifications and calibration procedures for the HNU and portable GC that will be utilized during the survey are listed in the QAPP. The parameters that the GC will be calibrated for are also listed in Section 5.2.

5.6.5 Sample Analysis

A list of analytical parameters has been developed to provide information on all parameters previously detected at the site in ground water, surface water, air and soil samples. The parameters are listed on Table 2-3 in Section 2 of the QAPP. Further information regarding analytical methodologies detection limits, report deliverables, quality assurance samples and detection limits can be found in Section 2 of the QAPP.

## 5.7 VALIDATION OF ANALYTICAL DATA

Data validation is a process by which analytical data are compared against criteria that have been established as being technically and legally acceptable. There are two areas that must be evaluated in order for the analytical test results to be considered valid. The first is validation that the sampling protocols were properly adhered to and the

Revised Text

second is a review of the laboratory data package for the sample results to confirm the results are within the acceptable limits of the Data Quality Objectives (DQOs).

### 5.7.1 Field Data Validation

The validation of field data will take into account the verification that the following areas have been carried out in accordance with the QAPP standard operating procedures:

- review of field notes to see that the proper field information was collected (i.e., times of sample collection, field instrumentation calibration checks)
- conduct audits of sampling personnel
- review trip and field blank samples to see if sample contamination has occurred.
- compare duplicate sample results.

If, after a review of the data, the results are satisfactory, the field sampling procedures will be considered acceptable for use.

### 5.7.2 Laboratory Validation

Validation of laboratory data is a two-stage process. The laboratory is the first to validate its own data in accordance with its state approved quality assurance plan.

Once the laboratory certifies the results, Malcolm Pirnie personnel will review the data packages in accordance with the following guidelines: "Functional Guidelines for Evaluating Organic Analyses" (USEPA 1988) and "Evaluation of Metals Data for the Hazardous Waste Site Program" (SOP No. HW-2, USEPA 1985). At a minimum, 10 percent of the samples per media will have the data inspected in accordance with the above protocols. This level of evaluation will ensure that the analytical data is correct and an accurate representation of the site conditions.

### 5.7.3 Data Evaluation

Once the data have been validated as to their accuracy and precision, the data must be reduced and tabulated into a manageable format. The next step will be to evaluate the data to determine if they are sufficient to allow the remedial action objectives to be met by incorporating the data into one of the following activities.

- Ground water quality assessment
- Identification of potential treatment technologies capable of successfully treating known contaminants.
- Identification of additional sampling and analysis needs, if any.
- Definition of the horizontal and vertical extent of contamination.
- Determining what risks are associated with the site contaminant concentration levels in the baseline risk assessment.

Data collected will define the physical and hydraulic properties of each component of the flow system. An estimate will then be made of the rate of contaminant migration directions of transport via the surface and ground water media.

Once these activities are completed, the results will either identify data gaps which will require further investigative work to be performed or conclude that the data are sufficient to achieve the remedial action and data quality objectives.

## 5.8 BASELINE RISK ASSESSMENT

### 5.8.1 Purpose and Objectives of Risk Assessment

The purpose of the risk assessment is to provide an evaluation of the potential threat to human health and the environment in the absence of any remedial action and is intended to provide sufficient justification as to whether or not remedial actions need to be performed at the Columbia Mills site.

The objectives of the baseline risk assessment are as follows:

- Characterize the toxicity and quantity of hazardous substances present at the site.

- Identify environmental fate and transport mechanisms of contaminants.
- Identify potential exposure pathways.
- Identify potential human and or environmental receptors.
- Determine likelihodd of impact or threat occurring.
- Define acceptable levels of risk.

The following is a brief overview of each component of the risk assessment process.

Contaminant Characterization

This component is concerned with the development of the analytical data to define the nature and concentration of site contaminants in the various environmental media (air, soil, surface water, ground water). The development of these data (e.g., contaminant content of the soil and ground water, contaminant migration) will be completed as described above.

Hazard Identification

This component deals with the review of the site contaminants and the adverse health and environmental affects that result from both chronic and/or acute exposure. During this step, a review is conducted of water quality criteria, human health and toxicology data and similar information from a variety of sources. Only published (peer-reviewed data will be utilized.

Exposure Assessment

The third component of the risk assessment is an evaluation of what exposures are occurring or could be anticipated to occur under existing and realistic future conditions. Consideration is given to identification of physical and biological modes of contaminant migration, identification of exposure methods (e.g. direct contact, ingestion, inhalation), identification of target population and target receptors, and evaluation of target-receptor probability and frequency of exposure.

### Risk Evaluation

The final component involves an evaluation of the hazards identified when coupled with the exposure potentials. Also factored in is other relevant information (e.g., seasonal effects on potential exposures).

## 5.9 REFINEMENT OF REMEDIAL ACTION OBJECTIVE

During the process of updating the Columbia Mills remedial investigation report, the limitations of the data collected will be assessed to see if additional work is required to adequately address the remedial action objectives. If the data are sufficient, then the remedial action objectives will be reviewed to see if changes are required based on the new data and their interpretation.

Examples of changes would be better defining the extent of contamination, eliminating particular preliminary remedial actions because site conditions are not conducive to a particular technology, eliminating particular exposure pathways or identifying clean-up levels which would provide adequate protection to human health and the environment, but are higher than State or Federal standards. Once these refinements are made, they can be incorporated into the feasibility study plan and report.

# 6.0 FEASIBILITY STUDY PLAN

## 6.1 TECHNICAL APPROACH

The primary objective of the Feasibility Study Plan is to present a methodology to develop alternatives that will achieve the remedial action objectives established for the Columbia Mills site.

As part of this work plan, remedial action alternatives will be developed based on the available data in order for the RI portion of the work plan to be interactive with the FS portion.

The feasibility study will be performed in three tasks:

- development of alternatives
- screening of alternatives
- conducting detailed analysis of the remaining alternatives.

At this point in the project, the FS plan is fairly generic. Specific details will be developed as the RI is implemented.

## 6.2 DEVELOPMENT OF REMEDIAL ACTION ALTERNATIVES

This process consists of six general steps, as presented in the USEPA March 1988 draft guidance document for conducting RI/FS investigations under CERCLA. The six steps are as follows.

1. Develop remedial action objectives specifying the contaminants and media of interest, exposure pathways, and remediation goals that permit a range of treatment and containment alternatives to be developed. The objectives developed are based on contaminant-specific ARARs, when available and risk-related factors.
2. Develop general response actions for each medium of interest defining contaminant, treatment, excavation, pumping, or other actions, singly or in combination, that may be taken to satisfy the remedial action objectives for the site.

3. Identify volumes or areas of media to which general response actions might be applied, taking into account the requirements for protectiveness as identified in the remedial action objectives and the chemical and physical characterization of the site.
4. Identify and screen the technologies applicable to each general response action to eliminate those that cannot be implemented technically at the site. It is important to distinguish between this medium-specific technology screening step during development of alternatives and the alternative screening that may be conducted subsequently to reduce the number of alternatives prior to the detailed analysis.
5. Identify and evaluate technology process options to select a representative process for each technology type retained for consideration. Although specific processes are selected for alternative development and evaluation, these processes are intended to represent the broader range of process options within a general technology type.
6. Assemble the selected representative technologies into alternatived representating a range of treatment and containment combinations, as appropriate.

Alternatives for remediation of the Columbia Mills site will be developed by assembling combinations of technologies for each identified contaminated media that singularly or in combination will address the extent of contamination on a site-wide basis.

The development of the alternatives will encompass the following process:

- Develop general response actions for each media by defining: containment, treatment, removal, collection and disposal actions that singularly or in combination will achieve the remedial response objectives.
- Identify volumes and/or areas of media to which general response actions might be applied.

- Identify and screen technologies applicable to each general response action and begin elimination of those technologies that cannot technically be implemented at the site.
- Identify and evaluate technology process options to select a representative process for each technology.
- Assemble the selected representative technologies into alternatives.

The results of this process will yield a group of alternatives that conceptually would be able to achieve the remedial action objectives for the Columbia Mills site. Preliminary remedial action alternatives have been presented earlier based on available information.

Upon completion of the updated draft RI report, the remedial action objectives will be reevaluated and updated as required to reflect new data obtained in the field investigation activities and baseline risk assessment.

## 6.3 SCREENING OF REMEDIAL ALTERNATIVES

The screening of remedial alternatives will be conducted in three steps. Step one consists of refining the alternatives by quantifying areas and volumes of the media of interest, along with the size and capacities of options that make up each of the alternatives. The second step is to evaluate each alternative on a general basis as to its effectiveness, implementability and cost. Step three is to decide, based on the general evaluation, which alternative(s) should be retained for detailed analysis. The objective of screening the alternatives is to eliminate those alternatives which:

- Cannot accomplish the remedial action objectives on the basis of effectiveness.
- Cannot be reasonably implemented.
- Are cost prohibitive (i.e., other technologies can achieve the same results at less cost).

At a minimum, five remedial action alternatives will be retained for detailed analysis. The remedial action alternatives fall into the following categories as specified in 40 CFR 300.68.

- No action.
- Alternatives for treatment or disposal at an off-site facility.
- Alternatives which achieve ARARs.
- Alternatives which exceed ARARs.
- Alternatives that do not attain ARARs, but will reduce the likelihood of present or future threat from hazardous substances and that provide significant protection to the public health and welfare and the environment.

## 6.4 DETAILED ANALYSIS OF REMEDIAL ALTERNATIVES

The detailed analysis of alternatives includes the analysis and presentation of relevant information needed to allow decision makers to select a site remedy. During the detailed analysis of the Columbia Mills alternatives, each alternative will be assessed against nine criteria:

- Short-term effectiveness
- Long-term effectiveness
- Reduction of toxicity, mobility and volume
- Implementability
- Cost
- Compliance with ARARs
- Overall protection of human health and the environment
- State acceptance
- Community acceptance

The results of this nine-criteria assessment will allow for a comparative analysis to be made and key tradeoffs identified among the alternatives. Once the analysis is completed, the results (the selected remedial alternative) will be able to address the following CERCLA requirements:

- Be protective of human health and environment
- Attain ARARs
- Be cost-effective
- Use permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent possible.
- Satisfy the preference for treatment that reduces toxicity, mobility and volume as a principal element.

### 6.4.1 Alternative Definition

If any treatability study data and/or additional field investigation data are generated after the updated draft RI report is prepared, the alternatives left from the screening process will need to be more fully refined prior to performing the detailed analysis.

### 6.4.2 Nine Point Criteria Analysis

The following paragraphs provide brief descriptions of the nine criteria to be evaluated in the detailed analysis of potential remedial alternatives:

Short-term Effectiveness - Under this criterion, the alternatives will be evaluated with respect to their effectiveness in protecting human health and the environment during the construction and implementation phase until the action objectives are met. Areas of concern that will be addressed for each alternative include protection of contractors and the surrounding community, potential adverse environmental impacts, and the time required to achieve action objectives.

Long-Term Effectiveness and Permanence - The components of this criterion will evaluate the magnitude of risk remaining after the action objectives have been achieved, and the adequacy of controls to contain contaminants and ensure the remediation is sufficient to maintain designed protection levels.

Reduction of Toxicity, Mobility and Volume - CERCLA legislation provides a statutory preference to selecting remedial actions which employ treatment technologies that permanently reduce toxicity, mobility or volume of hazardous substances as their principal element. The evaluation will focus on the following factors:

- Treatment processes and the materials they treat.
- The amount of hazardous materials destroyed or treated and how principal threats will be addressed.
- Degree of expected reduction in toxicity mobility or volume.
- Irreversibility of the process.
- Type and quantity of residual material remaining after treatment.

Implementability - This criterion will be assessed based on technical feasibility, administrative feasibility, and availability of services and materials required for implementation of each alternative. The technical feasibility analysis will consist of an evaluation of the difficulty and unknowns associated with construction and operation of each technology, the ease of undertaking additional remedial action and the ability to monitor the effectiveness of the remedial action. Administrative feasibility will consist of an evaluation of the ability and time required to obtain approvals and permits for the remedial action. Availability of services and materials includes availability of construction materials, necessary equipment and specialists, and ability to procure the necessary materials and services.

Cost - The cost criterion will be evaluated in four areas:

- Capital Costs - construction, equipment, land-development, disposal, indirect costs (i.e. engineering fees, permitting and contingency allowance).
- Annual Operation and Maintenance Costs - labor, disposal, power, administrative contingency.
- Present Worth Analysis - apply a discount rate of five percent for the anticipated length of the remediation not to exceed 30 years.
- Sensitivity Analysis - identify areas of uncertainty (i.e. effective life, duration of cleanup, sizing of treatment system, etc.) and evaluate how they would impact the total cost of the alternatives.

Compliance with ARARs - This criterion will be used to determine how each alternative complies with applicable or relevant and appropriate State and Federal requirements as defined in CERCLA. The detailed analysis will summarize which requirements are applicable or relevant to each alternative.

Overall Protection of Human Health and the Environment - The overall assessment of the degree of protection provided will be based on several factors assessed under the other criteria, especially, long-term effectiveness, short-term effectiveness and compliance with ARARs. The primary focus of this analysis will be the extent to which leachate generation and migration (and any resultant surface water or ground water contamination) is controlled by the various alternatives.

State Acceptance - This criterion evaluates how the alternatives address the formal technical and administrative comments and concerns NYSDEC may have raised during the review of the draft RI report or the interim report describing the alternatives screening.

Community Acceptance - This analysis will address public comments received by the NYSDEC or other agencies during preparation of RI/FS documents.

6.4.3 Comparative Analyses of Alternatives

Once each of the alternatives has been assessed against the nine criteria, a comparative analysis will be conducted to evaluate the relative performance of each alternative in relation to each specific evaluation criterion. The purpose of the comparative analysis is to identify the advantages and disadvantages relative to one another and will be presented in a narrative format that describes the above analysis. Factors which will be considered include variations in the key uncertainties and how they impact the alternative's performance.

# 7.0 PROJECT MANAGEMENT

Proper management of the RI/FS project is important for several reasons. First, the interactive nature of the RI and the FS makes it necessary to have one project team performing the work to ensure continuity in the work products. Second, proper management is required to enable integration of regulatory input at critical times during both portions of the project.

## 7.1 PROJECT ORGANIZATION

The Organization Chart proposed for this project is shown on Figure 7-1. The following sections are brief descriptions of the duties and responsibilities, key positions and personnel responsible for that position.

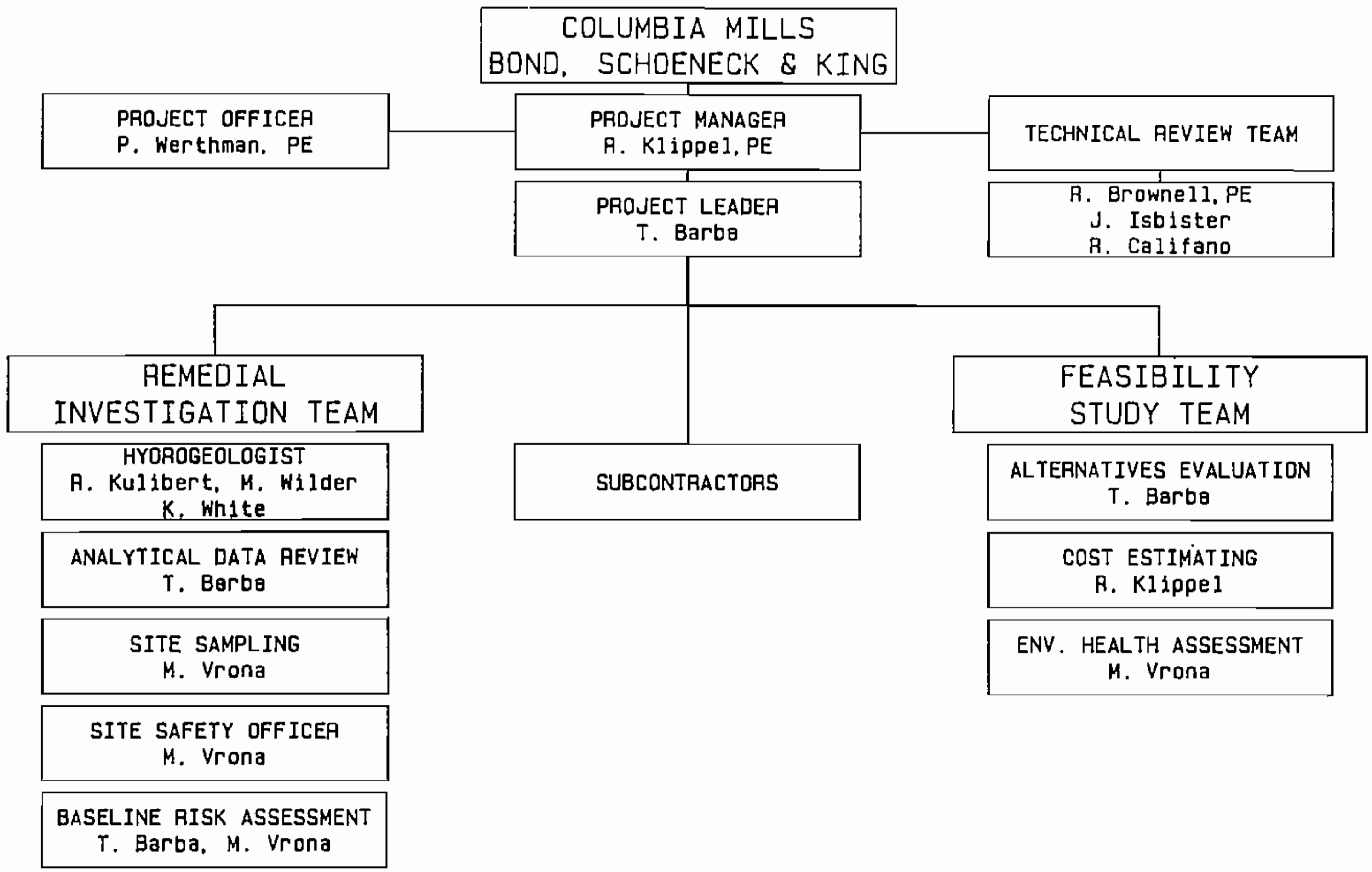
### 7.1.1 Project Manager - Richard Klippel, P.E.

Mr. Klippel will have overall project management responsibilities. His duties will include keeping the project on-schedule and on-budget and to serve as regulatory liaison.

### 7.1.2 Technical Review Team - Richard Brownell, P.E., V.P. Paul Werthman, P.E., V.P., Richard Califano and John Isbister, P.G.

The technical review team is responsible for providing quality assurance review for various parts of the project. Mr. Werthman, in his position as Project Officer, and Mr. Brownell will be responsible for the overall review of the RI/FS report. Dr. Califano will be responsible for final technical review of the baseline risk assessment. Mr. Isbister will review the hydrogeological data during the field investigation activities and also during the report preparation.

# FIGURE 7-1
# COLUMBIA MILLS - RI/FS
# ORGANIZATION CHART



7.1.3 Project Leader - Thomas Barba

Mr. Barba will manage the day-to-day project activities of the two project teams. He will also oversee the activities of the subcontractors.

7.1.4 Project Team Members

Two teams have been proposed: a remedial investigation team and a feasibility study team. The remedial investigation team will be responsible for the field investigation activities, analytical data validation and baseline risk assessments. The feasibility study team will consist of individuals experienced in developing remedial action alternatives, preparing cost estimates and conducting environmental/ health assessments of the screened alternatives.

## 7.2 SUBCONTRACTOR

7.2.1 Drilling Subcontractor

We propose to utilize North Star Drilling, Cortland, New York for drilling test borings and installing monitoring wells at the site. Representatives from North Star Drilling have considerable experience at the Columbia Mills site and have the required health and safety training for working at hazardous waste sites.

7.2.2 Analytical Subcontractor

The analytical subcontractor will be selected from a list of laboratories that are qualified for performing the required analyses and are on the NYSDEC list of technically acceptable laboratories.

7.2.3 Survey Subcontractor

A licensed surveyor will be subcontracted for performance of the required surveying at the site.

## 7.3 PROJECT SCHEDULE

Figure 7-2 depicts the proposed project schedule identifying major project segments. It is anticipated that it will take approximately 15 months from work plan approval to successfully complete the RI/FS report.

## 7.4 PROJECT DELIVERABLES

### 7.4.1 Draft Remedial Investigation Report

A draft Remedial Investigation report will be prepared and submitted to the NYSDEC for review and comment. Included in this report will be the following:

- Discussion of field investigation activities
- Presentation of analytical tests for all media tested
- QA/QC evaluation of analytical data
- Description of the extent of contamination
- Baseline risk assessment results (i.e. identified receptors, risks associated with the site and ARARs)
- Identification of any further data requirements

### 7.4.2 Interim Remedial Action Alternatives Screening Report

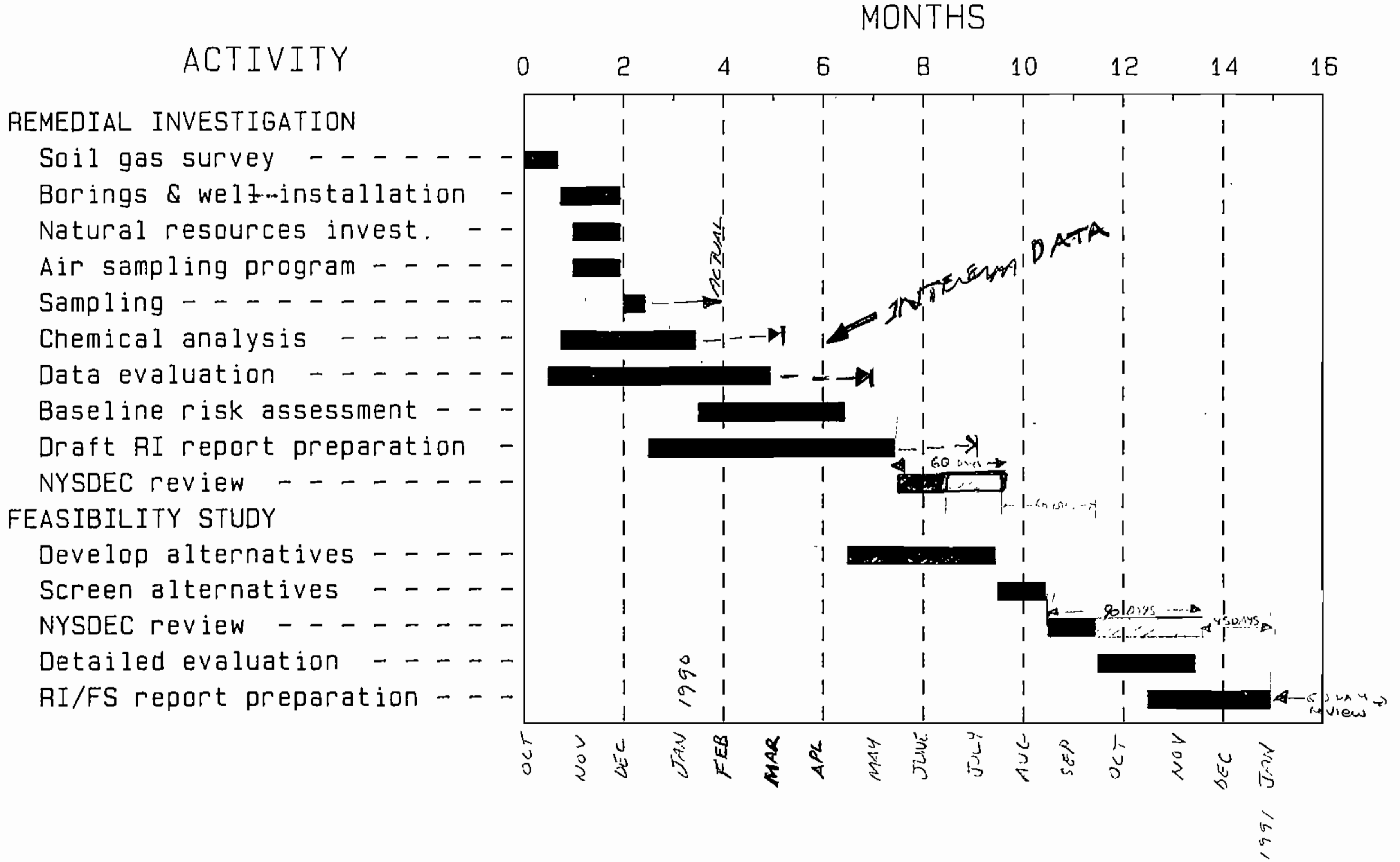
At the end of the alternatives screening process, an interim report describing the screening process, evaluation of alternatives and the basis for selection of the alternatives will be prepared and submitted to the NYSDEC for review and comment.

### 7.4.3 Final RI/FS Report

Upon completion of the detailed analysis of the remaining remedial action alternatives and selection of a preferred remedial alternative, a final report will be prepared which will address any comments and concerns the NYSDEC had in both the updated draft remedial investigation report and the interim remedial action alternative screening report. The final report will be submitted to the NYSDEC for review and comment.

# FIGURE 7-2
# COLUMBIA MILLS - RI/FS
# PROPOSED PROJECT SCHEDULE

See Revision 3/16/90



#### 7.4.4 Monthly Reports

Monthly status reports of the progress of the project will be sent to Columbia Mills with copies to the NYSDEC. The status report will be in a letter format and will include the following information.

- Work accomplished during the report period
- Problems encountered and corrective actions taken
- Items which need regulatory attention
- Work planned for the next month

#### 7.4.5 Certification

Upon completion of the final RI/FS report, the consultant will certify that all work on this project was completed in substantial accordance with the work plan and written revisions thereof.

### 7.5 COMMUNITY RELATIONS

Columbia Mills acknowledges that the information contained in the RI/FS will become public information upon its submittal to the NYSDEC. If, in the course of complying with the consent agreement terms and conditions, it becomes necessary for public hearings to be held regarding the disposition of what remedial action will be taken to clean up the site, representatives of Columbia Mills will participate to the extent required.

# Appendices

MALCOLM PIRNIE

# APPENDIX A

# QUALITY ASSURANCE PROJECT PLAN
(QAPP)

# QUALITY ASSURANCE PROJECT PLAN

COLUMBIA MILLS

REMEDIAL INVESTIGATION/FEASIBILITY STUDY
AND
INTERIM REMEDIAL MEASURES

RICHARD W. KLIPPEL, P.E.
PROJECT MANAGER

THOMAS A. BARBA
QUALITY ASSURANCE MANAGER

PROJECT NUMBER: 1069-02-1
VERSION: 1.03
APRIL 1989
REVISED JULY 1989
REVISED AUGUST 1989
REVISED SEPTEMBER 1989

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# 1.0 INTRODUCTION

## 1.1 GENERAL

This Quality Assurance Project Plan (QAPP) has been developed for the Remedial Investigation/Feasibility Study (RI/FS) and the Interim Remedial Measures (IRM) to be conducted at the Columbia Mills site in Minetto, New York. The RI/FS is being conducted to further evaluate contamination found at the site during previous investigations. The IRM's are being conducted to remediate known "hotspots" at the site.

Specific information regarding the site location and history is provided in the RI/FS workplan.

## 1.2 PROJECT ORGANIZATION AND MANAGEMENT

The sections below identify the key personnel on this project that have quality assurance responsibilities. Additional information regarding these personnel is provided below. Resumes for these personnel are included in Appendix D.

### 1.2.1 Project Director

Richard W. Klippel, P.E. will serve as the Project Director for the Columbia Mills RI/FS and IRMs. Mr. Klippel has considerable experience overseeing large scale projects and has been responsible for the conduct of numerous investigative studies at inactive hazardous waste sites.

### 1.2.2 Quality Assurance Manager

Thomas A. Barba will serve as the Quality Assurance Manager - Data Validator on this project. The Quality Assurance Manager's responsibilities will be to insure that all of the appropriate procedures in this QAPP are followed and that the proper documentation is maintained. The Quality Assurance Manager is also responsible for overseeing the review and analysis of analytical data and insuring that all chemical testing is performed in accordance with previously agreed upon procedures. A copy of Mr. Barba's resume is contained in Appendix D.

Revised Text

1.2.3 Sampling and Equipment Coordinator

Marcia Vrona will serve as the Malcolm Pirnie coordinator for all sampling services needed as part of the RI/FS and IRM's. Ms. Vrona will be responsible for insuring that the proper procedures, containers, and preservatives are utilized. In addition, she will be responsible for insuring that all field equipment is in operable condition and calibrated and that all chain-of-custody and other recordkeeping requirements are completed.

1.2.4 Boring Program Coordinator

Mark Wilder will be the coordinator for the boring program and test pit excavations. Mr. Wilder will coordinate all activities with the drilling subcontractor and will arrange for all geotechnical soil testing.

1.2.5 Data Validation

Data Validation of Analytical laboratory reports will be conducted by Rock J. Vitale of Environmental Standards, Inc. (Valley Forge, PA).

1.3 QAPP ORGANIZATION

Section 2 of this QAPP discusses the data quality objectives and analytical requirements for the Columbia Mills RI/FS and IRM's. Section 3 describes standardized sampling procedures for various environmental media. Section 4 describes field monitoring procedures. Section 5 contains the requirements for maintaining sample integrity. Field instrument calibration and maintenance are covered in Section 6.

Revised Text (2)

# 2.0 QUALITY ASSURANCE OBJECTIVES

## 2.1 INTRODUCTION

This section describes the quality assurance objectives (QAO) that have been established for the Columbia Mills RI/FS and IRM's. Quality assurance objectives are the requirements specifying the quality of the environmental data needed to support the decision-making process. Establishment of QAO's identifies the target levels of measurement for various laboratory and field activities and also serves to identify the uncertainty that will be inherent in these measurements. One of the goals of the site investigation is to keep the uncertainty to levels that will allow the resultant data to be utilized.

Various procedures will be utilized to monitor the precision, accuracy and representativeness. Section 2.2 discusses the data quality requirements for the Columbia Mills project. Section 2.3 discusses the sampling and analysis planned for this RI/FS. Section 2.4 discusses the quality assurance samples.

## 2.2 DATA QUALITY REQUIREMENTS

Table 2-1 identifies the data quality requirements (DQR) for the Columbia Mills RI/FS. Several of these items are discussed below.

- Sample analysis - Analytical testing for the RI portion of the project will be conducted on ground water, soil, air and soil gas samples from the Columbia Mills site. The quality of the data needed is determined by the intended end use in the feasibility study portion of the project. A large historical data-base has been developed from several years of monitoring at the site. Based on that data-base of information, a list of parameters of concern has been developed that will allow for a more refined definition of the levels of contaminants

# TABLE 2-1

## DATA QUALITY REQUIREMENTS
## COLUMBIA MILLS RI/FS

| Data Needed | Data Quality Required |
|---|---|
| Contaminant identification/ concentration levels for sediment, ground water, and air | See Section 2 of QAPP. |
| Soil gas | GC: Detection Levels of 10% of lowest PEL for contaminants detected on site.<br>HNU: 1 ppm. |
| Water level | ±0.01 foot. |
| Population information | Most recent census and field verification. |
| ARARs | Existing regulatory levels. |
| Acceptable risk clean-up criteria | ARAR's when available; if ARAR's are not available:<br>- non-carcinogens - no appreciable risk of significant adverse effect<br>- carcinogens - $10^{-4}$ to $10^{-7}$ lifetime excess cancer risk. |
| Treatment technology evaluation | Actual remedial action data, where available. |
| Estimated quantities of contaminated media | ±20% of actual volume. |
| Unit costs | Vendor quotations and actual costs from similar projects preferred. Compendium costs adjusted to current dollars. |
| Cost estimates | +50% to 30% of actual current year dollars |

in the various media being sampled. Further information regarding parameters, analytical methodologies and detection limits is provided in subsection 2.3 of this QAPP.

- Water levels - Water level readings will be conducted on a monthly basis (for six months from completion of the new wells) in all monitoring wells. This data will be needed to develop the rate and direction of ground water flow at the Columbia Mills site. Water levels will be measured to the nearest 0.01 foot. Surveying of measuring points (i.e., top of the well casing) will be conducted by a New York State licensed surveyor.
- Population information - Data regarding the number of residents and workers in the area surrounding the site is needed to develop exposure potentials during the baseline risk assessment. The data will be from the most recent census data available, and it will be verified in the field to the extent possible.
- ARAR's - Development of applicable or relevant and appropriate requirements (ARAR's) is needed to evaluate the impact of the site on the environmental media in the area. Standards used include the USEPA and New York State drinking water and ambient water quality standards, and NYSDEC class GA ground water standards. Soil levels of PCB's will be compared to the current PCB spill cleanup standards as given in 40 CFR 761, Subpart G (PCB Spill Cleanup Policy). There are currently no other Federal or State standards for contaminant levels in soil.
- Acceptable Risk Clean-up Criteria - During the development and analysis of alternatives, the risks associated with potential alternatives will be evaluated based on a reasonable maximum exposure scenario. Evaluation of acceptable risks will be based on the current USEPA guidelines as follows. ARAR's will be used if available. For noncarcinogenic chemicals for which

Revised Text

an ARAR is not available, acceptable risk is when exposures are such that no appreciable risk of significant adverse effects to individuals over a lifetime of exposure exist. For carcinogens, health-based ARAR's will be used when available. When an ARAR is not available, remedies will be selected that result in cumulative risks that fall within a range of $10^{-4}$ to $10^{-7}$ individual lifetime excess cancer risk (ref.: 53 FR 51394-51520, 12/21/88).

- Estimated quantities of contaminated media - The estimates of contaminated media that will need to be cleaned up will be used in determining remedial activities and for cost estimates for those activities. The estimates used will be ± 20 percent of actual quantity.
- Cost estimates - Estimates of the total cost for various alternative actions will be needed during the FS process to properly evaluate and select the appropriate remedy. Cost estimates in the range of +50 percent to -30 percent of actual cost (in current year dollars) will be utilized.

## 2.3 ANALYTICAL REQUIREMENTS

The following sections discuss the analytical requirements for samples being taken during the RI/FS and IRM's at the Columbia Mills site. Table 2-2 identifies the type and number of samples along with the required analytical testing. All analyses will be in accordance with the NYSCLP 1987 or most recent publication. All samples will be delivered to the laboratory within 48 hours from the day of collection. The laboratory will be acceptable to the NYSDEC and will have DOH-ELAP certification for all-subcategories of solid and hazardous wastes.

### 2.3.1 Ground Water Samples

Samples will be obtained from the 24 new and existing monitoring wells, and from three boreholes in the Test Pit 3 area as part of the IRM. Each monitoring well will be purged of four to ten well volumes (or to dryness) by hand-bailing with dedicated PVC bailers. Samples from the wells will also be collected utilizing dedicated bailers. Analysis of samples will be as shown on Tables 2-2 and 2-3. Metals samples will be both filtered and unfiltered.

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# TABLE 2-2
## SAMPLING & ANALYSIS MATRIX
## COLUMBIA MILLS RI/FS & IRMS

| SAMPLE TYPE | SAMPLES | QA/QC | PARAMETER* | HOLDING TIMES** |
|---|---|---|---|---|
| REMEDIAL INVESTIGATION | | | | |
| Ground water | 24 | 2 MS, 2 MSD, 2 DU | Inorganics (see note 2) | cyanide - 14 days, metals - 6 months |
| | 24 | 2 MS, 2 MSD, 1 TB, 2 DU | Organics - volatiles | 7 days |
| | 24 | 2 MS, 2 MSD, 2 DU | Organics - semivolatiles | 40 days (5 days for extraction) |
| | 24 | 2 MS, 2 MSD, 2 DU | Pesticides/PCBs | 40 days (5 days for extraction) |
| Soil - borings in tank area #1 | 5 | 1 MS, 1 MSD, 1 DU | Organics - volatiles | 7 days |
| | 5 | 1 MS, 1 MSD, 1 DU | Inorganics | |
| Soil - tank area #1 | 5 | Included with above | Inorganics | |
| Soil - drum area | 3 | 1 MS, 1 MSD | Organics - dioxins & furans | 40 days (10 days for extraction) |
| Soil test pits | 10 | 1 DU | EP toxicity (metals only) | |
| | 10 | 1 MS, 1 MSD, 1 DU | Inorganics | |
| Sediment - tank area #1 | 5 | 1 MS, 1 MSD, 1 DU | Inorganics | |
| | 5 | 1 MS, 1 MSD, 1 DU | Organics - volatiles | 7 days |
| Sediment - stream | 10 | Included with above | Inorganics | |
| Soil - background area | 2 | 1 MS, 1 MSD | TCL parameters | See note 1 |
| INTERIM REMEDIAL MEASURES | | | | |
| Soil- borings in Test pit #3 area | 8 | 1 MS, 1 MSD, 1 DU | Inorganics | |
| | 8 | 1 MS, 1 MSD, 1 DU | Organics - volatiles | 7 days |
| | 8 | 1 MS, 1 MSD, 1 DU | Organics - semivolatiles | 40 days (10 days for extraction) |
| Ground water - test pit #3 area | 3 | 1 MS, 1 MSD, 1TB | Organics - volatiles | 7 days |
| Soil - piles #1 - 4 | 26 | 2 MS, 2 MSD, 3 DU | Organics - volatiles | 7 days |
| | 26 | 2 MS, 2 MSD, 3 DU | Cd, Pb, Hg, Zn | |
| Soil - Piles #5 | 5 | Included with above | Organics - volatiles | 7 days |
| | 5 | 1 MS, 1 MSD | Organics - semivolatiles | 40 days (10 days for extraction) |
| | 5 | Included with above | Cd, Pb, Hg, Zn | |
| Soil - near power house | 10 | 1 MS, 1 MSD, 1 DU | PCBs | 40 days (10 days for extraction) |

* See Table 2-3 for parameter list for each category.

** Holding times from day of sampling.

MS = matrix spike, MSD = matrix spike duplicate, TB = VOC trip blank, DU = duplicate sample

Note 1: 7 days - volatiles, 40 days (10 for extraction) for semivolatiles & pesticides/PCBs.

Note 2: Metals analysis on ground water samples will be on both filtered and unfiltered samples.

Revised: 09/18/89

TABLE 2-3
PARAMETERS AND DETECTION LIMITS

| | | DRINKING WATER | | GROUND WATER | SURFACE WATER | | | TARGET DETECTION LIMIT | |
|---|---|---|---|---|---|---|---|---|---|
| PARAMETER | USEPA METHOD | USEPA MCL | NYSDEC MCL | NYSDEC GA-S | NYSDEC AWQ-S | USEPA FAC-AT | USEPA FAC-CT | WATER (ug/l) | SOIL (ug/kg) |
| **VOLATILES** | | | | | | | | | |
| Chloromethane | 8240 | | 5 | | | | | 5 * | 10 |
| Methylene chloride | 8240 | | 50 | | | | | 5 | 5 |
| 1,1-Dichloroethene | 8240 | 7 | 50 | | | 11600 | | 1.4 | 5 |
| Chloroform | 8240 | 100 | | 100 | 0.2 | 28900 | 1240 | 0.9 * | 5 |
| 2-Butanone | 8240 | | 50 | | | | | 5 | 10 |
| 1,1,1-Trichloroethane | 8240 | 200 | 5 | | | | | 1 | 5 |
| 1,1,2,2-Tetrachloroethane | 8240 | | 5 | | | | | 1 | 5 |
| Trichloroethene | 8240 | 5 | 5 | 10 | | 45000 | 21900 | 1 | 5 |
| Benzene | 8240 | 5 | 5 | ND | | 5300 | | 1 | 5 |
| Methyl isobutyl ketone | 8240 | | 50 | | | | | 10 | 10 |
| Toluene | 8240 | | 5 | | | | | 1 | 5 |
| Ethylbenzene | 8240 | | 5 | | | 32000 | | 1 | 5 |
| Xylenes, total | 8240 | | 5 | | | | | 1 | 5 |
| **SEMIVOLATILES** | | | | | | | | | |
| Phenol | 8270 | | 50 | 1 | 1 | 10200 | 2560 | 10 | 330 |
| 2-Methylphenol | 8270 | | 50 | | | | | 10 | 330 |
| 4-Methylphenol | 8270 | | 50 | | | | | 10 | 330 |
| Naphthalene | 8270 | | 50 | | 10 | | | 2 | 330 |
| Acenaphthylene | 8270 | | 50 | | | | | 10 | 330 |
| Phenanthrene | 8270 | | 50 | | | | | 10 | 330 |
| Anthracene | 8270 | | 50 | | | | | 10 | 330 |
| Di-n-butyl phthalate | 8270 | | 50 | 770 | | | | 10 | 330 |
| Fluoranthene | 8270 | | 50 | | | 3980 | | 10 | 330 |
| Pyrene | 8270 | | 50 | | | | | 10 | 330 |
| Benzo(a)anthracene | 8270 | | 50 | | | | | 10 | 330 |
| Chrysene | 8270 | | 50 | | | | | 10 | 330 |
| Benzo(b)fluoranthene | 8270 | | 50 | | | | | 10 | 330 |
| Benzo(k)fluoroanthene | 8270 | | 50 | | | | | 10 | 330 |
| Benzo(a)pyrene | 8270 | | 50 | ND | | | | 10 | 330 |
| Indeno(1,2,3-cd)pyrene | 8270 | | 50 | | | | | 10 | 330 |
| **PESTICIDES/PCBS** | | | | | | | | | |
| 4,4'-DDE | 8080 | | 50 | ND | 0.01 | 1050 | | 0.1 * | 16 |
| 4,4'-DDD | 8080 | | 50 | ND | 0.01 | | | 0.1 * | 16 |
| 4,4'-DDT | 8080 | | 50 | ND | 0.01 | | | 0.1 * | 16 |
| PCB-1016 | 8080 | | | | | | | 0.5 * | 80 |
| PCB-1221 | 8080 | | | | | | | 0.5 * | 80 |
| PCB-1232 | 8080 | | | | | | | 0.5 * | 80 |
| PCB-1242 | 8080 | | | | | | | 0.5 * | 80 |
| PCB-1248 | 8080 | | | | | | | 0.5 * | 80 |
| PCB-1254 | 8080 | | | | | | | 1.0 * | 160 |
| PCB-1260 | 8080 | | | | | | | 1.0 * | 160 |
| PCBs, total | 8080 | | 1 | 0.1 | 0.01 | 2 | 0.014 | 1.0 * | 160 |

TABLE 2-3
PARAMETERS AND DETECTION LIMITS

| PARAMETER | USEPA METHOD | DRINKING WATER USEPA MCL | DRINKING WATER NYSDEC MCL | GROUND WATER NYSDEC GA-S | SURFACE WATER NYSDEC AWQ-S | SURFACE WATER USEPA FAC-AT | SURFACE WATER USEPA FAC-CT | TARGET DETECTION LIMIT WATER (ug/l) | TARGET DETECTION LIMIT SOIL (ug/kg) |
|---|---|---|---|---|---|---|---|---|---|
| INORGANICS | | | | | | | | | (mg/kg) |
| Aluminum | 6010 | — | — | — | 100 | — | — | 20 | 40 |
| Antimony | 6010 | — | — | — | — | — | — | 60 | 12 |
| Arsenic | 7060 | 50 | 50 | 25 | 360 | — | — | 5 | 2 |
| Cadmium | 7131 | — | — | 10 | 10 | — | — | 2 | 1 |
| Chromium | 6010 | 50 | 50 | — | 50 | — | — | 10 | 2 |
| Chromium, hexavalent | 7195 | — | — | — | — | — | — | 20 | 4 |
| Copper | 6010 | — | 1000 | 1000 | 200 | — | — | 40 | 5 |
| Iron | 6010 | — | 300 | 300 | 300 | — | — | 60 | 20 |
| Lead | 7421 | 50 | 50 | 25 | 220 | — | — | 5 | 1 |
| Magnesium | 6010 | — | — | — | 35000 | — | — | 7000 * | 1000 |
| Manganese | 6010 | — | 300 | 300 | 300 | — | — | 60 | 3 |
| Zinc | 6010 | — | 5000 | 5000 | 300 | — | — | 60 | 4 |
| Cyanide | 9010 | — | — | 200 | 100 | — | — | 20 | 2 |
| DIOXINS & FURANS | | | | | | | | | (ug/kg) |
| PCDF's | 8280 | | | | | | | 0.1 | 5 |
| PCDD's | 8280 | | | | | | | 0.1 | 5 |
| SOIL GAS | | | | | | | | AIR (ppb) | |
| Xylenes, total | | | | | | | | 10 | |
| Toluene | | | | | | | | 10 | |
| Ethylbenzene | | | | | | | | 10 | |
| 2-Butanone (MEK) | | | | | | | | 10 | |
| Methyl isobutyl ketone | | | | | | | | 10 | |
| Benzene | | | | | | | | 10 | |
| 1,1,1-Trichloroethane | | | | | | | | 100 | |
| 1,1-Dichloroethene | | | | | | | | 100 | |
| 1,1,2,2-Tetrachloroethane | | | | | | | | 100 | |

NOTES:

1. All values in ug/l.
2. Updated: September 11, 1989
3. * = minimum laboratory detection limit is greater than one-half of the lowest ARAR.
4. File: a:\colmmdls.wk1

2.3.2 Soil Samples

As indicated on Table 2-2 and in the work plan, a variety of soil samples will be taken. Parameters for analysis were selected based on the existing data-base of information and the intended use of the data. In some cases, parameters for analysis are based on NYSDEC requests. Table 2-3 identifies specific parameters for each class of parameters listed on Table 2-2.

2.3.3 Soil Gas

Soil-gas samples will be collected as part of the survey in the main plant area. Analysis of samples will be conducted in the field utilizing either an HNU PI101 photoionization instrument or a portable GC. Detection limits for the HNU are approximately 0.2 ppm above background. Parameters for analysis and associated detection limits for GC analysis are shown in Table 2-3.

2.3.4 Detection Limits

Target Detection Limits (TDLs) for the various analytical programs are identified in Table 2-3. TDLs for water samples are based on one-fifth of the lowest ARAR. In those cases where the analytical laboratory could not meet the target detection limit, the achievable detection limit is given and noted with an asterisk (*). TDLs for soils are the standard low contract required detection limits provided in the QAPP. TDLs for the TCL analysis of background soils will be the low contract required detection limits (see Table 2-4).

The target detection limits are based on conducting the analysis in the absence of matrix interference and high levels of target and non-target analytes. When necessary and appropriate, the analytical laboratory will utilize standard cleanup procedures and dilution to improve analytical results. No sample will be diluted more than 1 to 5 to alleviate matrix interference.

Revised Text

TABLE 2-4

Superfund Target Compound List (TCL) and
Contract Required Quantitation Limits (CRQL)*
Page 1 of 6

| | Volatiles | CAS Number | Quantitation Limits** Low Water µg/L | Low Soil/Sediment µg/Kg |
|---|---|---|---|---|
| 1. | Chloromethane | 74-87-3 | 10 | 10 |
| 2. | Bromomethane | 74-83-9 | 10 | 10 |
| 3. | Vinyl chloride | 75-01-4 | 10 | 10 |
| 4. | Chloroethane | 75-00-3 | 10 | 10 |
| 5. | Methylene chloride | 75-09-2 | 5 | 5 |
| 6. | Acetone | 67-64-1 | 10 | 10 |
| 7. | Carbon Disulfide | 75-15-0 | 5 | 5 |
| 8. | 1,1-Dichloroethylene | 75-35-4 | 5 | 5 |
| 9. | 1,1-Dichloroethane | 75-35-3 | 5 | 5 |
| 10. | 1,2-Dichloroethylene (total) | 540-59-0 | 5 | 5 |
| 11. | Chloroform | 67-66-3 | 5 | 5 |
| 12. | 1,2-Dichloroethane | 107-06-2 | 5 | 5 |
| 13. | 2-Butanone | 78-93-3 | 10 | 10 |
| 14. | 1,1,1-Trichloroethane | 71-55-6 | 5 | 5 |
| 15. | Carbon tetrachloride | 56-23-5 | 5 | 5 |
| 16. | Vinyl acetate | 108-05-4 | 10 | 10 |
| 17. | Bromodichloromethane | 75-27-4 | 5 | 5 |
| 18. | 1,1,2,2-Tetrachloroethane | 79-34-5 | 5 | 5 |
| 19. | 1,2-Dichloropropane | 78-87-5 | 5 | 5 |
| 20. | cis-1,3-Dichloropropene | 10061-01-5 | 5 | 5 |
| 21. | Trichloroethene | 79-01-6 | 5 | 5 |
| 22. | Dibromochloromethane | 124-48-1 | 5 | 5 |
| 23. | 1,1,2-Trichloroethane | 79-00-5 | 5 | 5 |
| 24. | Benzene | 71-43-2 | 5 | 5 |
| 25. | trans-1,3-Dichloropropene | 10061-02-6 | 5 | 5 |
| 26. | Bromoform | 75-25-2 | 5 | 5 |
| 27. | 2-Hexanone | 591-78-6 | 10 | 10 |
| 28. | 4-Methyl-2-pentanone | 108-10-1 | 10 | 10 |
| 29. | Tetrachloroethylene | 127-18-4 | 5 | 5 |
| 30. | Toluene | 108-88-3 | 5 | 5 |
| 31. | Chlorobenzene | 108-90-7 | 5 | 5 |
| 32. | Ethyl Benzene | 100-41-4 | 5 | 5 |
| 33. | Styrene | 100-42-5 | 5 | 5 |
| 34. | Total Xylenes | 1330-20-7 | 5 | 5 |

*Specific quantitation limits are highly matrix dependent. The quantitation limits listed herein are provided for guidance and may not always be achievable.

**Quantitation Limits listed for soil/sediment are based on wet weight. The quantitation limits calculated by the laboratory for soil/sediment, calculated on dry weight basis, as required by the protocol, will be higher.

TABLE 2-4

Superfund Target Compound List (TCL) and
Contract Required Quantitation Limits (CRQL)*



| | Semivolatiles | CAS Number | Quantitation Limits** Low Water µg/L | Low Soil/Sediment µg/Kg |
|---|---|---|---|---|
| 35. | Phenol | 108-95-2 | 10 | 330 |
| 36. | bis(2-Chloroethyl) ether | 111-44-4 | 10 | 330 |
| 37. | 2-Chlorophenol | 95-57-8 | 10 | 330 |
| 38. | 1,3-Dichlorobenzene | 541-73-1 | 10 | 330 |
| 39. | 1,4-Dichlorobenzene | 106-46-7 | 10 | 330 |
| 40. | Benzyl alcohol | 100-51-6 | 10 | 330 |
| 41. | 1,2-Dichlorobenzene | 95-50-1 | 10 | 330 |
| 42. | 2-Methylphenol | 95-48-7 | 10 | 330 |
| 43. | bis(2-Chloroisopropyl) ether | 108-60-1 | 10 | 330 |
| 44. | 4-Methylphenol | 106-44-5 | 10 | 330 |
| 45. | N-Nitroso-dipropylamine | 621-64-7 | 10 | 330 |
| 46. | Hexachloroethane | 67-72-1 | 10 | 330 |
| 47. | Nitrobenzene | 98-95-3 | 10 | 330 |
| 48. | Isophorone | 78-59-1 | 10 | 330 |
| 49. | 2-Nitrophenol | 88-75-5 | 10 | 330 |
| 50. | 2,4-Dimethylphenol | 105-67-9 | 10 | 330 |
| 51. | Benzoic acid | 65-85-0 | 50 | 1600 |
| 52. | bis(2-Chloroethoxy) methane | 111-91-1 | 10 | 330 |
| 53. | 2,4-Dichlorophenol | 120-83-2 | 10 | 330 |
| 54. | 1,2,4-Trichlorobenzene | 120-82-1 | 10 | 330 |
| 55. | Naphthalene | 91-20-3 | 10 | 330 |
| 56. | 4-Chloroaniline | 106-47-8 | 10 | 330 |
| 57. | Hexachlorobutadiene | 87-68-3 | 10 | 330 |
| 58. | 4-Chloro-3-methylphenol (p-chloro-m-cresol) | 59-50-7 | 10 | 330 |
| 59. | 2-Methylnaphthalene | 91-57-6 | 10 | 330 |
| 60. | Hexachlorocyclopentadiene | 77-47-4 | 10 | 330 |
| 61. | 2,4,6-Trichlorophenol | 88-06-2 | 10 | 330 |
| 62. | 2,4,5-Trichlorophenol | 95-95-4 | 50 | 1600 |
| 63. | 2-Chloronaphthalene | 91-58-7 | 10 | 330 |
| 64. | 2-Nitroaniline | 88-74-4 | 50 | 1600 |
| 65. | Dimethyl phthalate | 131-11-3 | 10 | 330 |
| 66. | Acenaphthylene | 208-96-8 | 10 | 330 |
| 67. | 2,6-Dinitrotoluene | 606-20-2 | 10 | 330 |
| 68. | 3-Nitroaniline | 99-09-2 | 50 | 1600 |
| 69. | Acenaphthene | 83-32-9 | 10 | 330 |
| 70. | 2,4-Dinitrophenol | 51-28-5 | 50 | 1600 |
| 71. | 4-Nitrophenol | 100-02-7 | 50 | 1600 |
| 72. | Dibenzofuran | 132-64-9 | 10 | 330 |

TABLE 2-4

Superfund Target Compound List (TCL) and
Contract Required Quantitation Limits (CRQL)*



| | Semivolatiles (cont.) | CAS Number | Quantitation Limits** Low Water µg/L | Low Soil/Sediment[b] µg/Kg |
|---|---|---|---|---|
| 73. | 2,4-Dinitrotoluene | 121-14-2 | 10 | 330 |
| 74. | Diethylphthalate | 84-66-2 | 10 | 330 |
| 75. | 4-Chlorophenyl phenyl ether | 7005-72-3 | 10 | 330 |
| 76. | Fluorene | 86-73-7 | 10 | 330 |
| 77. | 4-Nitroaniline | 100-01-6 | 50 | 1600 |
| 78. | 4,6-Dinitro-2-methylphenol | 534-52-1 | 50 | 1600 |
| 79. | N-nitrosodiphenylamine | 86-30-6 | 10 | 330 |
| 80. | 4-Bromophenyl phenyl ether | 101-55-3 | 10 | 330 |
| 81. | Hexachlorobenzene | 118-74-1 | 10 | 330 |
| 82. | Pentachlorophenol | 87-86-5 | 50 | 1600 |
| 83. | Phenanthrene | 85-01-8 | 10 | 330 |
| 84. | Anthracene | 120-12-7 | 10 | 330 |
| 85. | Di-n-butyl phthalate | 84-74-2 | 10 | 330 |
| 86. | Fluoranthene | 206-44-0 | 10 | 330 |
| 87. | Pyrene | 129-00-0 | 10 | 330 |
| 88. | Butyl benzyl phthalate | 85-68-7 | 10 | 330 |
| 89. | 3,3'-Dichlorobenzidine | 91-94-1 | 20 | 660 |
| 90. | Benz(a)anthracene | 56-55-3 | 10 | 330 |
| 91. | Chrysene | 218-01-9 | 10 | 330 |
| 92. | bis(2-ethylhexyl)phthalate | 117-81-7 | 10 | 330 |
| 93. | Di-n-octyl phthalate | 117-84-0 | 10 | 330 |
| 94. | Benzo(b)fluoranthene | 205-99-2 | 10 | 330 |
| 95. | Benzo(k)fluoranthene | 207-08-9 | 10 | 330 |
| 96. | Benzo(a)pyrene | 50-32-8 | 10 | 330 |
| 97. | Indeno(1,2,3-cd)pyrene | 193-39-5 | 10 | 330 |
| 98. | Dibenz(a,h)anthracene | 53-70-3 | 10 | 330 |
| 99. | Benzo(g,h,i)perylene | 191-24-2 | 10 | 330 |

*Specific quantitation limits are highly matrix dependent. The quantitation limits listed herein are provided for guidance and may not always be achievable.

**Quantitation limits listed for soil/sediment are based on wet weight. The quantitation limits calculated by the laboratory for soil/sediment, calculated on dry weight basis as required by the contract, will be higher.

TABLE 2-4

Superfund Target Compound List (TCL) and
Contract Required Quantitation Limits (CRQL)*



| | Pesticides/PCBs | CAS Number | Quantitation Limits** Low Water µg/L | Low Soil/Sediment µg/Kg |
|---|---|---|---|---|
| 100. | alpha-BHC | 319-84-6 | 0.05 | 8.0 |
| 101. | beta-BHC | 319-85-7 | 0.05 | 8.0 |
| 102. | delta-BHC | 319-86-8 | 0.05 | 8.0 |
| 103. | gamma-BHC (Lindane) | 58-89-9 | 0.05 | 8.0 |
| 104. | Heptachlor | 76-44-8 | 0.05 | 8.0 |
| 105. | Aldrin | 309-00-2 | 0.05 | 8.0 |
| 106. | Heptachlor epoxide | 1024-57-3 | 0.05 | 8.0 |
| 107. | Endosulfan I | 959-98-8 | 0.05 | 8.0 |
| 108. | Dieldrin | 60-57-1 | 0.10 | 16. |
| 109. | 4,4'-DDE | 72-55-9 | 0.10 | 16. |
| 110. | Endrin | 72-20-8 | 0.10 | 16. |
| 111. | Endosulfan II | 33213-65-9 | 0.10 | 16. |
| 112. | 4,4'-DDD | 72-54-8 | 0.10 | 16. |
| 113. | Endosulfan sulfate | 1031-07-8 | 0.10 | 16. |
| 114. | 4,4'-DDT | 50-29-3 | 0.10 | 16. |
| 115. | Endrin ketone | 53494-70-5 | 0.10 | 16. |
| 116. | Methoxychlor | 72-43-5 | 0.5 | 80. |
| 117. | alpha-Chlordane | 5103-71-9 | 0.5 | 80. |
| 118. | gamma-Chlordane | 5103-74-2 | 0.5 | 80. |
| 119. | Toxaphene | 8001-35-2 | 1.0 | 160. |
| 120. | AROCLOR-1016 | 12674-11-2 | 0.5 | 80. |
| 121. | AROCLOR-1221 | 11104-28-2 | 0.5 | 80. |
| 122. | AROCLOR-1232 | 11141-16-5 | 0.5 | 80. |
| 123. | AROCLOR-1242 | 53469-21-9 | 0.5 | 80. |
| 124. | AROCLOR-1248 | 12672-29-6 | 0.5 | 80. |
| 125. | AROCLOR-1254 | 11097-69-1 | 1.0 | 160. |
| 126. | AROCLOR-1260 | 11096-82-5 | 1.0 | 160. |

*Specific quantitation limits are highly matrix dependent. The quantitation limits listed herein are provided for guidance and may not always be achievable.

**Quantitation Limits listed for soil/sediment are based on wet weight. The quantitation limits calculated by the laboratory for soil/sediment, calculated on dry weight basis, as required by the protocol, will be higher.

TABLE 2-4

Superfund Target Compound List (TCL) and
Contract Required Quantitation Limit



| Parameter | Quantitation Level [1 2] | |
|---|---|---|
| | Low water (ug/L) | Low soil/sediment (mg/kg) |
| 1. Aluminum | 200 | 40 |
| 2. Antimony | 60 | 12 |
| 3. Arsenic | 10 | 2 |
| 4. Barium | 200 | 40 |
| 5. Beryllium | 5 | 1 |
| 6. Cadmium | 5 | 1 |
| 7. Calcium | 5000 | 1000 |
| 8. Chromium | 10 | 2 |
| 9. Cobalt | 50 | 10 |
| 10. Copper | 25 | 5 |
| 11. Iron | 100 | 20 |
| 12. Lead | 5 | 1 |
| 13. Magnesium | 5000 | 1000 |
| 14. Manganese | 15 | 3 |
| 15. Mercury | 0.2 | 0.2 |
| 16. Nickel | 40 | 8 |
| 17. Potassium | 5000 | 1000 |
| 18. Selenium | 5 | 1 |
| 19. Silver | 10 | 2 |
| 20. Sodium | 5000 | 1000 |
| 21. Thallium | 10 | 2 |
| 22. Vanadium | 50 | 10 |
| 23. Zinc | 20 | 4 |
| 24. Cyanide | 10 | 2 |
| 25. Hexavalent Chromium | 20 | 4 |

1: Any analytical method specified in Exhibit D, CLP-Inorganics may be utilized as long as the documented instrument or method detection limits meet the Contract Required Quantitation Level (CRQL) requirements. Higher quantitation levels may only be used in the following circumstance:

If the sample concentration exceeds two times the quantitation limit of the instrument or method in use, the value may be reported even though the instrument or method detection limit may not equal the contract required quantitation level. This is illustrated in the example below:

For lead:
Method in use = ICP
Instrument Detection Limit (IDL) = 40
Sample concentration = 85
Contract Required Quantitation Level (CRQL) = 5

The value of 85 may be reported even though instrument detection limit is greater than Contract Required Quantitation Limit. The instrument or method detection limit must be documented as described in Exhibit E.

2: These CRQL are the instrument detection limits obtained in pure water that must be met using the procedure in Exhibit E. The quantitation limits for samples may be considerably higher depending on the sample matrix.

### 2.3.5 Analytical Report Deliverables

Documentation for analytical reports for the Columbia Mills project will be in accordance with the NYSDEC CLP. The tables in Appendix E will be included in the analytical reports.

## 2.4 QUALITY ASSURANCE SAMPLES

Table 2-2 identifies the quality assurance samples that will be required for each type of sampling being conducted during the Columbia Mills RI/FS and IRM's. Duplicate samples will be taken for approximately 10 percent of each type of sample taken. Trip blanks will be utilized for water analysis for volatile organics, with one trip blank for each day of sampling. Since dedicated bailers will be utilized for ground water sampling, field blanks will not be taken. All matrix spike and matrix spike duplicates will be done on site-specific samples. Locations of the QA Samples will be determined in the field upon consideration of such factors as sample size, well recovery rates, etc.

Revised Text (2)

# 3.0 SAMPLING PROCEDURES

## 3.1 GROUND WATER

### 3.1.1 Introduction

In order to assess the impact of the site waste materials on ground water quality, the behavior of pollutants in the subsurface environment and the processes governing this behavior must be evaluated. The fundamental objective of monitoring land disposal sites is to serve as a check on potential ground water contamination by leachate. The subsurface environment, however, is an extremely complex system, subject to extensive physical, chemical and biological changes within small vertical and horizontal distances. Samples from a monitoring well represent a small part of an aquifer horizontally and in many cases, vertically. Special precautions must be taken to ensure that the sample taken from a given well is representative of the ground water at that location and that the sample is neither altered nor contaminated by the sampling and handling procedure.

The following subsections detail the basic procedures followed by Malcolm Pirnie field crews in monitoring ground water at disposal facilities. These procedures are based on USEPA manuals and other ground water monitoring manuals.

### 3.1.2 Representative Sample Collection

During any ground water sampling program, it must be understood that the composition of the water within the well casing and in close proximity to the well is probably not representative of the overall ground water quality at that sampling site. This is due to the possible presence of drilling contaminants near the well and because important environmental conditions such as pH and oxidation-reduction potential may differ drastically near the well from the conditions in the surrounding water-bearing materials. In addition, stagnation as well as stratification of water can take place within the well.

To safeguard against collecting non-representative water in a sample, it is highly desirable that a well be pumped or bailed until the well is thoroughly flushed of standing water and contains fresh water from the aquifer. The recommended length of time required to pump or bail prior to sampling is dependent on many factors including the characteristics of the well, the hydrogeological nature of the aquifer, the type of sampling equipment being used, and the parameters of interest.

The generally accepted procedure is to bail between three and ten well volumes prior to sampling. In those situations where the well is bailed to dryness, the amount bailed prior to sampling will be less. Note also that non-representative samples can result from excessive pre-pumping of the monitoring well. Stratification of the leachate concentrations in the ground water formation may occur, and excessive bailing can dilute or increase the contaminant concentrations from what is representative of the sampling point of interest.

Determination of the quantity of water in one well volume is calculated from the following formula:

$$V = 5.875\ I^2\ (D-W)$$

WHERE V = one well volume (gallons)

I = inside diameter of well casing (feet)

D = well depth (feet)

W = Depth to water from top of casing (feet)

For a 2-inch ID well, 6 feet of water is approximately one gallon. In most cases, monitoring of temperature, pH and conductivity during bailing will indicate when the well is adequately purged. When these parameters stabilize, it is probable that little or no water from casing storage is left in the well.

### 3.1.3 Water Level Elevations

Valuable hydrogeological data can be obtained from the periodic monitoring of water level elevations in the ground water monitoring system at a facility. This information is necessary for the determination of the flow and direction of ground water and to monitor

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For a 2-inch ID well, 6 feet of water is approximately one gallon. In most cases, monitoring of temperature and pH during bailing will indicate when the well is adequately purged. When these two parameters stabilize, it is probable that little or no water from casing storage is left in the well.

### 3.1.3 Water Level Elevations

Valuable hydrogeological data can be obtained from the periodic monitoring of water level elevations in the ground water monitoring system at a facility. This information is necessary for the determination of the flow and direction of ground water and to monitor seasonal changes in the ground water elevation in the area. Frequency of these measurements should be determined by the Project Engineer and Hydrogeologist, but at a minimum, they should be taken at each sampling occurrence.

Water level measurements are made using an electronic water level indicator. Depths are measured from the top of the well casing to the water surface. These measurements are converted to elevations (above mean sea level) using a survey elevation of the well. Measurements should be accurate to ±0.01 foot.

### 3.1.4 Soil Pore Water Sampling

Since few soils or sediments are chemically inert, movement of leachate through the unsaturated zone frequently will result in chemical changes to the leachate. Samples of soil pore water in the unsaturated zone are collected using vacuum/pressure lysimeters. The lysimeters work by creating a vacuum within the sampling vessel; pore water moves toward the sampler and enters the lysimeter through a porous cup. Pressure is then placed on the lysimeter and the sample is forced to the surface.

It should be noted that there are a number of inherent limitations involved with the use of vacuum/pressure lysimeters. These include the uncertainty of the degree to which the collected sample represents the surrounding pore water, the disruption of normal drainage patterns caused by suction induced sampling, clogging of the lysimeter itself, and the potential sample contamination from materials used in lysimeter construction. In addition, their use may be limited by the nature of the site soils.

### 3.1.5 Collection of Ground Water Samples - Equipment

Malcolm Pirnie utilizes a variety of sampling equipment to bail wells and obtain samples. Selection of the type of equipment used is based on depth of well, recovery rate, accessibility, parameters of interest and cost. The following sections describe the equipment and techniques normally used:

- Bailers

Use of bailers is one of the oldest and simplest methods of sampling ground water wells. Malcolm Pirnie normally utilizes PVC bailers with a PVC check valve on the bottom, but Teflon or stainless steel bailers are also used for certain projects. The PVC bailers are 1.66" OD and will fit in a 2 inch well. The low cost of the PVC bailers allows them to be dedicated to individual wells as a means of minimizing cross contamination. In addition, there is no need for external power.

Bailing and sampling techniques are dictated by the recovery rate of the well. However, for most situations, the bailer is lowered to the bottom of the well and retrieved. In the case of wells that have historically had high recovery rates, the first well volume is retrieved from the top of the water column. Fresh water entering from the bottom insures that the water within the well is fresh and representative of the aquifer of concern.

- Air Lift Sampler

The air lift system uses air under pressure that is fed down the well and forces water up and out of the well. This system is comprised of threaded PVC pipe sections that are connected together as the screened section is lowered into the well. When the sampler is in place, it is capped off with a top section of PVC which allows for the introduction of pressurized air or gas. This forces a check valve closed and the well water up out of the sampler.

The air lift sampler, which can be used as either a portable or permanently installed system, is not suitable for pH sensitive parameters such as metals. Gas stripping of volatile organics may occur, and if air or oxygen is used, oxidation may be a problem. For this reason, the airlift system is normally used only for bailing of the well and samples are collected by other methods.

Bladder Pumps (Gas Pressure Displacement Pumps)

Bladder pumps (also referred to as gas squeeze pumps) consist of a flexible tube enclosed in a rigid plastic or stainless steel housing. Water enters the housing through a screen and check valve at the bottom of the pump. Air pressure inflates the bladder and forces the water to the surface (Note: In a similar design, the water enters the bladder and the air pressure introduced into the housing compresses the bladder and forces water to the surface). Upon release of the pressure, an upper check valve prevents water from flowing back into the pump. An automated control system regulates gas flow rates and pressurization cycles to produce a nearly continuous flow.

The bladder pump has several advantages including a wide range of pumping rates, no contact between air and well water and the unit is fairly portable. In addition, once the unit is set up and in operation, constant operator attendance is not needed during bailing operations.

Because of the time involved in disassembly, cleaning and reassembly between uses, Malcolm Pirnie recommends that, where used, bladder pumps should be permanently installed.

- Handpump

A hand operated pump that pumps over 2.5 gallons per minute and fits inside a 2-inch well can sample down to 50 feet or further with extensions. The high flow volume provides for rapid bailing of wells with a high well volume.

- Suction Lift Pumps

While not normally used for monitoring well sampling, both automatic and manual suction lift pumps can be used in special situations. These pumps (both peristaltic and vacuum) are relatively portable, but sampling is limited to ground water that is within 20 feet of the surface. Use of these pumps may result in degassing and loss of volatile compounds.

Use of these pumps is generally restricted to monitoring installations such as shallow wells and seepage galleries that are not feasibly sampled by the above described techniques.

3.1.6 Collection of Ground Water Samples - Procedures

The following subsections describe procedures used for sampling ground water monitoring wells. The procedures are adapted from various USEPA guidance manuals (see references in Appendix A).

Prior to the use of any of these procedures, the following steps should be completed.

a. Put on the necessary personal protective equipment and a new pair of disposable gloves.
b. Insure that all sampling and monitoring equipment has been properly decontaminated prior to use.
c. Place a square sheet of plastic, with a slit in the middle, over the well to cover the working area around the well.
d. Unlock the well and remove the inner protective cap. Place this in a location that will not contribute contamination to the well when it is replaced.
e. Using the pre-cleaned electric well depth probe, measure the depth to the water surface in the well (to 0.01 foot) from the top of the internal well casing. Record this information on the log sheet.

It should be noted that all down-hole and potentially wetted surfaces must also be non-contaminating/non-contributing. This includes power cables, suspension cables or rope, compressed gas lines, and sample tubing.

3.1.6.1 Purging With a Peristaltic Pump

- Discussion

The peristaltic pump as described in subsection 2.5 can be implemented for the presample purging of ground water monitoring wells.

- Uses

The use of a peristaltic pump for well purging is particularly advantageous since in many instances, the same system can later be used for sample collection. The application, however, is limited to wells with a depth of less than approximately 8 meters, due to the limited lift capabilities of peristaltic action. In addition, certain parameters particularly volatile organics, can be affected by this sampling process.

- Procedures For Use

1. Based on well depth and water elevation, determine well volume of water in well.
2. Lower intake into the well to a short distance below the water surface and begin water removal. Collect or dispose of purged water in an acceptable manner. Lower suction intake, as required, to maintain submergence.
3. Measure rate of discharge frequently. A bucket and stopwatch are most commonly used.
4. Purge a minimum of three casing volumes or until the well is dry or until discharge pH, temperature, or conductivity stabilize.

3.1.6.2 Purging With a Gas Pressure Displacement System

- Discussion

A pressure displacement system consists of a chamber equipped with a gas inlet line, a water discharge line and two check valves. When the chamber is lowered into the casing, water floods in from the bottom through the check valve. Once full, a gas (i.e., nitrogen or air) is forced into the top of the chamber at a pressure sufficient to result in the upward displacement of the water out of the discharge tube. The check valve in the bottom prevents water from being forced back into the casing, and the upper check valve prevents water from flowing back into the chamber when the gas pressure is released. This cycle can be repeated as necessary until purging is complete.

- Uses

  The pressure lift system is particularly useful when the well depth is beyond the capability of a peristaltic pump. The water is displaced up the discharge tube by the increased gas pressure. The potential for increased gas diffusion into the water makes this system unsuitable when sampling for volatile organic and most pH critical parameters.

- Procedures For Use

  1. Based on well depth and water level elevation, determine the well volume of water in the well.
  2. Lower displacement chamber until top is just below water level.
  3. Attach gas supply line to pressure adjustment valve on cap.
  4. Gradually increase gas pressure to maintain discharge flow rate.
  5. Measure rate of discharge, pH and temperature frequently. A bucket and stopwatch are usually sufficient for flow measurement.
  6. Purge a minimum of three casing volumes or until discharge characteristics stabilize unless the well becomes dry first.

3.1.6.3 Purging With a Bailer

- Discussion

  Bailers are long narrow tubes equipped with a check valve on the bottom. This valve allows water to enter from the bottom as the bailer is lowered, then prevents its release as the bailer is raised. Top filling bailers are also available and are useful for bailing wells, but they should not be used for sampling unless the purpose is to sample the water surface for floating materials.

- Uses

  Bailers are not generally practical for bailing wells since the procedure is labor intensive. In particular, deep or large diameter wells with large well volumes require long bailing times. The primary advantage of bailers are low cost and easy decontamination.

- Procedures For Use

  1. Based on the well depth and water level elevation, determine the volume of water in the well.
  2. Attach a new piece of rope to the pre-cleaned bailer and lower it to just fill the bailer. Withdraw the bailer and note the pH and appearance of the water on the log sheet, along with the time.
  3. Continue to bail until at least three complete well volumes have been removed, or the pH or other characteristics stabilize or the well becomes dry.

3.1.6.4 Sampling Monitoring Wells With a Bailer

- Discussion

  As mentioned above, bailers are tall narrow tubes equipped with a check valve on the bottom. This valve allows water to enter from the bottom as the bailer is lowered, then prevents its release as the bailer is raised. Top filling bailers are not recommended for sample acquisition except for specific applications.

- Uses

  This device is particularly useful when samples must be recovered from depths greater than the range (or capability) of suction lift pumps, when volatile stripping is of concern, or when well casing diameters are too narrow to accept submersible pumps. It is the method of choice for the collection of samples which are susceptible to volatile component stripping or degradation due to the aeration associated with most other recovery systems. Samples can be recovered with a minimum of aeration if care is taken to gradually lower the bailer until it contacts the water surface and is then allowed to sink as it fills. Teflon is generally the most acceptable construction material but other materials (PVC, stainless steel, etc.) are acceptable if compatible with designated sample analysis. The primary disadvantages of bailers are their limited sample volume and inability to collect discrete samples from a depth below the water surface. In some cases, especially where analyses for trace contaminants are desired, it may be prudent to use a separate bailer for each well, thus avoiding cross-contamination between wells.

- <u>Procedures For Use</u>

1. Attach precleaned bailer to a new line for lowering.
2. Lower bailer slowly until it contacts water surface.
3. Allow bailer to sink and fill with a minimum of surface disturbance.
4. Slowly raise bailer to surface. Do not allow bailer line to contact ground.
5. Tip bailer to allow slow discharge from top to flow gently down the side of the sample bottle with minimum entry turbulence.
6. Repeat steps 2-5 as needed to acquire sufficient sample volume.
7. Select sample bottles and preserve the sample, if necessary, according to the guidelines in Section 5.
8. Check that a Teflon-liner is present in cap if required. Secure the cap tightly. In the case of vials for volatile organic analyses, insure that no air bubbles are present.
9. Label the sample bottle with an appropriate label and complete all chain-of-custody documents.
10. If non-dedicated bailers are being used, thoroughly decontaminate the bailer and add clean rope after each use according to the guidelines in Section 5.

3.1.6.5 Sampling Monitoring Wells With a Peristaltic Pump

- Discussion

A pump system is considered advantageous when analytical requirements demand sample volumes in excess of several liters. The major drawback of a pump system is the potential for increased volatile component stripping as a result of the required lift vacuum. Samples for volatile organic analysis should be collected with a bailer as described in Section 3.1.6.4 and should precede any sample collection which may further disturb the well by contact.

- Uses

The peristaltic pump system can be used for monitoring well sampling whenever the lift requirements do not exceed 8 meters. It becomes particularly important to use a heavy wall tubing in this application in order to prevent tubing collapse under the high vacuums needed for lifting from depth.

- Procedures For Use

1. Install clean medical grade silicon tubing in the peristaltic pump head.
2. Attach the pump to the required length of precleaned suction line and lower the end of the line to the midpoint of the well screen.
3. Consider the first liter of liquid collected as a system purge/rinse. NOTE: If well yield is insufficient for required analysis, this purge volume may be suitable for some less critical analysis.
4. Fill necessary sample bottles by allowing pump discharge to flow gently down the side of bottle with minimal entry turbulence. Cap each bottle as filled.
5. Select sample bottles and preserve the sample, if necessary, as per guidelines in Section 5.
6. Check that a Teflon-liner is present in cap if required. Secure the cap tightly.

7. Label the sample bottle with the appropriate label. Complete the chain-of-custody documents.
8. Allow system to drain then disassemble. Return tubing to lab for decontamination.

3.1.6.6 Sampling Monitoring Wells With a Submersible Pump

- Discussion

Several types of submersible pumps are available for ground water monitoring and offer considerable advantages over other systems. They are able to operate from depths beyond the capabilities of peristaltic pumps and save significant time and effort relative to hand bailing. Further, if constructed of suitable materials and properly used, they can both purge and adequately sample the well.

- Uses

Submersible pumps generally use one of two types of power supplies, either electric or compressed gas. Electric powered pumps generally run off a 12 VDC rechargeable battery from an automotive electrical system. Those units powered by compressed gas normally use a small electric compressor which also needs 12 VDC power. They may also utilize compressed gas from bottles or even high performance hand pumps.

These pumps are generally constructed of "more or less" noncontaminating materials "suitable for Priority Pollutant Sampling". They often contain plastics, rubber or metal parts which may contribute or otherwise effect the analysis of samples for certain trace components. Such pumps may not be suitable when samples are collected for analyses of a wide range of trace contaminants. They may, however, be useful for initial purging of such wells. In any case, when doubt remains, bailers are the best choice for actual sample acquisition.

Procedures For Use

1. Lower the precleaned pump to just below the water level and begin pumping. Consider the first liter of water as a system purge/rinse. Lower the pump as required to maintain submergence.
2. Fill necessary sample bottles by allowing pump discharge to flow gently down the side of bottle with minimal entry turbulence. Cap each bottle as filled.
3. Select appropriate sample bottles and preserve the sample if necessary as per guidelines in Section 5.
4. Check that a Teflon-liner is present in cap if required. Secure the cap tightly.
5. Label the sample bottle with an appropriate label. Complete chain-of-custody documents.
6. Allow system to drain then disassemble. Return tubing to lab for decontamination.

## 3.2 SURFACE WATER

### 3.2.1 Considerations in Determining Representative Sample Locations

The collection of surface water samples is performed for the purpose of assessing the general water quality of a particular body of water and/or to measure the impact of point or non-point source discharges on that body. To properly meet the objective of the sampling, consideration must be given to mixing zones, stratification areas, stream hydraulics, flow status (high flow vs. low flow), and any other conditions which influence the character of the water being sampled.

When monitoring the general water quality of a body of surface water, a determination must be made as to the homogeneity of the water both vertically and horizontally. This can be accomplished by either researching historical data on the water body and surrounding land use patterns, by preliminary random sampling, or by in-situ measurement (usually by probe) of certain water quality parameters (such as pH, temperature, dissolved oxygen or specific conductance) prior to sampling.

If the water is known to be homogeneous, a representative sample can be collected at any reasonable location. If the homogeneity of the water cannot be determined, or if it is known to be heterogeneous, the monitoring program must be structured to take into account all sources of variability. At Malcolm Pirnie, this is usually accomplished by theoretically dividing the water body into approximately equal sized sections and taking a representative sample from each section. These samples can be analyzed separately, or composited into one or more representative samples. Stratification of the water column is accounted for by taking samples at more than one depth. These samples can be also be composited if desired.

In addition to the above considerations, samples collected to assess the impact of a particular discharge on a body of water must be defined in terms of the discharge conditions which they represent. Initially, the discharge location(s) must be pin-pointed so that representative samples can be collected both upstream and downstream of the site. The extent of the mixing zone should be defined so that well-mixed or unmixed samples can be collected, depending on the objectives of the study. Turbulence or aeration at the discharge point is an important consideration when sampling for volatile compounds because these mechanisms may cause the compounds to dissipate. For a worst case analysis of the impact of a particular discharge, samples should be collected when the receiving water is at low flow; this is usually during the summer months.

3.2.2 Sampling Methods

A variety of surface water sampling procedures can be utilized depending on the water body to be sampled and parameters of concern. The following subsections describe the four basic methods utilized by Malcolm Pirnie.

### 3.2.2.1 Sampling Surface Waters Using a Dipper or Other Transfer Device

- Discussion

A dipper or other container constructed of inert material, such as glass, stainless steel or Teflon, can be used to transfer liquid wastes from their source to a sample bottle. This prevents unnecessary contamination of the outer surface of the sample bottle that would otherwise result from direct immersion in the liquid. Use of this device also prevents the technician from having to physically contact the water stream. Depending upon the sampling application, the transfer vessel can be either disposed of or reused. If reused, the vessel should be thoroughly rinsed and/or decontaminated prior to sampling a different source.

- Uses

A transfer device can be utilized in most sampling situations except where aeration must be eliminated (samples for volatile organic analysis) or where significant material may be lost due to adhesion to the transfer container.

- Procedures For Use

1. Submerge a precleaned stainless steel dipper or other suitable device with minimal surface disturbances.
2. Allow the device to fill slowly and continuously.
3. Retrieve the dipper/device from the surface water with minimal disturbance.
4. Remove the cap from the sample bottle and slightly tilt the mouth of the bottle below the dipper/device edge.
5. Empty the dipper/device slowly, allowing the sample stream to flow gently down the side of the bottle with minimal entry turbulence.
6. Continue delivery of the sample until the bottle is almost completely filled.
7. Select appropriate bottles and preserve the sample if necessary as per guidelines in Section 5.

8. Check that a Teflon liner is present in the cap if required. Secure the cap tightly.
9. Label the sample bottle with an appropriate label and complete the chain-of-custody form.
10. Properly clean and decontaminate the equipment prior to reuse or storage (Section 5).

3.2.2.2 Use of Pond Sampler For the Collection of Surface Water Samples

- Discussion

The pond sampler consists of bottle or similar container attached to the end of a two- or three-piece telescoping tube that serves as the handle.

- Uses

The pond sampler is used to collect surface water samples from near shore and liquid waste samples from disposal ponds, pits, lagoons, and similar reservoirs. The handle may bow when sampling very viscous liquids if sampling is not done slowly.

- Procedures For Use

1. Assemble the pond sampler. Make sure that the sampling container and the bolts and nuts that secure the clamp to the pole are tightened properly.
2. Take grab samples by slowly submerging the precleaned container with minimal surface disturbance.
3. Retrieve the pond sampler from the surface water with minimal disturbance
4. Remove the cap from the sample bottle and slightly tilt the mouth of the bottle below the dipper/device edge.
5. Empty the sampler slowly, allowing the sample stream to flow gently down the side of the bottle with minimal entry turbulence.
6. Continue delivery of the sample until the bottle is almost completely filled.
7. Select appropriate sample bottles and preserve the sample if necessary as per guidelines in Section 5.

8. Check that a Teflon liner is present in the cap if required. Secure the cap tightly.
9. Properly label the sample bottle and complete the chain-of-custody documents.
10. Properly clean and decontaminate the equipment prior to reuse or storage using recommended guidelines of Section 5.

3.2.2.3 Peristaltic Pump For Sampling Surface Water Bodies

- Discussion

This collection system consists of a peristaltic pump capable of achieving a pump rate of 1 to 3 liters per minute, and an assortment of tubing for extending the suction intake. A battery operated pump is preferable as it eliminates the need for DC generators or AC inverters.

- Uses

The system is highly versatile since it is portable and the sample collection is conducted through essentially chemically nonreactive material. It is practical for a wide range of applications including streams, ponds, and containers. This procedure can both extend the lateral reach of the sampler and allow sampling from depth. Likewise, it can function both as a well purge and a surface water sample collection system. The chief disadvantage of this method is the limited lift capacity of the pump, approximately 8 meters.

- Procedures For Use

1. Install clean, medical-grade silicone tubing in the pump head, as per the manufacturer's instructions. Allow sufficient tubing on the discharge side to facilitate convenient dispensation of liquid into sample bottles and only enough on the suction end for attachment to the intake line. This practice will minimize sample contact with the silicone pump tubing.
2. Select the length of suction intake tubing necessary to reach the required sample depth and attach to intake side of pump tubing. Heavy-wall Teflon, of a diameter equal

to the required pump tubing, suits most applications. (Heavier wall will allow for a slightly greater lateral reach.) Tygon or equivalent tubing may be applicable depending on the parameters of concern.

3. If possible, allow several liters of sample to pass through the system, before actual sample collection. Collect this purge volume and then return to source after the sample aliquot has been withdrawn.
4. Fill necessary sample bottles by allowing pump discharge to flow gently down the side of bottle with minimal entry turbulence. Cap each bottle as filled.
5. Select appropriate bottles and preserve the sample, if necessary, as per guidelines in Section 5.
6. Check that a Teflon liner is present in the cap if required. Secure the cap tightly.
7. Label the sample bottle with an appropriate label and complete the chain-of-custody documents.
8. Allow the system to drain, then disassemble. Return tubing to lab for decontamination (if feasible). See Section 5 for general decontamination procedures.

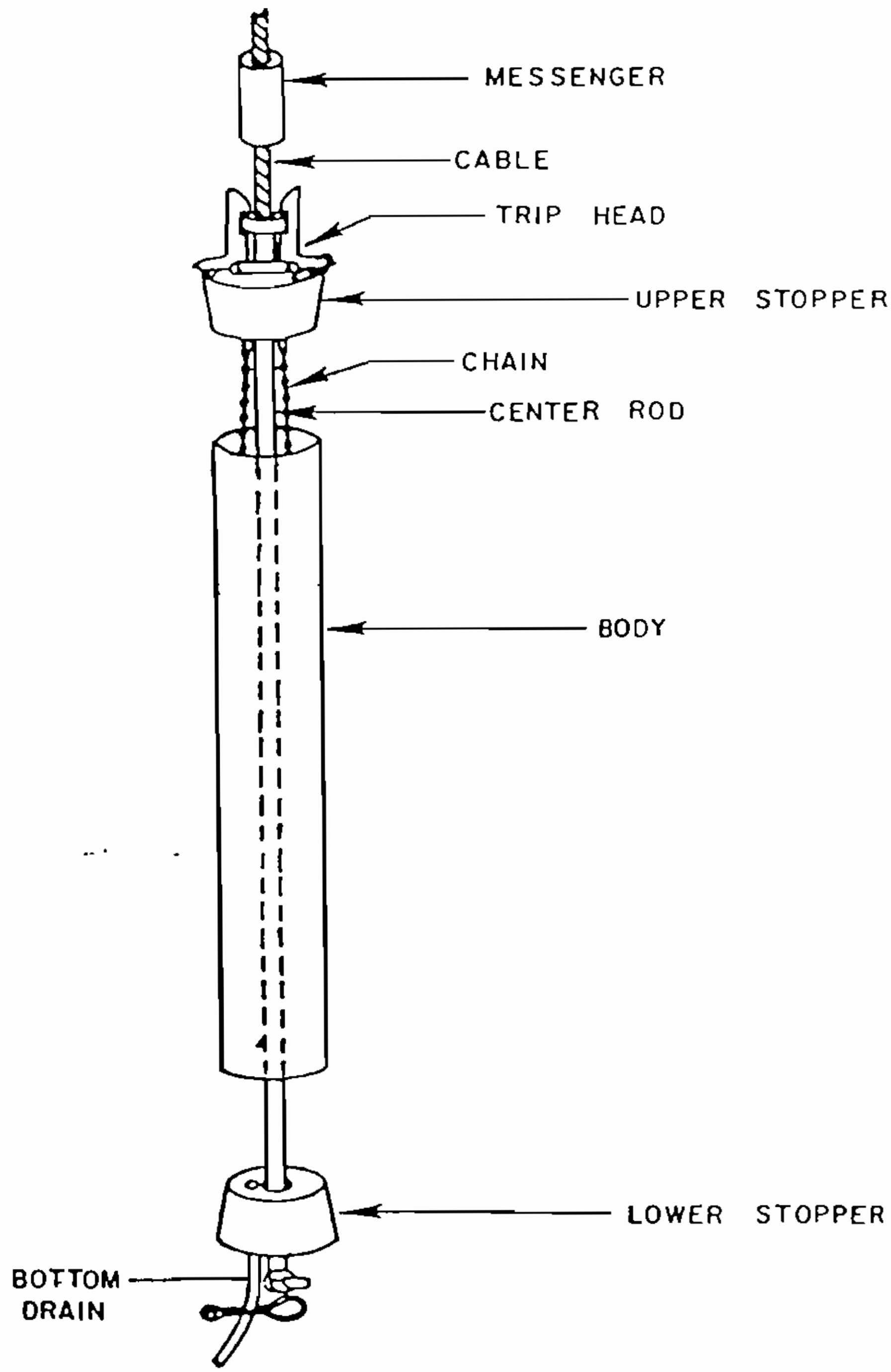
3.2.2.4 Collection of Water Samples From Depth With a Kemmerer Bottle

- Discussion

The kemmerer bottle is a messenger-activated water sampling device (see Figure 3-1). In the open position, water flows easily through the device. Once lowered to the desired depth, a messenger is dropped down the sample line tripping the release mechanism and closing the bottle. In the closed position, the bottle is sealed, both on top and bottom, from any additional contact with the water column and can be retrieved.

- Uses

The kemmerer bottle is currently the most practical method of collecting discrete, at-depth samples from surface waters or vessels where the collection depth exceeds the lift

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MODIFIED KEMMERER SAMPLER

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FIGURE 3-1

capacity of pumps. The application is limited however by the incompatability of various construction materials with some analytical techniques. Proper selection, i.e., all metal assemblies for organic analysis or all plastic assemblies for trace element analysis, will overcome this deficiency.

- Procedures For Use

1. Inspect kemmerer bottle for thorough cleaning and insure that sample drain valve is closed (if bottle is so equipped).
2. Measure and then mark sample line at desired sampling depth.
3. Open bottle by lifting top stopper-trip head assembly.
4. Gradually lower bottle until desired level is reached (predesignated mark from Step 2).
5. Place messenger on sample line and release.
6. Retrieve sampler; hold sampler by center stem to prevent accidental opening of bottom stopper.
7. Rinse or wipe off exterior of sampler body (wear proper gloves and protective clothing, if required).
8. Recover sample by grasping lower stopper and sampler body with one hand (gloved), and transfer sample by either (a) lifting top stopper with other hand and carefully pouring contents into sample bottles, or (b) holding drain valve (if present) over sample bottle and opening valve.
9. Allow sample to flow slowly down side of sample bottle with minimal disturbance.
10. Select sample bottles and preserve the sample if necessary as per guidelines in Section 5.
11. Check that a Teflon liner is present in the cap if required. Secure the cap tightly.
12. Label the sample bottle with an appropriate label and complete all chain-of-custody records.
13. Decontaminate sampler and messenger or place in plastic bag for return to lab. See Section 5 for general decontamination procedures.

## 3.3. SOIL, SLUDGE, & SEDIMENT

### 3.3.1 Introduction

The sampling of solid or semi-solid materials such as soils, sludges and sediments is complicated by the structural properties of the materials and the fact that the material to be sampled can be below the soil or water surface. In addition, solids may not have uniform characteristics with respect to depth and areal distance.

Soil sampling is an important factor in site investigations, especially in conjunction with ground water investigation. Acquisition of samples can be limited by such factors as grain size, cohesiveness, associated moisture, depth to bedrock and depth to water table. Shallow sampling of soils is accomplished by Malcolm Pirnie through the use of trowels, hand auger-type tools, and thin wall tube samplers. Sampling at greater depth is usually accomplished in conjunction with a boring/monitoring well installation program. Soil samples at depth are collected in accordance with ASTM D-1586, "Standard Method for Penetration Test and Split-Barrel Sampling of Soils" (See Appendix B). The actual sampling is conducted by a drilling subcontractor with supervision by Malcolm Pirnie personnel.

Sludges (semi-dry materials ranging from dewatered solids to high viscosity liquids) and sediments (deposited material underlying a body of waste) require somewhat different procedures and equipment due to their physical nature. Sludge sampling methods can vary from the use of a peristaltic pump, to the use of thin-tube samplers. Sediment sampling is similar except that factors such as inflows and discharges may cause significant variations in sediment composition. In addition, the presence of moving and/or deep waste complicates sampling.

### 3.3.2 Soil Sampling Methods

The following subsections describe several soil sampling procedures utilized by Malcolm Pirnie personnel. They have been adapted from the USEPA (Reference 1).

### 3.3.2.1 Soil Sampling With a Spade and Scoop

- Discussion

The simplest, most direct method of collecting soil samples for subsequent analysis is with the use of a spade and scoop. A normal lawn or garden spade can be utilized to remove the top cover of soil to the required depth and then a smaller stainless steel scoop can be used to collect the sample.

- Uses

This method can be used in most soil types but is limited to sampling the near surface. Gathering of samples from depths greater than 20 feet becomes extremely labor intensive in most soil types. Very accurate, representative samples can be collected with this procedure depending on the care and precision demonstrated by the technician. The use of a flat, pointed mason trowel to cut a block of the desired soil will be of aid when undisturbed profiles are required. A stainless steel scoop or lab spoon will suffice in most other applications. Care should be exercised to avoid the use of devices plated with chrome or other materials. Plating is particularly common with garden implements such as potting trowels.

- Procedures For Use

1. Carefully remove the top layer of soil to the desired sample depth with a precleaned spade.
2. Using a precleaned stainless steel scoop or trowel, remove and discard a thin layer of soil from the area which comes in contact with the shovel.
3. Transfer sample into an appropriate sample bottle with a stainless steel lab spoon or equivalent.
4. Check that a Teflon liner is present in the cap if required. Secure the cap tightly. The chemical preservation of solids is generally not recommended. Refrigeration is usually the best approach supplemented by a minimal holding time.

5. Label the sample bottle. Complete all chain-of-custody documents.
6. Decontaminate equipment after use and between sample locations. For specific decontamination guidelines, consult Section 5.

3.3.2.2 <u>Subsurface Soil Sampling With Auger and Thin-Wall Tube Sampler</u>

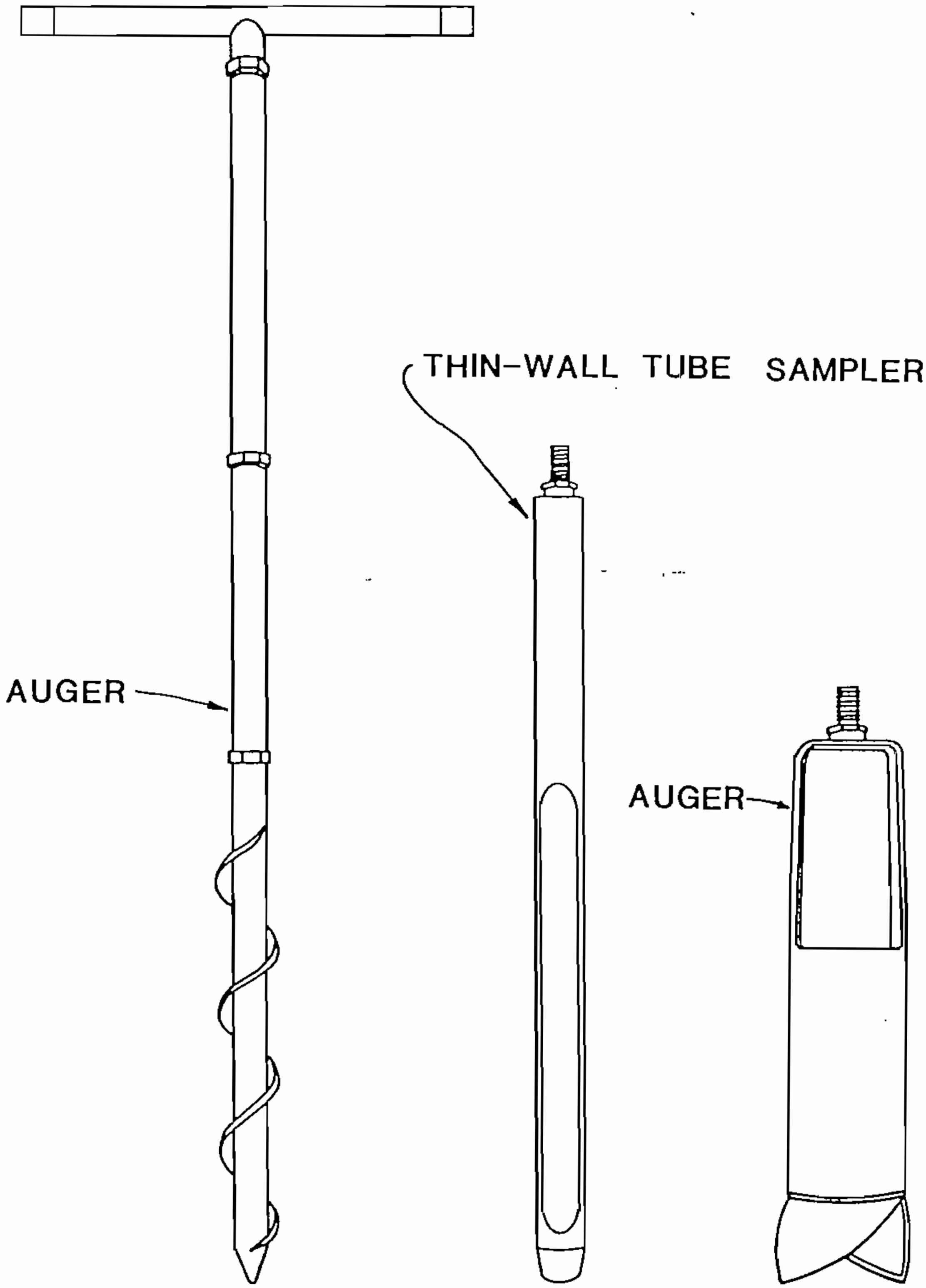
- <u>Discussion</u>

This system consists of an auger bit, a series of drill rods, a "T" handle, and a thin-wall tube corer (see Figure 3-2). The auger bit is used to bore a hole to the desired sampling depth and then withdrawn. The auger tip is them replaced with the tube corer, lowered down the borehole, and forced into the soil at the completion depth. The corer is then withdrawn and the sample collected.

Alternately, the sample can be recovered directly from the auger. This technique however, does not provide an "undisturbed" sample as would be collected with a thin tube sampler. In situations where the soil is rocky, it may not be possible to force a thin tube sampler through the soil or sample recovery may be poor. Sampling directly from the auger may be the only viable method. In soils where the borehole will not remain open when the tool is removed, a temporary casing can be used until the desired sampling depth is reached.

- <u>Uses</u>

This system can be used in a wide variety of soil conditions. It can be used to sample both from the surface, by simply driving the corer without preliminary boring, or to depths in excess of 6 meters. The presence of rock layers and the collapse of the borehole, however, usually prohibit sampling at depths in excess of 6-7 feet. Interchangeable cutting tips on the corer reduce the disturbance to the soil during sampling and aid in maintaining the core in the device during removal from the borehole.

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AUGERS and THIN-WALL TUBE SAMPLER

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FIGURE 3-2

Procedures For Use

1. Attach the auger bit to a drill rod extension and further attach the "T" handle to the drill rod.
2. Clear the area to be sampled of any surface debris (twigs, rocks, litter). It may be advisable to remove the first 3 to 6 inches of surface soil for an area approximately 6 inches in radius around the drilling location.
3. Begin drilling, periodically removing accumulated soils. This prevents accidentally brushing loose material back down the borehole when removing the auger or adding drill rods.
4. After reaching desired depth, slowly and carefully remove auger from boring. (Note: When sampling directly from auger, collect sample after auger is removed from boring and proceed to Step 10).
5. Remove auger tip from drill rods and replace with a precleaned thin-wall tube sampler. Install proper cutting tip.
6. Carefully lower corer down borehole. Gradually force corer into soil. Care should be taken to avoid scraping the borehole sides. Hammering of the drill rods to facilitate coring should be avoided as the vibrations may cause the boring walls to collapse.
7. Remove corer and unscrew drill rods.
8. Remove cutting tip and remove core from device.
9. Discard top of core (approximately 1 inch), which represents any material collected by the corer before penetration of the layer in question. Place remaining core into sample container.
10. Check that a Teflon liner is present in the cap if required. Secure the cap tightly. The chemical preservation of solids is generally not recommended. Refrigeration is usually the best approach supplemented by a minimal holding time.

11. Label the sample bottle. Complete all chain-of-custody documents.
12. Decontaminate sampling equipment after use and between sampling locations. Refer to Section 5 for decontamination requirements.

3.3.3 Sludge and Sediment Sampling

The following subsections describe several methods for obtaining representative sludge and sediment samples. These have been adapted from USEPA methods (Reference 1).

3.3.3.1 Collection of Sludge or Sediment Samples With a Scoop

- Discussion

  Sludge and sediment samples are collected using the simple laboratory scoop or garden type trowel specified in Subsection 3.3.2.1. This method is more applicable to sludges but it can be used for sediments provided the water depth is very shallow (a few inches). It should be noted, however, that this method can be disruptive to the water/sediment interface and might cause substantial alterations in sample integrity if extreme care is not exercised. The stainless steel laboratory scoop is generally recommended due to its noncorrosive nature. Single grab samples may be collected or, if the area in question is large, it can be divided into grids and multiple samples can be collected and composited.

- Uses

  This method provides for a simple, quick, and easy means of collecting a disturbed sample of a sludge or sediment.

- Procedures For Use

  1. Sketch the sample area or note recognizable features for future reference. If practical, place a numbered stake at the sample site.
  2. Insert scoop or trowel into material and remove sample. In the case of sludges exposed to air, it may be

desirable to remove the first ½ to 1 inch of material prior to collecting sample.

3. If compositing a series of grab samples, use a stainless steel mixing bowl, Teflon tray, or a hard surface covered with aluminum foil for mixing.
4. Transfer sample into an appropriate sample bottle with a stainless steel lab spoon or equivalent.
5. Check that a Teflon liner is present in cap if required. Secure the cap tightly. The chemical preservation of solids is generally not recommended. Refrigeration is usually the best approach supplemented by a minimal holding time.
6. Label the sample bottle and complete all chain-of-custody documents.
7. Decontaminate sampling equipment after use and between sample locations according to the guidelines presented in Section 5.

3.3.3.2 <u>Sampling Sludge or Sediments With a Hand Corer</u>

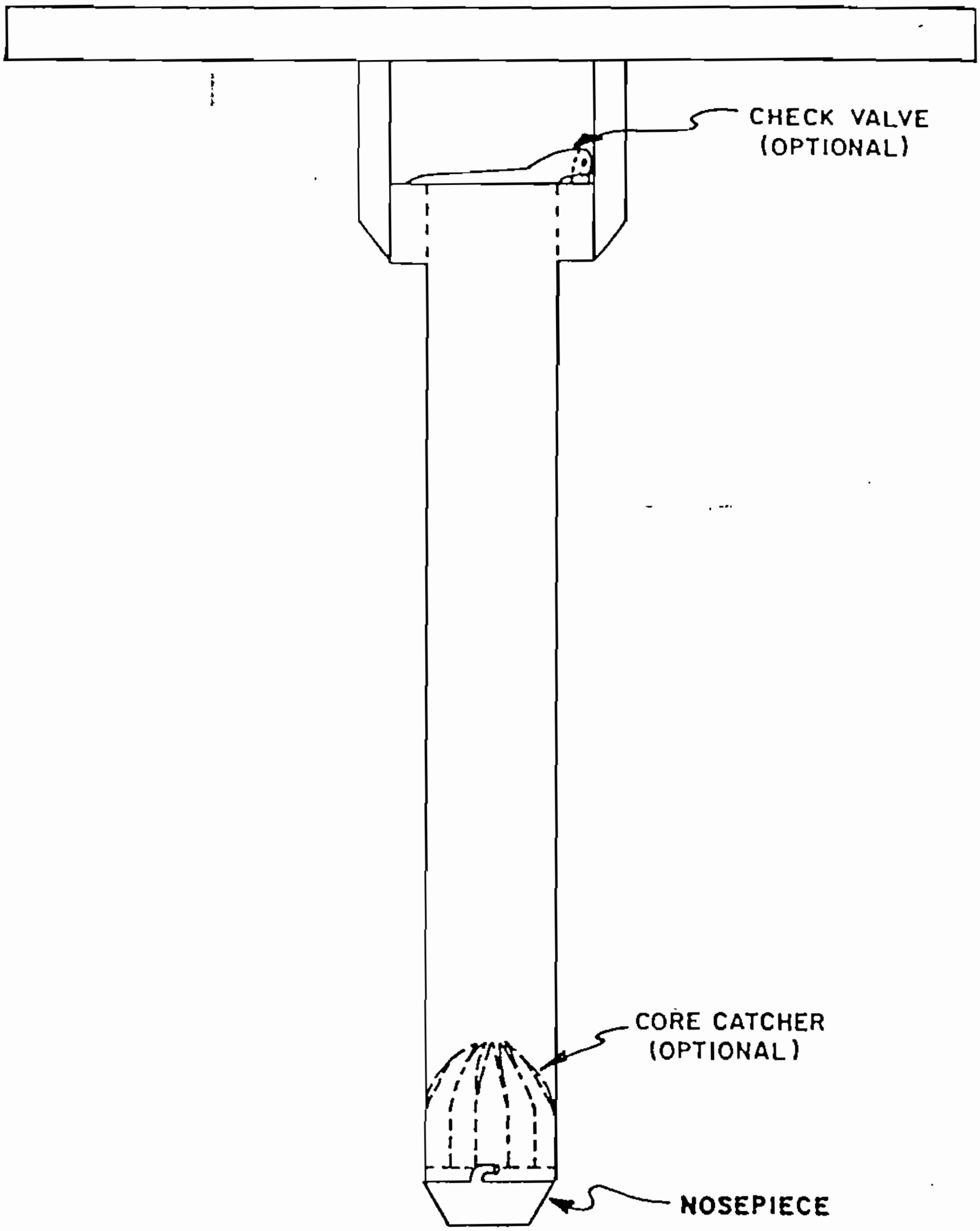
- <u>Discussion</u>

This device is essentially the same type of thin-wall corer described for collecting soil samples (Subsection 3.3.2.2). It is modified by the addition of a handle to facilitate driving the corer (see Figure 3-3) and a check valve on top to prevent washout during retrieval through an overlying water layer.

- <u>Uses</u>

Hand corers are applicable to the same situations and materials as the scoop described in Subsection 3.3.3.1. It has the advantage of collecting an undisturbed sample which can profile any stratification in the sample as a result of changes in the deposition.

Some hand corers can be fitted with extension handles which will allow the collection of samples underlying a shallow layer of liquid. Most corers can also be adapted to

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**HAND CORER**

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FIGURE 3-3

hold liners generally available in brass, polycarbonate plastic or Teflon. Care should be taken to choose a material which will not compromise the intended analytical procedures.

- Procedures For Use

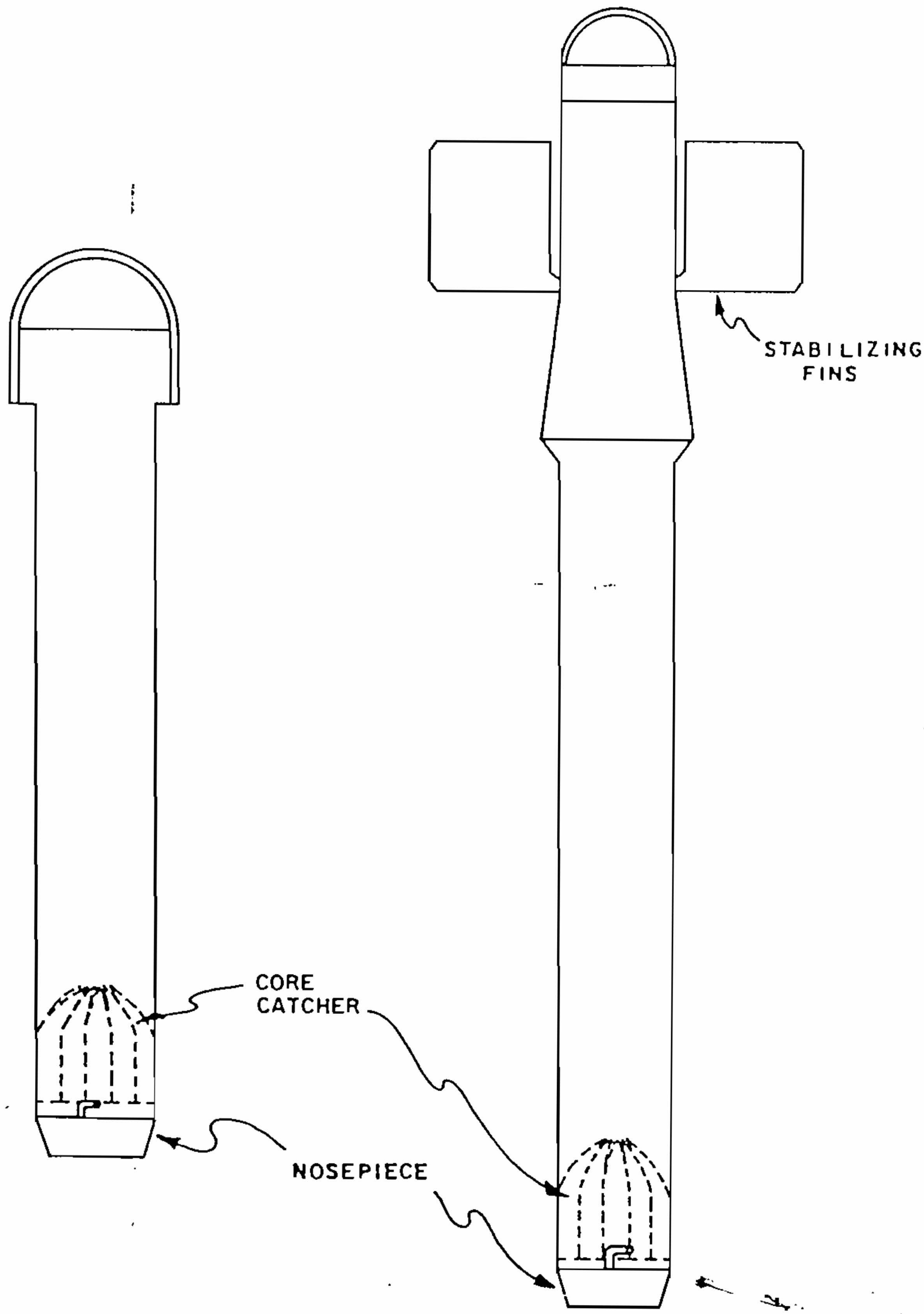
1. Inspect the corer for proper precleaning, and select sample location.
2. Force corer in with smooth continuous motion.
3. Twist corer then withdraw in a single smooth motion.
4. Remove nosepiece and withdraw sample into a stainless steel or Teflon tray, or a tray covered with aluminum foil.
5. Transfer sample into an appropriate sample bottle with a stainless steel lab spoon or equivalent.
6. Check that a Teflon liner is present in cap if required. Secure the cap tightly. The chemical preservation of solids is generally not recommended. Refrigeration is usually the best approach supplemented by a minimal holding time.
7. Label the sample bottle and complete all chain-of-custody documents.
8. Decontaminate sampling equipment after use and between sample locations as required by procedures in Section 5.

3.3.3.3 Sampling Bottom Sludges or Sediments With a Gravity Corer

- Discussion

A gravity corer is a metal tube with a replacement tapered nosepiece on the bottom and an optional ball or other type of check valve on the top. The check valve allows water to pass through the corer on descent but prevents a washout during recovery. The tapered nosepiece facilitates cutting and reduces core disturbance during penetration.

Most corers are constructed of brass or steel and many can accept plastic liners and additional weights (see Figure 3-4).

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GRAVITY CORERS

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FIGURE 3-4

- Uses

Corers are capable of collecting samples of most sludges and sediments. They collect essentially undisturbed samples which represent the profile of strata which may develop in sediments and sludges during variations in the deposition process. Depending on the density of the substrate and the weight of the corer, penetration to depths of 30 inches can be attained.

Care should be exercised when using gravity corers in vessels or lagoons that have liners because penetration depths could exceed that of the subsurface and result in damage to the liner material.

- Procedures For Use

1. Attach a precleaned corer to the required length of sample line. Solid braided 5 mm (3/16 inch) nylon line is sufficient; 20 mm (3/4 inch) nylon, however, is easier to grasp during hand hoisting.
2. Secure the free end of the line to a fixed support to prevent accidental loss of the corer.
3. Allow corer to free fall through liquid to bottom.
4. Retrieve corer with a smooth, continuous lifting motion. Do not bump corer as this may result in some sample loss.
5. Remove nosepiece from corer and slide sample out of corer into stainless steel or Teflon pan, or a hard surface lined with aluminum foil.
6. Transfer sample into appropriate sample bottle with a stainless steel lab spoon or equivalent.
7. Check that a Teflon liner is present in cap if required. Secure the cap tightly. The chemical preservation of solids is generally not recommended. Refrigeration is usually the best approach supplemented by a minimal holding time.
8. Label the sample bottle. Complete all chain-of-custody documents.

9. Consult Section 5 for decontamination requirements and decontaminate sampling equipment after use and between sampling locations.

3.3.3.4 Sampling Bottom Sludges or Sediments With a Ponar Grab

- Discussion

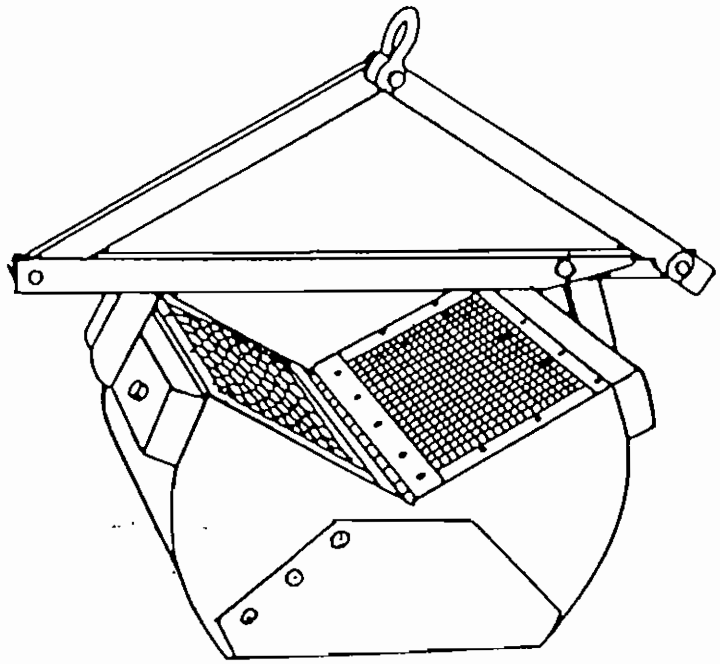
The Ponar grab is a clamshell type scoop activated by a counter lever system. The shell is opened and latched in place and slowly lowered to the bottom. When tension is released on the lowering cable the latch releases and the lifting action of the cable on the lever system closes the clamshell (see Figure 3-5).

- Uses

Ponars are capable of sampling most types of sludges and sediments from silts to granular materials. They are available in a "Petite" version with a 36 square inch sample area that is light enough to be operated without a winch or crane. Penetration depths will usually not exceed 2-3 inches. Grab samplers, unlike the corers described in Subsection 3.3.3.3 are not capable of collecting undisturbed samples. As a result, material in the first inch of sludge cannot be separated from that a lower depths. The sampling action of these devices causes agitation currents which may temporarily resuspend some settled solids. This disturbance can be minimized by slowly lowering the sampler the last one to two feet and allowing a very slow contact with the bottom. It is advisable, however, to only collect sludge or sediment samples after all overlying water samples have been obtained.

- Procedures For Use

1. Attach a precleaned Ponar to the necessary length of sample line. Solid braided 3/16 inch nylon line is usually of sufficient strength; however, 3/4 inch or greater nylon line allows for easier hand hoisting.



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PONAR GRAB

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FIGURE 3-5

2. Measure and mark the distance to bottom on the sample line. A secondary mark, 1½ foot shallower, will indicate proximity so that lowering rate can be reduced, thus preventing unnecessary bottom disturbance.
3. Open sampler jaws until latched. From this point on, support sampler by its lift line or the sampler will be tripped and the jaws will close.
4. Tie free end of sample line to fixed support to prevent accidental loss of sampler.
5. Begin lowering the sampler until the proximity mark is reached.
6. Slow rate of descent through last 1½ foot until contact is felt.
7. Allow sample line to slack several inches. In strong currents more slack may be necessary to release mechanism.
8. Slowly raise dredge clear of water surface.
9. Place Ponar into a stainless steel, Teflon or aluminum foil lined tray and open. Lift Ponar clear of the tray.
10. Collect a suitable aliquot with a stainless steel lab spoon or equivalent and place sample into appropriate sample bottle.
11. Check for a Teflon liner in cap if required and secure cap tightly. The chemical preservation of solids is generally not recommended. Refrigeration is usually the best approach supplemented by a minimal holding time.
12. Label the sample bottle with the appropriate label. Complete all chain-of-custody documents.
13. Consult Section 5 Decontamination, for appropriate decontamination procedures to be used on sampling equipment after use and between sampling locations.

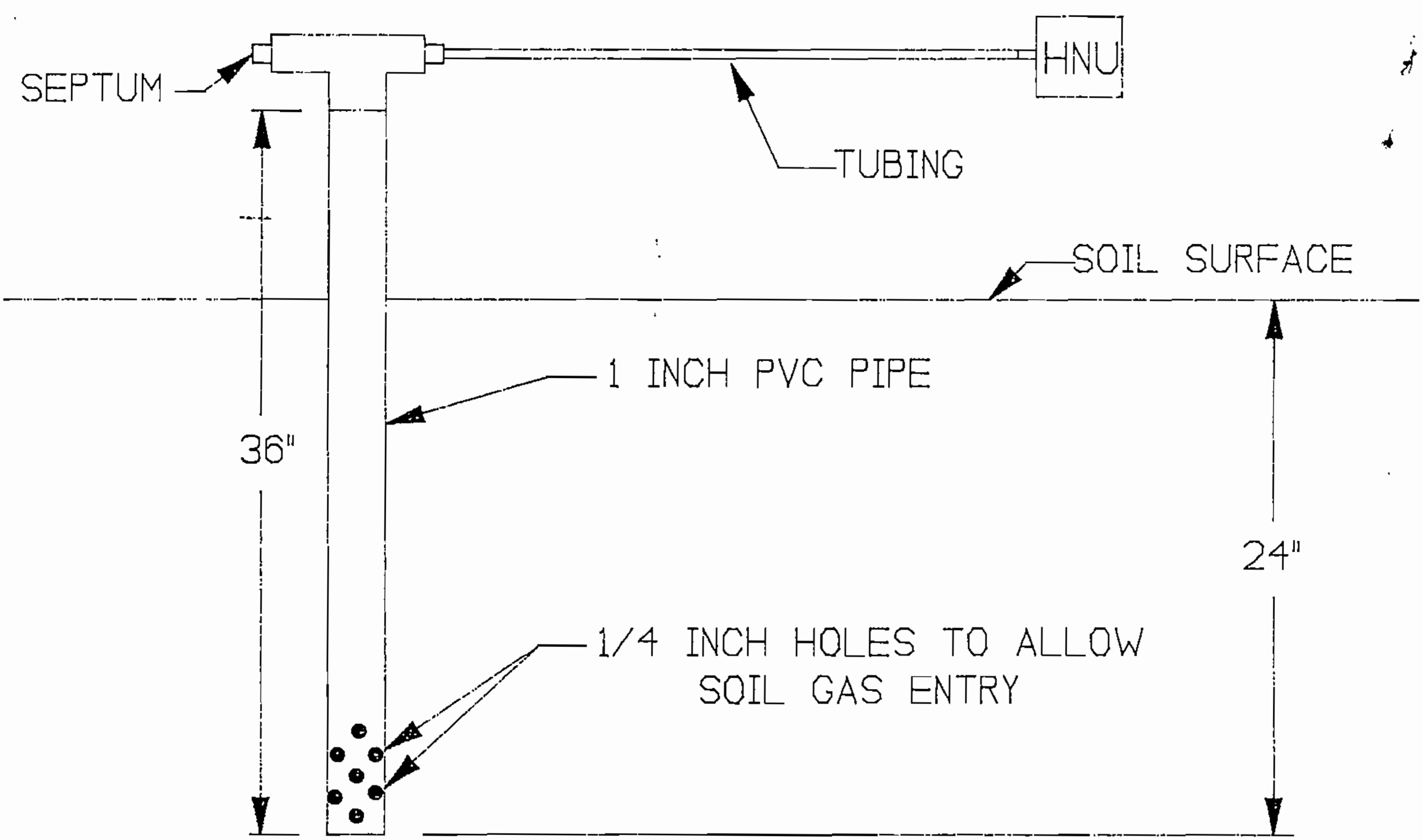
## 3.4 SOIL GAS

Since soil gas survey results can be affected by weather conditions, surveys will be conducted when both soil temperature and ambient temperature exceed 40 degrees F. Other factors which can affect the outcome of the survey are: the chemical and physical properties of the organic compounds being monitored, properties of the unsaturated zone, hydrogeologic properties, and size and concentration of the contaminant plume. All of these factors will have been considered when planning the soil gas survey described in the work plan.

The following procedure will be used at the site to conduct the soil gas survey described in the work plan. Two inch diameter borings will be drilled to a depth of 24 inches below the land surface (or 24 inches below the bottom of any cap material). The boring will be drilled with a hand or power auger, depending on soil conditions. The soil gas probe (see Figure 3-6) will be inserted into the boring and the probe will be sealed off at the soil surface by compressing the natural soil around the PVC pipe. The probe will be left in place at least 24 hours to allow the area to come to equilibrium.

An HNU PI101 organic vapor analyzer will be connected to the probe as shown in Figure 3-6 and soil gas will be drawn into the unit and two readings will be taken and recorded. The first is the maximum reading noted during the screening of soil gas. The second reading is the level at which the HNU stabilizes after the peak reading.

Depending upon the requirements of the work plan, further on-site characterization of the soil gas may be performed utilizing a portable gas chromatograph (GC). Soil gas for GC analysis will be collected using a gas-tight syringe. The syringe will be inserted through the septum on the probe filled with the proper volume, and then injected into the GC. Minimum detection limits will be as required for the particular parameters being analyzed; these detection limits are spelled out in the work plan.

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SOIL GAS PROBE SCHEMATIC

FIGURE 3-6
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## 3.5 AIR SAMPLING

### 3.5.1 General

Air monitoring for the purpose of conducting site investigations can be useful for indicating potential health and safety concerns for both on-site workers and off-site residents. The data is necessary in some cases for evaluating the extent of contamination, the need for remediation and also for conducting the risk assessment. This subsection describes various methodologies that can be used during site investigations to develop the needed information. Since air monitoring procedures are generally determined by the parameters to be monitored, this section provides general information regarding the types of monitoring commonly conducted. Specifics regarding the sampling and analysis of air samples are provided in the work plan and in section 2 of this QAPP. Procedures for conducting soil gas surveys are described in subsection 3.4 of the QAPP. Air monitoring requirements for protection of workers and the community are provided in the site Health & Safety Plan. Procedures for screening soil samples for volatile organics are provided in subsection 4.1.

### 3.5.2 Volatile Organics in Ambient Air

Monitoring of volatile organics in air is conducted utilizing an HNU PI101 photoionization instrument. The HNU is capable of detecting a wide variety of organic chemicals. Detection levels are as low as 0.2 ppm depending on the specific parameter being monitored. One drawback with the HNU is the inability to quantitate specific parameters when one or more organics are present.

When lower detection limits are needed or specific parameters need to be identified and quantified, gas chromatography (GC) is needed. The GC can be either a portable model that is brought to the site or it can be in the laboratory and samples are then collected at the site and transported to the laboratory for analysis. For the on-site GC, samples can be introduced into the GC by direct injection (gas-tight syringe) or through a gas sampling loop

3.5.3 Combustible Gases in Air

Combustible gases in air are monitored with a Neotronix Ecotox Model 40. This instrument reports the level of combustible gases in air as a percentage of the Lower Explosive Limit (LEL). The combustible gas meter provides a general indication of the presence of high levels of volatile organics. The instrument does not provide information for trace levels of volatiles in air.

3.5.4 Detector Tubes

A variety of detector tubes are available for monitoring a specific compound or classes of compounds in air. Malcolm Pirnie utilizes a Drager hand pump for site monitoring. Selection of tubes is based on the parameters of concern and the detection level needed. A major advantage of detector tubes is the ability to obtain compound-specific, real-time information. The tubes are easily used by personnel with a minimum amount of training. The tubes are generally adequate for verifying the presence or absence of non-trace levels of numerous organic and inorganic compounds. They may not be adequate for off-site or non-work zone ambient air monitoring due to the low sample volume analyzed.

3.5.5 Particulates in Ambient Air

Particulate sampling of ambient air, mainly off-site or at the property line, is conducted with a high-volume (hi-vol) sampler. Basically this involves the use of a high-volume blower to draw air through one of more filters. The mass concentration in air of particulate samples of a given size is determined from the weight of particles collected and the volume of air pulled through the filter. Specific filters can be utilized depending on the nature of the particulates being monitored and whether chemical analyis of the particulates is needed. Real-time particulate monitoring and dust control will be in accordance with the procedures provided in Appendix F.

Revised Text

# 4.0 FIELD MONITORING PROCEDURES

## 4.1 SOIL SCREENING FOR HYDROCARBON VAPOR DETECTION

### 4.1.1 Procedure For Soil Screening With An HNU

During drilling activities, a total hydrocarbon vapor analyzer (HNU PI101) can be used to monitor the borehole and split-spoon samples upon opening of each sampler. The monitoring results will provide a vertical profile of possible soil contamination by volatile organic substances.

Generally, the hydrocarbon vapor analyzer is a portable trace gas analyzer that can be used to measure the concentration of a wide variety of organic vapors. The instrument relies upon the fact that an ultraviolet (UV) light source at a given intensity will emit photons with an energy level high enough to ionize many trace species, particularly organics, but not high enough to ionize the major components of air, ($O_2$, $N_2$, CO, $CO_2$) or $H_2O$.

Although the analyzer can be used to detect the presence of a single, pre-specified species, results should be taken as indicative rather than absolute. For precise results, a detailed lab analysis should be performed.

The following procedures shall be incorporated when testing for volatile organic vapors.

- Upon opening each split-spoon sampler, a subsample of the soil will be place into a precleaned glass VOA vial, sealed with a teflon-lined septum cap, labeled, and placed immediately on ice in an ice chest. The remainder of the sample will be placed in a comparable labeled wide-mouth glass jar and sealed with aluminum foil and a screw top cap. All samples of the latter type will be staged at a single location and maintained at a temperature that will be as near as possible to $70^{0}$ F. (Note that a VOA vial sample is not needed if screening will not be followed by laboratory analysis for volatile organics).

Revised Text

After a minimum of 15 minutes, and before the end of the work day, a head-space analysis of any organic vapor present in each sample bottle will be performed by inserting the sample probe of the total organic vapor analyzer through the aluminum foil seal.

4.1.2 Procedure For Soil Screening With Portable Gas Chromatograph

Once the soil gas sampling probes have been installed, a calibrated, battery-operated air pump will be used to purge a volume of air equal to two times the sample probe volume from the probe. An HNU organic vapor detector will then be connected to the soil gas probe and the volatile organic content of the soil gas will be monitored. If HNU values register above background levels, a syringe will be inserted through the septum on the sample probe and a soil gas sample will be withdrawn for analysis with a portable GC unit. A model 511A Thermo Electron portable GC with a photoionization detector will be utilized for the analysis.

The Model 511A is a completely self-contained flame ionization gas chromatograph containing rechargeable batteries and refillable gas supplies. This allows the instrument to be carried fully operational to the sampling area and operated immediately upon arrival. The instrument provides either eight hours of fully portable operation or operation from 110V source while the batteries recharge. The FID is a sensitive detector for any materially containing organically bound carbon. Generally, conditions can be chosen to provide at least 0.05 ppm minimum detectable for most organic compounds with the FID. However, when the Model 511A is coupled with the Analysis Option 23, containing the photoionization detector, the sensitivity is increased six to 10 times. For example, benzene can be detected down to 5 ppb.

The lack of reponse to air makes the instrument ideally suited for the trace analysis of orgnaic materials in air.

Revised Text

### 4.1.3 Field Recording Procedure

Field records will be maintained during all field activities. Data and information which will be recorded during soil screening for hydrocarbon vapor detection will include:

- Date
- Time
- Location
- Sampler Name
- Weather
- General Observations/Remarks
- Sample Description and Identification
- Sample Handling Method
- Equipment Used
- Instrument Reading

## 4.2 SOIL BORING LOG DESCRIPTION PROCEDURES

### 4.2.1 General

This procedure is presented as a means for insuring proper field identification and description of soils collected from a split barrel sampler according to American Standard Testing Method (ASTM) D 1586, "Penetration Test and Split Barrel Sampling of Soils". The lithology and moisture content of each soil sample can be visually and physically characterized according to either the Burmister Soil Classification System or the Unified Soil Classification System. Both of these methods of soil classification describe soil types on the basis of grain size and liquid and plastic limits and include moisture content.

### 4.2.2 Data Recording Forms

Enter all data pertaining to the soil descriptions on the Field Borehole Log. Write the dominant particle size in capital letters. Record additional notes such as water loss or gain, drill chatter, odor, etc.

Revised Text

Maintain a daily drilling report indicating the day's drilling activities. This latter report will include all drilling starting and ending times, footage drilled, consumables, and any other important notes about the day's drilling process.

4.2.3 Soil Boring Sampling and Borehole Log Descriptions

1. Maintain a daily drilling report describing the day's activities in addition to the field borehole log.
2. With the split-spoon sample barrel resting on the bottom of the borehole, the entire length of the sampler (24 inches) is driven into the sub-soil by a 140 lb. weight free falling from a height of 30 inches.
3. Record the number of blows necessary to drive the sampler 6 inches on the borehole log sheet as blow counts. If the sampler is not driven the 6 inch interval after 100 blows are delivered, measure the penetration distance for that interval.
4. After the split-spoon is pried open with a screwdriver, measure and record the length of the sample, the upper 2 to 3 inches of the sample should be neglected since this material will consist of cuttings and sludge.
5. Shave a thin layer off the entire length of the sample to prevent descriptive errors that may result from smearing of the outer sample surface while the sample barrel is being driven.
6. After the sample has been described, place a representative portion of the sample in the pre-cleaned jars and tightly seal with a screw-on cap. Label the jar with the number of blow counts, sample interval, borehole number, and date and store at a safe location.

4.2.4 Descriptive Terms For Soil Characteristics

Use the following terms to identify major characteristics of the soils:

1. Color: Describe soil color utilizing a single color descriptor preceded by a modifier to denote variations in

shade or color mixtures. Soil color should be described while the sample is still moist.

2. Density: Classify the relative density of a soil according to the number of blow counts from the standard penetration test while sampling:

| Designation | Blows per Foot |
|---|---|
| Very loose | 0 to 4 |
| Loose | 5 to 10 |
| Med. dense | 11 to 30 |
| Dense | 31 to 50 |
| Very dense | Over 50 |

3. Particle Size: Base particle size classification upon the grain sizes in the Burmister and Unifies Soil Classification Systems (See Tables 4-1 and 4-2).
4. Soil Descriptors: Describe the relative weight proportions of each soil sample using terms as: and, some, little or trace. Each term represents a range of percentage by weight. See the Burmister Classification System for further details (Table 4-1).
5. Moisture Content: Estimate moisture content according to four categories: dry, moist, wet and saturated. In dry soil, there appears to be little or no water. Saturated samples contain more water than can hold. Moist and wet are used to describe samples that contain more or less water than these two extremes. The application of these terms is subjective, but if consistency is used throughout the drilling project, they will prove to be adequate.

## TABLE 4-1

### KEY TO SOILS IDENTIFICATION
Burmister Classification

### Granular Soils - Particle Size Classification

| Material | | Fractions | Passing | Retaines On |
|---|---|---|---|---|
| BOULDERS | Material retained on the 9 in. sieve | | | 9 in. |
| COBBLES | Material passing the 9 in. sieve and retained on the 3 in. sieve | | 9 in. | 3 in. |
| GRAVEL | Material passing the 3 in. sieve and retained on the No. 10 sieve | coarse (c) | 3 in. | 1 in. |
| | | medium (m) | 1 in. | 3/8 in. |
| | | fine (f) | 3/8 in. | No. 10 |
| SAND | Material passing the No. 10 sieve and retained on the No. 200 sieve | coarse (c) | No. 10 | No. 30 |
| | | medium (m) | No. 30 | No. 60 |
| | | fine (f) | No. 60 | No. 200 |
| SILT | Material passing the No. 200 sieve that is nonplastic in character and exhibits little or no strength when air-dried | | No. 200 | |

### Clay Soils - Plasticity Classification

| Material* | Degree of Overall Plasticity | Overall Plasticity Index Sand - Silt - Clay Components |
|---|---|---|
| Clayey SILT | Slight | 1 to 5 |
| SILT & CLAY | Low | 5 to 10 |
| CLAY & SILT | Medium | 10 to 20 |
| Silty CLAY | High | 20 to 40 |
| CLAY | Very High | 40 and greater |

*Soils passing the No. 200 sieve which can be made to exhibit plasticity and clay qualities within a certain range of moisture content, and which exhibits considerable strength when air-dried.

### Penetration Resistance and Soil Properties on Basis of the Standard Penetration Test (After Peck, Hanson and Thornburg, 1974)

| Sands (Fairly Reliable) | | Clays (Rather Unreliable) | |
|---|---|---|---|
| Number of Blows per ft. N | Relative Density | Number of Blows per ft. N | Consistency |
| | | Below 2 | Very Soft |
| 0-4 | Very Loose | 2-4 | Soft |
| 4-10 | Loose | 4-8 | Medium |
| 10-30 | Medium | 8-15 | Stiff |
| 30-50 | Dense | 15-30 | Very Stiff |
| Over 50 | Very Dense | Over 30 | Hard |

### Terms Identifying Composition of Soil

| Written* | Defining Range of Percentage by Weight |
|---|---|
| and | 35 to 50 |
| some | 20 to 35 |
| little | 10 to 20 |
| trace | 0 to 10 |

*Plus (+) or minus (-) sign used after identifying term denotes extremes of range, e.g., "some (-) Gravel" indicates 20 to 24 percent Gravel; "some (+) Gravel" indicates 31 to 35 percent Grave.

AA03088/FORMS

TABLE 4-2

# SOIL TERMS

## UNIFIED SOIL CLASSIFICATION ( USCS )

### COARSE GRAINED SOILS

More than half of material is LARGER than No. 200 sieve size

| | | FIELD IDENTIFICATION PROCEDURES (Excluding particles larger than 3" & basing fractions on estimated weights) | GROUP SYMBOLS | TYPICAL NAMES |
|---|---|---|---|---|
| GRAVELS 50% (+) > 1/4" ø | CLEAN GRAVELS Low % fines | Wide range in grain size and substantial amounts of all intermediate particle sizes | GW | Well graded gravels, gravel-sand mixtures, little or no fines |
| | | Predominantly one size or a range of sizes with some intermediate sizes missing | GP | Poorly graded gravels, gravel-sand mixtures, little or no fines |
| | GRAVELS W/FINES High % fines | Non-plastic fines (for identification procedures see ML) | GM | Silty gravels, poorly graded gravel-sand-silt mixtures |
| | | Plastic fines (for identification procedures see CL) | GC | Clayey gravels, poorly graded gravel-sand-clay mixtures |
| SANDS 50% (+) < 1/4" ø | CLEAN SANDS Low % fines | Wide range in grain size and substantial amounts of all intermediate particle sizes | SW | Well graded sand, gravelly sands, little or no fines |
| | | Predominantly one size or a range of sizes with some intermediate sizes missing | SP | Poorly graded sands, gravelly sands, little or no fines |
| | SANDS W/FINES High % fines | Non-plastic fines (for identification procedures see ML) | SM | Silty sands, poorly graded sand-silt mixtures |
| | | Plastic fines (for identification procedures see CL) | SC | Clayey sands, poorly graded sand-clay mixtures |

### FINE GRAINED SOILS

More than half of material is SMALLER than No. 200 sieve size

| | FIELD IDENTIFICATION PROCEDURES (Excluding particles larger than 3" & basing fractions on estimated weights) | | | GROUP SYMBOLS | TYPICAL NAMES |
|---|---|---|---|---|---|
| | Identification procedures on fraction smaller than No. 40 sieve size | | | | |
| | DRY STRENGTH (Crushing Characteristics) | DILATANCY (Reaction to Shaking) | TOUGHNESS (Consistency Near Plastic Limit) | | |
| SILTS & CLAYS Liquid limit < 50 | None to slight | Quick to slow | None | ML | Inorganic silts and very fine sands, rock flour, silty or clayey fine sands with slight plasticity |
| | Medium to high | None to very slow | Medium | CL | Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays |
| | Slight to medium | Slow | Slight | OL | Organic silts and organic silt-clays of low plasticity |
| SILTS & CLAYS Liquid limit > 50 | Slight to medium | Slow to none | Slight to medium | MH | Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts |
| | High to very high | None | High | CH | Inorganic clays of high plasticity, fat clays |
| | Medium to high | None to very slow | Slight to medium | OH | Organic clays of medium to high plasticity |
| HIGHLY ORGANIC SOILS | Readily identified by color, odor, spongy feel and frequently by fibrous texture | | | Pt | Peat and other organic soils |

Boundary classifications-Soils possessing characteristics of two groups are designated by combining group symbols. For example GW-GC, well graded gravel-sand mixture with clay binder.
All sieve sizes on this chart are U.S. standard.

### DENSITY OF GRANULAR SOILS

| DESIGNATION | STANDARD PENETRATION RESISTANCE — BLOWS/FOOT |
|---|---|
| Very loose | 0 - 4 |
| Loose | 5 - 10 |
| Medium dense | 11 - 30 |
| Dense | 31 - 50 |
| Very dense | Over 50 |

### CONSISTENCY OF COHESIVE SOILS

| CONSISTENCY | UNC. COMPRESSIVE STR. TONS /SQ. FT. | STANDARD PENETRATION RESISTANCE — BLOWS/FOOT | FIELD IDENTIFICATION METHODS |
|---|---|---|---|
| Very soft | Less than 0.25 | 0 to 2 | Easily penetrated several inches by fist |
| Soft | 0.25 to 0.50 | 2 to 4 | Easily penetrated several inches by thumb |
| Medium stiff | 0.50 to 1.0 | 4 to 8 | Can be penetrated several inches by thumb |
| Stiff | 1.0 to 2.0 | 8 to 15 | Readily indented by thumb |
| Very stiff | 2.0 to 4.0 | 15 to 30 | Readily indented by thumbnail |
| Hard | More than 4.0 | Over 30 | Indented with difficulty by thumbnail |

## ROCK TERMS

### ROCK HARDNESS ( FROM CORE SAMPLES )

| DESCRIPTIVE TERMS | SCREWDRIVER OR KNIFE EFFECTS | HAMMER EFFECTS |
|---|---|---|
| Soft | Easily gouged | Crushes when pressed with hammer |
| Medium soft | Can be gouged | Breaks (one blow) Crumbly edges |
| Medium hard | Can be scratched | Breaks (one blow) Sharp edges |
| Hard | Cannot be scratched | Breaks conchoidally (several blows) Sharp edges |

### ROCK BROKENNESS

| DESCRIPTIVE TERMS | ABBREVIATION | SPACING |
|---|---|---|
| Very broken | (V. Br.) | 0 - 2" |
| Broken | (Br.) | 2" - 1' |
| Blocky | (Bl.) | 1' - 3' |
| Massive | (M.) | 3' - 10' |

## LEGEND

**SOIL SAMPLES - TYPES**

S - 2" O.D. Split Barrel Sample
ST - 3" O.D. Undisturbed Sample

**ROCK SAMPLES - TYPES**

X - NX ( Conventional ) Core (~ 2-1/8" O.D. )
Q - NQ ( Wireline ) Core ~1-7/8" O.D. )
T - Other Core Sizes Specify in Remarks

**WATER LEVELS**

12/18
▽ 12.6' Initial Level w/Date & Depth
12/18

## 4.3 HYDRAULIC CONDUCTIVITY DATA COLLECTION

### 4.3.1 General

This procedure is presented for calculating the hydraulic conductivity of an aquifer from the rate of rise or fall of the water level in a monitoring well after a certain volume of water is removed or added.

### 4.3.2 Data Collection Procedures

1. Obtain the static ground water surface elevation by measuring the distance from the ground water surface to a stable reference point (viz., top of well riser) with an electronic water level indicator. The top of the protective steel casing should not be used as a reference point since th elevation may be altered by physical disturbance (i.e., heaving due to freeze-thaw cycles, disturbance resulting from vehicle or other heavy equipment bumping into protective casings, etc.)
2. Remove or add a known volume of water (slug).
3. Quickly measure the water level with the electronic water level indicator and note the time corresponding to that reading. Simultaneously read and record the water level and time every 15 seconds for the first 2 to 3 minutes. The frequency of subsequent water level and time recording are based upon the rate of well recovery and are generally taken every few minutes. Record all readings in the field notebook.
4. Data is plotted on log-normal graph paper as the logarithm of drawdown versus time.

### 4.3.3 Calculation of Hydraulic Conductivity

A slug-test procedure applicable to fully or partially penetrating wells in unconfined aquifers was developed by Bouwer and Rice (1976).

The formula for computing the hydraulic conductivity from the field data is given by the following equation. Well geometry is shown in Figure 4-1.

$$K = \frac{r_c^2 \ln(R_e/r_w)}{2L_e} \frac{1}{t} \ln \frac{y_o}{y_t} \qquad (3)$$

where $R_e$ = effective radial distance over which the head difference y is dissipated

$r_w$ = radial distance between well center and undisturbed aquifer ($r_c$ plus thickness of gravel envelope or developed zone outside casing)

$L_e$ = height of perforated, screened, uncased, or otherwise open section of well through which ground water enters

$y_o$ = y at time zero

$y_t$ = y at time t, on the straight-line portion of the data plot

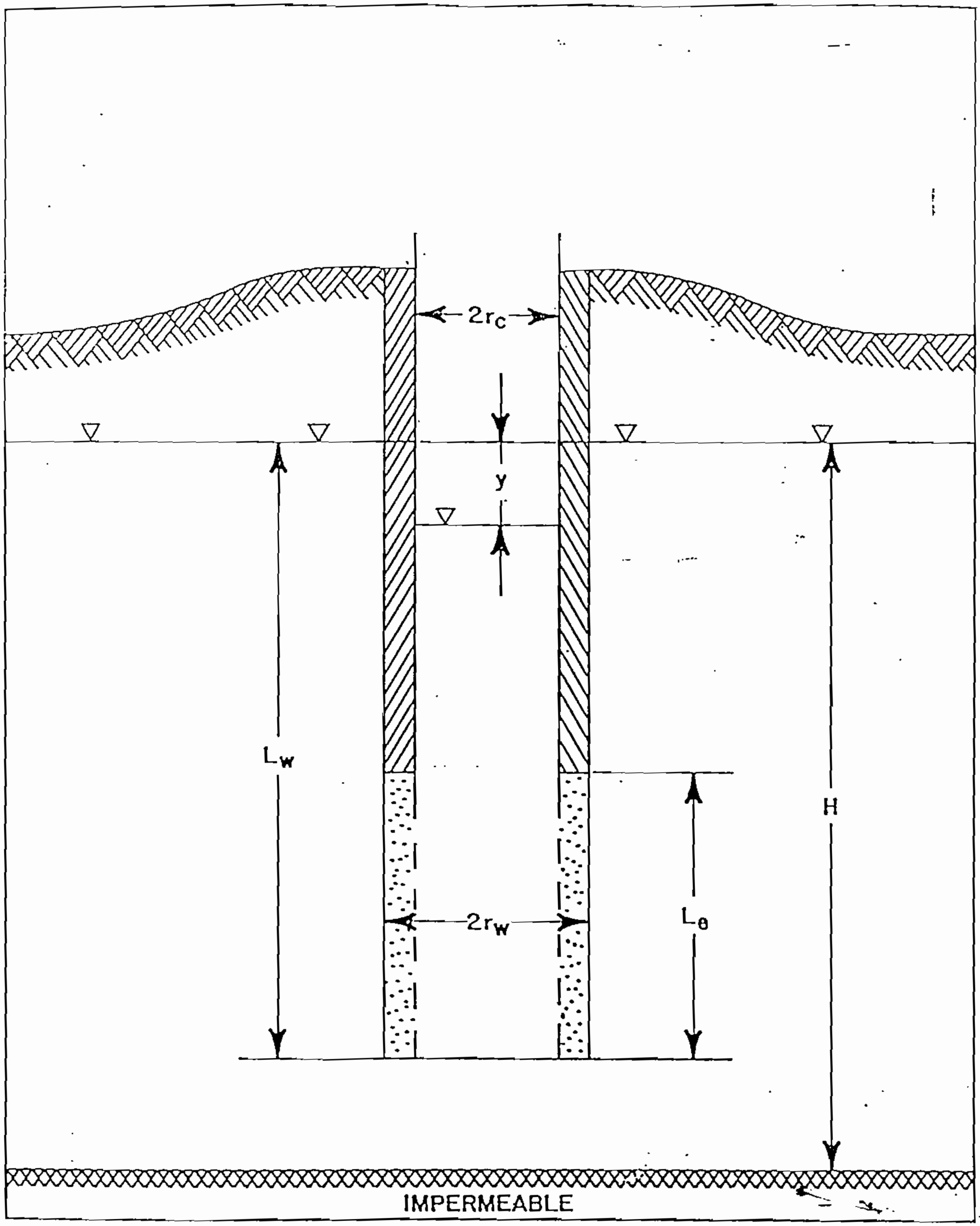
t = time since $y_o$

and:

$$\ln \frac{R_e}{r_w} = \frac{1}{\dfrac{1.1}{\ln(L_w/r_w)} + \dfrac{A + B \ln[(H - L_w)/r_w]}{(L_e/r_w)}} \quad (\text{if } H > L_w) \qquad (4)$$

or:

$$\ln \frac{R_e}{r_w} = \frac{1}{\dfrac{1.1}{\ln(L_w/r_w)} + \dfrac{C}{(L_e/r_w)}} \quad (\text{if } H = L_w)$$

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**GEOMETRY & SYMBOLS OF MONITORING WELL**

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FIGURE 4-1

where A, B and C are dimensionless coefficient shown in Figure 4-2 as a function of $L_e/r_w$.

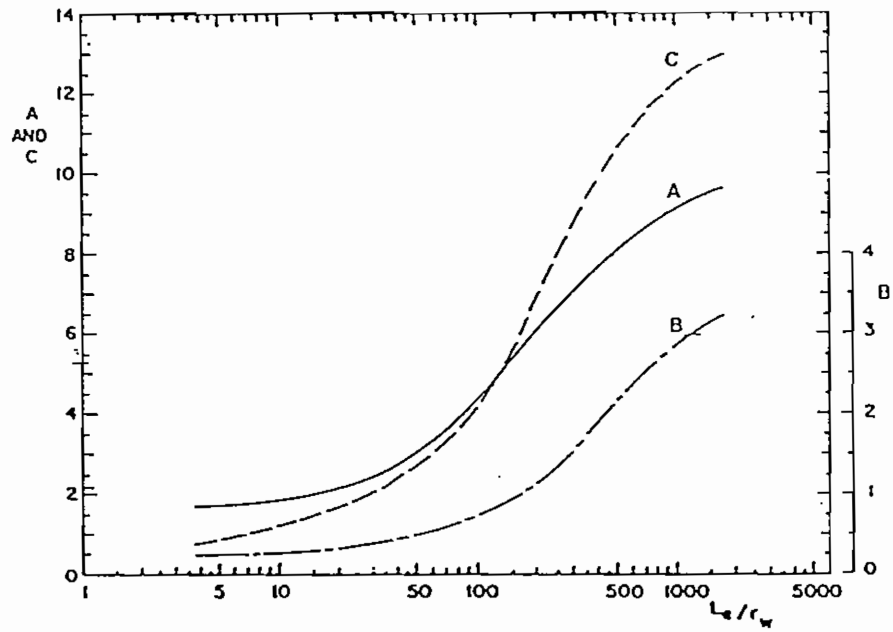


Figure 4-2. Curves relating to coefficients A, B, and C to $L_e/r_w$

# 5.0 SAMPLE INTEGRITY

## 5.1 EQUIPMENT CLEANING

Contamination of samples is precluded by proper cleaning of sampling equipment and containers prior to their use in the field, or by the utilization of dedicated equipment. The actual cleaning process is dictated by the analytical procedures designated for the sample, but usually includes the following steps:

1. detergent washing
2. rinse with tap water
3. rinse with a dilute hydrochloric acid solution (inorganics only)
4. one or more rinses with distilled water
5. rinse with pesticide grade methanol or hexane
6. rinse with organic-free water

Steps 5 and 6 are generally performed only when samples are to be analyzed for organic compounds.

The cleaning is performed prior to going out in the field. When discrete samples are to be collected at multiple locations, additional cleaning between samples is performed on-site to prevent carry-over of contaminants. Also, in the case of surface water sampling, the sample jars are usually rinsed in the field with sample water prior to filling. During sampling, equipment is not allowed to come in contact with the ground, other equipment, or potential sources of contamination.

The use of dedicated equipment is optimal for projects where a long-term monitoring program is in place, or where protection from contamination is not adequate through the use of normal cleaning procedures. Malcolm Pirnie frequently uses dedicated equipment for extended ground water monitoring programs. In this application, well bailers and pumps are used in only one well and are stored in the well between samplings.

Revised Text (2)

## 5.2 CONTAINERS, PRESERVATIVES AND HOLDING TIMES

Sample integrity is preserved through the use of proper sample containers, addition of the correct preservatives to the samples and meeting designated holding times (the time from sample collection to sample analysis). Containers, preservatives and holding times used by Malcolm Pirnie are taken from 40 CFR Part 136 and are shown in Table 5-1. Note that preservation techniques, other than cooling to 4°C, and holding times have not been promulgated for soil samples. Holding time for samples submitted for volatile organic analysis will be seven days from the day the sample is taken. This requirement applies to all sample matrices.

## 5.3 QUALITY CONTROL SAMPLES

### 5.3.1 Trip Blanks

Trip blanks are prepared prior to going on-site. Clean sample bottles are filled with distilled or organic-free water, depending on the analyses to be performed. These blanks are taken to the site, kept with the samples collected there, and submitted to the laboratory for the same analyses that the samples will receive. Results of the analysis will be indicative of quality control on container cleanliness, external contamination and the analytical method. Trip blanks are only utilized for water samples.

### 5.3.2 Field Blanks

Field blanks are prepared in the field. Distilled or organic-free water is placed in or through the sampling equipment in the same manner that a sample would be collected, placed in a clean sample container, and preserved like other samples. Analysis of the field blank will indicate potential contamination from sampling equipment, sample preservation and external site conditions. Field blanks are not used for dedicated well bailers if no preservative is utilized. Field blanks are only used for water samples.

### 5.3.3 Duplicate and Split Samples

Duplicate samples are multiple samples collected at the same time, from the same location, and using the same procedure and containers.

Revised Text

# TABLE 5-1
# REQUIRED CONTAINERS, PRESERVATION TECHNIQUES, AND HOLDING TIMES


| Parameter No./name | Container [1] | Preservation [2,3] | Maximum holding time [4] |
|---|---|---|---|
| Table IA—Bacterial Tests: | | | |
| 1–4. Coliform, fecal and total | P, G | Cool, 4°C, 0.008% $Na_2S_2O_3$ [5] | 6 hours. |
| 5. Fecal streptococci | P, G | do | Do. |
| Table IB—Inorganic Tests: | | | |
| 1. Acidity | P, G | Cool, 4°C | 14 days. |
| 2. Alkalinity | P, G | do | Do. |
| 4. Ammonia | P, G | Cool, 4°C, $H_2SO_4$ to pH<2 | 28 days. |
| 9. Biochemical oxygen demand | P, G | Cool, 4°C | 48 hours. |
| 11. Bromide | P, G | None required | 28 days. |
| 14. Biochemical oxygen demand, carbonaceous. | P, G | Cool, 4°C | 48 hours. |
| 15. Chemical oxygen demand | P, G | Cool, 4°C, $H_2SO_4$ to pH<2 | 28 days. |
| 16. Chloride | P, G | None required | Do. |
| 17. Chlorine, total residual | P, G | do | Analyze immediately. |
| 21. Color | P, G | Cool, 4°C | 48 hours. |
| 23–24. Cyanide, total and amenable to chlorination. | P, G | Cool, 4°C, NaOH to pH>12, 0.6g ascorbic acid [5]. | 14 days.[6] |
| 25. Fluoride | P | None required | 28 days. |
| 27. Hardness | P, G | $HNO_3$ to pH<2, $H_2SO_4$ to pH<2. | 6 months. |
| 28. Hydrogen ion (pH) | P, G | None required | Analyze immediately. |
| 31, 43. Kjeldahl and organic nitrogen | P, G | Cool, 4°C, $H_2SO_4$ to pH<2 | 28 days. |
| Metals:[7] | | | |
| 18. Chromium VI | P, G | Cool, 4°C | 24 hours. |
| 35. Mercury | P, G | $HNO_3$ to pH<2 | 28 days. |
| 3, 5–8, 10, 12, 13, 19, 20, 22, 26, 29, 30, 32–34, 36, 37, 45, 47, 51, 52, 58–60, 62, 63, 70–72, 74, 75. Metals, except chromium VI and mercury. | P, G | do | 6 months. |
| 38. Nitrate | P, G | Cool, 4°C | 48 hours. |
| 39. Nitrate-nitrite | P, G | Cool, 4°C, $H_2SO_4$ to pH<2 | 28 days. |
| 40. Nitrite | P, G | Cool, 4°C | 48 hours. |
| 41. Oil and grease | G | Cool, 4°C, $H_2SO_4$ to pH<2 | 28 days. |
| 42. Organic carbon | P, G | Cool, 4°C, HCl or $H_2SO_4$ to pH<2. | Do. |
| 44. Orthophosphate | P, G | Filter immediately, Cool, 4°C | 48 hours. |
| 46. Oxygen, Dissolved Probe | G Bottle and top. | None required | Analyze immediately. |
| 47. Winkler | do | Fix on site and store in dark | 8 hours. |
| 48. Phenols | G only | Cool, 4°C, $H_2SO_4$ to pH<2 | 28 days. |
| 49. Phosphorus (elemental) | G | Cool, 4°C | 48 hours. |
| 50. Phosphorus, total | P, G | Cool, 4°C, $H_2SO_4$ to pH<2 | 28 days. |
| 53. Residue, total | P, G | Cool, 4°C | 7 days. |
| 54. Residue, Filterable | P, G | do | 7 days. |
| 55. Residue, Nonfilterable (TSS) | P, G | do | 7 days. |
| 56. Residue, Settleable | P, G | do | 48 hours. |
| 57. Residue, volatile | P, G | do | 7 days. |
| 61. Silica | P | do | 28 days. |
| 64. Specific conductance | P, G | do | Do. |
| 65. Sulfate | P, G | do | Do. |
| 66. Sulfide | P, G | Cool, 4°C add zinc acetate plus sodium hydroxide to pH>9. | 7 days. |
| 67. Sulfite | P, G | None required | Analyze immediately. |
| 68. Surfactants | P, G | Cool, 4°C | 48 hours. |
| 69. Temperature | P, G | None required | Analyze. |
| 73. Turbidity | P, G | Cool, 4°C | 48 hours. |
| Table IC—Organic Tests.[8] | | | |
| 13, 18–20, 22, 24–28, 34–37, 39–43, 45–47, 56, 66, 88, 89, 92–95, 97. Purgeable Halocarbons. | G, Teflon-lined septum. | Cool, 4°C, 0.008% $Na_2S_2O_3$.[5] | 7 days. |
| 6, 57, 90. Purgeable aromatic hydrocarbons | do | Cool, 4°C, 0.008% $Na_2S_2O_3$[5], HC1 to pH2[9]. | Do. |
| 3, 4. Acrolein and acrylonitrile | do | Cool, 4°C, 0.008% $Na_2S_2O_3$[5]; Adjust pH to 4–5 [10]. | Do. |
| 23, 30, 44, 49, 53, 67, 70, 71, 83, 85, 96. Phenols [11]. | G, Teflon-lined cap. | Cool, 4°C, 0.008% $Na_2S_2O_3$[5] | 7 days until extraction, 40 days after extraction. |
| 7, 38. Benzidines [11] | do | do | 7 days until extraction.[13] |
| 14, 17, 48, 50–52. Phthalate esters [11] | do | Cool, 4°C | 7 days until extraction; 40 days after extraction. |
| 72–74. Nitrosamines [11,14] | do | Cool, 4°C, store in dark, 0.008% $Na_2S_2O_3$[5]. | Do. |
| 76–82. PCBs [11] acrylonitrile | do | Cool, 4°C | Do. |
| 54, 55, 65, 69. Nitroaromatics and isophorone [11] | do | Cool, 4°C, 0.008% $Na_2S_2O_3$[5] store in dark. | Do. |
| 1, 2, 5, 8–12, 32, 33, 58, 59, 64, 68, 84, 86. Polynuclear aromatic hydrocarbons.[11]. | do | do | Do. |
| 15, 16, 21, 31, 75. Haloethers [11] | do | Cool, 4°C, 0.008% $Na_2S_2O_3$[5] | Do. |
| 29, 35–37, 60–63, 91. Chlorinated hydrocarbons [11]. | do | Cool, 4°C | Do. |
| 87. TCDD [11] | do | Cool, 4°C, 0.008% $Na_2S_2O_3$[5] | Do. |
| Table ID—Pesticides Tests: | | | |
| 1–70. Pesticides [11] | do | Cool, 4°C, pH 5–9 [15] | Do. |
| Table IE—Radiological Tests: | | | |
| 1–5 Alpha, beta and radium | P, G | $HNO_3$ to pH<2 | 6 months. |

[1] Polyethylene (P) or Glass (G).

[2] Sample preservation should be performed immediately upon sample collection. For composite chemical sa aliquot should be preserved at the time of collection. When use of an automated sampler makes it impossible each aliquot, then chemical samples may be preserved by maintaining at 4°C until compositing and sample completed.

[3] When any sample is to be shipped by common carrier or sent through the United States Mails, it must com Department of Transportation Hazardous Materials Regulations (49 CFR Part 172). The person offering such transportation is responsible for ensuring such compliance. For the preservation requirements of Table II, th Hazardous Materials, Materials Transportation Bureau, Department of Transportation has determined that the Materials Regulations do not apply to the following materials: Hydrochloric acid (HCl) in water solutions at conce 0.04% by weight or less (pH about 1.96 or greater); Nitric acid ($HNO_3$) in water solutions at concentrations of 0.15% or less (pH about 1.62 or greater); Sulfuric acid ($H_2SO_4$) in water solutions at concentrations of 0.35% by weight about 1.15 or greater); and Sodium hydroxide (NaOH) in water solutions at concentrations of 0.080% by weight about 12.30 or less).

[4] Samples should be analyzed as soon as possible after collection. The times listed are the maximum times th may be held before analysis and still be considered valid. Samples may be held for longer periods only if the p monitoring laboratory, has data on file to show that the specific types of samples under study are stable for the l and has received a variance from the Regional Administrator under § 136.3(e). Some samples may not be sta maximum time period given in the table. A permittee, or monitoring laboratory, is obligated to hold the sample fo time if knowledge exists to show that this is necessary to maintain sample stability. See § 136.3(e) for details.

[5] Should only be used in the presence of residual chlorine.

[6] Maximum holding time is 24 hours when sulfide is present. Optionally all samples may be tested with lead ac before pH adjustments in order to determine if sulfide is present. If sulfide is present, it can be removed by the cadmium nitrate powder until a negative spot test is obtained. The sample is filtered and then NaOH is added

[7] Samples should be filtered immediately on-site before adding preservative for dissolved metals.

[8] Guidance applies to samples to be analyzed by GC, LC, or GC/MS for specific compounds.

[9] Sample receiving no pH adjustment must be analyzed within seven days of sampling.

[10] The pH adjustment is not required if acrolein will not be measured. Samples for acrolein receiving no pH adjus be analyzed within 3 days of sampling.

[11] When the extractable analytes of concern fall within a single chemical category, the specified preservative an holding times should be observed for optimum safeguard of sample integrity. When the analytes of concern fall wi more chemical categories, the sample may be preserved by cooling to 4°C, reducing residual chlorine with 0.00 thiosulfate, storing in the dark, and adjusting the pH to 6-9; samples preserved in this manner may be held for s before extraction and for forty days after extraction. Exceptions to this optional preservation and holding time pro noted in footnote 5 (re the requirement for thiosulfate reduction of residual chlorine), and footnotes 12, 13 (re the benzidine).

[12] 1,2-diphenylhydrazine is likely to be present, adjust the pH of the sample to 4.0±0.2 to prevent rearrangement to benzi

[13] Extracts may be stored up to 7 days before analysis if storage is conducted under an inert (oxidant-free) atmosphere.

[14] For the analysis of diphenylnitrosamine, add 0.008% $Na_2S_2O_3$ and adjust pH to 7-10 with NaOH within 24 hours of samp

[15] The pH adjustment may be performed upon receipt at the laboratory and may be omitted if the samples are extracted wit of collection. For the analysis of aldrin, add 0.008% $Na_2S_2O_3$.

These samples provide a check on any variability introduced during the sampling process. Split samples are one sample that is divided into two or more aliquots. The aliquots may then be sent to separate laboratories as a check on analytical results or one of the aliquots may be assigned a fictitious number and submitted to the same laboratory as a "blind split". This "blind split" is a check on the analytical variability within the laboratory.

Unless otherwise specified, a field blank and trip blank are used by Malcolm Pirnie for each day of sampling. Duplicate or split samples are collected at a rate of approximately 5% (1 in 20) for each type of sample.

5.3.4 Matrix Spike Samples

Matrix spikes and matrix spike duplicates are collected, when required by the work plan, in the same manner as duplicate samples (see Section 5.3.3). The extra sample volume is used by the analytical laboratory to prepare sample aliquots to which they add known concentrations of sample constituents. Recovery rates of the spike compounds provide quality control data on the sample extraction/digestion procedures and also indicate sample matrix effects.

## 5.4 CHAIN-OF-CUSTODY

An important part of quality control is proper documentation of all aspects of the sampling program. This includes careful labeling of the sample containers, the use of field logs to record pertinent data on-site during sampling events, and the use of chain-of-custody sheets which accompany the sample from collection through analysis. Malcolm Pirnie uses pre-gummed labels with spaces to record client name, sample location, date and time of sampling, sampler's name, filtered or not, preservatives added, and sample ID number. The chain-of-custody sheets used by Malcolm Pirnie includes all the information on the label, and in addition: sample type, sampling method, number and type of containers, name, date and time of delivering and receiving the sample at the laboratory; and the date, method and person performing each sampling. Custody sheets used specifically for well-monitoring include information on the type of well, size of well, well depth, depth to water, number of volumes pumped, total volume and pH, temperature, color and appearance of the sample. Standard documents used by Malcolm Pirnie are included in Appendix C of this report. Care should be taken to avoid the use of inks that run when wetted.

# 6.0 FIELD INSTRUMENT CALIBRATION AND MAINTENANCE

## 6.1 INTRODUCTION

Calibration and maintenance procedures for the field instruments identified below are presented in the following sections.

## 6.2 PORTABLE FIELD pH METER

### 6.2.1 Accuracy

The calibrated accuracy of the pH meter will be 0.1 pH unit, over the temperature range of -2°C to 40°C.

### 6.2.2 Calibration

The pH meter will be calibrated by immersing the sensing probe in a container of certified pH buffer solution traceable to the National Bureau of Standards. The meter reading will be compared to the known value of the buffer solution, which is stirred. The meter will be two-point calibrated in the field at the beginning and end of each group of measurements. Precalibration at the office will be performed for local jobs.

### 6.2.3 Maintenance

1. When not in use or between measurements, the pH probe will be kept immersed in or moist with buffer solution.
2. The meter batteries will be checked at the end of each day and replaced when needed.
3. The pH probe will be replaced any time that the meter response time becomes greater than two minutes or the metering system consistently fails to retain its calibrated accuracy for a minimum of ten sample measurements.
4. If replacement of the pH probe fails to resolve instrument response time and stability problems, the instrument will be sent to the manufacturer for maintenance and repair.

5. A maintenance log will be kept for each pH monitoring instrument. All maintenance performed on the instrument will be recorded on this log with date and name of the organization performing the maintenance.

### 6.2.4 Data Validation

All instrument calibrations will be documented, indicating the meter readings before and after the meter has been adjusted. The pH buffers used to calibrate the meter will also be documented. This is important, not only for data validation, but also to establish maintenance schedules and component replacement.

## 6.3 PORTABLE FIELD CONDUCTIVITY METER

### 6.3.1 Accuracy

The calibrated accuracy of the specific-conductance meter will be within three percent of full-scale over the temperature range of -2°C to 40°C.

### 6.3.2 Calibration

The specific-conductance meter will be calibrated by immersing the sensor in a container of potassium-chloride standard solution and comparing the meter reading with the known value of the standard solution. The potassium-chloride solution will be prepared in accordance with Standard Methods for the Examination of Water and Wastewater, sixteenth edition, 1985, Part 205, or a purchased standard solution will be used.

### 6.3.3 Maintenance

1. The meter batteries will be checked at the end of each day and replaced when needed.
2. The meter response time and stability will be tracked to determine the need for instrument maintenance. When response time becomes greater than two minutes and the meter must be recalibrated more than once per day, the instrument will be sent to the manufacturer for maintenance and repair.

3. A maintenance log will be kept for each specific-conductance meter. All maintenance performed on the instrument will be recorded on this log with date and name of the organization performing the maintenance.

#### 6.3.4 Data Validation

All instrument calibrations will be documented, indicating the meter readings before and after the meter has been adjusted. The standard solution used to calibrate the meter will also be documented.

## 6.4 HNU PHOTOIONIZATION ANALYZER

### 6.4.1 Accuracy

The HNU PI101 is temperature compensated so that a 20°C change in temperature corresponds to a change in reading of less than two percent full-scale at maximum sensitivity. The useful range of the instrument is from 0.2 to 2000 ppm. Response time is less than three seconds to 90 percent of full-scale.

### 6.4.2 Calibration

The meter will be calibrated using a cylinder of pressurized gas certified by a reputable supplier. The calibration gas will be in the same matrix in which the measurements will be taken. The span pot will be adjusted so the instrument will read the exact value of the calibration gas. For a HNU factory-calibrated by benzene, the calibration will be made using bottled "span gas" supplied by HNU.

### 6.4.3 Maintenance

1. If any of the following conditions occur, consult the troubleshooting guide provided in the Instruction Manual:

   a. No meter response in any switch position (including BATT CHK).

b. Meter response in BATT CHK, but reads zero or near zero for all others.
c. Instrument reads correctly in BATT CHK and STBY, but not in measuring mode.
d. Instrument responds in all positions, but signal is lower than expected.
e. Erratic meter movement occurs.
f. Instrument response slow or irreproducible.
g. Low battery indicator.

Should the troubleshooting techniques fail to resolve the problem, send the instrument to the manufacturer for repair and maintenance.

2. The light source window will be cleaned every four weeks during periods of continued use.
3. The meter battery will be checked at the beginning and end of each day. If the needle is not within or above the green battery arc on the scale-plate, the battery will be recharged prior to making any measurements.

#### 6.4.4 Data Validation

All instrument calibrations will be documented, indicating meter readings and the standard gas mixture utilized.

### 6.5 THERMO ELECTRON MODEL 511A PORTABLE GC

#### 6.5.1 Sampling System Reproducibility

The sampling system reproducibility of the Model 511A portable gas chromatograph is less than ± 1 percent with a gas sampling valve.

Revised Text

6.5.2 Calibration

Standards are initially calibrated at Upstate Laboratories, and then on the average, after every five samples in the field. Blanks are also analyzed after every eight samples to minimize cross contamination.

6.5.3 Maintenance

The battery service life is eight hours per charging, however, the unit can be operated from 110v source while the batteries recharge. The self contained, refillable carrier-gas cylinder has a service life of approximately 30 hours. The batteries and carrier gas will be checked routinely during the working day.

Revised Text

# APPENDIX A
# REFERENCES

## REFERENCES


1. USEPA, Characterization of Hazardous Waste Sites - A Methods Manual: Volume II, Available Sampling Methods, Second Edition, EPA-600/4-84-076, December 1984.

2. USEPA, RCRA Ground-Water Monitoring Technical Enforcement Guidance Document, OSWER-9950.1, September 1986.

3. USEPA, Soil Sampling Quality Assurance User's Guide EPA-600/4-84-043, May 1984.

4. USEPA, Procedures Manual For Ground Water Monitoring At Solid Waste Disposal Facilities, SW-611, December 1980.

5. USEPA, Practical Guide For Ground-Water Sampling, EPA/600/2-85/104, September 1985.

6. USEPA, Sediment Sampling Quality Assurance User's Guide, EPA/600/4-85/048, July 1985.

7. USEPA, Test Methods For Evaluating Solid Waste, Physical/Chemical Methods, SW846, third edition, September 1986.

8. 40 CFR 136.3, Table II - Required Containers, Preservation Techniques, and Holding Times.

9. USEPA, Soil Sensing For Detection and Mapping of Volatile Organics, EPA/600/8-87/036, August 1987.

# APPENDIX B

# ASTM METHOD D-1586

Designation: D 1586 – 67 (Reapproved 1974)

# Standard Method for
# PENETRATION TEST AND SPLIT-BARREL SAMPLING OF SOILS[1]

This standard is issued under the fixed designation D 1586; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

*This method has been approved for use by agencies of the Department of Defense and for listing in the DoD Index of Specifications and Standards.*

## 1. Scope

1.1 This method describes a procedure for using a split-barrel sampler to obtain representative samples of soil for identification purposes and other laboratory tests, and to obtain a measure of the resistance of the soil to penetration of the sampler.

## 2. Apparatus

2.1 *Drilling Equipment*—Any drilling equipment shall be acceptable that provides a reasonably clean hold before insertion of the sampler to ensure that the penetration test is performed on undisturbed soil, and that will permit the driving of the sampler to obtain the sample and penetration record in accordance with the procedure described in Section 3. To avoid "whips" under the blows of the hammer, it is recommended that the drill rod have a stiffness equal to or greater than the A-rod. An "A" rod is a hollow drill rod or "steel" having an outside diameter of 1⅝ in. (41.2 mm) and an inside diameter of 1⅛ in. (28.5 mm), through which the rotary motion of drilling is transferred from the drilling motor to the cutting bit. A stiffer drill rod is suggested for holes deeper than 50 ft (15 m). The hole shall be limited in diameter to between 2¼ and 6 in. (57.2 and 152 mm).[2]

2.2 *Split-Barrel Sampler*—The sampler shall be constructed with the dimensions indicated in Fig. 1. The drive shoe shall be of hardened steel and shall be replaced or repaired when it becomes dented or distorted. mm) (minimum diameter) vent ports and shall contain a ball check valve. If sizes other than the 2-in. (50.8-mm) sampler are permitted, the size shall be conspicuously noted on all penetration records.

2.3 *Drive Weight Assembly*—The assembly shall consist of a 140-lb (63.5-kg) weight, a driving head, and a guide permitting a free fall of 30 in. (0.76 m). Special precautions shall be taken to ensure that the energy of the falling weight is not reduced by friction between the drive weight and the guides.

2.4 *Accessory Equipment*—Labels, data sheets, sample jars, paraffin, and other necessary supplies should accompany the sampling equipment.

## 3. Procedure

3.1 Clear out the hole to sampling elevation using equipment that will ensure that the material to be sampled is not disturbed by the operation. In saturated sands and silts withdraw the drill bit slowly to prevent loosening of the soil around the hole. Maintain the water level in the hole at or above ground water level.

3.2 In no case shall a bottom-discharge bit be permitted. (Side-discharge bits are permissible.) The process of jetting through an open-tube sampler and then sampling when the

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[1] This method is under the jurisdiction of ASTM Committee D-18 on Soil and Rock.

Current edition approved Oct. 20, 1967. Originally issued 1958. Replaces D 1586 – 64 T.

[2] Hvorslev, M. J., *Surface Exploration and Sampling of Soils for Civil Engineering Purposes*, The Engineering

desired depth is reached shall not be permitted. Where casing is used, it may not be driven below sampling elevation. Record any loss of circulation or excess pressure in drilling fluid during advancing of holes.

3.3 With the sampler resting on the bottom of the hole, drive the sampler with blows from the 140-lb (63.5-kg) hammer falling 30 in. (0.76 m) until either 18 in. (0.45 m) have been penetrated or 100 blows have been applied.

3.4 Repeat this operation at intervals not longer than 5 ft (1.5 m) in homogeneous strata and at every change of strata.

3.5 Record the number of blows required to effect each 6 in. (0.15 m) of penetration or fractions thereof. The first 6 in. (0.15 m) is considered to be a seating drive. The number of blows required for the second and third 6 in. (0.15 m) of penetration added is termed the penetration resistance, $N$. If the sampler is driven less than 18 in. (0.45 m), the penetration resistance is that for the last 1 ft (0.30 m) of penetration (if less than 1 ft (0.30 m) is penetrated, the logs shall state the number of blows and the fraction of 1 ft (0.30 m) penetrated).

3.6 Bring the sampler to the surface and open. Describe carefully typical samples of soils recovered as to composition, structure, consistency, color, and condition; then put into jars without ramming. Seal them with wax or hermetically seal to prevent evaporation of the soil moisture. Affix labels to the jar or make notations on the covers (or both) bearing job designation, boring number, sample number, depth penetration record, and length of recovery. Protect samples against extreme temperature changes.

## 4. Report

4.1 Data obtained in borings shall be recorded in the field and shall include the following:

4.1.1 Name and location of job,

4.1.2 Date of boring—start, finish,

4.1.3 Boring number and coordinate, if available,

4.1.4 Surface elevation, if available,

4.1.5 Sample number and depth,

4.1.6 Method of advancing sampler, penetration and recovery lengths,

4.1.7 Type and size of sampler,

4.1.8 Description of soil,

4.1.9 Thickness of layer,

4.1.10 Depth to water surface; to loss of water; to artesian head; time at which reading was made,

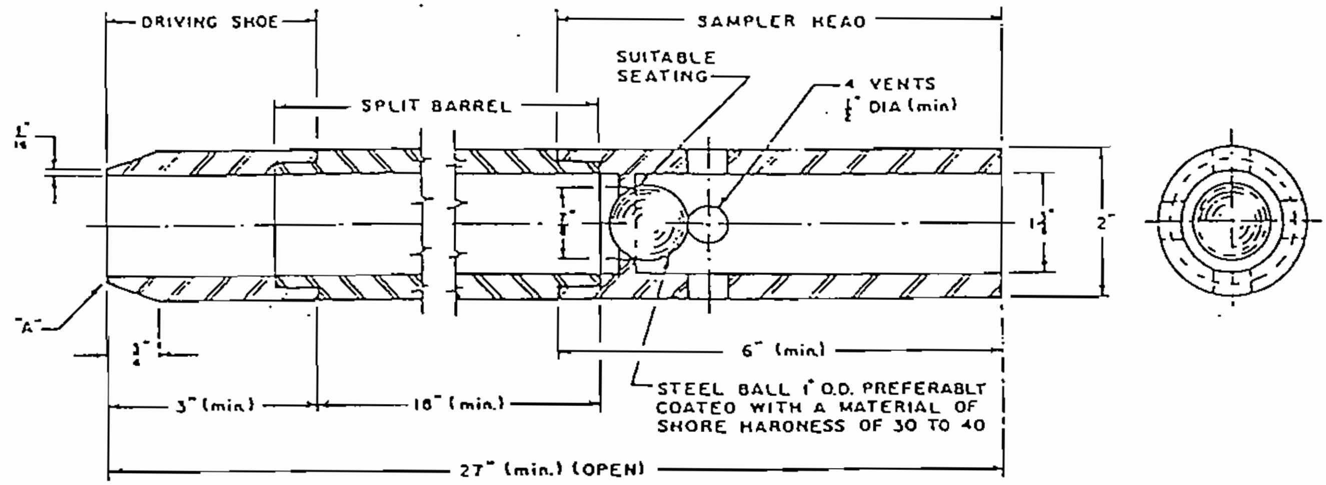
4.1.11 Type and make of machine,

4.1.12 Size of casing, depth of cased hole,

4.1.13 Number of blows per 6 in. (0.15 m),

4.1.14 Names of crewmen, and

4.1.15 Weather; remarks.




NOTE 1—Split barrel may be 1½ in. inside diameter provided it contains a liner of 16-gage wall thickness.
NOTE 2—Core retainers in the driving shoe to prevent loss of sample are permitted.
NOTE 3—The corners at *A* may be slightly rounded.

Metric Equivalents

| in. | mm | in. | mm |
|---|---|---|---|
| $^1/_{16}$ (16 gage) | 1.5 | 2 | 50.8 |
| ½ | 12.7 | 3 | 76.2 |
| ¾ | 19.0 | 6 | 152.4 |
| ⅞ | 22.2 | 18 | 457.2 |
| 1⅜ | 34.9 | 27 | 685.8 |
| 1½ | 38.1 | | |

FIG. 1 Standard Split Barrel Sampler Assembly.

# APPENDIX C
# CHAIN OF CUSTODY FORMS

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# CHAIN of CUSTODY

## SUMMARY FORM

890 SEVENTH NORTH STREET
LIVERPOOL, NEW YORK 13088
(315)457-4105

| CLIENT/LOCATION | | | | | | PROJECT NO. | ANALYSIS | | | | | | | | | | PRESERVATION |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SAMPLE I.D. | DATE SAMPLED | TIME SAMPLED | CONTAINERS | | DATE ANALYSIS NEEDED | | | | | | | | | | | | |
| | | | NO. | SIZE/TYPE | | | | | | | | | | | | | |
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| | | | | | | | | | | | | | | | | | |

| RELINQUISHED BY: | DATE/TIME | RECEIVED BY: | DATE/TIME | NOTES: |
|---|---|---|---|---|
| RELINQUISHED BY: | DATE/TIME | RECEIVED FOR LAB. BY: | DATE/TIME | |

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# MONITORING WELL SAMPLE CHARACTERIZATION & FIELD DATA SHEET

JOB NO. ______

## SOURCE

CLIENT ______ WELL NO. ______

LOCATION ______ WELL TYPE/SIZE ______

## EVACUATION

DATE ______

WELL DEPTH ______

DEPTH TO WATER ______

WELL VOLUME ______

METHOD ______

NO. OF VOLUMES ______

TOTAL VOLUME ______

| ITEM | START | FINISH |
|---|---|---|
| TIME | | |
| pH | | |
| TEMP. | | |
| DEPTH | | |
| COLOR | | |
| APPEAR. | | |

GAL./FT. 1-1/4": 0.077 1-1/2": 0.10 2" : 0.16 2-1/2" 0.24 3" 0.37 3-1/2" 0.50 4" 0.64 6" 1.46

## SAMPLING

DATE ______ pH ______

TIME ______ TEMP. ______

METHOD ______ COLOR ______

CONTAINER ______ APPEAR. ______

SAMPLED BY ______ Eh ______

## PRESERVATION

DATE ______

FILTERED: YES ______ NO ______ TIME ______ BY ______

PRESERVED: YES ______ NO ______ TIME ______ BY ______

PRESERVATIVE: ☐ $H_2SO_4$ ☐ $HNO_3$ ☐ NaOH ☐ $H_3PO_4+CuSO_4$ ☐ $Zn(C_2H_3O_2)_2$

☐ COOLED TO 4°C ☐ OTHER ______

## FIELD NOTES

______

______

______

______

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# SAMPLE CHARACTERIZATION & CHAIN OF CUSTODY SHEET

LAB SAMPLE LOG No. ________

## SOURCE

CLIENT ________ JOB No. ________

SAMPLE I.D. ________ LOCATION DESCRIPTION ________

## SAMPLING

SAMPLE TYPE ________ SAMPLING METHOD ________

CONTAINERS: No. ____ TYPE ________

COMPOSITE: DATE SET ________ TIME ________ BY ________

DATE PICKED-UP ________ TIME ________ BY ________

GRAB: DATE ________ TIME ________ BY ________

NOTES: ________

## PRESERVATION

DATE ________

FILTERED: YES ____ NO ____ TIME ________ BY ________

PRESERVED: YES ____ NO ____ TIME ________ BY ________

PRESERVATIVE: ☐ $H_2SO_4$ ☐ $HNO_3$ ☐ NaOH ☐ $H_3PO_4 + CuSO_4$ ☐ $Zn(C_2H_3O_2)_2$

☐ COOLED TO 4°C ☐ OTHER ________

NOTES: ________

## CUSTODY

DELIVERED BY ________

DATE ________ TIME ________

RECEIVED BY ________

DATE ________ TIME ________

## CUSTODY — LABORATORY SUBCONTRACTOR

NAME OF LAB ________

ADDRESS ________

DELIVERED BY ________

DATE ________ TIME ________

RECEIVED BY ________

DATE ________ TIME ________

## FIELD NOTES

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MALCOLM PIRNIE

# OBSERVATION WELL READINGS

PROJECT__________ LOCATION__________

METHOD OF READING__________

REFERENCE POINT__________

DATE__________ TIME (START)__________ TIME (END)__________ INITIALS__________

WEATHER CONDITIONS__________

| WELL NO. | DEPTH TO WATER | REF. ELEV. | ELEV. |
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| WELL NO. | DEPTH TO WATER | REF. ELEV. | ELEV. |
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MALCOLM PIRNIE

# HNU Air Monitoring Data

Site Sketch

Site Name ____________

Client Name ____________

Project No. ____________

Sampler's Name ____________

Weather & Notes ____________

| Date | Time | Wind Direction | Wind Speed | Location | Span Setting | Concen-tration |
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| MALCOLM PIRNIE<br>SYRACUSE | SAMPLE<br>ID |

CLIENT ____________________

LOCATION ____________________

DATE ____________ TIME ____________

SAMPLER ____________________

FILTERED ☐ PRESERVED ____________

SAMPLE LABEL

QAPP

# APPENDIX D

# RESUME OF QA OFFICER/DATA VALIDATOR AND OTHER KEY PROJECT TEAM PERSONNEL

MALCOLM PIRNIE

THOMAS A. BARBA
Senior Project Scientist

EDUCATION

BS (Chemistry) 1973; Syracuse University
BS (Biochemistry) 1973; SUNY College of Environmental Science and Forestry
Health and Safety Training for Hazardous Materials Spills and Emergency Response Operations
Risk Analysis in Environmental Health - Harvard University School of Public Health
Groundwater Pollution and Hydrology - Princeton University

SOCIETIES

American Chemical Society

SUMMARY OF EXPERIENCE

Mr. Barba has sixteen years of experience in solid and hazardous waste management, toxic substances management, and federal regulation compliance. He has been responsible for site investigations, surveys and remediations, health and safety programs, sampling and analysis programs, permit applications, training programs and contingency, waste analysis and closure plans.

1986 to Date Malcolm Pirnie, Inc.

As Senior Project Scientist: responsible for supervision of environmental projects in the hazardous waste and contaminant migration areas and for QA/QC and Health and Safety considerations on all projects in the Syracuse office. Responsible for projects involving environmental permitting, environmental auditing, and site investigations.

- Developed work plans for several Phase II and RI/FS projects involving hazardous waste sites. Supervised implementation and conduct of various aspects of these projects.

- Conducted investigation at an industrial plant to monitor extent of contamination from a solvent spill.

- Directed investigations at four coal ash disposal sites for a major New York State utility. Conducted risk assessments for these facilities.

- Conducted site investigations at scrap processing facilities to monitor extent of PCB contamination.

- Conducted data validation and review for several major investigations at inactive hazardous waste sites.

- Conducted environmental audits at several industrial facilities.

- Developed SPCC plans for a major industrial facility with numerous oil storage tanks.

1982 - 1986 Calocerinos & Spina, Consulting Engineers

As Senior Project Scientist and Project Scientist: Responsible for environmental projects involving solid and hazardous wastes, water and wastewater, and related activities for a variety of industrial and municipal clients.

- Conducted investigations at active and inactive disposal sites to monitor extent of organic and heavy metal contamination for numerous clients including Niagara Mohawk, Crucible Steel, Columbia Mills and Tonawanda Coke.

- Conducted risk assessments and developed conceptual remedial action alternatives for inactive hazardous waste site at Harbor Point in Utica, NY.

- Developed solid waste and hazardous waste permit applications with accompanying technical support and report for industrial landfill and storage facilities at Crucible Steel, Syracuse, NY.

- Directed cleanups at a PCB spill site in Syracuse, NY and a 1600 drum inactive storage facility in Utica, NY.

- Prepared air, wastewater discharge and solid waste permits, and closure plans for several industrial facilities including Ashland Chemical Co., Roth Bros. Smelting Corp., and Bernhards Bay Veneer Co.

- Developed industrial wastewater pretreatment programs for two major New York State municipalities (Town of Tonawanda, NY and City of Binghamton, NY).

- Directed field operations and health and safety aspects on sampling and analysis programs for all major environmental investigations at inactive and active hazardous waste sites conducted by C&S.

- Conducted environmental audits at industrial facilities handling wastes and wastewaters for Anaren Microwave, Syracuse, NY and Copperweld Flexowire, Oswego, NY.

1973-1982 Allied Chemical

As Supervisor and Environmental Chemist

- Responsible for all solid waste and toxic substance activities for three large chemical plants and two research and development laboratories in Upstate New York State.
- Responsible for administration of product safety and quality control programs including raw material standards and hazardous materials handling procedures for Solvay, NY chemical plant.
- Served as technical liaison between chemical plant and divisional sales, marketing and distribution staffs.
- Performed routine process and quality control functions including Food and Drug Administration and Department of Transportation compliance.

MALCOLM PIRNIE

RICHARD W. KLIPPEL
Project Manager

EDUCATION

BSCE (Sanitary Engineering) 1963; University of Kansas

REGISTRATION

Professional Engineer

SOCIETIES

Diplomate, American Academy of Environmental Engineers
Water Pollution Control Federation
National and NYS Societies of Professional Engineers
New York Water Pollution Control Association

SUMMARY OF EXPERIENCE

Mr. Klippel has over 23 years' of experience in industrial waste disposal and treatment including extensive work with hazardous wastes. He supervised Superfund RI/FS investigations, industrial wastewater treatment projects, wastewater treatment/reuse studies, municipal treatment plant designs and laboratory operations.

DETAILED EXPERIENCE

1986 to Date — Malcolm Pirnie, Inc.

As Manager of the Syracuse office, responsible for marketing, production supervision and client relations for the Firm's activities in Central and Northern New York State.

Served as Project Director for a wide variety of projects including:

- A hydrogeologic study and groundwater remediation project for Miller Brewing Company, Container Division in Fulton NY.
- A Phase II site investigation at an abandoned factory in Minetto NY.
- Hydrogeologic studies, risk assessment and conceptual remedial design for four ash landfills for New York State Electric & Gas Corporation.
- Conceptual study for upgrading a coal pile runoff treatment facility at NYSEG's Milliken Station.
- Conceptual study for combined treatment of contaminated groundwater and coal pile runoff for New York State Electric & Gas Corporation.
- An updated SPCC plan for IBM Corporation, Owego NY.

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DETAILED EXPERIENCE (Continued)

1986 to Date — Malcolm Pirnie, Inc.

- A conceptual study for evaluating plating waste treatment facilities at Xerox Corporation, Webster NY.
- An environmental audit of 11 rubber products manufacturing facilities being transferred to new owners.
- An evaluation of aeration efficiencies and costs at Finch Pruyn Paper Mill, Glens Falls NY.
- A Hydrogeologic Study and Engineering Report to accompany a Part 360 landfill application for Newton Falls Paper Mill.

1977-1986 — Calocerinos & Spina, Consulting Engineers

As Industrial Waste Manager:

- Responsible for the marketing and production management of the Firm's industrial wastewater treatment and solid/hazardous waste management and disposal projects.
- Supervised the development and documentation of comprehensive industrial waste pretreatment programs for Monroe County, New York, Onondaga County, New York Town of Tonawanda NY and the City of Cortland NY.
- Conducted wastewater treatment plant optimization studies and supervised treatment plant upgrading projects for Crucible Specialty Metals, Syracuse NY and Trent Tube Division, East Troy WI.
- Supervised preparation of NYS Part 360 landfill permits and RCRA Part B permit applications for numerous industrial facilities in Central and Northern NY, including Crouse Hinds Co., Oberdorfer Foundries, Newton Falls Paper Mill and Crucible Steel.
- Supervised citizen participation activities for BFI on project to locate new landfill in Columbia County NY.
- Directed NYS Superfund Phase II Site Investigations for Niagara Mohawk Power Company, Utica NY and Saratoga Springs NY, Tonawanda Coke, Tonawanda NY, Columbia Mills Minetto NY and an RI/FS for Niagara Mohawk's Harbor Point site in Utica NY.

(continued)

DETAILED EXPERIENCE (Continued)

1969-1976 O'Brien & Gere Engineers

As Managing Engineer:

- Supervised the Research Division staff who were involved with industrial water and wastewater management and wastewater treatment and reuse studies.
- Performed a plant-wide water and wastewater management study for the General Electric Company, Lynn MA. and Niskaywna NY, IBM Corporation, Endicott NY and Research Triangle NC and Xerox University Microfilms, Ann Arbor MI.
- Coordinated pilot plant work and design of wastewater treatment facilities for Newton Falls Paper Mill, Newton Falls NY and IBM Corporation, Endicott NY.
- Directed a pilot plant study of nitrification for Eastman Kodak Co., Rochester NY.
- Supervised development of Comprehensive Solid Waste Management Study of Franklin, Lewis and St. Lawrence Counties NY.
- Responsible for an extensive facilities planning project for the Madison Metropolitan Sewerage District, Madison WI.
- Established and supervised a branch office and laboratory operation in Madison, WI with a staff of six. Coordinated the work of 10-12 company staff plus the work of some 23 subcontractors including University grantees, plus biologists, geologists, chemists, water quality modelers and outside laboratories.
- Performed pilot plant studies and provided technical coordination of preliminary and final design of the 80 mgd Metropolitan Syracuse Wastewater Treatment Plant. Supervised a staff of 8-10 engineers and designers. Coordinated entire effort including mechanical, structural, architectural and trade portions as well as subcontractor efforts.

1963-1968 Phillips Petroleum Company

As Corporate Sanitary Engineer: Responsible for the process design, design coordination, start-up and regulatory approval of water and wastewater treatment systems serving a wide variety of facilities including refineries, petro-chemical plants, paper mills, offshore platforms, truck and marine terminals, truckstops and service stations.

(over)

PUBLICATIONS AND PRESENTATIONS

R.W. Klippel, A.F. Diefendorf, T.A. Barba and F.L. Sciortino, "Coal Tar Contamination Investigations, Utica, NY", Presented at 79th Annual Meeting of Air Pollution Control Association, Minneapolis, Minnesota, June, 1986.

R.W. Klippel, J.A. Hagarman and R.H. Wills, Jr., "Landfilling Air Pollution Dusts from Specialty Steel Production on a Solvay Process Wastebed", Presented at the 15th Mid-Atlantic Industrial Waste Conference, June, 1982.

R.W. Klippel, "The Pretreatment Problem - Fact or Fiction", Presented at the 55th Annual Meeting of the Water Pollution Control Federation, St. Louis, Missouri, October, 1982.

R.W. Klippel and Robert H. Wills, Jr., "Optimization of Wastewater Treatment and Reuse at a Specialty Steel Mill", Presented at 52nd Annual Meeting of the Water Pollution Control Federation, Houston, Texas, October, 1979.

R.W. Klippel, "Opportunities for Savings in Financing Industrial Wastewater Treatment Facilities in New York State", Presented at the Winter Meeting of the New York Water Pollution Control Association, New York City, January, 1977.

S.R. Garver, R.W. Klippel, "Multiple Reuse of Photo Processing Wastewater Using Reverse Osmosis, Brine Reclamation and Cooling Tower Application", Presented at the Seventh Mid-Atlantic Industrial Waste Conference, Drexel University, November, 1974.

R.W. Klippel, A.J. Oliver, "Pilot Plant Experiences with Rotating Biological Discs at the Newton Falls Paper Mill", Presented at NCASI Northeast Regional Meeting, Boston, Massachusetts, November 1, 1973.

R.W. Klippel, A.F. Hassett, "Food Processing Wastewater - Municipal Discharge or Separate Treatment", Presented at Fifth Cornell University Agricultural Waste Management Conference, Syracuse, New York, March, 1973.

R.W. Klippel, "The New Federal Water Pollution Control Act: Its Effect on Industrial Wastewater Treatment Costs", Presented at the 28th Purdue University Industrial Waste Conference, Lafayette, Indiana, May, 1973.

M.D. LaGrega, R.W. Klippel and N.L. Nemerow, "An Industrial Waste Case History, The Animal Glue Industry", Presented at Fifth Mid-Atlantic Industrial Waste Conference, Drexel University, November, 1971.

R.W. Klippel, "Pollution Control Built into Guayama Petrochemical Complex", Water and Sewage Works, March, 1969.

(continued)

PUBLICATIONS AND PRESENTATIONS (Continued)

R.W. Klippel, "Pollution Control Planning for the Guayama Petrochemical Complex", Presented at reconvened session of Annual Conference, Water Pollution Control Federation, San Juan, Puerto Rico, October, 1967.

J.C. Word and R.W. Klippel, "Multiplant Wastes Taken in Stride by Automated System", Chemical Processing, October, 1965.

J.C. Word, M.V. Wright and R.W. Klippel, "Treating Complex Petroleum Wastes at Borger, Texas", Presented at the Annual Conference Water Pollution Control Federation, Atlantic City, N.J., October, 1964.

MALCOLM PIRNIE

PAUL H. WERTHMAN
Vice President

EDUCATION

BS (Environmental Engineering) 1975; Rensselaer Polytechnic Institute
ME (Environmental Engineering) 1977; Rensselaer Polytechnic Institute
Groundwater Well Hydraulics, Short Course, University of Wisconsin, 1977
Hazardous Waste Safety Training Course, Corporate Short Course, 1981
EPA Hazardous Waste Research Symposia, 1981, 1982
Hazardous Waste Compliance Management Course, 1985

REGISTRATION

Professional Engineer

SOCIETIES

Water Pollution Control Federation
American Water Works Association
American Institute of Chemical Engineers

RECOGNITION

Author: Articles and technical presentations on industrial wastewater treatment and solid/hazardous waste management.

SUMMARY OF EXPERIENCE

Mr. Werthman has over 10 years of responsible experience in hazardous and solid waste management, industrial wastewater treatment process evaluation and facility design, and construction administration.

DETAILED EXPERIENCE

1979 to date Malcolm Pirnie, Inc.

As Project Manager:

- Directed 23-man team in field investigation of sewers and creeks in Love Canal area of Niagara Falls, NY. Over 1,000 liquid, sediment and soil core samples were collected and analyzed for a variety of organic and inorganic contaminants including TCDD. Prepared health and safety plan, performed remedial investigation, feasibility studies, and risk assessment for approximately 12 miles of contaminated sewers and creeks. Conceptual designs were prepared for a 5,000 cubic yard encapsulation facility with clay and synthetic liner, leachate collection, leak detection and liquid waste treatment systems.

- Granular activated carbon pilot-plant evaluation to simulate performance of the City of Niagara Falls 48 MGD wastewater treatment plant. Breakthrough curves were developed for more than 65 organic and inorganic parameters regulated by the SPDES permit. Alternative odor-control methods were also evaluated.

(over)

DETAILED EXPERIENCE (continued)

1979 to date — Malcolm Pirnie, Inc. (continued)

- Directed a detailed evaluation of alternatives for removal and replacement of underground chemical storage tanks for two major industries in Western New York.

- Developed remedial site plan and assisted in negotiation of a Consent Order for the clean-up of PCB-contaminated soils at non-ferrous secondary metals yard previously used for electrical transformer reclamation. Remedial action completed included excavation and secure burial of contaminated soils, leachate/groundwater collection and treatment, spill containment and surface runoff control. Prepared construction documents and supervised construction of recommended facilities. Currently working in conjunction with EPA MERL on field demonstration of in-situ PCB destruction processes.

- Provided technical assistance in the negotiation of Consent Order for the investigation and clean-up of PCB-contaminated soils at three ferrous and non-ferrous metals reclamation yards previously used for the dismantling of electrical transformers.

- Evaluated immediate remedial measures and prepared a feasibility study of remedial alternatives volatile organics-contaminated well-field in the Town of Vestal, New York (National Superfund site) for the NYSDEC.

- Preparation of RCRA Part B applications for two chemical manufacturing facilities, one Dept. of Defense facility, one steel manufacturer and one tannery, encompassing surface impoundment, tank storage, waste pile, drummed storage and a burning pit for confidential clients. This work included conducting complete RCRA groundwater evaluations for three industrial sites: one with surface impoundments, and the other two with land disposal facilities including design and siting of nested monitoring wells, and collection and interpretation of groundwater monitoring results. Prepared contract documents for construction of an 800-drum covered RCRA storage facility.

- Conducted an evaluation of stack test on boiler used for burning hazardous waste for confidential NY client.

- Siting, permitting and preliminary design of a special purpose landfill for disposal of vacuum-filtered sludge from City of Niagara Falls 60 MGD combined industrial/municipal wastewater treatment plant. The landfill was designed completely above-grade with an integrated leachate/surface water collection system with clay and synthetic bottom liner.

- Conducted hydrogeologic or remedial investigations of six inactive hazardous waste sites, eight sanitary landfills and one coal storage area for confidential NY clients.

(continued)

1979 to date — Malcolm Pirnie, Inc. (continued)

DETAILED EXPERIENCE (continued)

- Design and construction administration of an earthen lagoon for the treatment and partial reuse of water treatment plant wastewaters for the Niagara County Water District.

- Supervised the study, design and construction administration/inspection and SPDES permit assistance for wastewater treatment system upgrade at a pharmaceutical manufacturer. System improvements included: storm and sanitary sewer segregation; construction of a second stage earthen lagoon; installation of blowers and aeration system; tertiary multi-media pressure filters; chlorine contact; and building addition.

- Design and permitting of a sanitary landfill used to dispose of pressure-filtered tannery wastewater treatment plant sludge for a confidential NY client. The landfill was designed for wide trench operation with individual leachate collection/storage.

- Preparation of closure plans for three hazardous waste landfills, four hazardous waste surface impoundments, numerous above-ground and below-ground storage tanks, and a drum container storage area under RCRA (NYS Part 373).

- Preparation of five NYSDEC-approved sanitary landfill closures under NYCRR Part 360.

- Performed contaminated stormwater drainage evaluation at large integrated commercial waste disposal site. Samples were collected from the surface water drainage system to identify contaminant sources. Alternative ground and surface water collection/drainage modifications and treatment alternatives were evaluated to attain compliance with SPDES discharge permit.

- Preparation of contract documents, EIS and permit assistance and hydrogeologic investigations of "grass roots" double-level landfill for flyash disposal for a utility company.

1979 — Frontier Technical Associates

As Project Engineer:

- Hydrogeologic assessment of abandoned industrial solid waste disposal site for confidential NY client.

(continued)

DETAILED EXPERIENCE (Continued)

1976-1979 Calspan Corporation

As Project Engineer: Designed, supervised construction and operation of a mobile pilot-scale wastewater treatment plant to evaluate the treatability of a variety of wastewaters from the ore mining and milling industry, including acid mine drainage and wastewater from uranium, lead, zinc and copper mills.

As Engineer: Developed pretreatment standards and effluent limitation guidelines for inorganic chemical manufacturing and ore mining and milling industries; designed groundwater monitoring systems; and conducted hydrogeologic investigations at abandoned industrial and hazardous solid waste disposal sites. Established and supervised soils laboratory for physical soils tests (i.e. permeability, particle size, Atterberg limits, etc.)

MALCOLM PIRNIE

RICHARD P. BROWNELL
Vice President

EDUCATION

BS (Civil Engineering) 1966; Rensselaer Polytechnic Institute
MS (Civil Engineering) 1967; Stanford University
MBA 1976; New York University

REGISTRATION

Professional Engineer
Diplomate, American Academy of Environmental Engineers

SOCIETIES

American Society of Civil Engineers
Water Pollution Control Federation

SUMMARY OF EXPERIENCE

As Vice President in charge of Malcolm Pirnie's industrial waste group, Mr. Brownell's involvement bridges problem identification and problem solving. He has directed projects on site evaluation, groundwater pollution, remedial measures for hazardous waste problems, leachate, wastewater process design, and detailed design for hazardous and industrial wastewaters and landfill closure. All significant hazardous waste work performed by the firm is reviewed by Mr. Brownell.

DETAILED EXPERIENCE

1969 to Date — Malcolm Pirnie, Inc.

As Vice President:

- Developed remedial measures for Superfund and hazardous waste sites from New England (gas emissions from waste piles, groundwater contamination) to the southern U.S. (extensive pesticide contamination of river sediments) to the Far West (VOC removal). Responsible for the design of stripping towers and granular activated carbon systems for VOC removal; also directed contaminated soils removal, landfill closures and leachate treatment system improvements at various sites. Project Officer on environmental evaluations for portions of the Upper Hudson River PCB project and bench scale and pilot treatability studies on PCB wastes for the New York State Department of Environmental Conservation.

- Directed hazardous waste management activities for Carpenter Technology Corp., Koppers, Texaco, Estee Lauder Inc., Scott Paper Company and The Upjohn Company. Directed multiplant, regional industrial/hazardous waste disposal evaluations for two major industrial corporation.

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DETAILED EXPERIENCE (Continued)

1969 to Date — Malcolm Pirnie, Inc. (continued)

- Directed studies of new processes for treating various types of industrial wastes for numerous companies such as Olin Chemical Group, The Upjohn Company, Pfizer, Inc., Textron, Inc., Colgate-Palmolive, Scott Paper, and Gulf + Western. Evaluated ethylene glycol/urea collection and treatment systems for a major air freight carrier.

- Responsible for the design of various physical-chemical and biological treatment systems, including a 5-mgd granular activated carbon plant in the Midwest to remove TCE from groundwater, activated sludge treatment of 0.25 mgd of pharmaceutical wastewaters for Warner Lambert Co. in New Jersey and treatment of 0.05 mgd of plating wastewater for North and Judd in Connecticut.

- Directed a property transfer audit, performed two multiplant environmental audits, both in two countries, prior to property transfer; focused on PBB contamination at an industrial site for Ameribrom, Inc.; directed many groundwater and/or site investigations for industrial clients where remedial measures considered included: relining lagoons, groundwater, soil and sludge recovery, air stripping, activated carbon treatment, landfill closure, slurry walls, surface water diversions.

As Project Manager: Managed a testing and feasibility study for disposal of alum sludges from Scott Paper Company and treatability, feasibility and engineering design reports for approximately 20 corporations in the chemical processing, private utility, computer, and metal finishing industries.

As Project Engineer: Responsible for major pilot/prototype studies at Akron and Cleveland OH, and studies of high purity oxygen activated sludge for several corporations including American Cyanamid Company (Lederle Laboratories Division).

1967-1969 — U.S. Army Corps of Engineers
California and Republic of Korea

As Lieutenant: Deputy Post Engineer for 1,500-man organization; responsible for all facility planning; small project design and planning.

1966 — J. Kenneth Fraser and Associates

As Engineer: Comprehensive report for wastewater treatment facilities.

PUBLICATIONS AND PRESENTATIONS

Brownell, R.P., 1986. "A Consultant's Viewpoint of Underground Storage Tanks," presented at New Jersey Chapter, WPCA Seminar, January 9.

(continued)

PUBLICATIONS AND PRESENTATIONS (Continued)

Brownell, R.P., 1984. "A Report Card on the Waste of the 1970's - PCB's in the Environment," presented at the 14th American Chemical Society New England Regional Meeting, Fairfield CT, June.

Brownell, R.P., Stubbins, H.D., and Kuniholm, P.F., 1982. "Comprehensive Approach to Landfill Leachate Treatment," New York Water Pollution Control Association, New York NY, January.

Brownell, R.P., 1980. "Real World Solutions to Hazardous Waste Problems," Columbus Industrial Association, Plant Engineers Council, Columbus OH, December.

Brownell, R.P. and Brunner, C.R., 1980. "Hazardous Waste Management," Seminar with D'Appolonia Consultants, Dallas TX, January.

MALCOLM PIRNIE

RICHARD J. CALIFANO
Principal Toxicologist

EDUCATION

BS (Biology) 1973; Manhattan College
MS (Biology) 1979; New York University
PhD (Biology/Environmental Health Science) 1981; New York University

AWARDS

National Institute of Environmental Health Science Fellowship, 1975-1978
Sigma Xi R.E.S.A. Grant-in-Aid, 1977

SOCIETIES

Society of Environmental Toxicology and Chemistry
Society for Risk Analysis

SUMMARY OF EXPERIENCE

Dr. Califano specializes in environmental health science, where his work has included health risk assessments for remedial investigation/feasibility studies and resource recovery projects, environmental impact studies, and the management of health, safety and training programs.

DETAILED EXPERIENCE

1986 to Date    Malcolm Pirnie, Inc.

As Principal Toxicologist:

- Manages the Environmental Toxicology and Public Health Group which conducts public health and environmental risk assessments and toxicological evaluations for resource recovery, hazardous waste management and industrial waste projects. Directed or authored health risk assessments for the Town of North Hempstead NY, Union County NJ and York County PA resource recovery facilities, and endangerment assessments/public health evaluations for the Laurel Park Landfill CT, Long Prairie MN and Tucson Airport AZ groundwater contamination studies.

- Directs the corporate health, safety and training program for employees engaged in hazardous waste management projects.

- Manager of the aquatic toxicology laboratory which conducts multispecies chemical and effluent toxicity bioassays.

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DETAILED EXPERIENCE (Continued)

1984-1986 NUS Corporation

As Assistant Regional Project Manager: Managed a multidisciplinary, 60-member Field Investigation Team investigating uncontrolled hazardous waste sites under the U.S. EPA Superfund Program. Directed public health assessments for remedial investigation/feasibility studies as well as the review, interpretation and reporting of analytical data. Managed or assisted numerous remedial investigation/feasibility studies and multimedia field investigations.

1981-1984 New Jersey Department of Environmental Protection, Division of Water Resources

As Environmental Scientist II: Provided consultation in aquatic toxicology/environmental health to an engineering/professional staff issuing indirect discharge, surface water, and groundwater NJPDES permits. Developed and reviewed impact assessment studies, biomonitoring studies, treatability studies, and mitigation alternatives. Provided technical expertise to multimedia enforcement cases including hazardous waste sites.

1975-1981 New York University Medical Center, Institute of Environmental Medicine, Laboratory of Environmental Studies

As Research Assistant: Examined organic chemical transfer in estuarine and marine environments. Conducted research on the accumulation dynamics and distribution of PCBs in estuarine fish with implications to toxicology, ecosystem cycling, and human exposure. Studied the environmental behavior of trace contaminants in dredged spoils and spoils disposal options. Examined metabolic transformation of PCBs by estuarine anaerobic bacteria.

1973-1975 Lawler, Matusky and Skelly Engineers

As Biologist: Supervised professional/technical staff studying estuarine and marine ichthyoplankton in relation to life history and impact studies. Conducted fish life history analyses and macrozooplankton analyses. Supervised field personnel in multiphased plant and river sampling program.

PUBLICATIONS AND PRESENTATIONS

Lee, C.C., R.J. Califano and R.M. Sansur, "The Degradation of Polychlorinated Biphenyls (Aroclor 1254) by Anaerobic Bacteria and Fungi from the Hudson River," Atlantic Estuarine Research Society, Rehoboth Beach, DE, 1979.

Califano, R.J., J.M. O'Connor and L.S. Peters, "Uptake, Retention, and Elimination of PCB (Aroclor 1254) by Larval Striped Bass (MORONE SAXATILIS), Bulletin of Environmental Contamination and Toxicology, 24(3):467-472, 1980.

Califano, R.J., J.M. O'Connor and J.A. Hernandez, "PCB Dynamics in Hudson River Striped Bass: I. Accumulation in Early Life History Stages," Aquatic Toxicology, 2:187-204, 1982.

MALCOLM PIRNIE

JOHN ISBISTER
Principal Hydrogeologist

EDUCATION

BS (Geology) 1956; Columbia University

REGISTRATION

Professional Geologist

SOCIETIES

American Institute of Professional Geologists
Association of Professional Geological Scientists
National Water Well Association

SUMMARY OF EXPERIENCE

Mr. Isbister is an expert ground water geologist and hydrologist. He is responsible for the organization, direction, and evaluation of complex ground water quality investigations and ground water development projects carried out for the firm's major industrial clients and large ground water developers. Mr. Isbister also specializes in the investigation of contamination incidents and the development of cost-effective measures to control, contain, and abate ground water contamination. He has prepared documents for litigation relating to the actions of the firm's industrial clients, and he has delivered expert testimony on their behalf.

DETAILED EXPERIENCE

1987 to Date — Malcolm Pirnie, Inc.

As Principal Hydrogeologist: Responsible for administration and technical direction of all corporate services in hydrogeology. Provides technical review and quality control of hydrogeological work performed in regional offices.

1984-1987 — Lawler, Matusky & Skelly Engineers

As Director, Groundwater Section, Hazardous Waste and Groundwater Group and Chief Hydrogeologist:

- Responsible for the organization and management of ground water development projects and hazardous waste studies. Duties included management of projects involving hazardous waste contamination, ground water development, resources evaluation, and other types of hydrogeologic investigations.

- Manager of a project for a Superfund site located in the State of Delaware. Evaluation of field studies, basic data, and reports prepared by EPA consultants; expert testimony services to an industrial client and attorneys representing the generators; attendance at technical meetings chaired by EPA; and successful negotiation of an alternative remediation scheme. Preparation of

(over)

DETAILED EXPERIENCE (Continued)

1984-1987 Lawler, Matusky & Skelly Engineers (continued)

work plan for design testing phase will be followed by review of design testing data, specifications for construction, construction and preparation of Remedial Phase Monitoring Plan and long-term operation and maintenance monitoring.

- Manager of a project to assess and clean up a large gasoline spill in Dutchess County NY. A test drilling program was designed and directed to define the limits of the spill and the conceptual design for cleanup was prepared.

- Represented a group of several generators in connection with the assessment and remediation of a Superfund site in Indiana. Reports and data provided by EPA were evaluated and alternative plans for additional investigation prepared.

- Provided expert services to a legal firm representing a group of generators in connection with remediation of an industrial landfill in Pennsylvania. Field inspection of the cleanup work was provided, and all testimony, data, and reports relating to site assessment reviewed; expert testimony will be provided as needed.

- Directed several projects involving the collection and interpretation of hydrogeologic data and design, and the installation of monitoring well programs at industrial sites where ground water and soil contamination was suspected or known, including a Superfund site in southern New Jersey.

1966-1984 Geraghty & Miller, Inc.

As Vice President and Senior Scientist:

- Responsible for the organization, direction, and evaluation of over 500 complex ground water quality investigations and ground water development projects in 20 states carried out for the firm's several major industrial clients and ground water developers. Specialized in the development of ground water supplies for municipalities and large industries, and in the investigation of incidents involving contamination and the development of cost-effective measures to control, contain, and abate ground water contamination. Prepared reports and presented expert testimony before state agencies in support of diversion applications. Prepared documents for litigation and appear purposes relating to the actions of the firm's industrial clients and delivered expert testimony on their behalf.

- Managed the development of "Procedures Manual for Ground-Water Monitoring at Solid Waste Disposal Facilities." The manual was designed to assist supervisory personnel of solid waste regulatory agencies complying with the management practices established by the Resource Conservation and Recovery Act.

(continued)

DETAILED EXPERIENCE (Continued)

1966-1984 Geraghty & Miller, Inc. (continued)

- Manager of a project for a major chemical company involving an assessment of the plant property to determine whether contamination of the ground water had taken place. The investigation revealed the presence of carbon tetrachloride at the bottom of the water table aquifer. The contaminant body was bounded and a well abatement system was designed and tested.

- Manager for a ground water assessment study at a site near Toms River NJ, involving clandestine dumping of hazardous wastes by a trucking firm contracted by a major chemical company for delivery to an acceptable landfill. Based on the results of the investigation, the chemical company was able to clean up the dump site and negotiate an agreement on plume management with the regulatory agency.

- Investigated ground water contamination for a major chemical and pharmaceutical firm. Extensive ground water contamination was found on the plant site as well as the revelation that movement of the contaminants was controlled by the operation of the plant supply wells and that the contamination had not spread beyond the plant boundaries. Also provided advice and recommendations on a major lagoon cleanup program and a monitoring well system designed to answer the requirements of the regulatory agency.

- Manager of a project financed by several industrial firms to evaluate studies of EPA contractors on the Price Landfill near Atlantic City NJ. The studies assessed ground water contamination and the need to relocate the nearby Atlantic City MUA wellfield.

- Manager of a continuing project for a hazardous waste treatment facility in southern New Jersey. The investigation involved assessing ground water contamination and designing an abatement well system to contain and remove contamination from the ground water. Also provided advice and recommendations on ground water considerations of a major lagoon cleanup program.

- Manager of a large-scale investigation for a major chemical company in southern New Jersey which assessed the ground water impact of several waste disposal areas and made recommendations on cleanup/abatement measures.

1956-1966 U.S. Geological Survey
Water Resources Division

As Project Manager: Ground water investigations related to availability of ground water supplies, saltwater intrusion, artificial recharge, long-term changes in water levels, aquifer properties, and contamination. Studies were carried out on Long Island and the Catskill region NY and in parts of Rhode Island.

(over)

PUBLICATIONS AND PRESENTATIONS

Isbister, J., 1959. Ground water levels and related hydrologic data from selected observation wells in Nassau County, New York. New York State Water Power and Control Commission, Bulletin 41.

Isbister, J., 1962. Relation of fresh water to salt water at Centre Island, Nassau County, New York. U.S. Geological Survey Professional Paper 450, Chapter E.

Isbister, J., 1963. Records of wells and related hydrologic data in northeast Nassau County, Long Island, New York. U.S. Geological Survey Open-File Report.

Isbister, J., 1965. Geology and hydrology of northeastern Nassau County, Long Island, New York. U.S. Geological Survey Water Supply Paper 1825.

Isbister, J., 1968. The status of ground water resources, 1967, Nansemond County and Isle Wight County (co-author).

Isbister, J., 1970. Ground water resources in Cape May County (co-author).

Isbister, J., 1975. Study of ground water conditions on the Long Island Lighting Company tract, Jamesport, New York (principal author).

Isbister, J., 1976. Procedures manual for monitoring solid waste disposal sites, U.S. EPA Publications (principal author).

Isbister, J., 1977. Westchester County 208. U.S. Environmental Protection Agency Publication.

QAPP

APPENDIX E

REPORT DELIVERABLES FORMS

SAMPLE IDENTIFICATION ANO
ANALYTICAL REQUIREMENT SUMMARY

| Customer Sample Code | Laboratory Sample Code | Analytical Requirements* | | | | | |
|---|---|---|---|---|---|---|---|
| | | *VOA GC/MS | *BNA GC/MS | *VOA GC | *PEST PCB | *METALS | *OTHER |
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* Check Appropriate Boxes

* CLP, Non-CLP
* HSL, Priority Pollutant

SAMPLE PREPARATION AND ANALYSIS SUMMARY
B/N-A
ANALYSES

| SAMPLE ID | MATRIX | DATE COLLECTED | DATE REC'D AT LAB | DATE EXTRACTED | DATE ANALYZED |
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SAMPLE PREPARATION AND ANALYSIS SUMMARY
VOA
ANALYSES

| SAMPLE ID | MATRIX | DATE COLLECTED | DATE REC'D AT LAB | DATE EXTRACTED | DATE ANALYZED |
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SAMPLE PREPARATION AND ANALYSIS SUMMARY
PESTICIDE/PCB
ANALYSES

| SAMPLE ID | MATRIX | DATE COLLECTED | DATE REC'D AT LAB | DATE EXTRACTED | DATE ANALYZED |
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SAMPLE PREPARATION AND ANALYSIS SUMMARY

INORGANIC ANALYSES

| SAMPLE ID | MATRIX | METALS REQUESTED | DATE RECEIVED | DATE DIGESTED | DATE ANALYZED |
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APPENDIX F

PARTICULATE MONITORING PROGRAM

## PARTICULATE MONITORING PROGRAM

## 1. BACKGROUND

In 1971, the United States Environmental Protection Agency (USEPA) promulgated air quality standards for "total suspended particulate matter" (TSP). The primary standard for TSP was set at 260 $ug/m^3$, 24-hour average and the secondary standard at 150 $ug/m^3$, 24-hour average. On July 1, 1987, the USEPA announced their final decision on standards for particulate matter less than 10 microns ($PM_{10}$). The 24-hour primary $PM_{10}$ standard, has been set at 150 $ug/m^3$ and the secondary standard at 50 $ug/m^3$, expected annual arithmetic mean.

The real-time monitoring equipment available measures particulate matter less than 10 microns and can integrate over a period of six seconds to 10 hours. The equipment utilized by Malcolm Pirnie, Inc. is supplied by MDA and is called the P-5 Digital Dust Indicator. There is no equipment available for monitoring TSP on a real-time basis.

## 2. GUIDANCE

A program for monitoring particulate matter at hazardous waste sites during construction can be developed without placing an undue burden on construction activities and still be protective of health and the environment. The following particulate monitoring and dust suppression program shall be employed during construction activities at hazardous waste sites.

a. Particulate monitoring will be employed during the handling of waste or contaminated soil or when activities on site may generate fugitive dust from exposed waste or contaminated soil. Monitoring will not be necessary during the excavation, grading or placement of clean fill and after all waste or contaminated soil has been covered.

b. During the handling of waste or contaminated soil, or when activities on site may generate fugitive dust from exposed waste or contaminated soil, reasonable dust suppression techniques must be employed (see paragraph f).

c. It must be recognized that the generation of dust from waste or contaminated soil, that migrates off-site, has the potential for transporting contaminants. There may be situations when dust is being generated and leaving the site and the monitoring equipment does not measure $PM_{10}$ at or above the action level. Since this situation has the potential for off-site contaminant migration, this situation is unacceptable. It is not practical to quantify, on a real-time basis, total suspended particulates, therefore, it is appropriate to rely on visual observation. If visual dust is generated and observed leaving the working site additional dust suppression techniques must be employed (see paragraph f).

d. Particulate monitoring will be performed using the real-time particulate monitor and shall monitor particulate matter less than 10 microns. Particulate levels will be monitored immediately downwind at the working site and integrated over a period not to exceed 15 minutes.

e. The action level will be established at 150 $ug/m^3$ over the integrated period not to exceed 15 minutes. If particulate levels are detected in excess of 150 $ug/m^3$ the upwind background level must be measured immediately using the same portable monitor. If the working site particulate measurement is greater than 100 $ug/m^3$ above the background level additional dust suppression techniques must be implemented to reduce the generation of fugitive dust and corrective action taken to protect site personnel and reduce the potential for contaminant migration. Corrective measures may include increasing the level of protection and implementing additional dust suppression techniques (see paragraph f).

f. The following techniques have been shown to be effective for the controlling of the generation and migration of dust during construction activities.

1) Applying calcium on haul roads.
2) Wetting equipment and excavation faces.
3) Water spraying buckets during excavation and dumping.
4) Using watertight containers to haul materials.
5) Restricting vehicle speeds to 10 mph.
6) Covering excavated areas after excavation activity ceases.

Experience has shown that utilizing the above-mentioned dust suppression techniques, within reason as not to create excess water which would result in unacceptable wet conditions, the chance of exceeding the 150 $ug/m^3$ action level at hazardous waste site remediations is remote.

g. If the dust suppression techniques being utilized at the site do not lower particulate to an acceptable level (either below 150 $ug/m^3$ and no visible dust), work will be suspended until appropriate corrective measures are approved to remedy the situation.

# APPENDIX B

# SITE HEALTH AND SAFETY PLAN

# SITE SAFETY PLAN

FOR

COLUMBIA MILLS PROPERTY

REMEDIAL INVESTIGATION/FEASIBILITY STUDY
AND
INTERIM REMEDIAL MEASURES

APPROVED BY:

| | |
|---|---|
| PROJECT DIRECTOR | DATE May 16, 1989 |
| CERTIFIED INDUSTRIAL HYGIENIST | DATE May 19, 1989. |
| PROJECT LEADER | DATE May 26, 1989 |
| HEALTH AND SAFETY COORDINATOR | DATE May 16, 1989 |

MAY 1989


MALCOLM PIRNIE, INC.
ENVIRONMENTAL ENGINEERS,
SCIENTISTS & PLANNERS
890 Seventh North Street
Liverpool, New York 13088

# TABLE OF CONTENTS

## TABLE OF CONTENTS
(Continued)

## 1.0 SITE LOCATION AND BACKGROUND

The Columbia Mills site is located in Minetto, New York, just west of the Oswego River on New York State Route 48 (Figure 1).

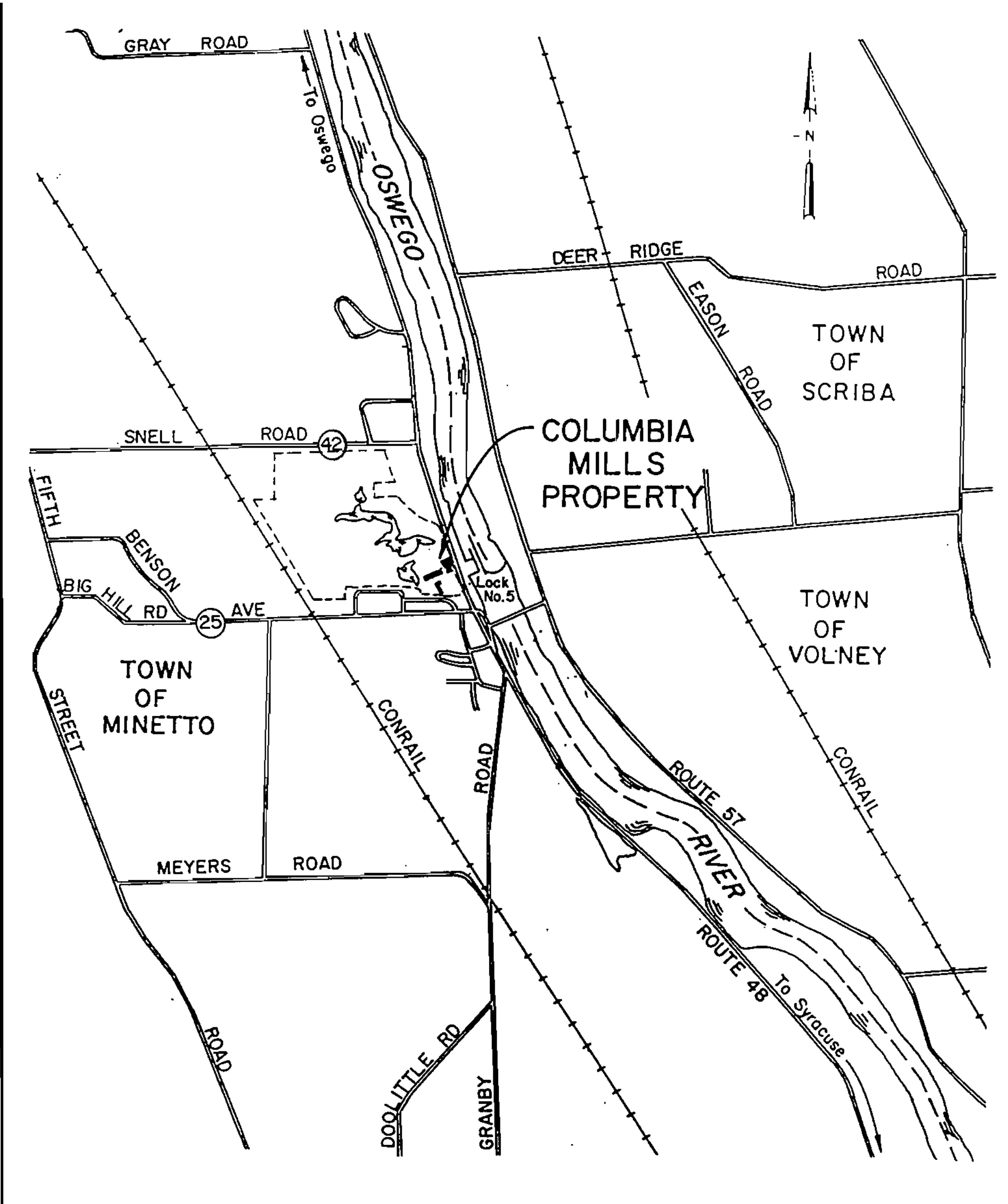
Columbia Mills was a manufacturer of cloth and vinyl products from 1887 until 1976, when the plant closed. The property was sold to Columin Development Corporation, who initiated salvaging operations. The salvaging ended prematurely and the property was abandoned. Currently, the property is jointly owned by the County of Oswego and Town of Minetto.

The property consists of approximately 10 acres of standing structures, partially and wholly demolished buildings, and rubble, plus approximately 90 acres of undeveloped property which includes several ponds, streams and the former plant's landfill (Figure 2).

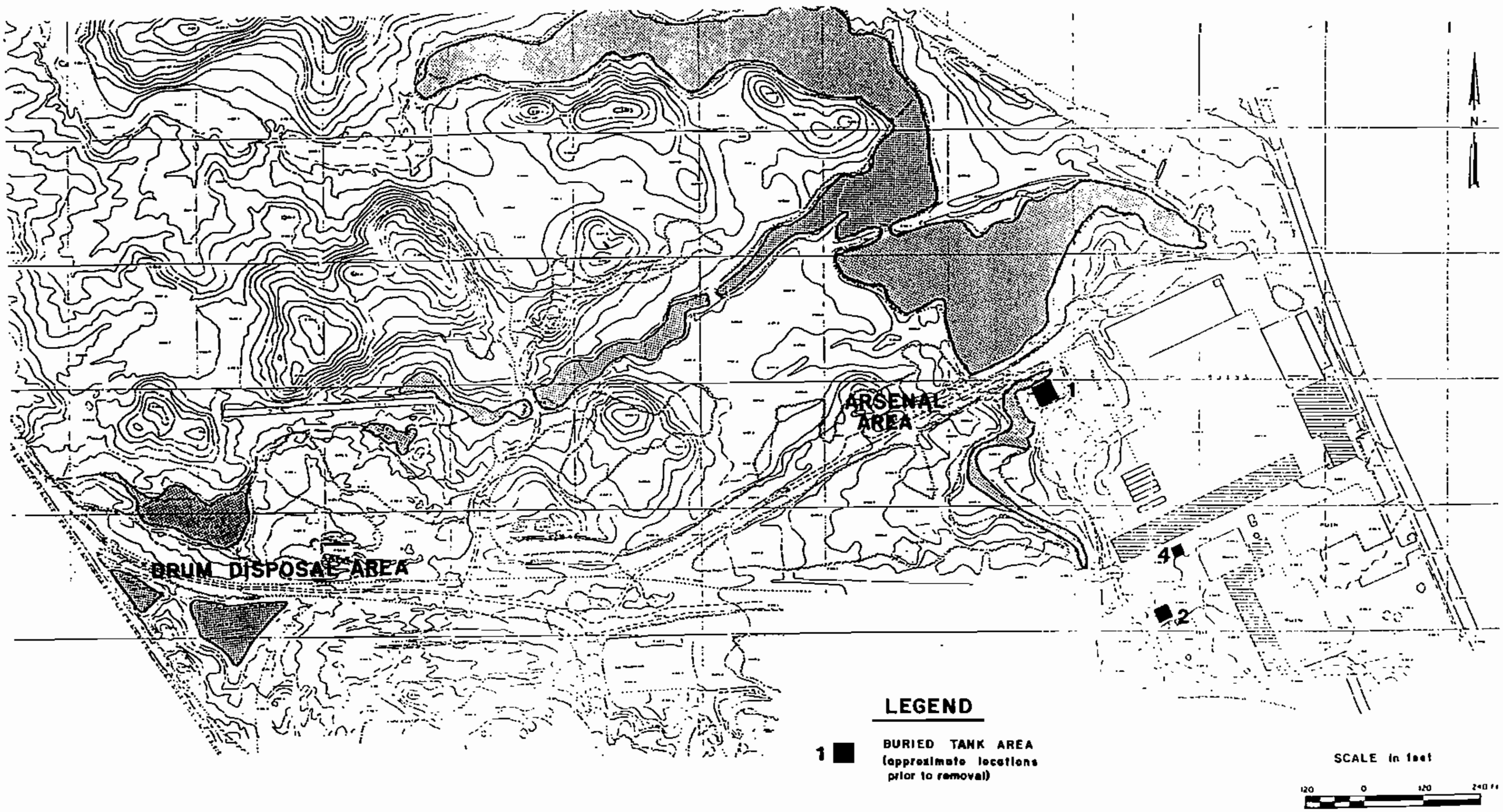
In 1980, the New York State Department of Environmental Conservation (NYSDEC) arranged for the licensed disposal of approximately 500 drums of waste removed from the plant area.

In 1984, Calocerinos & Spina, Consulting Engineers was retained by Oswego County to evaluate potential uses of the abandoned site and buildings. The study report documented potential hazards due to: (1) the presence of chemicals and/or wastes left in the buildings; (2) surface water, ground water and soil contamination by volatile organics in the vicinity of buried tanks, and; (3) heavy metals contamination of surface water in the drum disposal area.

In 1985, Calocerinos & Spina was retained by Bond, Schoeneck & King, attorneys for the former owners, to conduct a Phase II Site Investigation and develop a Hazard Ranking System (HRS) score for the site. The results of the investigation showed: (1) contamination of ground water by volatile organics near the buried tanks; (2) contamination of soil by non-volatile organics in the drum disposal area, and; (3) heavy metals contamination of soil, sediment and surface water in the drum disposal area. An HRS score of 31.78 was assigned to the site.




| MALCOLM PIRNIE | COLUMBIA MILLS SITE LOCATION MAP | FIGURE 1 |
|---|---|---|
| | | APRIL 1989 |
| | | SCALE: 1" = 2000' |




MALCOLM PIRNIE

COLUMBIA MILLS
MINETTO, NEW YORK

SITE MAP

MALCOLM PIRNIE, INC.
DATE APRIL 1989
FIGURE 2

Malcolm Pirnie, Inc. (MPI) was retained by Bond, Schoeneck & King in 1986 to perform additional site investigations based on NYSDEC comments on the Phase II study report. The scope or work for the project included the following tasks; (1) fencing of drum disposal area to reduce access to the site; (2) conducting an asbestos inventory throughout the remaining buildings and rubble; (3) conducting a domestic well inventory; (4) investigation of the deep aquifer; (5) investigation of site tunnels and storm sewers; (6) sampling and analysis of soils, surface waters and sediments; and (7) cleaning and further investigations of the buried tank area.

In 1987, Bond, Schoeneck & King authorized MPI to conduct a Remedial Investigation and Feasibility Study (RI/FS) at the Columbia Mills site. During this portion of the project interim tasks along with additional sampling and analysis were conducted. The interim tasks included; (1) maintenance of the fencing in the drum disposal area; (2) covering of the contaminated soil in the drum disposal area; and (3) removal of the underground storage tanks including inspection of tank interiors, and stockpiling of contaminated soil. Once all tasks were completed MPI prepared the RI report and submitted a Draft version to the NYSDEC.

## 2.0 PROJECT SCOPE OF WORK

Additional site investigations and the interim remedial action measures are planned to address the NYSDEC's comments on the Draft Remedial Investigation Report. The Scope-of-Work for the project consists of the following tasks:

A. Field Work

1. Remedial Investigation/Feasibility Study
    - Soil gas survey
    - Test borings and monitoring well installation
    - Develop wells
    - Periodic monitoring of water levels
    - Excavation of test pits

- Sampling and analysis of air, soils, and ground water
- Covertype and wildlife identification

2. Interim Remedial Tasks
   - Vacuum extraction near test pit 3
   - Aeration of stockpiled soils
   - PCB removal from basement floor of Building No. 8.

B. Office Work
   - Monthly Progress Reports Summarizing the Interim Measures
   - Revision of RI report to include additional tasks
   - Preparation of FS Report

## 3.0 PROJECT ORGANIZATION AND KEY PERSONNEL

### 3.1 MALCOLM PIRNIE PERSONNEL

Project Manager - Richard W. Klippel, P.E.
Health & Safety Officer - Richard J. Califano (White Plains)
Health & Safety Coordinator - Thomas A. Barba
Project Leader - Thomas A. Barba
Site Safety Officers - Mark D. Wilder, Keith White and Marcia Vrona
Others on Site - Richard J. Kulibert, Michael E. Florczykowski Wesley L. Jones, Gary W. Mullen and David W. Knutsen

### 3.2 OTHER CONTRACTORS

Contractors whose work will be performed on-site, or who otherwise could be exposed to health and safety hazards, will be advised of all known hazards through the distribution of this Site Safety Plan (SSP). All contractors are responsible for: (1) providing their own personal protection equipment; (2) training their employees in accordance with applicable Federal, State and local laws; (3) providing medical surveillance for their employees; (4) insuring their employees are advised of and meet the minimum requirements of this SSP; and, (5) designating their own site safety officer.

## 4.0 HAZARD AND RISK ANALYSIS

### 4.1 HAZARD ANALYSIS FOR EACH PROJECT TASK

Based on the results of previous site investigations, potential hazards have been identified for various work tasks. These hazards are listed in Table 1.

### 4.2 POTENTIAL EXPOSURE TO CONTAMINANTS

#### 4.2.1 Contaminants of Concern

Table 2 lists the contaminants found in various areas of the Columbia Mills site. The concentration levels shown represent the maximum values found for various sampling locations. In addition to the contaminants listed, asbestos is present in the buildings and piles of rubble.

#### 4.2.2 Contaminant Hazard Review & Risk Assessment

##### 4.2.2.1 Inhalation Hazard

Overall, very few volatile organics were found at high concentrations in the samples collected on-site. The areas of concern, with respect to an inhalation hazard, are the areas where the tanks were buried. High toluene and benzene levels, as well as free product were encountered at area "1" as shown on Figure 2. Table 3 contains Permissible Exposure Limits (PEL) and Threshold Limit Values (TLV) for the parameters of concern. PEL are OSHA standards while TLVs are guidance values from the American Council of Governmental Industrial Hygienists.

##### 4.2.2.2 Dermal and Oral Hazards

The dermal and oral hazard ratings for the contaminants found at the Columbia Mills site show a high oral toxicity for nine contaminants and potential skin and/or eye irritation for 15 contaminants. These compounds along with their associated hazards are listed on Table 4.

#### 4.2.2.3 Carcinogens

Several of the compounds detected at the site are known or suspected carcinogens. These compounds and areas where they were found are listed on Table 5.

#### 4.2.2.4 Asbestos

Inhalation of asbestos fibers can cause cancer and various lung diseases. The presence of asbestos is confirmed in all buildings and most of the debris in the plant area.

### 4.3 PHYSICAL HAZARDS

Physical hazards at the Columbia Mills site include the following: potential injury or hearing loss from the use of heavy machinery for drilling and excavation activities; potential accidents caused by unstable surfaces near excavations; hazards presented by the possible structural instability of site buildings and ruins; potential injury from loose nails and other debris strewn about the site, and safety hazards associated with on-site ponds and streams. The hazards associated with the heavy machinery will be minimized by wearing the proper protective equipment and by keeping all unnecessary personnel away from the drilling and excavation areas.

## 5.0 PERSONAL PROTECTION EQUIPMENT

Personal protection equipment (PPE) has been designated for each project task where potential hazards exist. The designated PPE is listed on Table 6. An attitude of safety-consciousness should be maintained during all on-site work.

## 6.0 TRAINING ASSIGNMENTS AND MEDICAL SURVEILLANCE REQUIREMENTS

There will be no special training assignments or medical surveillance requirements for work at the Columbia Mills site. Malcolm Pirnie's standards for training and medical surveillance for hazardous waste (including 29 CFR 1910) operations as described in the firm's Health & Safety Program are deemed adequate. A site-specific health and safety meeting will be conducted prior to project start-up.

## 7.0 AIR MONITORING

Air monitoring for volatile organics will be conducted on the site during the following tasks; soil gas survey, test borings and monitoring well installation, development of wells, excavation of test pits, all sampling activities, vacuum extraction tasks and during aeration of stockpiled soils.

Background concentrations prior to sampling will also be monitored. The monitoring will be conducted using an HNU PI101 photoionization analyzer. Data will be recorded on the form shown in Appendix A. The HNU will be calibrated according to the manufacturer's instruction manual prior to going on-site.

Since this is a site where disposal occurred, and the scope of work includes installation of new wells and excavation of test pits, standard USEPA guidance for respiratory protection will be used. This guidance specifies that persistent readings in the breathing zone of workers, as recorded on the HNU, will result in use of the following respiratory protection.

| Reading | Respiratory Protection |
|---|---|
| background | None required |
| 0 - 5 units above background | Chemical cartridge respirator with a full facepiece and organic vapor cartridges. To protect against particulate hazards, the chemical cartridge respirators will have organic vapor cartridges in combination with a dust filter. |

At this site, if persistent readings are recorded above 5 units on the HNU continuously in the breathing zone, work will be halted until air samples can be collected and analyzed by GC to identify the specific substance or substances causing the elevated reading. Respiratory protection will be provided in order to protect the workers against the identified substance(s). The respiratory protection to be used for those substances detected on-site and identified as posing an inhalation hazard is summarized in Tables 7 and 8. Workers will don the appropriate respiratory protection once the concentration in the breathing zone nears the OSHA PEL TWA.

## 8.0 SITE CONTROL

The majority of the contaminated portions of the Columbia Mills site are enclosed by fencing. This makes the hazardous waste inaccessible to the general public. The spread of contamination to off-site locations by on-site workers will be controlled by the use of decontamination zones.

The buddy system will be used for the work tasks designated on Table 1. The buddies may be a combination of Malcolm Pirnie and other contractor's personnel; however, in no case shall less than two people be on-site during the designated project tasks.

The following safe work practices will apply during all on-site activity:

1. Smoking, eating or drinking is forbidden.
2. Ignition of flammable liquids within or through improvised heating devices (e.g., barrels) is forbidden.
3. Contact with samples, excavated materials, or other contaminated materials must be minimized.
4. Use of contact lenses is prohibited.
5. Any injury or unusual health effect must immediately be reported to the Project Manager who will notify the Corporate

Health & Safety Officer. The location of medical assistance and other emergency procedures are described in Section 11 of this Plan.

## 9.0 DECONTAMINATION PROCEDURES

All decontamination will take place within the decontamination zones. Decontamination of personnel will consist of washing the outer boots with a brush using detergent and water and disposing of protective clothing (i.e., Tyvek suits and gloves). If personnel do not contact contaminated materials, decontamination will not be required. Non-disposable sampling equipment (e.g., trowel) will be decontaminated with a detergent-water-hexane wash between uses. Heavy equipment (i.e., backhoe, drilling rig and all drilling accessories) will be decontaminated using a pressurized steam cleaner between borings or test pits and prior to exiting the site.

## 10.0 STANDARD OPERATING AND CONFINED SPACE ENTRY PROCEDURES

Work at the Columbia Mills site will not require any standard operating procedures based on health and safety considerations other than those presented in Malcolm Pirnie's Health & Safety Program for Hazardous Work Operations. No confined space entry will be conducted during the project.

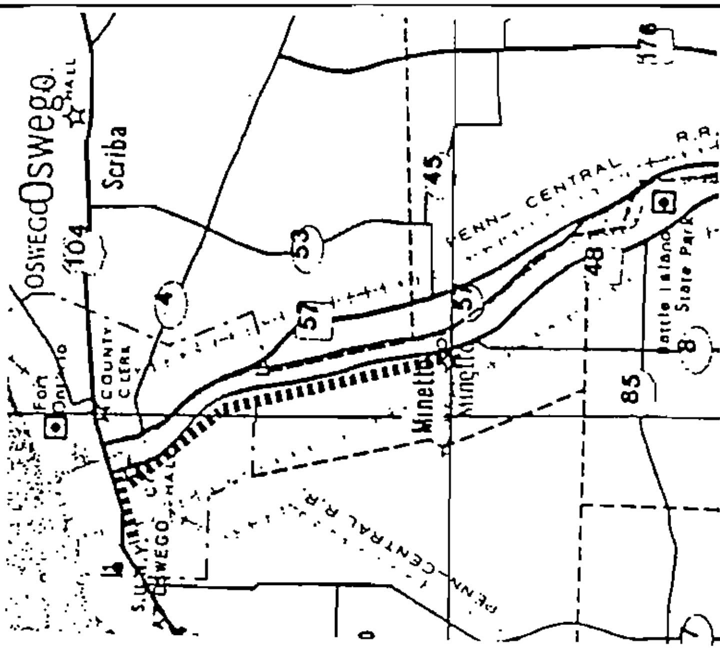
## 11.0 EMERGENCY RESPONSE PLAN

Emergency medical treatment can be obtained in the Oswego Hospital in Oswego. Additionally, the Minetto Fire Department is located just beyond the site boundary.

Hospital Phone Number: (315) 341-5541

Directions to Hospital: (See Figure 3) Exit Columbia Mills turning left on Route 48. Proceed north towards Oswego. Turn left on Route 104 (W. Bridge Street). Turn left again on W. 6th Street.

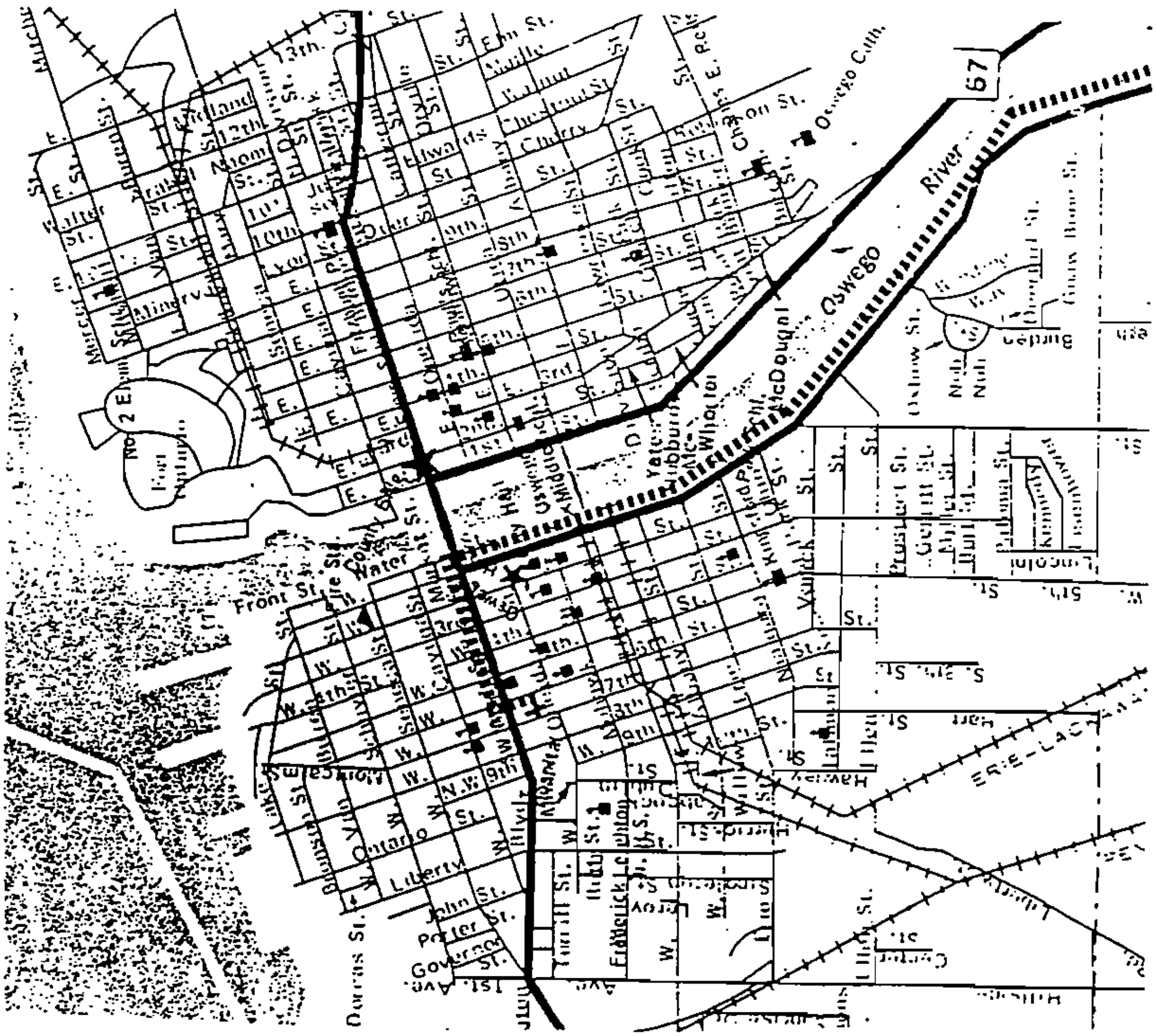
FIGURE 3




Oswego Hospital

110 W. 6th Street

341-5511




MALCOLM PIRNIE

## Route To Hospital

MALCOLM PIRNIE, INC.

APRIL 1989

## 12.0 RECORDS

Personal and Site Safety Logs will be maintained by Malcolm Pirnie personnel working on tasks designated on Table 1. These forms are included in Appendix A.

## 13.0 HEALTH AND SAFETY PROGRAM

Appendix B of this work plan contains the Health & Safety Program for Hazardous Waste Operations Manual.

# Tables

MALCOLM PIRNIE

TABLE 1

PROJECT TASKS WITH POTENTIAL HAZARDS

| PROJECT TASK | POTENTIAL HAZARDS |
|---|---|
| 1. Soil gas survey. | Exposure to contaminants: dermal, oral and inhalation. Physical hazards. |
| 2. Test borings and monitoring well installation | Exposure to contaminants: dermal, oral and inhaltion. Physical hazards. |
| 3. Develop wells | Exposure to contaminants: dermal, oral and inhalation. |
| 4. Periodic monitoring of water levels | Exposure to contaminants: dermal, oral and inhalation. |
| 5. Excavation of test pits | Exposure to contaminants: dermal, oral and inhalation. Physical hazards. |
| 6. Sampling of soils, air, ground water | Exposure to contaminants: dermal, oral and inhalation. Physical hazards. |
| 7. Covertype and wildlife identification | Exposure to contaminants: dermal and oral. Physical hazards. |
| 8. Vacuum extraction | Exposure to contaminants: dermal, oral and inhalation. Physical hazards. |
| 9. Aeration of stockpiled soils | Exposure to contaminants: dermal, oral and inhalation. Physical hazards. |
| 10. PCB removal | Exposure to contaminants: dermal and oral. Physical hazards. |

TABLE 2

MAXIMUM CONTAMINANT LEVELS MEASURED ON-SITE
(Page 1 of 4)

| CONTAMINANT | SOIL mg/kg | GROUND WATER ug/l | SURFACE WATER ug/l | SEDIMENT mg/kg |
|---|---|---|---|---|
| A. PLANT AREA | | | | |
| Benzo(a)anthracene | - | - | - | TR 0.77 |
| Benzo(b)fluoranthene | - | - | - | 1.6 |
| Benzene | * 13,150 | TR 24 | 72 | 0.023 |
| Chloroform | - | 1 | 3 | - |
| Chrysene | - | - | - | TR 1.1 |
| Ethylbenzene | 7 | 31 | - | 0.038 |
| 1,1-Dichloroethene | - | 14 | 8 | - |
| Dimethyl sulfide | - | - | - | 0.12 |
| Fluoranthene | - | TR 1 | - | 1.6 |
| Methyl ethyl ketone [2-butanone] | 6.6 | - | - | 0.052 |
| Methyl isobutyl ketone | 0.32 | - | - | - |
| 2-Methylphenol | - | 21 | - | - |
| 4-Methylphenol | - | 22 | - | - |
| Methyl chloride [chloromethane] | - | - | - | 0.073 |
| Naphthalene | - | TR 4 | - | - |
| Phenanthrene | - | TR 3 | - | 0.88 |
| Pyrene | - | TR 1 | - | 1.4 |
| 1,1,2,2-Tetrachloroethane | - | 13 | - | - |
| Tetrachloroethene | 0.034 | - | - | - |
| 1,1,1-Trichloroethane | - | 2 | TR LT 1 | - |
| Trichloroethene | - | 1 | - | - |
| Toluene | 83 | 190,000 | 34,300 | 8.4 |
| Xylenes | 59 | 110 | 50 | 0.180 |
| 4-4'-DDD | - | - | - | 0.013 |
| 4-4'-DDE | - | - | - | 0.033 |
| PCB's | 43,000 | - | - | - |
| Aluminum | - | 398 | - | 10,700 |
| Antimony | - | 64.1 | - | - |
| Arsenic | - | 19.7 | - | 7.7 |
| Barium | - | 513 | - | 288 |
| Cadmium | - | 18 | - | 3.5 |
| Calcium | - | 103,000 | - | 4,980 |
| Chromium | - | 220 | - | 71 |
| Copper | - | 140 | - | 193 |
| Iron | - | 15,700 | - | 20,500 |
| Lead | - | 600 | - | 280 |
| Nickel | - | 210 | - | 64 |
| Magnesium | - | 25,600 | - | - |
| Manganese | - | 4,250 | - | 645 |
| Selenium | - | - | - | 3.6 |
| Sodium | - | 58,700 | - | - |
| Silver | - | 17.3 | - | - |
| Vanadium | - | - | - | - |
| Zinc | - | 21,000 | - | 1,100 |
| Cyanide | - | 152 | - | - |

* One report which was never confirmed in later sampling

TABLE 2

MAXIMUM CONTAMINANT LEVELS MEASURED ON-SITE
(Page 2 of 4)

| CONTAMINANT | SOIL mg/kg | GROUND WATER ug/l | SURFACE WATER ug/l | SEDIMENT mg/kg |
|---|---|---|---|---|
| B. ARSENAL AREA | | | | |
| Benzene acetic acid | 0.6 (SS) | No Samples | No Samples | No Samples |
| Benzo(b)/(k)fluoranthene | 0.22 (TP) | | | |
| Bis(2-ethylhexyl)phthalate | 1.9 (TP) | | | |
| Chrysene | 0.21 (TP) | | | |
| Decamethylcycloterasiloxane | 0.26 (TP) | | | |
| 2-Ethyl-1-hexanol | 6 (SS) | | | |
| 4-Hydroxy-3-methoxy benzaldehyde | 0.18 (SS) | | | |
| Methylene chloride | 0.036 (TP) | | | |
| Octamethylcycloterasiloxane | 1.4 (TP) | | | |
| Cadmium | 1 (SS) | | | |
| Chromium | 11 (SS) | | | |
| Copper | 5.6 (SS) | | | |
| Lead | 100 (SS) | | | |
| Nickel | 2.7 (SS) | | | |
| Silver | 0.3 (SS) | | | |
| Zinc | 60 (SS) | | | |

| CONTAMINANT | SOIL mg/kg | GROUND WATER mg/l | SURFACE WATER mg/l | SEDIMENT mg/kg |
|---|---|---|---|---|
| C. DRUM DISPOSAL AREA | | Samples Analyzed for Only Volatile Organics | Samples Analyzed for Only Volatile Organics | |
| Acenaphthylene | 1 (SS) | - | - | - |
| Acetic acid, butyl ester | 0.35 (SS) | - | - | - |
| Anthracene | 0.25 (TP) | - | - | - |
| 1,2-Benzindicarboxylic acid | 0.011 (SS) | - | - | - |
| Benzo(a)anthracene | 0.80 (SS) | - | - | - |
| Benzo(a)pyrene | 0.85 (SS) | - | - | - |
| Benzo(b)/(k)fluoranthene | 1.2 (TP) | - | - | - |
| Benzo(e)pyrene | 0.43 (TP) | - | - | - |
| Benzo(g,h,i)perylene | 0.5 (TP) | - | - | - |
| Bis(2-ethylhexyl)phthalate | 280 (SS) | - | - | - |

TABLE 2

MAXIMUM CONTAMINANT LEVELS MEASURED ON-SITE
(Page 3 of 4)

| CONTAMINANT | SOIL mg/kg | GROUND WATER mg/l | SURFACE WATER mg/l | SEDIMENT mg/kg |
|---|---|---|---|---|
| C. DRUM DISPOSAL AREA (Continued) | | | | |
| Carboxylic acid | 0.71 (SS) | - | - | 3.4 |
| Chloroform | - | 0.11 | 0.002 | - |
| Chrysene | 0.87 (SS) | - | - | - |
| 1,3-Cyclopentadiene | 0.44 (SS) | - | - | - |
| Decane | 0.3 (SS) | - | - | - |
| 1,1-Dichloroethene | - | 0.004 | - | - |
| Dibutyl phthalate | 18 (SS) | - | - | - |
| 2-Ethyl-1-hexanol | 1 | - | - | - |
| Fluoranthene | 4 (SS) | - | - | - |
| Heptanol | 0.39 (SS) | - | - | - |
| Hexadecanoic acid, methyl ester | 0.23 (TP) | - | - | - |
| Indeno (1,2,3-c,d) pyrene | 0.5 (TP) | - | - | - |
| Methylene chloride | 0.011 (TP) | 0.026 | 0.0045 | - |
| 2-Methyl phenol | 0.47 (SS) | - | - | - |
| Nonanoic acid | 4.8 (TP) | - | - | - |
| 4-Methyl-2-heptanone | 0.27 (SS) | - | - | - |
| Octanoic acid | 1.2 (TP) | - | - | - |
| Phenanthrene | 1.2 (TP) | - | - | - |
| Phenol | 3 (SS) | - | - | - |
| 1-Propene-1,2,3-tricarboxylic acid | 0.55 (SS) | - | - | - |
| Pyrene | 9 (SS) | - | - | - |
| Toluene | 0.37 (SS) | 0.005 | - | - |
| 1,1,1-Trichloroethane | - | 0.002 | 0.001 | - |
| 2-Tridecanone | 0.28 (SS) | - | - | - |
| 4,4'-DDD | - | - | - | 0.043 |
| 4,4'-DDE | TR LT 0.012 | - | - | 0.040 |
| 4,4'-DDT | TR LT 0.016 | - | - | - |
| PCB's | 0.3 (SS) | - | - | - |
| Cyanide | - | 0.153 | - | - |
| Aluminum | 11,600 (SS) | - | - | 6,130 |
| Arsenic | 2.7 (SS) | - | - | - |
| Barium | 167 (SS) | 0.238 | - | - |
| Cadmium | 65 (SS) | 0.120 | 0.53 | 23.2 |
| Calcium | - | 56.3 | - | 4,620 |
| Chromium | 4,200 (SS) | 0.900 | 2.0 | 200 |
| Chromium (hex) | - | - | 0.010 | - |
| Cobalt | 20 (SS) | - | - | - |

TABLE 2

MAXIMUM CONTAMINANT LEVELS MEASURED ON-SITE


| CONTAMINANT | SOIL mg/kg | GROUND WATER mg/l | SURFACE WATER mg/l | SEDIMENT mg/kg |
|---|---|---|---|---|
| C. DRUM DISPOSAL AREA (Continued) | | | | |
| Copper | 10,000 (SS) | 2.5 | 0.8 | 590 |
| Iron | 14,600 (SS) | 0.512 | - | 12,300 |
| Lead | 65,000 (SS) | 58 | 3.5 | 13,000 |
| Manganese | 333 (SS) | 2.31 | - | 408 |
| Magnesium | 1,730 (SS) | 15.9 | - | - |
| Nickel | 1,250 (SS) | 14 | 7 | 130 |
| Selenium | - | - | - | 4.7 |
| Sodium | - | 12.9 | - | - |
| Silver | 0.6 (SS) | - | - | 4 |
| Vanadium | 18 | - | - | - |
| Zinc | 69,000 | 22 | 330 | 7,800 |

TP = Test Pit Sample
SS = Surface Soil Sample

TABLE 3

THRESHOLD LIMITS FOR SITE INHALATION HAZARDS

| PARAMETER | ACGIH TLV TWA ppm | ACGIH TLV STEL ppm | OSHA PEL TWA ppm | OSHA PEL STEL ppm | OSHA PEL CEILING ppm |
|---|---|---|---|---|---|
| Benzene | 10 | - | 1 | - | 5 |
| Chloroform | 10 | - | 2 | - | - |
| Cyclopentadiene | 75 | - | 75 | - | - |
| Dibutyl phthalate | 5 mg/m$^3$ | - | 5 mg/m$^3$ | - | - |
| Ethylbenzene | 100 | 125 | 100 | 125 | - |
| 1,1-Dichloroethene | 5 | 20 | 1 | - | - |
| Methyl ethyl ketone [2-butanone] | 200 | 300 | 200 | 300 | - |
| Methyl isobutyl ketone | 50 | 75 | 50 | 75 | - |
| Methyl chloride [chloromethane] | 50 | 100 | 50 | 100 | - |
| Methylene chloride* | 50 | - | 500 | - | 1000 |
| Naphthalene | 10 | 15 | 10 | 15 | - |
| Phenol (skin) | 5 | - | 5 | - | - |
| 1,1,2,2-Tetrachloroethane (skin) | 1 | - | 1 | - | - |
| Tetrachloroethene | 50 | 200 | 25 | - | - |
| Toluene | 100 | 150 | 100 | 150 | - |
| 1,1,1-Trichloroethane | 350 | 450 | 350 | 450 | - |
| Trichloroethylene | 50 | 200 | 50 | 200 | - |
| Xylenes | 100 | 150 | 100 | 150 | - |
| PCBs (42% Cl) skin | 1.0 mg/m$^3$ | - | 1.0 mg/m$^3$ | - | - |
| PCBs (54% Cl) skin | 0.5 mg/m$^3$ | - | 0.5 mg/m$^3$ | - | - |

* Transitional limits - final limits not established.

ACGIH = American Conference of Governmental Industrial Hygienists, a professional association establishing non-enforceable guidance levels for use in occupational environments.

OSHA = Occupational Safety and Health Administration.

TLV = Threshold Limit Value - guidance values.

TABLE 3

THRESHOLD LIMITS FOR SITE INHALATION HAZARDS
(Continued)

| | | |
|---|---|---|
| PEL | = | Permissable Exposure Limits - regulatory standard. |
| TWA | = | Time weighted average for a normal 8 hour day and 40 hour week, to which nearly all workers may be repeatedly exposed, day after day, without adverse effect. |
| STEL | = | A 15 minute time weighted average exposure which should not be exceeded at any time during a work day, even if the eight-hour TWA is met. Short term exposures should exceed three times the TLV-TWA for no more than a total of 30 minutes during a work day and under no circumstances should they exceed five times the TLV-TWA, provided that the TLV-STEL is not exceeded. |
| Ceiling | = | An instantaneous exposure not to be exceeded at any time during any part of the work day. |

References: ACGIH Threshold Limit Values for Chemical Substances in the Work Environment, 1988-89.
Federal Register, 54 FR 2329-2984, January 19, 1989.

TABLE 4

DERMAL AND ORAL HAZARDS

| DERMAL AND/OR EYE IRRITANT | ORAL THR-HIGH |
|---|---|
| Anthracene | Chloroform |
| Benzene | 1,1-Dichloroethene |
| Chloroform | 4-4'-DDT |
| Ethylbenzene | Phenol |
| Methyl ethyl ketone | Copper |
| Nonanoic acid | Lead |
| Phenol | Magnesium |
| Pyrene | Nickel |
| Toluene | Silver |
| Trichloroethene | |
| 1,1,2,2-Tetrachloroethane | |
| Xylenes | |
| Polychlorinated biphenyls | |
| Arsenic | |
| Zinc | |

Note: THR - Toxic Hazard Review
HIGH ORAL THR - $LD_{50}$: Dose per kilogram of body weight = 50-500 mg (Probable lethal dose for a 70 kg man - one ounce or 28.350 g).

Reference: Based on Dangerous Properties of Industrial Material, 6th Edition, N. Irving Sax Editor, Van Nostrand Reinhold Company, New York, 1984.

TABLE 5

KNOWN OR SUSPECTED CARCINOGENS DETECTED ON-SITE

| COMPOUND | CARCINOGENICITY | AREAS WHERE DETECTED |
|---|---|---|
| Arsenic | Known | Main Plant & Drum Disposal Areas |
| Asbestos | Known | Main Plant |
| Benzene | Known | Main Plant |
| Benzo(a)anthracene | Suspected | Main Plant & Drum Disposal Areas |
| Benzo(b)fluoranthene | Suspected | Main Plant, Arsenal & Drum Disposal Areas |
| Benzo(a)pyrene | Suspected | Drum Disposal Area |
| Bis(2-ethylhexyl)phthalate | Suspected | Drum Disposal Area |
| Cadmium | Suspected | Main Plant, Arsenal & Drum Disposal Areas |
| Chloroform | Suspected | Main Plant & Drum Disposal Area |
| Chromium | Known | Main Plant, Arsenal & Drum Disposal Areas |
| Chrysene | Suspected | Main Plant, Arsenal & Drum Disposal Areas |
| 1,1-Dichloroethene | Suspected | Main Plant & Drum Disposal Areas |
| Indeno(1,2,3-cd)pyrene | Suspected | Drum Disposal Areas |
| Methyl Chloride | Suspected | Main Plant |
| Methylene Chloride | Suspected | Arsenal & Drum Disposal Areas |
| Nickel | Suspected | Main Plant, Arsenal & Drum Disposal Areas |
| Polychlorinated biphenyls | Suspected | Main Plant & Drum Disposal Areas |
| 1,1,2,2-Tetrachloroethane | Suspected | Main Plant & Drum Disposal Areas |
| Trichloroethene | Suspected | Main Plant, Arsenal & Drum Disposal Areas |

References: Based on United States Department of Health and Human Services "Fourth Annual Report on Carcinogens" 1985 and ACGIH "Threshold Limit Values for Chemical Substances in the Work Environment", 1988-89.

TABLE 6

PPE FOR EACH PROJECT TASK WITH IDENTIFIED HAZARDS

| PROJECT TASK | PPE LEVEL |
|---|---|
| NOT WITHSTANDING ANY OF THE REQUIREMENTS LISTED BELOW, ANY ACTIVITY IN BUILDINGS, OR INVOLVING THE DISTURBANCE OF RUBBLE REQUIRES RESPIRATORS APPROVED FOR PROTECTION FROM ASBESTOS FIBERS. | |
| A. Remedial Investigation/Feasibility Study | |
| - Soil gas survey | C-3 |
| - Test borings and monitoring well installation | C-1 |
| - Develop wells | C-3 |
| - Periodic monitoring of water levels | D-1 |
| - Excavation of test pits | C-1 |
| - Sampling and analysis of soils, ground water and air | C-3 |
| - Covertype and wildlife identification | D-2 |
| B. Interim Remedial Tasks | |
| - Vacuum extraction<br>- test borings | C-1 |
| - Aeration of stockpiled soils | C-1 |
| - PCB removal from basement floor of building No. 8 | C-2 |

PPE Descriptions

Level C-1

- Full face air-purifying respirator, with organic vapor cartridges, on hand
- Tyvek suit, PE coated
- Chemical protective gloves (latex)
- Rubber boots (pull on) and safety shoes
- Safety glasses/goggles/face shield
- Hard hat
- Coveralls

TABLE 6

PPE FOR EACH PROJECT TASK WITH IDENTIFIED HAZARDS
(Continued)

Level C-2

- Same as C-1 except:

- Respirator with cartridges approved for protection from asbestos fibers must be worn
- Chemical protective gloves (nitrile)
- Tyvek suit to be Saranex coated

Level C-3

- Same as C-1, except hard hat not needed

Level D-1

- Chemical protective gloves (latex)
- Rubber boots (pull-on) and safety shoes
- Safety glasses
- Coveralls

Level D-2

- Same as D-1 except gloves not needed

TABLE 7
RESPIRATOR SELECTION

| PARAMETER | RESPIRATOR | CONCENTRATION RANGE | RESPIRATOR | CONCENTRATION RANGE |
|---|---|---|---|---|
| Benzene | See Table 8 - OSHA Standards for Benzene | | | |
| Chloroform | SCBAF:PD,PP/SAF:PD,PP: ASCBA | At any concentration | | |
| Cyclopentadiene | CCROV/SA/SCBA | less than or equal to 750 ppm | PAPROV/CCRFOV/PAPRTOV | less than or equal to 1000 ppm |
| Dibutyl phthalate | DMF | less than or equal to 50 mg/cu. m | PAPRDM/SA:CF | less than or equal to 125 mg/cu. m |
| Ethylbenzene | PAPROV/SA/SCBA/CCROV | less than or equal to 1000 ppm | GMFOV/SAF/SCBAF | less than or equal to 2000 ppm |
| 1,1-Dichloroethylene | SCBA | At any concentration | | |
| Methyl ethyl ketone (2-butanone) | PAPROV/CCRFOV | less than or equal to 1000 ppm | GMFOV/SA:CF/SCBAF/SAF | less than or equal to 3000 ppm |
| Methyl isobutyl ketone | CCROV/SA/SCBA | less than or equal to 500 ppm | PAPROV/CCRFOV | less than or equal to 1000 ppm |
| Methyl chloride (chloromethane) | SCBAF:PD,PP/SAF: PD,PP:ASCBA | At any concentration | | |
| Methylene chloride | SCBAF:PD,PP/SAF: PD,PP:ASCBA | At any concentration | | |
| Naphthalene | CCROVDM/SA/SCBA | less than or equal to 100 ppm | SA:CF/PAPROVDM | less than or equal to 250 ppm |
| Phenol | CCROVDM/SA/SCBA | less than or equal to 50 ppm | SA:CF/PAPROVDM | less than or equal to 250 ppm |
| 1,1,2,2-Tetrachloroethane | SCBAF:PD,PP/SAF: PD,PP:ASCBA | At any concentration | | |
| Tetrachloroethylene | SCBAF:PD,PP/SAF: PD,PP:ASCBA | At any concentration | | |
| Toluene | CCROV/SA/PAPROV/SCBA | less than or equal to 1000 ppm | SA:CF/SCBAF/SAF/GMFOV | less than or equal to 2000 ppm |

TABLE 7
RESPIRATOR SELECTION

| PARAMETER | RESPIRATOR | CONCENTRATION RANGE | RESPIRATOR | CONCENTRATION RANGE |
|---|---|---|---|---|
| 1,1,1-Trichloroethane | SA/SCBA | less than or equal to 1000 ppm | | |
| Trichloroethylene | SCBAF:PD,PP/ SAF:PD,PP:ASCBA | At any concentration | | |
| Xylenes | CCROV/PAPROV/SA/SCBA | less than or equal to 1000 ppm | | |

CCRFOV.............Any chemical cartridge respirator with a full facepiece and organic vapor cartridge(s)
CCROV..............Any chemical cartridge respirator with organic vapor cartridge(s)
CCROVDM............Any chemical cartridge respirator with organic vapor cartridge(s) in combination with a dust and mist filter
DMF................Any dust and mist respirator with a full facepiece
GMFOV..............Any air-purifying full facepiece respirator (gas mask) with a chin-style or front- or back-mounted organic vapor canister
PAPRDM.............Any powered air-purifying respirator with a dust and mist filter
PAPROV.............Any powered air-purifying respirator with organic vapor cartridge(s)
PAPROVDM...........Any powered air-purifying respirator with organic vapor cartridge(s) in combination with a dust and mist filter
PAPRTOV............Any powered purifying respirator with a tight fitting facepiece and organic vapor cartridge(s)
SA.................Any supplied air respirator
SA:CF..............Any supplied-air respirator operated in a continuous flow mode
SAF................Any supplied-air respirator with a full facepiece
SAF:PD,PP..........Any supplied-air respirator with a full facepiece and operated in pressure-demand or other positive pressure mod
SAF:PD,PP:ASCBA....Any supplied-air respirator with a full facepiece and operated in pressure-demand or other positive pressure mod in combination with an auxiliary self-contained breathing apparatus operated in pressure-demand or other positiv pressure mode
SCBA...............Any self-contained breathing apparatus
SCBAF..............Any self-contained breathing apparatus with a full facepiece
SCBAF:PD,PP........Any self-contained breathing apparatus with a full facepiece and operated in a pressure-demand or other positive pressure mode

Reference: Based on "NIOSH POCKET GUIDE TO CHEMICAL HAZARDS, U.S. Department of Health and Human Services, Washington, D.C., 1987.

TABLE 8

RESPIRATORY PROTECTION FOR BENZENE

| Airborne concentration of benzene or condition of use | Respirator type |
|---|---|
| (a) Less than or equal to 10 ppm. | (1) Half-mask air-purifying respirator with organic vapor cartridge. |
| (b) Less than or equal to 50 ppm. | (1) Full facepiece respirator with organic vapor cartridges. |
| | (1) Full facepiece gas mask with chin style canister.[1] |
| (c) Less than or equal to 100 ppm. | (1) Full facepiece powered air-purifying respirator with organic vapor canister.[1] |
| (d) Less than or equal to 1,000 ppm. | (1) Supplied air respirator with full facepiece in positive-pressure mode. |
| (e) Greater than 1,000 ppm or unknown concentration. | (1) Self-contained breathing apparatus with full facepiece in positive pressure mode. |
| | (2) Full facepiece positive-pressure supplied-air respirator with auxiliary self-contained air supply. |
| (f) Escape | (1) Any organic vapor gas mask; or |
| | (2) Any self-contained breathing apparatus with full facepiece. |
| (g) Firefighting | (1) Full facepiece self- contained breathing apparatus in positive pressure mode. |

[1] Canisters must have a minimum service life of four (4) hours when tested at 150 ppm benzene, at a flow rate of 64 LPM, 25 °C, and 85% relative humidity for non-powered air purifying respirators. The flow rate shall be 115 LPM and 170 LPM respectively for tight fitting and loose fitting powered air-purifying respirators.

Reference: Federal Register 29 CFR 1910.1028, July 1, 1988

# Appendices

MALCOLM PIRNIE

# APPENDIX A

## FORMS

MALCOLM PIRNIE

# HNU Air Monitoring Data

Site Sketch

Site Name ____________________

Client Name ____________________

Project No. ____________________

Sampler's Name ____________________

Weather & Notes ____________________

| Date | Time | Wind Direction | Wind Speed | Location | Span Setting | Concen- tration |
|---|---|---|---|---|---|---|
| | | | | | | |
| | | | | | | |
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| | | | | | | |

MALCOLM PIRNIE

# PERSONAL SAFETY LOG

Employee Name: ______________________ Site Name: ______________________

Client Name: ______________________ Project Number: ______________________

Work Performed: ____________________________________________

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Date | | | | | | | |
| Work Area | | | | | | | |
| Hours on Site | | | | | | | |
| Coveralls | | | | | | | |
| Tyvek | | | | | | | |
| Gloves, Inner | | | | | | | |
| Gloves, Outer | | | | | | | |
| Boots | | | | | | | |
| Hard Hat | | | | | | | |
| Face Shield | | | | | | | |
| Resp., Dust | | | | | | | |
| Resp., Half | | | | | | | |
| Resp., Full | | | | | | | |
| SCBA | | | | | | | |
| Resp., ESC | | | | | | | |
| Dosimeter | | | | | | | |
| Air Monitor | | | | | | | |
| Others | | | | | | | |
| Decontamination | | | | | | | |
| Complete | | | | | | | |
| Incomplete | | | | | | | |

Comments: ____________________________________________

MALCOLM PIRNIE

# SITE SAFETY LOG

Site Name: ______________________ Date: ______________

Client Name: ______________________ Project No.: ______________

Employees on Site: ______________________________

Others on Site: ______________________________

Work Area: ______________________________

Weather Conditions: ______________________________

Summary of Site Conditions (include air monitoring data): __________

______________________________________________

______________________________________________

______________________________________________

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______________________________________________

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______________________________________________

State Any First Aid Administered: ______________________

______________________________________________

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______________________________________________

______________________________________________

______________________________________________

______________________________________________

______________________________________________

Filled Out By: ______________________

MALCOLM PIRNIE

# PERSONAL HAZARDOUS WASTE EXPOSURE RECORD

Name: ______________________________ Date: ______________________

Site Location: ______________________________________________

Operation being Performed at Time of Exposure: ________________________

_________________________________________________________________

Hazardous Materials Present: ______________________________________

_________________________________________________________________

Type of Exposure: __________________________________________________

_________________________________________________________________

Decontamination Measures Taken: ___________________________________

_________________________________________________________________

_________________________________________________________________

Observed Reactions or Health Effects: ______________________________

_________________________________________________________________

_________________________________________________________________

Comments: _________________________________________________________

_________________________________________________________________

_________________________________________________________________

Employee's Signature: ____________

APPENDIX B

HEALTH AND SAFETY PROGRAM
HAZARDOUS WASTE OPERATIONS MANUAL

# HEALTH & SAFETY PROGRAM

FOR

HAZARDOUS WASTE OPERATIONS

MALCOLM PIRNIE, INC.
SYRACUSE, NEW YORK

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## TABLE OF CONTENTS
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## SECTION 1

## INTRODUCTION

Malcolm Pirnie, Inc. (MPI) has developed this Health and Safety Program (HSP) to protect its employees who are engaged in hazardous waste operations. The elements of the HSP conform to the Occupational Safety and Health Administration (OSHA) requirements of 29 CFR Part 1910. In addition to the program outlined in this document, a specific Site Safety Plan (SSP) is developed for each hazardous waste site where MPI works.

SECTION 2

PERSONNEL ORGANIZATION AND RESPONSIBILITIES

2.1 Malcolm Pirnie Personnel

The general organization of MPI, with respect to implementing the HSP, is described below. Specific personnel assignments are identified in the SSP for each site.

Project Director - The Project Director is responsible for the overall site investigation, including the implementation of the HSP. Specifically, this includes appropriate emphasis on providing adequate manpower, equipment and time resources to conduct the investigation safely; and appropriate disciplinary action when unsafe acts or practices occur.

Health and Safety Officer - The Health and Safety Officer is responsible for overall coordination of the Health and Safety Program. He advises the Project Director and other members of the project management team on matters involving the health and safety of personnel involved in all phases of the HWS investigation. He is responsible for establishing procedures for the protection of personnel and to monitor the effectiveness of the procedures.

Project Manager - Project Managers are responsible for insuring that personnel under their direction comply with all of the requirements of the HSP. They are also responsible for notifying the Health and Safety Officer of any incidents that affect the safety or health of personnel involved in the HWS investigation.

Site Safety Officers - Site Safety Officers will be designated by the Project Managers. They will be field personnel whose primary duties are technical in nature, but who will be responsible for insuring that personnel within their specific work area are in compliance with the requirements of the HSP. The Officers are also responsible for insuring that any visitors to the site while work is in progress comply with the Health and Safety Standards described herein.

2.2 Subcontractors

If MPI retains a subcontractor to work on a hazardous waste site, MPI will inform that subcontractor of any potential fire, explosion, health or other safety hazards that have been identified. This will be accomplished by giving them a copy of the SSP. All subcontractors are responsible for: (1) providing their own personal protection equipment; (2) training their employees; (3) providing medical surveillance for their employees, if required; and, (4) insuring their employees are advised of and meet the requirements of the SSP.

## SECTION 3

## SITE CHARACTERIZATION AND MONITORING

Site characterization is the process of data gathering and assessment. It provides the information needed to identify site hazards and select appropriate worker protection methods. Site characterization will be performed at MPI in three phases: (1) off-site survey, (2) on-site survey, and (3) on-going survey. Both the off-site and on-site surveys will be performed in advance of regular project work. The on-going survey is conducted after the site has been determined safe for the commencement of work.

### 3.1 Off-Site Survey

The off-site survey is conducted prior to site entry by project personnel. It is performed by gathering information away from the site (e.g. interview/records research) and conducting reconnaissance at the site perimeter. The information gathered is used to evaluate site hazards and establish personal protective equipment (PPE) to be used during the on-site survey.

#### 3.1.1 Interview/Records Research

The following information, to the extent available, will be collected during the off-site survey:

1. Location and approximate size of the site.
2. Description and duration of the hazardous waste activity that occurred at the site.
3. Description and duration of the hazardous waste operations to be performed by MPI.
4. Site topography, e.g., historical and current site maps, site photographs, USGS quadrangle map and land use maps.
5. Site accessibility by air and roads.
6. Pathways for hazardous substance dispersion.

7. Prevailing wind direction and other pertinent meteorologic data.
8. Present status and capabilities of emergency response teams that would provide assistance to on-site personnel at the time of an emergency.
9. Hazardous substances and health hazards involved or expected at the site and their chemical and physical properties.

3.1.2 Perimeter Reconnaissance

Perimeter reconnaissance, if conducted, may include the following types of activities.

1. Observe the site topography and facility lay-out.
2. Note any unusual conditions such as clouds, discolored liquids, oil slicks, vapors or other suspicious substances.
3. Note any unusual odors.
4. Monitor the ambient air at the site perimeter.
5. Note any biological indicators, such as dead animals or distressed vegetation.
6. Collect and analyze off-site samples.

3.1.3 IDLH Hazard Identification

All suspected conditions that may pose inhalation or skin absorption hazards that are immediately dangerous to life or health (IDLH), or other conditions that may cause death or serious harm will be identified during the off-site survey and evaluated during the on-site survey. Indicators of potential IDLH and other dangerous conditions are listed in Table 1, below.

## TABLE 1

### INDICATORS OF IDLH AND OTHER DANGEROUS CONDITIONS

1. Large containers or tanks that must be entered.
2. Enclosed spaces such as buildings or trenches that must be entered.
3. Potentially explosive or flammable situations (indicated by bulging drums, effervescence, gas generation or instrument readings).
4. Extremely hazardous materials (such as cyanide, phosgene, or radiation sources.
5. Visible vapor clouds.
6. Areas where biological indicators (such as dead animals or distressed vegetation) are located.

### 3.2 On-Site Survey

The purpose of the on-site survey is to verify and supplement the information collected during the off-site survey.

#### 3.2.1 On-Site Survey PPE

Personal protective equipment (PPE) used by MPI during the on-site survey will provide protection to a level of exposure below established permissible exposure limits for known or suspected hazardous substances and health hazards and will provide protection against other known and suspected hazards identified during the off-site survey. If the selected PPE does not include positive-pressure self-contained breathing apparatus, then an escape self-contained breathing apparatus of at least five minutes duration shall be carried by MPI personnel or kept available at their immediate work station.

#### 3.2.2 On-Site Survey Air Monitoring

During the on-site survey, air monitoring will be performed to identify the following IDLH and dangerous conditions, unless there is sufficient evidence to rule out their possibilities:

1. hazardous levels of ionizing radiation,
2. combustible or explosive atmospheres,
3. oxygen deficiency, and
4. toxic gases or vapors.

The guidelines in Table 2, below, will be used to evaluate the hazard level of the measured atmospheric conditions.

## TABLE 2

### GUIDELINES FOR EVALUATING ATMOSPHERIC HAZARDS

| HAZARD | MEASURED LEVEL | ACTION |
|---|---|---|
| Explosive Atmosphere | Less Than 10% LEL* | Continue investigation. |
| | 10%-25% LEL | Continue on-site monitoring with extreme caution as higher levels are encountered. |
| | Greater Than 25% LEL | Explosion hazard. Withdraw from area immediately. |
| Oxygen | Less Than 19.5% | Monitor oxygen wearing self-contained breathing apparatus. NOTE: Combustible gas readings are not valid in atmospheres with less than 19.5% oxygen. |
| | 19.5%-25% | Continue investigation with caution. Deviation from normal level may be due to the presence of other substances. |
| | Greater Than 25% | Fire hazard potential discontinue investigation. Consult a fire safety specialist. |
| Radiation | Less Than or Equal to 2 mrem/hr | Radiation above background levels (normally 0.01-0.02 mrem/hr) signifies the possible presence of radiation sources. Continue investigation with caution. Perform thorough monitoring. Consult with a health physicist. |
| | Greater Than 2 mrem/hr. | Potential radiation hazard. Evacuate site. Continue investigation only upon the advise of a health physicist. |
| Toxic Gases and Vapors | Depends on chemical | Consult standard reference manuals for air concentration/toxicity data. |

* LEL: Lower Explosive Limit

### 3.2.3 Other On-Site Survey Work

Depending on the type of site, other types of work to be performed during the on-site survey may include the following:

1. Note the types of containers, impoundments, or other storage systems:
   - Paper or wood packages.
   - Metal or plastic barrels or drums.
   - Underground tanks.
   - Aboveground tanks.
   - Compressed gas cylinders.
   - Pits, ponds, or lagoons.
   - Other.
2. Note the condition of waste containers and storage systems:
   - Sound (undamaged).
   - Visibly rusted or corroded.
   - Leaking.
   - Bulging.
   - Types and quantities of material in containers.
   - Labels on containers indicating corrosive, explosive, flammable, radioactive, or toxic materials.
3. Note the physical condition of the materials:
   - Gas, liquid, or solid.
   - Color and turbidity.
   - Behavior, e.g., corroding, foaming, or vaporizing.
   - Conditions conducive to splash or contact.
4. Identify natural wind barriers:
   - Buildings.
   - Hills.
   - Tanks.

5. Determine the potential pathways of dispersion:
   - Air.
   - Biologic routes, such as animals and food chains.
   - Groundwater.
   - Land surface.
   - Surface water.
6. If necessary, use one or more of the following remote sensing or subsurface investigative methods to locate buried wastes or contaminant plumes:
   - Electromagnetic resistivity.
   - Seismic refraction.
   - Magnetometry.
   - Metal detection.
   - Ground-penetrating radar.
7. Note any indicators of potential exposure to hazardous substances:
   - Dead fish, animals or vegetation.
   - Dust or spray in the air.
   - Fissures or cracks in solid surfaces that expose deep waste layers.
   - Pools of liquid.
   - Foams or oils on liquid surfaces.
   - Gas generation or effervescence.
8. Note any safety hazards. Consider:
   - Conditions of site structures.
   - Obstacles to entry and exit.
   - Terrain homogeneity.
   - Terrain stability.
   - Stability of stacked material.
9. Identify any reactive, incompatible, flammable, or highly corrosive wastes.
10. Note land features.

11. Note the presence of any potential naturally occurring skin irritants or dermatitis-inducing agents, for example:
    - Poison ivy.
    - Poison oak.
    - Poison sumac.
12. Note any tags, labels, markings, or other identifying indicators.
13. Collect samples:
    - Air.
    - Drainage ditches.
    - Soil (surface and subsurface).
    - Standing pools of liquids.
    - Storage containers.
    - Streams and ponds.
    - Groundwater (upgradient, beneath site, downgradient).
14. Sample for or otherwise identify:
    - Biologic or pathologic hazards.
    - Radiologic hazards.

### 3.3 Evaluation of Preliminary Survey Data

Once the presence and levels of specific chemicals have been established, the hazards associated with these chemicals will be determined. First, information concerning the chemical, physical and toxicologic properties of each substance known or expected to be present at the site will be collected. Then, the risk associated with these substances will be evaluated by making a comparison with established exposure guidelines. These guidelines are issued by the American Conference of Governmental Industrial Hygienists (ACGIH), the National Institute for Safety and Health (NIOSH) and OSHA. Where specific guidelines do not exist, the best information available will be used.

Once the hazards and risks are established, appropriate engineering controls, work practices and personal protective equipment can be selected (see Section 7). The preliminary survey information will also be used to complete the Site Safety Plan. Through the SSP and other aspects of the informational program (see Section 8), the site hazard information will be provided to all MPI personnel and subcontractors working on the site.

3.4 On-Going Survey

It is important to recognize that site characterization is an on-going process. Changes in site conditions or work activities that could affect worker safety must be continually evaluated. Accordingly, MPI will perform periodic air monitoring, as a minimum, when:

1. Work begins on a different portion of the site.
2. Contaminants other than those previously identified are being handled.
3. A different type of operation is initiated (e.g. drum sampling as opposed to well drilling).
4. Personnel are handling leaking drums or containers, or working in areas with obvious liquid contamination (e.g. a spill or lagoon).

The data collected during the on-going survey will be evaluated by the Health and Safety Officer to determine if it is safe to continue work, and whether PPE should be upgraded or downgraded.

# SECTION 4

## SITE CONTROL

Site control measures will be developed and included in the SSP for each site where MPI conducts hazardous waste operations. The site control measures will, as a minimum, include:

1. A site map.
2. Site work zones.
3. Use of a buddy system.
4. Site communications.
5. Safe work practices.
6. Identification of the nearest medical assistance.

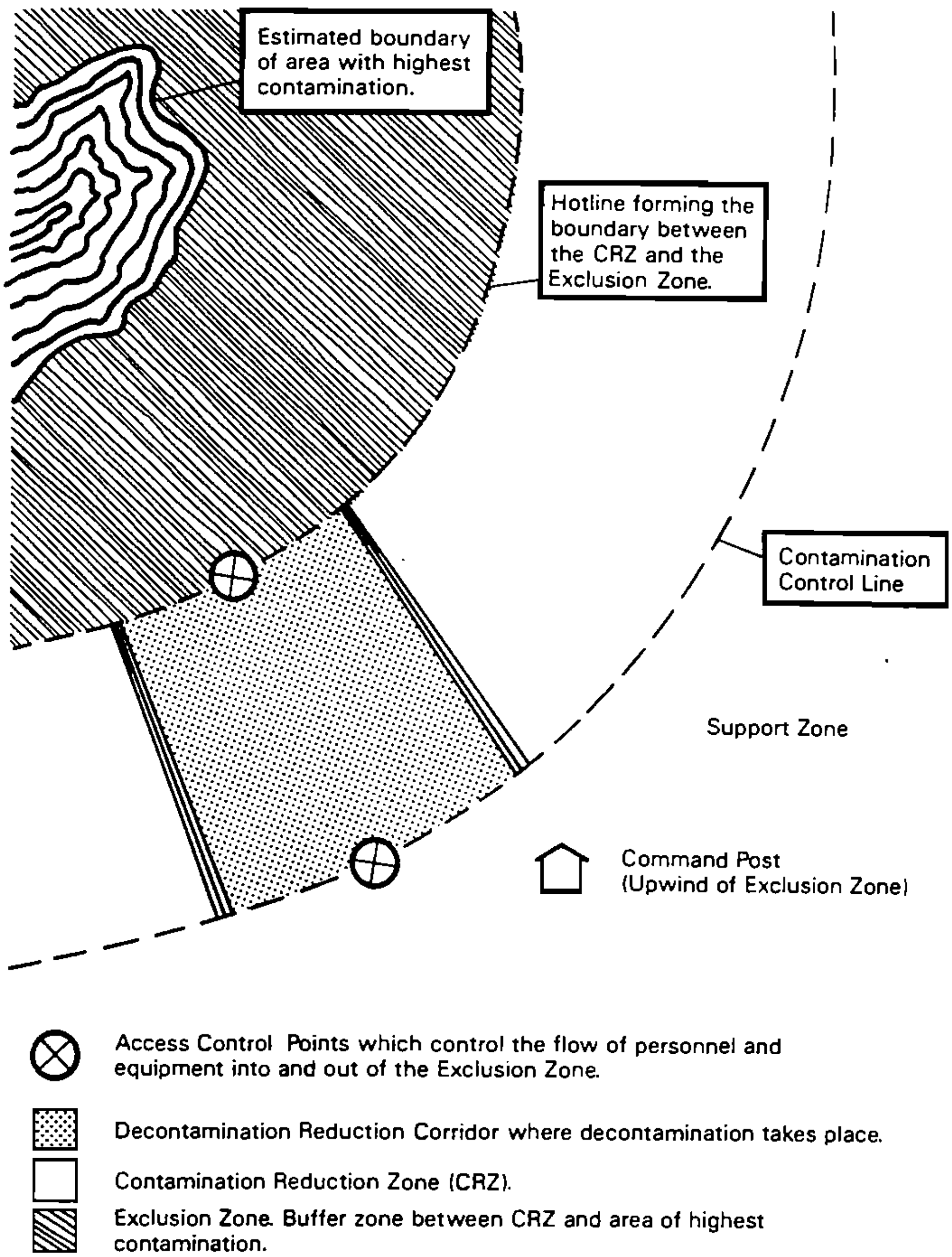
### 4.1 Site Map and Work Zone

A map showing topographic features, prevailing wind direction, drainage, and the location of buildings, containers, impoundments, pits and tanks will be prepared for each site. The main use of the map will be to identify access routes, evacuation routes and problem areas, and to establish site work zones.

The purpose of establishing site work zones is to reduce the accidental spread of hazardous substances from contaminated to clean areas, and to ensure that personnel can be located and evacuated in an emergency. While hazardous waste sites may be broken down into as many zones as necessary, there are generally three types of zones (Figure 1): (1) Exclusion Zone, (2) Contamination Reduction Zone, and (3) Support Zone.

#### 4.1.1 Exclusion Zone

The Exclusion Zone is the contaminated area of the site. The Hotline is the outer boundary of the Exclusion Zone. When establishing the Hotline, MPI will consider not only the location of hazardous substances, but also the distance needed to prevent an




| MALCOLM PIRNIE | SITE WORK ZONES | MALCOLM PIRNIE, INC. FIGURE 1 |
|---|---|---|

explosion, fire or air-borne contaminants from affecting personnel outside the Exclusion Zone. Within the Exclusion Zone, different levels of PPE may be required depending on the type of work being performed. The flow of personnel and equipment into and out of the Exclusion Zone will be regulated by establishing Access Control Points.

4.1.2 Contamination Reduction Zone

The Contamination Reduction Zone (CRZ) is the transition area between the contaminated area and the clean area. The Contamination Control Line marks the outer boundary of the CRZ. The Contamination Reduction Corridor (CRC) is the area within the CRZ where decontamination of equipment and personnel takes place. An Access Control Point will be established at each end of the CRC. In addition to decontamination, the CRZ may be used for equipment resupply, sample preparation or a worker rest area.

4.1.3 Support Zone

The Support Zone is the clean area where hazardous conditions should not exist. If possible, the Support Zone will be located upwind of the Exclusion Zone. Personnel in the support zone are responsible for emergency response. While they are not required to wear PPE, they should have it available in case they need to rescue someone in the Exclusion Zone.

4.2 Communications and the Buddy System

To facilitate emergency response, personnel in the Exclusion Zone and the Support Zone will have a pre-established system of communication. If verbal communication is not possible, communication will be established through the use of two-way radios, pre-arranged hand signals, or other visual signals, such as flares.

Personnel working in the Exclusion Zone will use the buddy system. "Buddy system" means a system of organizing employees into work groups such that each member of the work group is designated to observe the activities of at least one other employee in the work group. Under no circumstances will one site worker work alone in the Exclusion Zone. The purpose of a buddy is to:

1. Provide his or her partner with assistance.
2. Observe his or her partner for signs of chemical or heat exposure.
3. Periodically check the integrity of his or her partner's protective clothing.
4. Notify support personnel if emergency help is needed.

4.3 Safe Work Practices

The following rules apply to all personnel working at the hazardous waste site, unless specifically exempted under the Site Safety Plan.

1. Smoking, eating or drinking is forbidden while on site.
2. Personnel are to work in pairs at all times. At locations designated by the Health and Safety Officer, personnel shall not conduct operations on-site without off-site backup. This shall include any site where, when respiratory protection is in use, failure of th respirator could result in the user being overcome by a toxic or oxygen-deficient atmosphere. Use of SCBA's or other supplied air breathing apparatus requires the assistance of a standby person. The back-up person must be in constant contact with the site personnel (through voice, visual or signal-line) and must be suitably equipped to be able to assist the site personnel in case of emergency.

3. Ignition of flammable liquids within or through improvised heating devices (barrels, etc.) or space heaters is forbidden.
4. Entry into areas or spaces where toxic or explosive concentrations of gases or dust may exist without proper equipment is prohibited.
5. Any injury or unusual health effect must immediately be reported to one of the project managers.
6. Contact with samples or excavated materials must be minimized.
7. Use of contact lenses is prohibited while on site.
8. In situations where protective equipment will prevent verbal communication, hand signals should be developed beforehand.
9. Work clothes should be worn on-site (not civilian clothes). Work clothes should not be worn home.
10. Beards and other facial hair that would impair the effectiveness of respiratory protection are prohibited.

## SECTION 5

## TRAINING

All MPI personnel will receive hazardous waste operations training. The level of training will be consistent with their job functions and responsibilities.

### 5.1 General Training

#### 5.1.1 Training Schedule

Prior to engaging in any type of hazardous waste operation, all employees will receive a minimum of 40 hours of initial instruction off the site and a minimum of three days of actual field experience under the direct supervision of a trained experienced supervisor. On-site supervisors directly responsible for employees engaged in hazardous waste operations will receive an additional 8 hours of specialized training on managing such operations. Employees who have equivalent work experience and/or training, may be considered as meeting the initial training requirement. Workers who may be exposed to unique or special hazards will receive additional training, as needed.

All employees will receive 8 hours of refresher training annually.

#### 5.1.2 Training Syllabus

General training for all employees will cover at least the following topics:

1. Recognition of hazards.
2. Use and care of personal protective equipment.
3. Work practices by which the employee can minimize risks from hazards.
4. Safe use of engineering controls and field equipment.
5. Decontamination.

6. Medical surveillance requirements.

7. Recognition of symptoms and signs which might indicate over-exposure to hazards.

5.2 <u>Site-Specific Training</u>

Prior to initiating work at a new site, workers will receive site-specific training in the form of a pre-entry briefing. The training will cover certain elements of the SSP, including at least the following:

1. Names of personnel and alternates responsible for site safety and health.
2. Safety, health and other hazards present on the site.
3. Engineering controls, work practices and PPE required at the site.
4. Symptoms and signs which indicate over-exposure to hazards which may be encountered on the site.
5. Site control measures.
6. Confined space entry procedures (if applicable).
7. Site emergency response.

## SECTION 6
## MEDICAL SURVEILLANCE

### 6.1 Medical Examinations

MPI's Health and Safety Program includes medical surveillance for all employees who are or may be exposed to hazardous wastes. These employees receive medical examinations and consultations on the following occasions:

1. Prior to initial assignment to a hazardous waste job.
2. Annually.
3. At termination of employment or reassignment to a department which does not do hazardous waste work.
4. As soon as possible, upon notification by an employee that he/she has developed signs or symptoms indicating possible overexposure to hazardous substances or health hazards.
5. At more frequent times, if determined by the examining physician as medically necessary.

These medical examinations are performed by a licensed physician and are provided at no cost to the employee, without loss of pay, and at a reasonable time and place.

### 6.2 Medical Records

A record of the medical surveillance will be retained at MPI for the period specified in 20 CFR 1910.20 (30 years). The record will include the following information for each employee:

1. Name and social security number.
2. Physicians written opinions (only as related to occupational exposure), as follows:
    a. Results of the medical examination.
    b. Any detected medical conditions which could place the employee at increased risk of material impairment of health.
    c. Recommended limitations on the employee's assigned work.

   d. A statement that the employee has been informed by the physician of the results of the medical examination and any medical conditions which require further examination or treatment.

3. Any employee medical complaints related to exposure to hazardous substances.
4. Information provided to the physician, as follows:
   a. A description of the employee's duties, as relates to exposure.
   b. Employee's exposure levels or anticipated exposure levels.
   c. A description of any personal protective equipment used or to be used.
   d. Information from previous examinations which is not readily available to the examining physician.

## SECTION 7

## ENGINEERING CONTROLS, WORK PRACTICES, AND PERSONAL PROTECTIVE EQUIPMENT

Wherever feasible, MPI will institute engineering controls (e.g. remote equipment) and work practices (e.g. locating employees upwind of hazards) to maintain employee exposure below the permissible limits. However, in most situations, this exposure protection will be accomplished by the use of personal protective equipment (PPE).

### 7.1 Personal-Protective Equipment Program

This written PPE program has been established by MPI to protect the wearer from safety and health hazards, and to prevent injury to the wearer from incorrect use and/or malfunction of the PPE.

#### 7.1.1 Site Hazards and PPE Selections

Depending upon the types and levels of hazards present at a particular site, varying degrees of protective equipment will be selected. If the preliminary site evaluation does not produce sufficient information to identify the hazards or suspected hazards, then Level B PPE will be used, and direct reading instruments will be carried for identifying IDLH conditions. The levels of protection listed below are generally based on USEPA Guidelines. A list of the appropriate clothing for each level is also provided in Table 3.

Level A. Level A protection must be worn in IDLH conditions, or when a reasonable determination has been made that the highest available level of respiratory, skin, eye, and mucous membrane protection is needed. It should be noted that while Level A provides maximum available protection, it does not protect against all possible hazards. Consideration of the heat stress that can arise from wearing level A protection should also enter into the decision making process. (Comfort is not a decision factor, but heat stress will influence work rate, scheduling, and other work practices.)

Level B. Level B protection must be used when the highest level of respiratory protection but less skin protection is needed. Hazardous material exposure will not adversely affect the few unprotected areas of the body (i.e., the back of the neck).

Level C. Level C provides the same level of skin protection as Level B, but a lower level of respiratory protection. Level C is used when the hazardous air contaminants have been identified and measured, and a canister is available that can remove the contaminant. Hazardous material exposure will not adversely affect the few unprotected areas of the body (i.e., the back of the neck).

Level D. While not required by the EPA, this level is identical to Level C, except that half-face respirators are used.

Level E. Level E is the basic work uniform. It cannot be worn on any site where respiratory or skin hazards exist. Investigators and response personnel must not be permitted to work in civilian clothes.

## TABLE 3

### DESIGNATED PPE FOR EACH PROTECTION LEVEL

Level A.

- Open circuit, pressure-demand SCBA
- Totally encapsulated chemical resistant suit
- Gloves, inner (surgical type)
- Gloves, outer, chemical protective
- Boots, chemical protective, steel toe and shank
- 2-way radio communication

Level B.

- Open circuit, pressure-demand SCBA
- Chemical protective clothing:
  Overalls and long sleeved jacket; disposable chemical resistant coveralls; coveralls; one or two piece chemical splash suit with hood
- Gloves, inner (surgical type)
- Gloves, outer, chemical protective
- Boots, chemical protective, steel toe and shank
- 2-way radio communication

Level C.

- Full face air-purifying respirator
- Chemical protective clothing:
  Overall and long-sleeved jacket; disposable chemical resistant coveralls; coveralls; one or two piece chemical splash suit
- Gloves, inner (surgical type)
- Gloves, outer, chemical protective
- Boots, chemical protective, steel toe and shank
- 2-way radio communication

Level D.

- Half face air-purifying respirator
- Chemical protective clothing:
  Overalls and long-sleeved jacket; disposable chemical resistant coveralls; coveralls; one or two piece chemical splash suit
- gloves, inner (surgical type)
- Gloves, outer, chemical protective
- Boots, chemical protective with steel toe and shank
- Optional safety glasses, splash goggles or face shield

Level E.

- Coveralls
- Boots/shoes, safety
- Safety glasses
- Hard hat with optional faceshield

NOTE: In addition to the requirements above, a hard hat, chemical resistant overboots, and cloth coveralls (under protective clothing) may be required depending on site characteristics.

7.1.2 PPE Procedures

7.1.2.1 PPE Use

PPE can offer a high degree of protection only when used properly. Accordingly, when using PPE, MPI will adopt precautionary or prohibitive measures, as follows:

- Facial hair and long hair interfere with respirator fit and wearer vision. Any facial hair that passes between the face and the sealing surface of the respirator should be prohibited. Even a few days' growth of facial hair will allow excessive contaminant penetration. Long hair must be effectively contained within protective hair coverings.
- Eyeglasses with conventional temple pieces (earpiece bars) will interfere with the respirator-to-face seal of a full facepiece. A spectacle kit should be installed in the face masks of workers requiring vision correction.
- When a worker must wear corrective lenses as part of the facepiece, the lenses shall be fitted by qualified individuals to provide good vision, comfort, and a gas-tight seal. Contact lenses may trap contaminants and/or particulates between the lens and the eye, causing irritation, damage, absorption, and an urge to remove the respirator. Wearing contact lenses with a respirator in contaminated atmosphere is prohibited (20 CFR Part 1910.134(e)(5)(ii)).
- Gum and tobacco chewing should be prohibited during respirator use since they may cause ingestion of contaminants and may compromise the respirator fit.

7.1.2.2 Work Mission Duration

Prior to beginning work in PPE, the anticipated duration of the work mission will be determined. The purpose of this is to assure than an adequate air supply will be available and that suit permeation and penetration by contaminants will not occur.

7.1.2.3 PPE Maintenance and Storage

PPE will be stored in such a way as to prevent exposure to dust, moisture, sunlight, damaging chemicals, extreme temperatures and impact. Protective clothing (such as a totally encapsulated suit) will be folded or hung in accordance with manufacturer's recommendations. Different types and materials of clothing and gloves will be kept separated to prevent issuance of the wrong type by mistake. Potentially contaminated clothing (if not disposable) will be stored in a well-ventilated area, separate from street clothing. SCBAs, supplied-air respirators and air-purifying respirators will be dismantled, washed and disinfected after each use.

Maintenance of SCBAs and air supply equipment will be performed by authorized manufacturer's representatives.

7.1.2.4 PPE Decontamination

PPE decontamination is covered in Section 10 of this HSP.

7.1.2.5 PPE Training and Proper Fitting

MPI's HSP training program (Section 5) includes requirements for training personnel in the use and care of PPE. Personnel will also receive respirator fitting instructions including demonstrations and practice in how it is worn, how to adjust it, and how to determine that it fits properly. To assure proper protection, the facepiece fit shall be checked by the wearer each time he puts on the respirator.

7.1.2.6 PPE Donning Procedures

The following donning procedures are for Level A protection (totally encapsulated suit):

1. Inspect the clothing and respiratory equipment before donning (see Inspection).
2. Adjust hard hat or headpiece, if worn, to fit user's head.
3. Open back closure used to change air tank (if suit has one) before donning suit.
4. Standing or sitting, step into the legs of the suit; ensure proper placement of the feet within the suit; then gather the suit around the waist.
5. Put on chemical-resistant safety boots over the feet of the suit. Tape the leg cuff over the tops of the boots.
   - If additional chemical-resistant boots are required, put these on now.
   - Some one-piece suits have heavy-soled protective feet. With these suits, wear short, chemical-resistant safety boots inside the suit.
6. Put on air tanks and harness assembly of the SCBA. Don the facepiece and adjust it to be secure, but comfortable. Do not connect the breathing hose. Open valve on air tank.
7. Perform negative and positive respirator facepiece seal test procedures.
   - To conduct a negative-pressure test, close the inlet part with the palm of the hand or squeeze the breathing tube so it does not pass air, and gently inhale for about 10 seconds. Any inward rushing of air indicates a poor fit.

Note that a leaking facepiece may be drawn tightly to the face to form a good seal, giving a false indication of adequate fit.

- To conduct a positive-pressure test, gently exhale while covering the exhalation valve to ensure that a positive pressure can be built up. Failure to build a positive pressure indicates a poor fit.

8. Depending on type of suit:
   - Put on long-sleeved inner gloves (similar to surgical gloves).
   - Secure gloves to sleeves, for suits with detachable gloves (if not done prior to entering the suit).
   - Additional overgloves, worn over attached suit gloves, may be donned later.
9. Put sleeves of suit over arms as assistant pulls suit up and over the SCBA. Have assistant adjust suit around SCBA and shoulders to ensure unrestricted motion.
10. Put on hard hat, if needed.
11. Raise hood over head carefully so as not to disrupt face seal of SCBA mask. Adjust hood to give satisfactory comfort.
12. Begin to secure the suit by closing all fasteners on opening until there is only adequate room to connect the breathing hose. Secure all belts and/or adjustable leg, head, and waistbands.
13. Connect the breathing hose while opening the main valve.

14. Have assistant first ensure that wearer is breathing properly and then make final closure of the suit.
15. Have assistant check all closures.
16. Have assistant observe the wearer for a period of time to ensure that the wearer is comfortable, psychologically stable, and that the equipment is functioning properly.

For Level B protection, donning procedures similar to those for Level A will be used. For Levels C and D, the following procedures will be used:

1. Put on inner (surgical type) gloves.
2. Put on disposable chemical resistant coveralls.
3. Tape sleeves of coveralls to inner gloves.
4. Put on chemical protective boots and cinch tight or tape to legs.
5. Put on respirator and conduct fit test.
6. Put on hard hat and eye protection if needed.
7. Put on outer chemical protective gloves and tape to sleeves.

7.1.2.7 <u>PPE Doffing Procedures</u>

The following doffing procedures will be used, as appropriate to the protection level being worn:

If sufficient air supply is available to allow appropriate decontamination before removal:

1. Remove any extraneous or disposable clothing, boot covers, outer gloves, and tape.
2. Have assistant loosen and remove the wearer's safety shoes or boots.
3. Have assistant open the suit completely and lift the hood over the head of the wearer and rest it on top of the SCBA tank.
4. Remove arms, one at a time, from suit. Once arms are free, have assistant lift the suit

up and away from the SCBA backpack - avoiding any contact between the outside surface of the suit and the wearer's body - and lay the suit out flat behind the wearer. Leave internal gloves on, if any.

5. Sitting, if possible, remove both legs from the suit.
6. Follow procedure for doffing SCBA.
7. After suit is removed, remove internal gloves by rolling them off the hand, inside out.
8. Remove internal clothing and thoroughly cleanse the body.

If the low-pressure warning alarm has sounded, signifying that approximately 5 minutes of air remain:

1. Remove disposable clothing.
2. Quickly scrub and hose off, especially around the entrance/exit zipper.
3. Open the zipper enough to allow access to the regulator and breathing hose.
4. Immediately attach an appropriate canister to the breathing hose (the type and fitting should be predetermined). Although this provides some protection against any contamination still present, it voids the certification of the unit.
5. Follow Steps 1 through 8 of the regular doffing procedure above. Take extra care to avoid contaminating the assistant and wearer.

7.1.2.8 PPE Inspection

CLOTHING

Before use:

1. Determine that the clothing material is correct for the specified task at hand.

2. Visually inspect for:
   - imperfect seams
   - non-uniform coatings
   - tears
   - malfunctioning closures
3. Hold up to light and check for pinholes.
4. Flex product:
   - observe for cracks
   - observe for other signs of shelf deterioration
5. If the product has been used previously, inspect inside and out for signs of chemical attack:
   - discoloration
   - swelling
   - stiffness

During the work task, periodically inspect for:

1. Evidence of chemical attack such as discoloration, swelling, stiffening, and softening. Keep in mind, however, that chemical permeation can occur without any visible effects.
2. Closure failure.
3. Tears.
4. Punctures.
5. Seam discontinuities.

GLOVES

1. BEFORE USE, pressurize glove to check for pinholes. Either blow into glove, then roll gauntlet towards fingers or inflate glove and hold under water. In either case, no air should escape.

FULLY-ENCAPSULATING SUITS

Before use:

1. Check the operation of pressure relief valves.

2. Inspect the fitting of wrists, ankles, and neck.

3. Check faceshield, if so equipped, for:
   - cracks
   - crazing
   - fogginess

RESPIRATORS

1. Inspect respirators:
   - before and after each use
   - at least monthly when in storage
   - every time they are cleaned
2. Check all connections for tightness.
3. Check material conditions for:
   - signs of pliability
   - signs of deterioration
   - signs of distortion
4. Check for proper setting and operation of regulators and valves (according to manufacturers' recommendations).
5. Check operation of alarm(s).
6. Check faceshields and lenses for:
   - cracks
   - crazing
   - fogginess

7.1.2.9 PPE In-Use Monitoring

During equipment use, workers should report any perceived problems or difficulties to their supervisor. These malfunctions include, but are not limited to:

1. Degradation of the protective ensemble.
2. Perception of odors.
3. Skin irritation.
4. Unusual residues on PPE
5. Discomfort.
6. Resistance to breathing.
7. Fatigue due to respirator use.

8. Interference with vision or communication.

9. Restriction of movement.

10. Personal responses such as rapid pulse, nausea and chest pain.

7.1.2.10 Evaluation of the PPE Program

The PPE Program will be reviewed annually by the MPI Corporate Health and Safety Officer to assess its effectiveness.

7.1.2.11 Limitations During Temperature Extremes

Heat stress can be a serious problem for workers wearing PPE. The risk level is determined by the amount and type of PPE being worn, and the type and duration of work being performed. The effects can range from heat fatigue to serious illness or death. Workers developing signs of heat stress should discontinue work and notify their supervisor. Signs and symptons of heat stress are listed below:

1. Heat rash may result from continuous exposure to heat or humid air.

2. Heat cramps are caused by heavy sweating with inadequate electrolyte replacement. Signs and symptoms include:
   - muscle spasms
   - pain in the hand, feet and abdomen

3. Heat exhaustion occurs from increased stress on various body organs including inadequate blood circulation due to cardiovascular insufficiency or dehydration. Signs and symptons include:
   - pale, cool, moist skin
   - heavy sweating
   - dizziness
   - nausea
   - fainting

4. Heat stroke is the most serious form of heat stress. Temperature regulation fails and the body temperature rises to critical levels. Immediate action must be taken to cool the body before serious injury and death occur. Competent medical help must be obtained. Signs and symptons are:
   - red, hot, usually dry skin
   - lack of reduced perspiration
   - nausea
   - dizziness and confusion
   - strong, rapid pulse
   - coma

## SECTION 8
## INFORMATIONAL PROGRAMS

MPI's health and safety informational program consists of preparation of the Site Safety Plan (SSP), and pre-entry briefings of the work team.

### 8.1 Site Safety Plan

The SSP is developed based on the results of the preliminary off-site and on-site surveys. The purpose of the SSP is to delineate the hazards, procedures, and protective measures specific to the project site. At a minimum, the SSP will address the following:

1. Names of the Site Safety Officer and other key personnel responsible for site health and safety.
2. Analysis of the hazards and risks associated with each project task or operation.
3. Employee training assignments.
4. PPE to be used for each project task or operation.
5. Medical surveillance requirements above and beyond the standard requirements if warranted by site conditions or exposures.
6. Frequency and types of air monitoring, personnel monitoring and environmental sampling. Methods of maintenance and calibration of monitoring and sampling equipment to be used.
7. Site control measures.
8. Decontamination procedures.
9. Standard Operating Procedures (e.g. drum sampling).
10. Contingency (Emergency Response) Plan.
11. Confined space entry procedures, if applicable.

The Site Safety Officer will conduct inspections as necessary to determine the effectiveness of the SSP. Any deficiencies in the effectiveness of the plan will be immediately corrected.

8.2 Pre-Entry Briefings

Pre-entry briefings will be held prior to initiating site work, and at other times as necessary. The purpose of the briefings will be apprise the workers of the SSP and assure that it is followed. Unusual or extreme hazards and new procedures will be particularly stressed. Other areas to be covered are listed in Section 5.2 of this program are re-iterated below:

1. Names of personnel and alternates responsible for site safety and health.
2. Safety, health and other hazards present on the site.
3. Engineering controls, work practices and PPE required at the site.
4. Symptoms and signs which indicate over exposure to hazards which may be encountered on the site.
5. Site control measures.
6. Confined space entry procedures (if applicable).
7. Site emergency response.

## SECTION 9

## MATERIAL HANDLING PROCEDURES

### 9.1 General

1. Drums and containers used during the clean-up shall meet the appropriate DOT, OSHA, and EPA regulations for the wastes that they contain.
2. Drums and containers shall be inspected and their integrity shall be assured prior to being moved. Drums or containers that cannot be inspected before being moved because of inaccessible storage conditions shall be moved to an accessible location and inspected prior to further handling.
3. Unlabeled drums and containers shall be considered to contain hazardous substances and handled accordingly until the contents are positively identified and labeled.
4. Site operations shall be organized to minimize the amount of drum or container movement.
5. Prior to movement of drums or containers, all employees exposed to the transfer operation shall be warned of the potential hazards associated with the contents of the drums or containers.
6. U.S. Department of Transportation specified salvage drums or containers and suitable quantities of proper absorbent shall be kept available and used in areas where spills, leaks, or ruptures may occur.
7. Where major spills may occur, a spill containment program shall be implemented to contain and isolate the entire volume of the hazardous substance being transferred.

8. Drums and containers that cannot be moved without rupture, leakage, or spillage shall be emptied into a sound container using a device classified for the material being transferred.
9. A ground-penetrating system or other type of detection system or device shall be used to estimate the location and depth of drums or containers.
10. Soil or covering material shall be removed with caution to prevent drum or container rupture.
11. Fire extinguishing equipment meeting the requirements of 29 CFR Part 1910, Subpart L shall be on hand and ready for use to control small fires.

9.2 Opening Drums and Containers

1. Where an airline respirator system is used, connections to the bank of air cylinders shall be protected from contamination and the entire system shall be protected from physical damage.
2. Employees not actually involved in opening drums or containers shall be kept a safe distance from the drums or containers being opened.
3. If employees must work near or adjacent to drums or containers being opened, a suitable shield that does not interfere with the work operation shall be placed between the employee and the drums or containers being opened to protect the employee in case of accidental explosion.
4. Controls for drum or container opening equipment, monitoring equipment, and fire suppression equipment shall be located behind the explosion-resistant barrier.
5. Material handling equipment and hand tools shall be of the type to prevent sources of ignition.

6. Drums and containers shall be opened in such a manner that excess interior pressure will be safely relieved. If pressure cannot be relieved from a remote location, appropriate shielding shall be placed between the employee and the drums or containers to reduce the risk of employee injury.

7. Employees shall not stand upon or work from drums or containers.

9.3 Electrical Material Handling Equipment

Electrical material handling equipment used to transfer drums and containers shall:

1. Be positioned and operated to minimize sources of ignition related to the equipment from igniting vapors released from ruptured drums or containers, or

2. Meet the requirements of 29 CFR 1910.307 and be of the appropriate electrical classification for the materials being handled.

9.4 Radioactive Wastes

Drums and containers containing radioactive wastes shall not be handled until such time as their hazard to employees is properly assessed.

9.5 Shock Sensitive Wastes

As a minimum, the following special precautions shall be taken when drums and containers containing or suspected of containing shock-sensitive wastes are handled:

1. All non-essential employees shall be evacuated from the area of transfer.

2. Material handling equipment shall be provided with explosive containment devices or protective shields to protect equipment operators from exploding containers.

3. An employee alarm system capable of being perceived above surrounding light and noise

conditions shall be used to signal the commencement and completion of explosive waste handling activities.

4. Continuous communications (i.e. portable radios, hand signals, telephones, as appropriate) shall be maintained between the employee-in-charge of the immediate handling area and the site safety officer or command post until such time as the handling operation is completed. Communication equipment or methods that could cause shock sensitive materials to explode shall not be used.

5. Drums and containers under pressure, as evidenced by bulging or swelling, shall not be moved until such time as the cause for excess pressure is determined and appropriate containment procedures have been implemented to protect employees from explosive relief of the drum.

6. Drums and containers containing packaged laboratory wastes shall be considered to contain shock-sensitive or explosive materials until they have been characterized.

9.6 <u>Laboratory Waste Packs</u>

In addition to the requirements listed for shock sensitive wastes, the following precautions shall be taken, as a minimum in handling laboratory waste packs (lab packs):

1. Lab packs shall be opened only when necessary and then only by an individual knowledgeable in the inspection, classification, and segregation of the containers within the pack according the hazards of the wastes.

2. If crystalline material is noted on any container, the contents shall be handled as a shock-sensitive waste until the contents are identified.

9.7 Sampling Drums and Containers

Sampling of containers and drums shall be done in accordance with a sampling procedure which is part of the site safety plan.

9.8 Shipping and Transport

1. Drums and containers shall be identified and classified prior to packaging for shipment.
2. Drum or container staging areas shall be kept to the minimum number necessary to safely identify and classify materials and prepare them for transport.
3. Staging areas shall be provided with adequate access and egress routes.
4. Bulking of hazardous wastes shall be permitted only after a thorough characterization of the materials has been completed.

9.9 Tank and Vault Procedures

1. Tanks and vaults containing hazardous substances shall be handled in a manner similar to that for drums and containers taking into consideration the size of the tank or vault.
2. Appropriate tank or vault entry procedures will be specified in the SSP under "confined space entry procedures".

## SECTION 10

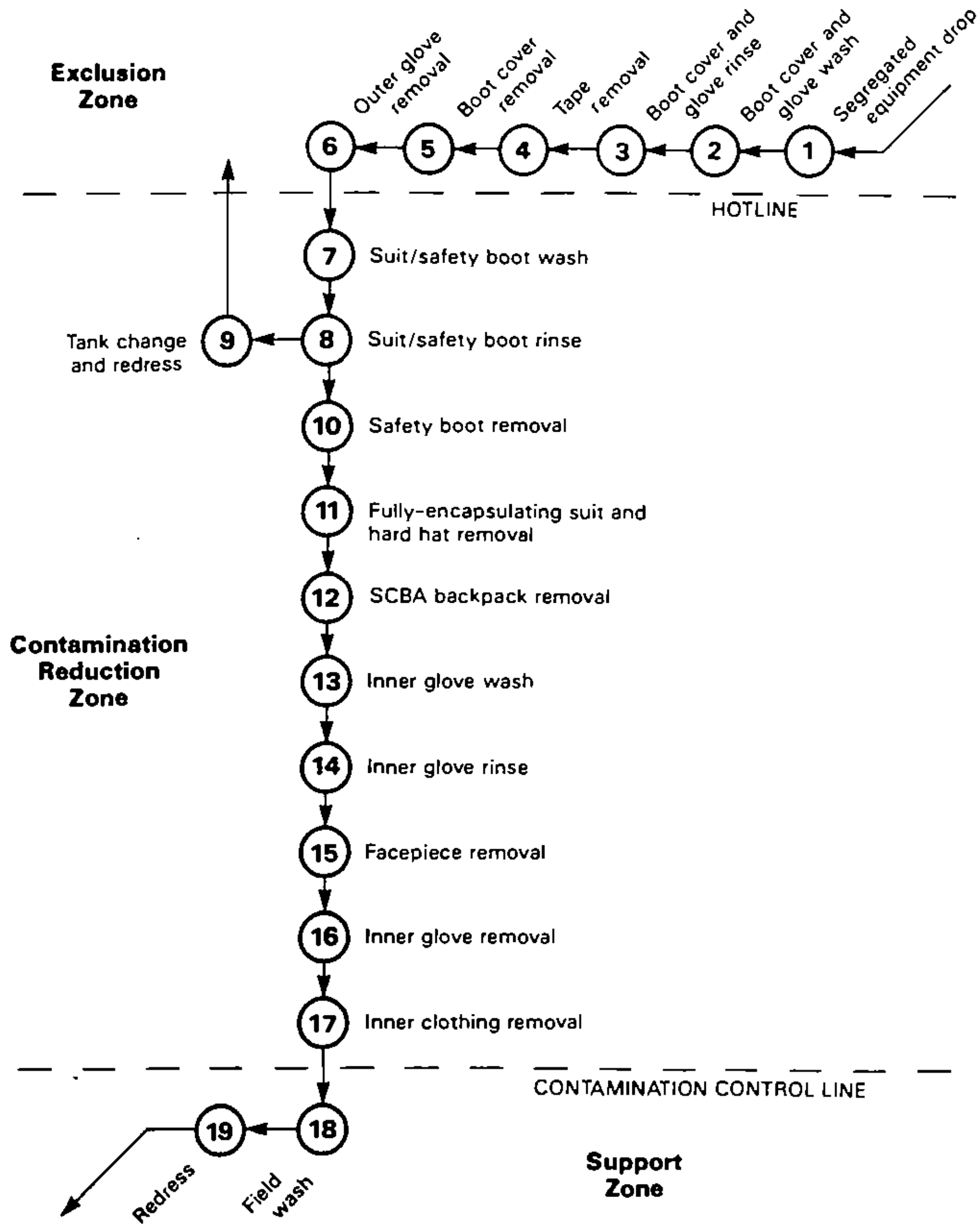
## DECONTAMINATION

Decontamination procedures are developed by MPI on a site-by-site basis and included in the SSP for each project. These procedures are monitored and revised as necessary by the Site Safety Officer to maintain their effectiveness. The SSP also includes standard operating procedures designed to minimize worker and equipment contact with hazardous substances.

Decontamination takes place in the site CRZ (see Section 4.1.2) and generally proceeds as shown on Figure 2. Under no circumstances are field personnel allowed to leave a contaminated area without proper decontamination. This also applies to equipment which is contaminated. Impermeable clothing which contacts hazardous substances is decontaminated prior to being removed by the worker. Workers whose non-impermeable clothing becomes wetted with hazardous substances will immediately remove that clothing and proceed to shower. The clothing will be disposed of or decontaminated. All equipment and solvents used for decontamination will be decontaminated or disposed of properly.

Where the decontamination procedure requires change rooms and showers, they will be provided in accordance with 29 CFR 1910.141. Unauthorized personnel are not allowed to remove PPE from the change rooms.

Protective clothing and equipment are decontaminated, cleaned, laundered, maintained or replaced as necessary to maintain their effectiveness. Where commercial laundries or cleaning establishments are used, they are informed of the potentially harmful effects of exposures to hazardous substances.




MALCOLM PIRNIE

DECONTAMINATION LAYOUT

MALCOLM PIRNIE, INC.

FIGURE 2

## SECTION 11
## EMERGENCY RESPONSE

Malcolm Pirnie will develop an emergency response plan for each site where hazardous waste operations are conducted. The plan will be included in the SSP as a separate section. It will be compatible and integrated with the disaster, fire and/or emergency response plans of local, state and federal agencies. The specific elements of the plan will depend on the types of emergencies anticipated at the site. For example, a site where only one drum of hazardous waste is stored will not require complex emergency planning. However, emergency plans will generally include the following elements:

1. Site topography, layout, and prevailing weather conditions.
2. Procedures for reporting incidents to local, state and federal governmental agencies.
3. Pre-emergency planning.
4. Personnel roles, lines of authority, training and communication.
5. Emergency recognition and prevention.
6. Safe distances and places of refuge.
7. Site security and control.
8. Evacuation routes and procedures.
9. Decontamination.
10. Emergency medical treatment and first aid.
11. Emergency alerting and response procedures.
12. PPE and emergency equipment.

APPENDIX C

GUIDANCE MEMORANDUM
ON THE DISPOSAL OF
DRILLING CUTTINGS

DRAFT

Regional Solid and Hazardous Waste Engineers, Bureau Directors and Section Chiefs

Michael J. O'Toole, Jr., Directors, Div. of Hazardous Waste Remediation

PROPOSED DIVISION TECHNICAL AND ADMINISTRATIVE GUIDANCE MEMORANDUM
TAGM - DISPOSAL OF DRILL CUTTINGS

## Purpose

This document presents disposal alternatives for drilling cuttings and spoils from the installation of monitoring wells or soil borings at Class 2 sites.

## Introduction

This document specifically addresses the handling of drill cuttings derived from Class 2 sites. These cuttings generally come under the derivative rule [Part 371.1 (d)(3) and (4)] which defines any constituent derived from a Class 2 hazardous waste site as a hazardous substance and requires handling of these materials as hazardous wastes.

## Disposal Alternatives

Disposal of monitoring well drill cuttings can be accomplished by one of two methods: on-site disposal or off site disposal.

1. On-site disposal to ground surface

   Drill cuttings may be disposed of on the ground surface provided the following conditions are met:

   a. The drill cuttings are disposed of within 20 feet of the well or bore hole.

   b. The drill cuttings are disposed of in such a manner that surface runoff does not move the cuttings or cause contaminants from the cuttings to migrate to a surface water body or a receiving stream.

   c. The drill cuttings are disposed of in such a manner so that infiltrate which comes in contact with the cuttings will migrate to the aquifer in contact with the area the cuttings came from. This is consistent with returning the contaminants to the aquifer of withdrawal.

   d. Drill cuttings do not pose an imminent threat to health and environment during disposal. Drill cuttings will be tested by field analytical techniques such as pH, conductivity, organic vapor levels, physical appearance or other Department approved field analytical methods to ascertain the threat to health and environment. This testing will be consistent with the Health and Safety Plan for the site. Drill cuttings which pose an imminent health threat will be handled on a case-by-case basis according to the determined risk.

e. Drill cuttings may be collected and disposed of at a specific central on-site location which provides the same protection as paragraphs (b) and (d) above.

2. Off site disposal

Drill cuttings may be disposed of off site provided the following conditions are met:

a. The drill cuttings are accompanied by a 6 NYCRR Part 372 manifest and a 6 NYCRR Part 364 Transporter Permit.

b. The drill cuttings are disposed of at facilities that are permitted to operate a hazardous waste disposal facility under 6 NYCRR Part 373 or a waiver of this regulation has been obtained.

c. In the case where drill cuttings have been determined not to be hazardous wastes, they can be disposed of at a permitted Part 360 disposal site.

c:newtagm

APPENDIX D

RESULTS OF ANALYSIS
ROMAN HOUSEHOLD WELL

Analysis Results
Report Number 111387001
Date: November 13, 1987

| CLIENT I.D.<br>Malcolm Pirnie, Inc.<br>(B.S.&K.-Columbia Mills)<br>(GRAB SAMPLES) | B-7D<br>10/20/87<br>12:00 PM | B-8D<br>10/20/87<br>10:45 AM | B-9<br>10/20/87<br>12:15 PM | Roman's Well<br>10/20/87<br>10:35 AM |
|---|---|---|---|---|
| ULI I.D. | 29487053 | 29487054 | 29487055 | 29487056 |
| Hexavalent Chromium | <0.01 | <0.01 | <0.01 | <0.01 |
| DISSOLVED: | | | | |
| Cadmium | <0.005 | <0.005 | 0.055 | <0.005 |
| Chromium | <0.05 | <0.05 | <0.05 | <0.05 |
| Copper | <0.02 | 0.04 | <0.02 | <0.02 |
| Lead | <0.1 | <0.1 | <0.1 | <0.1 |
| Nickel | 0.04 | 0.06 | 0.04 | <0.03 |
| Silver | <0.05 | <0.05 | <0.05 | <0.05 |
| Zinc | 0.054 | 0.029 | 0.055 | 0.041 |

All results are expressed as mg/l.

Approved: ______________

Date: 11/13/87

Analysis Results
Report Number 111387001
Date: November 13, 1987

EPA 624

| CLIENT I.D.<br>Malcolm Pirnie, Inc.<br>(B.S.&K.-Columbia Mills)<br>(GRAB SAMPLES) | B-7D<br>10/20/87<br>12:00 PM | B-8D<br>10/20/87<br>10:45 AM | B-9<br>10/20/87<br>12:15 PM | Roman's Well<br>10/20/87<br>10:35 AM |
|---|---|---|---|---|
| ULI I.D. | 29487053 | 29487054 | 29487055 | 29487056 |
| Chloromethane | <3 | <3 | <3 | <3 |
| Bromomethane | <3 | <3 | <3 | <3 |
| Vinyl Chloride | <3 | <3 | <3 | <3 |
| Chloroethane | <3 | <3 | <3 | <3 |
| Methylene Chloride | <3 | <3 | <3 | <3 |
| Trichlorofluoromethane | <3 | <3 | <3 | <3 |
| 1,1-Dichloroethylene | <3 | <3 | <3 | <3 |
| t-1,2-Dichloroethylene | <3 | <3 | <3 | <3 |
| 1,1-Dichloroethane | <3 | <3 | <3 | <3 |
| Chloroform | <3 | <3 | <3 | <3 |
| 1,2-Dichloroethane | <3 | <3 | <3 | <3 |
| 1,1,1-Trichloroethane | <3 | <3 | <3 | <3 |
| Benzene | <3 | <3 | <3 | <3 |
| Carbon Tetrachloride | <3 | <3 | <3 | <3 |
| 1,2-Dichloropropane | <3 | <3 | <3 | <3 |
| Bromodichloromethane | <3 | <3 | <3 | <3 |
| Trichloroethylene | <3 | <3 | <3 | <3 |
| c-1,3-Dichloropropene | <3 | <3 | <3 | <3 |
| t-1,3-Dichloropropene | <3 | <3 | <3 | <3 |
| 1,1,2-Trichloroethane | <3 | <3 | <3 | <3 |
| Toluene | <3 | <3 | <3 | <3 |
| Dibromochloromethane | <3 | <3 | <3 | <3 |
| Tetrachloroethylene | <3 | <3 | <3 | <3 |
| 2-Chloroethylvinyl ether | <3 | <3 | <3 | <3 |
| Chlorobenzene | <3 | <3 | <3 | <3 |
| Ethylbenzene | <3 | <3 | <3 | <3 |

All results are expressed as ug/l.

Analysis Results
Report Number 111387001
Date: November 13, 1987

EPA 624 (cont.)

| CLIENT I.D.<br>Malcolm Pirnie, Inc.<br>(B.S.&K.-Columbia Mills)<br>(GRAB SAMPLES) | B-7D<br>10/20/87<br>12:00 PM | B-8D<br>10/20/87<br>10:45 AM | B-9<br>10/20/87<br>12:15 PM | Roman's<br>Well<br>10/20/87<br>10:35 AM |
|---|---|---|---|---|
| ULI I.D. | 29487053 | 29487054 | 29487055 | 29487056 |
| Bromoform | <3 | <3 | <3 | <3 |
| 1,1,2,2-Tetrachloroethane | <3 | <3 | <3 | <3 |
| 1,2-Dichlorobenzene | <3 | <3 | <3 | <3 |
| 1,3-Dichlorobenzene | <3 | <3 | <3 | <3 |
| 1,4-Dichlorobenzene | <3 | <3 | <3 | <3 |
| Total Xylenes | <3 | <3 | <3 | <3 |

All results are expressed as ug/l.

Approved: ______________ 11/13/87

Disclaimer: The test results and procedures utilized, and laboratory interpretations of data obtained by ULI as contained in this report are believed by ULI to be accurate and reliable for sample(s) tested. In accepting this report, the customer agrees that the full extent of any and all liability for actual and consequential damages of ULI for the services performed shall be equal to the fee charged to the customer for the services as liquidated damages.

*PREPARED FOR*

FILE COPY 8

# BOND , SCHOENECK & KING

# COLUMBIA MILLS SITE
# MINETTO , NEW YORK

# INTERIM REMEDIAL MEASURES PROGRAM UPDATE

MALCOLM PIRNIE

ENVIRONMENTAL ENGINEERS, SCIENTISTS & PLANNERS

*FEBRUARY 1990*

# INTERIM REMEDIAL MEASURES
# PROGRAM UPDATE

FOR

BOND, SCHOENECK & KING



FOR

COLUMBIA MILLS SITE
MINETTO, NEW YORK

FEBRUARY 1990

MALCOLM PIRNIE, INC.
ENVIRONMENTAL ENGINEERS,
SCIENTISTS & PLANNERS
7481 Henry Clay Boulevard
Liverpool, New York 13088

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LIST OF APPENDICES

# 1.0 INTRODUCTION

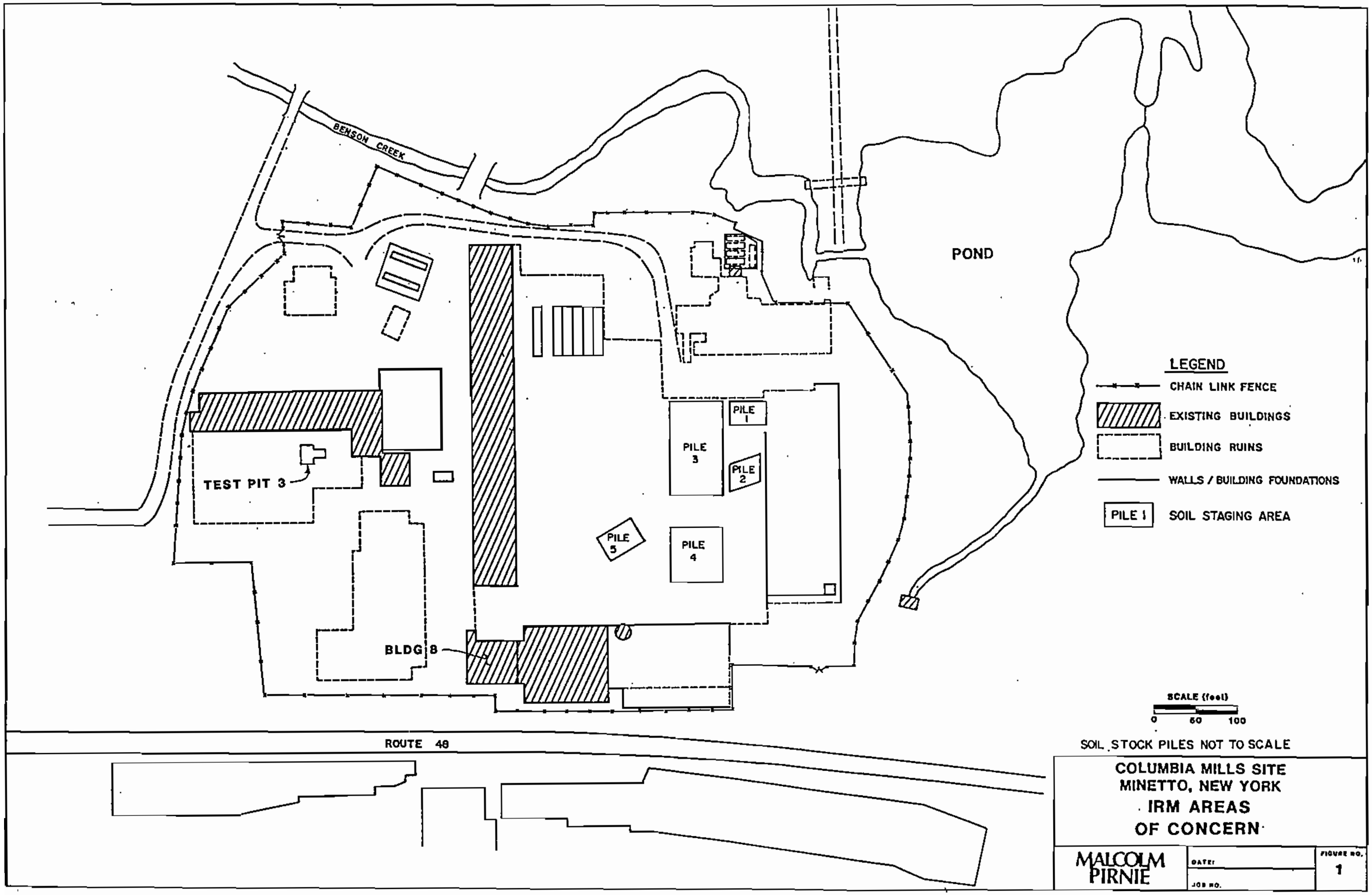
## 1.1 BACKGROUND

In March 1989, Columbia Mills entered into an agreement with the New York State Department of Environmental Conservation (NYSDEC) to develop and implement an Interim Remedial Measure (IRM) program according to the terms set forth in a formal Consent Order (A7-0167-89-02). The three areas of the site addressed under the IRM program are shown on Figure 1 and include the test pit #3 area (volatile organic compounds), the five piles of soil originating from the underground storage tank excavations (volatile organic compounds), and the Building No. 8 area (PCB's). Plans for the remediation of these areas were detailed in the "IRM Work Plan" dated April 1989 and revised in July 1989, and in Addendum No. 1 to the Work Plan (August 1989). I DO NOT HAVE THIS

Revisions to the original Work Plan were made in response to the NYSDEC's comments as contained in its June 16, 1989 and June 20, 1989 correspondences. Following the receipt of additional comments from the State in its August 18, 1989 letter, Addendum No. 1 to the Work Plan was submitted to the NYSDEC by Malcolm Pirnie, Inc. (MPI). Final comments on the IRM Work Plan (specifically, aeration of the soil piles) were contained in the State's September 14, 1989 correspondence, in which authorization was granted to begin the PCB remediation in Building No. 8.

## 1.2 PURPOSE AND SCOPE

The purpose of this report is to summarize the present status of the IRM program being conducted at the Columbia Mills site by MPI. Activities completed during 1989 are detailed in Section 2, and Section 3 outlines activities planned for 1990.




COLUMBIA MILLS SITE
MINETTO, NEW YORK
IRM AREAS
OF CONCERN

MALCOLM PIRNIE

DATE:

JOB NO.

FIGURE NO. 1

# 2.0 WORK PERFORMED DURING 1989

## 2.1 GENERAL

This section details actions undertaken as part of the IRM program during 1989.

## 2.2 REMEDIATION OF SOILS NEAR TEST PIT #3

The first phase of this IRM was to determine the extent of contamination in the area of test pit #3. During September 6-8, 1989, nine shallow borings (approximately twelve feet deep) and eight piezometers were installed by North Star Drilling Co., under the supervision of MPI, and soil and ground water samples were obtained. The soil samples were submitted to Weston and analyzed for volatile organics, metals and semivolatiles. Three ground water samples were obtained from the piezometers and submitted to Weston for volatile organics analysis. All samples submitted to Weston were analyzed in accordance with NYSDEC CLP 1987. The results are contained in Table 1, and Figure 2 shows the locations of the borings. Complete analytical results are contained in appendix A.

Elevated levels of semivolatiles were found in soil from Borings BP-6, 7 and 9, and volatile compounds (including tentatively identified compounds (TICs)) were present in soil from all borings, except BP-8. Toluene was estimated to be present at a concentration of 1 ppb in soil from BP-7. Inorganics analysis indicated all metal concentrations were well within the common ranges found in natural soils (USEPA, SW-874, p. 273), except for magnesium which was found in BP-8 at a concentration of 7150 mg/kg. Low levels (2 ug/l to 14 ug/l) of toluene, xylenes, ethylbenzene and 4-methyl-2-pentanone (or methyl isobutyl ketone (MIBK)) were found in the ground water samples obtained from BP-2, 4 and 5.

The investigation into the feasibility of utilizing vacuum extraction as a remedial alternative in the test pit #3 area commenced following the installation of the borings and piezometers. A firm experienced in the design of vacuum extraction systems was contacted, and a site visit was conducted. Initial extraction well locations were layed out on the pad surrounding test pit 3 during Fall 1989, but this layout was abandoned

TABLE 1 IRM SAMPLING IN TEST PIT 3 AREA



Soil borings in test pit #3 area

| PARAMETER | BP-1 | BP-1DL | BP-2 | BP-3 | BP-3 DIL:2.77 | BP-4 | BP-4 DIL:3.29 | BP-5 | BP-6 | BP-6RE | PB-7 | BP-8 | BP-9 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| VOLATILE ORGANICS (ug/kg) | | | | | | | | | | | | | |
| Methylene chloride | 9 B | 50 BD | 690 JB | 700 JB | 34 B | 1500 B | 34 B | 710 JB | 1000 B | 16000 B | 5 JB | 5 JB | 640 JB |
| Toluene | 6 U | 24 U | 740 U | 780 U | 17 U | 1500 U | 19 U | 780 U | 820 U | 8200 U | 1 J | 6 U | 710 U |
| Total xylenes | 6 U | 24 U | 1600 | 780 U | 17 U | 1500 U | 19 U | 2700 | 820 U | 8200 U | 6 U | 6 U | 9800 |
| 4-Methyl-2-pentanone | 420 E | 48 U | 2000 | 1600 U | 35 U | 5900 | 38 U | 1600 U | 14000 | 19000 | 11 U | 11 U | 1200 J |
| TIC's | | | | | | | | | | | | | |
| Unknown | 40 J | 200 J | 8000 J | 1000 J | 40 J | 10000 J | 400 J | 900 J | 40000 J | | | | 20000 J |
| Unknown | 30 J | 100 J | 5000 J | 3000 J | 100 J | | 300 J | 1000 J | | | | | 20000 J |
| Unknown | 40 J | 200 J | 20000 J | 3000 J | 60 J | | 400 J | 1000 J | | | | | 9000 J |
| Unknown | 40 J | 100 J | 10000 J | | 60 J | | 600 J | 800 J | | | | | 30000 J |
| Unknown | 60 J | 300 J | | | 80 J | | 500 J | 3000 J | | | | | |
| Unknown | 40 J | 100 J | | | 100 J | | 1000 J | | | | | | |
| Unknown | 90 J | 100 J | | | 50 J | | 800 J | | | | | | |
| Unknown | 60 J | 200 J | | | 70 J | | 800 J | | | | | | |
| Unknown | 20 J | 100 J | | | 200 J | | 700 J | | | | | | |
| Unknown | 30 J | 200 J | | | 100 J | | 900 J | | | | | | |
| Methyl-cyclohexane | | | 10000 J | | | 70000 J | | | | 300000 J | | | 30000 J |
| Dimethyl-cyclohexane | | | 10000 J | 2000 J | | 10000 J | | 2000 J | | 50000 J | | | 10000 J |
| Dimethyl-cyclohexane | | | | | | | | | | | | | 30000 J |
| Trimethyl-cyclohexane | | | 10000 J | | | | | | | | | | 200000 J |
| Bromofluorobenzene | | | 20000 J | | | | | | 20000 J | | | | |
| Trimethyl cyclopentane | | | 7000 J | 1000 J | | | | | | | | | 10000 J |
| Unknown cyclo-alkane | | | 7000 J | 2000 J | | | | | | | | | |
| Unknown alkane | | | | 2000 J | | 20000 J | | 800 J | 20000 J | 90000 J | | | |
| Unknown alkane | | | | | | 10000 J | | 1000 J | 30000 J | 60000 J | | | |
| Unknown alkane | | | | | | 40000 J | | | 20000 J | 100000 J | | | |
| Unknown alkane | | | | | | | | | | 60000 J | | | |
| Unknown alkane | | | | | | | | | | 50000 J | | | |
| Unknown alkane | | | | | | | | | | 50000 J | | | |
| Unknown alkane | | | | | | | | | | | | | |
| Unknown alkene | | | | 1000 J | | | | | | | | | |
| Hydroxylamine | | | | | | 20000 J | | | | 60000 J | | | |
| 3-Methyl-pentane | | | | | | 30000 J | | | 40000 J | 60000 J | | | |
| 3-Methyl-hexane | | | | | | | | | 50000 J | | | | |
| Heptane | | | | | | 60000 J | | | | | | | |
| Trimethyl-hexane | | | | | | 10000 J | | | 30000 J | | | | |
| C7 alkane | | | | | | | | | 200000 J | | | | |
| Ethyl-methyl-cyclopentane | | | | | | | | | | | | | 50000 J |

file: isb2.wk1

TABLE 1 IRM SAMPLING IN TEST PIT 3 AREA

Soil borings in test pit #3 area

| PARAMETER | BP-1 | BP-1RE | BP-1MS | BP-1MSD | BP-1MSRE | BP-IMSDRE | BP-2 | BP-2RE | BP-3 | BP-3RE | BP-4 | BP-4RE |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SEMIVOLATILES (ug/kg) | | | | | | | | | | | | |
| Napthalene | 380 U | 370 U | 380 U | 380 U | 370 U | 380 U | 370 U | 53 J | 420 U | 420 U | 390 U | 390 U |
| Acenaphthylene | 380 U | 370 U | 380 U | 380 U | 370 U | 380 U | 370 U | 370 U | 420 U | 420 U | 390 U | 390 U |
| Acenaphthene | 380 U | 370 U | S | S | S | S | 370 U | 370 U | 420 U | 420 U | 390 U | 390 U |
| Phenanthrene | 41 J | 370 U | 380 U | 300 J | 370 U | 39 J | 370 U | 370 U | 420 U | 420 U | 390 U | 390 U |
| Anthracene | 380 U | 370 U | 380 U | 72 J | 370 U | 380 U | 370 U | 370 U | 420 U | 420 U | 390 U | 390 U |
| Fluoranthene | 66 J | 44 J | 49 J | 410 | 55 J | 65 J | 46 J | 48 J | 420 U | 420 U | 41 J | 390 U |
| Pyrene | 77 J | 38 J | S | S | S | S | 36 J | 49 J | 420 U | 420 U | 45 J | 390 U |
| Benzo(a)anthracene | 39 J | 370 U | 380 U | 190 J | 370 U | 380 U | 370 U | 370 U | 420 U | 420 U | 390 U | 390 U |
| Chrysene | 42 J | 370 U | 380 U | 190 J | 370 U | 380 U | 370 U | 370 U | 420 U | 420 U | 390 U | 390 U |
| Benzo(b)fluoranthene | 380 U | 370 U | 380 U | 110 J | 370 U | 380 U | 370 U | 370 U | 420 U | 420 U | 390 U | 390 U |
| Benzo(k)fluoranthene | 380 U | 370 U | 380 U | 180 J | 370 U | 380 U | 370 U | 370 U | 420 U | 420 U | 390 U | 390 U |
| Benzo(a)pyrene | 380 U | 370 U | 380 U | 110 J | 370 U | 380 U | 370 U | 370 U | 420 U | 420 U | 390 U | 390 U |
| Indeno(1,2,3-cd)pyrene | 380 U | 370 U | 380 U | 67 J | 370 U | 380 U | 370 U | 370 U | 420 U | 420 U | 390 U | 390 U |
| di-n-Butylphthalate | 160 JB | 1800 B | 310 JB | 300 JB | 2000 B | 2700 B | 930 B | 1800 B | 210 JB | 2900 B | 210 JB | 1100 B |

| PARAMETER | BP-5 | BP-5RE | BP-6 | BP-6RE | PB-7 | PB-7DL | PB-7RE | BP-8 | BP-8RE | BP-9 | BP-9RE |
|---|---|---|---|---|---|---|---|---|---|---|---|
| SEMIVOLATILES (ug/kg) | | | | | | | | | | | |
| Napthalene | 440 U | 430 U | 360 U | 360 U | 1900 U | NA | 1900 U | 360 U | 360 U | 390 U | 390 U |
| Acenaphthylene | 440 U | 430 U | 360 U | 360 U | 470 J | NA | 1900 U | 360 U | 360 U | 390 U | 390 U |
| Acenaphthene | 440 U | 430 U | 360 U | 360 U | 2500 | NA | 470 J | 360 U | 360 U | 390 U | 390 U |
| Phenanthrene | 440 U | 430 U | 410 | 360 U | 26000 | NA | 7600 | 360 U | 360 U | 240 J | 110 J |
| Anthracene | 440 U | 430 U | 93 J | 360 U | 8300 | NA | 2200 | 360 U | 360 U | 54 J | 390 U |
| Fluoranthene | 440 U | 430 U | 530 | 360 U | E | 46000 | 12000 | 360 U | 360 U | 520 | 140 J |
| Pyrene | 440 U | 430 U | 480 | 360 U | E | 51000 | 10000 | 360 U | 360 U | 370 J | 140 J |
| Benzo(a)anthracene | 440 U | 430 U | 190 J | 360 U | 10000 | NA | 3700 | 360 U | 360 U | 230 J | 66 J |
| Chrysene | 440 U | 430 U | 200 J | 360 U | 19000 | NA | 5300 | 360 U | 360 U | 280 J | 71 J |
| Benzo(b)fluoranthene | 440 U | 430 U | 140 J | 360 U | 12000 | NA | 4000 | 360 U | 360 U | 180 J | 50 J |
| Benzo(k)fluoranthene | 440 U | 430 U | 200 J | 360 U | 17000 | NA | 3600 | 360 U | 360 U | 170 J | 59 J |
| Benzo(a)pyrene | 440 U | 430 U | 170 J | 360 U | 16000 | NA | 4600 | 360 U | 360 U | 200 J | 53 J |
| Indeno(1,2,3-cd)pyrene | 440 U | 430 U | 93 J | 360 U | 11000 | NA | 3100 | 360 U | 360 U | 120 J | 390 U |
| di-n-Butylphthalate | 870 B | 2600 B | 140 JB | 900 B | 800 JB | NA | 2000 B | 600 B | 1800 B | 150 J | 2500 B |

TABLE 1 IRM SAMPLING IN TEST PIT 3 AREA

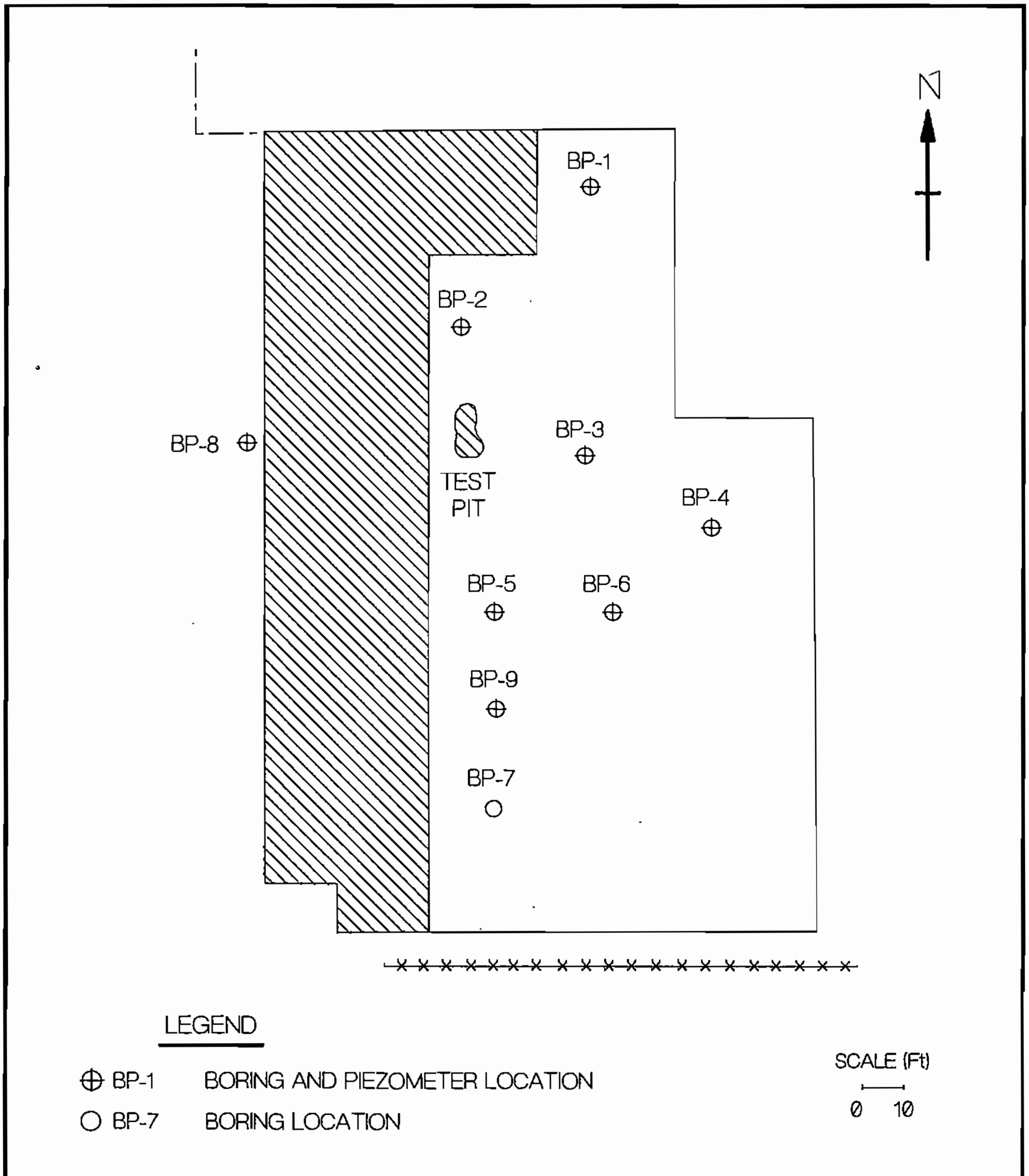
Soil borings in Test pit #3 area

| PARAMETER | BP-1 | BP-2 | BP-3 | BP-4 | BP-5 | BP-6 | BP-7 | BP-8 | BP-9 |
|---|---|---|---|---|---|---|---|---|---|
| INORGANICS (mg/kg) | | | | | | | | | |
| Aluminum | 3190 | 4240 | 3150 | 6830 | 5900 | 2980 | 5520 | 3260 | 5320 |
| Antimony | 5.4 U | 5.5 B | 4.9 U | 5.6 U | 5.1 U | 4.4 U | 5.2 U | 4.2 U | 5.4 U |
| Arsenic | 0.90 B | 2.0 B | 0.73 B | 2.9 B | 1.3 B | 1.3 B | 8.7 | 1.9 B | 1.9 B |
| Chromium | 5.6 | 15.1 | 3.7 | 8.5 | 5.4 | 7.0 | 10.0 | 4.3 | 7.5 |
| Chromium VI | 0.11 U | 0.11 U | 0.15 | 0.12 U | 0.13 U | 0.12 U | 0.12 U | 0.11 U | 0.11 U |
| Copper | 17.7 | 28.4 | 4.9 | 14.7 | 9.7 | 5.6 | 20.5 | 21.9 | 10.3 |
| Iron | 6880 | 8810 | 4410 | 12800 | 6740 | 6280 | 7260 | 7350 | 8060 |
| Lead | 0.42 B | 160 | 3.2 | 5.2 | 4.6 | 2.8 | 14.0 | 2.6 | 31.9 |
| Magnesium | 4610 | 2000 | 806 B | 1940 | 972 | 1580 | 1350 | 7150 | 1320 |
| Manganese | 285 | 472 | 107 | 196 | 148 | 167 | 216 | 619 | 169 |
| Zinc | 22.5 | 103 | 14.8 | 36.1 | 19.5 | 20.1 | 35.9 | 41.2 | 26.2 |
| Cyanide ,total | 1.1 U | 1.1 U | 1.2 U | 1.2 U | 1.3 U | 1.2 U | 1.9 | 1.1 U | 1.1 U |

Ground water – test pit #3 area

| PARAMETER | BP-2 | BP-2MS | BP-2MSD | BP-4 | BP-5 |
|---|---|---|---|---|---|
| VOLATILE ORGANICS (ug/l) | | | | | |
| Methylene chloride | 6 B | 6 B | 5 B | 5 U | 7 B |
| Toluene | 5 U | S | S | 5 | 5 U |
| Total xylenes | 5 U | 5 U | 5 U | 3 J | 5 U |
| Ethylbenzene | 3 J | 3 J | 3 J | 14 | 2 J |
| 4-Methyl-2-pentanone | 10 U | 10 U | 10 U | 10 U | 2 J |
| TIC's | | | | | |
| Unknown | 60 J | | | 300 J | 400 J |
| Unknown | 100 J | | | 400 J | 200 J |
| Unknown | 60 J | | | 200 J | 200 J |
| Unknown | 500 J | | | 300 J | 200 J |
| Unknown | 30 J | | | 200 J | 400 J |
| Unknown | 30 J | | | 200 J | 100 J |
| Unknown | 70 J | | | 200 J | 80 J |
| Unknown | 40 J | | | 100 J | 100 J |
| Unknown | 100 J | | | 100 J | 70 J |
| Unknown | 40 J | | | 70 J | 200 J |

U – Indicates compound was analyzed but not detected.
J – Indicates an estimated value.
B – Indicates the analyte was found in the associated blank as well as the sample.
D – Indicates a compound identified in an analysis at a higher dilution factor.
S – Indicates spike compound.
E – Indicates compounds whose concentration exceeds the calibration range of the GC/MS.
NA– Inidcates parameter was not analyzed in dilution.




MALCOLM PIRNIE

TEST PIT #3 AREA
BORING AND PIEZOMETER LOCATIONS

FIGURE 2

following the discovery of subsurface concrete walls running perpendicular to the planned air flow path. Maps of underground conduits, piping and other structures present in the immediate area have been reviewed, and a revised layout is now being evaluated.

## 2.3 TREATMENT OF CONTAMINATED SOILS FROM UNDERGROUND STORAGE TANK EXCAVATIONS

Following the receipt of the NYSDECs final comment letter on the aeration of the soil piles, dated September 14, 1989, efforts were coordinated with a subcontractor to supply a backhoe for the sampling of the five piles of soil. Environmental Oil, Inc. (EOI), Syracuse, New York was retained, and sampling of the soil piles took place during October 18-19, 1989. A NYSDEC representative was present to observe IRM and RI/FS site activities at this time.

Sampling was done in accordance with the IRM Work Plan. Decontamination of the backhoe's bucket, used to obtain samples from the bottom of the piles, was conducted between each sample location using a pressure washer-steam cleaner. Each sample was obtained with a clean-hexane rinsed stainless steel spoon and placed in pre-cleaned jars. Samples were submitted to Weston for analysis in accordance with NYSDEC CLP 1987. See Table 2 for analytical results (note, P1 = pile 1, P2 = pile 2, etc.). Sample locations are shown in Figure 3, and complete analytical results are contained in Appendix B.

Of the volatile organics analyzed, toluene was the constituent detected at the highest concentrations in the soil piles. Soil pile 3, the largest of the five piles, contains the largest concentration of this compound (up to 260 ppm). Other organics detected in the soils include xylenes, 2-Butanone (or methyl ethyl ketone (MEK)), MIBK and ethylbenzene. Benzene was estimated to be present at a concentration of 1 ppb in the replicate of sample A from pile 2, and trichloroethene was estimated to be present at 1-2 ppb in three replicate samples from pile 5. Many of the semivolatiles analyzed for in the samples from pile 5 were found to be present in the soil, and concentrations range up to 6.20 ppm. Slightly elevated levels of lead, zinc and mercury were present in samples from all piles except pile 4. Cadmium was present at 1.3 ppm in sample F from pile 2.

TABLE 2 IRM SAMPLING OF SOIL PILES



SOIL – PILES #1 – 5

| PARAMETER | P1-A | P1-B | P1-B reprep | P1-C | P1-C reprep | P1-D | P1-D reprep | P1-E | P1-F | P1-F reprep | P2-A | P2-A reprep | P2-B | P2-B MS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| VOLATILE ORGANICS (ug/kg) | | | | | | | | | | | | | | |
| Methylene chloride | 21 B | 15 B | 12 B | 17 B | 11 B | 18 B | 8 B | 16 B | 15 B | 15 B | 19 B | 13 B | 17 B | 11 B |
| Trichloroethene | 5 U | 5 U | 5 U | 6 U | 6 U | 6 U | 5 U | 5 U | 5 U | 6 U | 5 U | 5 U | 6 U | 76 % |
| Benzene | 5 U | 5 U | 5 U | 6 U | 6 U | 6 U | 5 U | 5 U | 5 U | 6 U | 5 U | 1 J | 6 U | 80 % |
| Toluene | 5 U | 5 U | 2 J | 2 J | 2 J | 120 | 17 | 5 U | 18 | 2 J | 5 U | 3 J | 8 | 92 % |
| Total xylenes | 5 U | 5 U | 5 U | 6 U | 6 U | 6 U | 5 U | 5 U | 5 U | 6 U | 5 U | 5 U | 6 U | 6 U |
| Ethylbenzene | 5 U | 5 U | 5 U | 6 U | 6 U | 6 U | 5 U | 5 U | 5 U | 6 U | 5 U | 5 U | 6 U | 6 U |
| 2-Butanone | 10 U | 11 U | 11 U | 12 U | 11 U | 11 U | 11 U | 11 U | 10 U | 11 U | 10 U | 10 U | 12 U | 11 U |
| 4-Methyl-2-pentanone | 10 U | 11 U | 11 U | 12 U | 11 U | 11 U | 11 U | 11 U | 10 U | 11 U | 10 U | 10 U | 12 U | 11 U |
| METALS (mg/kg) | | | | | | | | | | | | | | |
| Cadmium | 0.70 U | 0.93 U | | 0.90 U | | 0.87 U | | 0.67 U | 0.68 U | | 0.84 U | | 1.0 U | |
| Lead | 195 b | 242 | | 92.6 b | | 238 | | 306 | 414 | | 152 | | 221 | |
| Mercury | 0.38 | 0.12 | | 0.12 U | | 0.20 | | 0.11 U | 0.22 | | 0.11 U | | 0.12 U | |
| Zinc | 233 | 225 | | 130 | | 407 | | 206 | 300 | | 151 | | 232 | |

| PARAMETER | P2-B MSD | P2-C | P2-C reprep | P2-D | P2-E | P2-F | P2-F reprep | P3-A | P3-A reprep | P3-B | P3-B reprep | P3-C | P3-C reprep | P3-D |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| VOLATILE ORGANICS (ug/kg) | | | | | | | | | | | | | | |
| Methylene chloride | 12 B | 13 B | 8 B | 16 B | 14 B | 10 B | 8 B | 2100 B | 12000 B | 2200 B | 11000 B | 12 B | 14 B | 9500 B |
| Trichloroethene | 72 % | 6 U | 6 U | 6 U | 5 U | 5 U | 6 U | 740 U | 7400 U | 710 U | 3600 U | 6 U | 6 U | 3000 U |
| Benzene | 73 % | 6 U | 6 U | 6 U | 5 U | 5 U | 6 U | 740 U | 7400 U | 710 U | 3600 U | 6 U | 6 U | 3000 U |
| Toluene | 109 % | 6 U | 4 J | 6 U | 5 U | 2 J | 1 J | 1900 | 94000 | 27000 | 86000 | 13 | 2 J | 59000 |
| Total xylenes | 6 U | 6 U | 6 U | 6 U | 5 U | 5 U | 6 U | 740 U | 7400 U | 440 J | 3600 U | 6 U | 6 U | 1100 J |
| Ethylbenzene | 6 U | 6 U | 6 U | 6 U | 5 U | 5 U | 6 U | 740 U | 7400 U | 710 U | 3600 U | 6 U | 6 U | 3000 U |
| 2-Butanone | 11 U | 11 U | 12 U | 11 U | 11 U | 11 U | 12 U | 1500 U | 15000 U | 8300 | 11000 | 11 U | 12 U | 1000 J |
| 4-Methyl-2-pentanone | 11 U | 11 U | 12 U | 11 U | 11 U | 11 U | 12 U | 1500 U | 15000 U | 3200 | 5600 J | 11 U | 12 U | 770 J |
| METALS (mg/kg) | | | | | | | | | | | | | | |
| Cadmium | | 0.97 U | | 0.73 U | 0.77 U | 1.3 | | 0.95 U | | 0.97 U | | 0.97 U | | 0.95 U |
| Lead | | 82.4 | | 273 | 207 | 483 | | 212 | | 104 b | | 20.8 b | | 91.9 b |
| Mercury | | 0.11 U | | 0.35 | 0.34 | 0.11 U | | 0.15 | | 2.8 | | 0.12 U | | 0.19 |
| Zinc | | 172 | | 211 | 204 | 499 | | 199 | | 443 | | 51.6 | | 101 |

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TABLE 2 IRM SAMPLING OF SOIL PILES

SOIL - PILES #1 - 5

| PARAMETER | P3-E | P3-E MS | P3-E MSD | P3-F | P3-G | P3-H | P3-H reprep | P3-I | P3-I dil. | P3-J | P3-J dil. | P4-A | P4-A reprep | P4-B |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| VOLATILE ORGANICS (ug/kg) | | | | | | | | | | | | | | |
| Methylene chloride | 10 B | 11 B | 10 B | 10 B | 9 B | 11 B | 16 B | 32 B | NA | 63 B | NA | 11 B | 16 B | 28 B |
| Trichloroethene | 5 U | 91 % | 90 % | 6 U | 6 U | 5 U | 6 U | 18 U | NA | 28 U | NA | 5 U | 5 U | 6 U |
| Benzene | 5 U | 75 % | 63 % | 6 U | 6 U | 5 U | 6 U | 18 U | NA | 28 U | NA | 5 U | 5 U | 6 U |
| Toluene | 2 J | 446 % | 420 % | 6 U | 4 J | 5 U | 2 J | E | 3100 | E | 260000 | 5 U | 3 J | 6 U |
| Total xylenes | 5 U | 6 U | 6 U | 6 U | 6 U | 5 U | 6 U | 11 J | NA | 300 | NA | 5 U | 5 J | 6 U |
| Ethylbenzene | 5 U | 6 U | 6 U | 6 U | 6 U | 5 U | 6 U | 18 U | NA | 210 | NA | 5 U | 5 U | 6 U |
| 2-Butanone | 11 U | 11 U | 11 U | 11 U | 11 U | 11 U | 12 U | 35 U | NA | 57 U | NA | 10 U | 11 U | 11 U |
| 4-Methyl-2-pentanone | 11 U | 11 U | 11 U | 11 U | 11 U | 11 U | 12 U | 35 U | NA | 57 U | NA | 10 U | 11 U | 11 U |
| METALS (mg/kg) | | | | | | | | | | | | | | |
| Cadmium | 0.85 U | | | 0.96 U | 0.96 U | 0.86 U | | 0.85 U | | 1.0 U | | 0.86 U | | 1.0 U |
| Lead | 125 | | | 471 | 462 | 74.0 | | 54.3 b | | 21.4 | | 3.4 b | | 6.5 b |
| Mercury | 0.16 | | | 0.27 | 0.12 U | 0.12 U | | 0.12 U | | 0.12 U | | 0.11 U | | 0.11 U |
| Zinc | 157 | | | 274 | 359 | 55.2 | | 113 | | 77.4 | | 37.3 | | 21.0 |

| PARAMETER | P4-B reprep | P4-C | P4-C reprep | P4-D | P4-D reprep | P5-A | P5-A dil. | P5-B | P5-B reprep | P5-C | P5-C reprep | P5-D | P5-D reprep | P5-E |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| VOLATILE ORGANICS (ug/kg) | | | | | | | | | | | | | | |
| Methylene chloride | 19 B | 12 B | 15 B | 13 B | 12 B | 11 B | NA | 15 B | 17 B | 15 B | 19 B | 14 B | 15 B | 11 B |
| Trichloroethene | 6 U | 5 U | 5 U | 5 U | 6 U | 5 U | NA | 5 U | 6 U | 6 U | 6 U | 5 U | 1 J | 5 U |
| Benzene | 6 U | 5 U | 5 U | 5 U | 6 U | 5 U | NA | 5 U | 6 U | 6 U | 6 U | 5 U | 6 U | 5 U |
| Toluene | 2 J | 5 U | 5 U | 5 U | 6 U | E | 3500 | 1 J | 8 | 6 U | 3 J | 5 U | 7 | 6 |
| Total xylenes | 6 U | 5 U | 5 U | 5 U | 6 U | 26 | NA | 5 U | 10 | 6 U | 6 U | 5 U | 6 U | 5 U |
| Ethylbenzene | 6 U | 5 U | 5 U | 5 U | 6 U | 10 | NA | 5 U | 6 U | 6 U | 6 U | 5 U | 6 U | 5 U |
| 2-Butanone | 12 U | 10 U | 11 U | 10 U | 11 U | 10 U | NA | 11 U | 11 U | 13 U | 13 U | 10 U | 12 U | 11 U |
| 4-Methyl-2-pentanone | 12 U | 10 U | 11 U | 10 U | 11 U | 10 U | NA | 11 U | 11 U | 13 U | 13 U | 10 U | 12 U | 11 U |
| METALS (mg/kg) | | | | | | | | | | | | | | |
| Cadmium | | 0.87 U | | 0.84 U | | 0.92 U | | 0.88 U | | 0.89 U | | 0.87 U | | 0.77 U |
| Lead | | 25.0 | | 7.7 b | | 141 | | 217 | | 261 | | 2420 | | 104 b |
| Mercury | | 0.11 U | | 0.11 U | | 0.54 | | 0.11 U | | 0.12 U | | 0.13 | | 0.11 U |
| Zinc | | 20.0 | | 24.4 | | 632 | | 199 | | 379 | | 321 | | 159 |

TABLE 2 IRM SAMPLING OF SOIL PILES

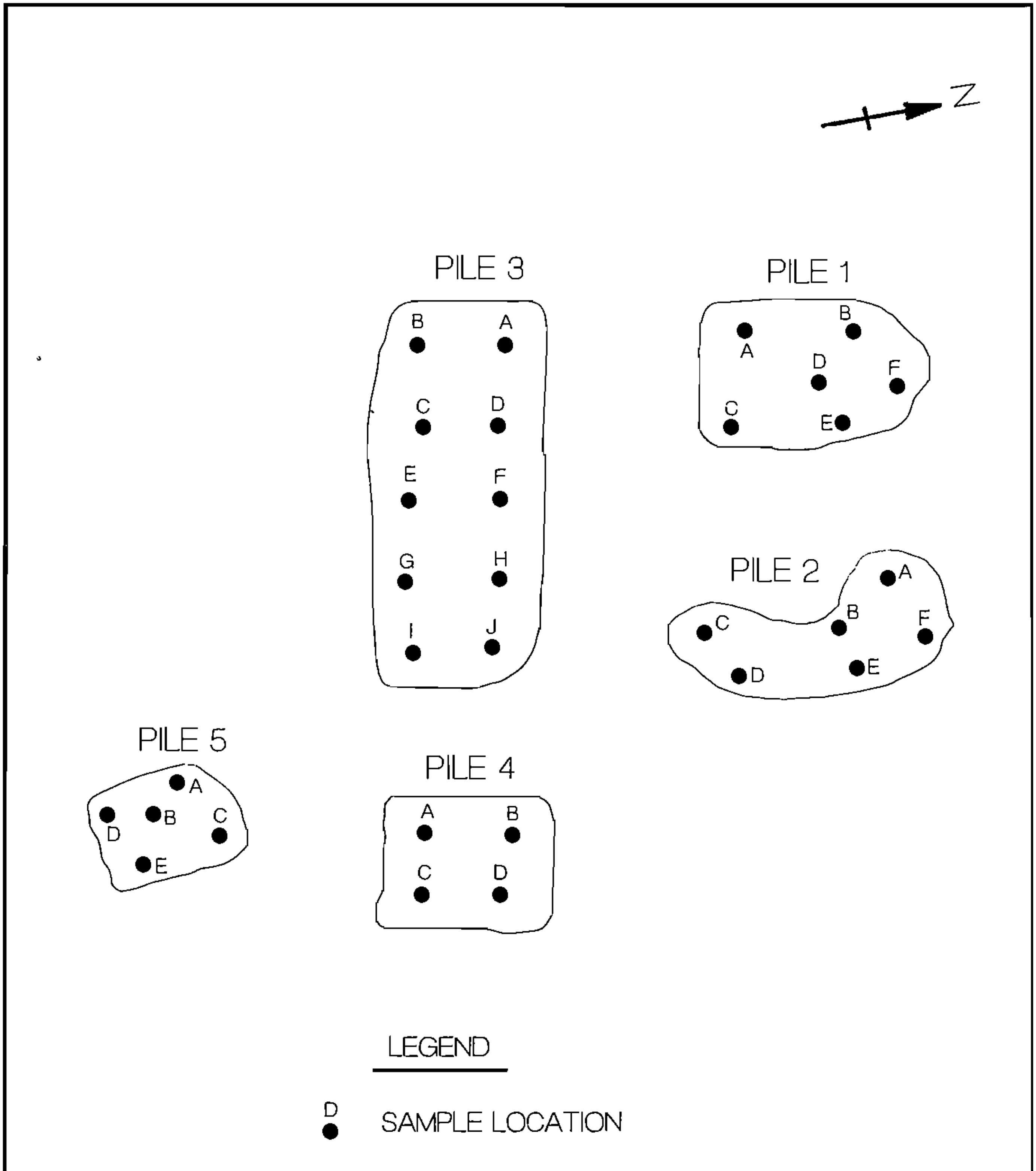
SOIL – PILES #1 – 5

| PARAMETER | P5–E reprep |
|---|---|
| VOLATILE ORGANICS (ug/kg) | |
| Methylene chloride | 19 B |
| Trichloroethene | 2 J |
| Benzene | 6 U |
| Toluene | 15 |
| Total xylenes | 6 U |
| Ethylbenzene | 6 U |
| 2–Butanone | 11 U |
| 4–Methyl–2–pentanone | 11 U |
| METALS (mg/kg) | |
| Cadmium | |
| Lead | |
| Mercury | |
| Zinc | |

Soil – Pile #5

| PARAMETER | P5–A | P5–A MS | P5–A MSD | P5–B | P5–C | P5–D | P5–E |
|---|---|---|---|---|---|---|---|
| SEMIVOLATILES (ug/kg) | | | | | | | |
| 2–Methylphenol | 130 J | 3700 U | 130 J | 47 J | 360 J | 38 J | 50 J |
| 4–Methylphenol | 69 J | 3700 U | 72 J | 370 U | 180 J | 360 U | 340 U |
| Naphthalene | 120 J | 3700 U | 140 J | 74 J | 270 J | 120 J | 72 J |
| Acenaphthylene | 210 J | 3700 U | 270 J | 72 J | 150 J | 100 J | 60 J |
| Acenaphthene | 44 J | 211 % | 96 % | 370 U | 110 J | 360 U | 340 U |
| Phenanthrene | 1200 | 34000 | 3200 | 410 | 2200 | 480 | 510 |
| Anthracene | 360 J | 9200 | 930 | 66 J | 360 J | 82 J | 84 J |
| Fluoranthene | 1600 | 3700 | 3900 | 610 | 3600 | 550 | 550 |
| Pyrene | 1100 | 1830 % | 134 % | 440 | 3300 | 420 | 390 |
| Benzo(a)anthracene | 980 | 19000 | 2100 | 330 J | 4100 | 280 J | 240 J |
| Chrysene | 950 | 20000 | 2100 | 360 J | 4400 | 320 J | 340 |
| Benzo(b)fluoranthene | 1000 | 1800 | 2400 | 390 | 5900 | 360 J | 390 |
| Benzo(k)fluoranthene | 1100 | 1400 | 1400 | 520 | 3000 | 290 J | 260 J |
| Benzo(a)pyrene | 1300 | 17000 | 2300 | 450 | 6200 | 340 J | 300 J |
| Indeno(1,2,3–cd)pyrene | 1100 | 9300 | 1900 | 410 | 4000 | 280 J | 270 J |

U – indicates compound was analyzed but not detected.
J – indicates an estimated value.
B – indicates the analyte was found in the associated blank as well as the sample.
E – indicates compounds whose concentration exceeds the calibration range of the GC/MS.
% – indicates per cent recovery for MS and MSD sample parameters.
NA– indicates parameter was not analyzed in dilution.
b – indicates that the reported value is less than the CRDL but greater than the IDL.

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SOIL PILES
OCTOBER 18-19, 1989 SAMPLE LOCATIONS

FIGURE 3

Soil from each pile was also analyzed for total organic matter content. Parratt Wolff, Inc., East Syracuse, New York analyzed the samples in accordance with ASTM D-2974 and the results are given below.

ORGANIC CONTENT

| Soil Pile | Percent Organic Matter (Volatile Solids) |
|---|---|
| 1 | 3.08 |
| 2 | 2.92 |
| 3 | 3.56 |
| 4 | 1.92 |
| 5 | 5.32 |

Since sampling of the piles occurred in October, and sample results were not available until January 1990, the aeration of the stockpiled soil could not be undertaken during this past year. Also, slightly elevated levels of metals were found to be present in most of the piles, and aeration may not be the most feasible remedial alternative. This matter is currently under investigation.

## 2.4 REMOVAL OF PCB CONTAMINATED SOILS IN BUILDING 8

During September 1989, EOI was retained by MPI to properly contain, sample and dispose of the PCB contaminated soil and debris covering the basement floor of the boiler room in Building No. 8. The work also included excavating, containing, sampling and disposing of soil within a five foot radius of a previous sample location outside the boiler room.

Work was conducted at the site during September 20-21, 1989. A dry vacuum truck was used to collect the soil and small debris from the basement floor, and approximately two cubic yards of soil were excavated from the area outside the building. All soil and debris removed and/or produced during remedial activities was drummed and removed from the site on December 12, 1989 for disposal at Chemical Waste Management, Model City, New York. A total of twelve drums of material were removed from the boiler room and outside location. Exit samples obtained from the outside excavation indicated clean-up levels had been attained, and this area was backfilled on November 9, 1989.

The interim remedial activities undertaken in the Building No. 8 area are documented in the "Interim Remedial Measure Report - Removal of PCB Contaminated Soils in Building 8 Area". This report only briefly outlines the tasks completed to avoid duplication of efforts and information.

# 3.0 WORK PLANNED FOR 1990

## 3.1 GENERAL

This section details actions to be undertaken as part of the IRM program during 1990.

## 3.2 REMEDIATION OF SOILS NEAR TEST PIT 3

During the first part of 1990, the investigation into utilizing vacuum extraction as a remedial alternative in the Test Pit #3 area will be completed. The possible effect of the subsurface structures on the remedial process will be determined, and a final system layout will be devised.

Based on the data obtained to date, a pilot scale study will be designed and implemented in the test pit #3 area. This is expected to occur during May 1990.

While the pilot study is being conducted, other remedial alternatives will be evaluated. These include: soil excavation and off-site disposal, soil excavation and volatilization and soil excavation and on-site incineration.

Following the completion of the pilot study and investigation into the feasibilities of other remedial alternatives, a report will be written summarizing our findings and conclusions. It is expected that vacuum extraction will be undertaken in the test pit #3 area to alleviate contamination in the subsurface soils. The report will recommend a final remedial alternative. This report is expected to be submitted to the NYSDEC by August 1990 due to the length of time required to coordinate and conduct the pilot study.

Remediation will be initiated following the NYSDEC's review of the report.

## 3.3 TREATMENT OF CONTAMINATED SOILS FROM UNDERGROUND STORAGE TANK EXCAVATIONS

The feasibility of spreading and aerating the piles of soil in the back of the plant area and subsequently using the soil as cover material is currently under investigation. It appears that elevated levels of metals (mainly lead and zinc) are present in the soils along with the volatile organics. Table 3 compares the metal concentrations in the piles to site background levels, as determined during RI/FS sampling, and common levels found in natural soils according to the United States Environmental Protection Agency (USEPA). All piles, except pile 4, contain lead, zinc and mercury at concentrations above their average site background levels of 12.3 ppm, 39.7 ppm and non-detectable, respectively. Most levels, though, are not excessively high when compared to the common levels present in natural soils (USEPA) except for mercury, present at 2.8 ppm in one sample from pile 3, and lead, present in one sample from pile 5 at a concentration of 2420 ppm.

Remedial alternatives, including aeration, stabilization and incineration and off-site disposal will be examined during the first half of 1990. Remediation will commence during early summer (June) 1990. If aeration is chosen as the remedial method, an emissions estimate will be calculated and the aeration pad will be inspected and improved. Spreading activities would be scheduled to take place when the air temperature is above 80°F and at least three consecutive sunny days are forecast. Exit samples would be obtained from the aerated dirt following spreading activities.

## 3.4 REMOVAL OF PCB CONTAMINATED SOILS IN BUILDING 8

Remediation of the Building #8 area is complete except for the removal of a small amount (1-2 cubic yards) of soil excavated from the area where approximately 20 gallons of spent fuel oil used in the decontamination of the vacuum truck was accidentally overturned. At the time of the spill, four 55-gallon drums of soil were removed from the area. Based on exit sampling of the excavation, an additional three drums of material were removed from the area along with 1-2 cubic yards, which were stockpiled on plastic, on November 9, 1989. An exit sample was again obtained from the excavation, and analyses indicated PCB levels were below detection limits. Clean up of the spill area was deemed completed, and a composite sample was obtained from the remaining stockpile on December 12, 1989 to determine if PCB levels are low enough for disposal at a non-hazardous waste landfill.

Disposal of the pile of soil and the backfilling of the resulting excavation with clean soil from off-site is expected to be complete by March 1990

TABLE 3
COMPARISON OF METAL CONCENTRATIONS IN SOIL PILES
TO BACKGROUND AND COMMON LEVELS

| PILE # | METAL | CONCENTRATIONS IN PILES (ppm) RANGE | CONCENTRATIONS IN PILES (ppm) AVERAGE | SITE BACKGROUND LEVELS (ppm) SAMPLE #1 | SITE BACKGROUND LEVELS (ppm) SAMPLE #2 | SITE BACKGROUND LEVELS (ppm) AVERAGE | COMMON LEVELS* (ppm) RANGE | COMMON LEVELS* (ppm) AVERAGE |
|---|---|---|---|---|---|---|---|---|
| 1 | Cadmium | 0.67(u)-0.93(u) | - | 0.69(u) | 0.66 | 0.50 | 0.01-0.7 | 0.06 |
| | Lead | 92.6-414 | 248 | 8.6 | 15.9 | 12.3 | 2-200 | 10 |
| | Mercury | 0.11(u)-0.38 | 0.17 | 0.14(u) | 0.11(u) | - | 0.01-0.3 | 0.03 |
| | Zinc | 130-407 | 250 | 33.9 | 45.5 | 39.7 | 10-300 | 50 |
| 2 | Cadmium | 0.73(u)-1.3 | 0.58 | | | | | |
| | Lead | 82.4-483 | 236 | | | | | |
| | Mercury | 0.11(u)-0.35 | 0.15 | | | | | |
| | Zinc | 151-499 | 245 | | | | | |
| 3 | Cadmium | 0.85(u)-1.0(u) | - | | | | | |
| | Lead | 20.8-471 | 164 | | | | | |
| | Mercury | 0.12(u)-2.8 | 0.39 | | | | | |
| | Zinc | 51.6-443 | 183 | | | | | |
| 4 | Cadmium | 0.84(u)-1.0(u) | - | | | | | |
| | Lead | 3.4-25 | 10.7 | | | | | |
| | Mercury | 0.11(u) | - | | | | | |
| | Zinc | 20.0-37.3 | 25.7 | | | | | |
| 5 | Cadmium | 0.77(u)-0.92(u) | - | | | | | |
| | Lead | 104-2420 | 629 (181)** | | | | | |
| | Mercury | 0.11(u)-0.54 | 0.17 | | | | | |
| | Zinc | 159-632 | 338 | | | | | |

NOTES: * Source: USEPA, SW-874, April, 1983, p.273.
** Average lead concentration in pile 5 is 629 ppm, and the average concentration without taking into account the highest value of 2420 ppm is 181 ppm.
(u) Undetected at given detection limit
For on-site average concentrations, levels below detectable are averaged as one half their detection limit.

1990. An addendum to the "Interim Remedial Measure Report - Removal of PCB Contaminated Soils in Building 8 Area" will detail these activities.

## 3.5 PROJECT SCHEDULE

The schedule for conducting the work described in Section 3 is shown on Figure 4.

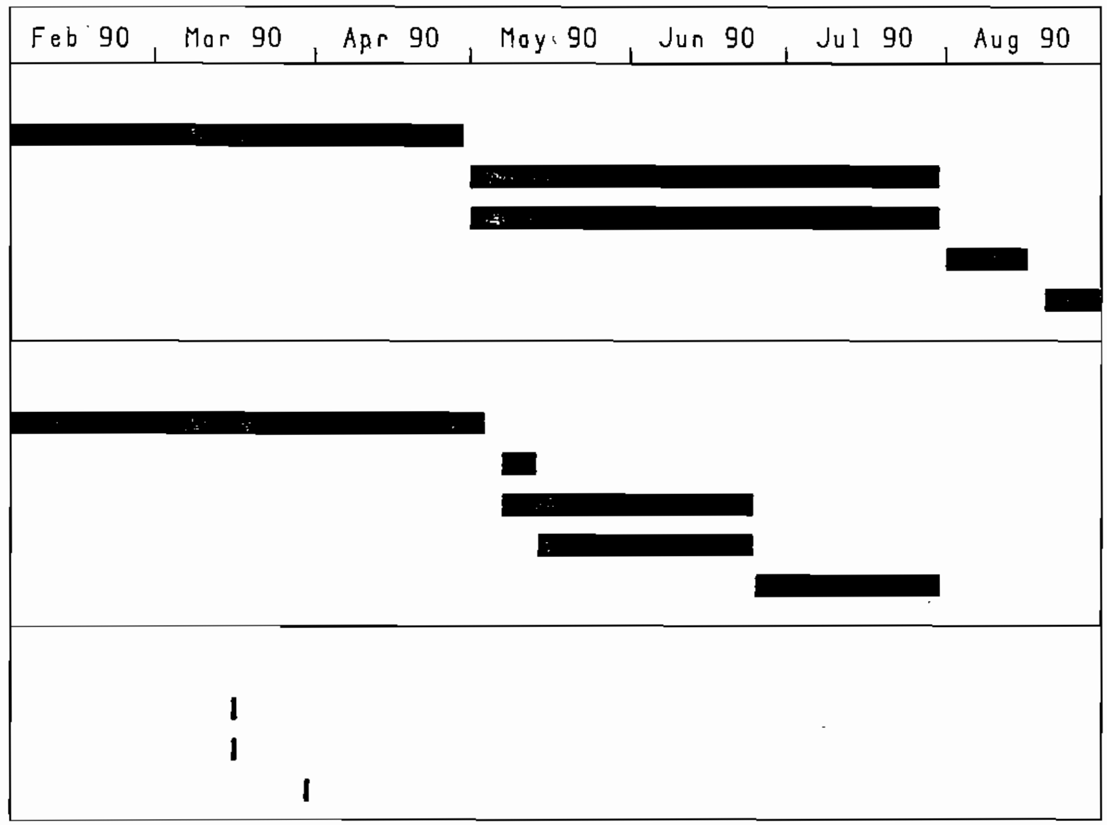
# COLUMBIA MILLS IRM PROGRAM 1990

## TASKS

1) TEST PIT 3 SOIL REMEDIATION
- A.Evaluate Vacuum Extraction
- B.Conduct Pilot Scale Study
- C.Evaluate Alternates & Report
- D.NYSDEC Review of Report
- E.Initiate Remediation

2) STOCKPILED SOIL TREATMENT
- A.Determine Treatment Method
- B.Prepare Emissions Estimate *
- C.Inspect/Improve Pad *
- D.Bid Process
- E.Soil Treatment/Disposal

3) PCB SOIL DISPOSAL
- A.Dispose of Stockpiled Soil
- B.Backfill Excavation (Spill)
- C.Submit Addendum to NYSDEC




* If aeration is chosen as soil treatment

Figure 4
Project Schedule
February 1990

# Appendices

MALCOLM PIRNIE

# APPENDIX A

## ANALYTICAL RESULTS
## IRM SAMPLING IN TEST PIT 3 AREA

Soil borings in test pit #3 area – volatiles UNITS: ug/kg

| PARAMETER | BP-1 | BP-1DL | BP-2 | BP-3 | BP-3 DIL:2.77 | BP-4 | BP-4 DIL:3.29 | BP-5 | BP-6 | BP-6RE | PB-7 | BP-8 | BP-9 | BP-X (BP-3) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| TARGET ANALYTES | | | | | | | | | | | | | | |
| Chloromethane | 2 U | 10 U | 300 U | 310 U | 7 U | 580 U | 8 U | 310 U | 330 U | 3300 U | 2 U | 2 U | 280 U | 2 U |
| Methylene chloride | 9 B | 50 BD | 690 JB | 700 JB | 34 B | 1500 B | 34 B | 710 JB | 1000 B | 16000 B | 5 JB | 5 JB | 640 JB | 5 JB |
| 1,1-Dichloroethene | 6 U | 24 U | 740 U | 780 U | 17 U | 1500 U | 19 U | 780 U | 820 U | 8200 U | 6 U | 6 U | 710 U | 6 U |
| Chloroform | 6 U | 24 U | 740 U | 780 U | 17 U | 1500 U | 19 U | 780 U | 820 U | 8200 U | 6 U | 6 U | 710 U | 6 U |
| 1,1,1-Trichloroethane | 1 U | 5 U | 150 U | 160 U | 3 U | 290 U | 4 U | 160 U | 160 U | 1600 U | 1 U | 1 U | 140 U | 1 U |
| Trichloroethene | 1 U | 5 U | 150 U | 160 U | 3 U | 290 U | 4 U | 160 U | 160 U | 1600 U | 1 U | 1 U | 140 U | 1 U |
| 1,1,2,2-Tetrachloroethane | 1 U | 5 U | 150 U | 160 U | 3 U | 290 U | 4 U | 160 U | 160 U | 1600 U | 1 U | 1 U | 140 U | 1 U |
| Benzene | 6 U | 24 U | 740 U | 780 U | 17 U | 1500 U | 19 U | 780 U | 820 U | 8200 U | 6 U | 6 U | 710 U | 6 U |
| Toluene | 6 U | 24 U | 740 U | 780 U | 17 U | 1500 U | 19 U | 780 U | 820 U | 8200 U | 1 J | 6 U | 710 U | 6 U |
| Total xylenes | 6 U | 24 U | 1600 | 780 U | 17 U | 1500 U | 19 U | 2700 | 820 U | 8200 U | 6 U | 6 U | 9800 | 6 U |
| Ethylbenzene | 6 U | 24 U | 740 U | 780 U | 17 U | 1500 U | 19 U | 780 U | 820 U | 8200 U | 6 U | 6 U | 710 U | 6 U |
| Chlorobenzene | 6 U | 24 U | 740 U | 780 U | 17 U | 1500 U | 19 U | 780 U | 820 U | 8200 U | 6 U | 6 U | 710 U | 6 U |
| 2-Butanone | 4 U | 19 U | 600 U | 620 U | 14 U | 1200 U | 15 U | 620 U | 660 U | 6600 U | 5 U | 5 U | 570 U | 5 U |
| 4-Methyl-2-pentanone | 420 E | 48 U | 2000 | 1600 U | 35 U | 5900 | 38 U | 1600 U | 14000 | 19000 | 11 U | 11 U | 1200 J | 110 |

| TIC's | BP-1 | BP-1DL | BP-2 | BP-3 | BP-3 DIL:2.77 | BP-4 | BP-4 DIL:3.29 | BP-5 | BP-6 | BP-6RE | PB-7 | BP-8 | BP-9 | BP-X (BP-3) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Unknown | 40 J | 200 J | 8000 J | 1000 J | 40 J | 10000 J | 400 J | 900 J | 40000 J | | | | 20000 J | 20 J |
| Unknown | 30 J | 100 J | 5000 J | 3000 J | 100 J | | 300 J | 1000 J | | | | | 20000 J | 40 J |
| Unknown | 40 J | 200 J | 20000 J | 3000 J | 60 J | | 400 J | 1000 J | | | | | 9000 J | 30 J |
| Unknown | 40 J | 100 J | 10000 J | | 60 J | | 600 J | 800 J | | | | | 30000 J | 50 J |
| Unknown | 60 J | 300 J | | | 80 J | | 500 J | 3000 J | | | | | | 20 J |
| Unknown | 40 J | 100 J | | | 100 J | | 1000 J | | | | | | | 30 J |
| Unknown | 90 J | 100 J | | | 50 J | | 800 J | | | | | | | 20 J |
| Unknown | 60 J | 200 J | | | 70 J | | 800 J | | | | | | | 40 J |
| Unknown | 20 J | 100 J | | | 200 J | | 700 J | | | | | | | 20 J |
| Unknown | 30 J | 200 J | | | 100 J | | 900 J | | | | | | | 40 J |
| Methyl-cyclohexane | | | 10000 J | | | 70000 J | | | | 300000 J | | | 30000 J | |
| Dimethyl-cyclohexane | | | 10000 J | 2000 J | | 10000 J | | 2000 J | | 50000 J | | | 10000 J | |
| Dimethyl-cyclohexane | | | | | | | | | | | | | 30000 J | |
| Trimethyl-cyclohexane | | | 10000 J | | | | | | | | | | 200000 J | |
| Bromofluorobenzene | | | 20000 J | | | | | | 20000 J | | | | | |
| Trimethyl cyclopentane | | | 7000 J | 1000 J | | | | | | | | | 10000 J | |
| Unknown cyclo-alkane | | | 7000 J | 2000 J | | | | | | | | | | |
| Unknown alkane | | | | 2000 J | | 20000 J | | 800 J | 20000 J | 90000 J | | | | |
| Unknown alkane | | | | | | 10000 J | | 1000 J | 30000 J | 60000 J | | | | |

Soil borings in test pit #3 area – volatiles UNITS: ug/kg

| PARAMETER | BP-1 | BP-1DL | BP-2 | BP-3 | BP-3 DIL:2.77 | BP-4 | BP-4 DIL:3.29 | BP-5 | BP-6 | BP-6RE | PB-7 | BP-8 | BP-9 | BP-X (BP-3) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Unknown alkane | | | | | | 40000 J | | | 20000 J | 100000 J | | | | |
| Unknown alkane | | | | | | | | | | 60000 J | | | | |
| Unknown alkane | | | | | | | | | | 50000 J | | | | |
| Unknown alkane | | | | | | | | | | 50000 J | | | | |
| Unknown alkane | | | | | | | | | | | | | | |
| Unknown alkene | | | | 1000 J | | | | | | | | | | |
| Hydroxylamine | | | | | | 20000 J | | | | 60000 J | | | | |
| 3-Methyl-pentane | | | | | | 30000 J | | | 40000 J | 60000 J | | | | |
| 3-Methyl-hexane | | | | | | | | | 50000 J | | | | | |
| Heptane | | | | | | 60000 J | | | | | | | | |
| Trimethyl-hexane | | | | | | 10000 J | | | 30000 J | | | | | |
| C7 alkane | | | | | | | | | 200000 J | | | | | |
| Ethyl-methyl-cyclopentane | | | | | | | | | | | | | 50000 J | |

U – indicates compound was analyzed but not detected.
J – indicates an estimated value.
B – indicates the analyte was found in the associated blank as well as the sample.
E – indicates compounds whose concentration exceeds the calibration range of the GC/MS.
D – indicates a compound identified in an analysis at a higher dilution factor.
A – indicates that the TIC is a suspected aldol-condensation product.

Soil borings in test pit #3 area -
semivolatiles UNITS: ug/kg

| PARAMETER | BP-1 | BP-1RE | BP-1MS | BP-1MSD | BP-1MSRE | BP-IMSDRE | BP-2 | BP-2RE | BP-3 | BP-3RE |
|---|---|---|---|---|---|---|---|---|---|---|
| TARGET ANALYTES | | | | | | | | | | |
| Phenol | 380 U | 370 U | S | S | S | S | 370 U | 370 U | 420 U | 420 U |
| 2-Chlorophenol | 380 U | 370 U | S | S | S | S | 370 U | 370 U | 420 U | 420 U |
| 1,4-Dichlorobenzene | 380 U | 370 U | S | S | S | S | 370 U | 370 U | 420 U | 420 U |
| 2-Methylphenol | 380 U | 370 U | 380 U | 380 U | 370 U | 380 U | 370 U | 370 U | 420 U | 420 U |
| 4-Methylphenol | 380 U | 370 U | 380 U | 380 U | 370 U | 380 U | 370 U | 370 U | 420 U | 420 U |
| N-Nitroso-di-n-propylamine | 380 U | 370 U | S | S | S | S | 370 U | 370 U | 420 U | 420 U |
| 1,2,4-Trichlorobenzene | 380 U | 370 U | S | S | S | S | 370 U | 370 U | 420 U | 420 U |
| Napthalene | 380 U | 370 U | 380 U | 380 U | 370 U | 380 U | 370 U | 53 J | 420 U | 420 U |
| 4-Chloro-3-methylphenol | 380 U | 370 U | S | S | S | S | 370 U | 370 U | 420 U | 420 U |
| Acenaphthylene | 380 U | 370 U | 380 U | 380 U | 370 U | 380 U | 370 U | 370 U | 420 U | 420 U |
| Acenaphthene | 380 U | 370 U | S | S | S | S | 370 U | 370 U | 420 U | 420 U |
| 4-Nitrophenol | 1900 U | 1900 U | S | S | S | S | 1900 U | 1900 U | 2100 U | 2100 U |
| 2,4-Dinitrotoluene | 380 U | 370 U | S | S | S | S | 370 U | 370 U | 420 U | 420 U |
| Phenanthrene | 41 J | 370 U | 380 U | 300 J | 370 U | 39 J | 370 U | 370 U | 420 U | 420 U |
| Anthracene | 380 U | 370 U | 380 U | 72 J | 370 U | 380 U | 370 U | 370 U | 420 U | 420 U |
| Fluoranthene | 66 J | 44 J | 49 J | 410 | 55 J | 65 J | 46 J | 48 J | 420 U | 420 U |
| Pyrene | 77 J | 38 J | S | S | S | S | 36 J | 49 J | 420 U | 420 U |
| Benzo(a)anthracene | 39 J | 370 U | 380 U | 190 J | 370 U | 380 U | 370 U | 370 U | 420 U | 420 U |
| Chrysene | 42 J | 370 U | 380 U | 190 J | 370 U | 380 U | 370 U | 370 U | 420 U | 420 U |
| Benzo(b)fluoranthene | 380 U | 370 U | 380 U | 110 J | 370 U | 380 U | 370 U | 370 U | 420 U | 420 U |
| Benzo(k)fluoranthene | 380 U | 370 U | 380 U | 180 J | 370 U | 380 U | 370 U | 370 U | 420 U | 420 U |
| Benzo(a)pyrene | 380 U | 370 U | 380 U | 110 J | 370 U | 380 U | 370 U | 370 U | 420 U | 420 U |
| Indeno(1,2,3-cd)pyrene | 380 U | 370 U | 380 U | 67 J | 370 U | 380 U | 370 U | 370 U | 420 U | 420 U |
| Pentachlorophenol | 1900 U | 1900 U | S | S | S | S | 1900 U | 1900 U | 2100 U | 2100 U |
| di-n-Butylphthalate | 160 JB | 1800 B | 310 JB | 300 JB | 2000 B | 2700 B | 930 B | 1800 B | 210 JB | 2900 B |

Soil borings in test pit #3 area -
semivolatiles UNITS: ug/kg

| PARAMETER | BP-4 | BP-4RE | BP-5 | BP-5RE | BP-6 | BP-6RE | PB-7 | PB-7DL | PB-7RE | BP-8 |
|---|---|---|---|---|---|---|---|---|---|---|
| TARGET ANALYTES | | | | | | | | | | |
| Phenol | 390 U | 390 U | 440 U | 430 U | 360 U | 360 U | 1900 U | NA | 1900 U | 360 U |
| 2-Chlorophenol | 390 U | 390 U | 440 U | 430 U | 360 U | 360 U | 1900 U | NA | 1900 U | 360 U |
| 1,4-Dichlorobenzene | 390 U | 390 U | 440 U | 430 U | 360 U | 360 U | 1900 U | NA | 1900 U | 360 U |
| 2-Methylphenol | 390 U | 390 U | 440 U | 430 U | 360 U | 360 U | 1900 U | NA | 1900 U | 360 U |
| 4-Methylphenol | 390 U | 390 U | 440 U | 430 U | 360 U | 360 U | 1900 U | NA | 1900 U | 360 U |
| N-Nitroso-di-n-propylamine | 390 U | 390 U | 440 U | 430 U | 360 U | 360 U | 1900 U | NA | 1900 U | 360 U |
| 1,2,4-Trichlorobenzene | 390 U | 390 U | 440 U | 430 U | 360 U | 360 U | 1900 U | NA | 1900 U | 360 U |
| Napthalene | 390 U | 390 U | 440 U | 430 U | 360 U | 360 U | 1900 U | NA | 1900 U | 360 U |
| 4-Chloro-3-methylphenol | 390 U | 390 U | 440 U | 430 U | 360 U | 360 U | 1900 U | NA | 1900 U | 360 U |
| Acenaphthylene | 390 U | 390 U | 440 U | 430 U | 360 U | 360 U | 470 J | NA | 1900 U | 360 U |
| Acenaphthene | 390 U | 390 U | 440 U | 430 U | 360 U | 360 U | 2500 | NA | 470 J | 360 U |
| 4-Nitrophenol | 1900 U | 1900 U | 2200 U | 2200 U | 1800 U | 1800 U | 9300 U | NA | 9400 U | 1800 U |
| 2,4-Dinitrotoluene | 390 U | 390 U | 440 U | 430 U | 360 U | 360 U | 1900 U | NA | 1900 U | 360 U |
| Phenanthrene | 390 U | 390 U | 440 U | 430 U | 410 | 360 U | 26000 | NA | 7600 | 360 U |
| Anthracene | 390 U | 390 U | 440 U | 430 U | 93 J | 360 U | 8300 | NA | 2200 | 360 U |
| Fluoranthene | 41 J | 390 U | 440 U | 430 U | 530 | 360 U | E | 46000 | 12000 | 360 U |
| Pyrene | 45 J | 390 U | 440 U | 430 U | 480 | 360 U | E | 51000 | 10000 | 360 U |
| Benzo(a)anthracene | 390 U | 390 U | 440 U | 430 U | 190 J | 360 U | 10000 | NA | 3700 | 360 U |
| Chrysene | 390 U | 390 U | 440 U | 430 U | 200 J | 360 U | 19000 | NA | 5300 | 360 U |
| Benzo(b)fluoranthene | 390 U | 390 U | 440 U | 430 U | 140 J | 360 U | 12000 | NA | 4000 | 360 U |
| Benzo(k)fluoranthene | 390 U | 390 U | 440 U | 430 U | 200 J | 360 U | 17000 | NA | 3600 | 360 U |
| Benzo(a)pyrene | 390 U | 390 U | 440 U | 430 U | 170 J | 360 U | 16000 | NA | 4600 | 360 U |
| Indeno(1,2,3-cd)pyrene | 390 U | 390 U | 440 U | 430 U | 93 J | 360 U | 11000 | NA | 3100 | 360 U |
| Pentachlorophenol | 1900 U | 1900 U | 2200 U | 2200 U | 1800 U | 1800 U | 9300 U | NA | 9400 U | 1800 U |
| di-n-Butylphthalate | 210 JB | 1100 B | 870 B | 2600 B | 140 JB | 900 B | 800 JB | NA | 2000 B | 600 B |

Soil borings in test pit #3 area -
semivolatiles UNITS: ug/kg

| PARAMETER | BP-8RE | BP-9 | BP-9RE | BP-X (BP-3) | BP-XRE |
|---|---|---|---|---|---|
| TARGET ANALYTES | | | | | |
| Phenol | 360 U | 390 U | 390 U | 410 U | 410 U |
| 2-Chlorophenol | 360 U | 390 U | 390 U | 410 U | 410 U |
| 1,4-Dichlorobenzene | 360 U | 390 U | 390 U | 410 U | 410 U |
| 2-Methylphenol | 360 U | 390 U | 390 U | 410 U | 410 U |
| 4-Methylphenol | 360 U | 390 U | 390 U | 410 U | 410 U |
| N-Nitroso-di-n-propylamine | 360 U | 390 U | 390 U | 410 U | 410 U |
| 1,2,4-Trichlorobenzene | 360 U | 390 U | 390 U | 410 U | 410 U |
| Napthalene | 360 U | 390 U | 390 U | 410 U | 410 U |
| 4-Chloro-3-methylphenol | 360 U | 390 U | 390 U | 410 U | 410 U |
| Acenaphthylene | 360 U | 390 U | 390 U | 410 U | 410 U |
| Acenaphthene | 360 U | 390 U | 390 U | 410 U | 410 U |
| 4-Nitrophenol | 1800 U | 2000 U | 1900 U | 2100 U | 2100 U |
| 2,4-Dinitrotoluene | 360 U | 390 U | 390 U | 410 U | 410 U |
| Phenanthrene | 360 U | 240 J | 110 J | 410 U | 410 U |
| Anthracene | 360 U | 54 J | 390 U | 410 U | 410 U |
| Fluoranthene | 360 U | 520 | 140 J | 410 U | 410 U |
| Pyrene | 360 U | 370 J | 140 J | 410 U | 410 U |
| Benzo(a)anthracene | 360 U | 230 J | 66 J | 410 U | 410 U |
| Chrysene | 360 U | 280 J | 71 J | 410 U | 410 U |
| Benzo(b)fluoranthene | 360 U | 180 J | 50 J | 410 U | 410 U |
| Benzo(k)fluoranthene | 360 U | 170 J | 59 J | 410 U | 410 U |
| Benzo(a)pyrene | 360 U | 200 J | 53 J | 410 U | 410 U |
| Indeno(1,2,3-cd)pyrene | 360 U | 120 J | 390 U | 410 U | 410 U |
| Pentachlorophenol | 1800 U | 2000 U | 1900 U | 2100 U | 2100 U |
| di-n-Butylphthalate | 1800 B | 150 J | 2500 B | 980 B | 2600 B |

U - indicates compound was analyzed but not detected.
J - indicates an estimated value.
B - indicates the analyte was found in the associated blank as well as the sample.
E - indicates compounds whose concentration exceeds the calibration range of the GC/MS.
D - indicates a compound identified in an analysis at a higher dilution factor.
A - indicates that TIC is a suspected aldol-condensation product.

Soil borings in Test pit #3 area - inorganics UNITS: mg/kg

| PARAMETER | BP-1 | BP-2 | BP-3 | BP-4 | BP-5 | BP-6 | BP-7 | BP-8 | BP-9 | BP-X (BP-3) |
|---|---|---|---|---|---|---|---|---|---|---|
| TARGET ANALYTES | | | | | | | | | | |
| Aluminum | 3190 | 4240 | 3150 | 6830 | 5900 | 2980 | 5520 | 3260 | 5320 | 3480 |
| Antimony | 5.4 U | 5.5 B | 4.9 U | 5.6 U | 5.1 U | 4.4 U | 5.2 U | 4.2 U | 5.4 U | 6.3 U |
| Arsenic | 0.90 B | 2.0 B | 0.73 B | 2.9 B | 1.3 B | 1.3 B | 8.7 | 1.9 B | 1.9 B | 0.78 B |
| Cadmium | 0.91 U | 0.81 U | 0.83 U | 0.94 U | 0.87 U | 0.74 U | 0.89 U | 0.70 U | 0.91 U | 1.1 U |
| Chromium | 5.6 | 15.1 | 3.7 | 8.5 | 5.4 | 7.0 | 10.0 | 4.3 | 7.5 | 5.3 |
| Chromium VI | 0.11 U | 0.11 U | 0.15 | 0.12 U | 0.13 U | 0.12 U | 0.12 U | 0.11 U | 0.11 U | 0.12 U |
| Copper | 17.7 | 28.4 | 4.9 | 14.7 | 9.7 | 5.6 | 20.5 | 21.9 | 10.3 | 7.5 |
| Iron | 6880 | 8810 | 4410 | 12800 | 6740 | 6280 | 7260 | 7350 | 8060 | 5090 |
| Lead | 0.42 B | 160 | 3.2 | 5.2 | 4.6 | 2.8 | 14.0 | 2.6 | 31.9 | 2.4 |
| Magnesium | 4610 | 2000 | 806 B | 1940 | 972 | 1580 | 1350 | 7150 | 1320 | 1040 B |
| Manganese | 285 | 472 | 107 | 196 | 148 | 167 | 216 | 619 | 169 | 68.4 |
| Zinc | 22.5 | 103 | 14.8 | 36.1 | 19.5 | 20.1 | 35.9 | 41.2 | 26.2 | 16.1 |
| Cyanide ,total | 1.1 U | 1.1 U | 1.2 U | 1.2 U | 1.3 U | 1.2 U | 1.9 | 1.1 U | 1.1 U | 1.3 U |

U - Indicates compound was analyzed but not detected.
E - indicates that the value is estimated because of interference.
B - Indicates that the value is greater than the IDL but less than the CRDL.

Ground water - test pit #3 area UNITS: ug/l

| PARAMETER | BP-2 | BP-2MS | BP-2MSD | BP-4 | BP-5 | TB |
|---|---|---|---|---|---|---|
| **TARGET ANALYTES** | | | | | | |
| Chloromethane | 2 U | 2 U | 2 U | 2 U | 2 U | 2 U |
| Methylene chloride | 6 B | 6 B | 5 B | 5 U | 7 B | 7 B |
| 1,1-Dichloroethene | 1 U | S | S | 1 U | 1 U | 1 U |
| Chloroform | 1 U | 1 U | 1 U | 1 U | 1 U | 1 U |
| 1,1,1-Trichloroethane | 1 U | 1 U | 1 U | 1 U | 1 U | 1 U |
| Trichloroethene | 1 U | S | S | 1 U | 1 U | 1 U |
| 1,1,2,2-Tetrachloroethane | 1 U | 1 U | 1 U | 1 U | 1 U | 1 U |
| Benzene | 5 U | S | S | 5 U | 5 U | 5 U |
| Toluene | 5 U | S | S | 5 | 5 U | 5 U |
| Total xylenes | 5 U | 5 U | 5 U | 3 J | 5 U | 5 U |
| Ethylbenzene | 3 J | 3 J | 3 J | 14 | 2 J | 5 U |
| Chlorobenzene | 5 U | S | S | 5 U | 5 U | 5 U |
| 2-Butanone | 4 U | 4 U | 4 U | 4 U | 4 U | 4 U |
| 4-Methyl-2-pentanone | 10 U | 10 U | 10 U | 10 U | 2 J | 10 U |
| **TIC's** | | | | | | |
| Unknown | 60 J | | | 300 J | 400 J | |
| Unknown | 100 J | | | 400 J | 200 J | |
| Unknown | 60 J | | | 200 J | 200 J | |
| Unknown | 500 J | | | 300 J | 200 J | |
| Unknown | 30 J | | | 200 J | 400 J | |
| Unknown | 30 J | | | 200 J | 100 J | |
| Unknown | 70 J | | | 200 J | 80 J | |
| Unknown | 40 J | | | 100 J | 100 J | |
| Unknown | 100 J | | | 100 J | 70 J | |
| Unknown | 40 J | | | 70 J | 200 J | |

U - indicates compound was analyzed but not detected.
J - indicates an estimated value.
B - indicates the analyte was found in the associated blank as well as the sample.
E - indicates compounds whose concentration exceeds the calibration range of the GC/MS.
D - indicates a compound identified in an analysis at a higher dilution factor.
A - indicates that the TIC is a suspected aldol-condensation product.
S - indicates spike compound.

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APPENDIX B

ANALYTICAL RESULTS
IRM SAMPLING OF SOIL PILES

SOIL – PILES #1 – 5

| PARAMETER | P1–A | P1–B | P1–B reprep | P1–C | P1–C reprep | P1–D | P1–D reprep | P1–E | P1–F | P1–F reprep | P2–A | P2–A reprep | P2–B | P2–B MS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| VOLATILE ORGANICS (ug/kg) | | | | | | | | | | | | | | |
| Chloromethane | 10 U | 11 U | 11 U | 12 U | 11 U | 11 U | 11 U | 11 U | 10 U | 11 U | 10 U | 10 U | 12 U | 11 U |
| Methylene chloride | 21 B | 15 B | 12 B | 17 B | 11 B | 18 B | 8 B | 16 B | 15 B | 15 B | 19 B | 13 B | 17 B | 11 B |
| 1,1-Dichloroethene | 5 U | 5 U | 5 U | 6 U | 6 U | 6 U | 5 U | 5 U | 5 U | 6 U | 5 U | 5 U | 6 U | 55 % |
| Chloroform | 5 U | 5 U | 5 U | 6 U | 6 U | 6 U | 5 U | 5 U | 5 U | 6 U | 5 U | 5 U | 6 U | 6 U |
| 1,1,1-Trichloroethane | 5 U | 5 U | 5 U | 6 U | 6 U | 6 U | 5 U | 5 U | 5 U | 6 U | 5 U | 5 U | 6 U | 6 U |
| Trichloroethene | 5 U | 5 U | 5 U | 6 U | 6 U | 6 U | 5 U | 5 U | 5 U | 6 U | 5 U | 5 U | 6 U | 76 % |
| 1,1,2,2-Tetrachloroethane | 5 U | 5 U | 5 U | 6 U | 6 U | 6 U | 5 U | 5 U | 5 U | 6 U | 5 U | 5 U | 6 U | 6 U |
| Benzene | 5 U | 5 U | 5 U | 6 U | 6 U | 6 U | 5 U | 5 U | 5 U | 6 U | 5 U | 1 J | 6 U | 80 % |
| Toluene | 5 U | 5 U | 2 J | 2 J | 2 J | 120 | 17 | 5 U | 18 | 2 J | 5 U | 3 J | 8 | 92 % |
| Total xylenes | 5 U | 5 U | 5 U | 6 U | 6 U | 6 U | 5 U | 5 U | 5 U | 6 U | 5 U | 5 U | 6 U | 6 U |
| Ethylbenzene | 5 U | 5 U | 5 U | 6 U | 6 U | 6 U | 5 U | 5 U | 5 U | 6 U | 5 U | 5 U | 6 U | 6 U |
| Chlorobenzene | 5 U | 5 U | 5 U | 6 U | 6 U | 6 U | 5 U | 5 U | 5 U | 6 U | 5 U | 5 U | 6 U | 107 % |
| 2-Butanone | 10 U | 11 U | 11 U | 12 U | 11 U | 11 U | 11 U | 11 U | 10 U | 11 U | 10 U | 10 U | 12 U | 11 U |
| 4-Methyl-2-pentanone | 10 U | 11 U | 11 U | 12 U | 11 U | 11 U | 11 U | 11 U | 10 U | 11 U | 10 U | 10 U | 12 U | 11 U |

| METALS (mg/kg) | P1–A | P1–B | P1–B reprep | P1–C | P1–C reprep | P1–D | P1–D reprep | P1–E | P1–F | P1–F reprep | P2–A | P2–A reprep | P2–B | P2–B MS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Cadmium | 0.70 U | 0.93 U | | 0.90 U | | 0.87 U | | 0.67 U | 0.68 U | | 0.84 U | | 1.0 U | |
| Lead | 195 b | 242 | | 92.6 b | | 238 | | 306 | 414 | | 152 | | 221 | |
| Mercury | 0.38 | 0.12 | | 0.12 U | | 0.20 | | 0.11 U | 0.22 | | 0.11 U | | 0.12 U | |
| Zinc | 233 | 225 | | 130 | | 407 | | 206 | 300 | | 151 | | 232 | |

SOIL – PILES #1 – 5

| PARAMETER | P2-B MSD | P2-C | P2-C reprep | P2-D | P2-E | P2-F | P2-F reprep | P3-A | P3-A reprep | P3-B | P3-B reprep | P3-C | P3-C reprep | P3-D |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| VOLATILE ORGANICS (ug/kg) | | | | | | | | | | | | | | |
| Chloromethane | 11 U | 11 U | 12 U | 11 U | 11 U | 11 U | 12 U | 1500 U | 15000 U | 1400 U | 7100 U | 11 U | 12 U | 6000 U |
| Methylene chloride | 12 B | 13 B | 8 B | 16 B | 14 B | 10 B | 8 B | 2100 B | 12000 B | 2200 B | 11000 B | 12 B | 14 B | 9500 B |
| 1,1-Dichloroethene | 48 % | 6 U | 6 U | 6 U | 5 U | 5 U | 6 U | 740 U | 7400 U | 710 U | 3600 U | 6 U | 6 U | 3000 U |
| Chloroform | 6 U | 6 U | 6 U | 6 U | 5 U | 5 U | 6 U | 740 U | 7400 U | 710 U | 3600 U | 6 U | 6 U | 3000 U |
| 1,1,1-Trichloroethane | 6 U | 6 U | 6 U | 6 U | 5 U | 5 U | 6 U | 740 U | 7400 U | 710 U | 3600 U | 6 U | 6 U | 3000 U |
| Trichloroethene | 72 % | 6 U | 6 U | 6 U | 5 U | 5 U | 6 U | 740 U | 7400 U | 710 U | 3600 U | 6 U | 6 U | 3000 U |
| 1,1,2,2-Tetrachloroethane | 6 U | 6 U | 6 U | 6 U | 5 U | 5 U | 6 U | 740 U | 7400 U | 710 U | 3600 U | 6 U | 6 U | 3000 U |
| Benzene | 73 % | 6 U | 6 U | 6 U | 5 U | 5 U | 6 U | 740 U | 7400 U | 710 U | 3600 U | 6 U | 6 U | 3000 U |
| Toluene | 109 % | 6 U | 4 J | 6 U | 5 U | 2 J | 1 J | 1900 | 94000 | 27000 | 86000 | 13 | 2 J | 59000 |
| Total xylenes | 6 U | 6 U | 6 U | 6 U | 5 U | 5 U | 6 U | 740 U | 7400 U | 440 J | 3600 U | 6 U | 6 U | 1100 J |
| Ethylbenzene | 6 U | 6 U | 6 U | 6 U | 5 U | 5 U | 6 U | 740 U | 7400 U | 710 U | 3600 U | 6 U | 6 U | 3000 U |
| Chlorobenzene | 101 % | 6 U | 6 U | 6 U | 5 U | 5 U | 6 U | 740 U | 7400 U | 710 U | 3600 U | 6 U | 6 U | 3000 U |
| 2-Butanone | 11 U | 11 U | 12 U | 11 U | 11 U | 11 U | 12 U | 1500 U | 15000 U | 8300 | 11000 | 11 U | 12 U | 1000 J |
| 4-Methyl-2-pentanone | 11 U | 11 U | 12 U | 11 U | 11 U | 11 U | 12 U | 1500 U | 15000 U | 3200 | 5600 J | 11 U | 12 U | 770 J |

| PARAMETER | P2-B MSD | P2-C | P2-C reprep | P2-D | P2-E | P2-F | P2-F reprep | P3-A | P3-A reprep | P3-B | P3-B reprep | P3-C | P3-C reprep | P3-D |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| METALS (mg/kg) | | | | | | | | | | | | | | |
| Cadmium | | 0.97 U | | 0.73 U | 0.77 U | 1.3 | | 0.95 U | | 0.97 U | | 0.97 U | | 0.95 U |
| Lead | | 82.4 | | 273 | 207 | 483 | | 212 | | 104 b | | 20.8 b | | 91.9 b |
| Mercury | | 0.11 U | | 0.35 | 0.34 | 0.11 U | | 0.15 | | 2.8 | | 0.12 U | | 0.19 |
| Zinc | | 172 | | 211 | 204 | 499 | | 199 | | 443 | | 51.6 | | 101 |

SOIL – PILES #1 – 5

| PARAMETER | P3–E | P3–E MS | P3–E MSD | P3–F | P3–G | P3–H | P3–H reprep | P3–I | P3–I dil. | P3–J | P3–J dil. | P4–A | P4–A reprep | P4–B |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| VOLATILE ORGANICS (ug/kg) | | | | | | | | | | | | | | |
| Chloromethane | 11 U | 11 U | 11 U | 11 U | 11 U | 11 U | 12 U | 35 U | NA | 57 U | NA | 10 U | 11 U | 11 U |
| Methylene chloride | 10 B | 11 B | 10 B | 10 B | 9 B | 11 B | 16 B | 32 B | NA | 63 B | NA | 11 B | 16 B | 28 B |
| 1,1–Dichloroethene | 5 U | 96 % | 99 % | 6 U | 6 U | 5 U | 6 U | 18 U | NA | 28 U | NA | 5 U | 5 U | 6 U |
| Chloroform | 5 U | 6 U | 6 U | 6 U | 6 U | 5 U | 6 U | 18 U | NA | 28 U | NA | 5 U | 5 U | 6 U |
| 1,1,1–Trichloroethane | 5 U | 6 U | 6 U | 6 U | 6 U | 5 U | 6 U | 18 U | NA | 28 U | NA | 5 U | 5 U | 6 U |
| Trichloroethene | 5 U | 91 % | 90 % | 6 U | 6 U | 5 U | 6 U | 18 U | NA | 28 U | NA | 5 U | 5 U | 6 U |
| 1,1,2,2–Tetrachloroethane | 5 U | 6 U | 6 U | 6 U | 6 U | 5 U | 6 U | 18 U | NA | 28 U | NA | 5 U | 5 U | 6 U |
| Benzene | 5 U | 75 % | 63 % | 6 U | 6 U | 5 U | 6 U | 18 U | NA | 28 U | NA | 5 U | 5 U | 6 U |
| Toluene | 2 J | 446 % | 420 % | 6 U | 4 J | 5 U | 2 J | E | 3100 | E | 260000 | 5 U | 3 J | 6 U |
| Total xylenes | 5 U | 6 U | 6 U | 6 U | 6 U | 5 U | 6 U | 11 J | NA | 300 | NA | 5 U | 5 J | 6 U |
| Ethylbenzene | 5 U | 6 U | 6 U | 6 U | 6 U | 5 U | 6 U | 18 U | NA | 210 | NA | 5 U | 5 U | 6 U |
| Chlorobenzene | 5 U | 93 % | 88 % | 6 U | 6 U | 5 U | 6 U | 18 U | NA | 28 U | NA | 5 U | 5 U | 6 U |
| 2–Butanone | 11 U | 11 U | 11 U | 11 U | 11 U | 11 U | 12 U | 35 U | NA | 57 U | NA | 10 U | 11 U | 11 U |
| 4–Methyl–2–pentanone | 11 U | 11 U | 11 U | 11 U | 11 U | 11 U | 12 U | 35 U | NA | 57 U | NA | 10 U | 11 U | 11 U |

| METALS (mg/kg) | P3–E | P3–E MS | P3–E MSD | P3–F | P3–G | P3–H | P3–H reprep | P3–I | P3–I dil. | P3–J | P3–J dil. | P4–A | P4–A reprep | P4–B |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Cadmium | 0.85 U | | | 0.96 U | 0.96 U | 0.86 U | | 0.85 U | | 1.0 U | | 0.86 U | | 1.0 U |
| Lead | 125 | | | 471 | 462 | 74.0 | | 54.3 b | | 21.4 | | 3.4 b | | 6.5 b |
| Mercury | 0.16 | | | 0.27 | 0.12 U | 0.12 U | | 0.12 U | | 0.12 U | | 0.11 U | | 0.11 U |
| Zinc | 157 | | | 274 | 359 | 55.2 | | 113 | | 77.4 | | 37.3 | | 21.0 |

SOIL – PILES #1 – 5

| PARAMETER | P4-B reprep | P4-C | P4-C reprep | P4-D | P4-D reprep | P5-A | P5-A dil. | P5-B | P5-B reprep | P5-C | P5-C reprep | P5-D | P5-D reprep | P5-E |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| VOLATILE ORGANICS (ug/kg) | | | | | | | | | | | | | | |
| Chloromethane | 12 U | 10 U | 11 U | 10 U | 11 U | 10 U | NA | 11 U | 11 U | 13 U | 13 U | 10 U | 12 U | 11 U |
| Methylene chloride | 19 B | 12 B | 15 B | 13 B | 12 B | 11 B | NA | 15 B | 17 B | 15 B | 19 B | 14 B | 15 B | 11 B |
| 1,1-Dichloroethene | 6 U | 5 U | 5 U | 5 U | 6 U | 5 U | NA | 5 U | 6 U | 6 U | 6 U | 5 U | 6 U | 5 U |
| Chloroform | 6 U | 5 U | 5 U | 5 U | 6 U | 5 U | NA | 5 U | 6 U | 6 U | 6 U | 5 U | 6 U | 5 U |
| 1,1,1-Trichloroethane | 6 U | 5 U | 5 U | 5 U | 6 U | 5 U | NA | 5 U | 6 U | 6 U | 6 U | 5 U | 6 U | 5 U |
| Trichloroethene | 6 U | 5 U | 5 U | 5 U | 6 U | 5 U | NA | 5 U | 6 U | 6 U | 6 U | 5 U | 1 J | 5 U |
| 1,1,2,2-Tetrachloroethane | 6 U | 5 U | 5 U | 5 U | 6 U | 5 U | NA | 5 U | 6 U | 6 U | 6 U | 5 U | 6 U | 5 U |
| Benzene | 6 U | 5 U | 5 U | 5 U | 6 U | 5 U | NA | 5 U | 6 U | 6 U | 6 U | 5 U | 6 U | 5 U |
| Toluene | 2 J | 5 U | 5 U | 5 U | 6 U | E | 3500 | 1 J | 8 | 6 U | 3 J | 5 U | 7 | 6 |
| Total xylenes | 6 U | 5 U | 5 U | 5 U | 6 U | 26 | NA | 5 U | 10 | 6 U | 6 U | 5 U | 6 U | 5 U |
| Ethylbenzene | 6 U | 5 U | 5 U | 5 U | 6 U | 10 | NA | 5 U | 6 U | 6 U | 6 U | 5 U | 6 U | 5 U |
| Chlorobenzene | 6 U | 5 U | 5 U | 5 U | 6 U | 5 U | NA | 5 U | 6 U | 6 U | 6 U | 5 U | 6 U | 5 U |
| 2-Butanone | 12 U | 10 U | 11 U | 10 U | 11 U | 10 U | NA | 11 U | 11 U | 13 U | 13 U | 10 U | 12 U | 11 U |
| 4-Methyl-2-pentanone | 12 U | 10 U | 11 U | 10 U | 11 U | 10 U | NA | 11 U | 11 U | 13 U | 13 U | 10 U | 12 U | 11 U |

| METALS (mg/kg) | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Cadmium | | 0.87 U | | 0.84 U | | 0.92 U | | 0.86 U | | 0.89 U | | 0.87 U | | 0.77 U |
| Lead | | 25.0 | | 7.7 b | | 141 | | 217 | | 261 | | 2420 | | 104 b |
| Mercury | | 0.11 U | | 0.11 U | | 0.54 | | 0.11 U | | 0.12 U | | 0.13 | | 0.11 U |
| Zinc | | 20.0 | | 24.4 | | 632 | | 199 | | 379 | | 321 | | 159 |

SOIL – PILES #1 – 5

| PARAMETER | P5–E reprep | (P1–D) PX–1 | PX–1 reprep | (P3–C) PX–2 | PX–2 reprep | (P5–B) PX–3 | PX–3 reprep |
|---|---|---|---|---|---|---|---|
| VOLATILE ORGANICS (ug/kg) | | | | | | | |
| Chloromethane | 11 U | 12 U | 12 U | 11 U | 12 U | 11 U | 10 U |
| Methylene chloride | 19 B | 12 B | 14 B | 16 B | 10 B | 9 B | 14 B |
| 1,1–Dichloroethene | 6 U | 6 U | 6 U | 5 U | 6 U | 6 U | 5 U |
| Chloroform | 6 U | 6 U | 6 U | 5 U | 6 U | 6 U | 5 U |
| 1,1,1–Trichloroethane | 6 U | 6 U | 6 U | 5 U | 6 U | 6 U | 5 U |
| Trichloroethene | 2 J | 6 U | 6 U | 5 U | 6 U | 6 U | 1 J |
| 1,1,2,2–Tetrachloroethane | 6 U | 6 U | 6 U | 5 U | 6 U | 6 U | 5 U |
| Benzene | 6 U | 6 U | 6 U | 5 U | 6 U | 6 U | 5 U |
| Toluene | 15 | 6 U | 6 U | 5 U | 55 | 9 | 3 J |
| Total xylenes | 6 U | 6 U | 6 U | 5 U | 6 U | 6 U | 5 U |
| Ethylbenzene | 6 U | 6 U | 6 U | 5 U | 6 U | 6 U | 5 U |
| Chlorobenzene | 6 U | 6 U | 6 U | 5 U | 6 U | 6 U | 5 U |
| 2–Butanone | 11 U | 12 U | 12 U | 11 U | 12 U | 11 U | 10 U |
| 4–Methyl–2–pentanone | 11 U | 12 U | 12 U | 11 U | 12 U | 11 U | 10 U |

| METALS (mg/kg) | | | | | | | |
|---|---|---|---|---|---|---|---|
| Cadmium | | 0.91 U | | 0.83 U | | 0.91 U | |
| Lead | | 485 | | 1.1 b | | 19.8 b | |
| Mercury | | 0.11 U | | 0.12 U | | 0.11 U | |
| Zinc | | 244 | | 63.5 | | 604 | |

U – indicates compound was analyzed but not detected.
J – indicates an estimated value.
B – indicates the analyte was found in the associated blank as well as the sample.
E – indicates compounds whose concentration exceeds the calibration range of the GC/MS.
D – indicates a compound identified in an analysis at a higher dilution factor.
A – indicates that the TIC is a suspected aldol–condensation product.
% – indicates per cent recovery for MS and MSD sample parameters.
NA– inidcates parameter was not analyzed in dilution.
b – indicates that the reported value is less than the CRDL but greater than the IDL.

Soil - Pile #5 - semivolatiles UNITS: ug/kg

| PARAMETER | P5-A | P5-A MS | P5-A MSD | P5-B | P5-C | P5-D | P5-E |
|---|---|---|---|---|---|---|---|
| TARGET ANALYTES | | | | | | | |
| Phenol | 390 U | 73 % | 74 % | 370 U | 430 U | 360 U | 340 U |
| 2-Chlorophenol | 390 U | 70 % | 81 % | 370 U | 430 U | 360 U | 340 U |
| 1,4-Dichlorobenzene | 390 U | 48 % | 53 % | 370 U | 430 U | 360 U | 340 U |
| 2-Methylphenol | 130 J | 3700 U | 130 J | 47 J | 360 J | 38 J | 50 J |
| 4-Methylphenol | 69 J | 3700 U | 72 J | 370 U | 180 J | 360 U | 340 U |
| N-Nitroso-di-n-propylamine | 390 U | 66 % | 84 % | 370 U | 430 U | 360 U | 340 U |
| 1,2,4-Trichlorobenzene | 390 U | 67 % | 72 % | 370 U | 430 U | 360 U | 340 U |
| Naphthalene | 120 J | 3700 U | 140 J | 74 J | 270 J | 120 J | 72 J |
| 4-Chloro-3-methylphenol | 390 U | 77 % | 84 % | 370 U | 430 U | 360 U | 340 U |
| Acenaphthylene | 210 J | 3700 U | 270 J | 72 J | 150 J | 100 J | 60 J |
| Acenaphthene | 44 J | 211 % | 96 % | 370 U | 110 J | 360 U | 340 U |
| 4-Nitrophenol | 2000 U | 77 % | 170 % | 1900 U | 2100 U | 1800 U | 1700 U |
| 2,4-Dinitrotoluene | 390 U | 72 % | 93 % | 370 U | 430 U | 360 U | 340 U |
| Phenanthrene | 1200 | 34000 | 3200 | 410 | 2200 | 480 | 510 |
| Anthracene | 360 J | 9200 | 930 | 66 J | 360 J | 82 J | 84 J |
| Fluoranthene | 1600 | 3700 | 3900 | 610 | 3600 | 550 | 550 |
| Pyrene | 1100 | 1830 % | 134 % | 440 | 3300 | 420 | 390 |
| Benzo(a)anthracene | 980 | 19000 | 2100 | 330 J | 4100 | 280 J | 240 J |
| Chrysene | 950 | 20000 | 2100 | 360 J | 4400 | 320 J | 340 |
| Benzo(b)fluoranthene | 1000 | 1800 | 2400 | 390 | 5900 | 360 J | 390 |
| Benzo(k)fluoranthene | 1100 | 1400 | 1400 | 520 | 3000 | 290 J | 260 J |
| Benzo(a)pyrene | 1300 | 17000 | 2300 | 450 | 6200 | 340 J | 300 J |
| Indeno(1,2,3-cd)pyrene | 1100 | 9300 | 1900 | 410 | 4000 | 280 J | 270 J |
| Pentachlorophenol | 2000 U | 35 % | 82 % | 1900 U | 2100 U | 1800 U | 1700 U |
| di-n-Butylphthalate | 120 JB | 490 JB | 120 JB | 180 JB | 280 JB | 93 JB | 88 JB |

U - Indicates compound was analyzed but not detected.
J - Indicates an estimated value.
B - Indicates the analyte was found in the associated blank as well as the sample.
E - Indicates compounds whose concentration exceeds the calibration range of the GC/MS.
D - Indicates a compound identified in an analysis at a higher dilution factor.
A - Indicates that TIC is a suspected aldol-condensation product.
% - per cent recovery for MS and MSD samples.

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9

**BOND , SCHOENECK & KING**

**COLUMBIA MILLS SITE**
**MINETTO , NEW YORK**

# INTERIM REMEDIAL MEASURE
# EVALUATION OF ALTERNATIVES FOR
# TREATMENT OF UST EXCAVATED SOIL

MALCOLM PIRNIE

ENVIRONMENTAL ENGINEERS, SCIENTISTS & PLANNERS

***MARCH 1990***

MALCOLM PIRNIE

MALCOLM PIRNIE, INC.
ENVIRONMENTAL ENGINEERS, SCIENTISTS & PLANNERS

RECEIVED
APR 9 1990
BUREAU OF WESTERN REMEDIAL ACTION
DIVISION OF HAZARDOUS WASTE REMEDIATION

April 3, 1990

Mr. Mike Cruden
Bureau of Construction Services
Division of Hazardous Waste Remediation
New York State Department of
Environmental Conservation
50 Wolf Road
Albany, New York 12233-7010

Dear Mr. Cruden:

Enclosed is one(1) copy of the report "Interim Remedial Measure - Evaluation of Alternatives For Treatment of UST Excavated Soil". This report evaluates the feasibilities of different alternatives for the treatment of the volatile organic compound (VOC) contaminated soil originating from the underground storage tank excavations at the Columbia Mills site.

Based on our analysis of different remedial methods, spreading and natural aeration of the soils in piles #3 and #5 is the most feasible alternative. Piles #1, #2 and #4 will not be treated because VOC contaminants are present at such low levels.

Work as outlined in this submittal and the Interim Remedial Measure Work Plan will commence at the site on June 18, 1990, at which time piles #1, #2 and #4 will be combined into one pile on an adjacent concrete pad to make room for spreading operations.

A schedule for the soil aeration program is included in the enclosed report.

If you have any questions or require further information, please contact us.

Very truly yours,

MALCOLM PIRNIE, INC.

Richard W. Klippel, P.E.
Senior Associate

slo
1069-03-1
enc.
c: Dave Camp, NYSDEC - Alb
Les Deming, B,S&K
John Metz, Columbia Mills

REPORT

# INTERIM REMEDIAL MEASURE
# EVALUATION OF ALTERNATIVES FOR
# TREATMENT OF UST EXCAVATED SOIL

COLUMBIA MILLS
Minetto, New York

MARCH 1990

MALCOLM PIRNIE, INC.
ENVIRONMENTAL ENGINEERS,
SCIENTISTS & PLANNERS
7481 Henry Clay Boulevard
Liverpool, New York 13088

# TABLE OF CONTENTS

# 1.0 INTRODUCTION

## 1.1 BACKGROUND INFORMATION

During the Summer of 1988, eight underground storage tanks (UST's) were removed from three of four areas where they were initially believed to be located, thoroughly cleaned and transported from the Columbia Mills site. The contaminated soil in the vicinity of each tank was excavated and staged in a separate portion of the site for subsequent treatment and/or disposal. See Figure 1 for the areas of excavation and the current locations of the soil piles.

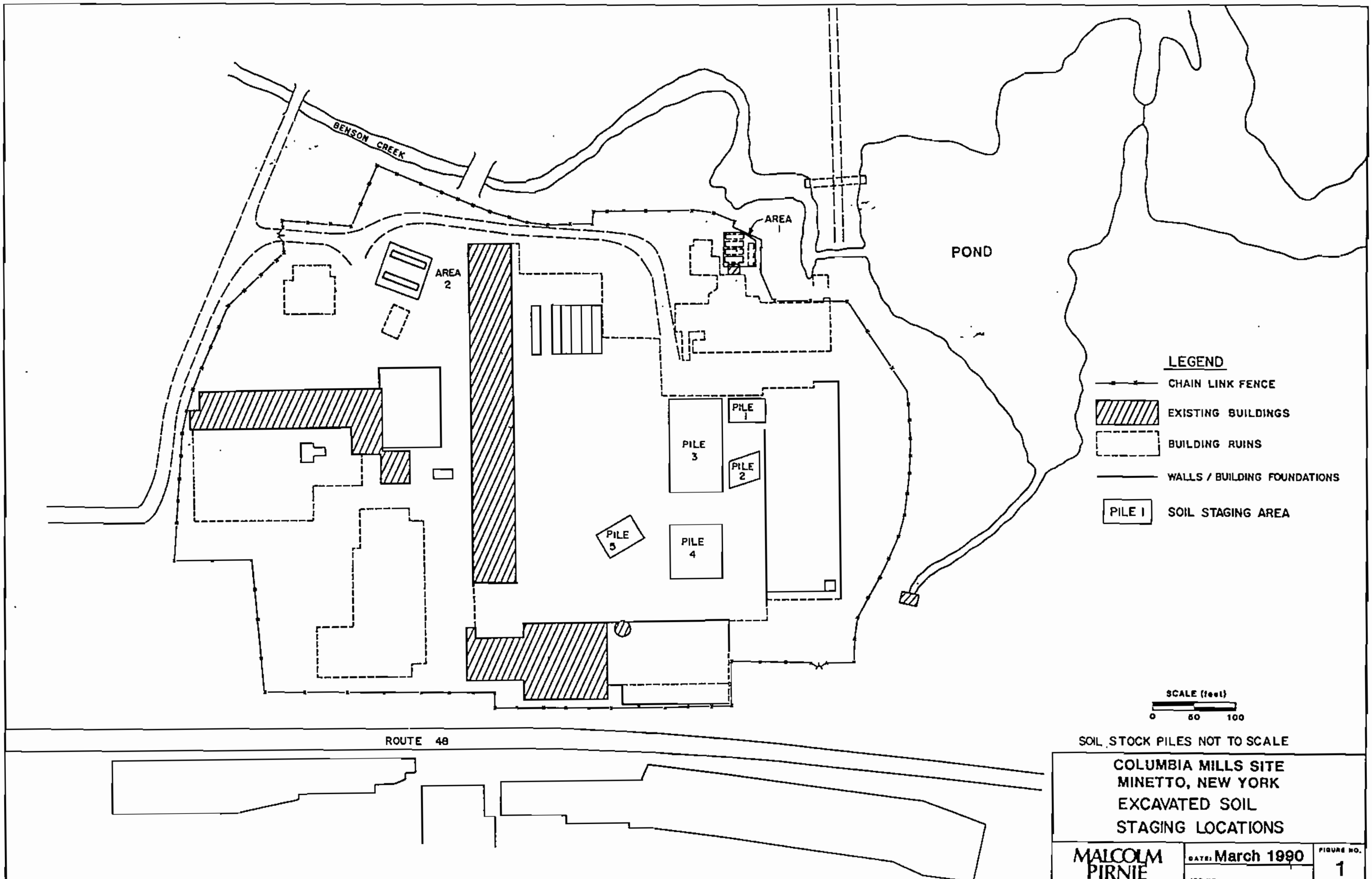
Soil excavated from Area 1 and Area 2 that was determined to be contaminated (by visual means and/or by using the HNU meter) was staged into five piles at the locations shown on Figure 1. A combined total of more than 1000 cubic yards of soil was excavated from the two areas.

Sampling of the soil in the five piles was conducted following the completion of the excavation process. Analyses indicated piles #1 and #4 were essentially free of organic contamination, while methyl ethyl ketone (MEK) and toluene were detected in soil from piles #3 and #5. Methyl isobutyl ketone (MIBK) was also detected in pile #5, and a low level of tetrachloroethylene was found in pile #2.

In March 1989, Columbia Mills entered into an agreement with the New York State Department of Environmental Conservation (NYSDEC) to develop and implement an Interim Remedial Measure (IRM) program according to the terms set forth in a formal Consent Order (A7-0167-89-02).

Included in the IRM program was the treatment of the soils from the underground storage tank excavations. Plans for the remediation of these soils were detailed in the "IRM Work Plan" dated April 1989 and revised in July 1989, and in Addendum No. 1 to the Work Plan (August 1989).

The report "Interim Remedial Measures Program Update", dated February 1990, contained the results of the most recent sampling of the piles and outlined the activities to be undertaken during 1990 to complete the IRM. Based on the sample results, which indicated volatile organic contaminants (VOCs) were present at levels greater than 100 parts per million (ppm) in two samples from pile #3, the feasibilities of different remedial alternatives were to be analyzed and a remedial action determined.




COLUMBIA MILLS SITE
MINETTO, NEW YORK
EXCAVATED SOIL
STAGING LOCATIONS

| | | |
|---|---|---|
| MALCOLM PIRNIE | DATE: March 1990 | FIGURE NO. 1 |
| | JOB NO. | |

## 1.2 PURPOSE AND SCOPE

This report evaluates potential technologies that could be utilized in the treatment of the contaminated soils originating from the UST areas. Each technology is evaluated using a specific set of criteria. Based on the results, one technology is chosen as the most favorable remedial action.

## 2.0 CONTAMINANT LEVELS/CLEAN-UP CRITERIA

### 2.1 GENERAL

This section summarizes past sampling activities and contaminant levels present in the soil piles. Criteria for the clean up of the soil are also outlined.

### 2.2 PAST SAMPLING ACTIVITIES - CONTAMINANT LEVELS

Sampling of the soil piles has been conducted a total of four times - once following the initial excavation of the tanks and three times under the IRM program. Sampling done as part of the IRM program has included: May 4, 1989 composite sampling of piles #3 and #5 for volatile organics (USEPA 601/602) and ketones; June 16, 1989 composite sampling of all five piles for Target Compound List (TCL) metals and semivolatiles (USEPA 8270) and October 18 - 19, 1989 discrete sampling of all five piles for volatile organics and four metals (cadmium, lead, mercury and zinc, based on past sampling) and sampling of pile #5 for semivolatiles. Analytical results from all sampling episodes are summarized in Appendix A.

Table 1 lists the highest concentrations of VOC's found in each of the five piles. These levels can be considered worst case levels and are based on all three VOC sampling episodes.

Piles #3 and #5 contain the highest maximum concentrations of VOC's at 279,050 parts per billion (ppb) and 7,035 ppb, respectively. The other piles contain very little volatile contamination - 8 ppb to 120 ppb.

Composite sampling for metals indicated four metals - cadmium, lead, mercury and zinc - may have been present at elevated concentrations in some of the piles. Discrete sampling conducted in October 1989 did indicate most of these levels were above on-site background concentrations but were not excessively high. The average concentrations are summarized in the table on page 2-2.

| | VOC | SEMI VOC'S | TCL METALS | SOME METALS |
|---|---|---|---|---|
| MAY | 3,5 | — | — | — |
| JUNE | — | ALL | ALL | — |
| OCT | ALL | 5 | — | ALL |

## TABLE 1

MAXIMUM CONCENTRATIONS OF VOLATILE
ORGANICS FOUND IN SOIL PILES #1 - #5

| | Pile #1 | Pile #2 | Pile #3 | Pile #4 | Pile #5 |
|---|---|---|---|---|---|
| Toluene | 120 | 8 | 260,000 | 3 | 3,700(2) |
| Benzene | - | 1 | - | - | - |
| Xylenes | - | - | 1,100 | 5 | 26 |
| Ethylbenzene | - | - | 210 | - | 10 |
| Trichloroethylene | - | - | 400(2) | - | 79(2) |
| Tetrachloroethylene | | 34(1) | 740(2) | - | - |
| Methyl ethyl ketone | - | - | 11,000 | - | 2,900(1) |
| Methyl isobutyl ketone | - | - | 5,600 | - | 320 |
| Total VOC's - Maximum | 120 | 43 | 279,050 | 8 | 7,035 |

NOTES: All concentrations in ppb.

Contaminant concentrations determined by October 18 - 19, 1989 sampling except where noted.

(1) Concentration as determined by sampling conducted during Summer 1988.

(2) Concentration as determined by sampling conducted May 4, 1989.

AVERAGE METAL CONCENTRATIONS IN PILES #1 - #5
(in ppm)

| METAL | Pile #1 | Pile #2 | Pile #3 | Pile #4 | Pile #5 | Background* | |
|---|---|---|---|---|---|---|---|
| Cadmium | - | 0.58 | - | - | - | 0.50 | TYPICAL |
| Lead | 248 | 236 | 164 | 10.7 | 629 | 12.3 | 10-300 |
| Mercury | 0.17 | 0.15 | 0.39 | - | 0.17 | - | 3.4 |
| Zinc | 250 | 245 | 183 | 25.7 | 338 | 39.7 | 5-2900 |

Based on October 18 - 19, 1989 discrete sampling.
* Based on November 14, 1989 discrete sampling (average of 2 background samples).

Composite sampling for semivolatiles in June 1989 indicated piles #3, #4 and #5 contained slightly elevated concentrations but the levels in pile #5 were higher than those in the others. Discrete sampling of pile #5 on October 19, 1989 indicated up to 38.1 ppm of semivolatiles were present. The top five semivolatile contaminants in this pile appear to be benzo(a)pyrene, benzo(b)fluoranthene, chrysene, benzo(a)anthracene, and indeno(1,2,3-cd)pyrene.

Analysis of the organic matter content of the soils in the piles in October 1989 indicated percent organic matter ranged from 1.92 (in pile #4) to 5.32 (in pile #5).

## 2.3 CLEAN-UP CRITERIA

The goal of the remediation of the soil piles is to reduce the total VOC contamination to less than 10 ppm. Since piles #1, #2 and #4 contain less than 0.5 ppm total VOC's, treatment of these piles is not deemed necessary, and they will be stockpiled on an adjacent concrete pad and held until a proper use can be determined.

Analytical results have indicated piles #3 and #5 contain VOC contamination at levels exceeding and near the 10 ppm clean-up level. HNU readings obtained from individual sample holes during the latest sampling indicated some levels in both piles exceeded this limit. Initial plans called for the spreading and aerating of piles #3 and #5, but since recent sampling indicated pile #3 contains greater than 100 ppm VOC's, other remedial alternatives (including off-site disposal) were examined and the results are contained herein.

Though some metals are present in the piles at above background concentrations, off-site disposal of all piles was not considered a viable alternative. It was stated in the IRM Work Plan that the soils would be disposed of properly off-site if metals were found to be present in high concentrations. The concentrations present are not excessively high, and are, in fact, one order of magnitude lower than those present in the area where drums were disposed of in the back of the site. The average concentration of lead in this area is 2272 ppm, zinc - 2973 ppm and cadmium - 18.8 ppm.

The semivolatile contamination in the piles can be considered minor due to the relatively low levels present. The semivolatiles of concern are very immobile, possessing low solutiblities ($10^{1}$ - $10^{-4}$ mg/l) and high partitioning coefficients ($10^{3}$ - $10^{6}$ ml/g). Since the organic matter content of the soil in the piles is relatively high, the high surface areas and exchange properties make it ideal for adsorption of organic compounds. Thus, the semivolatiles, which do possess high partitioning coefficients, would tend to adsorb onto the soil and remain there.

## 3.0 DEVELOPMENT OF TREATMENT TECHNOLOGIES

Based on the data and assumptions discussed in Section 1.0 and 2.0, a list of alternative treatment methodologies for the contaminated soil in piles #3 and #5 was developed. Due to the relatively small amount of material to be treated (approximately 590 cubic yards) and the volatile nature of the contamination present, the feasibilities of some technologies were initially ruled out. On-site high temperature incineration would not be necessary and would be too costly compared to a low temperature treatment. Infrared, rotary kiln and fluidized bed incineration were all high temperature processes screened out prior to a detailed evaluation of alternatives.

The table below lists the treatment technologies which may have the capability of decreasing the total VOC concentrations to less than 10 ppm or permanently remove the contamination from the site. These are some of the more common remedial methodologies currently in use, and their applications to treating piles #3 and #5 are evaluated in the following section.

<u>TREATMENT METHODOLOGIES</u>

- Mobile thermal volatilization (OH Materials process)
- Low temperature thermal treatment (Weston process)
- Soil venting (Continental Recovery Systems process)
- Vacuum extraction (Terra Vac process)
- Spreading and natural aeration
- Off-site disposal
- Off-site incineration

## 4.0 SCREENING OF TREATMENT ALTERNATIVES

Screening of each alternative involved the investigation into the following items: the treatment unit's removal or reduction capability (to less than 10 ppm), pretreatment requirements, availability of unit and cost per ton of material treated. This information is summarized in Table 2.

All of the methodologies investigated have the ability to reduce the total VOC concentration to less than 10 ppm, except for off-site disposal. The mobile incineration units would most likely require pretreatment of the soil to grind or crush the larger rocks present in the piles.

The costs of processing the materials range from less than $40 per ton to $1600 per ton. All costs, except for soil venting and vacum extraction, are based on treatment of both piles #3 and #5, which total 590 cubic yards (796 tons). Due to the relatively small amount of material comprising pile #5, vacuum extraction and soil venting were examined as feasible remedial methods for pile #3 only.

Aeration of the soil in piles #3 and #5 would be the most cost effective treatment. Estimated costs on a per ton basis are one order of magnitude less than costs associated with other on-site treatment alternatives (except for soil venting/vacuum extraction) and two orders of magnitude less than off-site incineration. The unit costs for on-site incineration were high due to the relatively small quantity of soil to be treated. Off-site disposal costs were estimated at $230 per ton and long term liability would be involved. Soil venting and vacuum extraction, the two second most cost-effective processes, were estimated to cost $20-$50/ton more than spreading and aerating, and approximately two to three months would be required to treat the soils compared to an estimated two to three weeks for aeration.

TABLE 2
REMEDIAL ALTERNATIVES FOR TREATMENT OF VOC CONTAMINATED
STOCKPILED SOILS ORIGINATING FROM UST EXCAVATIONS

| TREATMENT TECHNOLOGY | ACCEPTABILITY OF TECHNOLOGY TO REDUCE VOC CONCENTRATIONS TO < 10 ppm | PRETREATMENT NEEDED | AVAILABILITY (LEAD TIME) | COST (based on treatment of 796 tons) | NOTES |
|---|---|---|---|---|---|
| Mobile Thermal Volatilization | X | Possibly grinding or crushing | 30 day lead time | $175/ton (1) | |
| Low Temperature Thermal Treatment | X | Possibly grinding or crushing | Unit available in a few months | $251/ton (2) | |
| Soil Venting | X | | Units should be available during Summer 1990 | $70–$90/ton (3)* | Cost does not include disposal of recovered product from regenerated carbon. Operating time=3 months. |
| Vacuum Extraction | X | | | $58–$86/ton (4)* | Emissions treatment costs not included. Operating time=2 months. |
| Spread & Aerate | X | | | <$40/ton | Improvement of pad necesary prior to commencement of spreading operations |
| Off-site Disposal | | | | $230/ton (5) transportation $80–$90/ton | |
| Off-site Incineration | X | | | $1600/ton (6) | |

NOTES: (1) OH Materials, (2) Weston, (3) CRS, (4) Terra Vac, (5) WTS, (6) CWM
* Cost based on treatment of pile #3 only (676 tons). Additional costs may be involved for pile #5 remediation – vacuum extraction/soil venting were not examined as feasible remedial methods for pile #5 due to size.

## 5.0 DEVELOPMENT OF MOST VIABLE OPTION

Subsequent to the evaluation of treatment technologies described in Section 4.0, spreading and aerating piles #3 and #5 was chosen to be evaluated further. This is the most cost effective treatment method reviewed, and is capable of lowering VOC levels to less than 10 ppm.

The original IRM Work Plan called for the aeration of the soils via spreading on the concrete pad south of the piles, but also called for the off-site disposal of soil containing greater than 100 ppm VOC's. Two discrete soil samples obtained from pile #3 in October 1989 showed total VOC concentrations greater than 100 ppm. Instead of immediately disposing of the soil off-site and creating a long-term liability, several other alternatives have been analyzed, as contained in this report.

Since spreading and aerating the soils was determined to be the most cost-effective alternative, and concern existed over the higher VOC levels in pile #3, a detailed ambient air quality impact study was done to determine the effect of the spread-out volatilizing material on air quality. The analysis is contained in Appendix B.

The procedure described in the New York State Air Guide-1, Appendix A was utilized in evaluating the impact of the soil contaminants on on-site and off-site receptors. Calculations are based on an estimated 8000 cubic feet of contaminated dirt being spread out for volatilization in an area of 15,600 square feet. Since the designated area is not large enough to spread all of the soil to a depth of six inches, it is planned to spread half of the contaminated soil (or 3/5 of pile #3) to a depth of six inches, push aside the soil after aeration is complete and spread the remaining soil from the two piles.

In summary, the estimate shows that for the worst case, where each contaminant is assumed to volatilize within one quarter of a day (six hours), threshold limit values can be met at the work site, and average annual ambient air concentrations for the contaminants can be met at the nearest downwind houses on Rt. 48. This analysis confirms the fact that the levels of contaminants in the soil are not sufficient to cause a serious problem with air emissions during remediation, and off-site disposal will not be necessary.

# 6.0 SUMMARY AND CONCLUSIONS

## 6.1 SUMMARY

A list of possible treatment technologies for the removal/reduction of seven organics (toluene, xylenes, ethylbenzene, trichloroethylene, tetrachloroethylene, MEK and MIBK) from piles #3 and #5 was developed in response to the discovery of VOC contamination present at levels greater than 100 ppm in pile #3. Each technology was evaluated on the basis of treatment capabilities, cost and equipment availability. The results of the screening/evaluation resulted in the selection of the original option of spreading and aerating. Since there was concern over the possible impact of the high VOC levels present in pile #3 on air quality and other alternatives had been examined for this reason, an ambient air quality analysis was done. Results of this study showed levels of contaminants in the soil are not sufficient to cause a serious problem with air emissions during remediation.

## 6.2 CONCLUSIONS

Based on the comparison of different alternatives and the results of the ambient air impact analysis, spreading and aerating the soil in piles #3 and #5 will be done to remediate the VOC contamination. Piles #1, #2 and #4 will not be spread out to aerate due to the very low levels of VOC's present in the soils, and they will be stockpiled on an adjacent concrete pad prior to the treatment of piles #3 and #5. The soil in piles #3 and #5 will also be stockpiled following remediation, and all soils will be held until a proper use for them can be determined. Possible uses include spreading the soil on asbestos contaminated debris to aid in the prevention of blowing asbestos, and using the soil as fill or temporary cover material on-site.

The semivolatiles present in some of the piles are present in relatively low concentrations, are very immobile and will tend not to migrate from their soil of origin. Some metal concentrations in the soil piles are above background levels, but their average concentrations are much lower than those present in the drum disposal area in the back of the site.

Aeration of piles #3 and #5 will be conducted in accordance with the IRM Work Plan and Addendum No. 1. Air monitoring will include the use of two HNU's, one at the source and one at the property line, and a portable gas chromatograph, which will be used to obtain an air sample when persistent readings exceeding the lowest action level are recorded on the HNU at the property line.

Soils will be covered at night, and berms will be constructed to control runoff. A sump pump will be used to evacuate standing water from the aeration pad, and the water will be drummed and held for proper disposal.

The soils will be spread on the pads east of and beneath existing piles #1, #2 and #3 instead of the pads south of the piles (see Figure 2). This change was necessary due to the condition of the concrete pads south of the piles which are discontinuous and would require much improvement prior to commencing spreading operations. The pads on which the soil is currently planned to be spread are continuous units and will require very little repair.

The schedule for conducting the work is shown on Figure 3. All work will be completed by the end of Summer 1990.

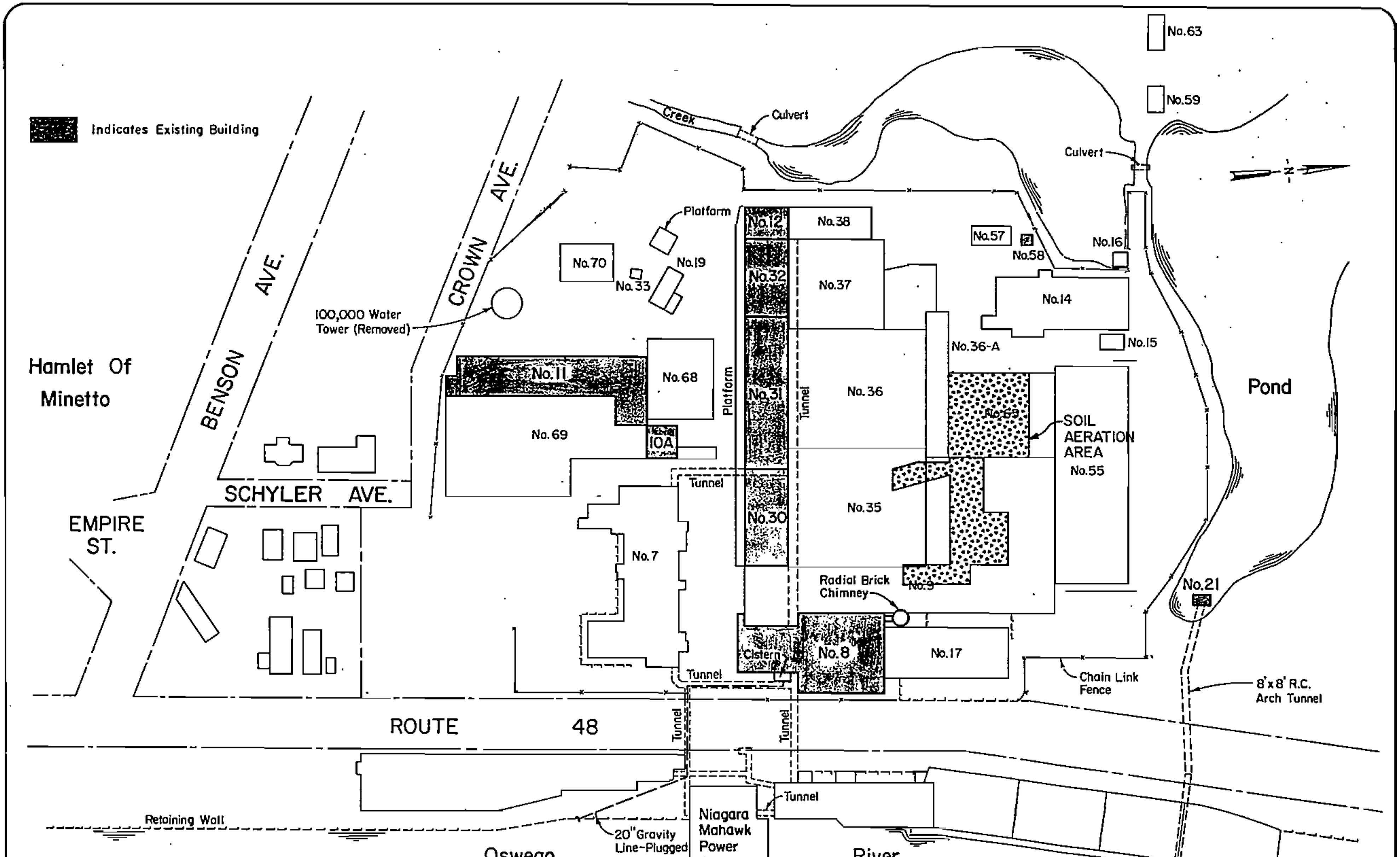
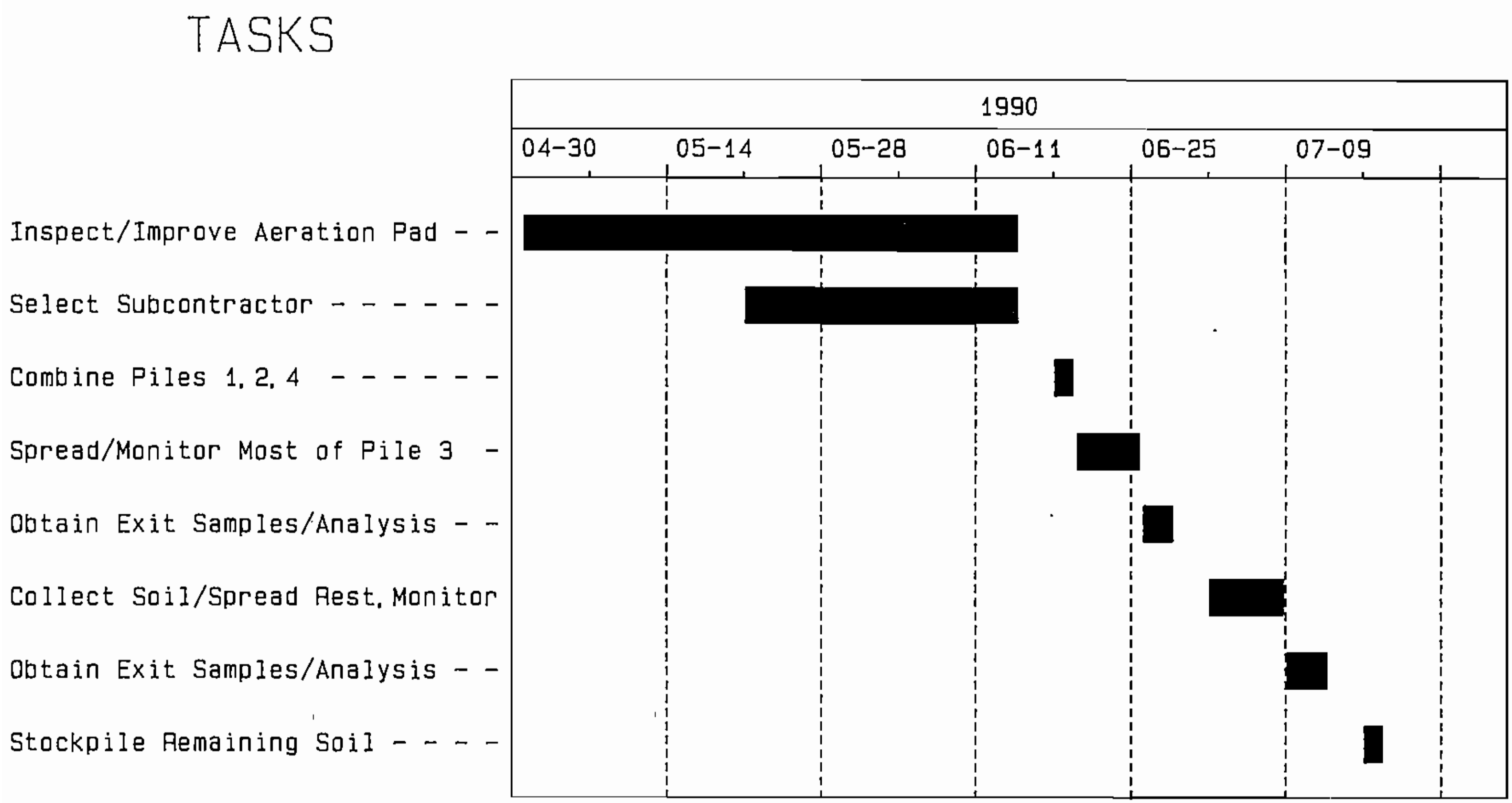



FIGURE 2
LOCATION OF SOIL AERATION AREA

# FIGURE 3

## IRM SOIL AERATION SCHEDULE



# Appendices

MALCOLM PIRNIE

# APPENDIX A

## PILES #1 - #5
## SUMMARY OF ANALYTICAL RESULTS
## FOUR SAMPLING EPISODES

## TABLE 1
COLUMBIA MILLS

ANALYTICAL RESULTS
SOILS IN COVERED PILES
**(1988)**

| | REACTIVE SULFIDE (ppm) | REACTIVE CYANIDE (ppm) | METHYL ETHYL KETONE (ppb) | METHYL ISOBUTYL KETONE (ppb) | TETRA-CHLORO-ETHYLENE (ppb) | TOLUENE (ppb) |
|---|---|---|---|---|---|---|
| Pile #1 | 250 | 2.1 | LT 30 | ND | LT 30 | LT 30 |
| Pile #2 | 150 | 18 | LT 30 | ND | 34 | LT 30 |
| Pile #3 | 130 | 2.3 | 2,800 | ND | LT 300 | 16,000 |
| Pile #4 | 460 | LT 1.0 | LT 30 | ND | LT 30 | LT 30 |
| Pile #5 | LT 20 | 3.9 | 2,900 | 320 | LT 20 | 1300 |

ND = Not Detected
LT = Less Than

# TABLE 2

COLUMBIA MILLS
ANALYTICAL RESULTS - PILES #3 AND #5
MAY 4, 1989 SAMPLING EPISODE

| | Trichloroethylene | Tetrachloroethylene | Toluene | Methyl Ethyl Ketone |
|---|---|---|---|---|
| Pile #3 | | | | |
| Composite A | 340 | 740 | <23 | N.R.* |
| Composite B | 270 | <20 | <20 | 510 |
| Composite C | 400 | <42 | 1200 | 560 |
| Pile #5 | 79 | <44 | 3700 | 730 |

All results expressed as ppb

*N.R. - sample not run

TABLE 3: COLUMBIA MILLS ANALYTICAL RESULTS - JUNE 16, 1989 SAMPLING EPISODE

| INORGANICS | PILE #1 (PPM) | PILE #2 (PPM) | PILE #3 (PPM) | PILE #4 (PPM) | PILE #5 (PPM) | COMMON RANGE OF ELEMENTS IN NATURAL SOILS (PPM) ** | AVERAGE VALUE IN NATURAL SOILS (PPM) ** |
|---|---|---|---|---|---|---|---|
| ALUMINUM | 5100 | 5500 | 5700 | 4600 | 5200 | 10,000 - 300,000 | 71,000 |
| ANTIMONY | <6 | <6 | <6 | <6 | <6 | 2 -10 | - |
| ARSENIC | 6 | 5 | 4 | 6 | 6 | 1 - 50 | 5 |
| BARIUM | 220 | 190 | 100 | 50 | 900 | 100 - 3000 | 430 |
| BERYLIUM | 0.58 | 0.40 | 0.32 | 0.18 | 0.22 | 0.1 - 40 | 6 |
| CADMIUM | 0.56 | 0.60 | 0.42 | 0.28 | 0.70 | 0.01 - 0.7 | 0.06 |
| CALCIUM | 1800 | 1300 | 990 | 4200 | 1100 | - | - |
| CHROMIUM | 26 | 26 | 17 | 11 | 68 | 1.0 - 1000 | 100 |
| COBALT | 4.6 | 5.6 | 5.0 | 4.4 | 5.2 | 1.0 - 40 | 8 |
| COPPER | 28 | 60 | 42 | 16 | 62 | 2.0 - 100 | 30 |
| IRON | 9000 | 14,000 | 9500 | 8000 | 10,000 | - | - |
| LEAD | 180 | 280 | 160 | 46 | 630 | 2 - 200 | 10 |
| MAGNESIUM | 2500 | 2800 | 2200 | 3200 | 2400 | 600 - 6000 | 5000 |
| MANGANESE | 300 | 360 | 200 | 340 | 350 | 20 - 3000 | 600 |
| MERCURY | 0.30 | 0.12 | 0.28 | 0.05 | 0.25 | 0.01 - 0.3 | 0.03 |
| NICKEL | 7 | 9.4 | 9.8 | 6.6 | 8.0 | 5 - 500 | 40 |
| POTASSIUM | 440 | 400 | 410 | 400 | 480 | - | - |
| SELENIUM | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 | 0.01 - 2.0 | 0.3 |
| SILVER | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | 0.01 - 5 | 0.05 |
| SODIUM | 94 | 72 | 98 | 94 | 86 | - | - |
| THALLIUM | <6 | <6 | <6 | <6 | <6 | - | - |
| VANADIUM | 12 | 14 | 12 | 12 | 14 | 20 - 500 | 100 |
| ZINC | 120 | 240 | 100 | 27 | 310 | 10 - 300 | 50 |

| SEMIVOLATILES (EPA 8270) | PILE #1 (PPM) | PILE #2 (PPM) | PILE #3 (PPM) | PILE #4 (PPM) | PILE #5 (PPM) |
|---|---|---|---|---|---|
| PHENANTHRENE | <1 | <1 | 1 | <1 | 2.7 |
| DIBUTYL PHTHALATE | <1 | <1 | 1.9 | 1 | <1 |
| FLUORANTHENE | <1 | <1 | 1 | <1 | 2.5 |
| PYRENE | <1 | <1 | 1.1 | <1 | 2.1 |
| CHRYSENE | <1 | <1 | <1 | <1 | 1.2 |
| BIS (2-ETHYLHEXYL) PHTHALATE | <1 | <1 | <1 | 1 | 1.4 |
| BENZO (a) ANTHRACENE | <1 | <1 | <1 | <1 | 1 |

** SOURCE: USEPA, SW - 874. PG. 273

TABLE 4 IRM SAMPLING OF SOIL PILES – OCTOBER 1989

SOIL – PILES #1 – 5

| PARAMETER | P3-E | P3-E MS | P3-E MSD | P3-F | P3-G | P3-H | P3-H reprep | P3-I | P3-I dil. | P3-J | P3-J dil. | P4-A | P4-A reprep | P4-B |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| VOLATILE ORGANICS (ug/kg) | | | | | | | | | | | | | | |
| Methylene chloride | 10 B | 11 B | 10 B | 10 B | 9 B | 11 B | 16 B | 32 B | NA | 63 B | NA | 11 B | 16 B | 28 B |
| Trichloroethene | 5 U | 91 % | 90 % | 6 U | 5 U | 5 U | 6 U | 18 U | NA | 28 U | NA | 5 U | 5 U | 6 U |
| Benzene | 5 U | 75 % | 63 % | 6 U | 6 U | 5 U | 6 U | 18 U | NA | 28 U | NA | 5 U | 5 U | 6 U |
| Toluene | 2 J | 446 % | 420 % | 6 U | 4 J | 5 U | 2 J | E | 3100 | E | 260000 | 5 U | 3 J | 6 U |
| Total xylenes | 5 U | 6 U | 6 U | 6 U | 6 U | 5 U | 6 U | 11 J | NA | 300 | NA | 5 U | 5 J | 6 U |
| Ethylbenzene | 5 U | 6 U | 6 U | 6 U | 6 U | 5 U | 6 U | 18 U | NA | 210 | NA | 5 U | 5 U | 6 U |
| 2-Butanone | 11 U | 11 U | 11 U | 11 U | 11 U | 11 U | 12 U | 35 U | NA | 57 U | NA | 10 U | 11 U | 11 U |
| 4-Methyl-2-pentanone | 11 U | 11 U | 11 U | 11 U | 11 U | 11 U | 12 U | 35 U | NA | 57 U | NA | 10 U | 11 U | 11 U |
| METALS (mg/kg) | | | | | | | | | | | | | | |
| Cadmium | 0.85 U | | | 0.96 U | 0.96 U | 0.86 U | | 0.85 U | | 1.0 U | | 0.86 U | | 1.0 U |
| Lead | 125 | | | 471 | 462 | 74.0 | | 54.3 b | | 21.4 | | 3.4 b | | 6.5 b |
| Mercury | 0.16 | | | 0.27 | 0.12 U | 0.12 U | | 0.12 U | | 0.12 U | | 0.11 U | | 0.11 U |
| Zinc | 157 | | | 274 | 359 | 55.2 | | 113 | | 77.4 | | 37.3 | | 21.0 |

| PARAMETER | P4-B reprep | P4-C | P4-C reprep | P4-D | P4-D reprep | P5-A | P5-A dil. | P5-B | P5-B reprep | P5-C | P5-C reprep | P5-D | P5-D reprep | P5-E |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| VOLATILE ORGANICS (ug/kg) | | | | | | | | | | | | | | |
| Methylene chloride | 19 B | 12 B | 15 B | 13 B | 12 B | 11 B | NA | 15 B | 17 B | 15 B | 19 B | 14 B | 15 B | 11 B |
| Trichloroethene | 6 U | 5 U | 5 U | 5 U | 6 U | 5 U | NA | 5 U | 6 U | 6 U | 6 U | 5 U | 1 J | 5 U |
| Benzene | 6 U | 5 U | 5 U | 5 U | 6 U | 5 U | NA | 5 U | 6 U | 6 U | 6 U | 5 U | 6 U | 5 U |
| Toluene | 2 J | 5 U | 5 U | 5 U | 6 U | E | 3500 | 1 J | 8 | 6 U | 3 J | 5 U | 7 | 6 |
| Total xylenes | 6 U | 5 U | 5 U | 5 U | 6 U | 26 | NA | 5 U | 10 | 6 U | 6 U | 5 U | 6 U | 5 U |
| Ethylbenzene | 6 U | 5 U | 5 U | 5 U | 6 U | 10 | NA | 5 U | 6 U | 6 U | 6 U | 5 U | 6 U | 5 U |
| 2-Butanone | 12 U | 10 U | 11 U | 10 U | 11 U | 10 U | NA | 11 U | 11 U | 13 U | 13 U | 10 U | 12 U | 11 U |
| 4-Methyl-2-pentanone | 12 U | 10 U | 11 U | 10 U | 11 U | 10 U | NA | 11 U | 11 U | 13 U | 13 U | 10 U | 12 U | 11 U |
| METALS (mg/kg) | | | | | | | | | | | | | | |
| Cadmium | | 0.87 U | | 0.84 U | | 0.92 U | | 0.86 U | | 0.89 U | | 0.87 U | | 0.77 U |
| Lead | | 25.0 | | 7.7 b | | 141 | | 217 | | 261 | | 2420 | | 104 b |
| Mercury | | 0.11 U | | 0.11 U | | 0.54 | | 0.11 U | | 0.12 U | | 0.13 | | 0.11 U |
| Zinc | | 20.0 | | 24.4 | | 632 | | 199 | | 379 | | 321 | | 159 |

TABLE 4 IRM SAMPLING OF SOIL PILES – OCTOBER 1989

SOIL – PILES #1 – 5

| PARAMETER | P1–A | P1–B | P1–B reprep | P1–C | P1–C reprep | P1–D | P1–D reprep | P1–E | P1–F | P1–F reprep | P2–A | P2–A reprep | P2–B | P2–B MS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| VOLATILE ORGANICS (ug/kg) | | | | | | | | | | | | | | |
| Methylene chloride | 21 B | 15 B | 12 B | 17 B | 11 B | 18 B | 8 B | 18 B | 15 B | 15 B | 19 B | 13 B | 17 B | 11 B |
| Trichloroethene | 5 U | 5 U | 5 U | 6 U | 6 U | 6 U | 5 U | 5 U | 5 U | 6 U | 5 U | 5 U | 6 U | 76 % |
| Benzene | 5 U | 5 U | 5 U | 6 U | 6 U | 6 U | 5 U | 5 U | 5 U | 6 U | 5 U | 1 J | 6 U | 80 % |
| Toluene | 5 U | 5 U | 2 J | 2 J | 2 J | 120 | 17 | 5 U | 18 | 2 J | 5 U | 3 J | 8 | 92 % |
| Total xylenes | 5 U | 5 U | 5 U | 6 U | 6 U | 6 U | 5 U | 5 U | 5 U | 6 U | 5 U | 5 U | 6 U | 6 U |
| Ethylbenzene | 5 U | 5 U | 5 U | 6 U | 6 U | 6 U | 5 U | 5 U | 5 U | 6 U | 5 U | 5 U | 6 U | 6 U |
| 2–Butanone | 10 U | 11 U | 11 U | 12 U | 11 U | 11 U | 11 U | 11 U | 10 U | 11 U | 10 U | 10 U | 12 U | 11 U |
| 4–Methyl–2–pentanone | 10 U | 11 U | 11 U | 12 U | 11 U | 11 U | 11 U | 11 U | 10 U | 11 U | 10 U | 10 U | 12 U | 11 U |
| METALS (mg/kg) | | | | | | | | | | | | | | |
| Cadmium | 0.70 U | 0.93 U | | 0.90 U | | 0.87 U | | 0.67 U | 0.68 U | | 0.84 U | | 1.0 U | |
| Lead | 195 b | 242 | | 92.6 b | | 238 | | 306 | 414 | | 152 | | 221 | |
| Mercury | 0.38 | 0.12 | | 0.12 U | | 0.20 | | 0.11 U | 0.22 | | 0.11 U | | 0.12 U | |
| Zinc | 233 | 225 | | 130 | | 407 | | 206 | 300 | | 151 | | 232 | |

| PARAMETER | P2–B MSD | P2–C | P2–C reprep | P2–D | P2–E | P2–F | P2–F reprep | P3–A | P3–A reprep | P3–B | P3–B reprep | P3–C | P3–C reprep | P3–D |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| VOLATILE ORGANICS (ug/kg) | | | | | | | | | | | | | | |
| Methylene chloride | 12 B | 13 B | 8 B | 16 B | 14 B | 10 B | 8 B | 2100 B | 12000 B | 2200 B | 11000 B | 12 B | 14 B | 9500 B |
| Trichloroethene | 72 % | 6 U | 6 U | 6 U | 5 U | 5 U | 6 U | 740 U | 7400 U | 710 U | 3600 U | 6 U | 6 U | 3000 U |
| Benzene | 73 % | 6 U | 6 U | 6 U | 5 U | 5 U | 6 U | 740 U | 7400 U | 710 U | 3600 U | 6 U | 6 U | 3000 U |
| Toluene | 109 % | 6 U | 4 J | 6 U | 5 U | 2 J | 1 J | 1900 | 94000 | 27000 | 86000 | 13 | 2 J | 59000 |
| Total xylenes | 6 U | 6 U | 6 U | 6 U | 5 U | 5 U | 6 U | 740 U | 7400 U | 440 J | 3600 U | 6 U | 6 U | 1100 J |
| Ethylbenzene | 6 U | 6 U | 6 U | 6 U | 5 U | 5 U | 6 U | 740 U | 7400 U | 710 U | 3600 U | 6 U | 6 U | 3000 U |
| 2–Butanone | 11 U | 11 U | 12 U | 11 U | 11 U | 11 U | 12 U | 1500 U | 15000 U | 8300 | 11000 | 11 U | 12 U | 1000 J |
| 4–Methyl–2–pentanone | 11 U | 11 U | 12 U | 11 U | 11 U | 11 U | 12 U | 1500 U | 15000 U | 3200 | 5600 J | 11 U | 12 U | 770 J |
| METALS (mg/kg) | | | | | | | | | | | | | | |
| Cadmium | | 0.97 U | | 0.73 U | 0.77 U | 1.3 | | 0.95 U | | 0.97 U | | 0.97 U | | 0.95 U |
| Lead | | 82.4 | | 273 | 207 | 483 | | 212 | | 104 b | | 20.8 b | | 91.9 b |
| Mercury | | 0.11 U | | 0.35 | 0.34 | 0.11 U | | 0.15 | | 2.8 | | 0.12 U | | 0.19 |
| Zinc | | 172 | | 211 | 204 | 499 | | 199 | | 443 | | 51.6 | | 101 |

TABLE 4 IRM SAMPLING OF SOIL PILES – OCTOBER 1989

SOIL – PILES #1 – 5

| PARAMETER | P5–E reprep |
|---|---|
| VOLATILE ORGANICS (ug/kg) | |
| Methylene chloride | 19 B |
| Trichloroethene | 2 J |
| Benzene | 6 U |
| Toluene | 15 |
| Total xylenes | 6 U |
| Ethylbenzene | 6 U |
| 2–Butanone | 11 U |
| 4–Methyl–2–pentanone | 11 U |
| METALS (mg/kg) | |
| Cadmium | |
| Lead | |
| Mercury | |
| Zinc | |

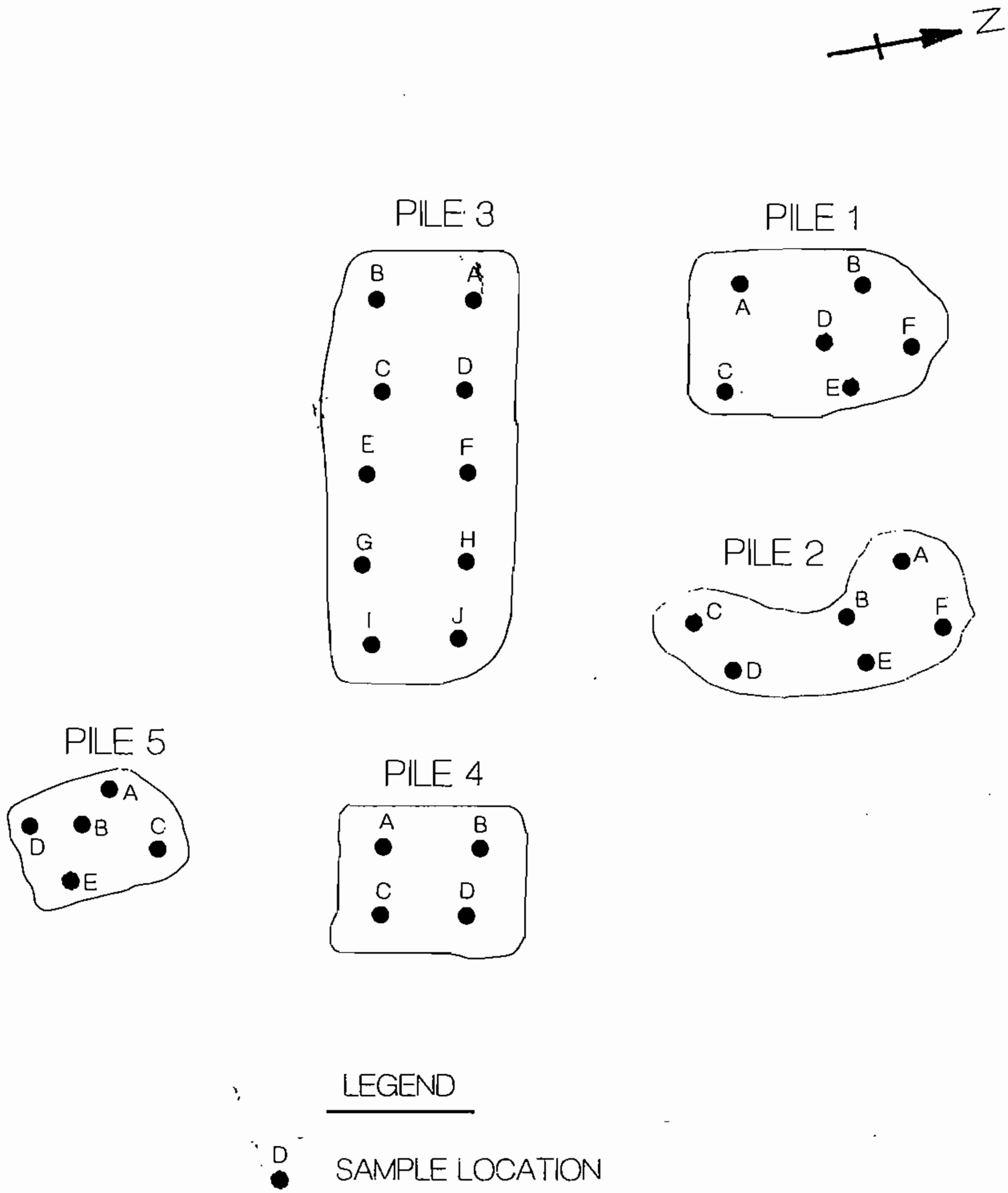
Soil – Pile #5

| PARAMETER | P5–A | P5–A MS | P5–A MSD | P5–B | P5–C | P5–D | P5–E |
|---|---|---|---|---|---|---|---|
| SEMIVOLATILES (ug/kg) | | | | | | | |
| 2–Methylphenol | 130 J | 3700 U | 130 J | 47 J | 360 J | 38 J | 50 J |
| 4–Methylphenol | 69 J | 3700 U | 72 J | 370 U | 180 J | 360 U | 340 U |
| Naphthalene | 120 J | 3700 U | 140 J | 74 J | 270 J | 120 J | 72 J |
| Acenaphthylene | 210 J | 3700 U | 270 J | 72 J | 150 J | 100 J | 60 J |
| Acenaphthene | 44 J | 211 % | 96 % | 370 U | 110 J | 360 U | 340 U |
| Phenanthrene | 1200 | 34000 | 3200 | 410 | 2200 | 480 | 510 |
| Anthracene | 360 J | 9200 | 930 | 66 J | 360 J | 82 J | 84 J |
| Fluoranthene | 1600 | 3700 | 3900 | 610 | 3600 | 550 | 550 |
| Pyrene | 1100 | 1830 % | 134 % | 440 | 3300 | 420 | 390 |
| Benzo(a)anthracene | 980 | 19000 | 2100 | 330 J | 4100 | 280 J | 240 J |
| Chrysene | 950 | 20000 | 2100 | 360 J | 4400 | 320 J | 340 |
| Benzo(b)fluoranthene | 1000 | 1800 | 2400 | 390 | 5900 | 360 J | 390 |
| Benzo(k)fluoranthene | 1100 | 1400 | 1400 | 520 | 3000 | 290 J | 260 J |
| Benzo(a)pyrene | 1300 | 17000 | 2300 | 450 | 6200 | 340 J | 300 J |
| Indeno(1,2,3–cd)pyrene | 1100 | 9300 | 1900 | 410 | 4000 | 280 J | 270 J |

THESE ARE very DIFFERENT ?

U – indicates compound was analyzed but not detected.
J – Indicates an estimated value.
B – indicates the analyte was found in the associated blank as well as the sample.
E – indicates compounds whose concentration exceeds the calibration range of the GC/MS.
% – indicates per cent recovery for MS and MSD sample parameters.
NA– inidcates parameter was not analyzed in dilution.
b – indicates that the reported value is less than the CRDL but greater than the IDL.

* VALUES ARE TYPICALLY LOWER THAN ALLOWABLE CONC. DETERMINED FROM PARTITION COEFFICIENTS.




MALCOLM PIRNIE

SOIL PILES
OCTOBER 18-19, 1989 SAMPLE LOCATIONS

FIGURE 1

# APPENDIX B

# SCREENING ANALYSIS OF AMBIENT AIR QUALITY IMPACT

SCREENING ANALYSIS OF AMBIENT
AIR QUALITY IMPACT FROM AREA SOURCE
AT COLUMBIA MILLS, MINETTO, NY

## A. 3/5 TOTAL VOLUME OF PILE #3 SPREAD OUT TO AERATE

1. 8108 cubic feet contaminated soil (approximately 3/5 of pile #3 or 1/2 of the total soil in piles #3 and #5) laid out to aerate and volatilize in sunshine in the designated aeration area.
2. Assume 100% volatilization occurs in 0.25 day (six hours)
3. Concentrations in contaminated soil (sampled 10/89 discretely) - 3/5 volume of pile #3 (samples A - F)

| | |
|---|---|
| Toluene | 29,769 ppb |
| Xylenes | 825 ppb |
| Ethylbenzene | 860 ppb (ND) |
| Trichloroethylene (TCE) | 860 ppb (ND) |
| Tetrachloroethylene (Perk) | 375 ppb* |
| Methyl ethyl ketone (MEK) | 3,175 ppb |
| Methyl isobutyl ketone (MIBK) | 1,983 ppb |

Notes: * Based on May 4, 1989 sampling

(ND) - compound not detected in any of the latest individual samples.

Concentrations of undetected compounds taken as one half their detection limits.

All compounds which have been detected in pile #3 are included in the above list.

4. Toxicity data from Air Guide #1
   a. Toluene - Low toxicity
      TLV = 100 pm or 375 $mg/m^3$
      AAL = 7500 $ug/m^3$ or 7.5 $mg/m^3$
   b. Xylenes - Moderate toxicity
      TLV = 100 ppm or 435 $mg/m^3$
      AAL = 1450 $ug/m^3$ or 1.45 $mg/m^3$

c. <u>Ethylbenzene</u> - Moderate toxicity
TLV = 100 ppm or 435 mg/m$^3$
AAL = 1450 ug/m$^3$ or 1.45 mg/m$^3$

d. <u>TCE</u> - Moderate toxicity
TLV = 50 ppm or 270 mg/m$^3$
AAL = 900 ug/m$^3$ or 0.90 mg/m$^3$

e. <u>Perk</u> - Moderate toxicity
TLV = 50 ppm or 335 mg/m$^3$
AAL = 1116 ug/m$^3$ or 1.116 mg/m$^3$

f. <u>MEK</u> - Moderate toxicity
TLV = 200 ppm or 590 mg/m$^3$
AAL = 1967 ug/m$^3$ or 1.97 mg/m$^3$

g. <u>MIBK</u> - Moderate toxicity
TLV = 50 ppm or 205 mg/m$^3$
AAL = 683 ug/m$^3$ or 0.683 mg/m$^3$

5. Total Contaminant Poundages From Data

Pile #3: 91 ft x 27 ft x 5.5 ft = 13,514 ft$^3$
Assume 3/5 of pile is spread - 8108 ft$^3$
(8108 ft$^3$)(100 lb/ft$^3$) = 810,800 lb of soil

conc. in ppb/1x10$^9$ = x/lbs of soil, x = lbs of contaminant

Amount of contaminants in 3/5 of pile #3

| | |
|---|---|
| Toluene | 24.1 lb |
| Xylenes | 0.669 lb |
| Ethylbenzene | 0.697 lb |
| TCE | 0.697 lb |
| Perk | 0.304 lb |
| MEK | 2.57 lb |
| MIBK | 1.61 lb |

6. Calculated Hourly Emission Rates (QA)

Assume that 3/5 of pile #3 is spread out in the aeration area (15,600 ft$^2$) and that 100% volatilization occurs in 0.25 day or 6 hours.

QA = lb/hr ft$^2$ = emission rate/area

QA Toluene = 24.1 lb/(6 hrs)(15,600 $ft^2$) = $2.57 \times 10^{-4}$ $lb/ft^2$ hr

QA - Xylenes = $7.15 \times 10^{-6}$ $lb/ft^2$ hr

QA - Ethylbenzene = $7.45 \times 10^{-6}$ $lb/ft^2$ hr

QA - TCE = $7.45 \times 10^{-6}$ $lb/ft^2$ hr

QA - Perk = $3.25 \times 10^{-6}$ $lb/ft^2$ hr

QA - MEK = $2.75 \times 10^{-5}$ $lb/ft^2$ hr

QA - MIBK = $1.72 \times 10^{-5}$ $lb/ft^2$ hr

7. Calculated Annual Concentration Within Area Source

Ca($ug/m^3$) = K x QA x Cm (pg. 18 Air Guide #1)

Ca (Toluene) = $15 \times 2.57 \times 10^{-4} \times 1.355 \times 10^{6} = 5.22 \times 10^{3}$

Ca (Xylenes) = $15 \times 7.15 \times 10^{-6} \times 1.355 \times 10^{6} = 145$

Ca (Ethylbenzene) = $15 \times 7.45 \times 10^{-6} \times 1.355 \times 10^{6} = 151$

Ca (TCE) = $15 \times 7.45 \times 10^{-6} \times 1.355 \times 10^{6} = 151$

Ca (Perk) = $15 \times 3.25 \times 10^{-6} \times 1.355 \times 10^{6} = 66.1$

Ca (MEK) = $15 \times 2.75 \times 10^{-5} \times 1.355 \times 10^{6} = 559$

Ca (MIBK) = $15 \times 1.72 \times 10^{-5} \times 1.355 \times 10^{6} = 350$

8. Comparison With TLV's and AAL's at Work Site

| | CALCULATED CONCENTRATION ($ug/m^3$) | TLV ($ug/m^3$) | AAL ($ug/m^3$) |
|---|---|---|---|
| Toluene | 5220 | 375,000 | 7500 |
| Xylenes | 145 | 435,000 | 1450 |
| Ethylbenzene | 151 | 435,000 | 1450 |
| TCE | 151 | 270,000 | 900 |
| Perk | 66.1 | 335,000 | 1116 |
| MEK | 559 | 590,000 | 1967 |
| MIBK | 350 | 205,000 | 683 |

Since Ca's for all compounds are less than their respective AAL's, the source impact is not significant and there is no need to determine the impact on off-site receptors (pg. 18 Air Guide #1).

9. Comparison With Odor Thresholds

On-site assuming 100% volatilization in 0.25 day

| | Calc. Conc. mg/m³ | Calc. Conc. ppm | Warning Conc.* ppm | TLV ppm |
|---|---|---|---|---|
| Toluene | 5.22 | 1.39 | 0.17-40 | 100 |
| Xylenes | 0.145 | 0.0335 | 0.05-200 | 100 |
| Ethylbenzene | 0.151 | 0.0349 | 0.25-200 | 100 |
| TCE | 0.151 | 0.0282 | 0.2-400 | 50 |
| Perk | 0.0661 | 0.00974 | 4.68-50 | 50 |
| MEK | 0.559 | 0.190 | 0.25-50 | 200 |
| MIBK | 0.350 | 0.0856 | 0.1-47 | 50 |

* From USEPA's Hazardous Materials Incident Response Operations, 8/19/88.

**B. REMAINING 2/5 OF PILE #3 AND ALL OF PILE #5 SPREAD OUT TO AERATE**

1. 7809 cubic feet contaminated soil (2/5 of pile #3 and all of pile #5) laid out to aerate and volatilize in sunshine in the designated area.
2. Assume 100% volatilization occurs in 0.25 day (six hours).
3. Concentrations in contaminated soil (sampled 10/89 discretely) - 2/5 volume of pile #3 (samples G - J) and pile #5.

| | Rest of Pile #3 | Pile #5 |
|---|---|---|
| Toluene | 52,622 ppb | 394 ppb |
| Xylenes | 64 ppb | 6.2 ppb |
| Ethylbenzene | 46 ppb | 3.6 ppb |
| TCE | 6.3 ppb (ND) | 2.4 ppb |
| Perk | 21 ppb (ND)* | -- |
| MEK | 13 ppb (ND) | 5.7 ppb (ND) |
| MIBK | 13 ppb (ND) | 5.7 ppb (ND) |

NOTES: * Based on May 5, 1989 sampling.

(ND) - Compound not detected in any of the latest individual samples.

Concentrations of undetected compounds taken as one half their detection limits.

All compounds which have been detected in each pile are included in the above list.

4. Total Contaminant Poundages From Data

2/5 of pile 3 = 13,514 $ft^3$ - 8108 $ft^3$ = 5406 $ft^3$

(5406 $ft^3$)(100 lb/$ft^3$) = 540,600 lb of soil

pile 5 = 31 ft x 31 ft x 2.5 ft = 2403 $ft^3$

(2403$ft^3$)(100 lb/$ft^3$) = 240,300 lb of soil

Amount of Contaminants in Piles (lbs)

| | Rest of Pile #3 | Pile #5 | Total |
|---|---|---|---|
| Toluene | 28.4 | 0.0947 | 28.5 |
| Xylenes | 0.0346 | 0.00149 | 0.0361 |
| Ethylbenzene | 0.0249 | 0.000865 | 0.0258 |
| TCE | 0.00341 | 0.000577 | 0.00399 |
| Perk | 0.0114 | - | 0.0114 |
| MEK | 0.00703 | 0.00137 | 0.00840 |
| MIBK | 0.00703 | 0.00137 | 0.00840 |

5. Calculated Hourly Emission Rates (QA)

Assume that 2/5 of Pile #3 and all of pile #5 is spread out in the aeration area (15,600 $ft^2$) ad that 100% volatilization occurs in 0.25 day or 6 hours.

QA - Toluene = $3.04 \times 10^{-4}$ lb/$ft^2$ hr

QA - Xylenes = $3.86 \times 10^{-7}$ lb/$ft^2$ hr

QA - Ethylbenzene = $2.76 \times 10^{-7}$ lb/$ft^2$ hr

QA - TCE = $4.26 \times 10^{-8}$ lb/$ft^2$ hr

QA - Perk = $1.22 \times 10^{-7}$ lb/$ft^2$ hr

QA - MEK = $8.97 \times 10^{-8}$ lb/$ft^2$ hr

QA - MIBK = $8.97 \times 10^{-8}$ lb/ft2 hr

6. Calculated Annual Concentration Within Source Area

$$Ca(ug/m^3) = K \times QA \times Cm$$

Ca (Toluene) = $15 \times 3.04 \times 10^{-4} \times 1.355 \times 10^6 = 6.18 \times 10^3$

Ca (Xylenes) = $15 \times 3.86 \times 10^{-7} \times 1.355 \times 10^6 = 7.85$

Ca (Ethylbenzene) = $15 \times 2.76 \times 10^{-7} \times 1.355 \times 10^6 = 5.61$

Ca (TCE) = $15 \times 4.26 \times 10^{-8} \times 1.355 \times 10^6 = 0.866$

Ca (Perk) = $15 \times 1.22 \times 10^{-7} \times 1.355 \times 10^6 = 2.48$

Ca (MEK) = $15 \times 8.97 \times 10^{-8} \times 1.355 \times 10^6 = 1.82$

Ca (MIBK) = $15 \times 8.97 \times 10^{-8} \times 1.355 \times 10^6 = 1.82$

7. Comparison With TLV's and AAL's at Work Site

| | CALCULATED CONCENTRATION (ug/m$^3$) | TLV (ug/m$^3$) | AAL (ug/m$^3$) |
|---|---|---|---|
| Toluene | 6180 | 375,000 | 7500 |
| Xylenes | 7.85 | 435,000 | 1450 |
| Ethylbenzene | 5.61 | 435,000 | 1450 |
| TCE | 0.866 | 270,000 | 900 |
| Perk | 2.48 | 335,000 | 1116 |
| MEK | 1.82 | 590,000 | 1967 |
| MIBK | 1.82 | 205,00 | 683 |

Since Ca's for all compounds are less than their respective AAL's, the source impact is not significant and there is no need to determine the impact on off-site receptors.

8. Comparison With Odor Thresholds

On-site assuming 100% volatilization in 0.25 day

| | Calc. Conc. mg/m$^3$ | Calc. Conc. ppm | Warning Conc. ppm | TLV ppm |
|---|---|---|---|---|
| Toluene | 6.18 | 1.64 | 0.17-40 | 100 |
| Xylenes | 0.00785 | 0.00181 | 0.05-200 | 100 |
| Ethylbenzene | 0.00561 | 0.00130 | 0.25-200 | 100 |
| TCE | 0.000866 | 0.000162 | 0.2-400 | 50 |
| Perk | 0.00248 | 0.000366 | 4.68-50 | 50 |
| MEK | 0.00182 | 0.000619 | 0.25-50 | 200 |
| MIBK | 0.00182 | 0.000445 | 0.01-47 | 50 |

## C. CONCLUSIONS

1. Based on analytical results, the ambient air quality impact calculations indicate the impact of the spread out aerating soil is not significant for both cases.
2. On-site monitoring will be done, though, utilizing two HNU's and a portable GC if necessary. Monitoring during the latest sampling episode indicated levels of volatile organics existed above 10 ppm in some of the sample holes. Because of this fact, the soil will be spread and respirators worn when concentrations in the breathing zone persist at 0-5 units above background.

10

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10

# PRELIMINARY DESIGN EVALUATION AND FULL SCALE CONCEPTUAL DESIGN OF A SOIL VAPOR EXTRACTION SYSTEM FOR THE TEST PIT 3 AREA AT THE COLUMBIA MILLS SITE, MINETTO, NY

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DECEMBER 1990

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**FIGURES**



**TABLES**

**APPENDICES**

## 1.0 INTRODUCTION

This report summarizes the vapor extraction feasibility work performed by Vapex Environmental Technologies, Inc. (*VAPEX*) at the Columbia Mills Site located in Minetto, NY. The site location plan is shown in Figure 1. Work was performed in accordance with *VAPEX's* proposal to Mr. Dave Knutsen of Malcolm Pirnie, Inc. (MPI), dated March 20, 1990.

The results of vadose and saturated zone soil sampling and analytical testing obtained during previous investigations by MPI had identified several volatile organic compounds (VOCs) present in the Test Pit 3 Area, as shown in Figure 2. The objectives of this project were to: 1) develop a preliminary design of a soil vapor extraction system (SVES) and conduct a pilot test in the vicinity of Test Pit 3 (site), 2) perform bench scale treatability tests on site soils to determine achievable cleanup levels for contaminants detected by MPI, 3) based on bench and pilot scale test results, establish design criteria for well spacing, radius of influence, air flow rates, and VOC removal rates for a full scale SVES, and 4) evaluate the overall feasibility (based on conceptual design criteria and technical constraints) of applying vapor extraction technology for the removal of VOC's from subsurface soils at the Columbia Mills site.

The vadose zone in the vicinity of Test Pit 3 is typically four to five feet thick. MPI headspace screening of soil samples in this area indicated that VOCs were detected on soil samples from approximately 3 feet to 12 feet below grade. These conditions require that ground water be artificially depressed in order to expose enough saturated zone soils to accurately assess the feasibility of SVE technology. Based on MPI drilling logs and soil sampling results, *VAPEX* determined that depressing the ground water table to a depth of approximately 13 feet below grade over a 25 foot by 25 foot area would be sufficient to assess the feasibility of applying SVE to the site soils. MPI subsequently determined the hydraulic performance of the site's underlying aquifer by the performance of a step drawdown pump test. The pump test results indicated that dewatering the site to *VAPEX's* specifications was feasible with the operation of one pumping well.

The project was carried out jointly by MPI and *VAPEX*. MPI was responsible for determining dewatering effectiveness in the Test Pit 3 vicinity and for operating the dewatering system during SVES pilot testing. MPI, in its role as prime contractor for the Columbia Mills Site, was also responsible for the contracting and coordination of all drilling activities associated with the installation of soil vapor extraction wells and vapor probes.

One vapor extraction well and seven soil vapor probes were installed on August 28 and 29, 1990, under the supervision of a *VAPEX* geologist. On September 12 and September 13, 1990, *VAPEX* performed soil vapor extraction field pilot and air permeability tests to generate *in-situ* performance data for use in the feasibility determination and conceptual full scale SVES design. The *in-situ* physical data collected during pilot testing was used to develop values of the relative intrinsic air permeability tensor for the soil strata through which air flow occurs. Following the evaluation of the soil air permeability tensor, applicable air flow models were selected based on site specific conditions. The *in-situ* chemical data (i.e., specific soil gas contaminant concentrations) collected during the conduct of the field pilot test was utilized in conjunction with bench scale test results to determine achievable contaminant removal rates. The pilot test data, airflow modeling, and chemical removal rates were utilized to assess the overall feasibility of applying soil vapor extraction technology at the site and in the conceptual design of an optimal full scale SVES.

The first sections of the report summarize the design, performance, and findings of the field pilot and air permeability tests. The following sections present the results of air flow modelling and chemical data interpretation performed by *VAPEX* as part of the overall feasibility determination. The final sections of the report present conclusions regarding the overall feasibility, conceptual design, and practicality of the application of soil vapor extraction in conjunction with ground water depression to remediate subsurface VOC contamination at the Columbia Mills site.

## 2.0 PRELIMINARY DESIGN AND PILOT TEST PREPARATION

### 2.1 Preliminary SVES Design

*VAPEX* reviewed data provided by MPI including: site plans, boring logs, and soil chemical data in order to develop a preliminary SVES design and a site specific field pilot test approach. The preliminary SVES design called for the installation of one vapor extraction well (VW-1) adjacent to Test Pit 3, a distance of approximately 10 feet from drawdown well RW-1. The location of the vapor extraction well was chosen to limit the potential for short circuiting from RW-1, to satisfy the two-dimensional air flow model assumption of a flat water table surface, and to provide operating conditions representative of full scale SVE conditions.

In addition to the extraction well, the preliminary SVES design called for the installation of vadose zone soil vapor probes. *VAPEX's* vapor probes are used to collect soil gas samples and to obtain vacuum pressure measurements under ambient test conditions. Soil gas samples are analyzed to help establish the nature and extent of vadose zone VOC contamination. Seven soil vapor probes were installed in five borings at the site. Borings were advanced adjacent to the vapor extraction well for the installation of nested vapor probes to obtain data for the evaluation of the vadose zone air flow characteristics in the vicinity of vacuum well VW-1.

## 2.2 Vapor Extraction Well and Soil Vapor Probe Installation

The soil borings for the installation of the extraction well and vapor probes were advanced under *VAPEX* supervision on August 28 and 29, 1990. Figure 3 presents the locations of the installed vapor extraction wells and probes.

### 2.2.1 Soil Boring and Sampling Procedures

The vacuum extraction wells and soil vapor probes were installed in borings which were advanced using hollow stem auger drilling techniques. As the borings were advanced, standard split spoon sampling procedures were used to collect subsurface soil samples. The samples were used for visual soil classification and to screen for hydrocarbon content using the jar headspace method.

### 2.2.2 Geologic Description and Jar Headspace Results

The site is covered by a four inch concrete slab, which is the ruin of a former factory building. This slab is underlain by approximately two to three feet of fill material consisting of sand and fine to medium gravel. Soils below the fill are primarily a soft, very fine to medium sand with traces of fine gravel and silt. Soil color varies from dark brown to olive brown to black with some evidence of mottling and the presence of natural organic matter. The soil was wet at a depth of approximately four feet. A concrete lined trench runs through the site at an estimated depth of three to four feet. The trench is indicated in Figure 3.

Split spoon soil samples from selected borings were screened for total hydrocarbons via the jar headspace method using a Thermo Environmental Model 580B (TE-580B) portable photoionization detector equipped with an 11.8 eV lamp. The detection limit for the TE-580B is 0.1 ppm v/v total ionizable hydrocarbons. The TE-580B response is very sensitive to environmental conditions and is generally utilized to detect the presence and relative concentrations of hydrocarbon contaminants. Soil jar headspace concentrations, which are summarized in Table 1, indicated areas of moderate (90 - 267 ppm v/v) to high (623 - 800 ppm-v/v) hydrocarbon concentrations in soils between 5 feet and 13 feet below grade. Soil samples showing high jar headspace concentrations also appeared to have a slight sheen and exhibited characteristic petroleum hydrocarbon odors.

### 2.2.3 Vapor Extraction Well Installation

The vapor extraction well was constructed of two inch Schedule 40 PVC well screen (20 slot) and riser. Prior to installing the well, a 2.5 foot bentonite pellet seal was placed in the bottom of the borehole. Five feet of well screen was placed from 5 feet to 10 feet below grade. The annular space between the boring wall and the well was backfilled with a sand pack from the top of the screen to six inches below. A bentonite pellet seal was placed above the sand pack backfill to a depth of one foot below grade. The well was finished to grade with a nine inch diameter flush mounted well cover which was installed such that the borehole was completely sealed at the surface. A typical vacuum extraction well installation detail is presented in Figure 4.

### 2.2.4 Soil Vapor Probe Installation

A total of seven vapor probes were installed in five borings at the site. A set of two probes were installed in borings VP-1 and VP-2. Borings VP-3, VP-4, and VP-5 each contained one probe. In general, borings were advanced to approximately 6" to 12" below the desired probe depth. Following the addition of a 6" to 12" sand pack, the assembled probe was placed in the borehole and the annular space between the borehole sidewalls and the vapor probe was backfilled with additional sand to one foot above the probe. A one to two foot bentonite pellet seal was placed above the sand pack to minimize the potential for short circuiting of soil gas through the borehole annular space. For boreholes containing a set of nested vapor probes, the installation procedure was repeated for each additional vapor probe. Installation finishing procedures were performed as described for the vacuum well installation. A typical vapor probe is presented in Figure 5. A schematic cross section drawing of the complete vacuum well and vapor probe installation including jar headspace readings is presented in Figure 6. Copies of the boring and installation logs are presented in Appendix A.

## 3.0 PILOT TEST PERFORMANCE

### 3.1 Vapor Probe Soil Gas Sampling and Analyses

Prior to the initiation of the pilot test operation, *VAPEX* sampled soil gas from all vapor probes using the 580B. The data obtained from this sampling event, which was used primarily to provide a screening base prior to gas chromatographic analyses of the pilot system discharge, are presented in Table 2. All 580B results are presented in terms of parts per million of total hydrocarbons on a volume per volume basis as benzene (ppm-v/v). 580B screening, which was conducted on September 12, 1990, resulted in the detection of hydrocarbons at all vapor probe locations, with concentrations ranging from 2,060 ppm-v/v at probe VP-5 to 5,756 at probe VP-1S. The 580B data, as stated previously, is not utilized quantitatively, but is used to detect the presence of VOCs in the soil gas and to provide a methodology for selection of locations for soil gas qualification and quantification by gas chromatographic analysis.

### 3.2 Field Air Permeability Test System and Procedures

*VAPEX* utilized a rotary vane vacuum pump with a 20 cfm maximum air flow capacity to conduct the field air permeability tests. The pump was located adjacent to the vacuum well and was plumbed to the well using 1-1/2 inch diameter Schedule 40 PVC pipe. The pilot system discharged through two, 200 pound vapor phase carbon cannisters connected in series. A schematic diagram of the pilot system is shown in Figure 7.

Sampling ports were provided at several locations to allow *VAPEX* to periodically monitor system performance by collecting data consisting of: vacuum levels and air flow rates at the well head, vacuum levels at the vapor probes, VOC concentrations in the pump discharge, and VOC concentration in the discharge from the carbon cannisters.

Detailed descriptions of the sampling methods, analytical equipment and protocols are provided in Appendix B.

### 3.3 Operating Conditions

*VAPEX* performed the field tests over a 2 day period. The vacuum well was tested at a flow rate of 5 cfm for a 24 hour period on September 12 and September 13 (Test 1), and at a flow rate of 7 cfm for approximately 4.5 hours on September 13, (Test 2).

The 10 foot distance between the vacuum well and the ground water pumping well caused local mounding of the water table beneath the vacuum well when a vacuum was applied. As a result of the vacuum induced mounding of the ground water table during pilot testing, ground water entered the lower screened interval of the vacuum well. Initial pilot test air flow rates were limited due to this mounding and due to the high degree of capillary saturation in the pores within the vicinity of the well screen. As the pilot test progressed, capillary water held in pore spaces adjacent to the vacuum well screen was removed by the vacuum well, thereby increasing the effective air porosity, which permitted higher air flow rates and lower operating vacuums.

Under the equilibrium vacuum dewatering condition, *VAPEX* found that a constant flow rate of 5 cfm was achievable without water accumulation in the vacuum well. At the increased test air flow rate of 7 cfm, periodic bailing of the vacuum extraction well was required during the test to prevent a buildup of water which subsequently resulted in a reduction in the effective screen length and restriction in the air flow into the well. At air flow rates of 7 cfm, ground water mounding reached an equilibrium in the bottom two feet of vacuum well screen. Vacuum pressures at the well and vapor probes were apparently unaffected by the bailing. A chronological description of pilot test activities is provided in Appendix D.

## 4.0 PILOT TEST RESULTS

### 4.1 Vacuum Measurement Results

Results of vacuum measurements are presented in Table 3 and are summarized below. During the initial test of VW1 at an air flow rate of 5 cfm, vacuum at the well head was measured at 3.9 inches of mercury and vacuum was detected at all vapor probes except VP-1S, the lack of measurable vacuum at this probe in relation to its distance from the vacuum well indicated it was probably damaged during or after installation. Vapor probe vacuum readings ranged from 11.5 inches of water at VP1-D (at a distance of 3.5 feet from VW1) to 0.16 inches of water at VP-5 (at a distance of 33 feet from VW1).

While operating at a vacuum well air flow rate of 7 cfm, the vacuum pressure at the well head was measured at 5.7 inches of mercury and vacuum was detected at all vapor probes with the exception of VP-1S. Vapor probe vacuum readings ranged from 16 inches of water at VP-1D, to 0.19 inches of water at VP-5. The relatively low well head vacuum at the 5 and 7 cfm air flow rates indicate that higher flow rates may be attained providing soil moisture in the unsaturated zone can be effectively removed from site soils and that ground water elevations can be lowered and maintained.

## 4.2 Discharge Sampling Results

### 4.2.1 Analytical Methods

During the conduct of each pilot test, *VAPEX* collected and analyzed soil gas samples from the vacuum well discharge prior to and subsequent to carbon treatment. An HNU Model 321 gas chromatograph, equipped with a photoionization detector (GC/PID) was utilized in the soil gas analyses. Details of the sampling and analytical procedures are presented in Appendix B. Six VOCs were selected as target compounds based on their prominence in soils and ground water previously analyzed at this site. The target compounds were: ethylbenzene, methylene chloride, m-xylene, methyl ethyl ketone, toluene, and benzene. The discharge sample analysis results from each pilot test are presented in Table 4; VOC concentrations are presented in terms of parts-per-million on a volume-per-volume basis (ppm-v/v).

In addition to VOC concentrations reported for target VOCs, "Estimated Other VOCs" were evaluated using an assumption of a direct correlation of the average ppm to chromatogram peak area counts for target compounds and the total area for non-target compounds. Total VOC concentrations were estimated based on an assumption of all known and estimated concentrations. The chromatograms developed in the GC/PID analyses are presented in Appendix C.

### 4.2.2 Test No. 1

The GC/PID analyses of discharge samples collected during Test 1 (5 cfm) indicate a high, but fluctuating discharge rate. Initial estimated total VOC concentrations were 38,835 ppm-v/v which decreased to 19,858 ppm-v/v after 2.83 hours, then increased to 26,433 ppm-v/v after 9.4 hours, followed by a steady decline to 24,530 after 22.95 hours, just before termination of Test 1. The predominant compounds detected in the discharge were benzene, toluene, and "Estimated Other VOCs", with minor concentrations of m-xylene and ethyl benzene. Benzene concentrations decreased steadily from 6,436 ppm-v/v at the start of the test to 3,885 ppm-v/v followed by an increased to 4,176 ppm-v/v before decreasing to 3,556 ppm-v/v at the end of the test. Toluene concentrations ranged from a high 2,992 ppm-v/v to 1,439 ppm-v/v followed by increases to 2,243 ppm-v/v and a final decrease to 1,841 ppm-v/v at the end of the test. "Estimated Other VOC" concentrations displayed variations similar to those observed for estimated total VOCs. Based on comparison with the bench scale GC/MS analytical results, no methyl ethyl ketone or methylene chloride was detected in soil gas discharge samples from Test 1. It is estimated that approximately 26.6 pounds of "Estimated Other VOCs" (quantified as benzene and adjusted for dilution) and 5.9 pounds of benzene contributed to a total of 36.1 pounds of estimated total VOCs removed from the vadose zone during the 23 hour VW1 test.

The VOC discharge concentrations measured in Test 1 are indicative of the presence of a free phase VOC source or residually saturated soils in the vadose zone within the vicinity of VW-1. The following decrease and subsequent increase of individual and total VOC concentrations indicates that VW-1 was influencing other vadose zone source areas containing free phase or residually saturated soil areas of contamination inside the nearfield of VW-1 and within the periphery of the area of vacuum influence.

Another factor which may have caused fluctuations in the soil gas discharge concentration is the pore water which is retained on freshly dewatered soils by capillary forces. During pilot testing of these soils, pore water is removed from the unsaturated zone which is within the influence of the vacuum well; thereby, increasing both the effective porosity and air flow permeability. These increases permit greater air flow from distant free phase or residually contaminated soils. The presence of a distant vadose zone source(s) and the dynamic condition of gradually increasing air flow permeability as was observed in these soils most likely caused the soil gas discharge concentration fluctuations observed during Test 1.

### 4.2.3 Test No. 2

The GC/PID analyses of discharge samples collected during Test 2 (7 cfm) indicate that initial estimated total VOC concentrations were 28,136 ppm-v/v which decreased to 17,550 ppm-v/v followed by an increase to 22,910 ppm-v/v. The predominant compounds detected in the discharge were toluene, benzene, and "estimated other VOCs" with minor concentrations of m-xylene and ethyl-benzene. All VOC concentrations showed relatively inconsistent discharge rates, similar to those observed in Test 1. The highest concentration in the discharge was "Estimated Other VOCs" with an initial concentration of 19,660 ppm-v/v which decreased to 12,832 ppm-v/v followed by an increase to 16,613 ppm-v/v. Benzene concentrations were the highest target compound, with an initial concentration of 4,938 ppm-v/v, a minimum concentration of 2,376 ppm-v/v and a final concentration of 3,156 ppm-v/v. Toluene concentrations fluctuated from 2,148 ppm-v/v to 1,341 ppm-v/v followed by an increase to 1,907 ppm-v/v. It is estimated that approximately 5.4 pounds of "Estimated Other VOCs" (quantified as benzene and adjusted for dilution) and 1.1 pounds of benzene contributed to a total VOC removal from the vadose zone of 7.4 pounds during the second four hour test.

The VOC concentrations initially measured in Test 2 are indicative of the presence of residually saturated soils in the vadose zone within the immediate vicinity of VW1. The patterns of discharge concentration fluctuation observed during Test 2 are similar to those observed during Test 1 which are indicative of significant vadose zone source(s) and variations in pore water content which effect local soils air flow permeability.

#### 4.2.4 Post Carbon Discharge Sampling Results

Throughout the course of each pilot test, *VAPEX* monitored the discharge from the carbon cannister(s) to evaluate the effectiveness of the carbon for providing control of VOCs discharge to the atmosphere. Periodic screening was performed over the total duration of pilot tests, using the 580B. The 580B results indicate that breakthrough of a low concentration of VOCs did occur at the first cannister, however, 580B analyses of discharge from the second cannister indicate that no breakthrough occurred from this cannister.

## 5.0 BENCH SCALE VENT TEST

A bench scale vent test was performed on a composite soil sample collected on September 12, 1990 from the boring advanced for the installation of VW1. The sample was collected from auger cuttings displaying high VOC concentrations at a depth of approximately 5 to 10 feet below ground surface. The purpose of the bench scale vent test was to qualify and quantify volatile and semi-volatile contaminants present in the soil sample, to evaluate the effects, if any, of the complex mixture of contaminants on the volatilization of the VOCs, and to demonstrate the level of remediation that may be achieved from the implementation of the proposed full scale SVES.

In general, the bench scale vent test procedures involved the simulation of soil vapor extraction on the soil sample from boring VW1 contained within a laboratory column under an enhanced air-flow condition. Volatile and semi-volatile contaminant concentrations in the soil sample were qualified and quantified by gas chromatography/mass spectrometry (GC/MS) prior to and following the performance of the test, utilizing EPA Methods 8240 and 8270, respectively. The vapor discharge from the column was sampled and analyzed by GC/FID at predetermined time intervals over the duration of the test. The vent test was run for a period of approximately eleven days. Based on compound listings from the EPA test methodology, no target compounds were identified or quantified during the analyses; quantification and qualification by a general GC/MS scan tentatively identified $C_7$ and $C_9$ hydrocarbons as the primary VOCs discharged. No chlorinated VOCs were identified in the discharge by the GC/MS analyses. The results of the bench scale are presented in Table 5 and a summary of operating conditions and vent test results is presented in the following tables.

Figure 10 presents a graphical depiction of the venting column discharge concentration (calculated as dimethyl cyclohexane) the representative $C_7$ to $C_9$ compound), over the duration of the test. Integration of the area under the curve in Figure 10 gives a more representative estimation of the mass of the VOCs removed during the bench scale vent test and therefore the initial concentrations of VOCs in the soil mass. Details on the laboratory procedures, data sheets, and analytical results are provided in Appendix E.

## 5.1 Bench Scale Pilot Test Results

| | | | | | |
|---|---|---|---|---|---|
| SOIL SAMPLE | MASS (g) | AREA ($cm^2$) | HEIGHT (cm) | PACKING DENSITY ($g/cm^3$) | TEMP (°C) |
| | 2618 | 45.3 | 33.0 | 1.7 | 20 |
| TEST EVENTS | 1. Initial sample analysis - EPA Method 8240 plus EPA Method 8270 for semivolatile organics [a]<br>2. Soil column preparation [a]<br>3. Laboratory vent test - per VAPEX specifications [b],[c]<br>4. Final sample analysis - EPA Method 8240 plus EPA Method 8270 for semivolatile organics [a] | | | | |
| TEST CONDITIONS | AIR FLOW RATE ($cm^3/min$) | AIR LOADING RATE ($cm^3/cm^2$-min) | PRESSURE 1 (mm Hg) | PRESSURE 2 (mm Hg) | PRESSURE DIFFERENCE (cm $H_2O$) |
| | 100 | 2.19 | 752.75 | 750.0 | 4.00 |
| | temperature of inlet air = 20°C<br>test duration hours = 266.60 hours<br>number of sample points = 16 | | | | |
| TEST RESULTS | EPA Method 8240, 8270<br>Soil Total VOC Contaminant Concentration (mg/kg)<br>Initial = 68.5 Final = 1 | | | | |
| | Semi and non-volatiles: See Section 4.2.2 | | | | |
| | Initial total soil contaminant concentration from integration of "Mass Loss Rate" curve (Figure 6) = 35.57 mg/kg | | | | |
| | Identified volatile contaminants removed - relative percentage<br>(C7 to C9) Hydrocarbons: 97.85% | | | | |

* the contaminants tentatively identified were predominantly C7 to C9 hydrocarbons

(a) Appendix E contains brief descriptions of the column preparation, column testing, and analytical procedures used in performance of the pilot tests.

(b) Appendix E presents the GC/FID data processed over the duration of the pilot tests.

(c) Appendix E presents the total ion chromatograms and ion fragmentation patterns obtained from the GC/MS analyses.

### 5.2 Discussion of Bench Scale Pilot Test Results

#### 5.2.1 Volatile Contaminants Identification by GC/MS

Two gas Chromatograph/Mass Spectrometry tests were performed on the soil sample using EPA Method 8240. A soil sample was tested prior and subsequent to soil venting. The target compounds incorporated in the EPA Method 8240 search are predominantly VOCs which are low molecular weight chlorinated compounds and simple aromatics; a listing of the target compounds is provided within the laboratory report in Appendix E. The results of the GC/MS scan demonstrated that all target compounds identified by EPA Method 8240 were below the method detection limit. Compounds quantified and qualified were C7 through C9 hydrocarbons representative of weathered gasoline or fuel oil product. Dimethyl cyclohexane was used to quantify the C7 to C9 hydrocarbons as this compound is considered to be representative of the C7 to C9 compound range.

NO BENZENE or TOLUENE HERE - IS THIS REPRESENTATIVE?

### 5.2.2 Semivolatile Contaminant Identification by GC/MS

Two soil samples were collected for analyses of semi-volatile compounds by EPA Method 8270. A soil sample was analyzed prior to and after the soil venting activities. No target semi-volatile compounds were qualified or quantified in the GC/MS analyses. A listing of the target compounds within Method 8270 are presented within the laboratory report provided in Appendix E. Further, a GC/MS 40,000 compound library search was not able to generate a sufficient match for compound identification purposes. Appendix E presents the total ion chromatogram generated during the analyses.

From the GC/MS analysis performed on a 5 gram composite soil sample prior to soil venting, the total VOC content was quantified as 68.5 mg/kg as dimethyl cyclohexane.

An advantage of the laboratory vent test is that the plot of contaminant mass loss rate versus time may be integrated to estimate and/or verify the total initial mass of unknown VOCs in the larger soil sample contained in the test column.

The VOC removal achieved during the vent test was calculated from the integration of Figure 10. From the results of the curve integration, the initial concentration of VOCs in the soil was calculated as 35.57 mg/kg. The difference observed in the VOC concentrations using the EPA 8240/8270 and curve integration methods of evaluation indicates the degree of heterogeneity in the distribution of VOCs in the soil sample. Due to the larger soil mass involved, *VAPEX* prefers to utilize the contaminant concentration value obtained from the integration of the mass loss rate versus time curves in evaluating site remediation requirements.

Following eleven days of venting of the soil sample and having observed a significant reduction in the contaminant removal rates, the vent test was terminated. A longitudinal core of soil was removed from the test column. Two 5 gram composite samples of the soil core (one from the top and one from the bottom of the core) were analyzed by EPA Method 8240/8270. The resulting VOC concentration from the GC/MS analyses was approximately 1 mg/kg.

Based on the initial soil contaminant concentrations calculated utilizing EPA 8240 and 8270, a greater than 98 percent reduction of VOCs in the soil sample from VW1 was achieved. Utilizing the initial soil contaminant concentration levels as calculated from the integration of Figure 10, a greater than 97 percent removal of VOCs were achieved.

*VAPEX* considers that the degree of contaminant removal achieved in the vent test confirms the feasibility of utilizing vapor extraction to remove VOCs from the unsaturated zone soils at the contaminated site. The results of these tests indicate that it is technically feasible to reduce the concentration of VOCs in the soil sample to less than 1 parts per million (by weight).

SVES is not considered an optimal technology to apply for remediation of non-volatile components; subsurface air movement (oxygen induction) during soil vapor extraction activities would be expected to enhance non-volatile compound remediation from the source soils through naturally occurring biodegradation.

## 6.0 COMPUTER MODELLING OF SUBSURFACE AIR FLOW

*VAPEX* utilizes proprietary air flow and contaminant transport models to evaluate the air flow characteristics of the vadose zone soils and to simulate vapor extraction system performance. Modeling allows *VAPEX* to determine overall system feasibility, to establish optimal vapor extraction system configurations and operating parameters, and to estimate the time required to remediate the soils to specified target contaminant closure levels.

### 6.1 Modelling Approach

Physical characteristics of the site such as soil type(s), soil heterogeneity, and anisotropy, surface cover, underground trenches, etc. are required data input to the airflow models utilized in the analysis and evaluation of a specific site.

The physical characteristics of each vacuum well/vapor probe system, the vacuum pressure data, and the air flow rates recorded during the field pilot testing were used as additional input into *VAPEX's* proprietary two-dimensional (2-D), radially symmetric air flow model.

The 2-D model is utilized to determine the permeability tensor of the soil strata through which the air flow occurs. The intrinsic air permeability tensor is the matrix of soil air permeability values along specified areas, e.g., in the x, y, and z direction in a Cartesian coordinate system. Values for the relative horizontal intrinsic permeability and the relative vertical intrinsic permeability are determined for each strata of concern, and the equivalent relative vertical intrinsic permeability is determined for surface and subsurface airflow boundaries that may exist.

The operation of the field pilot/air permeability test at more than one air flow rate allows for both the initial calibration (i.e., parameter evaluation using field data) and verification of the model (i.e., the model is set to simulate the system for the second air flow rate using the parameters established in the calibration mode; a comparison is made between the model predicted pressure distribution, and the actual pressure data measured at the well/probes at the second air flow rate).

Following calibration and verification, *VAPEX's* site specific air flow model is used in the simulation mode to obtain the pressure distributions associated with various system configurations. This allows determination of the expected air flow paths, air flow rates, and the achievable effective radius of influence of the simulated soil vapor extraction system.

### 6.2 Modelling Results

Based on vacuum measurements at the vapor probes and vacuum well, subsurface air flow pathways in the near influence of vacuum well VW-1 appeared to be predominantly in the radial direction.

The air flow rate, vacuum well/vapor probe vacuum data, and groundwater depths obtained during the 24 hour, 5 cfm pilot test at VW-1 was used as input to calibrate *VAPEX*'s two dimensional radially symmetric air flow model. The horizontal ($K_r$) and vertical ($K_z$) relative intrinsic permeabilities for the vacuum influenced soils in the vicinity of Test Pit 3 were calculated to be $8.85 \times 10^{-9}$ $cm^2$

and 6.0 x $10^{-10}$ $cm^2$, respectively. Soils displaying intrinsic air permeability values in these ranges are considered to be of moderate to low permeability. Figure 8 presents a comparison of predicted vacuum distribution and the observed vacuum data (observed at vapor probes VP-1, VP-2, and VP-3) during the 24 hour, 5 cfm test (model calibration).

Verification of the air flow model was performed by simulating SVES performance during the four hour (7 cfm) test. A comparison of predicted and observed vacuum distribution, shown in Figure 9, indicates good correlation and supports the modeling approach.

The calibrated/verified airflow model was utilized to simulate full scale SVES performance. The maximum achievable air flow rate for vapor extraction well VW1 is predicted to be in the range of 10 to 15 cfm with a maximum predicted radius of vacuum influence of approximately 30 feet. The predicted radius of vacuum influence is highly dependent of the relative intrinsic permeability of the surface boundary condition (i.e.; the concrete slab foundation). The observed vacuum at vapor probe VP-5 was slightly higher than the model predicted vacuum which may be a result of a local variation in the slab permeability.

The location selected for installation of vapor probe VP-3 was chosen to evaluate whether the Test Pit and/or the foundation of Building 11 effected subsurface air flow paths. Vacuum data collected from vapor probe VP-3 is depicted in Figures 8 and 9 as the field data point 18 feet from the vacuum well. Because the observed vacuum levels correlate fairly well with the model predicted levels, influences on subsurface air flow paths resulting from the Test Pit and the Building 11 foundation appear to be negligible.

VP-4 was installed at a depth of 12 feet adjacent to the pumping well RW-1 in order to determine pressure distribution within the well's zone of depression. During pilot Test 1 and Test 2, the observed vacuum readings within the cone of depression were high relative to within those recorded in other vacuum probes located equidistant from the vacuum well. This indicates that as expected, air flow within the cone of depression was significantly less than which occurs through overlying soils. For modeling purposes, the unsaturated zone was assumed to be a constant thickness of 11 feet throughout the pilot test area, therefore, data obtained from this probe was not used in calibrating the 2-D analytical model.

## 7.0 VAPOR EXTRACTION DESIGN CRITERIA DISCUSSION

### 7.1 Extraction Well Air Flow Rate and Configuration

Pilot test and air flow modelling results indicate that the maximum achievable air flow rate from VW-1 is approximately 10 to 15 cfm, which is relatively low. Vacuum system air flow rates can be effectively increased by the use of longer well screen intervals. The verified 2-D model was used to predict well flow rates and vacuum levels for a 10 foot screen interval vacuum well (screened from 4' to 14' below grade) in the vicinity of Test Pit 3. Depth to ground water was assumed to be depressed to a level of 15 feet below grade to allow placement of the vacuum well. Under these conditions, maximum vacuum well flow rates increase to a range of 20 to 25 cfm.

The achievable radius of vacuum influence is generally a function of local soil properties and surface layer permeability and is largely unaffected by vacuum well flow rates. The maximum radius of vacuum influence that can be achieved in the vicinity of Test Pit 3 is approximately 30 feet. Thus, a soil vapor extraction system for the soils in the vicinity of Test Pit 3 would consist of vertical vapor extraction wells spaced at intervals approximately 60 feet on center. The total number of wells will depend on the extent of the proposed remediation area.

The successful operation of a full scale SVES at the site dictates the use of a ground water drawdown system that can achieve dewatering to specifications as outlined in full scale soil vapor extraction system design specifications. If insufficient ground water control is maintained during SVES operation, mounding of groundwater directly under vacuum wells may occur which will negatively impact system performance by restricting air flow paths to the vacuum well. In turn, this will increase vacuum well operating vacuums, reduce well flow rates and hydrocarbon removal rates, and extend the duration of SVES operation. In order to avoid inefficient SVES designs, *VAPEX* recommends that final full scale vacuum well configurations be designed based on field verified ground water drawdown levels which will occur under steady state pumping conditions.

Regardless of water table elevations, pore water will also migrate into vacuum wells as unsaturated flow occurs from previously saturated soils. The degree of water accumulation will be greatest at the start of vacuum well operation and will decrease as surrounding soils are "dried" by the vacuum wells. A means of withdrawing water from vacuum wells as it accumulates will be necessary for optimum full scale system performance.

## 7.2 System Performance

MPI has provided *VAPEX* with the anticipated limits of the SVE treatment area and preliminary design specifications for a ground water pumping system which would provide hydraulic control of water levels in the vicinity of Test Pit 3 and areas to the east. The dewatering design specifies the installation of four pumping wells in addition to the existing pumping well. MPI has specified that a full scale SVES be designed to remediate soil extending from grade to a maximum depth of 13 feet below grade.

Based on these conditions, *VAPEX* has made several assumptions regarding the operating conditions of a full scale SVES which incorporated MPI's dewatering design. *VAPEX* anticipates that a total of 9 vacuum wells would be required to ensure adequate vacuum influence over the area delineated by MPI. Each well would produce an individual well air flow of approximately 20 cfm. If all full scale vacuum wells are operated simultaneously, individual vacuum well flow rates may be decreased. It is assumed that the ground water table will be lowered to a depth of 15 feet below grade during full scale SVES operation and that the highest soil gas concentrations will be encountered in the Test Pit 3 area with decreasing concentration gradients to the east, northeast, and southeast.

At an air flow rate of 20 cfm, it is anticipated that the maximum initial VOC removal rate in the vicinity of Test Pit 3 would vary from 116 to 227 pounds of VOCs per day, per well depending upon soil VOC concentrations in the vicinity of each specific extraction well. VOC removal rates would be expected to decrease rapidly following start up. Time to clean up would vary depending upon the initial soil VOC concentration, the specific types of VOCs occurring in soil gas, the soil clean up criteria, and possible discharge restrictions dictated by air controls. Thus, clean up times would likely vary at different locations.

For the purposes of this design discussion, *VAPEX* is assuming that clean up time represents the time required for the vapor extraction system to remove the majority of VOCs from vadose zone soils within its zone of influence. *VAPEX* considers that the removal of the "majority" of VOCs would be consistent with a clean up goal of 1 ppm total VOCs.

*VAPEX* utilized its proprietary chemical transport model (VaporChem™) to estimate the time required to remediate vadose zone soils in the areas delineated by MPI. Several assumptions were made concerning model input since the degree and extent of vadose zone contamination is as yet undefined. Model input parameters consisted of an individual well air flow rate of 20 cfm, increasing dilution factors, and an original spill volume of 100 gallons within the 30 foot radius of vacuum well influence.

The model results indicate that under the above conditions, it would require approximately four years to remediate contaminated vadose zone soils in the area delineated by MPI to a level of 1 ppm total VOCs. The variables used in this simulation represent a worst case cleanup time estimate.

# 8.0 CONCLUSIONS

## 8.1 Site Conditions

Subsurface soils are relatively consistent in description throughout the Test Pit 3 area. The upper soils consist of a gravelly, sand fill which extends to a depth of up to three to four feet. The fill is underlain by a loose fine sand with 0% to 10% silt and coarser sands.

Based on the results of soil borings, soil vapor probe sampling, and pilot test discharge vapor analyses, it is evident that petroleum range VOCs are widely distributed in the vadose and saturated zone soils in the Test Pit 3 area.

Vadose zone total VOC concentrations observed in the Test Pit 3 area ranged from 2,060 ppm at vapor probe VP5 to 5,756 ppm at VP1-S. The highest vapor concentrations were observed in shallow soils (four feet below grade) in the vicinity of VW-1. The primary VOCs were benzene, toluene, and "Estimated Other" VOCs. The estimated total VOC concentrations observed in soil vapor discharge from VW1 indicate that soils within the nearfield of VW1 are residually saturated with petroleum hydrocarbons. The fluctuations in soil gas discharge observed during both Test 1 and 2 suggest that other areas within the periphery of the radius of vacuum influence may contain free phase or residually saturated soils.

Vadose zone soils were found to be of moderate to low permeability. The relative intrinsic horizontal air permeability, $K_r$, was calculated to be $8.85 \times 10^{-9}$ $cm^2$ in the vicinity of Test Pit 3.

## 8.2 Soil Vapor Extraction Feasibility

Field pilot test and modelling results indicate that soil vapor extraction is a feasible technology for application in the remediation of vadose zone soils at the site. The largest measured zone of influence during pilot testing was 34 feet. Modelling results indicate that the maximum achievable zone of influence is approximately 30 feet. The maximum achievable air flow rate from vacuum extraction well VW-1 is estimated to be 10 to 15 cfm. However, air flow modeling also indicated that drawing ground water levels down to a depth of 15 feet or more below grade and installing extraction wells with 10 foot screen intervals will allow flow rates of 20 to 25 cfm from each well.

Estimated total VOC discharge concentrations at VW1 indicate that soil vapor extraction provides an effective means of removing vadose zone VOCs at Test Pit 3. Approximately 43.5 pounds of total VOCs were removed over the duration of Test No. 1 and No. 2 at VW1.

VOC removal rates of individual vacuum extraction wells vary significantly depending on their proximity to and the degree of a vadose zone VOC source. Under full scale operating conditions, vacuum extraction wells that are located within relatively close proximity to a significant vadose zone VOC source, such as VW1, would be expected to produce initial VOC removal rates of up to 227 pounds per day at an air flow rate of 20 cfm.

## 9.0 REPORT PREPARATION AND REVIEW

The report presented above was prepared and reviewed by *VAPEX*. The report was prepared by David J. Hazebrouck (Project Manager), Matthew Walsh (Geologist), and Michael C. Marley (Director, Technical Development).

**VAPEX ENVIRONMENTAL TECHNOLOGIES, INC.**

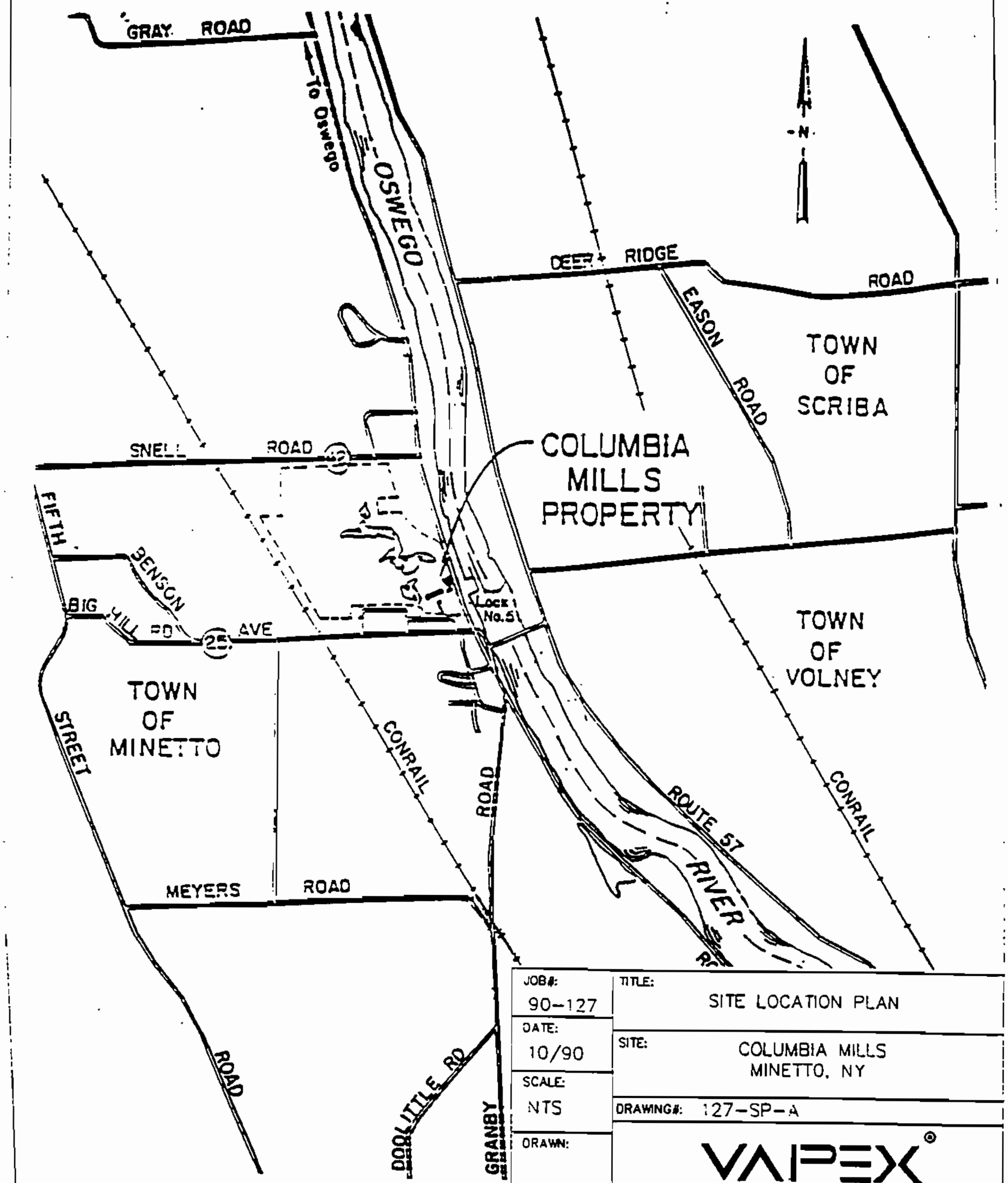
David J. Hazebrouck
Project Manager

Matthew T. Walsh
Geologist

Michael C. Marley
Director, Technical Development

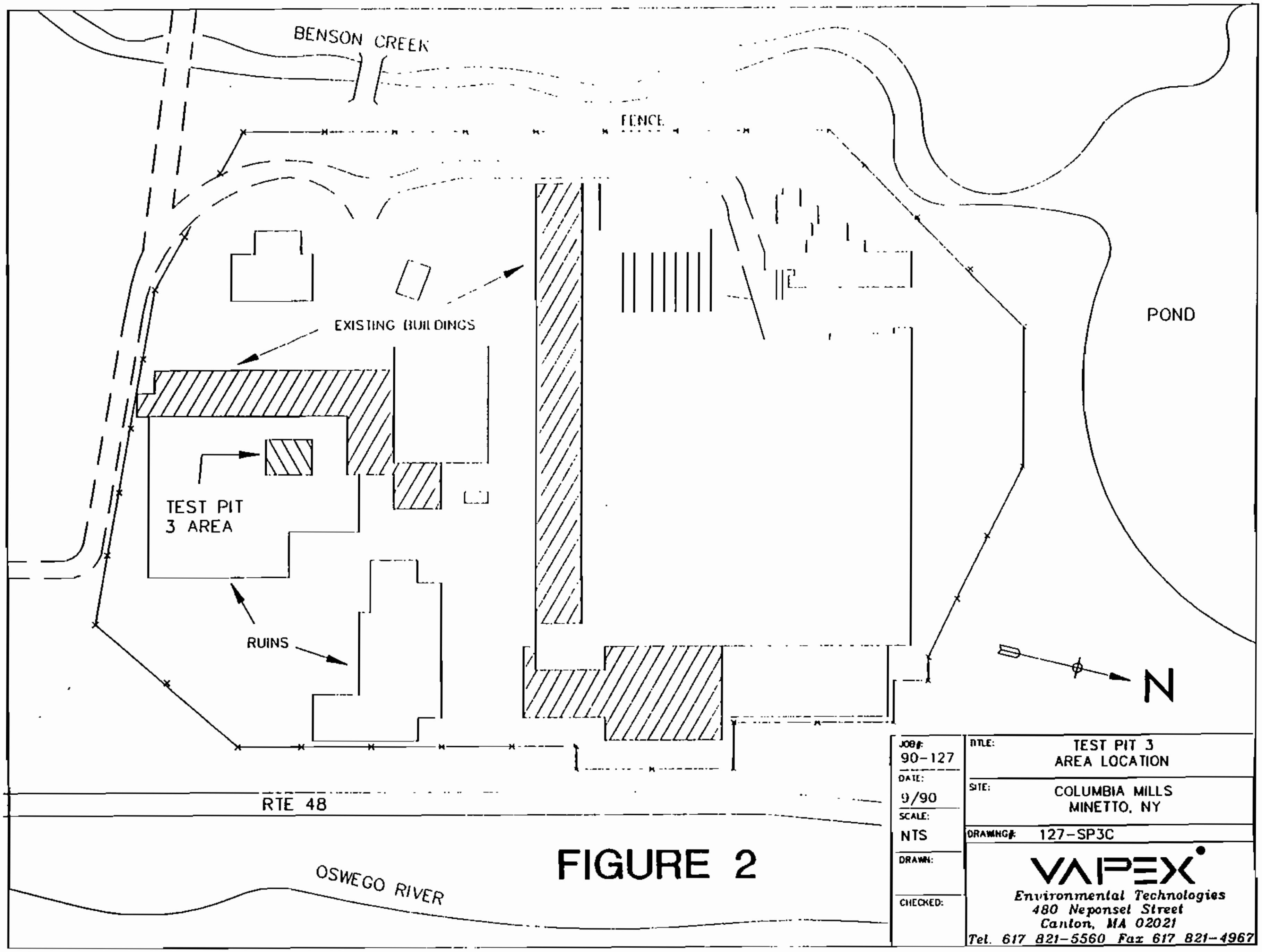
# FIGURES

SOURCE: SITE PLAN BASED ON MALCOLM PIRNIE PLAN



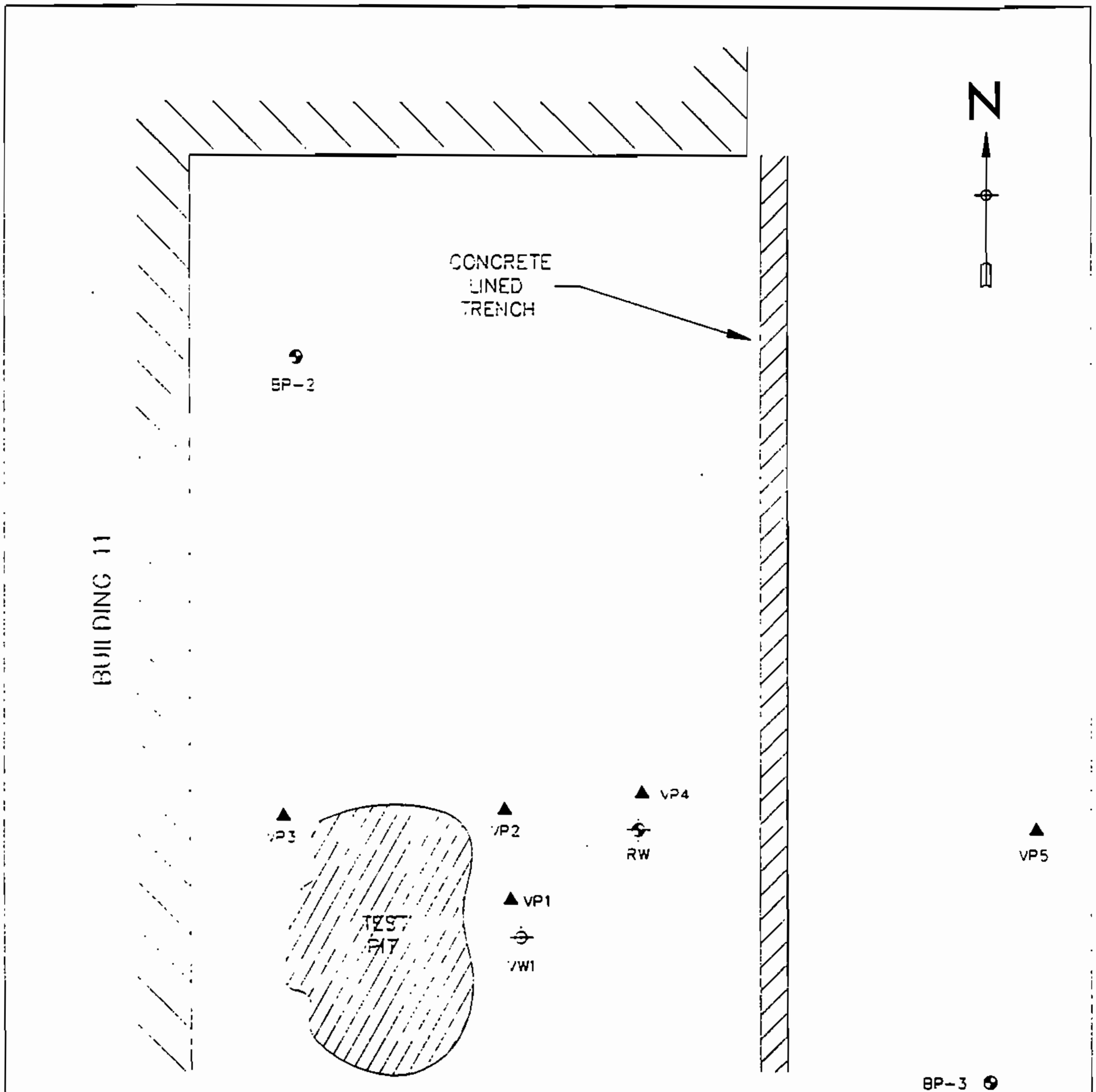

| JOB#: 90-127 | TITLE: SITE LOCATION PLAN |
|---|---|
| DATE: 10/90 | SITE: COLUMBIA MILLS MINETTO, NY |
| SCALE: NTS | DRAWING#: 127-SP-A |
| DRAWN: | VAPEX® *Environmental Technologies* *480 Neponset Street* *Canton, MA 02021* *Tel. 617 821-5560 Fax 617 821-4967* |
| CHECKED: | |

FIGURE 1



BENSON CREEK
FENCE
POND
EXISTING BUILDINGS
TEST PIT
3 AREA
RUINS
N
RTE 48
OSWEGO RIVER
JOB#: 90-127
DATE: 9/90
SCALE: NTS
DRAWN:
CHECKED:
TITLE: TEST PIT 3 AREA LOCATION
SITE: COLUMBIA MILLS MINETTO, NY
DRAWING#: 127-SP3C
VAPEX
Environmental Technologies
480 Neponset Street
Canton, MA 02021
Tel. 617 821-5560 Fax 617 821-4967


FIGURE 2




# FIGURE 3

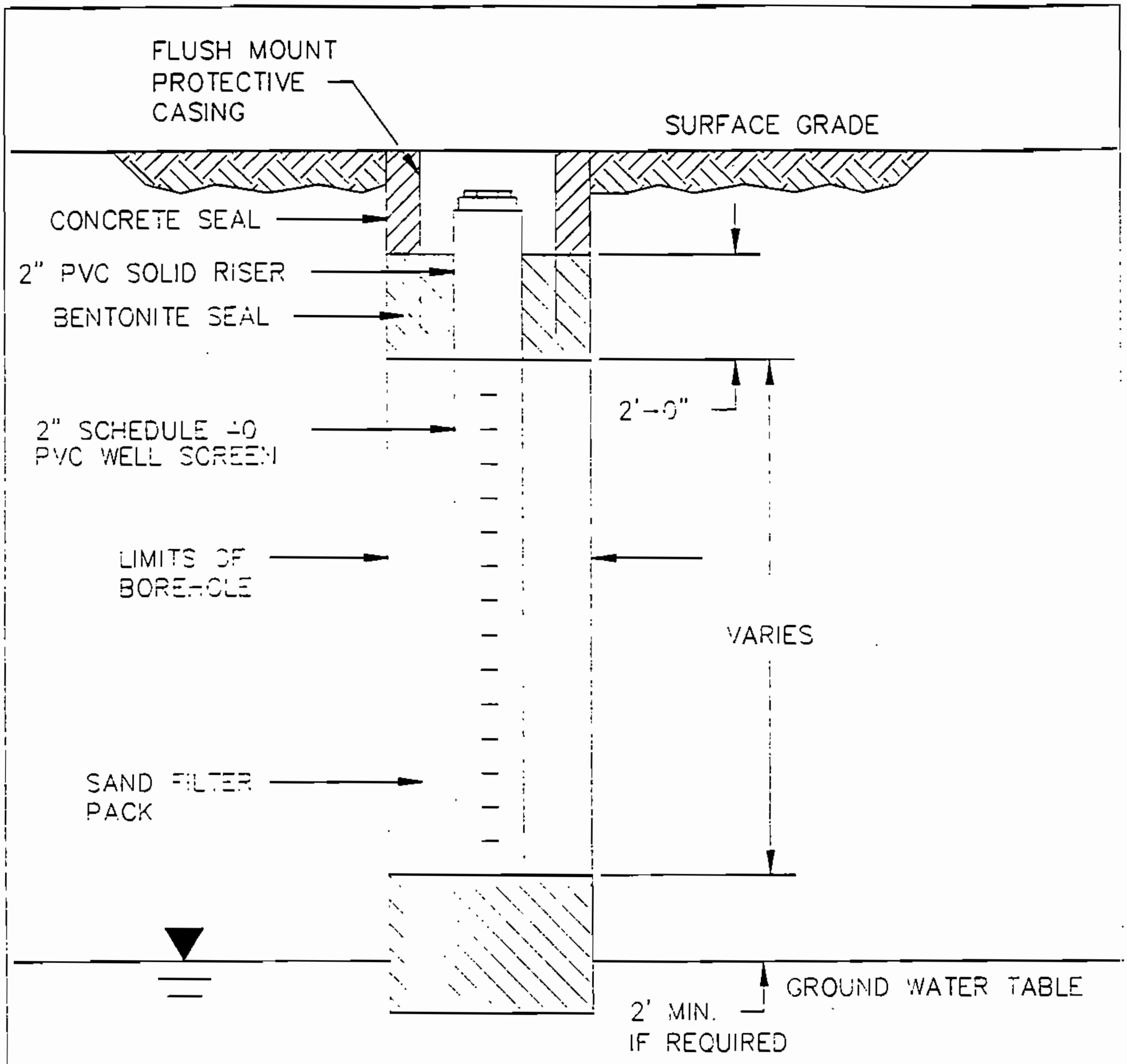
LEGEND

▲ - VAPOR PROBE

⌖ - VAPOR EXTRACTION WELL

⌖ - RECOVERY WELL

| | |
|---|---|
| JOB#: 90-127 | TITLE: ENLARGED VIEW OF PROBE LOCATIONS |
| DATE: 10/90 | SITE: COLUMBIA MILLS MINETTO, NY |
| SCALE: NTS | DRAWING#: 127-SP2B |
| DRAWN: | VAPEX® |
| CHECKED: | *Environmental Technologies 480 Neponset Street Canton, MA 02021 Tel. 617 821-5560 Fax 617 821-4967* |

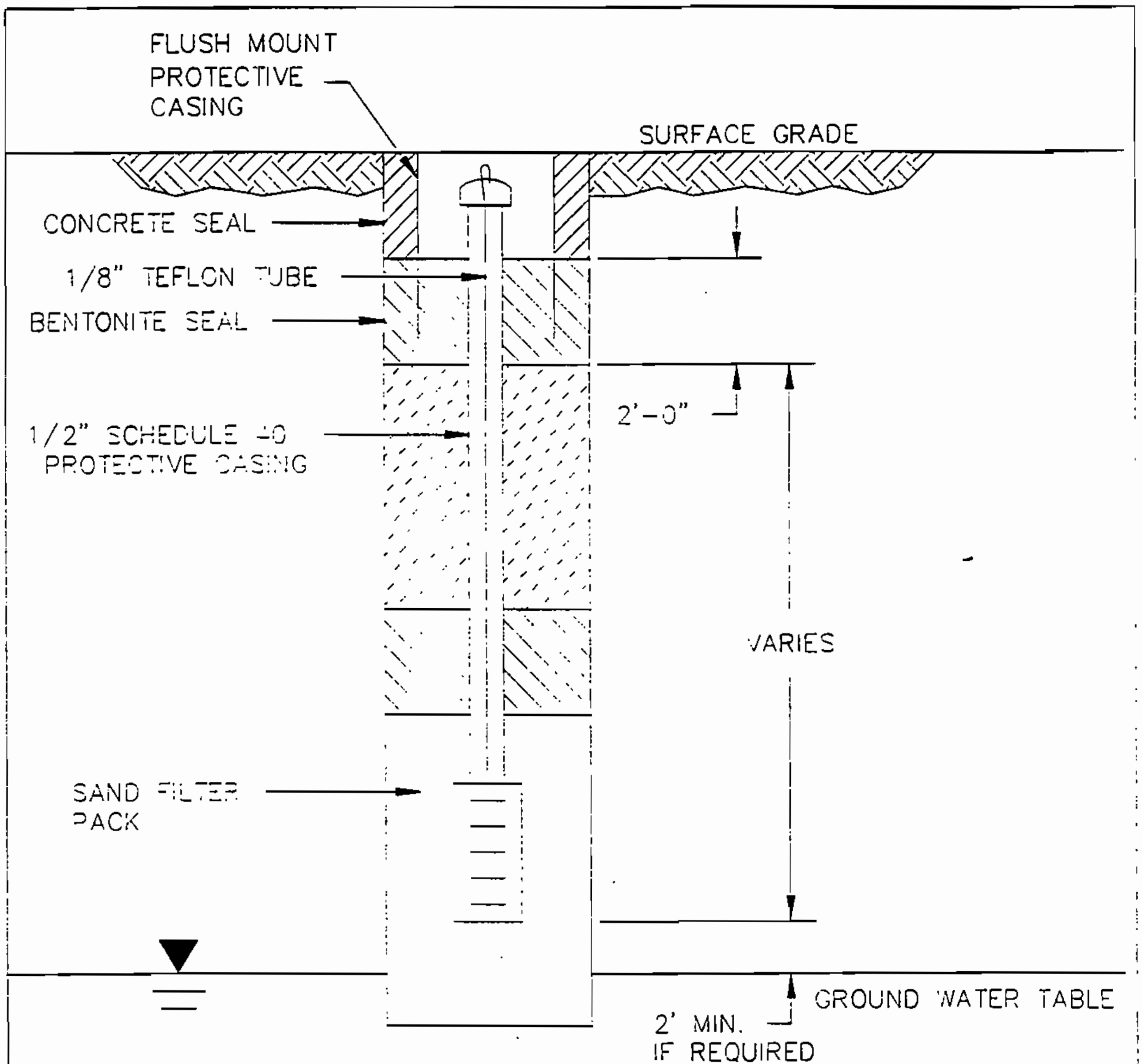



# FIGURE 4

KEY

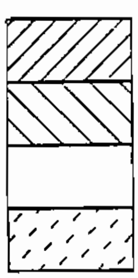
- CONCRETE
- BENTONITE
- SAND

| | |
|---|---|
| JOB#: 90127 | TITLE: TYPICAL EXTRACTION WELL |
| DATE: 7/90 | SITE: COLUMBIA MILLS MINETTO, NY |
| SCALE: NTS | DRAWING#: 127-VW-A |
| DRAWN: | VAPEX® *Environmental Technologies* *480 Neponset Street* *Canton, MA 02021* *Tel. 617 821-5560 Fax 617 821-4967* |
| CHECKED: | |




# FIGURE 5

KEY




| | |
|---|---|
| JOB#: 90127 | TITLE: TYPICAL VAPOR PROBE |
| DATE: 7/90 | SITE: COLUMBIA MILLS MINETTO, NY |
| SCALE: NTS | DRAWING#: 127–VP–A |
| DRAWN: | VAPEX® *Environmental Technologies 480 Neponset Street Canton, MA 02021 Tel. 617 821-5560 Fax 617 821-4967* |
| CHECKED: | |

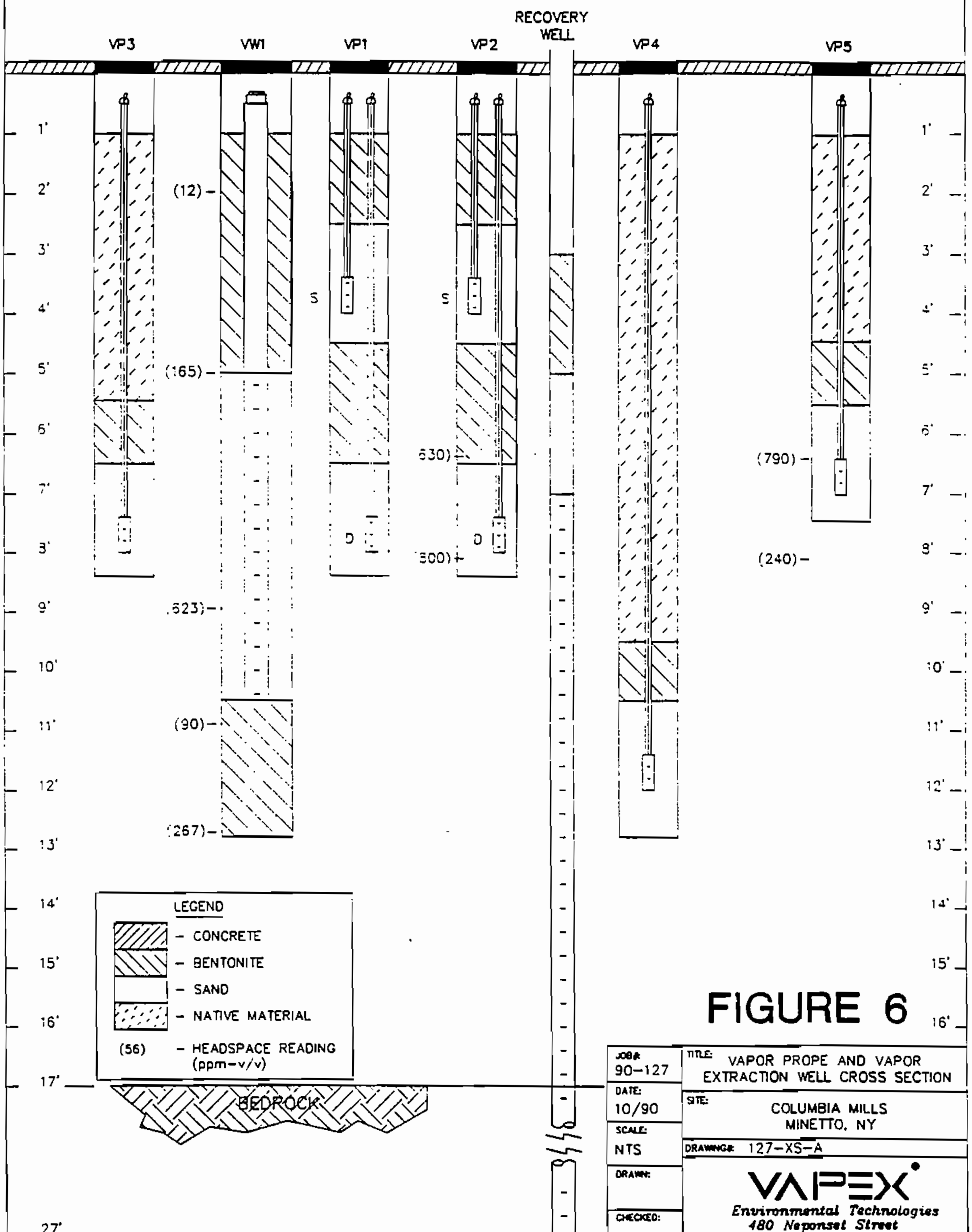
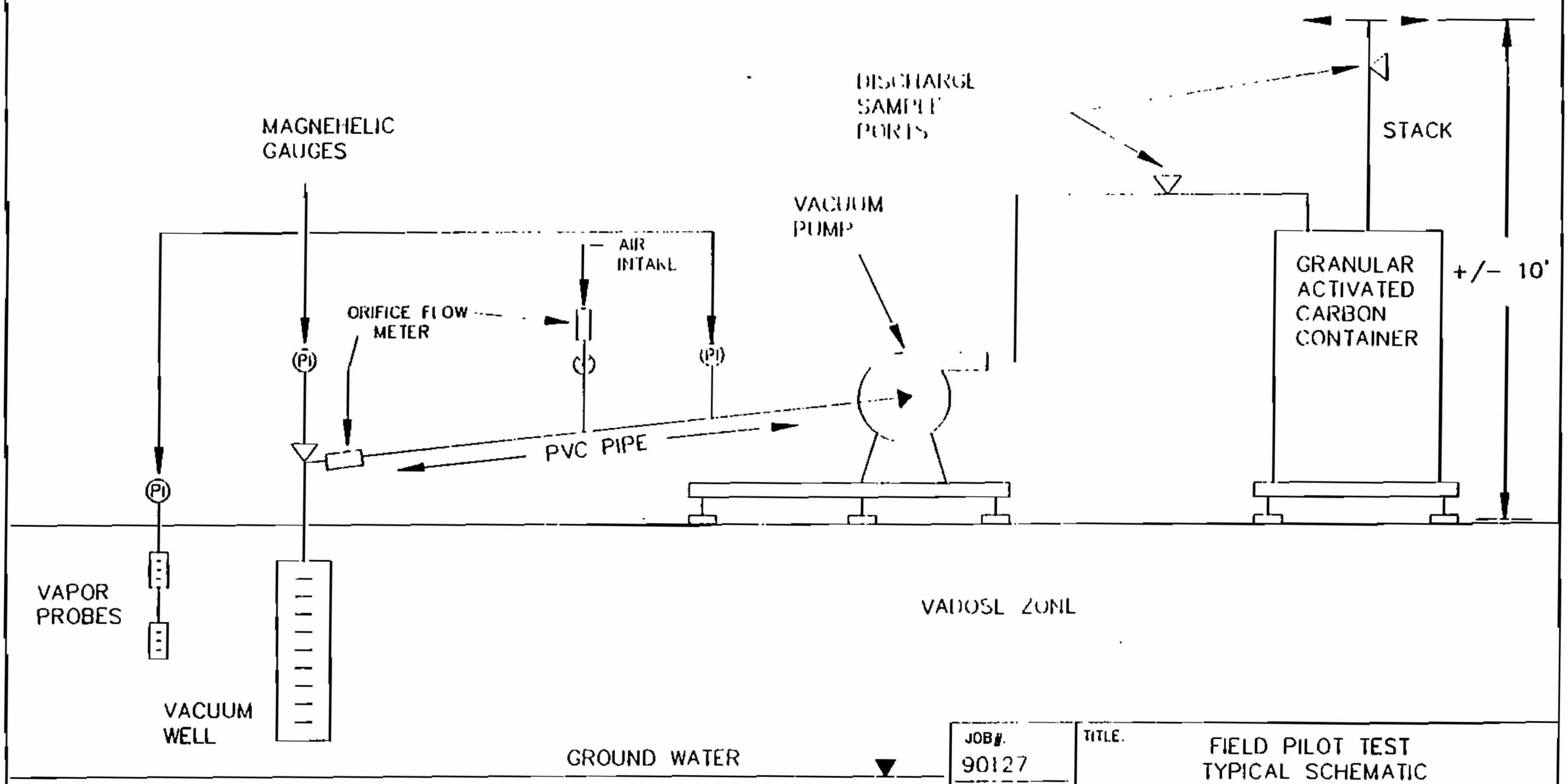



FIGURE 6

| | |
|---|---|
| JOB#: 90-127 | TITLE: VAPOR PROPE AND VAPOR EXTRACTION WELL CROSS SECTION |
| DATE: 10/90 | SITE: COLUMBIA MILLS MINETTO, NY |
| SCALE: NTS | DRAWING#: 127-XS-A |
| DRAWN: | VAPEX |
| CHECKED: | *Environmental Technologies* *480 Neponset Street* *Canton, MA 02021* *Tel. 617 821-5560 Fax 617 821-4967* |



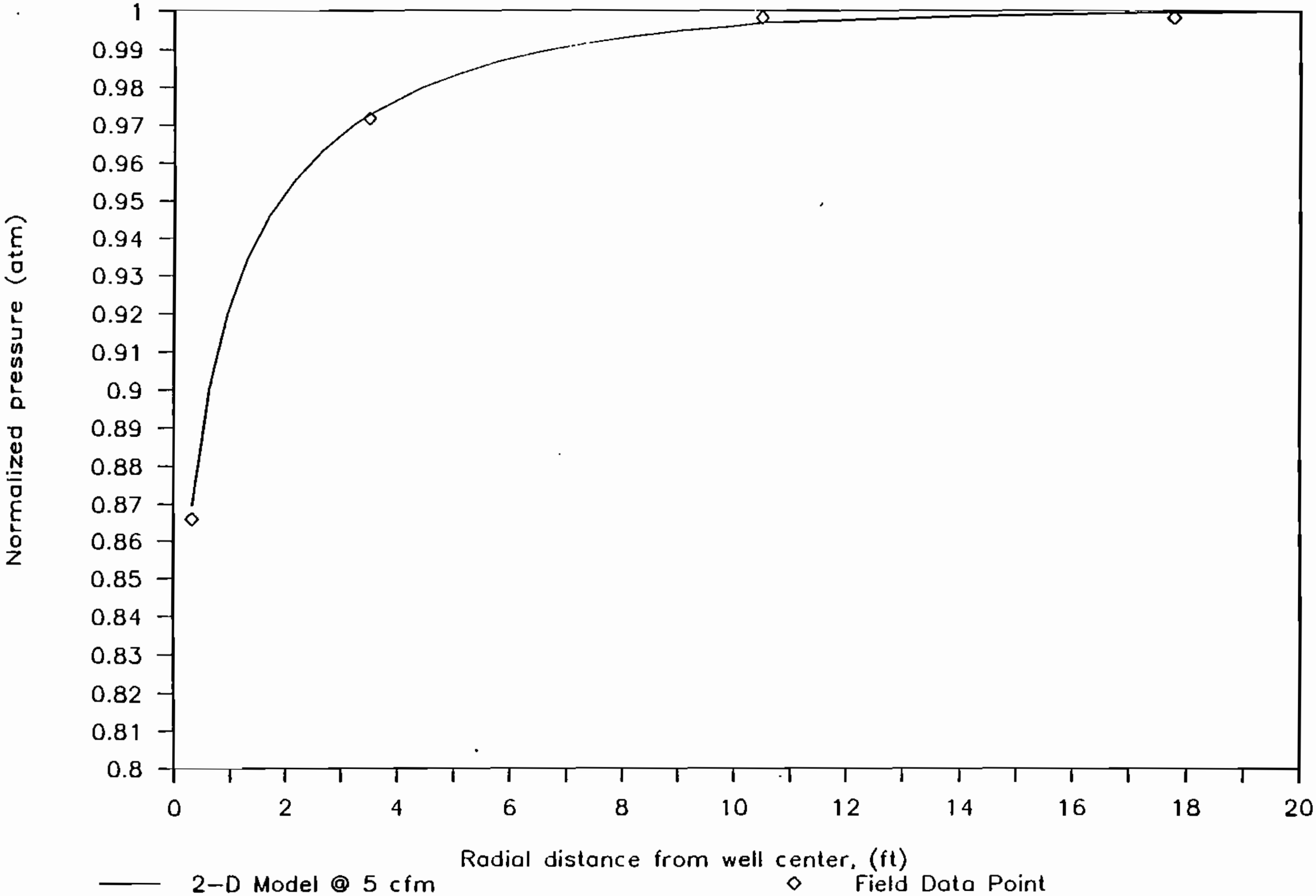

# FIGURE 7

| | | |
|---|---|---|
| JOB#: 90127 | TITLE: | FIELD PILOT TEST TYPICAL SCHEMATIC |
| DATE: 7/90 | SITE: | COLUMBIA MILLS MINETTO, NY |
| SCALE: NTS | DRAWING#: | 127-FP-A |
| DRAWN: | | |
| CHECKED: | | |

VAPEX®
Environmental Technologies
180 Neponset Street
Canton, MA 02021
Tel 617 821-5560 Fax 617 821-4967

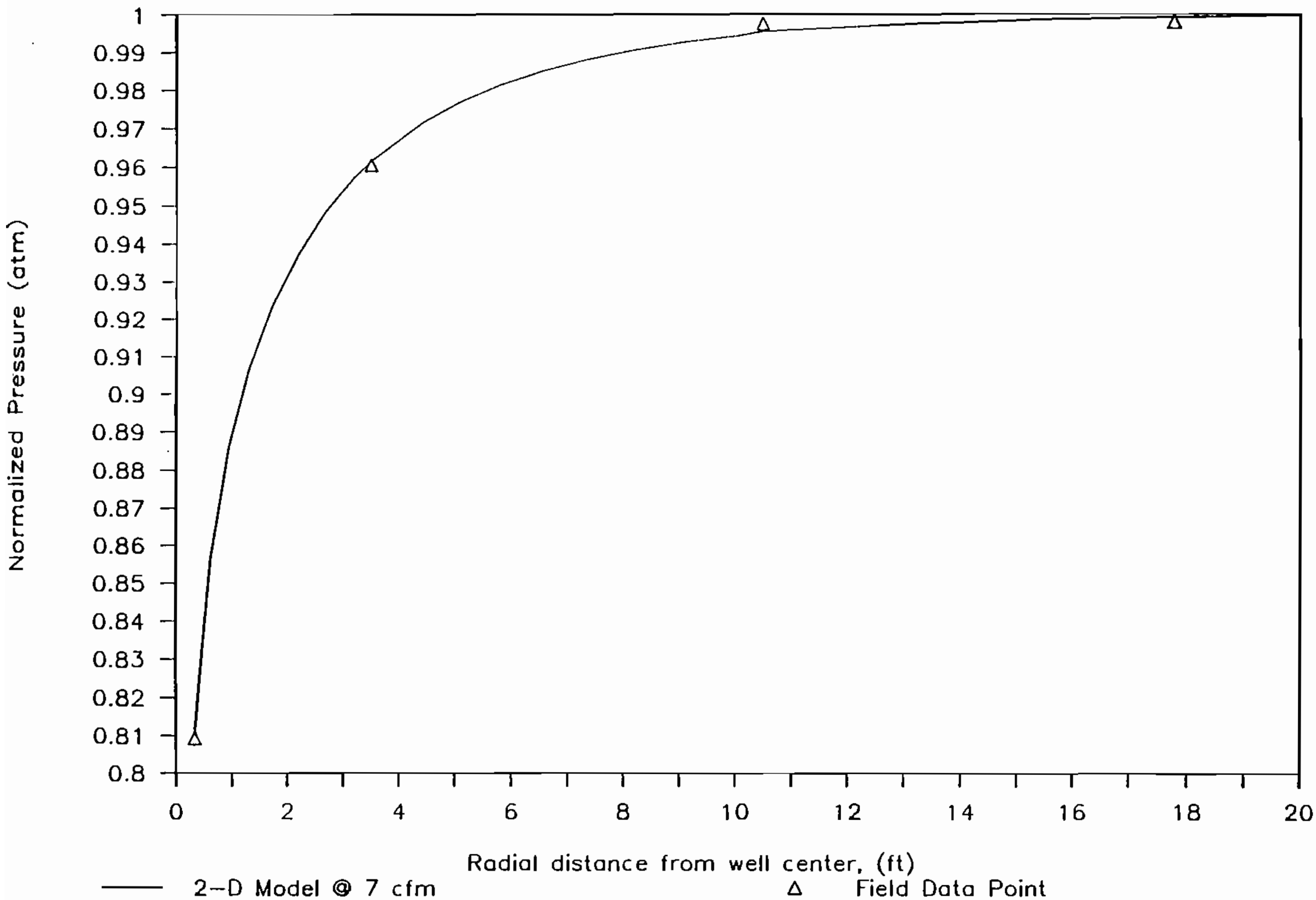
# Figure 8

2-D MODEL CALIBRATION, CO. MILLS



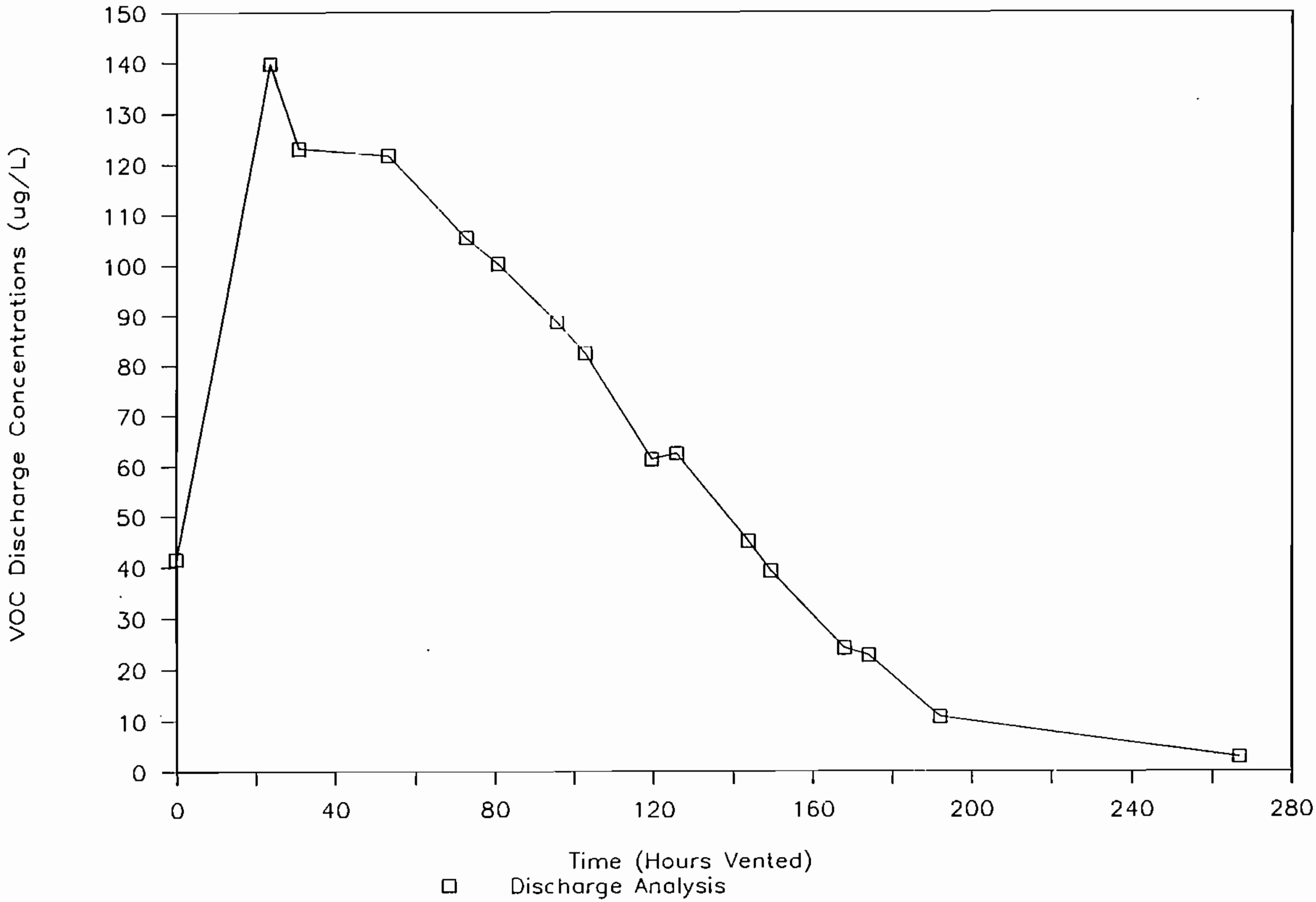
# Figure 9

2-D MODEL VERIFICATION, CO. MILLS



# FIGURE 10

Bench Scale Vent Test—Columbia Mills,NY



# TABLES

# TABLE 1

## Soil Sample Jar Headspace Analysis*

Columbia Mills – Minetto, NY
August 28–29, 1990

| Depth | Boring Location | | |
|---|---|---|---|
| | VW-1 | VP-2 | VP-5 |
| 2'–4' | 12 | – | – |
| 4'–6' | 165 | – | – |
| 6'–8' | No Rec. | 630** | 790** |
| 8'–10' | 623 | 800^ | 240^ |
| 10'–12' | 90 | – | – |
| 12'–14' | 267 | – | – |

127-T1-C

* Samples analysed using a Thermo Environmental Model 580B portable photoionization detector equipped with an 11.8 eV bulb. The instrument was calibrated to 100 ppm isobutylene prior to analysis.

** Sample taken from 5' to 7' below ground surface.

^ Sample taken from 7' to 9' below ground surface.

# TABLE 2

## Background Pressure and Soil Hydrocarbon Vapor Measurements at Probes Gas Analysis by PID

Columbia Mills – Minetto, NY
September 12, 1990

| Sample | Description | Depth (feet) | Ambient Vacuum Pressure (in. H2O) | Total VOC'S (PPM) |
|---|---|---|---|---|
| VP1-S | Shallow | 4 | ND | 5,756 |
| VP1-D | Deep | 8 | ND | 3,276 |
| VP2-S | Shallow | 4 | ND | 4,160 |
| VP2-D | Deep | 8 | ND | 4,160 |
| VP3 | Deep | 8 | ND | 3,230 |
| VP4 | Deep | 12 | ND | 3,010 |
| VP5 | Deep | 7 | ND | 2,060 |

127-T2-C

* Samples analyzed using a Thermo Electron instruments 580 B OVM equipped with an 11.8 eV Photoionization detector. OVM Calibrated to 1020 ppm benzene standard prior to sampling.

ND Not Detectable

# TABLE 3

## Vacuum Pressure Measurements During Pilot Test

Columbia Mills – Minetto, NY
September 12,13, 1990

| Sample Location | Vacuum* Test 1 5 cfm 24 Hours | Vacuum* Test 2 7 cfm 4 Hours | Radial Distance From Vacuum Well |
|---|---|---|---|
| VW1 | 3.9 Hg | 5.7 Hg | – |
| VP1-S | ND** | ND** | 3.5 |
| VP1-D | 11.5 | 16.0 | 3.5 |
| VP2-S | 0.70 | 1.00 | 10.5 |
| VP2-D | 0.75 | 1.05 | 10.5 |
| VP3 | 0.75 | 0.82 | 18 |
| VP4 | 2.40 | 3.20 | 15 |
| VP5 | 0.160 | 0.190 | 33 |

127-T3-A

* Vacuum in inches of water using Magnehelic differential pressure gauges unless otherwise stated.

** No detectable vacuum at VP1-S. Probes probably damaged.

Hg Vacuum in inches of Mercury.

ND Not Detected (less than 0.05" H2O)

# TABLE 4

## Soil Gas Discharge GC/PID Analysis

Columbia Mills – Minetto, NY
September 12–13, 1990

| Sample | Time | Run Time | MEK | Methylene Chloride | Benzene | Toluene | Ethyl Benzene | M-Xylene | ESTIMATED OTHERS | ESTIMATED TOTAL VOCs |
|---|---|---|---|---|---|---|---|---|---|---|
| Test1 | | | | | | | | | | |
| EX1 | 10:40 AM | 0.07 | ND | ND | 6,436 | 2,922 | 845 | 322 | 28,310 | 38,835 |
| EX2 | 11:46 AM | 1.17 | ND | ND | 5,516 | 2,147 | 385 | 160 | 22,889 | 31,098 |
| EX3 | 12:36 PM | 2.00 | ND | ND | 4,227 | 1,709 | 441 | 191 | 17,217 | 23,787 |
| EX4 | 01:26 PM | 2.83 | ND | ND | 3,520 | 1,493 | 434 | 176 | 14,232 | 19,858 |
| EX5 | 02:36 PM | 4.00 | ND | ND | 3,885 | 1,626 | 469 | 192 | 16,512 | 22,688 |
| EX6 | 04:08 PM | 5.53 | ND | ND | 4,160 | 1,762 | 419 | 149 | 17,347 | 23,843 |
| EX7 | 08:00 PM | 9.40 | ND | ND | 4,176 | 1,791 | 447 | 150 | 19,860 | 26,433 |
| EX8 | 11:05 AM | 12.48 | ND | ND | 3,995 | 1,830 | 324 | 100 | 19,309 | 25,570 |
| EX9 | 07:30 AM | 20.90 | ND | ND | 3,842 | 2,243 | 352 | 115 | 19,868 | 26,441 |
| EX10 | 09:33 AM | 22.95 | ND | ND | 3,556 | 1,841 | 334 | 112 | 18,664 | 24,530 |
| Test2 | | | | | | | | | | |
| EX11 | 12:08 PM | 0.00 | ND | ND | 4,938 | 2,148 | 1,187 | 202 | 19,660 | 28,135 |
| EX12 | 01:15 PM | 1.12 | ND | ND | 3,068 | 1,551 | 978 | 164 | 15,204 | 20,966 |
| EX13 | 02:56 PM | 2.80 | ND | ND | 2,376 | 1,341 | 855 | 143 | 12,832 | 17,550 |
| EX14 | 03:56 PM | 3.80 | ND | ND | 3,155 | 1,907 | 1,046 | 185 | 16,613 | 22,910 |

127-T4-B

Samples analyzed using an HNU model-321 Gas Chromatograph equipped with an 11.7 ev photoionization detector (GC/PID).
All results expressed in ppm-v/v.

MEK — Methylethylketone

ESTIMATED OTHERS — Estimated value of summation of all other non-target VOCs. In ppm-v/v as benxene.

Est. Total VOCs — Summation of all target and non-target VOCs in ppm-v/v.

NA — Not analyzed

ND — Not detected or below detection limit

# TABLE 5

## Bench Scale Test Results

Columbia Mills – Minetto, NY
Composit Soil Sample Collected From VW1

| Hours Vented | Minutes Vented | VOCs ug/L | Area ug min/L | Amount (ug) | Cumulative Total (ug) | Flow rate (L/min) |
|---|---|---|---|---|---|---|
| 0.00 | 0.00 | 41.52 | 0.00 | 0.00 | 0.00 | 0.1 |
| 23.60 | 1416.00 | 139.8 | 128374.56 | 2939.62 | 2939.62 | 0.1 |
| 30.95 | 1857.00 | 123.16 | 57982.68 | 3998.11 | 6937.72 | 0.1 |
| 53.25 | 3195.00 | 121.76 | 163851.48 | 17592.02 | 24529.75 | 0.1 |
| 72.70 | 4362.00 | 105.44 | 132571.20 | 14291.08 | 38820.83 | 0.1 |
| 80.65 | 4839.00 | 100.24 | 49054.68 | 5418.72 | 44239.55 | 0.1 |
| 95.60 | 5736.00 | 88.56 | 84676.80 | 9224.75 | 53464.30 | 0.1 |
| 102.80 | 6168.00 | 82.36 | 36918.72 | 4078.08 | 57542.38 | 0.1 |
| 119.62 | 7177.00 | 61.28 | 72466.38 | 8622.91 | 66165.29 | 0.1 |
| 125.87 | 7552.00 | 62.48 | 23205.00 | 2693.25 | 68858.54 | 0.1 |
| 143.80 | 8628.00 | 45 | 57824.24 | 6658.29 | 75516.83 | 0.1 |
| 149.37 | 8962.00 | 39.08 | 14041.36 | 1794.92 | 77311.74 | 0.1 |
| 167.73 | 10064.00 | 24.12 | 34823.20 | 4632.81 | 81944.55 | 0.1 |
| 173.78 | 10427.00 | 22.68 | 8494.20 | 1147.08 | 83091.63 | 0.1 |
| 191.88 | 11513.00 | 10.8 | 18179.64 | 2541.24 | 85632.87 | 0.1 |
| 266.60 | 15996.00 | 2.84 | 30574.06 | 7504.54 | 93137.41 | 0.1 |

127-T5-A

## APPENDIX A

# DRILLING AND WELL INSTALLATIONS

# VAPOR EXTRACTION PROCESS

# COLUMBIA MILLS

# MINETTO, NEW YORK

parratt wolff inc
FISHER RD., EAST SYRACUSE, N.Y. 13057
TELEPHONE AREA CODE 315/437-1429
FAX 315/437-1770

August 30, 1990

Malcolm Pirnie, Inc.
7481 Henry Clay Boulevard
Liverpool, New York 13088

Attention: Mr. Mark D. Wilder, CPG

Re: 90242
Drilling and Well Installations
Vapor Extraction Process
Columbia Mills
Minetto, New York

Gentlemen:

Enclosed are driller's field logs for one (1) groundwater monitoring well and five (5) piezometer installations made for you for the above project.

Soil samples from these borings were retained by your representative at the job site.

The borings were made at the locations requested and drilling was done in accordance with ASTM method D-1586 for split barrel sampling in soils. The well and piezometers were installed according to your instructions.

Thank you for this opportunity to work with you.

Very truly yours,

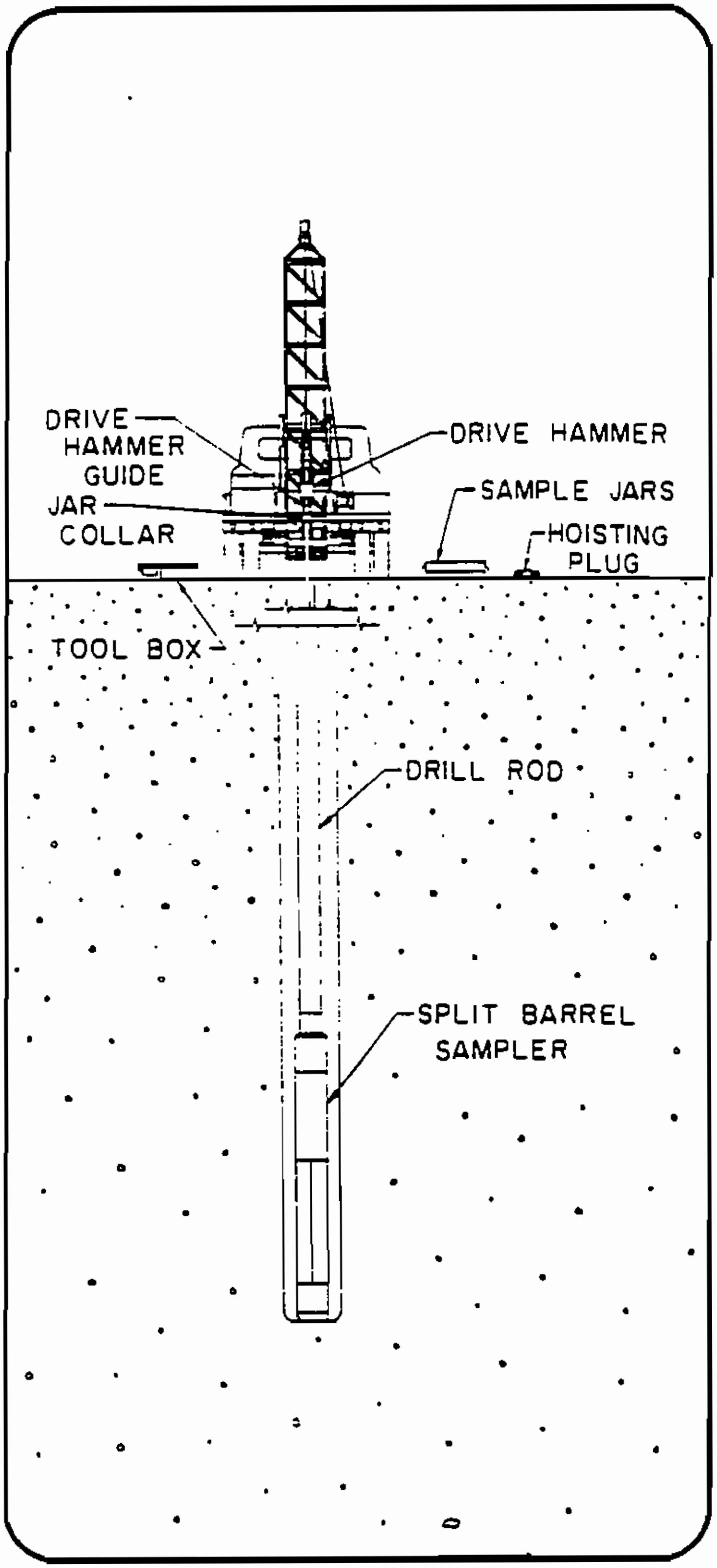
PARRATT - WOLFF, INC.

Steffen Wolff
SW/lc
encs:
cc: w/encls: (1) Vapex Environmental Technologies
480 Neponset Street
Canton, Massachusetts 02021
Attention: Mr. Matthew T. Walsh

(1) Leslie H. Deming, Esq.
Bond, Schoeneck and King
215 Washington Street
Watertown, New York 13601

# SOIL SAMPLING-METHODS

parratt wolff inc
FISHER RD., EAST SYRACUSE, N.Y. 13057
TELEPHONE AREA CODE 315/437-1429




# Split barrel sampling

The following excerpts are from "Standard Method for penetration test and split-barrel sampling of soils."[1] (ASTM designation: D-1586-67 AASHO Designation: T-206-70.)

1. Scope

1.1 This method describes a procedure for using a split-barrel sampler to obtain respresentative samples of soil for identification purposes and other laboratory tests, and to obtain a measure of the resistance of the soil to penetration of the sampler.

2. Apparatus

2.1 Drilling Equipment — Any drilling equipment shall be acceptable that provides a reasonably clean hole before insertion of the sampler to ensure that the penetration test is performed on undisturbed soil, and that will permit the driving of the sampler to obtain the sample and penetration record in accordance with the procedure described in 3. Procedure. To avoid "whips" under the blows of the hammer, it is recommended that the drill rod have stiffness equal to or greater than the A-rod. An "A" rod is a hollow drill rod or "steel" having an outside diameter of 1-5/8 in. or 41.2 mm and an inside diameter of 1-1/8 in. or 28.5 mm, through which the rotary motion of drilling is transferred from the drilling motor to the cutting bit. A stiffer drill rod is suggested for holes deeper than 50 ft (15m). The hole shall be limited in diameter to between 2-1/4 and 6 in. (57.2 and 152mm).

2.2 Split-Barrel Sampler — The sampler shall be constructed with the dimensions indicated (in Fig. 1.) The drive shoe shall be of hardened steel and shall be replaced or repaired when it becomes dented or distorted. The coupling head shall have four 1/2-in. (12.7-mm) (minimum diameter) vent ports and shall contain a ball check valve. If sizes other than the 2-in. (50.8-mm) sampler are permitted, the size shall be conspicuously noted on all penetration records.

2.3 Drive Weight Assembly — The assembly shall consist of a 140-lb (63.5-kg) weight, a driving head, and a guide permitting a free fall of 30 in. (0.76 m). Special precautions shall be taken to ensure that the energy of the falling weight is not reduced by friction between the drive weight and the guides.

2.4 Accessory Equipment — Labels, data sheets, sample jars, paraffin, and other necessary supplies should accompany the sampling equipment.

parratt wolff inc
FISHER RD., EAST SYRACUSE, N.Y. 13057
TELEPHONE AREA CODE 315/437-1429

# GENERAL NOTES

1. Soil boring logs, notes and other data shown are the results of personal observations and interpretations made by Parratt-Wolff, Inc.

Exploration records prepared by our drilling foreman in the field form the basis of all logs, and samples of subsurface materials retained by the driller are observed by technical personnel in our laboratory to check field classifications.

2. Explanation of the classifications and terms:

a. Bedrock — Natural solid mineral matter occurring in great thickness and extent in its natural location. It is classified according to geological type and structure (joints, bedding, etc.) and described as solid, weathered. broken or fragmented depending on its condition.

b. Soils — Sediments or other unconsolidated accumulations of particles produced by the physical and chemical disintegration of rocks and which may or may not contain organic matter.

## PENETRATION RESISTANCE

| *COHESIONLESS SOILS* | | *COHESIVE SOILS* | |
|---|---|---|---|
| Blows Per Ft. | Relative Density | Blows Per Ft. | Consistency |
| 0 to 4 | Very Loose | 0 to 2 | Very Soft |
| 4 to 10 | Loose | 2 to 4 | Soft |
| 10 to 30 | Medium Dense | 4 to 8 | Medium Stiff |
| 30 to 50 | Dense | 8 to 15 | Stiff |
| Over 50 | Very Dense | 15 to 30 | Very Stiff |
| | | Over 30 | Hard |

*Size Component Terms*

| | | | |
|---|---|---|---|
| Boulder | | Larger than 8 inches | |
| Cobble | | 8 inches to 3 inches | |
| Gravel | — coarse | 3 inches to 1 inch | |
| | — medium | 1 inch to 3/8 inch | |
| | — fine | 3/8 inch to 4.76 mm | |
| Sand | — coarse | 4.76 mm to 2.00 mm | (#10 sieve) |
| | — medium | 2.00 mm to 0.42 mm | (#40 sieve) |
| | — fine | 0.42 mm to 0.074 mm | (#200 sieve) |
| Silt and Clay | | Finer than 0.074 mm | |

*Proportion By Weight*

Major component is shown with all letters capitalized.

Minor component percentage terms of total sample are:

and . . . 35 to 50 percent
some . 20 to 35 percent
little . . 10 to 20 percent
trace . . 1 to 10 percent

c. Gradation Terms — The terms coarse. medium and fine are used to describe gradation of Sand and Gravel.

d. The terms used to describe the various soil components and proportions are arrived at by visual estimates of the recovered soil samples. Other terms are used when the recovered samples are not truly representative of the natural materials, such as soil containing numerous cobbles and boulders which cannot be sampled, thinly stratified soils, organic soils, and fills.

e. Ground water — The measurement was made during exploration work or immediately after completion, unless otherwise noted. The depth recorded is influenced by exploration methods, soil type and weather conditions during exploration. Where no water was observed it is so indicated. It is anticipated that the ground water will rise during periods of wet weather. In addition, perched ground water above the water levels indicated (or above the bottom of the hole where no ground water is indicated) may be encountered at changes in soil strata or top of rock.

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FISHER RD., EAST SYRACUSE, N.Y. 13057
TELEPHONE AREA CODE 315/437-1429

# A BRIEF DESCRIPTION OF THE UNIFIED SOIL SYSTEM

The Unified Classification System is an engineering soil classification that is an outgrowth of the Air-Field classification developed by Casagrande.

The system incorporates the textural characteristics of a soil into the engineering classification. All soils are classified into fifteen groups, each group being designated by two letters. These letters are as follows: G—gravel, S—sand, M—Non plastic or low plasticity fines, C—plastic fines, Pt—peat, humus and swamp soils, O—organic, W—well graded, P—poorly graded, L—low liquid limit, H—high liquid limit.

**GW and SW Groups**

These groups comprise well graded gravelly and sandy soils which contain less than 5% of non plastic fines passing a #200 sieve. Fines which are present must not noticeably change the strength characteristics of the coarse grain fraction and must not interfere with its free draining characteristics. In areas subject to frost action the material should not contain more than about 3% of soil grains smaller than .02 millimeters in size.

**GP and SP Groups**

These groups are poorly graded gravels and sands containing less than 5% non plastic fines. They may consist of uniform gravels, uniform sands, or non uniform mixtures of very coarse material and very fine sand with intermediate sizes lacking. Materials of this latter type are sometimes referred to as skip graded, cap graded, or step graded.

**GM and SM Groups**

In general, these groups include gravels or sands which contain more than 12% of fines having little or no plasticity. The plasticity index and liquid limit of a soil in either of these groups plot below the "A" line on a plasticity chart. Gradation is not important and both low grade and poorly graded materials are included. Some sands and gravels in these groups may have a binder composed of natural cementing agents so proportioned that the mixture shows negligible swelling or shrinkage. Thus, the dry strength is provided by a small amount of soil binder or dry cementation of calcareous materials or iron oxide. A fine fraction of non cemented materials may be composed of silts or rock flour types having little or no plasticity, and the mixture will exhibit no dry strength.

**GC and SC Groups**

These groups comprise gravelly or sandy soils with more than 12% of fines which exhibit either low or high plasticity. The plasticity index and liquid limit of a soil in either of these groups plot above the "A" line on the plasticity chart. Gradation of these materials is not important. Plasticity of the binder fraction has more influence on the behavior of the soils than does the variation in gradation. A fine fraction is generally composed of clays.

**ML and MH Groups**

These groups include predominantly silty materials and micaceous or diatomaceous soils. An arbitrary division between the two groups has been established with a liquid limit of 50. Soils in these groups are sandy silts, clayey silts or organic silts with relatively low plasticity. Also included are loassial soils and rock flours. Micaceous and diatomaceous soils generally fall within the MH group, but may extend into the ML group when their liquid limit is less than 50. The same is true for certain types of kaolin clays and some illite clays having relatively low plasticity.

**CL and CH Groups**

The CL and CH groups embrace clays with low and high liquid limits respectively. They are primarily inorganic clays. Low plasticity clays are classified as CL and are usually lean clays, sandy clays, and silty clays. The medium plasticity and high plasticity clays are classified as CH. These include fat clays, gumbo clays, certain volcanic clays and bentonite.

**OL and OH Groups**

The soils in these groups are characterized by the presence of organic matter including organic silts and clays. They have a plasticity range that corresponds with the ML and MH groups.

**Pt Group**

Highly organic soils which are very compressible have undesirable construction characteristics and are classified in one group with the symbol Pt. Peat, humus and swamp soils with a highly organic texture are typical of the group. Particles of leaves, grass, branches of bushes and other fibrous vegetable matter are common components of these soils.

**Borderline Classification**

Soils in the GW, SW, GP and SP groups ara non plastic materials having less than 5% passing the #200 sieve, while GM, SM, GC, and SC soils have more than 12% passing the #200 sieve. When these coarse grain materials contain between 5% and 12% of fines they are classified as borderline, and are designated by the dual symbol such as GW-GM. Similarly coarse grain soils which have less than 5% passing the #200 sieve, but which are not free draining or in which the fine fraction exhibits plasticity are also classed as borderline and are given a dual symbol. Still another type of borderline classification occurs when a liquid limit of a fine grain soil is less than 29 and the plasticity index lies in the range of four to seven. These limits are indicated by the shaded area on the plasticity chart.

**Silty and Clayey**

In the Unified System, these terms are used to describe soils whose Atterberg limits plot below and above the "A" line on the plasticity chart. The adjectives silty and clayey are used to describe soils whose limits plot close to the "A" line.

parratt wolff inc

# TEST BORING LOG

FISHER ROAD
EAST SYRACUSE, N.Y. 13057

PROJECT: Drilling and Well Installation - Vapor Extraction Process - Columbia Mills

LOCATION: Minetto, New York

DATE STARTED: 8/28/90 DATE COMPLETED: 8/28/90

HOLE NO. VW-1

SURF. EL.

JOB NO. 90242

GROUND WATER DEPTH
WHILE DRILLING 10.0'

BEFORE CASING REMOVED Dry

AFTER CASING REMOVED Installed Well

N — NO. OF BLOWS TO DRIVE SAMPLER 12" W/140# HAMMER FALLING 30" — ASTM D-1586, STANDARD PENETRATION TEST

C — NO. OF BLOWS TO DRIVE CASING 12" W/ # HAMMER FALLING "/OR — % CORE RECOVERY

CASING TYPE - HOLLOW STEM AUGER

SHEET 1 OF 1

DRILLER'S FIELD LOG

| DEPTH | SAMPLE DEPTH | SAMPLE NUMBER | C | SAMPLE DRIVE RECORD PER 6" | N | DESCRIPTION OF MATERIAL | STRATA CHANGE DEPTH |
|---|---|---|---|---|---|---|---|
| | | | | | | CONCRETE | 0.4' |
| | | | | | | Brown moist medium dense to loose fine to coarse SAND, some fine to medium gravel | |
| | 2.0'- | 1 | | 10/18 | | | |
| | 4.0' | | | 9/8 | 27 | | |
| 5.0 | 4.0'- | 2 | | 3/3 | | | |
| | 6.0' | | | 2/3 | 5 | | |
| | 6.0'- | 3 | No | 4/3 | | | |
| | 8.0' | | Rec | 3/2 | 6 | | |
| | 8.0'- | 4 | | 8/9 | | | |
| 10.0 ▼ | 10.0' | | | 8/3 | 17 | | 10.0' |
| WL | 10.0'- | 5 | | 5/4 | | Gray-brown wet loose to medium dense fine to coarse SAND, some silt, trace fine gravel | |
| | 12.0' | | | 1/1 | 5 | | |
| | 12.0'- | 6 | | 8/9 | | | |
| | 14.0' | | | 4/3 | 13 | | |
| 15.0 | | | | | | Bottom of Boring | 14.0' |
| | | | | | | Note: Installed 2" PVC 20 slot screen 10.0' to 5.0', 2" PVC riser to surface with 9" flush mounted cover. | |

parratt wolff inc

# TEST BORING LOG

FISHER ROAD
EAST SYRACUSE, N.Y. 13057

PROJECT: Drilling and Well Installation - Vapor Extraction Process - Columbia Mills

LOCATION: Minetto, New York

DATE STARTED: 8/28/90 DATE COMPLETED: 8/29/90

HOLE NO. VP-1

SURF. EL.

JOB NO. 90242

GROUND WATER DEPTH
WHILE DRILLING: Dry

BEFORE CASING REMOVED: Installed Piezometers

AFTER CASING REMOVED:

N — NO. OF BLOWS TO DRIVE SAMPLER 12" W/140# HAMMER FALLING 30" — ASTM D-1586, STANDARD PENETRATION TEST

C — NO. OF BLOWS TO DRIVE CASING 12" W/ # HAMMER FALLING "/OR — % CORE RECOVERY

CASING TYPE - HOLLOW STEM AUGER
DRILLER'S FIELD LOG

SHEET 1 OF 1

| DEPTH | SAMPLE DEPTH | SAMPLE NUMBER | C | SAMPLE DRIVE RECORD PER 6" | N | DESCRIPTION OF MATERIAL | STRATA CHANGE DEPTH |
|---|---|---|---|---|---|---|---|
| | | | | | | CONCRETE | 0.4' |
| 5.0 | | | | | | Brown-gray moist fine to coarse SAND, some to trace fine to medium gravel | |
| 10.0 | | | | | | Bottom of Boring | 8.0' |
| | | | | | | Note: Installed dual piezometers: 2" PVC 20 slot screen 8.0' to 7.2', 0.5" PVC tubing to surface - 2" PVC 20 slot screen 4.0' to 3.2', 0.5" tubing to surface with 9" flush mounted cover. | |

parratt wolff inc

# TEST BORING LOG

FISHER ROAD
EAST SYRACUSE, N.Y. 13057

PROJECT: Drilling and Well Installation - Vapor Extraction Process - Columbia Mills

LOCATION: Minetto, New York

DATE STARTED: 8/29/90 DATE COMPLETED: 8/29/90

HOLE NO. VP-2

SURF. EL.

JOB NO. 90242

GROUND WATER DEPTH
WHILE DRILLING: Dry

BEFORE CASING REMOVED: Installed Piezometers

AFTER CASING REMOVED:

N — NO. OF BLOWS TO DRIVE SAMPLER 12" W/140# HAMMER FALLING 30" — ASTM D-1586, STANDARD PENETRATION TEST

C — NO. OF BLOWS TO DRIVE CASING 12" W/ # HAMMER FALLING "/OR — % CORE RECOVERY

CASING TYPE - HOLLOW STEM AUGER
DRILLER'S FIELD LOG

SHEET 1 OF 1

| DEPTH | SAMPLE DEPTH | SAMPLE NUMBER | C | SAMPLE DRIVE RECORD PER 6" | N | DESCRIPTION OF MATERIAL | STRATA CHANGE DEPTH |
|---|---|---|---|---|---|---|---|
| | | | | | | CONCRETE | 0.4' |
| 5.0 | | | | | | Brown moist medium dense fine to coarse SAND, some fine to coarse gravel | |
| | 5.0'– | 1 | | 4/10 | | | |
| | 7.0' | | | 13/6 | 23 | | 7.0' |
| | 7.0'– | 2 | | 4/4 | | Brown-gray wet loose fine to coarse SAND and SILT, little fine to medium gravel | |
| | 9.0' | | | 4/6 | 8 | | |
| 10.0 | | | | | | | |
| | | | | | | Bottom of Boring | 9.0' |
| | | | | | | Note: Installed dual piezometers: 2" PVC 20 slot screen 8.0' to 7.2', 0.5" PVC tubing to surface - 2" PVC 20 slot screen 4.0' to 3.2', 0.5" tubing to surface with 9" flush mounted cover. | |

parratt wolff inc

# TEST BORING LOG

FISHER ROAD
EAST SYRACUSE, N.Y. 13057

PROJECT: Drilling and Well Installation - Vapor Extraction Process - Columbia Mills

LOCATION: Minetto, New York

DATE STARTED: 8/29/90 DATE COMPLETED: 8/29/90

HOLE NO. VP-3

SURF. EL.

JOB NO. 90242

GROUND WATER DEPTH
WHILE DRILLING: Dry

BEFORE CASING REMOVED: Installed Piezometer

AFTER CASING REMOVED:

N — NO. OF BLOWS TO DRIVE SAMPLER 12" W/140# HAMMER FALLING 30" — ASTM D-1586, STANDARD PENETRATION TEST

C — NO. OF BLOWS TO DRIVE CASING 12" W/ # HAMMER FALLING "/OR — % CORE RECOVERY

CASING TYPE - HOLLOW STEM AUGER
DRILLER'S FIELD LOG

SHEET 1 OF 1

| DEPTH | SAMPLE DEPTH | SAMPLE NUMBER | C | SAMPLE DRIVE RECORD PER 6" | N | DESCRIPTION OF MATERIAL | STRATA CHANGE DEPTH |
|---|---|---|---|---|---|---|---|
| | | | | | | CONCRETE | 0.4' |
| | | | | | | Brown moist fine to coarse SAND and SILT, some to little fine to coarse gravel | |
| 5.0 | | | | | | | |
| | | | | | | Bottom of Boring | 8.0' |
| 10.0 | | | | | | Note: Installed piezometer: 2" PVC 20 slot screen 8.0' to 7.2', 0.5" PVC tubing to surface with 9" flush mounted cover. | |

parratt wolff inc

# TEST BORING LOG

FISHER ROAD
EAST SYRACUSE, N.Y. 13057

PROJECT: Drilling and Well Installation - Vapor Extraction Process - Columbia Mills
LOCATION: Minetto, New York
DATE STARTED: 8/29/90    DATE COMPLETED: 8/29/90

HOLE NO. VP-4
SURF. EL.
JOB NO. 90242
GROUND WATER DEPTH WHILE DRILLING: Dry
BEFORE CASING REMOVED: Installed Piezometer
AFTER CASING REMOVED:

N — NO. OF BLOWS TO DRIVE SAMPLER 12" W/140# HAMMER FALLING 30" — ASTM D-1586, STANDARD PENETRATION TEST

C — NO. OF BLOWS TO DRIVE CASING 12" W/ # HAMMER FALLING "/OR — % CORE RECOVERY

CASING TYPE - HOLLOW STEM AUGER
DRILLER'S FIELD LOG

SHEET 1 OF 1

| DEPTH | SAMPLE DEPTH | SAMPLE NUMBER | C | SAMPLE DRIVE RECORD PER 6" | N | DESCRIPTION OF MATERIAL | STRATA CHANGE DEPTH |
|---|---|---|---|---|---|---|---|
| | | | | | | CONCRETE | 0.4' |
| | | | | | | Brown moist to wet fine to coarse SAND and SILT, some to little fine to coarse gravel | |
| 5.0 | | | | | | | |
| 10.0 | | | | | | | |
| | | | | | | Bottom of Boring | 13.0' |
| 15.0 | | | | | | Note: Installed piezometer: 2" PVC 20 slot screen 12.0' to 11.2', 0.5" PVC tubing to surface with 9" flush mounted cover. | |

parratt wolff inc

# TEST BORING LOG

FISHER ROAD
EAST SYRACUSE, N.Y. 13057

PROJECT: Drilling and Well Installation - Vapor Extraction Process - Columbia Mills

LOCATION: Minetto, New York

DATE STARTED: 8/29/90 DATE COMPLETED: 8/29/90

HOLE NO. VP-5

SURF. EL.

JOB NO. 90242

GROUND WATER DEPTH

WHILE DRILLING 7.5'

BEFORE CASING REMOVED: Installed Piezometer

AFTER CASING REMOVED

N — NO. OF BLOWS TO DRIVE SAMPLER 12" W/140# HAMMER FALLING 30" — ASTM D-1586, STANDARD PENETRATION TEST

C — NO. OF BLOWS TO DRIVE CASING 12" W/ # HAMMER FALLING "/OR — % CORE RECOVERY

CASING TYPE - HOLLOW STEM AUGER

DRILLER'S FIELD LOG

SHEET 1 OF 1

| DEPTH | SAMPLE DEPTH | SAMPLE NUMBER | C | SAMPLE DRIVE RECORD PER 6" | N | DESCRIPTION OF MATERIAL | STRATA CHANGE DEPTH |
|---|---|---|---|---|---|---|---|
| | | | | | | CONCRETE | 0.4' |
| | | | | | | Brown dry fine to coarse SAND and fine to coarse GRAVEL | |
| 5.0 | | | | | | | 5.0' |
| | 5.0'- | 1 | | 4/4 | | Brown moist to wet loose to medium dense fine to coarse SAND and SILT, little fine to medium gravel | |
| | 7.0' | | | 3/3 | 7 | | |
| | 7.0'- | 2 | | 8/11 | | | |
| | 9.0' | | | 8/6 | 19 | | |
| 10.0 | | | | | | Bottom of Boring | 9.0' |
| | | | | | | Note: Installed piezometer: 2" PVC 20 slot screen 7.0' to 6.2', 0.5" PVC tubing to surface with 9" flush mounted cover. | |

*GC/FID* - Gas Chromatograph with Flame ionization detector. GC/PID is equipped with 1 ml gas sampling loop, which ensures repetitive sample volume injection.

**Equipment Description:** Equipment used in the operation of the HNU Gas Chromatograph are listed below:

1. Hamilton 1 ul and 5 ul syringes
2. Two liter (2L) volumetric static dilution flask
3. HNU Model 321 GC Controller
4. HNU Model 321 Gas Chromatograph:
   *Column (Stainless)*: 1/8" stainless steel packed column, 5 percent SP-1200/1.75 percent Benton 34 on 100/120 Supelcoport (1-2134). *Column (Capillary)*: Supelco SPB-5 30m x 0.75mm ID wide-bore capillary column; 1 micron film.
   *Column temp (Stainless Column)*: 5 min. at 70 $^{O}$C, then to 160 $^{O}$C @ 5$^{O}$C/min. *Column temp (Capillary Column)*: 5 min. @ 40 oC, then to 160 oC @ 8oC/min.
   *Flow rate (Stainless)*: N2, 18-22 ml/min; H2 (GC/FID), 30 ml/min; Zero-Air (GC/FID), 300 ml/min. *Flow Rate (Capillary)*: N2, 8-12 ml/min; Make-up gas (N2), 8-12 ml/min,; H2 (GC/FID), same; Zero Air (GC/FID), same.
   *Detector*: 10.2/11.7 eV photoionization detector (PID) and/or flame ionization detector (FID).
5. Nelson Analytical A/D Interface
6. Toshiba T1200 laptop computer, equipped with P.E. Nelson Model 2100 PC Integrator Chromatography Software, Revision 5.0.
7. Formatted 3.5" floppy diskettes.
8. Extension cord equipped with a voltage surge protector and a Ground Fault Interrupter (GFI).
9. Nitrogen, Hydrogen (GC/FID) and Zero-Air (GC/FID) tanks equipped w/ swagelok fittings and copper tubing for hook-up w/ GC.
10. Hamilton 10 ml syringe ("BLANK" syringe)
11. Equimolar standard solution (Gasoline analysis: benzene, toluene and m-xylene; Halogenated hydrocarbon analysis: 111-TCA, TCE and PCE - typically) of known ppm concentration which is prepared in the field by the GC operator as described below in "Standard Preparation".
12. Supply of sample syringes (10 mL) Hamilton Gastight equipped with Teflon Minivert valves.
13. Heat gun.

**Health and Safety: 1) VITON or equivalent gloves will be used when handling chemicals. Work with chemicals must not be conducted in a closed/contained space. 2) Hydrogen is an extremely flammable gas - when starting the FID, always turn the Zero-Air on before the hydrogen; when turning the FID off, always turn the hydrogen off before turning the Zero-Air off.**

## 1.0 PROCEDURE: PHASE I/SET UP

1. Unload all GC equipment.
2. Set up equipment in configuration illustrated below:
3. Make all necessary connections/communication lines between equipment.

## APPENDIX B

**VAPEX ENVIRONMENTAL TECHNOLOGIES, INC.**

**STANDARD OPERATING PROCEDURES (SOP)**

**HNU MODEL 321 GAS CHROMATOGRAPH FIELD SETUP AND OPERATION**

**VAPEX SOP#: GC-OP**

**Purpose:** To document specific procedures for the operation of the HNU Gas Chromatograph.

**Objectives:** To outline procedures for setup and operation of the HNU Model 321 Gas Chromatograph and associated equipment. Setup and operation includes:

- o Setup of the GC and equipment
- o Procedures for establishment of a GC baseline
- o The preparation, injection and analysis of a field vapor standard
- o The injection and analysis of field samples
- o Procedures for shutting down the GC

**Required Associated SOPs:** *VAPEX* SOP Nos: GC-QAQC-I and GC-QAQC-II.

**Definitions:**

*carrier gas* - medium which moves sample through the GC column. This is typically an inert gas such as nitrogen (N2) or helium (H2). Synonym = "mobile phase."

*baseline* - chart recorder/integrator/computer baseline. This is the established level of chromatograph response and sensitivity which corresponds to levels which are below the detection limit.

*sample blank* - usually ambient air which is drawn into a Hamilton gas-tight glass syringe and injected into the GC/PID to establish the baseline and determine the existence and quantity of background contamination or column residual (if any). It is also used to establish the extent of baseline drift caused by temperature gradient program.

*temperature gradient program* - a program by which the temperature of the GC oven is varied with time. The temperature gradient program greatly increases the separation efficiency of the GC column as a result of an increase in molecular/column interactions.

*attenuation* - the level of GC/PID response/sensitivity which can be adjusted by the user in response to changes in sample concentration.

*GC/PID* - Gas Chromatograph with Photoionization detector. GC/PID is equipped with 1 ml gas sampling loop, which ensures repetitive sample volume injection.

4. Connect the Nitrogen (N2) to the GC (if using the GC/FID, also attach the hydrogen and zero-air).
5. Turn on N2. Record N2 tank and regulator psi.
6. After 2-3 min., turn on GC (do not turn on the detector).
7. After GC is on for 2-3 min., turn on the controller.
8. Program #1: Note that all program entries must be followed by an "ENTER" (the "down arrow" on the controller is the "enter").

   i. Enter "1" for "Temp only".
   ii. Ambient mode? **YES**
   iii. Inj./Det temp? **95** (11.7eV PID)/**250** (10.2eV PID)
   iv. Oven temp ramp? **No**

Note: a "NO" was programmed so as to bake the GC column for a period of time prior to use (usually 0.5 hr.).

   v. Final oven temp? **160 $^{o}$C**
   vi. Just hit **enter** for question #'s 10 and 11.
   vii. Press "**enter**" again to start the temperature control.
   viii. Turn on the **NELSON.**
   ix. While the GC warms up, format a 3.5" floppy diskette on the computer and download all appropriate GC Software methods onto the diskette.
   x. Continue preparing by establishing an entry in the **GC FIELD NOTEBOOK** and recording all GC operating parameters as shown in the example in Figure 2.
   xi. Once the GC warms up to the programmed parameters, allow the GC to stabilize at these settings for 30-60 min.

END PHASE I

## 2.0 PHASE II/TEMPERATURE RAMP

Program the controller for the following temperature ramp.

1. Press the "UP" arrow on the controller to get back to the start of the program.

2. Program as above in Steps 4i-4iii until the controller prompts for an oven temperature ramp. Enter "**YES**".

Continue the temperature program as follows:

| | |
|---|---|
| Initial temperature ($^{o}$C): | **70** |
| Hold time (**seconds**/units = 5 mins): | **500** |
| Ramp ($^{o}$C/min): | **5** |
| Second temperature ($^{o}$C): | **160** |
| Second hold time (**sec.**/ units=10 min.): | **1000** |
| Second ramp ($^{o}$C/min): | **ENTER** |
| Final Temperature ($^{o}$C): | **160** |
| #10, #11, #12: | **ENTER** |

4. After you start the temperature program, open the cover on the GC to facilitate cooling.

5. When controller lets you know it is ready, hit "enter" to start a run - EXCEPT, press **"STOP"** immediately after this.

Because the GC was allowed to warm up to 160 $^{O}C$, the short amount of time you allowed for cooling was not enough. So, because the controller thinks it is ready, it will try to maintain a 70 $^{O}C$ oven temp while the GC cover is open. Were you to close the lid without further cooling, the temp would immediately jump past 70 $^{O}C$.

6. When temp reaches approx. 48 $^{O}C$, close the GC cover, and press **"ENTER"** to start the temperature program.

7. Turn on the detector - check to see that it is on (purple glow).

8. If using the GC/FID: turn on the zero-air, then the hydrogen (flowrates are preset). Wait approximately 1 minutes to allow the gases to reach the FID. Ignite the FID by depressing the DETECTOR B switch and holding it down for approximately 1-3 seconds - you should hear a "pop" indicating the flame is lit. *Note: Do not hold down the igniter switch longer than 1-3 seconds - it is possible to burn out the igniter coil.* Check to see that the FID is lit by holding a small, glass vial above the exit port - you should see water vapor condense on the vial. Repeat if necessary.

END PHASE II

## 3.0 PHASE III/ESTABLISH BASELINE

1. Get into the main menu of the Nelson GC software by typing at the **C:>** prompt:

**GC**, enter
**MENU**, enter

2. Get into the GC Polling menu (hit enter = **0** on main menu). Press **F2** to get into method downloading, and load the appropriate preprogrammed data method (*.MET) file which should already be on A:\ (if not, copy it from C:\ to A:\).

Enter an appropriate file name and a description including the attenuation you expect to shoot the sample on: for example "BLANK, atten. = H1". Download to NELSON.

3. Inject three volumes of ambient air through the GC sample loop in both the INJECT (down position) and LOAD (up position) positions with the blank syringe to purge any hydrocarbon vapors remaining in the loop.

4. Simultaneously; **INJECT** the sample, press **ENTER** on the controller to start the run and press **START** on the NELSON to begin data sampling.

Note: If NELSON shows "Under Range" past 1.25 min., hit the "auto zero" on the GC till baseline stabilizes and Nelson remains in "Sampling" mode.

Also, if residuals are detected, let the chromatogram continue to elute for approximately 25 minutes, then:

1. Heat the sample loop with the heat gun while the injector is in the sample position (up).
2. Blow 10 volumes of air through loop with the "blank" syringe.
3. Cool the loop down with the heat gun on "cool" position.
4. Shoot another blank.
5. Press "**STOP**" on controller to end the run and "**STOP**" on NELSON to begin downloading the data into the computer. Open the GC cover to facilitate cooling.
6. When the Controller has cooled, it will print a small menu. At this point, close the GC cover and press **ENTER** on the Controller to start the temperature program.
7. When the GC has reached starting temperature (70 $^{O}$C), the Controller will print a "Ready" menu.
8. Repeat steps 2-7 for each consecutive blank injection.

END PHASE III

## 4.0 PHASE IV/STANDARD ANALYSIS

Once a steady baseline is established, a standard prepared in the field is injected. The standard is usually a equimolar mixture of at least three specified/target compounds which are expected to be detected in the field. The standard is prepared as follows:

Standard Preparation:

i. *A microliter (typically, 1 uL) syringe is rinsed with methanol (MeOH) and allowed to dry.*

ii. *A 2 liter static dilution flask is cleaned/heated with a heat gun (approx. 2-3 minutes) until it is free of any contamination. The flask is allowed to cool. The flask is tested with a Foxboro Century Model 128 Organic Vapor Analyzer (OVA) or an HNU Model HW-101 Portable Ionization Analyzer (PID: 10.2/11.7 eV) to ensure the flask is free of contamination. This step is repeated if necessary.*

iii. *A 3-5 mL vial of liquid/neat benzene is taken from storage *.*

iv. *The microliter syringe (1.0 uL) is introduced into the benzene through the septum of the sample vial. This is done to minimize contact with the benzene and/or vaporization of the chemical into the air.*

v. *While holding the needle of the syringe in the liquid and holding the syringe and vial up into the light, a small amount of liquid is slowly extracted into the syringe. This initial volume is expelled into the liquid and careful attention is paid to notice any small bubbles which may elute (even the tiniest bubble can have a dramatic effect on the resultant concentration of the final standard solution). This procedure is repeated until no bubbles are observed. At this point, a small (pre-calculated) volume is once again extracted up into the syringe. The syringe is carefully, but quickly, taken out of the liquid and vial and introduced into the static dilution flask where the sample is expelled. Note that the use of larger volume syringes (5, 10, 25 uL) would require procedural modifications, such as the incorporation of a volume of head space (air or methanol) prior to the extraction of sample into the syringe to 1) ensure accurate sample measurement, and 2) to provide a mechanism for the removal of all sample from the needle volume. However, the construction of the 1.0 uL syringe coupled with experimental analytical data for standards prepared with the 1.0 uL syringe indicate that consistently accurate standards can be generated without the* *addition of a headspace volume - these results are a function of a perfected analytical technique.*

**vi.** *The sample is allowed to evaporate off the needle and equilibrate.*

**vii.** *Steps iii through vi are repeated for trichloroethylene (TCE) and perchloroethylene (PCE) and/or any other chemicals of interest.*

**viii.** *Since the resultant mixture of standard components will be nonhomogeneous, the flask should be maintained at a constant temperature (70 °F) and agitated prior to use to ensure homogeneous mixing.*

In summary, the composition of the prepared standard sample should be characteristic of the expected field contaminant(s) and is designed to test the response of the detector and column over the effective range characteristic of the expected levels of the contaminant.

1. The GC Temperature Controller, the Nelson and the computer are reset to accept another run.

2. Flush the sample loop with three volumes of ambient air with the blank syringe.

3. Standards for injection are extracted from the two liter volumetric dilution flask via a 5 ml gastight syringe. Care is taken to avoid standard/sample dilution due to needle head space. The valve on the syringe is closed.

4. The syringe is attached to the loop; the syringe valve is opened and a portion of the standard in injected into the loop.

5. Simultaneously: **INJECT** the sample, hit the **ENTER** (down arrow) on the GC Temperature Controller and hit the **START** button on the Nelson Interface to start recording the run.

6. Allow the run to elute until it is certain that no other peaks may elute, then: hit the **STOP** button on the Controller to stop the run and the **STOP** button on the Nelson to begin the downloading process to the computer.

7. Open the cover of the GC to facilitate cooling and reset the GC for the next run as described above in Section 3.0.

Area counts (AC) and retention times (Rt) are calculated for each injection of standard and compared to assure statistical guidelines are met (briefly, both AC and Rt must be within at least 10 percent of known laboratory values for 90 percent confidence). Failure to meet these criteria might be caused by 1) an old and degrading column, 2) a leak in the mobile phase, 3) an unexpected change in carrier gas pressure or 4) non-equilibrated temperature ramp starting conditions. These and other possibilities should be investigated to determine the cause of the Rt discrepancy before continuing. Duplicate and/or replicate injections should be run if necessary.

b. Area Counts (AC) for each peak are compared to expected values by correlation with the computer-resident, programmed external standards. Deviation greater than 10% may indicate error in sample preparation or suggest that the GC/PID may need recalibration. A newly prepared sample may help to determine the cause. *NOTE: The preparation of standards which contain hydrocarbon vapor at very low concentrations is difficult to prepare.*

*The comparison of peak Rt may serve as a better evaluation of GC/PID performance at lower concentrations (x<100 ppb).*

8. If standard response is within quality assurance performance criteria, then a field sample may be collected and injected as described below. Note that a blank and a standard will be injected 1) after six field samples have been run 2) after a reattenuation has resulted in a change from a less sensitive (high concentration) GC/PID attenuation setting to that of a more sensitive (lower concentration) GC/PID attenuation setting.

** Liquid/neat chemical standards are kept in 3-5 mL brown, open-faced sample vials equipped with teflon-faced silicon septa. These sample vials are stored in a resealable plastic bag which is stored in a small container of carbon.*

## 5.0 PHASE V/SAMPLE ANALYSIS:

1. Collect field samples for GC/PID and/or GC/FID analysis as specified in VAPEX SOP No.GC-S.
2. Reset the GC, controller, Nelson and computer for the next sample.
3. Flush the sample loop with three (3) volumes of ambient air with the blank syringe.
4. Attach the sample syringe to the loop, open the syringe valve and inject a portion of the 10 mL syringe sample into the 1 mL sampling loop. *A portion of the sample can be saved for duplicate analysis by closing the valve to ensure that no sample leaks from the syringe.*
5. As described above, simultaneously: **INJECT** the sample, hit the **ENTER** (down arrow) on the GC Temperature Controller and hit the **START** button on the Nelson Interface to start recording the run.
6. Allow the run to elute until it is certain that no other peaks may elute, then: hit the **STOP** button on the Controller to stop the run and the **STOP** button on the Nelson to begin the downloading process to the computer.
7. Open the cover of the GC to facilitate cooling and reset the equipment for the next run.

**Note 1:** By screening the contaminated area(s) with a total hydrocarbon PID/FID, it is possible to approach the GC sampling round so that sampling locations of similar contamination concentrations can be grouped together. This is advantageous in that it reduces the frequency of GC attenuation adjustments. Furthermore, in regards to column dynamics, sampling strategy assumes that samples are selected in increasing concentration.

**Note 2:** Sample syringes will be sterilized with heat gun after use and checked with a total organic vapor analyzer (TOVA) for residual contamination before repeated use.

## 6.0 PHASE VI/BREAKDOWN

After all field analyses have been completed, the equipment must be broken down for transportation back to the lab.

1. Turn off detector (if using the FID, turn off the Hydrogen, then the Zero-Air).
2. Turn off computer.
3. Turn off Nelson.

4. Turn off Controller.
5. With GC cover up, make sure the GC oven temp is below 30 °C and the injector temperature is below 100 °C. Then, turn off the GC.
6. Turn off N2 and unhook the N2 line from the GC.

**REFERENCES:**


1. HNU Model 321 Gas Chromatograph Operator's Manual, Ver. 1.0; HNU Systems, Inc., Newton, Massachusetts.

2. P.E. Nelson 900 Series Intelligent Interface Operator's Manual; Perkin Elmer Nelson Systems, Inc., Cupertino, California.

3. P.E. Nelson PC Integrator User's Manual, Revision 5.0; Perkin Elmer Nelson Systems, Inc., Cupertino, California.

4. The Merck Index, 9th Ed.; Merck & Co., Inc., Rahway, New Jersey.

**VAPEX ENVIRONMENTAL TECHNOLOGIES, INC.**

**STANDARD QA/QC OPERATING PROCEDURES (SOP)**

**STANDARDIZATION/CALIBRATION OF HNU MODEL 321 GAS CHROMATOGRAPH**

**VAPEX SOP NO: GC-QAQC-I**

**Purpose:** To document specific procedures for the Standardization/Calibration of an HNU Model 321 Gas Chromatograph equipped with an 11.7 eV photoionization detector (GC/PID).

**Objectives:** Describe the procedures/techniques used in the calibration of the Gas Chromatograph for chlorinated and non-chlorinated hydrocarbons.

**Required Associated SOPs:** GC-OP and GC-QAQC-II

**Definitions:**

1. carrier gas - medium which moves sample through the GC column. This is typically an inert gas such as nitrogen (N2) or helium (H2). Synonym = "mobile phase."

2. baseline - chart recorder/integrator/computer baseline. This is the established level of chromatograph response and sensitivity which corresponds to levels which are below the detection limit.

3. sample blank - usually ambient air which is drawn into a Hamilton gas-tight glass syringe and injected into the GC/PID to establish the baseline and determine the existence and quantity of background contamination or column residual (if any). It is also used to establish the extent of baseline drift caused by temperature gradient program.

4. temperature gradient program - a program by which the temperature of the GC oven is varied with time. The temperature gradient program greatly increases the separation efficiency of the GC column as a result of an increase in molecular/column interactions.

5. attenuation - the level of GC/PID response/sensitivity which can be adjusted by the user in response to changes in sample concentration.

7. VOC's - Volatile Organic Compounds

8. GC/PID - Gas Chromatograph with Photoionization detector. GC/PID is equipped with 1 ml gas sampling loop, which ensures repetitive sample volume injection.

**Equipment Description:** Equipment used in the standardization/calibration of GC -

1. Hamilton 1 ul and 5 ul syringes
2. Three volumetric (2 liter) static dilution flasks
3. HNU Model 321 GC/PID Controller
4. HNU Model 321 GC/PID: 1/8" stainless steel packed column, 5% SP-1200/1.75% Benton 34 on 100/120 Supelcoport (1-2134). Column temp: 5 min. @ 70 $^{O}$C, then to 160 $^{O}$C @ 5 $^{O}$C/min. Flow rate: 23 ml/min., N2. Det.: Photoionization detector (PID) (11.7 eV).
5. Nelson Model 950 Intelligent Interface
6. Toshiba T1200 laptop computer (280K MS DOS), equipped with P.E. Nelson Model 2100 PC Integrator Chromatography Software, Revision 5.0.
7. Formatted 3.5" floppy diskettes.
8. Extension cord equipped with a voltage surge protector.
9. Nitrogen tank equipped with compression fittings and copper tubing for hook-up w/ GC.
10. Equimolar standard solutions (benzene, TCE and PCE - typically) or selected compounds which are expected to be encountered in the field.) The preparation of these standards can be found in the section entitled "Standard Preparation" in *VAPEX* SOP No. QA/QC-IIIA.
11. Hamilton 5 mL Gastight Syringe equipped with a teflon mininert valve and a removable needle.

**Procedure:**

1. The Gas Chromatograph is set up in the lab according to the procedure described in *VAPEX* SOP No. GC-OP; Sections 1 through 3.

2. The GC attenuation is set to the target level.

3. Three vapor standards (of known concentration) containing the selected compounds are prepared in static dilution flasks as described in *VAPEX* SOP No. GC-OP Section 3. The three standards are designed to allow calibration the GC over the linear range of the desired attenuation. The constituent concentration levels should reflect the lower, higher and intermediate values detectable within the given attenuation range. The concentrations of each standard is calculated in units of ppm, volume per volume.

4. Three samples of the least concentrated standard are injected and run on the GC as described below:

i. Because chlorinated solvents are heavier than air, the flask should be agitated to assure that the standard/sample is homogeneous and that a representative sample can be withdrawn. Additionally, the sample flask is kept at room temperature, 70 $^{O}$F.

ii. A small aliquot of sample is withdrawn into the 5 mL Hamilton gastight syringe from the dilution flask (approx. 0.5-1 mL) and expelled into the hood. This is to purge the head volume of the needle with sample so as to prevent sample dilution.

iii. The syringe is once again inserted into the flask and a sample is withdrawn (approx. 1.5-3 mL).

iv. The needle is removed, and the sample is injected into the GC via the 1 mL sample loop.

v. Steps i-v are repeated for three (3) separate injections.

5. Step 4 is repeated for each standard in increasing concentration until all three standards (for a total of nine injections) have been run. Note: a blank may be injected after each standard/mixture to assure that component residuals do not adversely effect peak quantification.

6. Results of each sample analysis are downloaded by the Nelson Intelligent Interface into the computer and stored on the 3.5" floppy diskette.

7. Data analysis is performed as specified in *VAPEX's* Standard Operating Procedure No. GC-QA/QC-II.

References:

1. HNU Model 321 Gas Chromatograph Operator's Manual, Ver. 1.0; HNU Systems, Inc., Newton, Massachusetts.

2. P.E. Nelson 900 Series Intelligent Interface Operator's Manual; Perkin Elmer Nelson Systems, Inc., Cupertino, California.

3. P.E. Nelson PC Integrator User's Manual, Revision 5.0; Perkin Elmer Nelson Systems, Inc., Cupertino, California.

4. The Merck Index, 9th Ed.; Merck & Co., Inc., Rahway, New Jersey.

## VAPEX ENVIRONMENTAL TECHNOLOGIES, INC.

## STANDARD QA/QC OPERATING PROCEDURES (SOP)

## DATA ANALYSIS AND STATISTICAL TREATMENT: AS APPLIED TO THE LABORATORY STANDARDIZATION OF HNU GAS CHROMATOGRAPH AND FIELD GENERATED DATA

## VAPEX SOP NO. GC-QAQC-II

**Purpose:** To document a specific procedure for the analysis and statistical treatment of data generated by HNU Model 321 Gas Chromatograph during the laboratory and/or field standardization/calibration of the instrument.

**Objectives:** Describe the procedures and statistical methods of analysis used in the treatment of data as generated by the HNU Model 321 Gas Chromatograph. Procedures described here apply to both laboratory standardization and field-generated data. Also included is standard field QA/QC protocol.

**Required Associated SOPs:** Vapex SOP Nos. GC-OP and GC-QA/QC-I

**Definitions:**

1. area count (AC) - a measure of the area under a chromatographic peak as calculated by the PC Integrator. Area is directly proportional to molecular concentration.

2. Retention time (Rt) - the time it takes a compound to elute from the column and be detected. Each compound has a characteristic Rt and this Rt is used in identifying each compound.

**Equipment Description:** Equipment used in the analysis of GC data:

1. Toshiba T1200 laptop computer (280K MS DOS), equipped with P.E. Nelson Model 2100 PC Integrator Chromatography Software, Revision 5.0.
2. Computer data files from field and/or standardization of Gas Chromatograph.

**Procedure:** Laboratory

1. Consecutive injections of a given concentration are analyzed to assure that peak response parameters for each compound are statistically consistent: Area Counts (AC) and Retention times (Rt) are compared to see that response remains within 95 percent confidence level as defined as plus (+) or minus (-) two standard deviations as determined by a Student's T-test on replicate analyses.

2. The area counts for each calibration level (ppm concentration) within a given GC attenuation are averaged. The retention times for each component (Rt is not a function of the calibration level, but is an intrinsic property characteristic of each component) are averaged.

3. The averaged AC and Rt for each component are entered into the Nelson Chromatographic software along with other chromatographic parameters unique to the particular method being generated.

4. Once requirements in Step 1 are satisfied, the Nelson chromatographic software is used to generate calibration curves from which vapor concentrations from field data is calculated.

5. The linearity of the calibration curve is tested via linear regression. The calibration curve is rejected if the R-squared value is less than 95 percent.

6. Quality control standards are analyzed periodically and accepted if the relative standard deviation of the response factors is less than 10 percent of the anticipated value(s). New calibration curves are prepared when quality control limits are exceeded.

**Procedure:** Field

1. As described in *VAPEX* GC-OP, blanks are injected and analyzed at the start of each GC field round and no less frequently then every six field samples. Field duplicates are integrated into the sampling protocol - at least two duplicates per sampling round.

2. As described in Step 6 above, standards are injected at the beginning of each sampling round and periodically throughout a single day's operation.

**Specific:**

Further calibration in the field may be necessary if it is determined that: 1) detected field concentrations are outside the linear range of the established laboratory calibration curve for the given GC attenuation, and 2) will have an adverse effect on peak quantification. In this case, a new set of vapor standards must be prepared for the new expected range. Data analysis and generation of new calibration curve follow before analysis of field samples can resume.

**References:**

1. P.E. Nelson PC Integrator User's Manual, Revision 5.0; Perkin Elmer Nelson Systems, Inc., Cupertino, California.

2. Young, R., Lee, C., Statistical Methods of Analysis, 3rd. Ed., MacGraw-Hill, Inc., New York.

**VAPEX ENVIRONMENTAL TECHNOLOGIES, INC.**

**STANDARD QA/QC OPERATING PROCEDURES (SOP)**

**PORTABLE TOTAL ORGANIC VAPOR ANALYZER CALIBRATION**

**VAPEX SOP NO.: TOVA-QAQC-I**

**Purpose:** To establish an operating procedure for the laboratory and field calibration of the portable total organic vapor analyzers (TOVA) with prepared or pre-prepared standard samples of gaseous volatile organic compounds (VOC's).

**Objectives:** To outline techniques for the laboratory and field calibration of TOVAs and discuss methods for the assessment of instrument performance

This procedure is applicable to several portable total organic vapor analyzers, including the following:

- Foxboro Century Model 128 Organic Vapor Analyzer (OVA).
- Foxboro Century Model 108 Organic Vapor Analyzer (OVA).
- HNU Model HW-101 Total Organic Vapor Analyzer (PID).

The Foxboro OVAs are equipped with flame ionization detectors (FID). The PID is equipped with an 11.7 eV photoionization detector (PID).

## LABORATORY CALIBRATION

NOTE: For procedures to START UP and OPERATE any of the Total instruments, refer to VAPEX SOP NO. ST-CHECK or the appropriate instrument operation manual.

**PROCEDURE NO.1: Preparation of Standards from Liquid**

**Materials:**

1. Three to five, 1-2 Liter Teflon or Tedlar gas sampling bags, each equipped with a sampling nozzle and gastight septum.
2. Sampling pump equipped with fresh tygon tubing.
3. 1, 5, 10 and 25 uL Hamilton syringes.
4. A sample of liquid benzene (FID) or perchloroethylene (PCE).
5. A 500 mL Hamilton gastight syringe.
6. Tygon tubing for attachment from bag to instrument.
7. TOVA
8. Computer with Lotus 123.

**Procedure:**

1. Line up all the Teflon/Tedlar bags on a clean table with the septa and nozzles closest to you. (Each Teflon bag is dedicated to one sample gas concentration level.)

2. Use the positive pressure from the sampling pump to fill each bag with clean air (test the quality of the air from the pump with an instrument to verify that the air is free of residual contamination). Use the vacuum side of the pump to flush the air out of the bag. Repeat this procedure a minimum of three times for each bag or until exhaust gas sampled and analyzed from the bag with a TOVA indicates no residual contamination.
3. Establish the number of calibration points (concentration) you expect to have (at least three, five to six is recommended). Target calibration concentration levels to test the instrument response over the range of the instrument and/or the range of each attenuation on the instrument.
4. For the first bag, calculate the number of microliters of liquid sample necessary to make up the desired vapor concentration.
5. Use the pump to pull a vacuum on the bag to completely empty the bag of any residual air - close the nozzle.
6. Fill the 500 mL Hamilton syringe with 500 mL of zero grade or contaminant-free ambient air.
7. Hook up the charged 500 mL syringe to the bag.
8. Open the bag nozzle and expel the 500 mL of air into the bag. With the syringe still hooked up to the bag, close the bag nozzle (Note: As a requirement for step 9, the idea is to fill the bag with volume sufficient to allow space for the insertion of the microliter syringe. The syringe must not accidently puncture the the other side of the bag).
9. Carefully extract the required liquid (standard) aliquot into the microliter syringe (for information on the techniques used for sampling of liquid samples with Hamilton microliter syringes, see VAPEX SOP No. GC-OP, Section 3: Sample Preparation); carefully and quickly insert the needle into the bag thru the septa and inject the sample.
10. Allow the sample to equilibrate for a period of 5-10 minutes.
11. While the bag equilibrates, turn on the TOVA and allow it to warm up.
12. Add another 500 mL (or the residual volume necessary for the final desired concentration) of air to the bag as described above.
13. Let the bag equilibrate for another 5 minutes.
14. Hook up the bag directly to the TOVA, open the bag nozzle and sample the air with the TOVA - record the instrument's response.
15. Repeat steps 4-14 for each calibration concentration level.
16. Flush out all the bags as described in 1 and 2 above and store them away.
17. Clean up all other materials.
18. Use Lotus 123 to generate a calibration curve and equation. Because TOVA's operate over a wide range of concentration, the resultant curve may not exactly conform linearly. This may be a result of the instrument's attenuation settings. Therefore, to attain linearity and to allow for a linear regression analysis, it may be necessary to analyze the data between attenuation settings and generate calibration curves for each attenuation. This is particularly relevant to the PID because of the effects of concentration on PID response as defined by Beer's law.
19. To verify the calibration curve, a test sample of known concentration is prepared and sampled by the instrument and its response is recorded and compared to the calibration curve. If the response does not agree with the calibration curve, repeat. If response discrepancies continue, the calibration curve or the instrument may be suspect. A new calibration curve should be generated.
20. The calibration data and data analysis should be recorded in the *Total Instrument Calibration Notebook* for future reference.

**PROCEDURE NO.2: Scott Specialty Gas Benzene Standards**
*Note: Calibration of an instrument to any chemical other than benzene will require Procedure No.1.*

Refer to Figure 1 for the following procedure.

Scott Specialty Benzene Gas Standards are pre-prepared benzene (in air) standards. Scott gases are accurate, reliable sources of calibrant gas for FID (occationally PID) calibration and can be used to calibrate the instrument in a very short time. Scott gases are stored in three large (AL-size) cylinders which are located in the back room along the far wall.

**Materials:**

1. Three AL-size cylinders of Scott Specialty benzene gas standard - each tank equipped with a Tedlar gas sampling bag.
2. Sampling pump equipped with fresh tygon tubing.
3. Tygon tubing for attachment from bag to instrument.
4. TOVA
5. Computer with Lotus 123.

**Procedure:**

1. Set a small section of 3/16 inch tygon tubing aside for use when connecting the FID probe to the gas sampling bag.
2. Remove the sample bag which is stored hanging above the gas cylinder and attach it to the cylinder regulator using a three to six inch length of tygon tubing - this should already be attached to the cylinder regulator. Make certain that the bag is completely emptied - you may wish to connect a sampling pump to the bag to evacuate any residual air.
3. With the bag connected to the regulator, open the sample bag valve. Two turns to the left will open bag sufficiently.
4. Open the middle regulator valve counter clockwise until it turns easily. When the regulator valve is turned in this fashion it is actually closing the valve off, so no gas can travel from the regulator valve to the fill valve and the bag.
5. Open the 51.7 ppm (or lowest concentration) cylinder by opening the screw valve on TOP of the CYLINDER. The pressure guage on top of the cylinder should read between 500 and 2000 psi.
6. Carefully begin to close the REGULATOR VALVE (clockwise) to pressurize the regulator. Note the incremental increase in pressure on the REGULATOR PRESSURE GUAGE. Continue pressurizing the regulator until approximately 10-20 psi has been achieved.
7. Shut the CYLINDER off by closing the CYLINDER VALVE at the TOP of the CYLINDER (leave the regulator pressurized).
8. Carefully begin to open the STOPCOCK VALVE and begin to fill up the sample bag. When the bag is NEAR full, close the STOPCOCK VALVE and simultaneously "open" the REGULATOR VALVE by turning it counter-clockwise.
9. Since the regulator flow has been shut off, the residual psi between the REGULATOR and the STOPCOCK can be emptied into the sample bag without danger of overfilling. Note that there may be some residual pressure between the REGULATOR and the CYLINDER - this is acceptable. If more standard is desired in the sampling bag, the residual pressure can be released into the bag by "closing" the REGULATOR

VALVE (clockwise) until it reads a maximum value. At this point, opening of the STOPCOCK will allow the residual pressure to escape into the bag.

10. Close the sample bag; close the STOPCOCK; "open" the REGULATOR VALVE (counter-clockwise).
11. The bag sample can now be analyzed with the total instrument.
12. Hook up the bag directly to the TOVA, open the bag nozzle and sample the air with the TOVA - record the instrument's response. The response should be close to the actual concentration of the gas. If it is not, the instrument may need adjusting - notify a person who is qualified to work on the instrument or if you think you understand the instrument, go to the section on Instrument Calibration Parameter Adjustments.
15. Repeat steps 2-12 for each Scott gas concentration level.
16. Flush out all the bags as described in steps 1 and 2 of Procedure No. 1 above and store them away.
17. Clean up all other materials.
18. Use Lotus 123 to generate a calibration curve and equation. Because TOVA's operate over a wide range of concentration, the resultant curve may not exactly conform linearly. This may be a result of the instrument's attenuation settings. Therefore, to attain linearity and to allow for a linear regression analysis, it may be necessary to analyze the data between attenuation settings and generate calibration curves for each attenuation. This is particularly relevant to the PID because of the effects of concentration on PID response as defined by Beer's law.
19. To verify the calibration curve, a test sample of known concentration is prepared and sampled by the instrument and its response is recorded and compared to the calibration curve. If the response does not agree with the calibration curve, repeat. If response discrepancies continue, the calibration curve or the instrument may be suspect. A new calibration curve should be generated.
20. The calibration data and data analysis should be recorded in the *Total Instrument Calibration Notebook* for future reference.

## FIELD CALIBRATION

Empirical data indicates that the OVA 108 is the only TOVA whose performance deviates significantly on a regular basis. Such data warrents that a quick field QA test be performed on the 108 to ensure that it is operating within the bounds of the laboratory calibration. Since the other TOVAs are more consistent in their response, a field calibration is optional.

**PROCEDURE NO.3: Field Calibration Check: OVA 108**

The field calibration check is designed to allow a rapid, yet controlled, one-point QA evaluation of the response of the OVA 108; the response is evaluated for statistical consistency with the laboratory calibration. For calibration ponts above 1000 ppm, liquid benzene (described in Procedure No.1) is the only available alternative. Note: analysis by GC of Calgaz standards have determined Calgaz concentrations to be as much as 44 percent off the stated concentration. Therefore, if Calgaz is to be used, it must first be analyzed by GC to determine the correct concentration. Generally, unless the GC is already set up, it is easier to use liquid benzene.

1. Use the worksheet form in Figure 2 as a template to record all calculations and measurements. The worksheet has information on each of the chemicals on the back of the sheet to assist in calculations.

2. Determine the type of calibration procedure to apply (Calgaz or liquid sample). If liquid sample, refer to Procedure No.1 and Figure 2 for materials and explanations. For calibration with Calgaz, you will need the following materials:

1. One, 1-2 liter Tedlar gas sampling bag with valve.
2. Two feet of Tygon tubing
3. One cannister of 1,020 ppm benzene gas
4. TOVA: OVA or PID.
5. Field Notebook

**Procedure:**

1. Using a short section (approximately three to six inches) of Tygon tubing, connect the 1020 ppm benzene standard cannister to the on/off valve of the Tedlar bag.
2. Connect the small Calgaz cylinder regulator to the Calgaz cylinder and attach a clean Tedlar bag.
3. Fill the Tedlar bag with approximately one liter of the gas standard. Close the Calgaz cylinder, close the bag and disconnect the cannister from the regulator valve.
3. Connect the sampling probe of the TOVA to the Tedlar bag using a short section of Tygon tubing.
4. Record the total hydrocarbon reading from the instrument once a steady reading is observed.
5. Compare the instrument's response to the laboratory calibration data. Does it agree?
7. If the response is in agreement, clean up materials and record the result in the field notebook. If not, perform another calibration point (Procedure No.1) to verify the previous results. If this new calibration point is consistent with the prior sample, then a calibration adjustment may need to be performed - but the data obtained from the field calibration should be enough to delineate the instrument's performance.

**Instrument Calibration Parameter Adjustments**
**OVA 108:**

A. If the instrument response from above indicates an adjustment of the instrument's calibration parameters is necessary, fill up a sample bag with the higher concentration Scott gas as in Steps 2-11.
B. As the sample is being analyzed by the instrument, carefully adjust the "zero adjust screw" until the meter reading corresponds to the actual concentration of the sample.
C. Close the "Hydrogen Supply" valve and subsequently, the "Hydrogen Tank" valve.
D. When the FID has been extinguished (the meter will suddenly drop to zero), turn off the pump.
E. Move the "Calibrate Switch" to HIGH.
F. If the meter is not reading 10,000 (or 10X), unlock the "Gas Select" and adjust the span until the meter reads 10,000 (10X) corresponding to full scale deflection.

G. Lock in the "Gas Select" reading.

H. Report the latest changes into calibration notebook, making certain to record the new "Gas Select" setting.

**OVA 128**

A. After the instrument is in operation and the normal background is zeroed, draw a sample of the calibration gas into the instrument. The "Gas Select" knob is then used to adjust the probe meter to correspond to the concentration of the calibration gas.

B. The new "Gas Select" setting should be recorded.

**HNU HW-101**

A. After the instrument is in operation and the normal background is zeroed, draw a sample of the calibration gas into the instrument. Adjust the "Span Control" so the meter reading corresponds to the concentration of the standard vapor.

B. Turn the "Function Switch" back to the STANDBY position. Check and reset the zero setting if necessary. If this setting is changed, recheck the calibration setting.

Note: If the span setting resulting from the calibration is 0.0 or if the calibration cannot be achieved, then the PID lamp may need cleaning. Under such conditions, inform a person who is qualified to work on these instruments - do not attempt to take apart the instrument.

# APPENDIX C

## CHROMATOGRAM INDEX

### CHROMATOGRAMS

a. Vacuum Well Ex1 - Ex11
b. Vacuum Well Ex12 - Ex15
c. Blanks
d. Standards

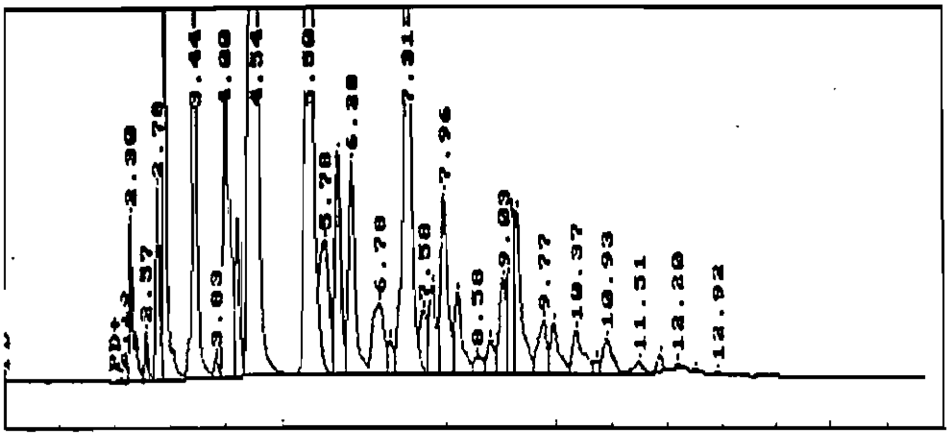
### RETENTION TIME (Rt) INDEX^

| | COMPOUND | ABBREVIATION | Rt (min) |
|---|---|---|---|
| 1. | methylchloride | MC | 2.97 |
| 2. | methylethyl ketone | MEK | 3.51 |
| 3. | benzene | Benz | 4.85 |
| 4. | toluene | Tol | 7.71 |
| 5. | ethylbenzene | EB | 10.73 |
| 6. | m-xylene | m-xy | 10.77 |

^ Retention times may differ with each run. The Rt index is an average of all the field standard Rts.

**A. Vacuum Well #1 Ex1 - Ex11**
**(5cfm)**

ıta File = B:exl.PTS  Printed on 09-25-1990 at 13:41:05
:art time:  0.00 min.  Stop time:  17.00 min.  Offset:  20 mv.
:il Range:  200 millivolts



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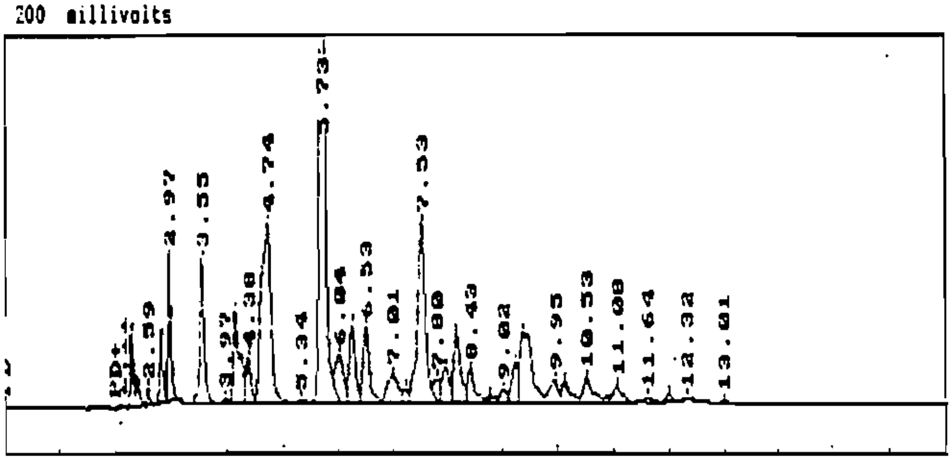
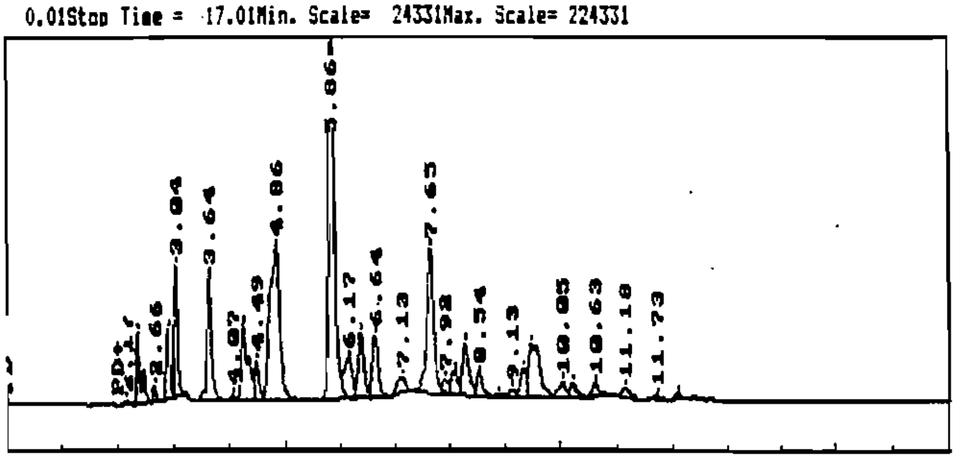
:il Range:  200 millivolts



:ot of data file:  B:ex3.PTS
ıte:  09-25-1990  Time:  13:46:17
ımple Name:  Ex.#3  100uL  H8
:art Time=  0.01Stop Time =  17.01Min. Scale=  24331Max. Scale= 224331



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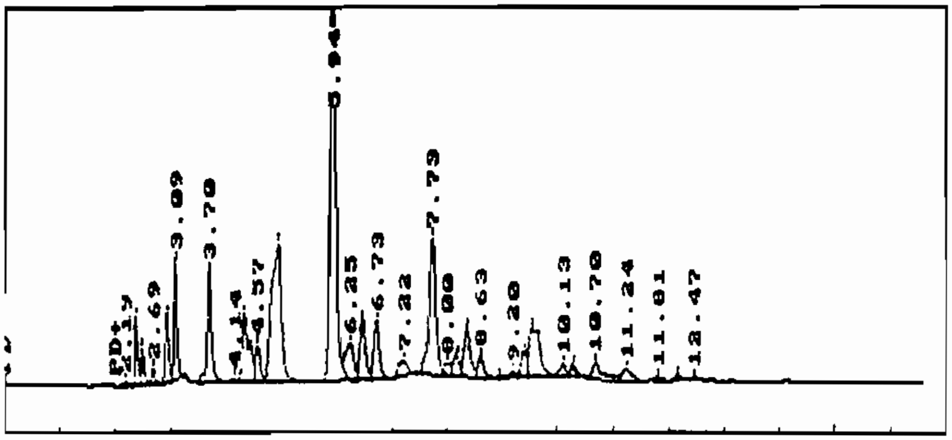


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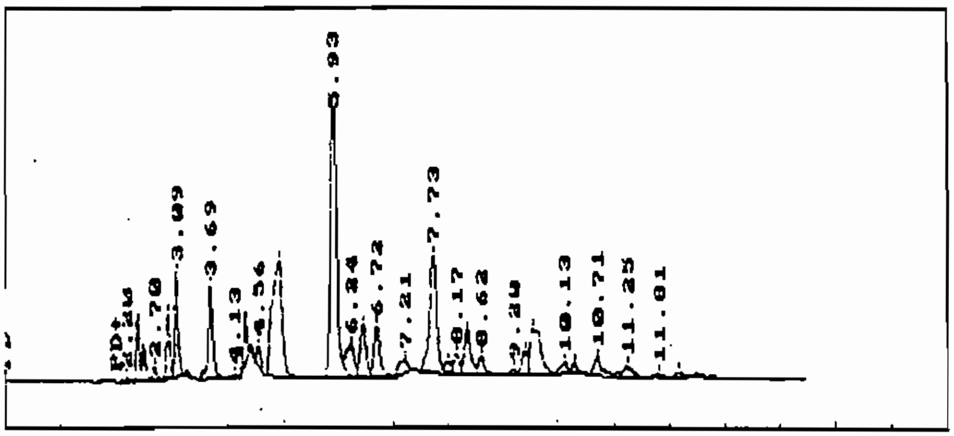


ata File = B:ex6.PTS  Printed on 09-25-1990 at 13:53:47
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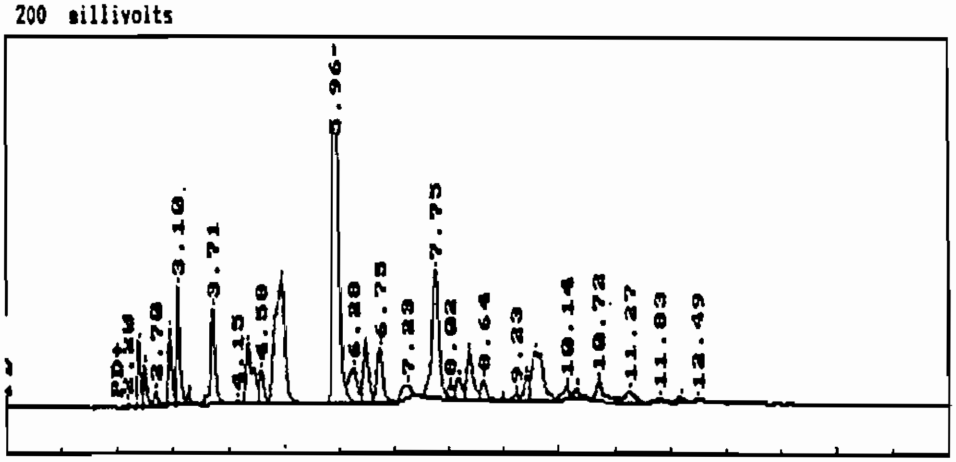

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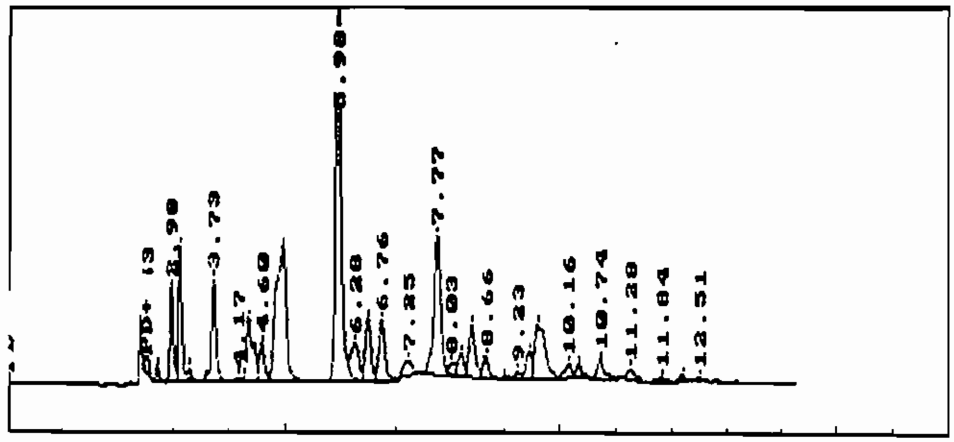


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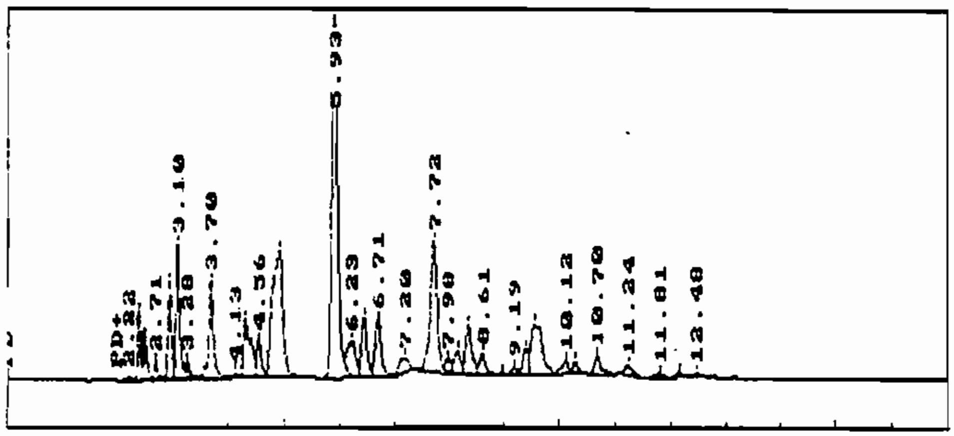


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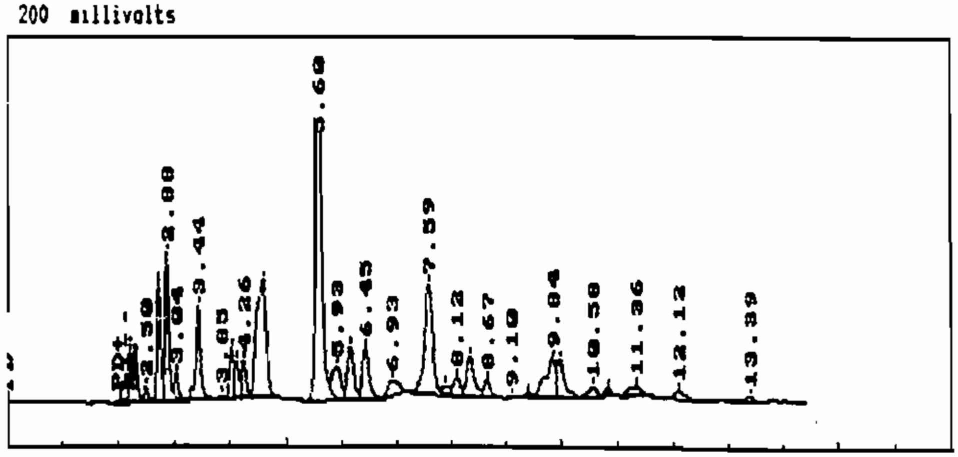

**B. Vacuum Well #1 Ex12 - Ex15**
**(7cfm)**

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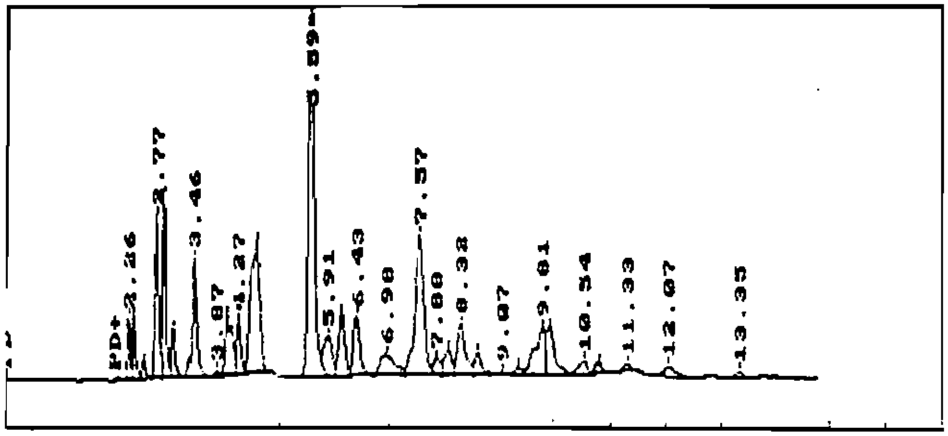


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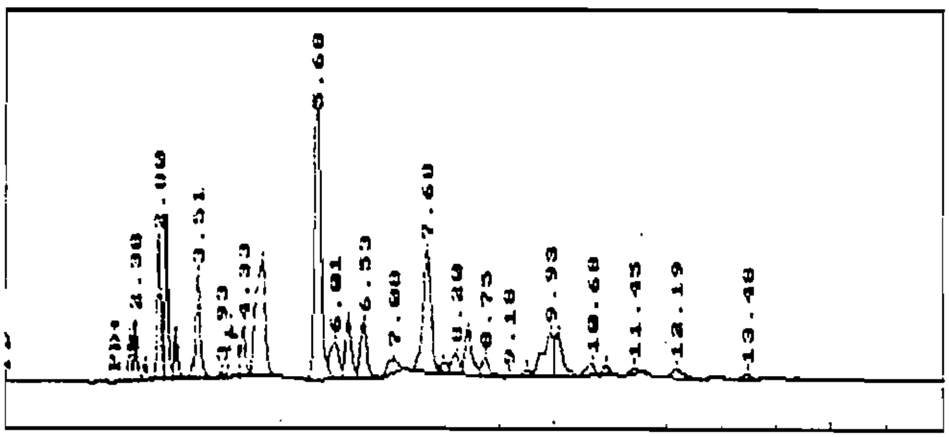

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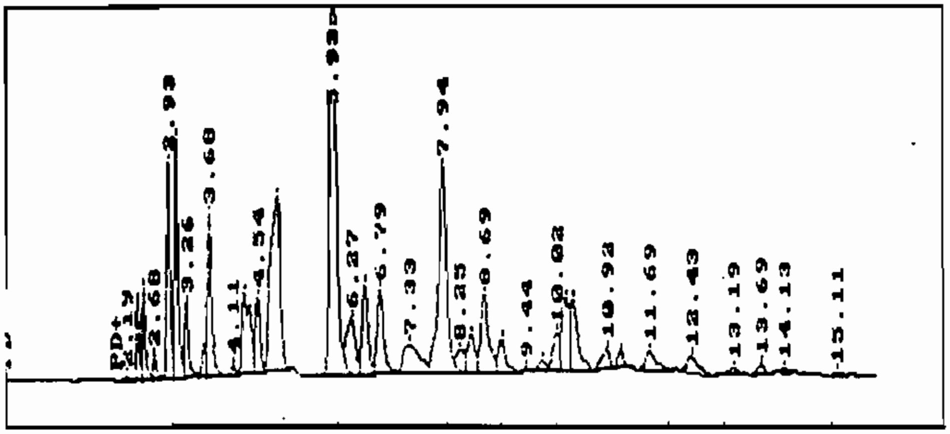

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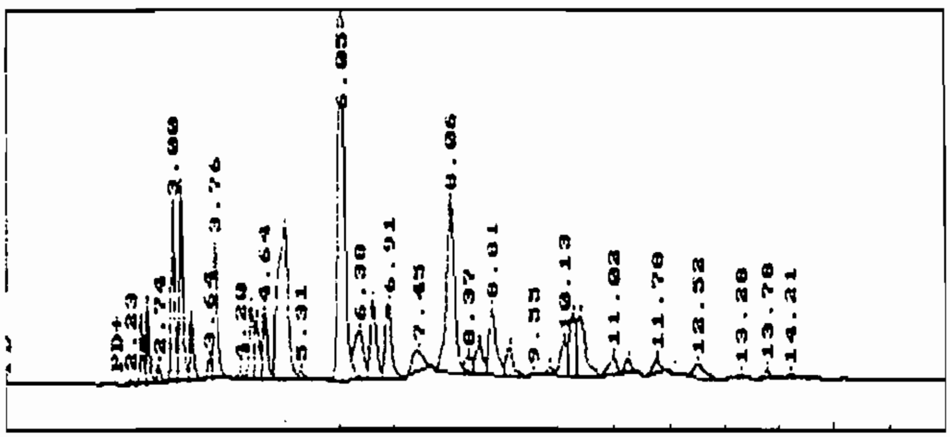

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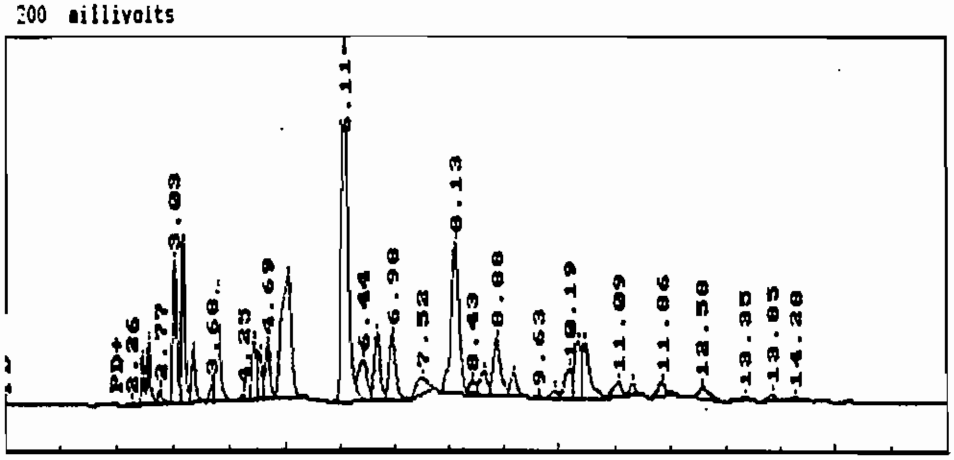

ıta File = A:ex15.PTS  Printed on 10-03-1990 at 10:33:05
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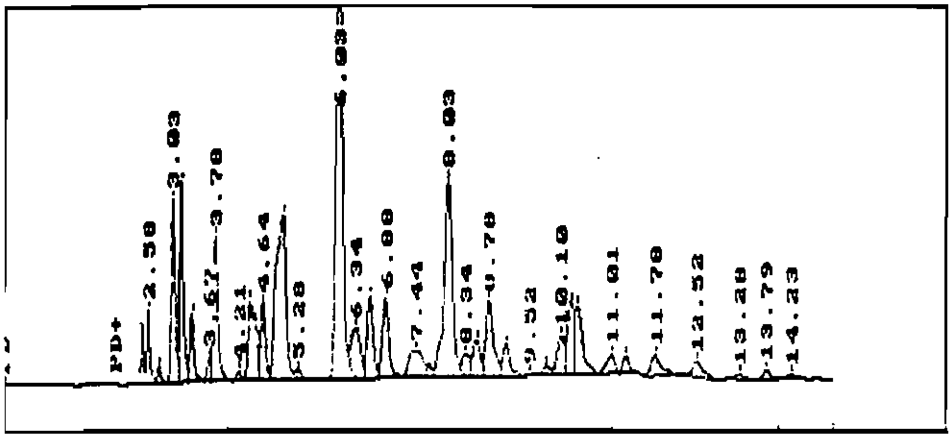
.ll Range:  200  millivolts



## C. Blanks

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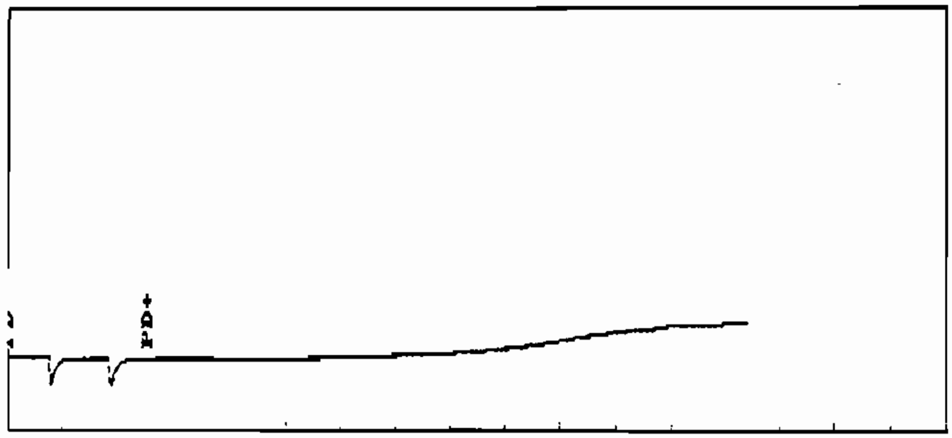

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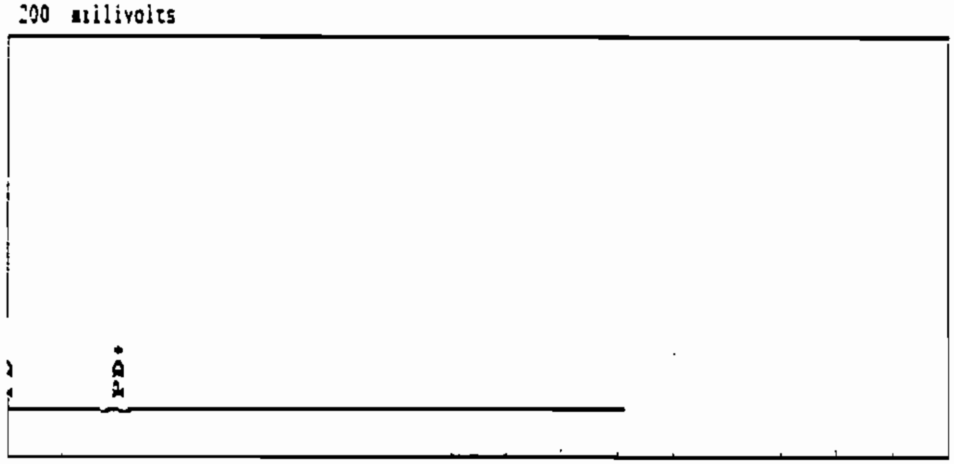
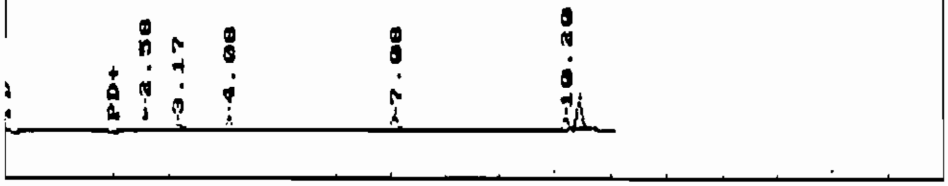
ull Range:  200 millivolts

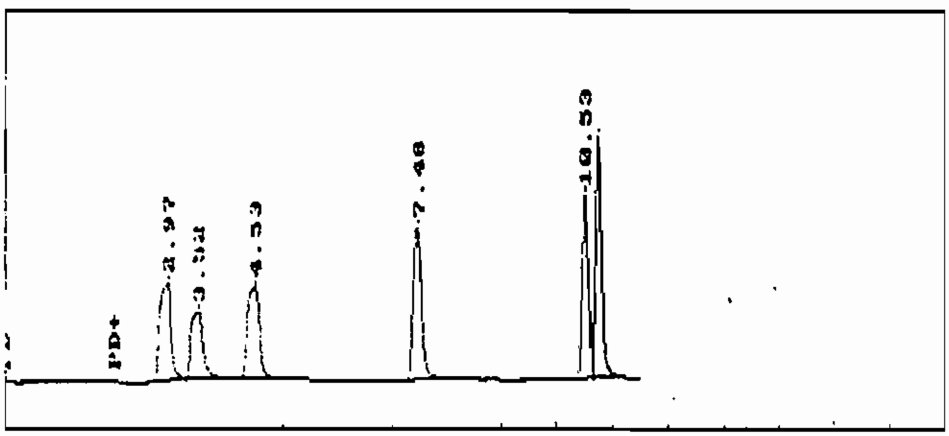


## D. Standards

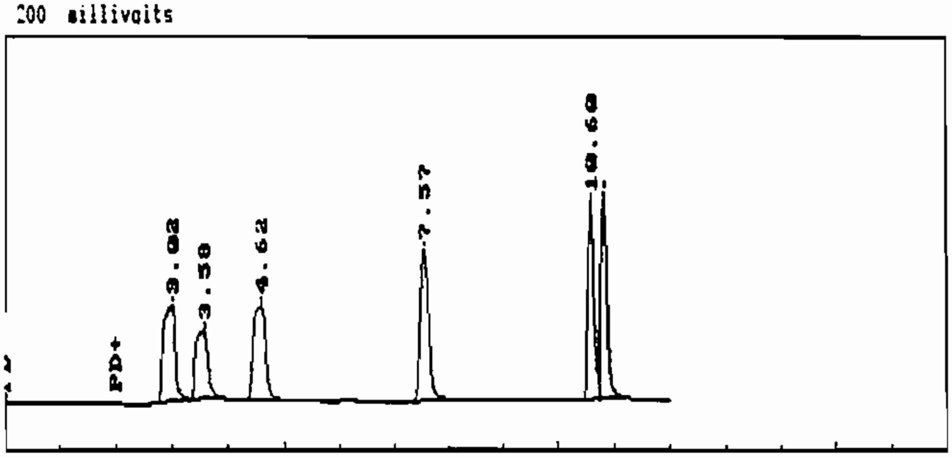
ta File = A:stda-1.PTS  Printed on 10-03-1990 at 11:26:38
art time:   0.00 min.  Stop time:   17.00 min.   Offset:  20 mv.
il Range:  200  millivolts



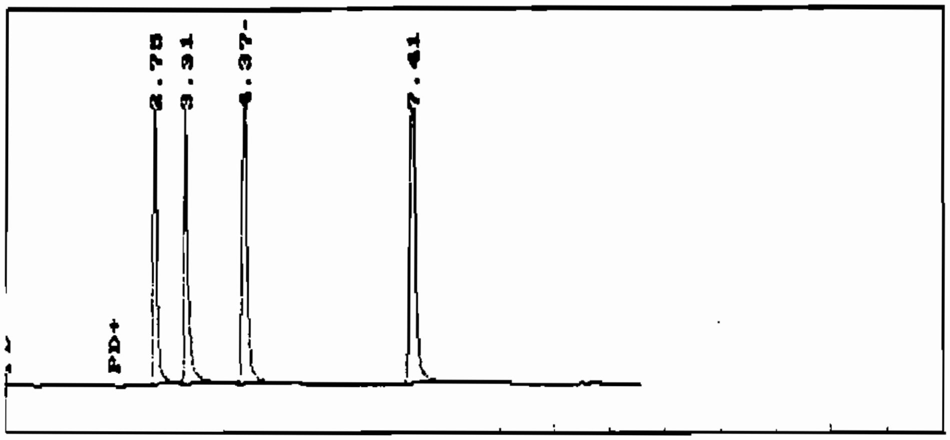

ta File = A:stda-2.PTS  Printed on 10-03-1990 at 11:27:34
art time:   0.00 min.  Stop time:   17.00 min.   Offset:  20 mv.
il Range:  200  millivolts



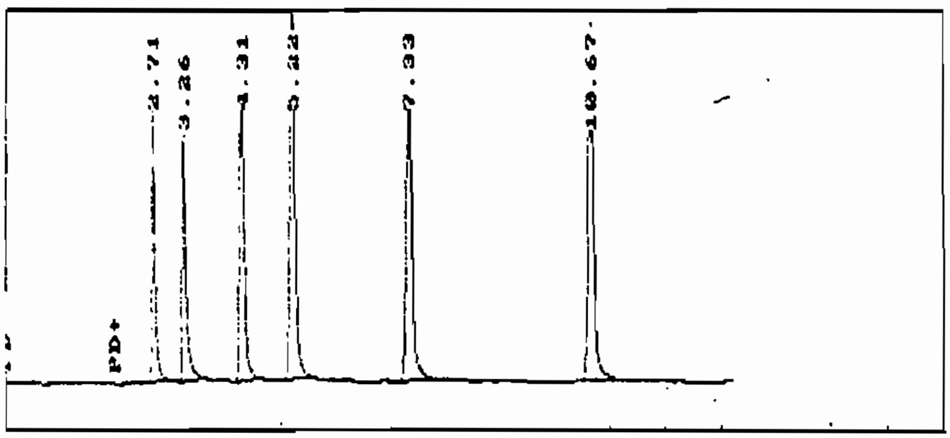

ta File = A:stda-3.PTS  Printed on 10-03-1990 at 11:28:40
art time:   0.00 min.  Stop time:   17.00 min.   Offset:  20 mv.
il Range:  200  millivolts



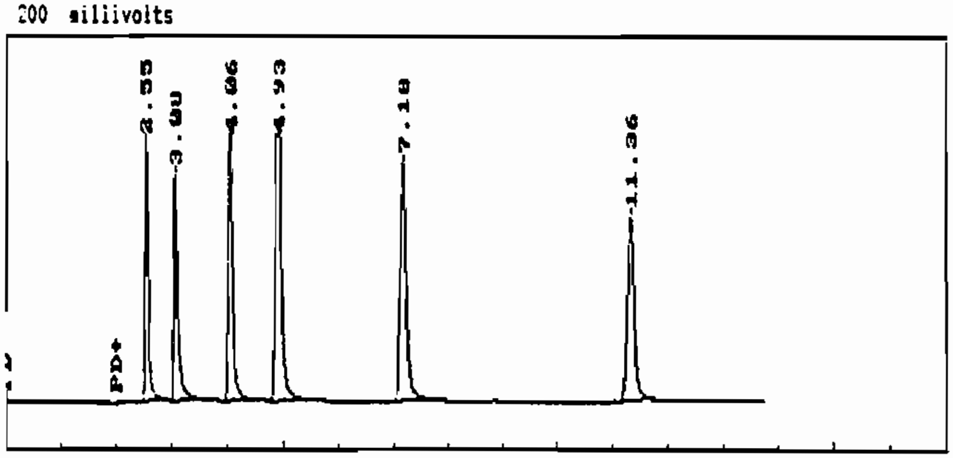
ata File = A:stdb-1.PTS  Printed on 10-03-1990 at 11:29:55
tart time:  0.00 min.  Stop time:  17.00 min.  Offset:  20 mv.
ull Range:  200  millivolts



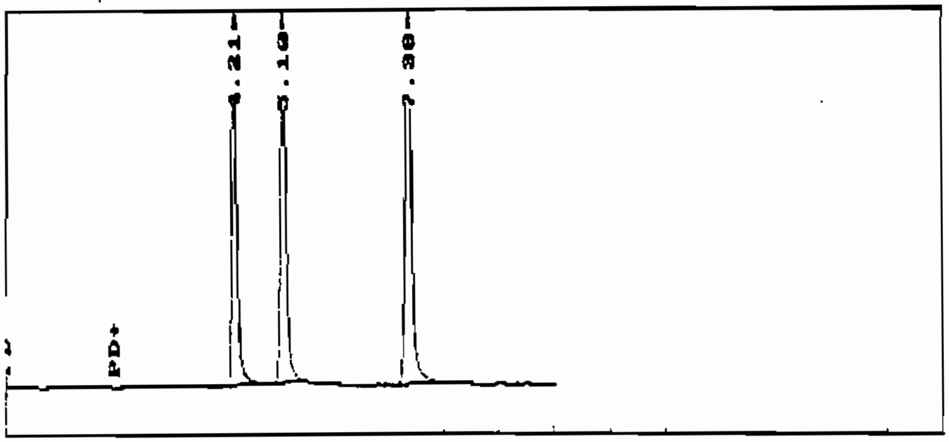

ata File = A:stdb-2.PTS  Printed on 10-03-1990 at 11:31:07
tart time:  0.00 min.  Stop time:  17.00 min.  Offset:  20 mv.
ull Range:  200  millivolts



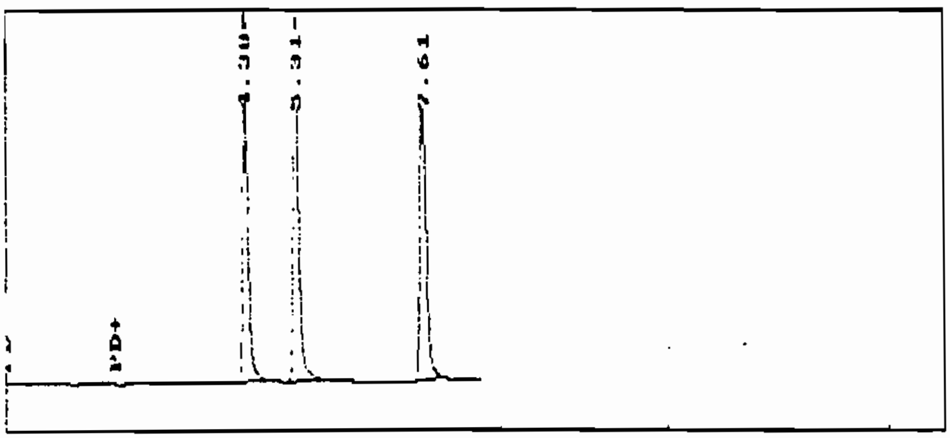

ata File = A:stdb-3.PTS  Printed on 10-03-1990 at 11:32:05
tart time:  0.00 min.  Stop time:  17.00 min.  Offset:  20 mv.
ull Range:  200  millivolts



at of data file: A:stdc-1.PTS
te: 10-03-1990 Time: 11:33:14
ample Name: Std C #1 H8
art Time= 0.01Stop Time = 17.01Min. Scale= 24799Max. Scale= 224799




ta File = A:stdc-2.PTS Printed on 10-03-1990 at 11:34:10
art time: 0.00 min. Stop time: 17.00 min. Offset: 20 mv.
.l Range: 200 millivolts



# APPENDIX D

## DETAILED CHRONOLOGICAL DESCRIPTION OF ACTIVITIES

*VAPEX* performed soil vapor extraction feasibility tests for Malcolm Pirnie, Inc. in Minetto, NY during the week of September 14, 1990. The scope of the tests included the following:

**September 11**

1. Set up the HNU Gas Chromatograph Model 321, equipped with an 11.7 eV photoionization detector (GC).

2. Sealed test pit in vacinity of extraction well with sheet polyethylene.

3. Set up 20 cfm rotary vaned vacuum pump (20 cfm pump) at extraction well. Pump soil vapor discharge was manifolded to 2 carbon drums in series prior to venting to ambient air.

**September 12**

1. Measured background vacuum pressure and obtained soil vapor samples from vapor probes and analyzed using Thermo Environmental 580B with 11.8 eV lamp.

2. Initiated 5 cfm test at 10:30 a.m.. Soil vapor discharge samples (pre and post carbon), vacuum pressure measurements (at the wellhead and vapor probes) and ground water elevations (at monitoring wells and piezometer locations) were obtained periodically throughout the test. Vapor samples were analyzed using the PID and the GC.

**September 13**

1. Conducted final round of vacuum pressure monitoring and obtained final discharge samples for the 5 cfm flow rate test. Terminated 5cfm test at 10:30 a.m. and bailed extraction well of all accumulated water.

2. Initiated 7 cfm test at 12:08 p.m. Soil vapor discharge samples (pre and post carbon), vacuum pressure measurements (at the wellhead and vapor probes) and ground water elevations (at monitoring wells and piezometer locations) were obtained periodically throughout the test. Vapor samples were analyzed using the PID and the GC. Extraction well was bailed of accumulated water periodically to maintain desired vacuum and flow rate.

3. Conducted final round of vacuum pressure monitoring and obtained final discharge samples for the 7 cfm flow rate test. Terminated 7 cfm test at 4:30 p.m..

**September 14**

1. Demobilized equipment. Carbon drums left on site.

2. VAPEX personnel left site at 10:00 a.m..

APPENDIX E

SOILVENT.XLS

| Soil Venting Data Sheet | | |
|---|---|---|
| Sample Name : Vapex Job 90-127 | | |
| Soil Column Diameter (cm): | 7.6 | |
| Packing Length(cm): | 33.0 | |
| Packing Volume (ml): | 1496.3 | |
| Packing Density (g/ml): | 1.7 | |
| Mass of Soil Before Venting(g) | 2618 | |
| Mass of Soil After Venting(g) | 2370 | |
| Concentration* before Venting(mg/kg) | 68.5 | |
| Concentration* after Venting(mg/kg) | 1 | |
| Moisture before venting (%) | 17 | |
| Moisture after venting (%) | 5.6 | |
| *concentration is calculated as dimethyl cyclohexane | | |
| Permiability Data | | |
| air flow rate ml/min | Flow rate | Pressure |
| pressure difference (between 20.5 cm | 50 | 3.1 |
| soil in the colume) as cm water | 100 | 4 |
| | 150 | 5.2 |
| | 200 | 6.4 |
| | 250 | 7.5 |

## Soil Venting Data

**Date Received:** **Date Analyzed:**

| DATE | TIME | GC File | Volume ml | Peak Area | Amount ug | Flow ml/min |
|---|---|---|---|---|---|---|
| 09/20 | 9:25 | #285 | 2.50 | 8.3E6 | 0.1038 | 100 |
| 09/21 | 9:01 | #295 | 2.50 | 24.6E6 | 0.3495 | 100 |
| 09/21 | 16:22 | #307 | 2.50 | 24.5E6 | 0.3079 | 100 |
| 09/22 | 14:40 | #316 | 2.50 | 24.2E6 | 0.3044 | 100 |
| 09/23 | 10:07 | #317 | 2.50 | 21.0E6 | 0.2636 | 100 |
| 09/23 | 18:04 | #318 | 2.50 | 20.0E6 | 0.2506 | 100 |
| 09/24 | 9:01 | #319 | 2.50 | 17.6E6 | 0.2214 | 100 |
| 09/24 | 16:13 | #321 | 2.50 | 16.4E6 | 0.2059 | 100 |
| 09/25 | 9:02 | #322 | 2.50 | 12.2E6 | 0.1532 | 100 |
| 09/25 | 15:17 | #323 | 2.50 | 12.4E6 | 0.1562 | 100 |
| 09/26 | 9:13 | #324 | 2.50 | 8.96E6 | 0.1125 | 100 |
| 09/26 | 14:47 | #325 | 2.50 | 7.78E6 | 0.0977 | 100 |
| 09/27 | 9:09 | #327 | 2.50 | 4.80E6 | 0.0603 | 100 |
| 09/27 | 15:12 | #328 | 2.50 | 4.51E6 | 0.0567 | 100 |
| 09/28 | 9:18 | #329 | 2.50 | 2.15E6 | 0.0270 | 100 |
| 10/01 | 12:01 | #334 | 2.50 | 0.57E6 | 0.0071 | 100 |
| | | | | | | |
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## The Summary of the GCMS Analyses

Samples of the soil before venting and after venting were analyzed for volatile organic compounds and semi-volatile organic compounds. All the target compounds listed in the volatile and semi-volatile data sheets have been analyzed. None of those target compounds has been found above its detection limit. In the total ion chromatograms for volatile organic (VOC6A31A and VOC6A32A), many peaks are found. According to the spectra search results, these compounds are tentatively identified as $C_7$ to $C_9$ hydrocarbon. The example of the tentative identification are as following:

| Retention Time (min.) | Compound |
|---|---|
| 9.8 to 9.9 | methyl cyclohexane |
| 10.5 to 10.6 | trimethyl cyclopetane |
| 12.3 to 12.5 | dimethyl cyclohexane |
| 15.0 to 15.5 | trimethyl cyclohexane |

The ratios of peak height for same compound before and after venting are about 200 to 6.

## GCMS VOLATILE ORGANICS ANALYSIS DATA SHEET

Sample ID: VAPEX Job127 Before Venting
Matrix (soil/water): Soil
Level (Low/High): Low
Dilution Factor: 4

Report File ID:VP127VC1
Data File ID: VOV6A32A
Date Received: 09/17/90
Date Analyzed: 10/02/90
Date Reported: 10/18/90

| CAS NO . | COMPOUND | CONCENTRATION ug/kg | Q* |
|---|---|---|---|
| 74-78-3 | Chloromethane | < 50 | U |
| 74-83-9 | Bromomethane | < 50 | U |
| 75-01-4 | Vinyl Chloride | < 50 | U |
| 75-00-3 | Chloroethane | < 50 | U |
| 75-09-2 | Methylene Chloride | < 25 | U |
| 67-64-1 | Acetone | < 50 | U |
| 75-15-0 | Carbon Disulfide | < 50 | U |
| 75-35-4 | 1,1-dichloroethene | < 25 | U |
| 75-34-3 | 1,1-dichloroethane | < 25 | U |
| 540-59-0 | 1,2-Dichloroethene (total) | < 25 | U |
| 67-66-3 | Chloroform | < 25 | U |
| 107-06-2 | 1,2-Dichloroethane | < 25 | U |
| 78-93-3 | 2-Butanone | < 50 | U |
| 71-55-6 | 1,1,1-Trichloroethane | < 25 | U |
| 56-23-5 | Carbon Tetrachloride | < 25 | U |
| 108-05-4 | Vinyl Acetate | < 50 | U |
| 75-27-4 | Bromodichloromethane | < 25 | U |
| 78-87-5 | 1,2-Dichloropropane | < 25 | U |
| 10061-01-5 | cis-1,3-Dichlorpropene | < 25 | U |
| 79-01-6 | Trichloroethene | < 25 | U |
| 124-48-1 | Dibromochloromethane | < 25 | U |
| 79-00-5 | 1,1,2-Trichloroethane | < 25 | U |
| 71-43-2 | Benzene | < 25 | U |
| 10061-02-6 | trans-1,3-Dichloropropene | < 25 | U |
| 75-25-2 | Bromoform | < 25 | U |
| 108-10-1 | 4-Mehtyl-2-Pentanone | < 50 | U |
| 591-78-6 | 2-Hexanone | < 50 | U |
| 127-18-4 | Tetrachloroethene | < 25 | U |
| 79-34-5 | 1,1,2,2-Tetrachloroethane | < 25 | U |
| 108-88-3 | Toluene | < 25 | U |
| 108-90-7 | Chlorobenzene | < 25 | U |
| 100-41-4 | Ethylbenzen | < 25 | U |
| 100-42-5 | Styrene | < 25 | U |
| 1330-20-7 | Xylene (total) | < 25 | U |

U - Indicates the analyte was analyzed for but below the detection limit.

GCMS VOLATILE ORGANICS ANALYSIS DATA SHEET

Sample ID: VAPEX Job127 After Venting
Matrix (soil/water): Soil
Level (Low/High): Low
Dilution Factor: 4

Report File ID:VP127VC2
Data File ID: VOV6A31A
Date Received: 09/17/90
Date Analyzed: 10/02/90
Date Reported: 10/18/90

| CAS NO . | COMPOUND | CONCENTRATION ug/kg | Q* |
|---|---|---|---|
| 74-78-3 | Chloromethane | < 50 | U |
| 74-83-9 | Bromomethane | < 50 | U |
| 75-01-4 | Vinyl Chloride | < 50 | U |
| 75-00-3 | Chloroethane | < 50 | U |
| 75-09-2 | Methylene Chloride | < 25 | U |
| 67-64-1 | Acetone | < 50 | U |
| 75-15-0 | Carbon Disulfide | < 50 | U |
| 75-35-4 | 1,1-dichloroethene | < 25 | U |
| 75-34-3 | 1,1-dichloroethane | < 25 | U |
| 540-59-0 | 1,2-Dichloroethene (total) | < 25 | U |
| 67-66-3 | Chloroform | < 25 | U |
| 107-06-2 | 1,2-Dichloroethane | < 25 | U |
| 78-93-3 | 2-Butanone | < 50 | U |
| 71-55-6 | 1,1,1-Trichloroethane | < 25 | U |
| 56-23-5 | Carbon Tetrachloride | < 25 | U |
| 108-05-4 | Vinyl Acetate | < 50 | U |
| 75-27-4 | Bromodichloromethane | < 25 | U |
| 78-87-5 | 1,2-Dichloropropane | < 25 | U |
| 10061-01-5 | cis-1,3-Dichlorpropene | < 25 | U |
| 79-01-6 | Trichloroethene | < 25 | U |
| 124-48-1 | Dibromochloromethane | < 25 | U |
| 79-00-5 | 1,1,2-Trichloroethane | < 25 | U |
| 71-43-2 | Benzene | < 25 | U |
| 10061-02-6 | trans-1,3-Dichloropropene | < 25 | U |
| 75-25-2 | Bromoform | < 25 | U |
| 108-10-1 | 4-Mehtyl-2-Pentanone | < 50 | U |
| 591-78-6 | 2-Hexanone | < 50 | U |
| 127-18-4 | Tetrachloroethene | < 25 | U |
| 79-34-5 | 1,1,2,2-Tetrachloroethane | < 25 | U |
| 108-88-3 | Toluene | < 25 | U |
| 108-90-7 | Chlorobenzene | < 25 | U |
| 100-41-4 | Ethylbenzen | < 25 | U |
| 100-42-5 | Styrene | < 25 | U |
| 1330-20-7 | Xylene (total) | < 25 | U |

U - Indicates the analyte was analyzed for but below the detection limit.

GCMS VOLATILE ORGANICS ANALYSIS DATA SHEET

Sample ID: VAPEX Job127 Before Venting
Matrix (soil/water): Soil
Level (Low/High): Low
Dilution Factor: 4

Report File ID:VP127VC1
Data File ID: VOV6A32A
Date Received: 09/17/90
Date Analyzed: 10/02/90
Date Reported: 10/18/90

| CAS NO . | COMPOUND | CONCENTRATION ug/kg | Q* |
|---|---|---|---|
| 74-78-3 | Chloromethane | < 50 | U |
| 74-83-9 | Bromomethane | < 50 | U |
| 75-01-4 | Vinyl Chloride | < 50 | U |
| 75-00-3 | Chloroethane | < 50 | U |
| 75-09-2 | Methylene Chloride | < 25 | U |
| 67-64-1 | Acetone | < 50 | U |
| 75-15-0 | Carbon Disulfide | < 50 | U |
| 75-35-4 | 1,1-dichloroethene | < 25 | U |
| 75-34-3 | 1,1-dichloroethane | < 25 | U |
| 540-59-0 | 1,2-Dichloroethene (total) | < 25 | U |
| 67-66-3 | Chloroform | < 25 | U |
| 107-06-2 | 1,2-Dichloroethane | < 25 | U |
| 78-93-3 | 2-Butanone | < 50 | U |
| 71-55-6 | 1,1,1-Trichloroethane | < 25 | U |
| 56-23-5 | Carbon Tetrachloride | < 25 | U |
| 108-05-4 | Vinyl Acetate | < 50 | U |
| 75-27-4 | Bromodichloromethane | < 25 | U |
| 78-87-5 | 1,2-Dichloropropane | < 25 | U |
| 10061-01-5 | cis-1,3-Dichlorpropene | < 25 | U |
| 79-01-6 | Trichloroethene | < 25 | U |
| 124-48-1 | Dibromochloromethane | < 25 | U |
| 79-00-5 | 1,1,2-Trichloroethane | < 25 | U |
| 71-43-2 | Benzene | < 25 | U |
| 10061-02-6 | trans-1,3-Dichloropropene | < 25 | U |
| 75-25-2 | Bromoform | < 25 | U |
| 108-10-1 | 4-Mehtyl-2-Pentanone | < 50 | U |
| 591-78-6 | 2-Hexanone | < 50 | U |
| 127-18-4 | Tetrachloroethene | < 25 | U |
| 79-34-5 | 1,1,2,2-Tetrachloroethane | < 25 | U |
| 108-88-3 | Toluene | < 25 | U |
| 108-90-7 | Chlorobenzene | < 25 | U |
| 100-41-4 | Ethylbenzen | < 25 | U |
| 100-42-5 | Styrene | < 25 | U |
| 1330-20-7 | Xylene (total) | < 25 | U |

U - Indicates the analyte was analyzed for but low than detection limit.

## GCMS VOLATILE ORGANICS ANALYSIS DATA SHEET

Sample ID: VAPEX Job127 After Venting
Matrix (soil/water): Soil
Level (Low/High): Low
Dilution Factor: 4

Report File ID:VP127VC2
Data File ID: VOV6A31A
Date Received: 09/17/90
Date Analyzed: 10/02/90
Date Reported: 10/18/90

| CAS NO . | COMPOUND | CONCENTRATION ug/kg | Q* |
|---|---|---|---|
| 74-78-3 | Chloromethane | < 50 | U |
| 74-83-9 | Bromomethane | < 50 | U |
| 75-01-4 | Vinyl Chloride | < 50 | U |
| 75-00-3 | Chloroethane | < 50 | U |
| 75-09-2 | Methylene Chloride | < 25 | U |
| 67-64-1 | Acetone | < 50 | U |
| 75-15-0 | Carbon Disulfide | < 50 | U |
| 75-35-4 | 1,1-dichloroethene | < 25 | U |
| 75-34-3 | 1,1-dichloroethane | < 25 | U |
| 540-59-0 | 1,2-Dichloroethene (total) | < 25 | U |
| 67-66-3 | Chloroform | < 25 | U |
| 107-06-2 | 1,2-Dichloroethane | < 25 | U |
| 78-93-3 | 2-Butanone | < 50 | U |
| 71-55-6 | 1,1,1-Trichloroethane | < 25 | U |
| 56-23-5 | Carbon Tetrachloride | < 25 | U |
| 108-05-4 | Vinyl Acetate | < 50 | U |
| 75-27-4 | Bromodichloromethane | < 25 | U |
| 78-87-5 | 1,2-Dichloropropane | < 25 | U |
| 10061-01-5 | cis-1,3-Dichlorpropene | < 25 | U |
| 79-01-6 | Trichloroethene | < 25 | U |
| 124-48-1 | Dibromochloromethane | < 25 | U |
| 79-00-5 | 1,1,2-Trichloroethane | < 25 | U |
| 71-43-2 | Benzene | < 25 | U |
| 10061-02-6 | trans-1,3-Dichloropropene | < 25 | U |
| 75-25-2 | Bromoform | < 25 | U |
| 108-10-1 | 4-Mehtyl-2-Pentanone | < 50 | U |
| 591-78-6 | 2-Hexanone | < 50 | U |
| 127-18-4 | Tetrachloroethene | < 25 | U |
| 79-34-5 | 1,1,2,2-Tetrachloroethane | < 25 | U |
| 108-88-3 | Toluene | < 25 | U |
| 108-90-7 | Chlorobenzene | < 25 | U |
| 100-41-4 | Ethylbenzen | < 25 | U |
| 100-42-5 | Styrene | < 25 | U |
| 1330-20-7 | Xylene (total) | < 25 | U |

U - Indicates the analyte was analyzed for but low than detection limit.

## GCMS SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET

Sample ID: VAPEX Job# 90-127
Before Venting
Matrix: (soil/water): soil
level: (low/med) low
% Moisture: 17
Extraction: hexane-acetone (1+1)
GPC Cleanup: (Y/N) N

Report File ID: VP127SV1
Lab File ID: BNA1A20A
Date Received: 09-17-90
Date Extracted: 09-19-89
Date Analyzed: 10-11-89

| CAS NO . | COMPOUND | CONCENTRATION(ug/kg) | Q |
|---|---|---|---|
| 108-95-2 | Phenol | < 330 | U |
| 111-44-4 | bis(2-Chlorophenol)ether | < 330 | U |
| 95-57-8 | 2-Chlorophenol | < 330 | U |
| 541-73-1 | 1,3-Dichlorobenzene | < 330 | U |
| 106-46-7 | 1,4-Dichlorobenzene | < 330 | U |
| 100-51-6 | Benzyl alcohol | < 330 | U |
| 95-50-1 | 1,2-Dichlorobenzene | < 330 | U |
| 95-48-7 | 2-Methylphenol | < 330 | U |
| 108-60-1 | bis(2-Chlorophenol)ether | < 330 | U |
| 106-44-5 | 4-Methylphenol | < 330 | U |
| 621-64-7 | N-Nitroso-di-n-propylamine | < 330 | U |
| 67-72-1 | Hexachloroethane | < 330 | U |
| 98-95-3 | Nitrobenzene | < 330 | U |
| 78-59-1 | Isophorone | < 330 | U |
| 88-75-5 | 2-nitrophenol | < 330 | U |
| 105-67-9 | 2,4-Dimethylphenol | < 330 | U |
| 65-85-0 | Benzoic acid | < 1600 | U |
| 111-91-1 | bis(2-Chorophenol)methane | < 330 | U |
| 120-83-2 | 2,4-Diclorobenzene | < 330 | U |
| 120-82-1 | 1,2,4-Trichlorobenzene | < 330 | U |
| 91-20-3 | Naphthalene | < 330 | U |
| 106-47-8 | 4-Chloroaniline | < 330 | U |
| 87-68-3 | Hexachlorobutadiene | < 330 | U |
| 59-50-7 | 4-Chloro-3-Methlphenol | < 330 | U |
| 91-57-6 | 2-Methylnaphthalene | < 330 | U |
| 77-47-4 | Hexachlorocyclopentadiene | < 330 | U |
| 88-06-2 | 2,4,6-Trichlorophenol | < 330 | U |
| 95-95-4 | 2,4,5-Trichlorophenol | < 1600 | U |
| 91-58-7 | 2-Chloronaphthalene | < 330 | U |
| 88-74-4 | 2-Nitroaniline | < 1600 | U |
| 131-11-3 | Dimethylphthalate | < 330 | U |
| 208-96-8 | Acenaphthylphthylene | < 330 | U |
| 606-20-2 | 2,6-Dinitrotoluene | < 330 | U |

## GCMS SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET

Sample ID: VAPEX Job# 90-127 Before venting



| CAS NO . | COMPOUND | CONCENTRATION ug/kg | Q |
|---|---|---|---|
| 99-09-2 | 3-Nitroaniline | < 1600 | U |
| 83-32-9 | Acenaphthene | < 330 | U |
| 51-28-5 | 2,4-Dinitrophenol | < 1600 | U |
| 100-02-7 | 4-Nitrophenol | < 1600 | U |
| 132-64-9 | Dibenzofuran | < 330 | U |
| 121-14-2 | 2,4-Dinitrotoluene | < 330 | U |
| 84-66-2 | Diethylphthalate | < 330 | U |
| 7005-72-3 | 4-Chlorophenyl-phenylether | < 330 | U |
| 86-73-7 | Fluorene | < 330 | U |
| 100-01-6 | 4-Nitroaniline | < 1600 | U |
| 534-52-1 | 4,6-Dinitro-2-methylphenol | < 1600 | U |
| 86-30-6 | N-Nitrosodiphenylamine | < 330 | U |
| 101-55-3 | 4-BromophenyI-phenylether | < 330 | U |
| 118-74-1 | Hexachlorobenzene | < 330 | U |
| 87-86-5 | Pentachlorophenol | < 1600 | U |
| 85-01-8 | Phenanthene | < 330 | U |
| 120-12-7 | Anthracene | < 330 | U |
| 84-74-2 | Di-n-butylphthalate | < 330 | U |
| 206-44-0 | Fluoranthene | < 330 | U |
| 129-00-0 | Pyrene | < 330 | U |
| 85-68-7 | Butylbenzylphthalate | < 330 | U |
| 91-94-1 | 3,3'-Dichlorobenzidine | < 660 | U |
| 56-55-3 | Benzo(a)anthracene | < 330 | U |
| 218-01-9 | Chrysene | < 330 | U |
| 117-81-7 | bis(2-Ethylhexyl)phthalate | < 330 | U |
| 117-84-0 | Di-n-octylphalate | < 330 | U |
| 205-99-2 | Benzo(b)fluoranthene | < 330 | U |
| 207-08-9 | Benzo(k)fluoranthene | < 330 | U |
| 50-32-8 | Benzo(a)pyrene | < 330 | U |
| 193-39-5 | Indeno(1,2,3-cd)pyrene | < 330 | U |
| 53-70-3 | Dibenz(a,h)anthracene | < 330 | U |
| 191-24-2 | Benz(g,h,i)perylene | < 330 | U |

FORM I SV-2

## GCMS SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET

Sample ID: VAPEX Job# 90-127
After Venting

Matrix: (soil/water): soil
level: (low/med) low
% Moisture: 5.6
Extraction: hexane-acetone (1+1)
GPC Cleanup: (Y/N) N

Report File ID: VP127SV3
Lab File ID: BNA1A19A
Date Received: 09-17-90
Date Extracted: 10-09-89
Date Analyzed: 10-11-89

| CAS NO . | COMPOUND | CONCENTRATION(ug/kg) | Q |
|---|---|---|---|
| 108-95-2 | Phenol | < 330 | U |
| 111-44-4 | bis(2-Chlorophenol)ether | < 330 | U |
| 95-57-8 | 2-Chlorophenol | < 330 | U |
| 541-73-1 | 1,3-Dichlorobenzene | < 330 | U |
| 106-46-7 | 1,4-Dichlorobenzene | < 330 | U |
| 100-51-6 | Benzyl alcohol | < 330 | U |
| 95-50-1 | 1,2-Dichlorobenzene | < 330 | U |
| 95-48-7 | 2-Methylphenol | < 330 | U |
| 108-60-1 | bis(2-Chlorophenol)ether | < 330 | U |
| 106-44-5 | 4-Methylphenol | < 330 | U |
| 621-64-7 | N-Nitroso-di-n-propylamine | < 330 | U |
| 67-72-1 | Hexachloroethane | < 330 | U |
| 98-95-3 | Nitrobenzene | < 330 | U |
| 78-59-1 | Isophorone | < 330 | U |
| 88-75-5 | 2-nitrophenol | < 330 | U |
| 105-67-9 | 2,4-Dimethylphenol | < 330 | U |
| 65-85-0 | Benzoic acid | < 1600 | U |
| 111-91-1 | bis(2-Chorophenol)methane | < 330 | U |
| 120-83-2 | 2,4-Diclorobenzene | < 330 | U |
| 120-82-1 | 1,2,4-Trichlorobenzene | < 330 | U |
| 91-20-3 | Naphthalene | < 330 | U |
| 106-47-8 | 4-Chloroaniline | < 330 | U |
| 87-68-3 | Hexachlorobutadiene | < 330 | U |
| 59-50-7 | 4-Chloro-3-Methlphenol | < 330 | U |
| 91-57-6 | 2-Methylnaphthalene | < 330 | U |
| 77-47-4 | Hexachlorocyclopentadiene | < 330 | U |
| 88-06-2 | 2,4,6-Trichlorophenol | < 330 | U |
| 95-95-4 | 2,4,5-Trichlorophenol | < 1600 | U |
| 91-58-7 | 2-Chloronaphthalene | < 330 | U |
| 88-74-4 | 2-Nitroaniline | < 1600 | U |
| 131-11-3 | Dimethylphthalate | < 330 | U |
| 208-96-8 | Acenaphthylphthylene | < 330 | U |
| 606-20-2 | 2,6-Dinitrotoluene | < 330 | U |

## GCMS SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET

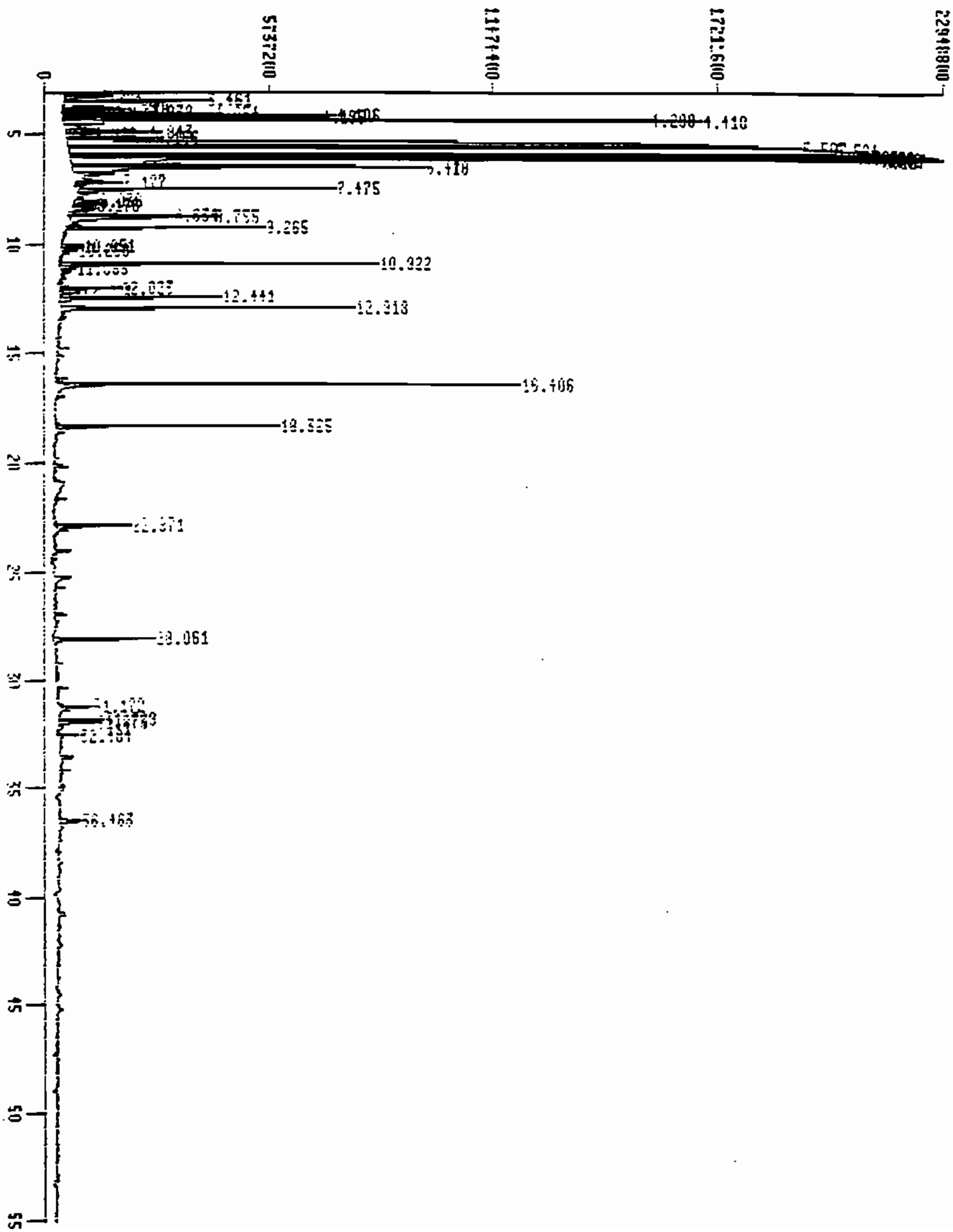
Sample ID: VAPEX Job# 90-127 After venting Page 2-2

| CAS NO . | COMPOUND | CONCENTRATION ug/kg | Q |
|---|---|---|---|
| 99-09-2 | 3-Nitroaniline | < 1600 | U |
| 83-32-9 | Acenaphthene | < 330 | U |
| 51-28-5 | 2,4-Dinitrophenol | < 1600 | U |
| 100-02-7 | 4-Nitrophenol | < 1600 | U |
| 132-64-9 | Dibenzofuran | < 330 | U |
| 121-14-2 | 2,4-Dinitrotoluene | < 330 | U |
| 84-66-2 | Diethylphthalate | < 330 | U |
| 7005-72-3 | 4-Chlorophenyl-phenylether | < 330 | U |
| 86-73-7 | Fluorene | < 330 | U |
| 100-01-6 | 4-Nitroaniline | < 1600 | U |
| 534-52-1 | 4,6-Dinitro-2-methylphenol | < 1600 | U |
| 86-30-6 | N-Nitrosodiphenylamine | < 330 | U |
| 101-55-3 | 4-BromophenyI-phenylether | < 330 | U |
| 118-74-1 | Hexachlorobenzene | < 330 | U |
| 87-86-5 | Pentachlorophenol | < 1600 | U |
| 85-01-8 | Phenanthene | < 330 | U |
| 120-12-7 | Anthracene | < 330 | U |
| 84-74-2 | Di-n-butylphthalate | < 330 | U |
| 206-44-0 | Fluoranthene | < 330 | U |
| 129-00-0 | Pyrene | < 330 | U |
| 85-68-7 | Butylbenzylphthalate | < 330 | U |
| 91-94-1 | 3,3'-Dichlorobenzidine | < 660 | U |
| 56-55-3 | Benzo(a)anthracene | < 330 | U |
| 218-01-9 | Chrysene | < 330 | U |
| 117-81-7 | bis(2-Ethylhexyl)phthalate | < 330 | U |
| 117-84-0 | Di-n-octylphalate | < 330 | U |
| 205-99-2 | Benzo(b)fluoranthene | < 330 | U |
| 207-08-9 | Benzo(k)fluoranthene | < 330 | U |
| 50-32-8 | Benzo(a)pyrene | < 330 | U |
| 193-39-5 | Indeno(1,2,3-cd)pyrene | < 330 | U |
| 53-70-3 | Dibenz(a,h)anthracene | < 330 | U |
| 191-24-2 | Benz(g,h,i)perylene | < 330 | U |

FORM I SV-2

## SEMIVOLATILE ORGANIC AFTER VENTING

1: TIC of DATA:BNA1A19A.D



SEMIVOLATILE ORGANIC BEFORE VENTING

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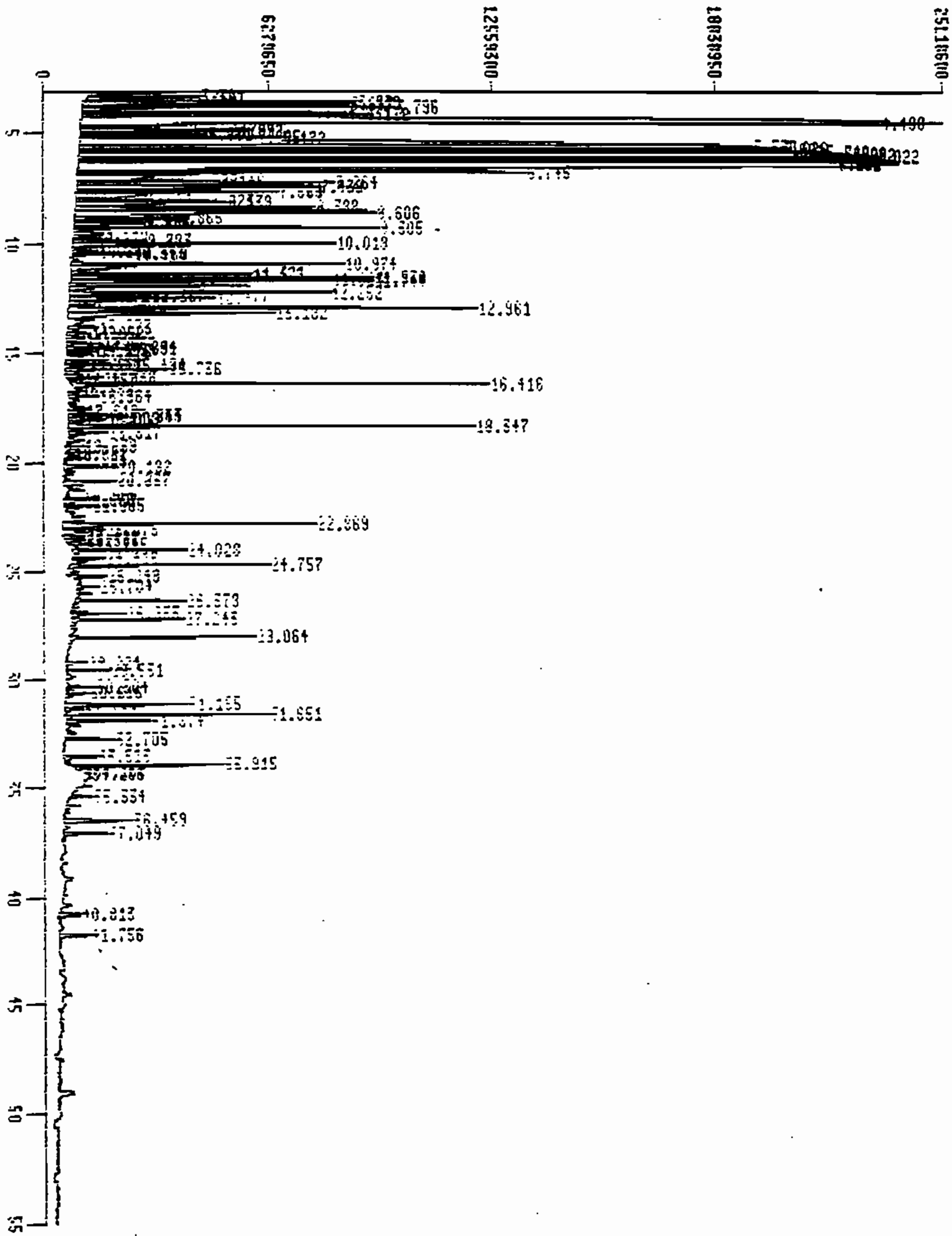

## VOLATILE ORGANIC AFTER VENTING

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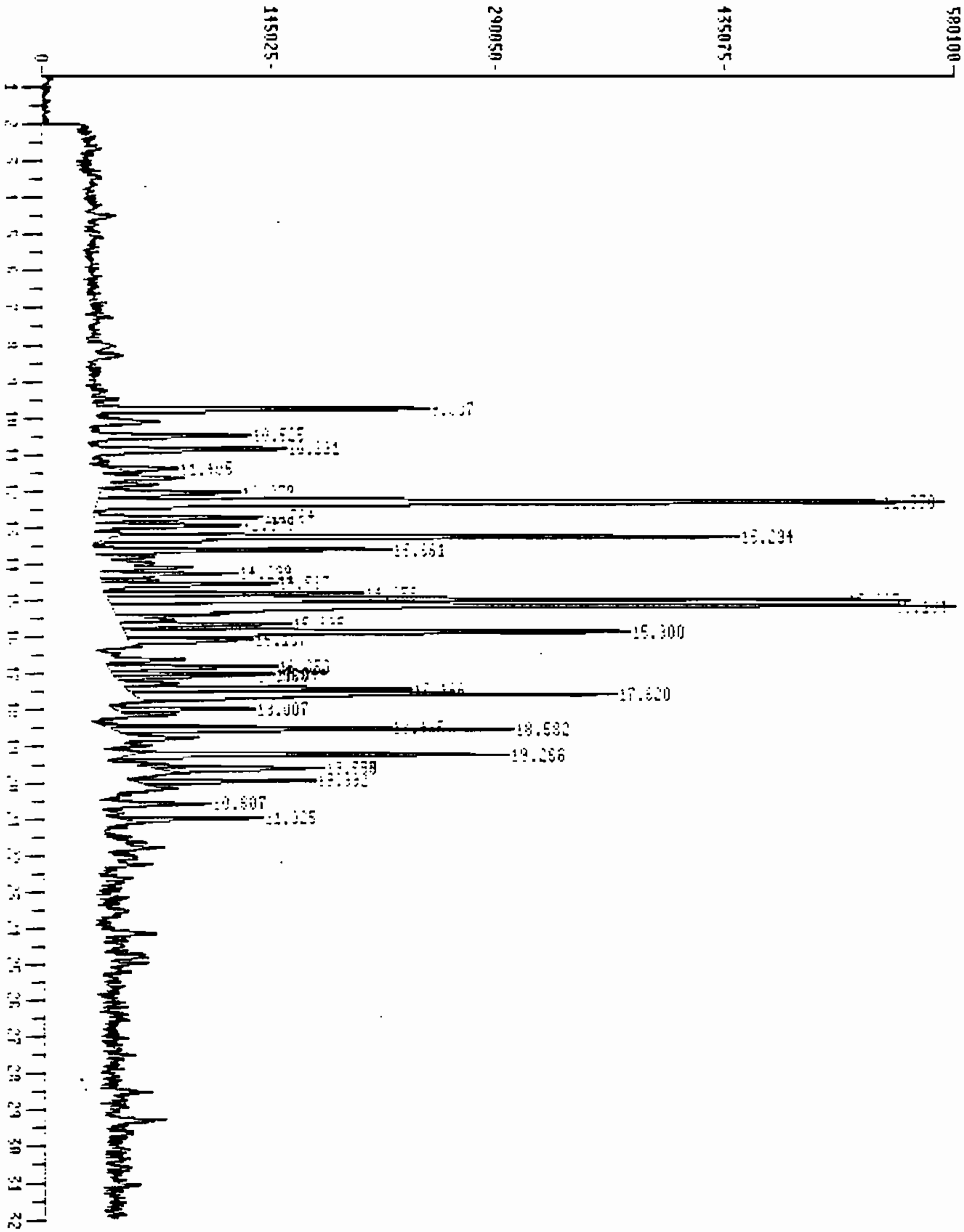

## VOLATILE ORGANIC BEFORE VENTING

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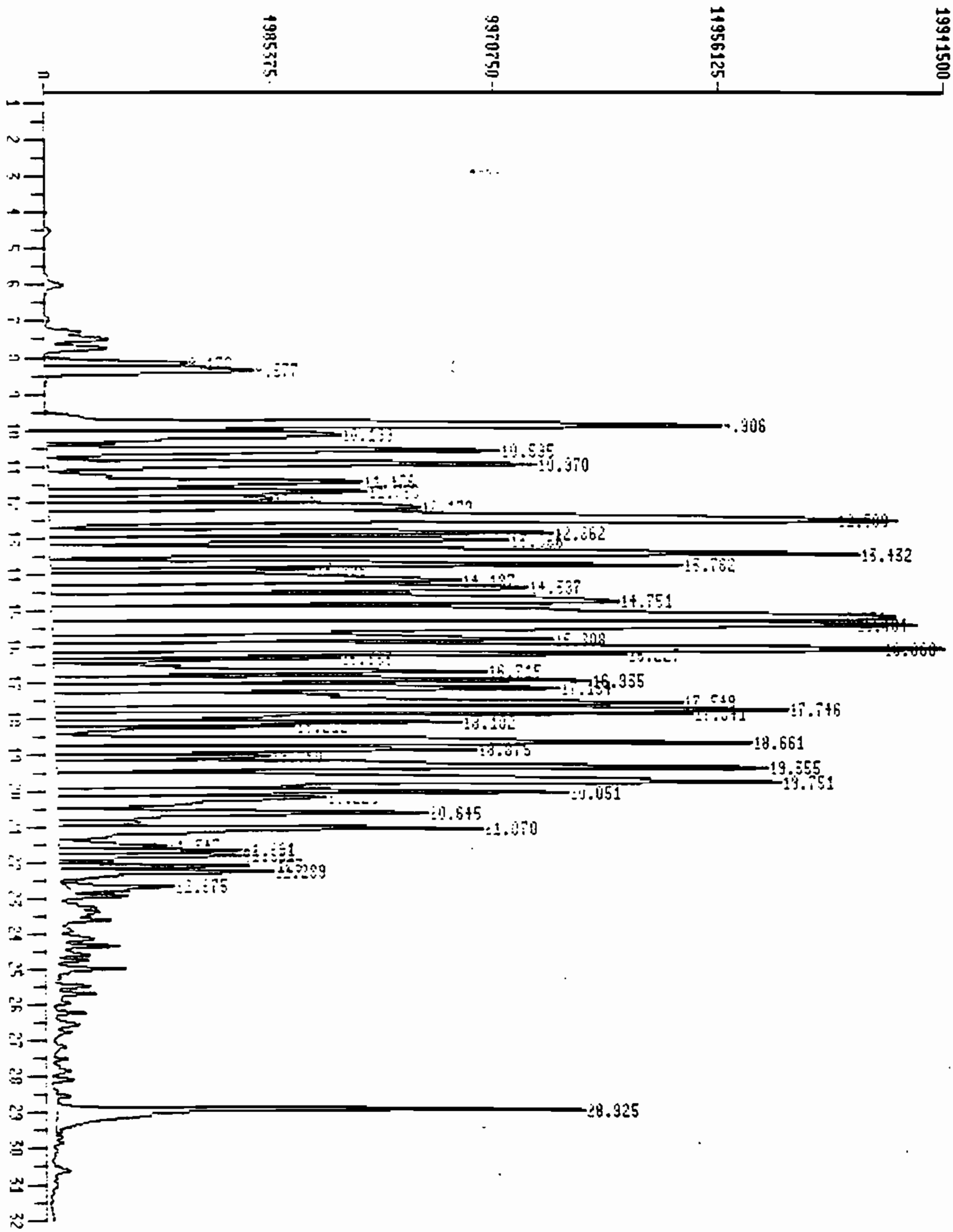


End of plot. Time = 0.73 to 32.01 minutes     Chart speed = 0.64 cm/min

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PREPARED FOR

BOND, SCHOENECK & KING

COLUMBIA MILLS SITE

MINETTO, NEW YORK

# INTERIM REMEDIAL MEASURE REPORT

## EVALUATION OF ALTERNATIVES FOR TREATMENT OF VOC CONTAMINATED SUBSURFACE SOILS IN TEST PIT 3 AREA

MALCOLM PIRNIE



FEBRUARY 1991

REVISED APRIL 1991

MALCOLM PIRNIE

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# INTERIM REMEDIAL MEASURE REPORT EVALUATION OF ALTERNATIVES FOR TREATMENT OF VOC CONTAMINATED SUBSURFACE SOILS IN TEST PIT 3 AREA

**COLUMBIA MILLS SITE**
**MINETTO, NEW YORK**

**FEBRUARY 1991**
**REVISED APRIL 1991**


MALCOLM PIRNIE, INC.

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Liverpool, New York 13088

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1069-03-1

MALCOLM PIRNIE

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MALCOLM PIRNIE

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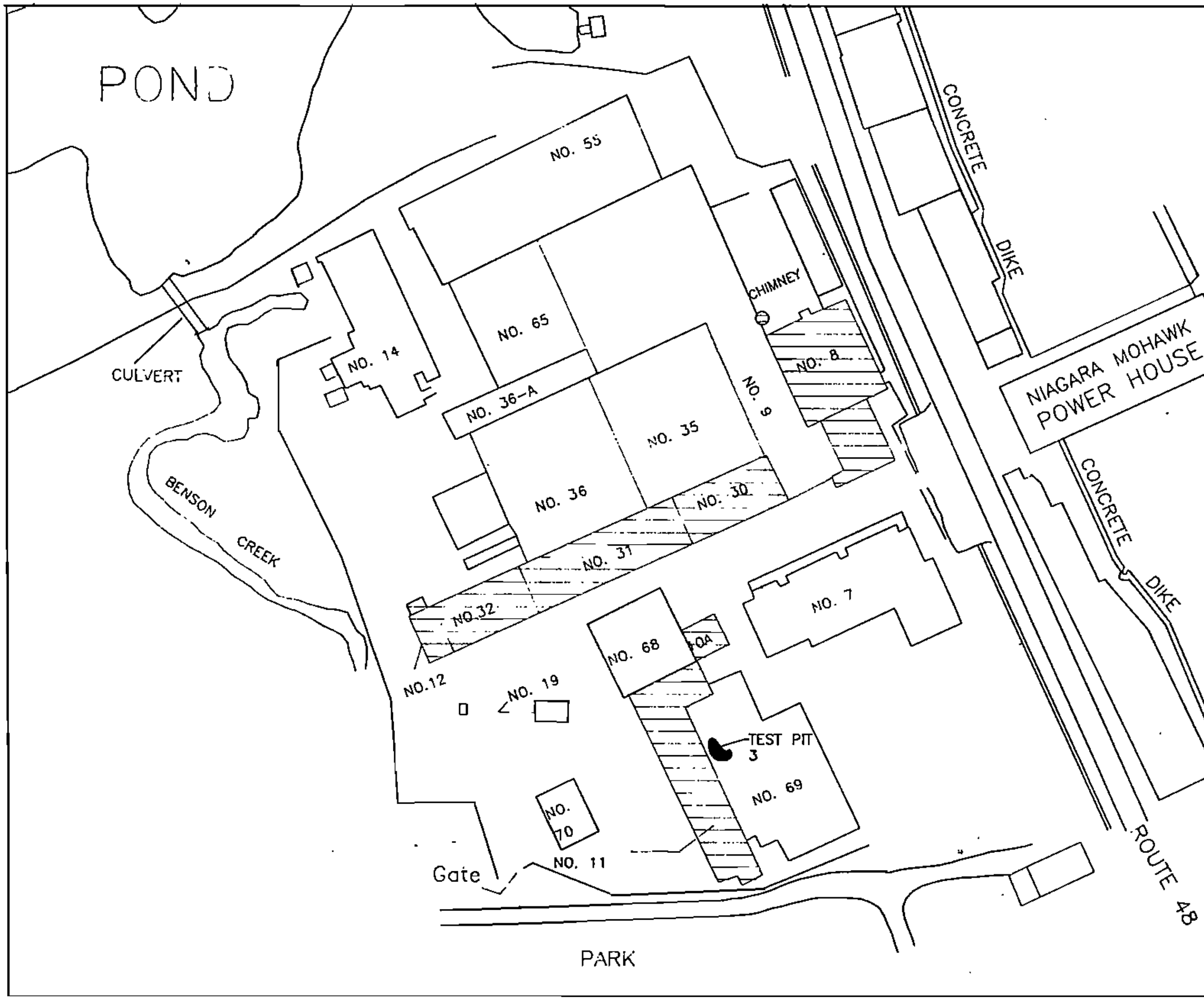
# 1.0 INTRODUCTION

This report describes the feasibility study undertaken by Malcolm Pirnie, Inc. (MPI) to address the volatile organic compound (VOC) contaminated soils in the Test Pit 3 area at the Columbia Mills site, Minetto, New York (see Figure 1-1). This study is being conducted under the Interim Remedial Measure (IRM) Program, the terms of which were set forth in a formal Consent Order (A7-0167-89-02), signed in March, 1989. Plans for the development and execution of this feasibility study were detailed in the IRM Work Plan dated April 1989 and revised in July 1989.

This report is divided into three sections, each section detailing one phase of the study. The first phase defines the extent of contamination and develops the frame work within which the contamination problem will be addressed. Applicable remedial technologies are identified and remedial action alternatives are formulated. In Phase II, the alternatives are screened to reduce the number to be subjected to detailed analysis in Phase III. Based on the analysis in Phase III, a preferred remedial action will be selected. The three phases of the study are contained separately in sections 2, 3 and 4 respectively.




| COLUMBIA MILLS | | |
|---|---|---|
| TEST PIT 3 LOCATION | | |
| MALCOLM PIRNIE | Date February 1991 | Figure No. 1–1 |

# 2.0 PHASE I: DEVELOPMENT OF REMEDIAL ALTERNATIVES

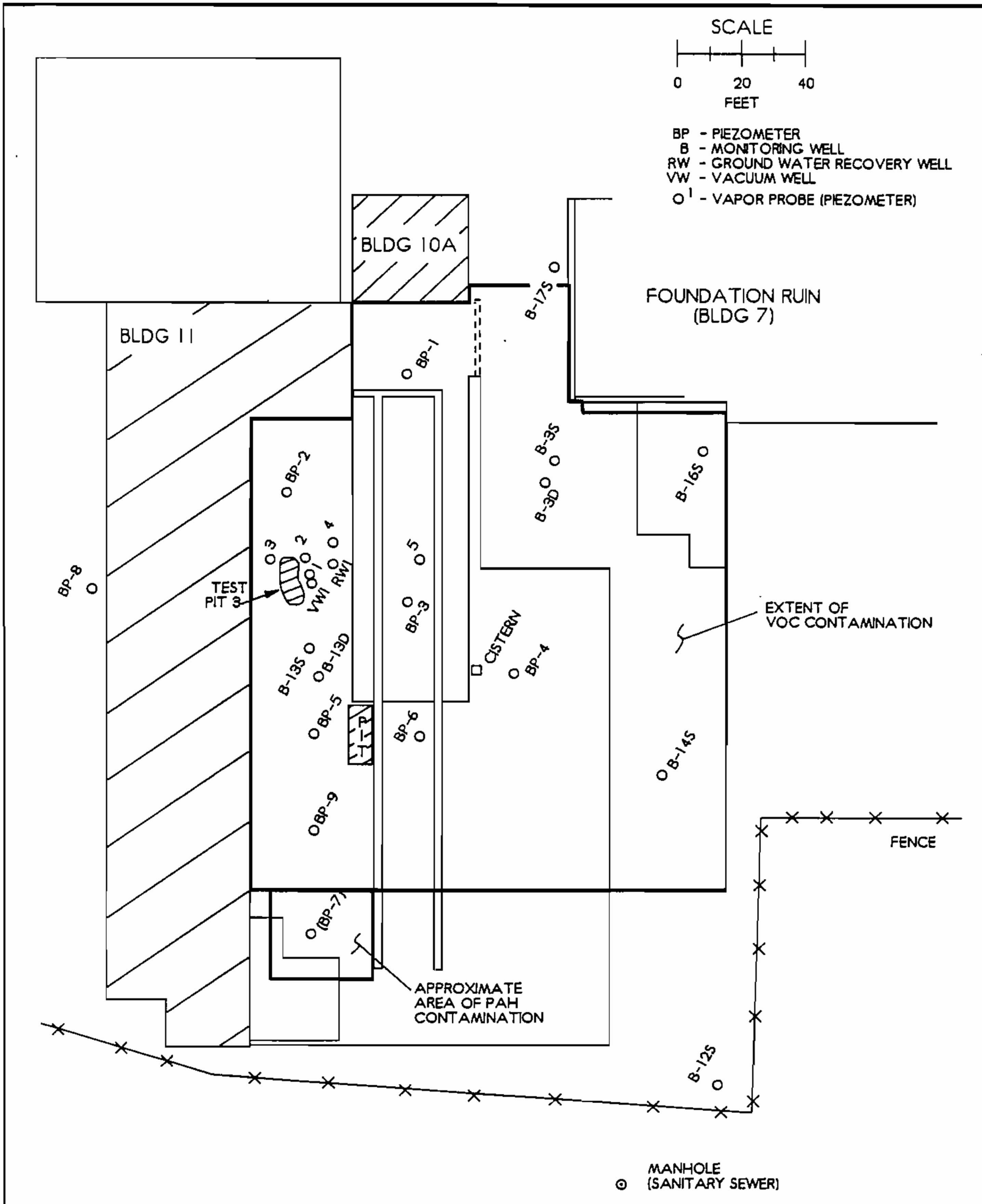
## 2.1 DEFINITION OF REMEDIAL UNIT

The contaminated media in the Test Pit 3 area remedial unit are VOC and polynuclear aromatic hydrocarbon (PAH) contaminated subsurface soils and VOC contaminated ground water. The treatment of the VOC contaminated subsurface soils is being addressed under the IRM program, and the feasibilities of remedial alternatives will be examined in this study. The need for remediation of the ground water and/or the segregated area of PAH contaminated soils will be determined through the risk analysis process. If remediation of either area is determined to be necessary, it will be addressed under the Remedial Investigation/Feasibility Study (RI/FS) program.

The extent of VOC contamination in the Test Pit 3 area subsurface soils was determined through the analysis of data collected in and around that area. These data include results of soil boring head space analyses (performed with an HNU photoionization detector), soil gas survey results, ground water and soil sampling results. The results of the chemical and physical analyses are summarized in Appendix A. Included are:

- Summary logs for the Test Pit 3 area soil borings.
- Three figures summarizing the results of the three soil gas surveys conducted at the site.
- Results of ground water sampling conducted in the Test Pit 3 area under the IRM program and the RI.
- Results of sampling of soil from the nine borings installed under the IRM program.
- Results of grain size distribution and organic matter content analyses on soil samples collected from the borings.

The horizontal extent of VOC contamination in the Test Pit 3 area soils is shown in Figure 2-1. This area encompasses approximately 22,900 square feet ($ft^2$). VOC contamination of the soils appears to extend to a depth just above the shallow bedrock which underlies the area. The depth of bedrock averages 17 to 18 feet below land surface, but becomes much shallower (eight feet below land surface) at the southern end of the area

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# COLUMBIA MILLS

**EXTENT OF VOC CONTAMINATED SOIL IN TEST PIT 3 AREA REMEDIAL UNIT**

MALCOLM PIRNIE, INC.

FIGURE # 2-1

February 1991

(BP-7). Assuming VOC contaminated soils average 15 feet in depth, approximately 343,500 cubic feet ($ft^3$), or 12,700 cubic yards ($yd^3$) of soil must be treated.

The majority of VOCs present in the subsurface soils in this remedial unit are tentatively identified compounds (TICs), mainly unknowns, cycloalkanes and alkanes. TIC concentrations in the Test Pit 3 area range from 450 parts per billion (ppb) to 880,000 ppb. Soil sampling conducted most recently also indicated the presence of methyl isobutyl ketone (MIBK) (up to 19,000 ppb) and xylenes (up to 9,800 ppb) in the subsurface soils. Xylenes (59,000 ppb), toluene (11,000 ppb), ethylbenzene (4,800 ppb) and traces of MIBK and methyl ethyl ketone (MEK) were originally detected in 1987 in the test pit soil.

Although benzene has not been detected in soil samples obtained in the Test Pit 3 Area, results of past soil gas surveys have indicated the presence of the VOC. Benzene has been detected in soil gas samples obtained from two of the probes installed in the area between the concrete pad surrounding Test Pit 3 and the Building 7 foundation. Benzene was also detected in the vacuum well discharge during the vapor extraction pilot study conducted in the Test Pit 3 Area by Vapex Environmental Technologies, Inc. during September 1990. Refer to Vapex's report entitled "Preliminary Design Evaluation and Full Scale Conceptual Design of a Soil Vapor Extraction System for the Test Pit 3 Area at the Columbia Mills Site, Minetto, New York", dated December 1990, for pilot scale sampling results.

PAHs were detected in several soil samples obtained from the Test Pit 3 Area borings installed under the IRM program. There were minor concentrations detected in the VOC contaminated soils (up to approximately 2,500 ppb). Since concentrations of these more stable PAHs were low, remediation of these soils for semi-volatile contamination was determined not to be necessary. Higher levels of PAHs were detected in soil from boring BP-7, located just south of the area of VOC contaminated soil. Approximately 219,000 ppb total PAHs were detected here. As mentioned previously, the need for remediation of this separate area of PAH contaminated soil will be determined through the risk analysis process under the RI/FS program.

On an annual basis, the depth of the ground water table in the Test Pit 3 area typically ranges from 2.5 feet to 9 feet below the top of the concrete pad or 0.5 feet to 7 feet below land surface at locations off the concrete pad. In general, the shallow ground water flows toward the north-northeast, but flow is affected locally by sewer piping and the more permeable sewer bedding.

VOC contamination of the ground water appears to be slight. Analytical results of RI and IRM sampling of ground water in the Test Pit 3 area indicates that sporadic detection of toluene, xylenes, ethylbenzene, MIBK, trichloroethene (TCE) and MEK has occurred. The concentrations of most of the compounds detected in the samples were at or below the New York State Department of Environmental Conservation (NYSDEC) GA ground water standards. As with the soil in the Test Pit 3 area, TICs comprise the majority of contaminants in the ground water. Up to 1,950 ppb total TICs have been detected. In general, TIC concentrations are less in the deeper ground water (shallow bedrock) than in the shallow ground water.

The above information on the ground water and PAH contaminated soils was provided to fully characterize the physical features of and the media interactions occurring in the Test Pit 3 area remedial unit. If remediation of these areas is necessary, as determined in the RI risk assessment, the RI/FS program will address it.

## 2.2 REMEDIAL ACTION OBJECTIVE

No standards, criteria and guidelines (SCGs) exist for the in-situ VOC contaminated soils in the Test Pit 3 area remedial unit. The majority of soils in this unit are capped by the concrete pad foundation of former Building 69. Thus, access to the soils is limited. Sampling results also indicate that very little VOC contamination is leaching into the ground water and that most is adsorbed onto the soils. Based on this information, the remedial action objective for the Test Pit 3 remedial unit VOC contaminated soils is to reduce total target VOC concentrations to approximately 1 part per million (ppm).

## 2.3 GENERAL RESPONSE ACTIONS

Based on the chemical and geological information gathered during the IRM and RI programs, general response actions were identified for the VOC contaminated soil medium. The response actions that were considered applicable address the contamination problem so as to meet the remedial action objective.

The general response actions can be considered as conceptual alternatives for the treatment of the Test Pit 3 area VOC contaminated soils. The "no action" alternative was included as a baseline for comparison with other potential response actions. Also, the no action alternative is mandated by the Superfund Amendments and Reauthorization Act (SARA) to be included. Table 2-1 presents a summary of the general response actions.

Containment would reduce leaching resulting from percolation and ground water infiltration. Excavation, treatment and/or disposal and in-situ treatment of the soil would immobilize or separate VOC contaminants as well as remove the source of contamination.

## 2.4 IDENTIFICATION OF APPLICABLE REMEDIAL TECHNOLOGIES

Applicable remedial technologies were identified for each general response action. The remedial technologies were identified by taking the following into account:

- Site conditions and characteristics that may affect implementability.
- Physical and chemical characteristics of contaminants that determine the effectiveness of various technologies.
- Performance and operating reliability.

Table 2-1 lists the applicable remedial technologies for the Test Pit 3 area VOC soils. The following sections describe each of these applicable technologies.

### 2.4.1 Containment - Vertical Barriers

Containment consists of constructing subsurface barriers to restrict ground water movement through contaminated soil or other unconsolidated material. A typical technology includes the construction of vertical barriers, such as slurry walls. Slurry walls are impervious barriers constructed through the subsurface soils. Construction of these walls creates a ground water flow barrier and restricts the transport of contaminants. The walls are constructed with either a soil-bentonite or a cement-bentonite slurry. Most commonly, a vertical trench of limited width is excavated with a backhoe or other appropriate equipment. In a soil-bentonite slurry wall, the trench sides are supported by hydrated bentonite slurry during excavation. The trench is subsequently filled with a mixture of select soil and bentonite slurry, thus creating a continuous wall. In a cement-bentonite slurry wall, a properly designed cement-bentonite slurry is introduced into the trench during excavation. This slurry provides support to the trench sides during excavation and is allowed to harden to form the wall.

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TABLE 2-1

SUMMARY OF APPLICABLE REMEDIAL TECHNOLOGIES
TEST PIT 3 AREA VOC SOILS

| General Response Action | Applicable Remedial Technology |
| --- | --- |
| No Action | No Action |
| Containment | Vertical Barriers/Slurry Walls |
| Excavation/Treatment/Disposal | Excavation<br>On-Site Disposal<br>Off-Site Disposal<br>Physical Treatment - Soil Aeration<br>Thermal Treatment - Low Temperature Incineration |
| In-Situ Treatment | Vapor Extraction<br>Soil Washing<br>Bioremediation |

### 2.4.2 Excavation

Contaminated soils excavation and removal is usually followed by land disposal or treatment. Treatment is required for those wastes classified as hazardous. There are no absolute limitations on the types of waste which can be excavated and removed. Factors to be considered while evaluating the usefulness of this technology include an assessment of the wastes mobility and comparison with the feasibility of on-site containment or in-situ treatment.

### 2.4.3 On-Site or Off-Site Disposal

On-Site On-site disposal of contaminated soils and sludges generated by contaminated material excavation or on-site treatment/pretreatment processes, requires the construction of a secure landfill that ideally meets Resource Conservation and Recovery Act (RCRA) and State requirements. Criteria associated with the construction of a RCRA hazardous waste landfill, include the following:

- The landfill should be designed so that the local ground water table will not be in contact with the facility.
- The landfill should be constructed of, or lined with, natural or synthetic material of low permeability to inhibit leachate migration.
- An impermeable cover is required to minimize infiltration and leachate production.
- A leachate and runoff collection system must be provided.
- Periodic monitoring of surface water, ground water and soils adjacent to the facility must be conducted to determine the integrity of the liner and leachate collection system.

However, an on-site landfill would not necessarily have to meet all the RCRA requirements if it is intended to contain only low-hazard or detoxified wastes not specifically designated by RCRA as hazardous.

Off-Site Off-site contaminated soil/waste disposal involves excavated soil/waste hauling to a commercial sanitary or secure landfill for disposal. Several factors influence the effectiveness of off-site disposal in secure or sanitary landfills. The primary factor is whether the excavated soil is classified as hazardous by RCRA. Soil can be so classified either by virtue of its source, as with the soils contaminated by waste, or through the exhibition of a hazardous characteristic, such as reactivity, corrosiveness, ignitability or toxic characteristic leaching procedure (TCLP) toxicity. For the soils remedial unit, the only hazard characteristic that may be exhibited is TCLP toxicity. Those soils that are not hazardous can be disposed of in a sanitary landfill. Hazardous wastes may only go to a secure landfill. However, certain hazardous wastes are banned from secure landfills unless they are treated to specific standards.

### 2.4.4 Physical Treatment - Soil Aeration

Soil aeration utilizes the volatility of VOC contaminants to remove them from the soil medium. Contaminated soil is spread out on an impermeable surface to expose the VOCs to the atmosphere. The soil is allowed to aerate naturally or is tilled to further enhance volatilization. At the Columbia Mills site there is ample room to spread out contaminated soils on the concrete slab foundations of some of the previously existing buildings. Air monitoring for VOCs and particulates is necessary to insure the safety of those working on the site as well as those off-site.

### 2.4.5 Thermal Treatment - Low Temperature Incineration

The basic operation of the thermal treatment technology of low temperature incineration is the application of heat energy to the soil medium and VOC contaminants. The increase in temperature causes a breakdown of the organic material and VOCs. The substance being treated degrades into products that generally include carbon dioxide, water vapor, sulfur dioxide, nitrogen oxides, gases and ash. Low temperature incineration is applicable for lower boiling point compounds, including the VOCs present in the Test Pit 3 area soils.

### 2.4.6 In-Situ Treatment

A number of methods are currently being developed which involve physical subsurface manipulation to immobilize or detoxify waste constituents. These technologies include soil vapor extraction, soil washing and bioremediation.

<u>Vapor Extraction</u> The vapor extraction process is probably the simplest of all VOC in-situ treatment methods. The system operates by inducing air flow through contaminated soil. As the air passes through the soil, it entrains and removes contaminants that exist in the vapor phase. The VOC-laden gas is collected and discharged to the air. The gas may be treated prior to discharge, depending on regulatory requirements.

A typical system consists of a series of vacuum wells installed at strategic locations in the contaminated soil area. The wells are connected by piping and manifolded to a blower or vacuum pump. The pump is generally connected to a vapor treatment unit (usually activated carbon), which reduces VOC concentrations to acceptable discharge levels.

Soil Washing Contaminants can be washed from contaminated soils by means of an extraction process termed "in-situ soil washing". An aqueous solution containing surfactant is injected into the area of contamination, and the contaminant elutriate is pumped to the surface for removal, recirculation or on-site treatment and reinjection. During elutriation, sorbed contaminants are mobilized into solution by reason of solubility, emulsion formation or chemical reaction with the flushing solution.

Soil washing can be conducted by gravity feeding the washing solution onto the site via flooding and ponding or forcing the solution through injection wells. Recovery can be via wells, open ditches or drains. This process generates large amounts of water and requires the construction of a treatment facility to separate the VOC/surfactant mixture from the water.

Bioremediation The bioremediation method that has been most developed and is most feasible for in-situ treatment is one that relies on aerobic (oxygen requiring) microbial processes. This method involves optimizing environmental conditions by providing an oxygen source and nutrients, which are delivered to the subsurface through an injection well or infiltration system to enhance microbial activity. Indigenous micro-organisms can generally be relied upon to degrade a wide range of compounds, given proper nutrients and sufficient oxygen. Specially adapted or genetically manipulated micro-organisms are also available and may be added to the soil/ground water zone.

## 2.5 DEVELOPMENT OF REMEDIAL ACTION ALTERNATIVES

Following identification of potentially applicable technologies, these technologies were combined into alternatives to address the VOC contaminated soils in the Test Pit 3 Area. Summaries of the remedial action alternatives are presented below.

- Alternative 1 - No Action.
- Alternative 2 - Installation of Slurry Walls.
- Alternative 3 - Excavation and On-Site Disposal.
- Alternative 4 - Excavation and Off-Site Disposal.

- Alternative 5 - Vapor Extraction and Ground Water Extraction to Lower Shallow Water Table.
- Alternative 6 - In-Situ Bioremediation.
- Alternative 7 - In-Situ Soil Washing.
- Alternative 8 - Excavation, Soil Aeration and Backfill.
- Alternative 9 - Excavation, Low Temperature Incineration and Backfill.

Alternative 1 - No Action The no action alternative is included as a base line control for comparison with other alternatives. This alternative would likely be unacceptable in terms of public health concerns and environmental impacts.

Alternative 2 - Slurry Walls Slurry walls would minimize surface water and ground water infiltration into the VOC contaminated soils and reduce the chance of contaminant migration.

Alternative 3 - Excavation and On-Site Disposal Under this alternative, the contaminated soil would be excavated and moved to an on-site, lined disposal area or landfill.

Alternative 4 - Excavation and Off-Site Disposal The remedial actions under this alternative would include excavation of the contaminated soil and transportation to an off-site landfill for final disposal. Based on the results of TCLP testing, it would be determined whether disposal would be in a sanitary landfill or in a hazardous waste landfill.

Alternative 5 - Vapor Extraction and Ground Water Extraction A vapor extraction system would be installed in conjunction with a ground water extraction system. Prior to the initiation of vapor extraction, the ground water table would be lowered to increase the depth of unsaturated soils and effectiveness of the vapor extraction system. The extracted ground water would be discharged to the sanitary sewer or surface water.

Alternative 6 - In-Situ Bioremediation Under this alternative, organisms necessary for the success of bioremediation must be present in or introduced to the contaminated soils. Nutrients and oxygen would be delivered to the subsurface soils to enhance the biodegradation process through injection wells and an infiltration system. This would enhance biodegradation of the VOCs in both the vadose zone soils and saturated soils.

Alternative 7 - In-Situ Soil Washing This alternative is similar to bioremediation, but an aqueous solution of surfactant would be injected and allowed to infiltrate into the contaminated soils instead of nutrients, oxygen and possibly the aerobic micro organisms. Recovery wells would be necessary to capture the contaminated ground water, and a treatment facility would be constructed to separate the VOC/surfactant mixture from the extracted water.

Alternative 8 - Excavation, Soil Aeration and Backfill Under this alternative, the VOC contaminated soils would be excavated and spread out on the concrete pad foundations in the northern area of the plant. Berms would be constructed to reduce the possibility of contaminant transport via surface water run off. At the completion of aeration activities, the cleaned material would be backfilled in the resulting excavation.

Alternative 9 - Excavation, Low Temperature Incineration and Backfill The contaminated soil would be excavated and incinerated to destroy the VOC contaminants. The material would be returned to the excavation following thermal treatment.

# 3.0 PHASE II: SCREENING OF REMEDIAL ACTION ALTERNATIVES

In this section, remedial action alternatives developed in Section 2 are screened on the basis of effectiveness and implementability. The objective is to select alternatives to be analyzed in detail in Section 4.

The NYSDEC Technical and Administrative Guidance Memorandum (TAGM), dated September 13, 1989, on the selection of remedial actions at inactive hazardous waste sites is used as a guidance in the alternative screening process. The two tables contained in the TAGM are utilized to preliminarily screen the alternatives, rating both their short term and long term effectiveness and their implementability. These tables are contained in Appendix B. Table 3-1 summarizes the results of the screening process.

## 3.1 COMPARISON OF EFFECTIVENESS OF ALTERNATIVES

The effectiveness of each alternative was evaluated as to the extent to which it would eliminate significant threats to public health and the environment through reductions in the volume, toxicity and mobility of the VOCs. Vapor extraction in conjunction with ground water depression was determined to be the most effective alternative, while the no action alternative was determined to be the least. Vapor extraction would remove the VOC contamination present in the soils without disturbing or altering the surface and subsurface soils. In order for the in-situ alternatives of bioremediation and soil washing to be effective, the concrete pad covering the majority of the area would have to be removed. This would allow for the treatment of contaminated vadose zone soils which would not be effectively treated by injecting the aqueous solutions through wells into the ground water and saturated soils.

Removal of the concrete pad, though, would allow VOCs currently trapped in the soils beneath the pad to volatilize, which could cause potential air problems. Excavation of these soils would further increase volatilization and greatly increase the potential for air related problems. In general, alternatives requiring excavation were rated lower than the in-situ alternatives in terms of effectiveness, and the in-situ alternatives requiring pad

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# TABLE 3-1
# COLUMBIA MILLS
# PRELIMINARY SCREENING RESULTS
# REMEDIATION OF TEST PIT 3 AREA SOILS
# VOLATILE ORGANICS

| Remedial Alternative | Effectiveness (Maximum = 25) | Implementability (Maximum = 15) | Total |
|---|---|---|---|
| No Action | 4 | 13 | 17 |
| Vertical Barrier-Slurry Wall | 12 | 9 | 21 |
| Excavation/On Site Disposal | 13 | 8 | 21 |
| Excavation/Off Site Disposal | 17 | 9 | 26 |
| Vapor Extraction/Ground Water Extraction | 22 | 12 | 34* |
| Bioremediation (In-Situ) | 19 | 10 | 29* |
| Soil Washing (In-Situ) | 18 | 10 | 28* |
| Excavation/Spread Out (Aerate) | 16 | 9 | 25 |
| Excavate/Low Temperature Incineration | 15 | 10 | 25 |

* Indicates remedial alternative carried through to detailed evaluation.

removal rated lower than vapor extraction, which would not greatly disturb the pad's integrity.

All alternatives would require less than two years to implement, except for excavation and soil aeration. Based on experience gained during the aeration of VOC contaminated soils excavated from underground storage tank (UST) areas under the IRM program, it was determined that a time frame of three to four years would be required for the aeration of all contaminated soil from the Test Pit 3 area. Although modeling conducted as a part of the vapor extraction pilot scale study indicated that vapor extraction would require approximately four years to remediate contaminated soils in the area, this was a worst case estimate. The actual clean up time frame is expected to be less. Refer to Vapex's report for pilot scale and modeling results.

Most treatment alternatives were determined to be permanent, removing the majority of contamination from the soils and requiring few controls and little long term operation and maintenance. The alternatives of no action, slurry wall construction and excavation/on-site disposal would leave the contamination at the site and require more extensive controls and operation and maintenance. Though off-site disposal was not considered a permanent remedy, it would remove the majority of contaminated soils from the site.

## 3.2 COMPARISON OF IMPLEMENTABILITY OF ALTERNATIVES

The implementability of each alternative was evaluated by examining the technical and administrative feasibility of each alternative as well as the availability of services and materials needed to conduct the remedial action. The no action alternative, obviously, was determined to be the most implementable since it is not difficult to construct and minimal coordination is required. Vapor extraction/ground water extraction was determined to be the second most implementable while excavation/on-site disposal was determined to be least.

Vapor extraction/ground water extraction was determined to be the most implementable action alternative since the ability to construct the system was rated high, no future remedial actions would be anticipated and services and materials needed for the construction and operation are available. The other in-situ processes were rated lower because of the degree of uncertainty and difficulty in construction associated with them. In general, the alternatives involving excavation were rated lower than the in-situ methods because of the difficulty involved in removing the concrete pad and excavating the VOC contaminated soils while controlling VOC emissions.

## 3.3 RESULTS OF SCREENING PROCESS

As a result of the screening process, three remedial alternatives were selected to be evaluated in more detail: vapor extraction/ground water extraction, in-situ bioremediation and in-situ soil washing. These alternatives were ranked the highest with total "scores" of 34, 29 and 28, respectively.

The no action alternative was eliminated because of the possible risk posed by migrating soil gas and the leaching of contaminants into the ground water. The alternatives involving soil excavation were eliminated due to the great risk posed by resulting uncontrolled VOC emissions to both workers on site and residents in close proximity off site.

The construction of slurry walls was eliminated due to the inability to key them into a competent confining layer. There is no continuous low permeability geologic unit across the site, which indicates the unconsolidated material and the bedrock are in direct hydraulic communication. The slurry walls would have to be keyed into the bedrock, which is fractured. The fractures in the bedrock would act as pathways for contaminant migration. Thus containment would not be a feasible alternative.

The in-situ methods will be carried through to a detailed evaluation based on their ability to treat the soils in place while minimizing the release of VOCs into the air. While removal of the concrete pad for bioremediation and soil washing may allow some volatiles to escape from the soils, it is not expected that as significant a risk would be posed as with excavation.

# 4.0 PHASE III: DETAILED ANALYSIS OF ALTERNATIVES

In this section, each of the alternatives retained by the screening process in Section 3 is analyzed with respect to the criteria presented in the NYSDEC TAGM on the selection of remedial actions at inactive hazardous waste sites. Each alternative is analyzed with respect to short term effectiveness, long term effectiveness, reduction of toxicity, mobility and volume, implementability, compliance with SCGs, protection of human health and the environment and cost. The tables contained in the TAGM are utilized in the detailed analysis of the alternatives. These tables are contained in Appendix C, and Table 4-1 summarizes the results.

Following the individual analyses, the alternatives for the remediation of Test Pit 3 Area VOC contaminated soils are compared and contrasted, and a preferred alternative is recommended.

## 4.1 INDIVIDUAL ANALYSIS OF ALTERNATIVES

### 4.1.1 Vapor Extraction/Ground Water Depression

Vapor extraction is classified as a permanent remedial alternative. In conjunction with ground water extraction, it would effectively alleviate VOC contamination in the Test Pit 3 Area soils while posing little to no short term risks to the community and environment. Treatment of the extracted soil gas would be conducted prior to its discharge to the atmosphere. Although this could concentrate the VOCs in the treatment medium (i.e. carbon) disposal of the medium would most likely consist of off-site destruction or treatment. The extracted ground water would probably be discharged to an existing sanitary sewer which is tributary to the Minetto Wastewater Treatment Plant. Pretreatment of the water prior to its discharge to the sewer would be done initially. If pretreatment is then determined not to be necessary through monitoring and sampling, treatment might then be cut back or the unit bypassed altogether.

This alternative would meet the action-specific SCGs determined to be applicable for air and water discharge. Action limits, as defined in the NYSDEC's Air Cleanup Criteria document (January 8, 1990) are examples of air related SCGs. The extracted ground water would more than likely be discharged to the sanitary sewer in accordance with conditions set forth by the NYSDEC.

MALCOLM PIRNIE

# TABLE 4-1
## COLUMBIA MILLS
## DETAILED ANALYSIS RESULTS
## REMEDIATION OF TEST PIT 3 AREA SOILS
## VOLATILE ORGANICS

| Alternative | Short Term Effectiveness (10) | Long Term Effectiveness (15) | Reduction of Mobility, Toxicity and Volume (15) | Implementability (15) | Compliance With ARARs (10) | Protection of Human Health and Environment (20) | Cost (15) | Total (100) |
|---|---|---|---|---|---|---|---|---|
| Vapor Extraction/ Ground Water Extraction | 9 | 13 | 15 | 12 | 10 | 20 | 15 | 94 |
| Bioremediation (In-Situ) | 6 | 13 | 15 | 10 | 10 | 20 | 8 | 82 |
| Soil Washing (In-Situ) | 6 | 13 | 15 | 10 | 10 | 20 | 8 | 82 |

Because the contamination would be removed from the site, a minimal amount of long term monitoring and operation and maintenance would be required.

The pilot scale study conducted by Vapex indicated that vapor extraction would be an effective alternative for the treatment of Test Pit 3 Area VOC soils. This technology has initially been proven effective. Thus, the components of the alternative are well demonstrated and all materials would be readily available.

Assuming an approximate vapor extraction unit cost of \$15 per $yd^3$ of soil treated and an amount of soil requiring treatment equal to 12,700 $yd^3$, the project cost was estimated as \$190,500. This does not include ground water extraction, which would be conducted concurrently with vapor extraction. To account for this, the project cost was doubled and the total project cost was estimated to be \$381,000. The unit cost value of \$15 per $yd^3$ used above represents the mid-range value in the estimated cost range of \$5 to \$25 per $yd^3$ (Geraghty & Miller, Inc., correspondence to Wildlife Management, Washington, D.C., December 3, 1990).

**4.1.2 In-Situ Bioremediation**

Bioremediation is classified as a permanent remedial alternative. Although it appears that the application of this alternative to the VOC contaminated soils would be effective, short term risks could be posed to the nearby community. In order to treat the vadose zone soils, the concrete pad currently covering the majority of the area would require removal. Removal of the pad could cause uncontrolled VOC emissions which would pose a threat to neighboring residents. Removal of the pad would have to be done in a manner in which VOC emissions could be controlled and minimized.

This alternative would, more than likely, meet the SCGs applicable to the technology. A water recirculating system would be utilized to capture the contaminated ground water and injected aqueous solution downgradient from the contaminated area, treat it and deliver it back to the soil and ground water. Contaminant levels in the treated water being pumped back into the ground water would have to be brought down to the applicable NYSDEC effluent limitations for discharge to Class GA waters.

A minimal amount of long term monitoring and operation and maintenance would be required since the contamination at the site would be destroyed.

As mentioned previously, this alternative would be difficult to implement since the concrete pad foundation would have to be removed, and it is uncertain whether or not bioremediation would actually be applicable to the Test Pit 3 area soils. Several factors have negative impacts on the success of bioremediation, including the presence of elevated levels of metals. Although metal levels in the Test Pit 3 area soils appear to be "normal", bench scale and pilot testing would have to be conducted in order to ensure the applicability of the technology.

Assuming an approximate bioremediation cost of \$63 per $yd^3$ of soil treated and an amount of soil requiring treatment equal to 12,700 $yd^3$, the overall project cost was estimated at \$800,100. The unit cost of \$63 represents the middle value in the range of \$25 to \$100 per $yd^3$ (Geraghty & Miller, Inc.). Included in the project cost would be the expense of removing, transporting and disposing of the concrete pad. In the VOC contaminated soil area, the pad covers an area of approximately 15,000 $ft^2$. Since the concrete is 0.5 feet thick, approximately 280 $yd^3$ of concrete would have to be removed and disposed of.

### 4.1.3 In-Situ Soil Washing

As with vapor extraction and bioremediation, soil washing is classified as a permanent remedial alternative. The process is similar to bioremediation in that it is applied to unexcavated soils using a ground water extraction/reinjection system. The difference, of course, is that an aqueous solution of surfactant is injected into the soils instead of nutrients for microorganisms. As with bioremediation, the concrete pad covering the majority of the Test Pit 3 Area must be removed in order to effectively treat the contaminated vadose zone soils. This could pose a threat to those living in close proximity to the site.

Action-specific SCGs should be met with this alternative. As with bioremediation, any recirculated water pumped back into the ground water would have to meet NYSDEC standards for discharge to GA waters.

A minimal amount of long term monitoring and operation and maintenance would be required since the contamination at the site would be removed.

This alternative would be difficult to implement since the concrete pad would have to be removed and VOC emissions would have to be controlled. Also, a bench scale or pilot scale study would have to be conducted in order to verify that soil washing would be an effective remedial action in this area of the site.

In-situ soil washing would generally involve the same costs as bioremediation. Based on this assumption, a total project cost was estimated at \$800,100.

## 4.2 COMPARATIVE ANALYSIS OF ALTERNATIVES

In this section, remedial alternatives for the Test Pit 3 Area VOC contaminated soils are compared to each other on a criterion-by-criterion basis to identify the relative advantages and disadvantages of each.

Of the three treatment alternatives, vapor extraction/ground water extraction would present the fewest short term adverse effects, as the pad covering the area would not be removed. The other two alternatives would present equivalent short term adverse effects. These include possible VOC emission problems and generation of airborne dust and particulates.

All three alternatives would be equally effective in the long term. The three remedies are classified as permanent, and a minimal amount of operation and maintenance and long term monitoring would be required for each. All alternatives provide for equal reduction in the volume and toxicity of the VOC contamination in the soils.

A difference exists between vapor extraction/ground water extraction and the other two alternatives with respect to implementability. Vapor extraction/ground water extraction is the most easily implemented alternative, involving little to no surface and subsurface alteration. Also, the vapor extraction process has been shown to be effective on the Test Pit 3 Area soils. Employing in-situ bioremediation or soil washing would require a pilot study prior to full scale design.

All alternatives provide adequate protection of human health and the environment. No chemical-specific SCGs exist for the VOC soils in the Test Pit 3 Area remedial unit. The three treatment alternatives are expected to readily meet all action-specific SCGs, which include NYSDEC air action limits and effluent limits for discharges to Class GA ground waters.

Of the three alternatives, vapor extraction/ground water extraction is the least expensive, at an estimated cost of $381,000. The other two alternatives were estimated to cost over twice as much.

## 4.3 SELECTION OF RECOMMENDED ALTERNATIVE

MPI recommends that the vapor extraction/ground water extraction alternative be implemented to remediate the VOC contaminated soils in the Test Pit 3 area remedial unit.

This alternative should meet the remedial action objective of reducing total target VOC soil concentrations to approximately 1 ppm. This alternative is more effective in the short term and easier to implement. It is also more cost effective.

Following MPI's selection of vapor extraction/ground water extraction as the most feasible alternative, a more detailed cost analysis was performed (see Table 4-2). Total capital costs were estimated at $176,220. Capital costs include costs associated with well, piezometer and system installation as well as the initial purchase of activated carbon for ground water and vapor treatment. Operation and maintenance costs were estimated at $162,205 for the first year and $150,200 for the second year. The net present worth of this alternative, at a 10% interest rate, assuming two years of operation was determined to be $474,975.

MALCOLM PIRNIE

TABLE 4-2

VAPOR EXTRACTION/GROUND WATER EXTRACTION
PRESENT WORTH COST ANALYSIS

CAPITAL COSTS

| | |
|---|---|
| Well, piezometer installation | $34,285. |
| Outside piping, pumps/installation | $11,205. |
| Building construction/system installation | $66,540. |
| Initial carbon supply | $27,273. |
| Subtotal | $139,303 |
| Contingency (10%) | $13,930. |
| Subtotal | $153,233. |
| Engineering (15%) | $22,985. |
| Total Cost | $176,220. |

OPERATION AND MAINTENANCE COSTS

| Unit | Annual Cost |
|---|---|
| Filter bags - ground water filtration system | $7,280. |
| Electricity | $12,000. |
| Carbon - supply/disposal | year 1 - $69,125. |
| | year 2 - $57,120. |
| Labor | $25,000. |
| Sampling/Screening | $48,800. |

TOTAL PRESENT WORTH

| Years | Capital | O&M | Total | Present Worth |
|---|---|---|---|---|
| 0 | $176,220. | $162,205. | $338,425. | $338.425. |
| 1 | | $150,200. | $150,200. | $136,550. |

TOTAL PRESENT WORTH $474,975.

# REFERENCES

Ecology and Environment, Inc. Feasibility Study - Madison Wire Site - West Seneca, New York, Lancaster, New York, April 1990.

Mann, Michael J., P.E., Geraghty & Miller, Inc. (Tampa, Florida) correspondence to Bob Byrne, Wildlife Management (Washington, D.C.), December 3, 1990.

Newton, Jim, P.E., "Remediation of Petroleum Contaminated Soils" Pollution Engineering, December 1990, Volume 22, No. 13, pp 46-52.

New York State Department of Environmental Conservation, "Division Technical and Administrative Guidance Memorandum on Selection of Remedial Actions at Inactive Hazardous Waste Sites", September 13, 1989.

United States Environmental Protection Agency, Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA, EPA/540/6-89/004, Washington, D.C., October 1988.

United States Environmental Protection Agency, Technology Screening Guide for Treatment of CERCLA Soils and Sludges, EPA/540/2-88/004, Washington, D.C., September 1988.

# APPENDICES

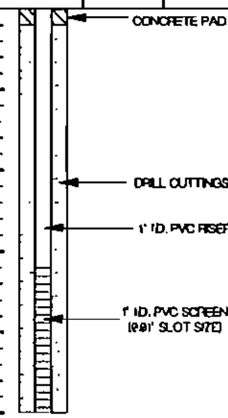
# *APPENDIX A*
## *Summary of Results*
## *Test Pit 3 Area Sampling*

Summary Logs
Test Pit 3 Area Soil Borings

# MONITORING WELL AND BOREHOLE SUMMARY SHEET

| DEPTH (FEET) | ELEVATION (MSL) | SAMPLES | SAMPLE # | BLOWS | SOIL OR ROCK DESCRIPTION | UNIFIED SOIL CLASS. | HYDRAULIC CONDUCTIVITY (CM/SEC) | HNU (PPM) |
|---|---|---|---|---|---|---|---|---|
| 0–2 | | | BP-1 S-1 | 3, 3, 1, 1 | 0.0'-0.5' -> CONCRETE PAD; 0.5'-2.5' -> MULTI COLORED FINE SAND AND SILT, LITTLE GRAVEL (FILL), MOIST | | | 0.6 |
| 2–4 | | | BP-1 S-2 | 3, 3, 4, 4 | 2.5'-8.5' -> MODERATE BROWN FINE SAND, SOME SILT, TRACE GRAVEL, MOIST TO WET ODORS FROM 4.5'-8.5' | | | 2.4 |
| 4–6 | | | BP-1 S-3 | 5, 6, 6, 12 | | | | 34 |
| 6–8 | | | BP-1 S-4 | 8, 12, 18, 12 | ? | | | |
| 8–10 | | | BP-1 S-5 | 2, 1, 1, 1 | 8.5'-10.5' -> OLIVE GRAY FINE SAND AND GRAVEL, SOME SILT, SATURATED, ODORS | | | 126 |
| 10–12 | | | BP-1 S-6 | 5, 15, 22, 31 | 10.5'-12.5' -> GRAYISH BROWN FINE SAND, SILT AND GRAVEL, COMPACT, SATURATED, ODORS | | | 78 |
| | | | | | BOB @ 12.5' BLS | | | BKGND HNU-0.2 |

MONITORING WELL CONSTRUCTION DETAILS: BP-1




NOTES

0.0'-0.5' -> CONCRETE PAD
0.5'-2.5' -> FILL
2.5'-8.5' -> MODERATE BROWN FINE SAND, SOME SILT, TRACE GRAVEL
6.5' 8.5' -> NO RECOVERY
8.5'-10.5' -> OLIVE GRAY FINE SAND AND GRAVEL, SOME SILT
10.5' 12.5' -> GRAYISH BROWN FINE SAND, SILT AND GRAVEL

Surface Elevation 309.82
Date Installed 9/7/89
Driller NORTH STAR DRILLING CO.
Method HOLLOW-STEM AUGERS
Classified By KEITH A. WHITE
MPI Inspector KEITH A. WHITE

NOTE: DATA ON THIS SUMMARY SHEET COMPOSITED FROM DRILLER'S LOGS, MPI-COLLECTED DATA AND FIELD OBSERVATIONS

PROJECT: B S & K COLUMBIA MILLS MINETTO, NY

MALCOLM PIRNIE

LOCATION NO. BP-1
SHEET 1 OF 1

# MONITORING WELL AND BOREHOLE SUMMARY SHEET

| DEPTH (FEET) | ELEVATION (MSL) | SAMPLES | SAMPLE # | BLOWS | SOIL OR ROCK DESCRIPTION | UNIFIED SOIL CLASS. | MONITORING WELL CONSTRUCTION DETAILS BP-2 | HYDRAULIC CONDUCTIVITY (CM/SEC) | HNU (PPM) | NOTES |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | 0.0'-1.0' -> CONCRETE PAD | | CONCRETE PAD | | | |
| | | | BP-2 S-1 | 8, 11, 10, 8 | 1.0'-3.0' -> MODERATE BROWN SAND AND SILT, SOME GRAVEL, GLASS FRAGMENTS (FILL) MOIST | | | | 3.8 | |
| | | | BP-2 S-2 | 2, 5, 4, 3 | 3.0'-5.0' -> MODERATE BROWNISH GRAY SAND AND SILT, SOME CLAY, LITTLE GRAVEL, MOIST TO WET | | | | 24 | |
| 5 | | | BP-2 S-3 | 5, 7, 3, 5 | -?- | | DRILL CUTTINGS | | | 5 |
| | | | BP-2 S-4 | 3, 3, 2, 1 | ~7.0'-13.0' -> OLIVE GRAY FINE SAND AND SILT, SOME SUBANGULAR GRAVEL, WET TO SATURATED | | 1" I.D. PVC RISER | | 150 | |
| 10 | | | BP-2 S-5 | 3, 8, 10, 9 | | | 1" I.D. PVC SCREEN (0.01" SLOT SIZE) | | 30 | 10 |
| | | | BP-2 S-6 | 7, 10, 7, 8 | | | | | 18 | 12.7-12.9' -> MODERATE REDDISH BROWN FINE TO MEDIUM SAND LENS |
| | | | | | BOB @ 13.0 BLS | | | | BKGND HNU-0.2 | |
| 15 | | | | | | | | | | 15 |
| 20 | | | | | | | | | | 20 |
| | | | | | | | | | | 0.0-1.0' -> CONCRETE PAD<br>1.0'-3.0' -> FILL<br>3.0'-5.0' -> MODERATE BROWNISH GRAY SAND AND SILT, SOME CLAY AND GRAVEL<br>5.0'-7.0' -> NO RECOVERY<br>~7.0'-13.0' -> OLIVE GRAY FINE SAND AND SILT, SOME GRAVEL |
| 25 | | | | | | | | | | 25 |

Surface Elevation 311.20 Classified By KEITH A. WHITE

Date Installed 9/6/89 MPI Inspector KEITH A. WHITE

Driller NORTH STAR DRILLING CO.

Method HOLLOW-STEM AUGERS

NOTE: DATA ON THIS SUMMARY SHEET COMPOSITED FROM DRILLER'S LOGS, MPI-COLLECTED DATA AND FIELD OBSERVATIONS

PROJECT: B S & K COLUMBIA MILLS MINETTO, NY

MALCOLM PIRNIE

LOCATION NO. BP - 2

SHEET 1 OF 1

# MONITORING WELL AND BOREHOLE SUMMARY SHEET

| DEPTH (FEET) | ELEVATION (M.S.L.) | SAMPLES | SAMPLE # | BLOWS | SOIL OR ROCK DESCRIPTION | UNIFIED SOIL CLASS. | MONITORING WELL CONSTRUCTION DETAILS BP-3 | HYDRAULIC CONDUCTIVITY (CM/SEC) | HNU (PPM) | NOTES |
|---|---|---|---|---|---|---|---|---|---|---|
| 0.0–1.0 | | | | | 0.0'-1.0' -> CONCRETE PAD | | CONCRETE PAD | | | |
| 1.0–1.5 | | | BP-3 S-1 | 3, 2, 5, 2 | 1.0'-1.5' -> MODERATE BROWN FINE TO MEDIUM SAND, SOME SILT AND GRAVEL (FILL), DRY | | | | 32 | |
| 1.5–12.7 | | | BP-3 S-2 | | 1.5'-12.7' -> OLIVE GRAY FINE SAND AND SILT, SOME CLAY, LITTLE GRAVEL, MOIST TO SATURATED | | DRILL CUTTINGS; 1" I.D. PVC RISER | | 100 | |
| | | | BP-3 S-3 | 1, WOH, 1 | | | | | | |
| | | | BP-3 S-4a | 5, 7, 11, 9 | | | 1" I.D. PVC SCREEN (0.01" SLOT SIZE) | | 84 | |
| | | | BP-3 S-4b | 2, 1, 1, 2 | | | | | | |
| | | | BP-3 S-5 | 1, 4, 2, 1 | | | | | 38 | 10.5'-11.0' -> LAYER OF CLAYEY SILT |
| 12.7–12.9 | | | | | 12.7'-12.9' -> MODERATE REDDISH BROWN FINE TO MEDIUM SAND | | | | BKGND HNU=0.0 | |
| 12.9–13.0 | | | | | 12.9'-13.0' -> OLIVE GRAY FINE SAND AND SILT, WET | | | | | |
| | | | | | B.O.B. @ 13.0' BLS | | | | | |

NOTES:
0.0'-1.0' -> CONCRETE PAD
1.0'-1.5' -> MISCELLANEOUS FILL
5.0'-7.0' -> NO RECOVERY
1.5'-12.7' -> OLIVE GRAY FINE SAND AND SILT, SOME CLAY AND GRAVEL
12.7'-12.9' -> MODERTAE REDDISH BROWN FINE TO MEDIUM SAND
12.9'-13.0' -> OLIVE GRAY FINE SAND AND SILT

Surface Elevation 309.88
Date Installed 9/7/89
Driller NORTH STAR DRILLING CO.
Method HOLLOW-STEM AUGERS
Classified By KEITH A WHITE
MPI Inspector KEITH A. WHITE

NOTE: DATA ON THIS SUMMARY SHEET COMPOSITED FROM DRILLER'S LOGS, MPI-COLLECTED DATA AND FIELD OBSERVATIONS

PROJECT: B S & K COLUMBIA MILLS MINETTO, NY

MALCOLM PIRNIE

LOCATION NO. BP - 3
SHEET 1 OF 1

# MONITORING WELL AND BOREHOLE SUMMARY SHEET

| SAMPLE # | BLOWS |
| --- | --- |
| BP-4 S-1 | 8, 10, 9, 9 |
| BP-4 S-2 | 4, 5, 7, 9 |
| BP-4 S-3 | 3, 2, 2, 6 |
| BP-4 S-4 | 3, 8, 16, 20 |
| BP-4 S-5 | 25, 14, 10, 8 |
| BP-4 S-6 | 5, 8, 14, 10 |

**SOIL OR ROCK DESCRIPTION**

0.0'-1.0' -> CONCRETE PAD

1.0'-3.0' -> MULTI-COLORED FINE TO MEDIUM SAND, SOME GRAVEL, LITTLE SILT (FILL), DRY TO MOIST

3.0'-5.0+' -> MODERATE BROWN FINE SAND AND SILT, SOME GRAVEL, MOIST TO WET

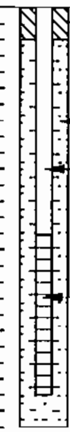
?

7.0'-13.0' -> OLIVE GRAY AND BLACK FINE SAND AND SILT, LITTLE GRAVEL, SATURATED, ODORS

B.O.B. @ 13.0' BLS

**MONITORING WELL CONSTRUCTION DETAILS**

BP-4



- CONCRETE PAD
- DRILL CUTTINGS
- 1" I.D. PVC RISER
- 1" I.D. PVC SCREEN (0.01" SLOT SIZE)

| HNU (PPM) |
| --- |
| 9.4 |
| 24 |
| |
| 8 |
| 16 |
| 100 |
| BKGND HNU-0.0 |

**NOTES**

0.0'-1.0'-> CONCRETE PAD
1.0'-3.0'-> MISCELLANEOUS FILL
3.0'-5.0+'-> MODERATE BROWN FINE SAND AND SILT, SOME GRAVEL
5.0'-7.0'-> NO RECOVERY
~7.0'-13.0'-> OLIVE GRAY FINE SAND AND SILT, LITTLE GRAVEL

Surface Elevation 311.30 Classified By KEITH A. WHITE
Date Installed 9/7/89 MPI Inspector KEITH A. WHITE
Driller NORTH STAR DRILLING CO.
Method HOLLOW-STEM AUGERS

NOTE: DATA ON THIS SUMMARY SHEET COMPOSITED FROM DRILLER'S LOGS, MPI-COLLECTED DATA AND FIELD OBSERVATIONS

PROJECT: B S & K COLUMBIA MILLS MINETTO, NY

MALCOLM PIRNIE

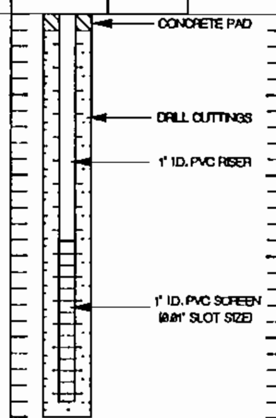
LOCATION NO. BP - 4
SHEET 1 OF 1

# MONITORING WELL AND BOREHOLE SUMMARY SHEET

| SAMPLE # | BLOWS |
|---|---|
| BP-5 S-1 | 12, 12, 23 |
| BP-5 S-2 | 20, 6, 7, 7 |
| BP-5 S-3 | 1, 1, 2, 2 |
| BP-5 S-4 | 1, 2, 1, 10 |
| BP-5 S-5 | 2, 4, 1, 2 |
| BP-5 S-6 | 1, 2, 1, 10 |

| DEPTH | SOIL OR ROCK DESCRIPTION |
|---|---|
| 0.5' | 0.0'-0.5' -> CONCRETE PAD |
| | 0.5'-4.5' -> MODERATE BROWN FINE TO COARSE SAND AND ANGULAR GRAVEL. ODORS FROM 3.5'-4.0' |
| 4.5' | 4.5'-6.5' -> MODERATE BROWN TO GRAYISH GREEN FINE TO COARSE SAND AND GRAVEL, MOIST AT 5.5' |
| 6.5' | 6.5'-8.5' -> MODERATE GRAYISH GREEN SILT, SOME FINE SAND, ODORS, WET AT 7.5' |
| 8.5' | 8.5'-10.0' -> MODERATE BROWN FINE TO MEDIUM SAND, SOME SILT |
| 10.0' | 10.0'-10.5' -> MODERATE GRAY SILT, SOME SAND, SOME CLAY |
| 10.5' | 10.5'-12.5' -> MODERATE BROWN SILT, SOME SAND, SOME GRAY STAINING, ODORS, WET |
| | B.O.B. @ 12.5' BLS |

MONITORING WELL CONSTRUCTION DETAILS: BP-5




| HNU (PPM) |
|---|
| 0.2 |
| 78 |
| 176 |
| 132 |
| 84 |
| 68 |
| BKGND HNU-0.2 |

NOTES

0.0'-0.5' -> CONCRETE PAD
0.5'-4.5' -> MODERATE BROWN SAND AND GRAVEL
4.5'-6.5' -> MODERATE BROWN AND GRAYISH GREEN SAND AND GRAVEL
6.5'-8.5' -> MODERATE GRAYISH GREEN SILT
8.5'-10.0' -> MODERATE BROWN SAND
10.0'-10.5' -> MODERATE GRAY SILT
10.5'-12.5' -> MODERATE BROWN SILT

Surface Elevation 311.21 Classified By MARK D. WILDER
Date Installed 9/6/89 MPI Inspector MARK D. WILDER
Driller NORTH STAR DRILLING CO.
Method HOLLOW-STEM AUGERS

NOTE: DATA ON THIS SUMMARY SHEET COMPOSITED FROM DRILLER'S LOGS, MPI-COLLECTED DATA AND FIELD OBSERVATIONS

PROJECT: B S & K COLUMBIA MILLS MINETTO, NY

MALCOLM PIRNIE

LOCATION NO. BP-5
SHEET 1 OF 1

# MONITORING WELL AND BOREHOLE SUMMARY SHEET

| DEPTH (FEET) | ELEVATION (MSL) | SAMPLE # | BLOWS | SOIL OR ROCK DESCRIPTION | UNIFIED SOIL CLASS. | MONITORING WELL CONSTRUCTION DETAILS (BP-6) | HYDRAULIC CONDUCTIVITY (CM/SEC) | HNU (PPM) |
|---|---|---|---|---|---|---|---|---|
| 1.0' | | | | 0.0'-1.0' -> CONCRETE PAD | | CONCRETE PAD | | |
| | | BP-6 S-1 | 6, 8 | 1.0'-5.0' -> MODERATE BROWN FINE SAND, SOME SILT AND GRAVEL, MOIST | | DRILL CUTTINGS | | 1.2 |
| | | BP-6 S-2 | 4, 2, 3, 2 | | | 1" I.D. PVC RISER | | 0.1 |
| 5.0' | | BP-6 S-3 | 2, 1, 1, 2 | 5.0'-11.0' -> MODERATE BROWN, OLIVE GRAY AND BLACK FINE TO MEDIUM SAND LITTLE GRAVEL, WET TO SATURATED<br>ODORS AT 6.0' | | | | 0.6 |
| | | BP-6 S-4 | 1, 1, 1, 9 | | | | | 2.2 |
| | | BP-6 S-5 | 7, 3, 2, 14 | | | 1" I.D. PVC SCREEN (0.01" SLOT SIZE) | | 8.2 |
| 11.0' | | BP-6 S-6 | 12, 18, 38, 18 | 11.0'-13.0' -> MODERATE RED-BROWN AND GRAY FINE SAND, SILT AND GRAVEL, SATURATED, STRONG ODORS<br>B.O.B. @ 13.0' BLS | | | | 5.2 |
| | | | | | | | | BKGND HNU=0.0 |

NOTES

0.0'-1.0' -> CONCRETE PAD
1.0'-5.0' -> FINE SAND, SOME SILT AND GRAVEL
5.0'-11.0' -> FINE TO MEDIUM SAND AND SILT, LITTLE GRAVEL
11.0'-13.0' -> FINE SAND, SILT AND GRAVEL

Surface Elevation 311.26 Classified By KEITH A. WHITE
Date Installed 9/7/89 MPI Inspector KEITH A. WHITE
Driller NORTH STAR DRILLING CO.
Method HOLLOW-STEM AUGERS

NOTE: DATA ON THIS SUMMARY SHEET COMPOSITED FROM DRILLER'S LOGS, MPI-COLLECTED DATA AND FIELD OBSERVATIONS

PROJECT: B S & K COLUMBIA MILLS MINETTO, NY

MALCOLM PIRNIE

LOCATION NO. BP - 6
SHEET 1 OF 1

# MONITORING WELL AND BOREHOLE SUMMARY SHEET

| SAMPLE # | BLOWS | SOIL OR ROCK DESCRIPTION | HNU (PPM) |
|---|---|---|---|
| | | 0.0'-1.0' -> CONCRETE PAD | |
| BP-7 S-1 | 4, 10, 22, 14 | 1.0'-4.5' -> MODERATE BROWN FINE TO COARSE SAND AND GRAVEL (FILL), DRY | 0.2 |
| BP-7 S-2 | 5, 6, 6, 6 | 4.5'-5.0' -> MODERATE REDDISH BROWN FINE SILT, MOIST | 0.4 |
| BP-7 S-3 | 6, 5, 4, 27 | 5.0'-6.0' -> MODERATE TO DARK BROWN FINE SAND AND GRAVEL, TRACE SILT AND CLAY; 6.0'-7.0' -> LIGHT BROWN SAND, SOME SILT | 0.1 |
| BP-7 S-4 | 15, 22 | 7.0'-7.5' -> MODERATE BROWN SAND AND SILT, SOME GRAVEL, DRY TO MOIST; 7.5'-8.0' -> MODERATE RED BROWN SAND, SILT AND RED SANDSTONE ROCK FRAGMENTS, DRY | 0.2 |
| | | B.O.B. @ 8.0' BLS | BKGND HNU=0.0 |

**NOTES**

WET ZONE FROM 6.5'-7.0' BLS

AUGER REFUSAL @ 8.0'
NO PIEZOMETER INSTALLED

0.0'-1.0' -> CONCRETE PAD
1.0'-4.5' -> MODERATE BROWN FINE TO COARSE SAND AND GRAVEL
4.5'-5.0' -> MODERATE REDDISH BROWN SILT
5.0'-6.0' -> MODERATE TO DARK BROWN FINE SAND AND GRAVEL, TRACE SILT AND CLAY
6.0'-7.0' -> LIGHT BROWN SAND, SOME SILT
7.0'-7.5' -> MODERATE BROWN SAND AND SILT, SOME GRAVEL
7.5'-8.0' -> MODERATE REDDISH BROWN SAND, SILT, AND SANDSTONE FRAGMENTS

Surface Elevation ______
Date Installed 9/6/89
Driller NORTH STAR DRILLING CO.
Method HOLLOW-STEM AUGERS
Classified By MARK D. WILDER
MPI Inspector MARK D. WILDER

NOTE: DATA ON THIS SUMMARY SHEET COMPOSITED FROM DRILLER'S LOGS, MPI-COLLECTED DATA AND FIELD OBSERVATIONS

PROJECT. B S & K COLUMBIA MILLS MINETTO, NY

MALCOLM PIRNIE

LOCATION NO. BP-7
SHEET 1 OF 1

# MONITORING WELL AND BOREHOLE SUMMARY SHEET

| Sample # | Blows |
|---|---|
| BP-8 S-1 | 6, 8, 6, 4 |
| BP-8 S-2 | 5, 15, 6, 8 |
| BP-8 S-3 | 6, 3, 1, 2 |
| BP-8 S-4 | 5, 4, 5, 8 |
| BP-8 S-5 | 6, 12, 12, 14 |
| BP-8 S-6 | 10, 10, 12, 10 |

**SOIL OR ROCK DESCRIPTION**

0.0'-4.5' -> MODERATE BROWN MEDIUM TO COARSE SAND AND GRAVEL, TRACE BRICK FRAGMENTS (FILL), DRY TO MOIST

4.5'-6.0' -> MODERATE TO DARK BROWN SAND AND SILT, TRACE CLAY, WET

6.0'-7.5' -> MODERATE TO LIGHT BROWN FINE SAND AND SILT, SOME GRAVEL, TRACE CLAY

7.5'-8.0' -> MEDIUM GRAY SAND AND SILT, WET

8.0'-9.0' -> DARK BROWN SILT AND SAND

9.0'-10.0' -> LIGHT TO MODERATE BROWN SAND AND GRAVEL, SOME SILT

10.0'-12.0' -> MULTI COLORED SAND AND SILT, SOME GRAVEL, WET

BOB @ 12.0' BLS

**MONITORING WELL CONSTRUCTION DETAILS** — BP-8

- CEMENT GROUT
- DRILL CUTTINGS
- 1" I.D. PVC RISER
- 1" I.D. PVC SCREEN (0.01" SLOT SIZE)

**HYDRAULIC CONDUCTIVITY (CM/SEC)**

| HNU (PPM) |
|---|
| 0.2 |
| 0.2 |
| 0.1 |
| 0.4 |
| 0.4 |
| 2.4 |
| BKGND HNU=0.0 |

**NOTES**

DRILLER NOTES WET @ 5.0' BLS

0.0'-4.5' -> FILL
4.5'-6.0' -> MODERATE TO DARK BROWN SAND AND SILT, TRACE CLAY
6.0'-7.5' -> LIGHT TO MODERATE BROWN FINE SAND AND SILT, SOME GRAVEL, TRACE CLAY
7.5'-8.0' -> MEDIUM GRAY SAND AND SILT [illegible]
8.0'-9.0' -> DARK BROWN SILT AND SAND
9.0'-10.0' -> LIGHT TO MODERATE BROWN SAND AND GRAVEL, SOME SILT
10.0'-12.0' -> MULTI COLORED SAND AND SILT, SOME GRAVEL

Surface Elevation 309.49 | Classified By MARK D. WILDER
Date Installed 9/6/89 | MPI Inspector MARK D. WILDER
Driller NORTH STAR DRILLING CO.
Method HOLLOW-STEM AUGERS

NOTE: DATA ON THIS SUMMARY SHEET COMPOSITED FROM DRILLER'S LOGS, MPI-COLLECTED DATA AND FIELD OBSERVATIONS

PROJECT: B S & K COLUMBIA MILLS MINETTO, NY

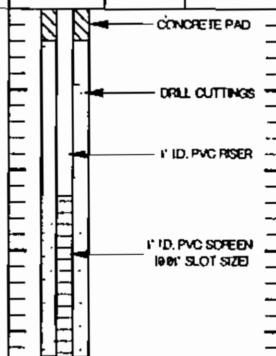
MALCOLM PIRNIE

LOCATION NO. BP - 8
SHEET 1 OF 1

# MONITORING WELL AND BOREHOLE SUMMARY SHEET

| DEPTH (FEET) | ELEVATION (MSL) | SAMPLE # | BLOWS | SOIL OR ROCK DESCRIPTION | UNIFIED SOIL CLASS. | HYDRAULIC CONDUCTIVITY (CM/SEC) | HNU PPM |
|---|---|---|---|---|---|---|---|
| 0.0'–1.0' | | | | 0.0' 1.0' -> CONCRETE PAD | | | |
| 1.0' | | BP-9 S-1 | 10, 12, 18, 18 | 1.0'-3.0' -> MODERATE BROWN FINE SAND AND SILT, SOME GRAVEL, MOIST, ODORS | | | 0.1 |
| | | BP-9 S-2 | 6, 3, 2, 2 | ? | | | |
| 5 | | BP-9 S-3 | 1, 1, 1, 1 | ~5.0'-9.3' -> MODERATE TO DARK BROWN SILT AND FINE SAND, SOME GRAY MOTTLING, WET TO SATURATED, ODORS | | | 172 |
| | | BP-9 S-4 | 10, 15, 17, 17 | | | | 174 |
| 9.3' | | BP-9 S-5 | 17, 15, 33, W/P-3 | 9.3'-10.7' -> DARK REDDISH BROWN SAND, SILT AND ANGULAR GRAVEL | | | 190 |
| 10 | | | | B.O.B. @ 10.7' BLS | | | BKGND HNU-89 |

MONITORING WELL CONSTRUCTION DETAILS




NOTES

0.0 1.0 -> CONCRETE PAD
1.0 3.0 -> MODERATE BROWN FINE SAND AND SILT, SOME GRAVEL
3.0 5.0 -> NO RECOVERY
5.0 9.3 -> MODERATE TO DARK BROWN SILT AND FINE SAND, SOME GRAVEL
9.3-10.7 -> DARK REDDISH BROWN SAND, SILT AND ANGULAR GRAVEL

Surface Elevation 311.17
Date Installed 9/6/89
Driller NORTH STAR DRILLING CO.
Method HOLLOW-STEM AUGERS
Classified By KEITH A. WHITE
MPI Inspector KEITH A. WHITE

NOTE: DATA ON THIS SUMMARY SHEET COMPOSITED FROM DRILLER'S LOGS, MPI-COLLECTED DATA AND FIELD OBSERVATIONS

PROJECT: B S & K COLUMBIA MILLS MINETTO, NY

MALCOLM PIRNIE

LOCATION NO. BP - 9
SHEET 1 OF 1

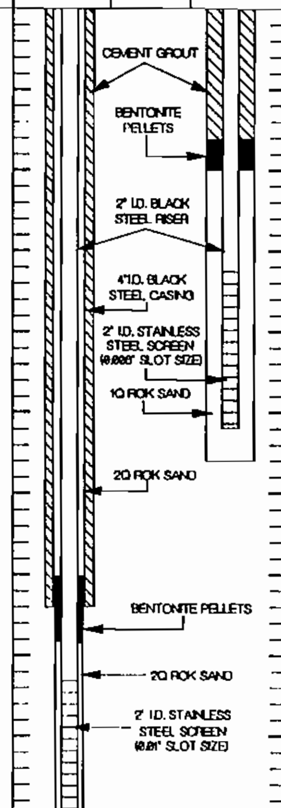
# MONITORING WELL AND BOREHOLE SUMMARY SHEET

| SAMPLE # | BLOWS |
|---|---|
| B-3D S-1 | 4, 8, 5, 5 |
| B-3D S-2 | 2, 2, 2, 2 |
| B-3D S-3 | 6, 10, 11, 18 |
| B-3D S-4 | 6, 4, 2, 4 |
| B-3D S-5 | WOR, 1 |
| B-3D S-6 | 1, 3, 4, 5 |
| B-3D S-7 | 1, 2, 6, 24 |
| B-3D S-8 | 2, 3, 7, 17 |
| B-3D S-9 | 17, 50/0.2 |
| R-1 | |
| R-2 | |

| SOIL OR ROCK DESCRIPTION | HNU (PPM) | NOTES |
|---|---|---|
| 0.0' - 7.5' -> BROWN TO BLACK FINE TO COARSE SAND, SOME GRAVEL UP TO 1/2" | 22, 1.8, 154, 178 | |
| 7.5' - 10.5' -> GRAYISH BROWN TO MODERATE BROWN SILTY CLAY AND CLAYEY SILT | 42, 1.8 | |
| 10.5' - 13.5' -> MEDIUM GRAY SAND AND GRAVEL UP TO 1", TRACE TO SOME CLAY | 72 | |
| 13.5' - 16.5' -> MODERATE REDDISH BROWN SAND AND GRAVEL UP TO 1", SOME CLAY | 6, 10.2 | DRILLER NOTES BEDROCK @ 16.5' |
| 16.5' - 28.7' -> DUSKY RED SANDSTONE, MODERATELY TO HIGHLY FRACTURED, OCCASIONAL GREEN MOTTLING | BKGND HNU - 0.4 | BOTTOM OF 4" STEEL CASING @ 18.5'<br>R-1 RECOVERY - 4.0' ROD -<br>R-2 RECOVERY - ROD - |

DEPTH (FEET) 0–25; ELEVATION (MSL); UNIFIED SOIL CLASS.; HYDRAULIC CONDUCTIVITY (CM/SEC)

MONITORING WELL CONSTRUCTION DETAILS




Surface Elevation 316.77-S/306.36-D  Classified By MARK D. WILDER / KEITH A. WHITE
Date Installed 9/24/85, 10/25/89  MPI Inspector MARK D. WILDER / KEITH A. WHITE
Driller NORTH STAR DRILLING CO.
Method HOLLOW-STEM AUGERS/ROLLER BIT/NX CORE

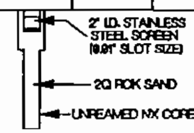
NOTE: DATA ON THIS SUMMARY SHEET COMPOSITED FROM DRILLER'S LOGS, MPI-COLLECTED DATA AND FIELD OBSERVATIONS

PROJECT: B S & K COLUMBIA MILLS MINETTO, NY

MALCOLM PIRNIE

LOCATION NO. B-3S,D
SHEET 1 OF 2

# MONITORING WELL AND BOREHOLE SUMMARY SHEET

| DEPTH (FEET) | ELEVATION (MSL) | SAMPLES | SAMPLE # | BLOWS | SOIL OR ROCK DESCRIPTION | UNIFIED SOIL CLASS. | MONITORING WELL CONSTRUCTION DETAILS B-3D | HYDRAULIC CONDUCTIVITY (CM/SEC) | HNU PPM | NOTES |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | R-2(CONT) | | B.O.B. @ 28.7 BLS | |  | | | |
| 30 | | | | | | | | | | |
| 35 | | | | | | | | | | |
| 40 | | | | | | | | | | |
| 45 | | | | | | | | | | 0.0'-7.5' -> MISCELLANEOUS FILL<br>7.5'-10.8' -> GRAYISH BROWN TO MODERATE BROWN SILTY CLAY AND CLAYEY SILT<br>10.8'-13.5' -> MEDIUM GRAY SAND AND GRAVEL<br>13.5'-16.5' -> MODERATE REDDISH BROWN SAND AND GRAVEL<br>16.5'-28.7' -> DUSKY RED SANDSTONE BEDROCK |
| 50 | | | | | | | | | | |

Surface Elevation 316.77-S/308.36-D
Classified By MARK D. WILDER / KEITH A. WHITE
Date Installed 9/24/85, 10/25/89
MPI Inspector MARK D. WILDER / KEITH A. WHITE
Driller NORTH STAR DRILLING CO.
Method HOLLOW-STEM AUGERS/ROLLER BIT/NX CORE

NOTE: DATA ON THIS SUMMARY SHEET COMPOSITED FROM DRILLER'S LOGS, MPI COLLECTED DATA AND FIELD OBSERVATIONS

PROJECT: B S & K COLUMBAI MILLS MINETTO, NY

MALCOLM PIRNIE

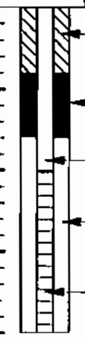
LOCATION NO. B-3SD

SHEET 2 OF 2

# MONITORING WELL AND BOREHOLE SUMMARY SHEET

| DEPTH (FEET) | ELEVATION (MSL) | SAMPLES | SAMPLE # | BLOWS | SOIL OR ROCK DESCRIPTION | UNIFIED SOIL CLASS | HYDRAULIC CONDUCTIVITY (CM/SEC) | HNU (PPM) |
|---|---|---|---|---|---|---|---|---|
| 0–2 | | | B-12S S-1 | 3, 5, 11, 2 | 0.0'-5.2' -> MODERATE BROWN (5YR 3/4) FINE TO MEDIUM SAND, LITTLE GRAVEL AND SILT, OCCASIONAL COAL FRAGMENTS (FILL), MOIST. | | | 0.6 |
| 2–4 | | | B-12S S-2 | 2, 2, 1, 1 | | | | 1.7 |
| 4–6 | | | B-12S S-3 | 2, 3, 2, 3 | 5.2' — 5.0'-5.2' -> BLACK CINDER, SLAG AND SAND LENS<br>5.2'-6.0' -> DARK YELLOWISH BROWN (10YR 4/2) FINE TO MEDIUM SAND, LITTLE SILT, WET<br>6.0' | | | 0.7 |
| 6–8 | | | B-12S S-4 | 1, 1, 1, 2 | 6.0'-8.0' -> PALE BROWN (5YR 5/2) INTERBEDDED SILTY SAND AND SANDY, CLAYEY SILT, WET. | | | 1.3 |
| 8–10 | | | B-12S S-5 | 1, 1, 1, 8 | 8.0'-9.0' -> GRADES TO PALE BROWN INTERBEDDED SILT AND CLAY WITH OCCASIONAL FINE SAND LAMINAE, WET.<br>9.0'-9.8' -> PALE BROWN FINE TO COARSE SAND AND SILT, SOME CLAY, LITTLE GRAVEL<br>9.8' — DUSKY RED (5R 3/4) FINE TO COARSE SAND AND GRAVEL, SOME SILT AND CLAY (TILL), WET.<br>BOB @ 10.0' BLS | | | 1.4 |
| | | | | | | | | BKGND HNU - 0.2 |

MONITORING WELL CONSTRUCTION DETAILS: B-12S




NOTES

DRILLER NOTES WATER @ 5.0' BLS IN OPEN HOLE.

0.0'-5.2' -> MISCELLANEOUS FILL
5.2'-6.0' -> DARK YELLOWISH BROWN FINE TO MEDIUM SAND, LITTLE SILT
6.0'-9.8' -> INTERBEDDED PALE BROWN SILTY SAND AND SANDY, CLAYEY SILT
9.8'-10.0' -> DUSKY RED SANDY TILL

Surface Elevation 308.04
Date Installed 10/23/89
Driller NORTH STAR DRILLING CO.
Method HOLLOW-STEM AUGERS
Classified By KEITH A. WHITE
MPI Inspector KEITH A. WHITE

NOTE: DATA ON THIS SUMMARY SHEET COMPOSITED FROM DRILLER'S LOGS, MPI-COLLECTED DATA AND FIELD OBSERVATIONS

PROJECT: B S & K COLUMBIA MILLS MINETTO, NY

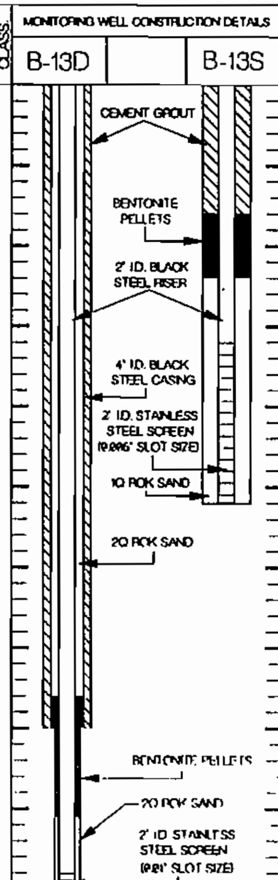
MALCOLM PIRNIE

LOCATION NO. B-12S
SHEET 1 OF 1

# MONITORING WELL AND BOREHOLE SUMMARY SHEET

| Samples (Sample #) | Blows | Depth | Soil or Rock Description | HNU PPM | Notes |
|---|---|---|---|---|---|
| | | 0.3 | 0.0'-0.3 -> CONCRETE PAD | | |
| B-13D S-1 | 2, 7 | | 0.3'-3.3'-> MODERATE BROWN, FINE TO MEDIUM SAND, TRACE SILT; 2.0'-2.2'->CLEAN WHITE MEDIUM SAND LENS | 34 | |
| B-13D S-2 | 4, 6, 3, 4 | 3.3' | 2.5'-3.3'-> VARIEGATED RED BRICK, WHITE AND BROWN FILL, DRY | 22 | |
| | | | 3.3'-4.0' -> OLIVE GRAY (5Y 3/2) SILT, SOME CLAY, TRACE FINE SAND, MOIST | | |
| B-13D S-3 | 1, WOH, 3, 2 | | 4.0'-0.0' -> OLIVE GRAY (5Y 3/2) FINE TO MEDIUM SAND, SOME CLAY AND MEDIUM GRAVEL, SOME IRON STAINING, MOIST TO WET | 11.6 | |
| B-13D S-4 | 1, 1, 3, 2 | | 0.0'-9.0'-> OLIVE BROWN (5YR 3/2) SILT AND CLAY, TRACE FINE SAND AND SMALL GRAVEL, MOIST TO WET, ODORS | 5.8 | |
| B-13D S-5 | 1, 2, 2, 1 | | 9.0'-10.5' -> OLIVE GRAY (5Y 3/2) SILT AND CLAY, TRACE FINE SAND, TRACE IRON STAINING, SOME INTERBEDDED BLACK SAND | 5.4 | |
| B-13D S-6 | 3, 3, 3, 2 | | 10.5'-12.4' -> OLIVE BROWN (5YR 3/2) FINE TO MEDIUM SAND, LITTLE GRAVEL, TRACE IRON STAINING | 8 | |
| B-13D S-7 | 12/0.4, 40/0.2 | 12.4' | 12.4'-14.5' -> COBBLES AND BOULDERS | 64 | NO SPOON SAMPLE @ 14.0' DUE TO INTERFERENCE |
| B-13D S-8 | 1, 4, 1, 1 | 14.5' | 14.5'-18.8' -> MODERATE RED BROWN SAND AND GRAVEL, TRACE CLAY AND SILT (TILL), WET | 4.2 | |
| B-13D S-9 | 4, 10, 50, 50/0.3 | 18.8 | | 3.6 | DRILLER NOTES BEDROCK @ 18.8' |
| R-1 | | | 18.8'-21.5' -> DUSKY RED SANDSTONE, MODERATELY TO HIGHLY FRACTURED | BKGND HNU-0.4 | BOTTOM OF 4" STEEL CASING @ 20.0' BLS; R-1 RECOVERY - 5.0' RQD - 70% |

Columns on form: DEPTH (FEET), ELEVATION (MSL), SAMPLES, SAMPLE #, BLOWS, SOIL OR ROCK DESCRIPTION, UNIFIED SOIL CLASS., MONITORING WELL CONSTRUCTION DETAILS (B-13D, B-13S), HYDRAULIC CONDUCTIVITY (CM/SEC), HNU PPM, NOTES




Surface Elevation 311.21-S/311.15-D Classified By MARK D WILDER / KEITH A WHITE

Date Installed 10/24/89, 10/20/89 MPI Inspector MARK D WILDER / KEITH A WHITE

Driller NORTH STAR DRILLING CO.

Method HOLLOW-STEM AUGERS / NX CORE

NOTE: DATA ON THIS SUMMARY SHEET COMPOSITED FROM DRILLER'S LOGS, MPI-COLLECTED DATA AND FIELD OBSERVATIONS

PROJECT: B S & K COLUMBIA MILLS MINETTO, NY

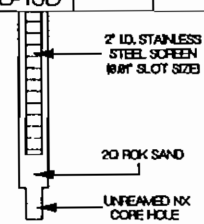
MALCOLM PIRNIE

LOCATION NO. B-13 SD

SHEET 1 OF 2

# MONITORING WELL AND BOREHOLE SUMMARY SHEET

| DEPTH (FEET) | ELEVATION (M.S.L.) | SAMPLES | SAMPLE # | BLOWS | SOIL OR ROCK DESCRIPTION | UNIFIED SOIL CLASS. | MONITORING WELL CONSTRUCTION DETAILS | HYDRAULIC CONDUCTIVITY (CM/SEC) | HNU (PPM) | NOTES |
|---|---|---|---|---|---|---|---|---|---|---|
| 25 | | | R-1 (CONT) | | | | B-13D | | | |
| | | | R-2 | | | | | | | R-2 RECOVERY = 5.8' RQD = 77% |
| 30 | | | | | | | | | | |
| | | | | | B.O.B. @ 31.5' BLS | | | | | |
| 35 | | | | | | | | | | 0.0'-0.3'-> CONCRETE PAD<br>0.3'-3.3'-> MISCELLANEOUS FILL<br>3.3'-12.4'-> INTERBEDDED OLIVE GRAY AND OLIVE BROWN SILT, SAND AND CLAY UNITS, TRACE GRAVEL<br>12.4'-14.5'-> COBBLES AND BOULDERS<br>14.5'-18.8'-> MODERATE RED-BROWN SANDY TILL<br>18.8'-31.5'-> DUSKY RED SANDSTONE BEDROCK |
| 40 | | | | | | | | | | |
| 45 | | | | | | | | | | |
| 50 | | | | | | | | | | |




Surface Elevation 311.21-S/311.15-D  Classified By MARK D. WILDER / KEITH A. WHITE

Date Installed 10/24/89, 10/26/89  MPI Inspector MARK D. WILDER / KEITH A. WHITE

Driller NORTH STAR DRILLING CO.

Method HOLLOW-STEM AUGERS / NX CORE

NOTE: DATA ON THIS SUMMARY SHEET COMPOSITED FROM DRILLER'S LOGS, MPI-COLLECTED DATA AND FIELD OBSERVATIONS

PROJECT: B S & K COLUMBIA MILLS MINETTO, NY

MALCOLM PIRNIE

LOCATION NO. B-13 S,D

SHEET 2 OF 2

# MONITORING WELL AND BOREHOLE SUMMARY SHEET

| Depth (feet) | Sample # | Blows | Soil or Rock Description | HNU (PPM) |
|---|---|---|---|---|
| 0.0–2.0 | B-14S S-1 | 4, 8, 15, 7 | 0.0'-1.1' -> BLACK CINDERS, SLAG, SAND (FILL), LOOSE, MOIST; 1.1'-4.0' -> MODERATE BROWN (5YR 3/4), GRAY AND BLACK MOTTLED FINE TO COARSE SAND AND GRAVEL, LITTLE SILT (FILL), MOIST | 0.8 |
| 2.0–4.0 | B-14S S-2 | 2, 2, 2, 2 | | 32 |
| 4.0–6.0 | B-14S S-3 | 7, 8, 18, 18 | 4.0'-6.0' ->PALE YELLOWISH BROWN (10YR 6/2) WELL SORTED MEDIUM SAND, SOME BLACK STREAKING, FAINT LAMINATION PRESENT, STRONG ODORS, WET. | 172 |
| 6.0–8.0 | B-14S S-4 | 8, 18, 12, 15 | 6.0'-8.0' -> BROWNISH GRAY (5YR 4/1) MEDIUM SAND, WELL SORTED, ODORS, WET | 154 |
| 8.0–10.0 | B-14S S-5 | 1, 3, 4, 4 | 8.0'-8.3' -> PALE BROWN SILT AND CLAY, SOME FINE SAND, MOIST; 8.3'-11.5' ->MEDIUM GRAY (N5) FINE TO MEDIUM SAND AND SILT, SOME SUBANGULAR TO SUBROUNDED GRAVEL, LITTLE CLAY, ODORS, WET | 120 |
| 10.0–11.9 | B-14S S-6 | 4, 6, 18, 50/0.4 | 11.5'-11.9' -> DUSKY RED (5R 3/4) SANDSTONE ROCK FRAGMENTS<br>B.O.B. @ 11.9' BLS | 62 |

BKGND HNU=0.4

MONITORING WELL CONSTRUCTION DETAILS: B-14S


HYDRAULIC CONDUCTIVITY (CM/SEC)

NOTES

125 PPM IN BORE HOLE ON HNU DURING SANDPACK INSTALLATION

0.0'-4.0' -> MISCELLANEOUS FILL
4.0'-6.0' -> PALE YELLOWISH BROWN SAND
6.0'-8.0' -> BROWNISH GRAY SAND
8.0'-8.3' -> PALE BROWN SILT AND CLAY
8.3'-11.5' -> MEDIUM GRAY SAND AND SILT
11.5'-11.9' -> DUSKY RED SANDSTONE ROCK FRAGMENTS

Surface Elevation 307.49
Date Installed 10/24/89
Driller NORTH STAR DRILLING CO.
Method HOLLOW-STEM AUGERS
Classified By KEITH A. WHITE
MPI Inspector KEITH A. WHITE

NOTE: DATA ON THIS SUMMARY SHEET COMPOSITED FROM DRILLER'S LOGS, MPI COLLECTED DATA AND FIELD OBSERVATIONS

PROJECT: B S & K COLUMBIA MILLS MINETTO, NY

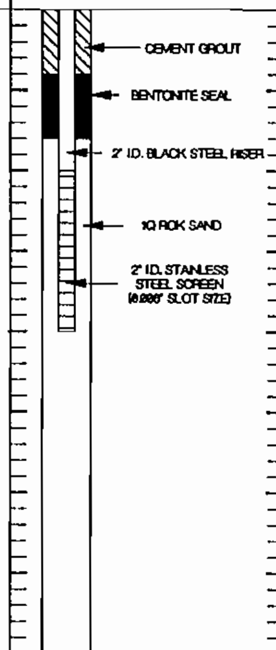
MALCOLM PIRNIE

LOCATION NO. B-14S
SHEET 1 OF 1

# MONITORING WELL AND BOREHOLE SUMMARY SHEET

| Depth (feet) | Sample # | Blows | Soil or Rock Description |
| --- | --- | --- | --- |
| 1.0' | | | 0.0'-1.0' -> CONCRETE PAD |
| 2.0' | B-15S S-1 | 2, 2 | 1.0'-2.0' -> MODERATE BROWN, FINE TO MEDIUM SAND, SOME GRAVEL, MOIST, LOOSE |
| | B-15S S-2 | 2, 4, 10, 16 | 2.0'-2.8' -> LIGHT BROWNISH GRAY TO BROWNISH GRAY FINE TO MEDIUM SAND, WELL SORTED |
| 5.8' | B-15S S-3 | 8, 13, 8, 6 | 2.8'-5.8' -> DARK YELLOWISH BROWN (WITH OCCASIONAL BLACK OR RUST COLORED STREAKS) FINE TO MEDIUM SAND, MOIST TO WET, LOOSE |
| 10.8' | B-15S S-4 | 5, 5, 6, 5 | 5.8'-10.8' -> INTERBEDDED BROWNISH GRAY FINE TO MEDIUM SAND AND SANDY SILT, SOME RED, BLACK AND GREENISH GRAY STREAKS, TRACE CLAY, WET, ODORS |
| | B-15S S-5 | 1, 2, 1, 2 | |
| 11.2' | B-15S S-6 | 1, 2, 1, 2 | 10.8'-11.2' -> BROWNISH GRAY CLAY, LITTLE SILT, WET |
| 14.0' | B-15S S-7 | 1, 1, 1, 1 | 11.2'-14.0' -> INTERBEDDED BROWNISH GRAY FINE TO MEDIUM SAND AND CLAYEY SILT, WET |
| | B-15S S-8 | 1, 1, 1, 1 | 14.0'-16.0' -> BROWNISH GRAY FINE TO MEDIUM SAND, WELL SORTED, LITTLE SILT, WET, GRADES TO SOFT, FINE GRAINED SAND AND SILT AT 15.7' |
| 19.7 | B-15S S-9 | WOH | 16.0'-19.7' -> INTERBEDDED BROWNISH GRAY CLAY, GRAVEL, SILTY SAND, AND SILTY CLAYEY SAND LAYERS (SEE NOTES) |
| | B-15S S-10 | 10, 7, 15, 16, 17 | 19.7'-20.0' -> DUSKY RED (5R 3/4) SAND, SOME CLAY AND SILT, LITTLE GRAVEL<br>B.O.B. @ 20.0' BLS |

Monitoring Well Construction Details — B-16S




Hydraulic Conductivity (CM/SEC): SILTY SAND -> 5.2; TILL -> 0.0

| HNU (PPM) |
| --- |
| 0.6 |
| 0.8 |
| 180 |
| 200 |
| 28 |
| 22 |
| 6.4 |
| 8.0 |
| 11.2 |
| 5.2 |
| 0.0 |
| BKGND HNU-0.4 |

**NOTES**

SILT AND CLAY CONTENT INCREASES GRADUALLY FROM 5.8'-10.8'

0.0'-1.0' -> CONCRETE PAD
1.0'-2.0' -> MODERATE BROWN SAND, SOME GRAVEL
2.0'-2.8' -> BROWNISH GRAY SAND
2.8'-5.8' -> DARK YELLOWISH BROWN SAND
5.8'-10.8' -> BROWNISH GRAY SAND AND SANDY SILT
10.8'-11.2' -> BROWNISH GRAY CLAY
11.2'-14.0' -> INTERBEDDED BROWNISH GRAY SAND AND CLAYEY SILT
14.0'-16.0' -> BROWNISH GRAY SAND AND SILT
16.0'-17.0' -> BROWNISH GRAY CLAY
17.0'-18.0' -> GRAVEL
18.0'-18.3' -> BROWNISH GRAY SILTY, CLAYEY SAND
18.3'-19.0' -> BROWNISH GRAY CLAY
19.0'-19.7' -> BROWNISH GRAY SILTY SAND
19.7'-20.0' -> DUSKY RED SANDY TILL

Surface Elevation - 308.26
Date Installed 10/24/89
Driller NORTH STAR DRILLING CO.
Method HOLLOW-STEM AUGERS

Classified By KEITH A. WHITE
MPI Inspector KEITH A. WHITE

NOTE: DATA ON THIS SUMMARY SHEET COMPOSITED FROM DRILLER'S LOGS, MPI-COLLECTED DATA AND FIELD OBSERVATIONS

PROJECT: B S & K COLUMBIA MILLS MINETTO, NY

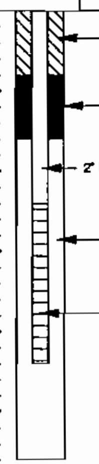
MALCOLM PIRNIE

LOCATION NO. B-16S
SHEET 1 OF 1

# MONITORING WELL AND BOREHOLE SUMMARY SHEET

| SAMPLE # | BLOWS | SOIL OR ROCK DESCRIPTION | HNU (PPM) |
|---|---|---|---|
| B-17S S-1 | 2, 5, 6, 6 | 0.0'-2.0' -> MODERATE BROWN (5YR 3/4) FINE TO COARSE SAND AND GRAVEL, LITTLE SILT, CINDERS (FILL), LOOSE, MOIST. | 2.0 |
| B-17S S-2 | 5, 5, 5, 5 | 2.0'-4.0' -> DARK YELLOWISH BROWN (10YR 4/2) FINE TO COARSE SAND, SOME GRAVEL, LITTLE SILT (FILL), LOOSE, MOIST. | 0.6 |
| B-17S S-3 | 1, 1, 1, 1 | 4.0'-7.2' -> BROWNISH GRAY (5YR 4/1) FINE TO MEDIUM SAND AND SILT, SOME CLAY, TRACE GRAVEL, SLAG (FILL), MOIST TO WET. | 4.0 |
| B-17S S-4 | 1, 1, 2, 1 | 7.2'-8.0' -> BROWNISH GRAY INTERBEDDED FINE TO MEDIUM SAND AND SILTY SAND, LITTLE CLAY, WET. | 32 |
| B-17S S-5 | 1, 1 | 8.0'-10.0' -> LIGHT BROWNISH GRAY (5YR 6/1) INTERBEDDED SILTY CLAY AND SAND, WET | 0.8 |
| B-17S S-6 | WOH, 1 | 10.0'-13.8' -> BROWNISH GRAY FINE TO MEDIUM SAND AND SILT, SOME CLAY AND FINE GRAVEL, WET. | 0.8 |
| B-17S S-7 | 1, 1, 7, 23 | | 0.9 |
| | | DUSKY RED (5R 3/4) TILL<br>B.O.B. @ 14.0' BLS | BKGND HNU-0.4 |

Monitoring Well Construction Details: B-17S




NOTES:

6:50 A.M.- WATER @ 7.0' BLS OVERNIGHT
10:56 A.M.- WATER @ 11.0' BLS

0.0'-7.2' -> MISCELLANEOUS FILL
7.2'-13.8' -> BROWNISH GRAY INTERBEDDED FINE TO MEDIUM SAND, SILTY SAND, AND SILTY CLAY
13.8'-?-> DUSKY RED TILL

Surface Elevation 308.49
Classified By KEITH A. WHITE
Date Installed 10/25/89
MPI Inspector KEITH A. WHITE
Driller NORTH STAR DRILLING CO.
Method HOLLOW-STEM AUGERS

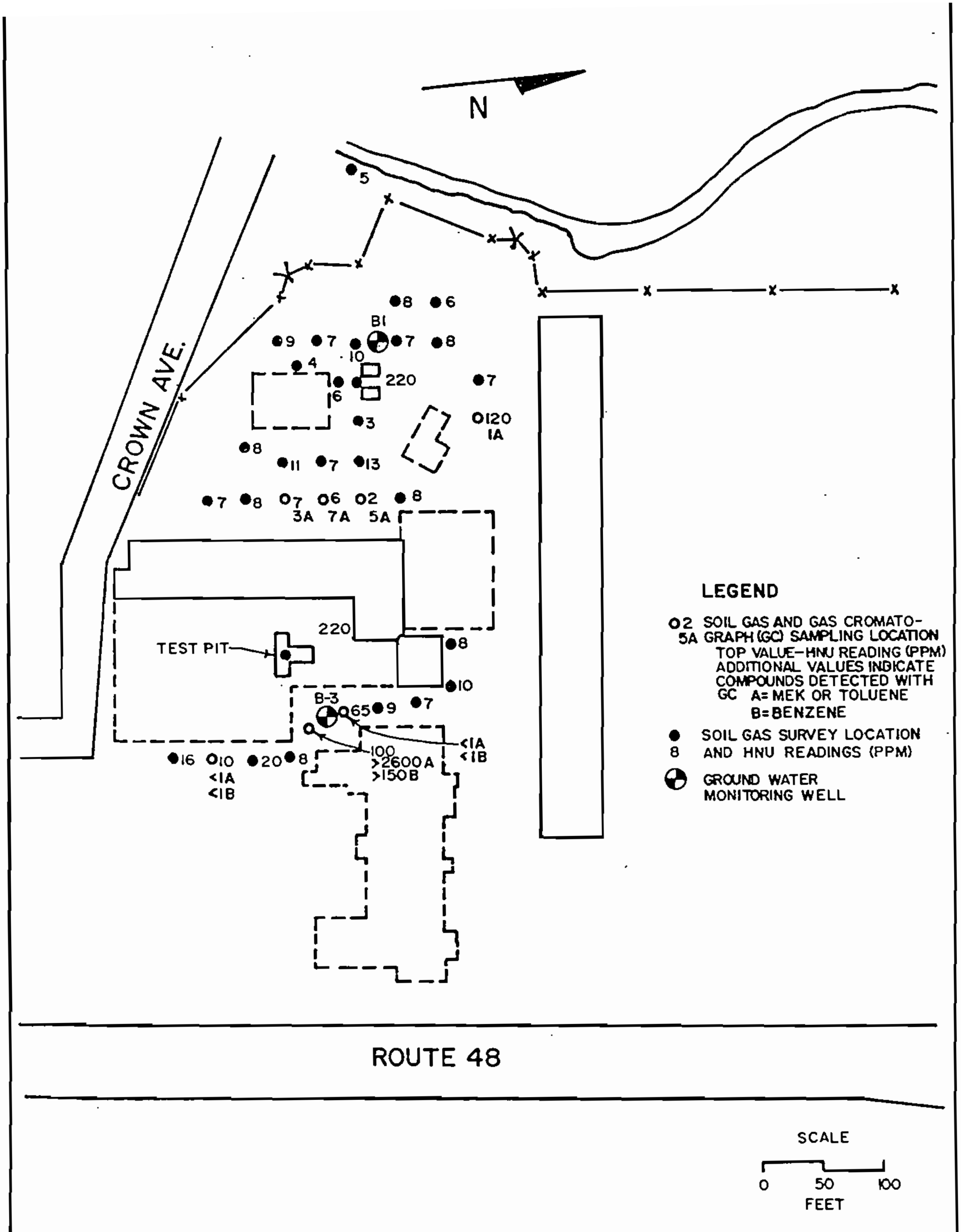
NOTE: DATA ON THIS SUMMARY SHEET COMPOSITED FROM DRILLER'S LOGS, MPI-COLLECTED DATA AND FIELD OBSERVATIONS

PROJECT: B S & K COLUMBIA MILLS MINETTO, NY

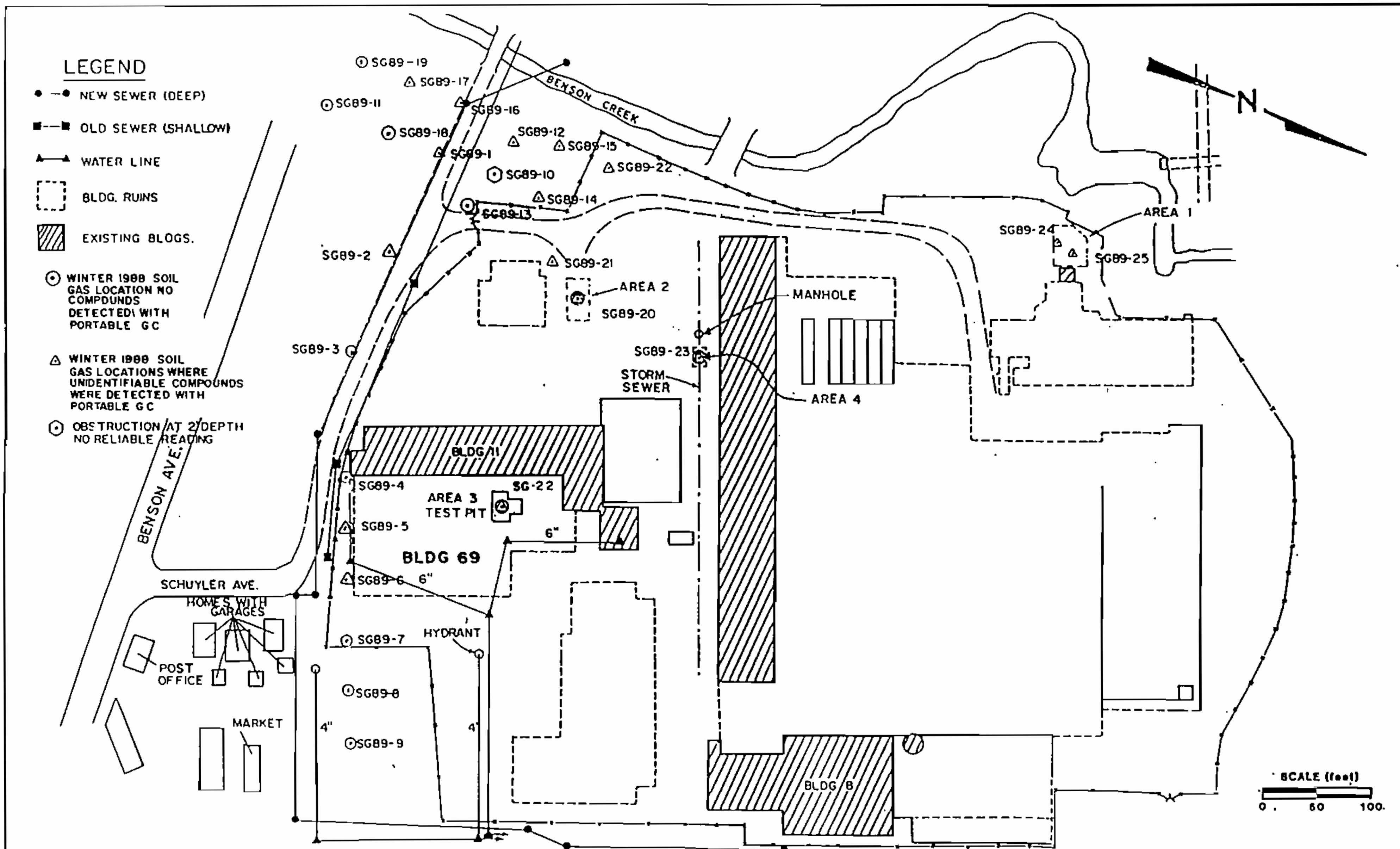
MALCOLM PIRNIE

LOCATION NO. B-17S
SHEET 1 OF 1

## Soil Gas Survey Results




| | | |
|---|---|---|
| MALCOLM PIRNIE | COLUMBIA MILLS MINETTO, NEW YORK<br>SOIL GAS SURVEY – SUMMER 1988 | MALCOLM PIRNIE, INC.<br>FIGURE |

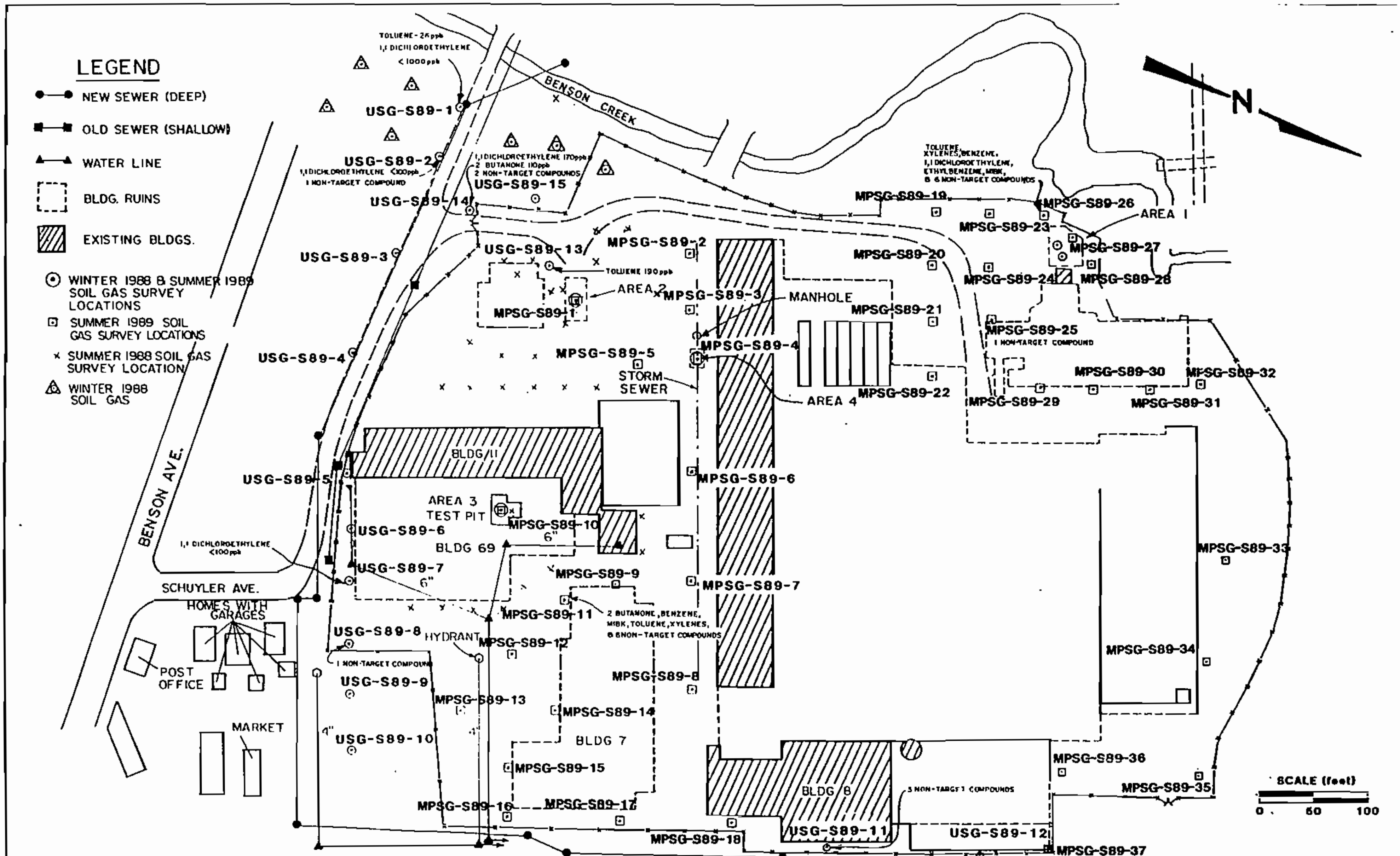



MALCOLM PIRNIE

SOIL GAS SURVEY - WINTER 1988

MALCOLM PIRNIE, INC.

FIGURE




MALCOLM PIRNIE

SOIL GAS SURVEY SUMMER 1989
COMPOUNDS DETECTED BY PORTABLE GC

MALCOLM PIRNIE, INC.
FIGURE

Summary of
Ground Water Sampling Results
Test Pit 3 Area

TABLE 1
TEST PIT 3 AREA
IRM SAMPLING OF GROUND WATER - SEPTEMBER 1989
SUMMARY OF ANALYTICAL RESULTS

| PARAMETER | BP-2 | BP-4 | BP-5 |
|---|---|---|---|
| **VOLATILE ORGANICS (ug/l)** | | | |
| Methylene chloride | 6 B | 5 U | 7 B |
| Toluene | 5 U | 5 | 5 U |
| Total xylenes | 5 U | 3 J | 5 U |
| Ethylbenzene | 3 J | 14 | 2 J |
| Methyl isobutyl ketone | 10 U | 10 U | 2 J |
| **TICs** | | | |
| Unknown | 60 J | 300 J | 400 J |
| Unknown | 100 J | 400 J | 200 J |
| Unknown | 60 J | 200 J | 200 J |
| Unknown | 500 J | 300 J | 200 J |
| Unknown | 30 J | 200 J | 400 J |
| Unknown | 30 J | 200 J | 100 J |
| Unknown | 70 J | 200 J | 80 J |
| Unknown | 40 J | 100 J | 100 J |
| Unknown | 100 J | 100 J | 70 J |
| Unknown | 40 J | 70 J | 200 J |

U - indicates compound was analyzed but not detected.
J - indicates an estimated value.
B - indicates the analyte was found in the associated blank as well as the sample.
TICs Tentatively identified compounds

IGW12

**TABLE 2**
**TEST PIT 3 AREA**
**COLUMBIA MILLS RI GROUND WATER SAMPLING – FEBRUARY 1990**
**SUMMARY OF ANALYTICAL RESULTS – TARGET ANALYTES DETECTED**

| PARAMETER | NYSDEC GA STANDARD/ GUIDANCE VALUE (ug/l) | B-3S | B-3D ** | B-12S | B-13S | B-13D*** | B-14S | B-16S | B-17S |
|---|---|---|---|---|---|---|---|---|---|
| A. VOLATILES | | | | | | | | | |
| Toluene | 5 | 1 U | 5 U | 1 U | 1 | 10 | 5 | 1 U | 1 U |
| Total xylenes | 5 | 1 U | 5 U | 1 U | 6 | 5 U | 1 U | 1 U | 1 U |
| Trichloroethene | 5 | 1 U | 5 U | 1 U | 3 | 5 U | 1 U | 1 U | 1 U |
| Methylene chloride | 5 | 3 JB | 5 U | 5 U | 5 U | 5 U | 5 U | 5 U | 5 U |
| B. SEMIVOLATILES | | | | | | | | | |
| di-n-Butylphthalate | 50 | 2 J | 11 U | 3 J | 11 U | 11 U | 11 U | 11 U | 11 U |
| C. PESTICIDES/PCB's* | | | | | | | | | |
| D. INORGANICS | | | | | | | | | |
| Aluminum | | 15800 | 84.0 U | 542 | 1820 | 84.0 U | 8890 | 216 | 156 b |
| Antimony | 3 | 22.0 U | 22.0 U | 22.0 U | 22.0 U | 30.6 b | 22.0 U | 22.0 U | 22.0 U |
| Arsenic | 25 | 2.4 b | 9.8 b | 2.0 U | 2.0 U | 2.0 U | 3.4 b | 2.0 U | 2.0 U |
| Barium | 1,000 | | 404 | | | 375 | | | |
| Cadmium | 10 | 3.0 U | 3.0 U | 3.0 U | 4.4 b | 3.0 U | 3.0 U | 3.0 U | 3.0 U |
| Calcium | | | 60100 | | | 76300 | | | |
| Chromium | 50 | 22.3 | 2.2 b | 4.5 b | 3.7 b | 2.0 U | 17.1 | 2.0 U | 5.2 b |
| Chromium VI | 50 | 20 U | 20 U | 20 U | 20 U | 20 U | 20 U | 40 | 20 U |
| Cobalt | | | 5.6 b | | | 4.0 U | | | |
| Copper | 200 | 53.3 | 5.2 b | 11.7 b | 23.6 b | 5.0 U | 33.3 | 7.5 b | 5.4 b |
| Iron | 300 | 57800 E | 5260 | 9460 E | 50500 E | 4070 | 28000 E | 2030 E | 5750 E |
| Lead | 25 | 16.6 | 3.0 U | 6.0 U | 6.0 U | 3.0 U | 24.4 | 3.0 U | 3.0 U |
| Magnesium | 35,000 | 16600 | 19300 | 19300 | 10100 | 26900 | 13900 | 5530 | 9340 |
| Manganese | 300 | 3660 E | 4790 | 1280 E | 7790 E | 1540 | 2890 E | 181 E | 2750 E |
| Potassium | | | 1870 b | | | 3950 b | | | |
| Sodium | 20,000 | | 57000 | | | 31800 | | | |
| Vanadium | | | 16.9 b | | | 21.8 b | | | |
| Zinc | 300 | 120 E | 41.8 | 100 E | 526 E | 62.4 | 97.7 E | 35.5 E | 70.5 E |
| Cyanide | 100 | 22.7 | 12.2 | 26.8 | 23.3 | 10.0 U | 10.7 | 10.0 | 12.9 |
| Cyanide ,total | 100 | 22.7 | | 26.8 | 23.3 | 10.0 U | 10.7 | 10.0 U | 12.9 |

NOTES: All concentrations in ug/l (ppb).
- * Neither PCBs nor pesticides were detected in any of the ground water samples.
- ** Also detected were 9 volatile and 8 semivolatile unknowns
- *** Also detected were 6 semivolatile unknowns

U – indicates compound was analyzed but not detected.
J – indicates an estimated value.
B – indicates the analyte was found in the associated blank as well as the sample.
b – indicates that the value is greater than the IDL but less than the CRDL.
E – indicates that the value is estimated because of interference.

TABLE 3
TEST PIT 3 AREA
CONFIRMATORY RI GROUND WATER SAMPLING – APRIL 1990
SUMMARY OF ANALYTICAL RESULTS

| PARAMETER | B–13S | B–13D | B–14S | B–16S |
|---|---|---|---|---|
| VOLATILE ORGANICS (ug/l) | | | | |
| Toluene | 3 U | 3 | 30 U | 3 U |
| Methyl ethyl ketone | 11 | 21 | 140 | 10 U |
| Acetone | 14 B | 92 B | 100 U | 13 B |

U – indicates compound was analyzed but not detected.
B – indicates the analyte was found in the associated blank as well as the sample.

GWT3

TABLE 3 (cont)
TEST PIT 3 AREA
CONFIRMATORY RI GROUND WATER SAMPLING – APRIL 1990
TENTATIVELY IDENTIFIED COMPOUNDS DETECTED

| MONITORING WELL | COMPOUND | CONCENTRATION |
|---|---|---|
| B – 13D | 1. Decane | 25 |
| B – 13S | 1. Cycloheptane | 26 |
| | 2. Unknown | 22 |
| | 3. 1,2,4–Trimethylcyclopentene | 39 |
| | 4. Unknown | 78 |
| | 5. Unknown | 39 |
| | 6. Unknown | 42 |
| | 7. 1,2–Dimethylcyclohexane | 79 |
| | 8. c–1,4–Dimethycyclohexane | 18 |
| | 9. 1,1,3–Trimethylcyclohexane | 18 |
| | 10. Octahydropentalene | 15 |
| | 11. Octahydro–2–Methylpentalene | 12 |
| | 12. Unknown | 10 |
| B–14S | 1. Unknown | 17 |
| | 2. Unknown | 23 |
| | 3. Unknown | 8 |
| | 4. Unknown | 6 |
| | 5. Unknown | 9 |
| | 6. Methylcyclohexane | 26 |
| | 7. Methylcyclohexane | 81 |
| | 8. Ethylcyclopentane | 3 |
| | 9. Unknown | 30 |
| | 10. c–1,3–Dimethylcyclohexane | 26 |
| | 11. t–1,2–Dimethylcyclohexane | 5 |
| | 12. c–1,4–Dimethylcyclohexane | 4 |
| B–16S | 1. Unknown | 29 |
| | 2. Unknown | 19 |
| | 3. Methylcyclohexane | 11 |
| | 4. Unknown | 61 |
| | 5. Unknown | 30 |
| | 6. 1,1–Dimethylcyclohexane | 8 |
| | 7. t–1,2–Dimethylcyclohexane | 24 |
| | 8. 1,2–Dimethylcyclohexane | 9 |
| | 9. Unknown | 23 |
| | 10. 1,1,3–Trimethylcyclohexane | 17 |
| | 11. 1,3,5–Trimethylcyclohexane | 3 |
| | 12. 1,2,3–Trimethylcyclohexane | 3 |

Note: all concentrations in ug/l (ppb)

TABLE 4
COLUMBIA MILLS IRM PROGRAM
TEST PIT 3 (BUILDING 69) AREA
RW1 GROUNDWATER SAMPLE RESULTS

| PARAMETER | RW1 PUMP TEST | | | | GROUND WATER EXRACTION DURING VAPOR EXTRACTION PILOT TEST | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 07/09/90 | | 07/11/90 | | 08/27/90 | | 09/05/90 | | 09/14/90 | |
| | CARBON INLET | CARBON OUTLET | CARBON INLET | CARBON OUTLET | CARBON INLET | CARBON OUTLET | CARBON INLET | CARBON OUTLET | CARBON INLET | CARBON OUTLET |
| A.VOLATILES (ug/l) | | | | | | | | | | |
| Toluene | 1 U | 1 U | 1 U | 1 U | 14 | 1 U | 5 U | 1 U | 1 U | 1 U |
| Ethylbenzene | 1 U | 1 U | 1 U | 1 U | 6 | 1 U | 5 U | 1 U | 1 U | 1 U |
| Xylenes | 1 U | 1 U | 68 | 1 U | 170 | 1 U | 120 | 1 U | 1 U | 1 U |
| B.TOC (mg/l) | - | - | - | - | 12 | 5 | 8 | 4 | 7 | 1 U |
| C.COD (mg/l) | - | - | - | - | 20 | 10 U | 30 | 40 | 70 | 20 |
| D.BOD5 (mg/l) | - | - | - | - | 10 U | 5 U | 20 U | 5 U | 40 U | 10 U |

NOTES: TOC - Total organic carbon
COD - Chemical oxygen demand
BOD5- Biological oxygen demand
U - indicates compound was analyzed but not detected.

RWIVOC

Summary of
Subsurface Sampling Results
Test Pit 3 Area

Soil borings in test pit #3 area

| PARAMETER | BP-1 | BP-1DL | BP-2 | BP-3 | BP-3 DIL:2.77 | BP-4 | BP-4 DIL:3.29 | BP-5 | BP-6 | BP-6RE | BP-7 | BP-8 | BP-9 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| VOLATILE ORGANICS (ug/kg) | | | | | | | | | | | | | |
| Methylene chloride | 9 B | 50 BD | 690 JB | 700 JB | 34 B | 1500 B | 34 B | 710 JB | 1000 B | 16000 B | 5 JB | 5 JB | 640 JB |
| Toluene | 6 U | 24 U | 740 U | 780 U | 17 U | 1500 U | 19 U | 780 U | 820 U | 8200 U | 1 J | 6 U | 710 U |
| Total xylenes | 6 U | 24 U | 1600 | 780 U | 17 U | 1500 U | 19 U | 2700 | 820 U | 8200 U | 6 U | 6 U | 9800 |
| Methyl Isobutyl Ketone | 420 E | 48 U | 2000 | 1600 U | 35 U | 5900 | 38 U | 1600 U | 14000 | 19000 | 11 U | 11 U | 1200 J |
| TIC's | | | | | | | | | | | | | |
| Unknown | 40 J | 200 J | 8000 J | 1000 J | 40 J | 10000 J | 400 J | 900 J | 40000 J | | | | 20000 J |
| Unknown | 30 J | 100 J | 5000 J | 3000 J | 100 J | | 300 J | 1000 J | | | | | 20000 J |
| Unknown | 40 J | 200 J | 20000 J | 3000 J | 60 J | | 400 J | 1000 J | | | | | 9000 J |
| Unknown | 40 J | 100 J | 10000 J | | 60 J | | 600 J | 800 J | | | | | 30000 J |
| Unknown | 60 J | 300 J | | | 80 J | | 500 J | 3000 J | | | | | |
| Unknown | 40 J | 100 J | | | 100 J | | 1000 J | | | | | | |
| Unknown | 90 J | 100 J | | | 50 J | | 800 J | | | | | | |
| Unknown | 60 J | 200 J | | | 70 J | | 800 J | | | | | | |
| Unknown | 20 J | 100 J | | | 200 J | | 700 J | | | | | | |
| Unknown | 30 J | 200 J | | | 100 J | | 900 J | | | | | | |
| Methyl-cyclohexane | | | 10000 J | | | 70000 J | | | | 300000 J | | | 30000 J |
| Dimethyl-cyclohexane | | | 10000 J | 2000 J | | 10000 J | | 2000 J | | 50000 J | | | 10000 J |
| Dimethyl-cyclohexane | | | | | | | | | | | | | 30000 J |
| Trimethyl-cyclohexane | | | 10000 J | | | | | | | | | | 200000 J |
| Bromofluorobenzene | | | 20000 J | | | | | | 20000 J | | | | |
| Trimethyl cyclopentane | | | 7000 J | 1000 J | | | | | | | | | 10000 J |
| Unknown cyclo-alkane | | | 7000 J | 2000 J | | | | | | | | | |
| Unknown alkane | | | | 2000 J | | 20000 J | | 800 J | 20000 J | 90000 J | | | |
| Unknown alkane | | | | | | 10000 J | | 1000 J | 30000 J | 60000 J | | | |
| Unknown alkane | | | | | | 40000 J | | | 20000 J | 100000 J | | | |
| Unknown alkane | | | | | | | | | | 80000 J | | | |
| Unknown alkane | | | | | | | | | | 50000 J | | | |
| Unknown alkane | | | | | | | | | | 50000 J | | | |
| Unknown alkane | | | | | | | | | | | | | |
| Unknown alkene | | | | 1000 J | | | | | | | | | |
| Hydroxylamine | | | | | | 20000 J | | | | 60000 J | | | |
| 3-Methyl-pentane | | | | | | 30000 J | | | 40000 J | 60000 J | | | |
| 3-Methyl-hexane | | | | | | | | | 50000 J | | | | |
| Heptane | | | | | | 60000 J | | | | | | | |
| Trimethyl-hexane | | | | | | 10000 J | | | 30000 J | | | | |
| C7 alkane | | | | | | | | | 200000 J | | | | |
| Ethyl-methyl-cyclopentane | | | | | | | | | | | | | 50000 J |
| | | 1.6 | 110 | 15 | | 236 | 6.4 | 13.2 | 464 | 900 | | | 420 |

# IRM SAMPLING IN TEST PIT 3 AREA

Soil borings in test pit #3 area

| PARAMETER | BP-1 | BP-1RE | BP-1MS | BP-1MSD | BP-1MSRE | BP-IMSDRE | BP-2 | BP-2RE | BP-3 | BP-3RE | BP-4 | BP-4RE |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SEMIVOLATILES (ug/kg) | | | | | | | | | | | | |
| Napthalene | 380 U | 370 U | 380 U | 380 U | 370 U | 380 U | 370 U | 53 J | 420 U | 420 U | 390 U | 390 U |
| Acenaphthylene | 380 U | 370 U | 380 U | 380 U | 370 U | 380 U | 370 U | 370 U | 420 U | 420 U | 390 U | 390 U |
| Acenaphthene | 380 U | 370 U | S | S | S | S | 370 U | 370 U | 420 U | 420 U | 390 U | 390 U |
| Phenanthrene | 41 J | 370 U | 380 U | 300 J | 370 U | 39 J | 370 U | 370 U | 420 U | 420 U | 390 U | 390 U |
| Anthracene | 380 U | 370 U | 380 U | 72 J | 370 U | 380 U | 370 U | 370 U | 420 U | 420 U | 390 U | 390 U |
| Fluoranthene | 66 J | 44 J | 49 J | 410 | 55 J | 65 J | 46 J | 48 J | 420 U | 420 U | 41 J | 390 U |
| Pyrene | 77 J | 38 J | S | S | S | S | 36 J | 49 J | 420 U | 420 U | 45 J | 390 U |
| Benzo(a)anthracene | 39 J | 370 U | 380 U | 190 J | 370 U | 380 U | 370 U | 370 U | 420 U | 420 U | 390 U | 390 U |
| Chrysene | 42 J | 370 U | 380 U | 190 J | 370 U | 380 U | 370 U | 370 U | 420 U | 420 U | 390 U | 390 U |
| Benzo(b)fluoranthene | 380 U | 370 U | 380 U | 110 J | 370 U | 380 U | 370 U | 370 U | 420 U | 420 U | 390 U | 390 U |
| Benzo(k)fluoranthene | 380 U | 370 U | 380 U | 180 J | 370 U | 380 U | 370 U | 370 U | 420 U | 420 U | 390 U | 390 U |
| Benzo(a)pyrene | 380 U | 370 U | 380 U | 110 J | 370 U | 380 U | 370 U | 370 U | 420 U | 420 U | 390 U | 390 U |
| Indeno(1,2,3-cd)pyrene | 380 U | 370 U | 380 U | 67 J | 370 U | 380 U | 370 U | 370 U | 420 U | 420 U | 390 U | 390 U |
| di-n-Butylphthalate | 160 JB | 1800 B | 310 JB | 300 JB | 2000 B | 2700 B | 930 B | 1800 B | 210 JB | 2900 B | 210 JB | 1100 B |

| PARAMETER | BP-5 | BP-5RE | BP-6 | BP-6RE | BP-7 | BP-7DL | BP-7RE | BP-8 | BP-8RE | BP-9 | BP-9RE |
|---|---|---|---|---|---|---|---|---|---|---|---|
| SEMIVOLATILES (ug/kg) | | | | | | | | | | | |
| Napthalene | 440 U | 430 U | 360 U | 360 U | 1900 U | NA | 1900 U | 360 U | 360 U | 390 U | 390 U |
| Acenaphthylene | 440 U | 430 U | 360 U | 360 U | 470 J | NA | 1900 U | 360 U | 360 U | 390 U | 390 U |
| Acenaphthene | 440 U | 430 U | 360 U | 360 U | 2500 | NA | 470 J | 360 U | 360 U | 390 U | 390 U |
| Phenanthrene | 440 U | 430 U | 410 | 360 U | 26000 | NA | 7600 | 360 U | 360 U | 240 J | 110 J |
| Anthracene | 440 U | 430 U | 93 J | 360 U | 8300 | NA | 2200 | 360 U | 360 U | 54 J | 390 U |
| Fluoranthene | 440 U | 430 U | 530 | 360 U | E | 46000 | 12000 | 360 U | 360 U | 520 | 140 J |
| Pyrene | 440 U | 430 U | 480 | 360 U | E | 51000 | 10000 | 360 U | 360 U | 370 J | 140 J |
| Benzo(a)anthracene | 440 U | 430 U | 190 J | 360 U | 10000 | NA | 3700 | 360 U | 360 U | 230 J | 66 J |
| Chrysene | 440 U | 430 U | 200 J | 360 U | 19000 | NA | 5300 | 360 U | 360 U | 280 J | 71 J |
| Benzo(b)fluoranthene | 440 U | 430 U | 140 J | 360 U | 12000 | NA | 4000 | 360 U | 360 U | 180 J | 50 J |
| Benzo(k)fluoranthene | 440 U | 430 U | 200 J | 360 U | 17000 | NA | 3600 | 360 U | 360 U | 170 J | 59 J |
| Benzo(a)pyrene | 440 U | 430 U | 170 J | 360 U | 16000 | NA | 4600 | 360 U | 360 U | 200 J | 53 J |
| Indeno(1,2,3-cd)pyrene | 440 U | 430 U | 93 J | 360 U | 11000 | NA | 3100 | 360 U | 360 U | 120 J | 390 U |
| di-n-Butylphthalate | 870 B | 2600 B | 140 JB | 900 B | 800 JB | NA | 2000 B | 600 B | 1800 B | 150 J | 2500 B |

IRM SAMPLING IN TEST PIT 3 AREA

Soil borings in Test pit #3 area

| PARAMETER | BP-1 | BP-2 | BP-3 | BP-4 | BP-5 | BP-6 | BP-7 | BP-8 | BP-9 |
|---|---|---|---|---|---|---|---|---|---|
| INORGANICS (mg/kg) | | | | | | | | | |
| Aluminum | 3190 | 4240 | 3150 | 6830 | 5900 | 2980 | 5520 | 3260 | 6320 |
| Antimony | 5.4 U | 5.5 b | 4.9 U | 5.6 U | 5.1 U | 4.4 U | 5.2 U | 4.2 U | 5.4 U |
| Arsenic | 0.90 b | 2.0 b | 0.73 b | 2.9 b | 1.3 b | 1.3 b | 8.7 | 1.9 b | 1.9 b |
| Chromium | 5.6 | 15.1 | 3.7 | 8.5 | 5.4 | 7.0 | 10.0 | 4.3 | 7.5 |
| Chromium VI | 0.11 U | 0.11 U | 0.15 | 0.12 U | 0.13 U | 0.12 U | 0.12 U | 0.11 U | 0.11 U |
| Copper | 17.7 | 28.4 | 4.9 | 14.7 | 9.7 | 5.6 | 20.5 | 21.9 | 10.3 |
| Iron | 6880 | 8810 | 4410 | 12800 | 6740 | 6280 | 7260 | 7350 | 8060 |
| Lead | 0.42 b | 160 | 3.2 | 5.2 | 4.6 | 2.8 | 14.0 | 2.6 | 31.9 |
| Magnesium | 4610 | 2000 | 806 b | 1940 | 972 | 1580 | 1350 | 7150 | 1320 |
| Manganese | 285 | 472 | 107 | 196 | 148 | 167 | 216 | 619 | 169 |
| Zinc | 22.5 | 103 | 14.8 | 36.1 | 19.5 | 20.1 | 35.9 | 41.2 | 26.2 |
| Cyanide ,total | 1.1 U | 1.1 U | 1.2 U | 1.2 U | 1.3 U | 1.2 U | 1.9 | 1.1 U | 1.1 U |

U – indicates compound was analyzed but not detected.
J – indicates an estimated value.
B – indicates the analyte was found in the associated blank as well as the sample.
D – indicates a compound identified in an analysis at a higher dilution factor.
E – indicates concentration exceeds calibration range.
NA – indicates compound was not analyzed in dilution.
b – indicates that the value is greater than the IDL but less than the CRDL.
S – indicates spike compound.

Grain Size Distribution and
Organic Matter Content Results
Test Pit 3 Area

Dave

parratt wolff inc
FISHER RD., EAST SYRACUSE, N.Y. 13057
TELEPHONE AREA CODE 315/437-1429

1069-03-1
Test Pit 3 Area

September 28, 1989

Malcolm Pirnie
890 Seventh North Street
Liverpool, New York 13088

Attention: Mr. Mark Wilder

Re: L-89024
Laboratory Testing
BS&K Columbia Mills
Minetto, New York

Gentlemen:

Enclosed are results of laboratory testing performed at your request on soil samples delivered to our office on 9-15-89 from and for the above project.

| | | |
|---|---|---|
| 1. | Sieve Analysis | 6 each |
| 2. | Hydrometer Analysis w/curves | 6 each |
| 3. | Organic Carbon Content | 6 each |

Thank you for this opportunity to work with you.

Very truly yours,

PARRATT - WOLFF, INC.

Donald P. Blasland, SET
V.P. - Laboratory Manager
DPB/ar
encs:

L-89024

MALCOLM PIRNIE
BS&K COLUMBIA MILLS
Project #1069-03-1

PERCENT ORGANIC MATTER (VOLATILE SOLIDS)

| | | |
|---|---|---|
| BP-2A | -- | 2.72 |
| BP-4A | -- | 1.32 |
| BP-5A | -- | 2.76 |
| BP-5B | -- | 3.20 |
| BP-7A | -- | 2.48 |
| BP-9A | -- | 3.80 |

pe[illegible]at[illegible] wolff inc
FISHER RD., EAST SYRACUSE, N.Y. 13057
TELEPHONE AREA CODE 315/437-1429

[illegible]ject No. [illegible]-8[illegible]

Project Title BS&K Columbia Mills Project #1069-03-1

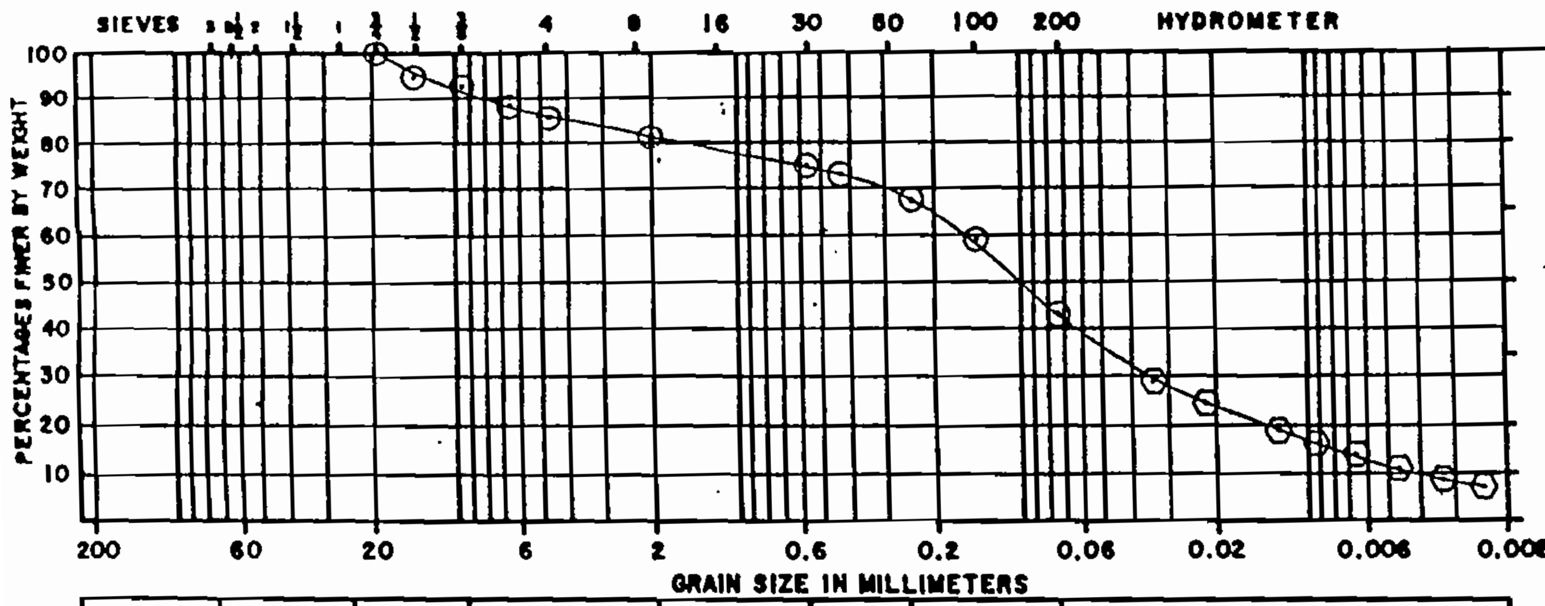
Sieve Analysis ASTM D422

| Sample | | Sieve Size - Percent Passing Sieve | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 2" | 1" | 3/4" | ½" | 3/8" | ¼" | #4 | #10 | #30 | #40 | #60 | #100 | #200 |
| BP-2A | 8-10' | -- | -- | 100 | 94.7 | 92.0 | 88.3 | 86.0 | 80.6 | 74.5 | 72.6 | 67.7 | 59.5 | 42.3 |
| BP-4A | 3-7' | -- | 100 | 95.7 | 93.8 | 91.5 | 87.8 | 84.6 | 77.0 | 69.6 | 67.2 | 60.7 | 48.4 | 31.9 |
| BP-5A | 1-4' | 100 | 95.4 | 90.5 | 85.0 | 79.4 | 73.1 | 68.8 | 59.1 | 49.6 | 46.8 | 40.1 | 31.3 | 20.0 |
| BP-5B | 6-8' | -- | -- | 100 | 99.6 | 99.6 | 98.4 | 97.1 | 93.9 | 89.6 | 88.2 | 82.7 | 69.6 | 46.6 |
| BP-7A | 2-4' | -- | 100 | 97.3 | 95.7 | 93.1 | 88.2 | 83.3 | 69.9 | 59.1 | 56.3 | 49.8 | 41.2 | 27.6 |
| BP-9A | 3-5' | 100 | 94.5 | 94.5 | 92.2 | 91.3 | 86.3 | 82.6 | 72.7 | 64.1 | 61.6 | 55.7 | 47.2 | 32.3 |

Remarks:

Prewashed ASTM C-117
Yes X No
Performed By J.G.

# GRAIN SIZE ANALYSIS




| BOULDERS COBBLES | GRAVEL C | GRAVEL M | GRAVEL F | SAND C | SAND M | SAND F | SILT-CLAY SOIL |
|---|---|---|---|---|---|---|---|

228 | 76.2 | 25.4 | 9.52 | 2.0 | 0.59 | 0.25 | 0.074 MM. OPENING

9 In. | 3 In. | 1 In. | 3/8 In. | Nos. 10 | 30 | 60 | 200 SIEVE

L-89024 SAMPLE – BP-2A

LABORATORY TESTING

BS&K COLUMBIA MILLS

PROJECT # 1069-03-1

⊙ SIEVE ANALYSIS

⊙ HYDROMETER ANALYSIS

parratt wolff inc
FISHER RD., EAST SYRACUSE, N.Y. 13057
TELEPHONE AREA CODE 315/437-1429

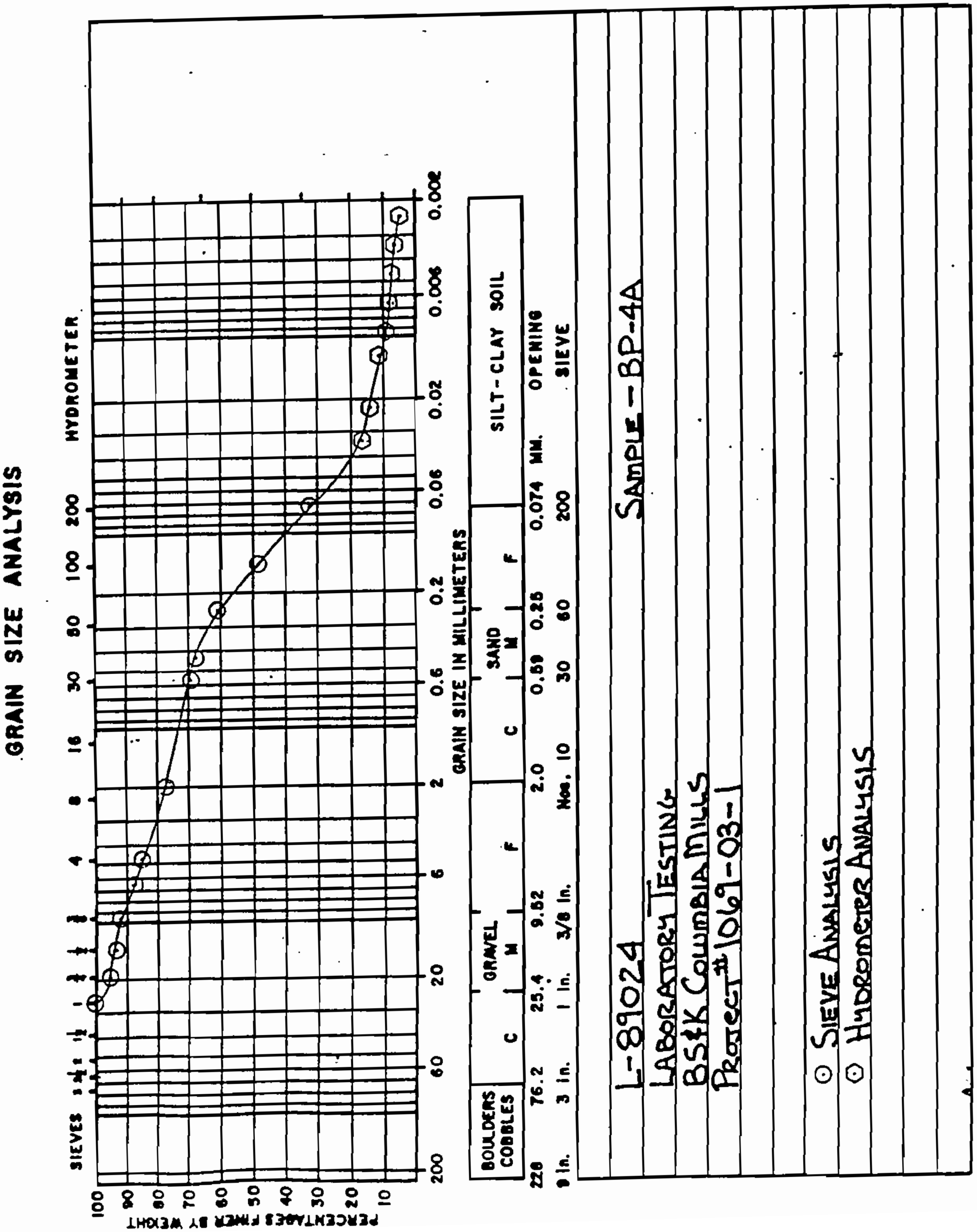
JOB NO. L-89024

REPORT NO. 1

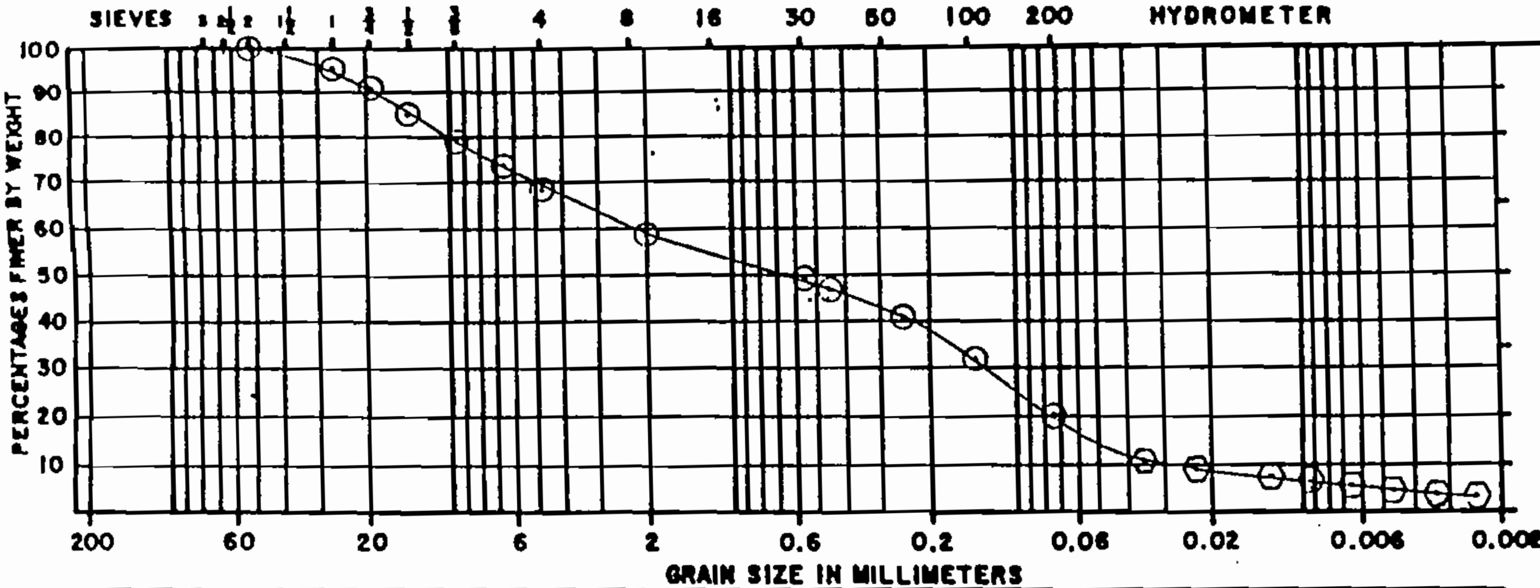
parratt wolff inc

FISHER RD., EAST SYRACUSE N.Y 13057
TELEPHONE AREA CODE 315/437-1429

JOB NO. L-89024
REPORT NO. 2



## GRAIN SIZE ANALYSIS




| BOULDERS COBBLES | GRAVEL C | GRAVEL M | GRAVEL F | SAND C | SAND M | SAND F | SILT-CLAY SOIL |
|---|---|---|---|---|---|---|---|

228 76.2 25.4 9.52 2.0 0.59 0.25 0.074 MM. OPENING

9 In. 3 In. 1 In. 3/8 In. Nos. 10 30 60 200 SIEVE

L-89024 SAMPLE – BP-5A

LABORATORY TESTING

BS&K COLUMBIA MILLS

PROJECT # 1069-03-1

⊙ SIEVE ANALYSIS

⊙ HYDROMETER ANALYSIS

parratt wolff inc

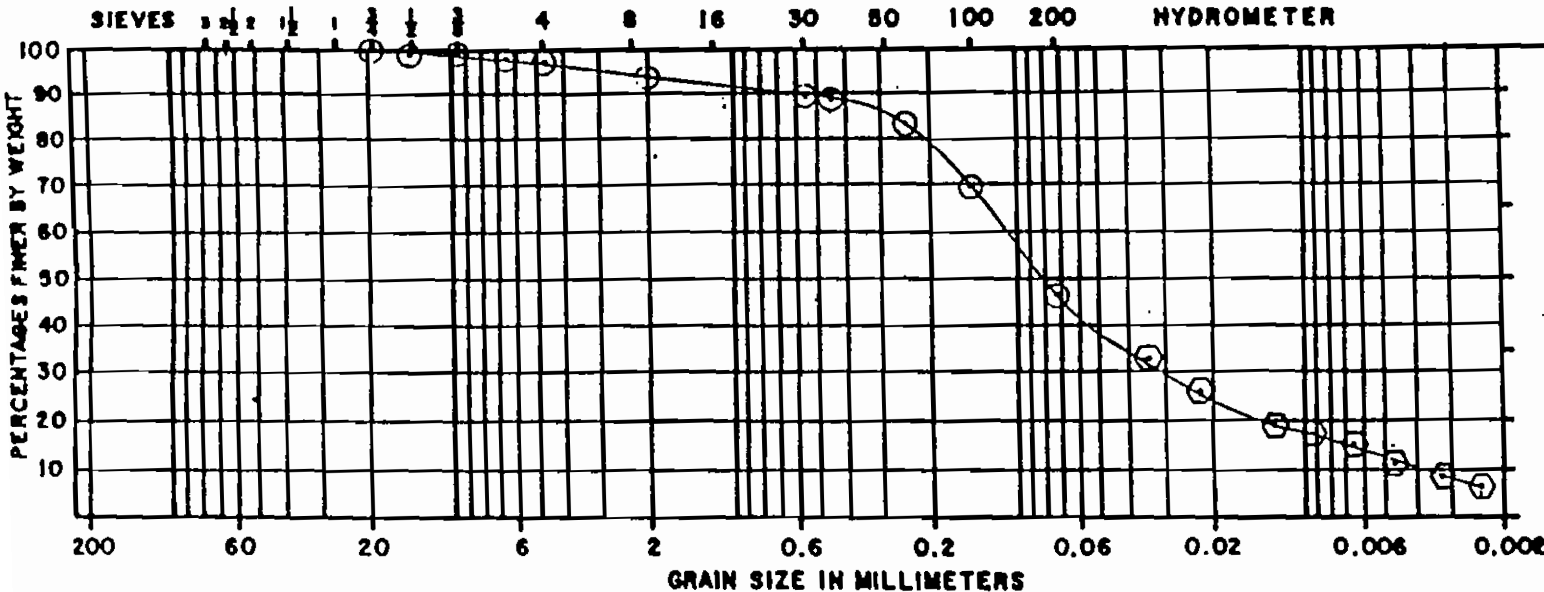
FISHER RD., EAST SYRACUSE N.Y. 13057

TELEPHONE AREA CODE 315/437 1429

JOB NO. L-89024

REPORT NO. 3

# GRAIN SIZE ANALYSIS




| BOULDERS COBBLES | GRAVEL C | GRAVEL M | GRAVEL F | SAND C | SAND M | SAND F | SILT-CLAY SOIL |
|---|---|---|---|---|---|---|---|

228 76.2 25.4 9.52 2.0 0.59 0.25 0.074 MM. OPENING

9 In. 3 In. 1 In. 3/8 In. Nos. 10 30 60 200 SIEVE

L-89024 SAMPLE – BP-5B

LABORATORY TESTING

BS&K COLUMBIA MILLS

PROJECT # 1069-03-1

⊙ SIEVE ANALYSIS

⊙ HYDROMETER ANALYSIS

parratt wolff inc
FISHER RD., EAST SYRACUSE N.Y 13057
TELEPHONE AREA CODE 315/437-1429

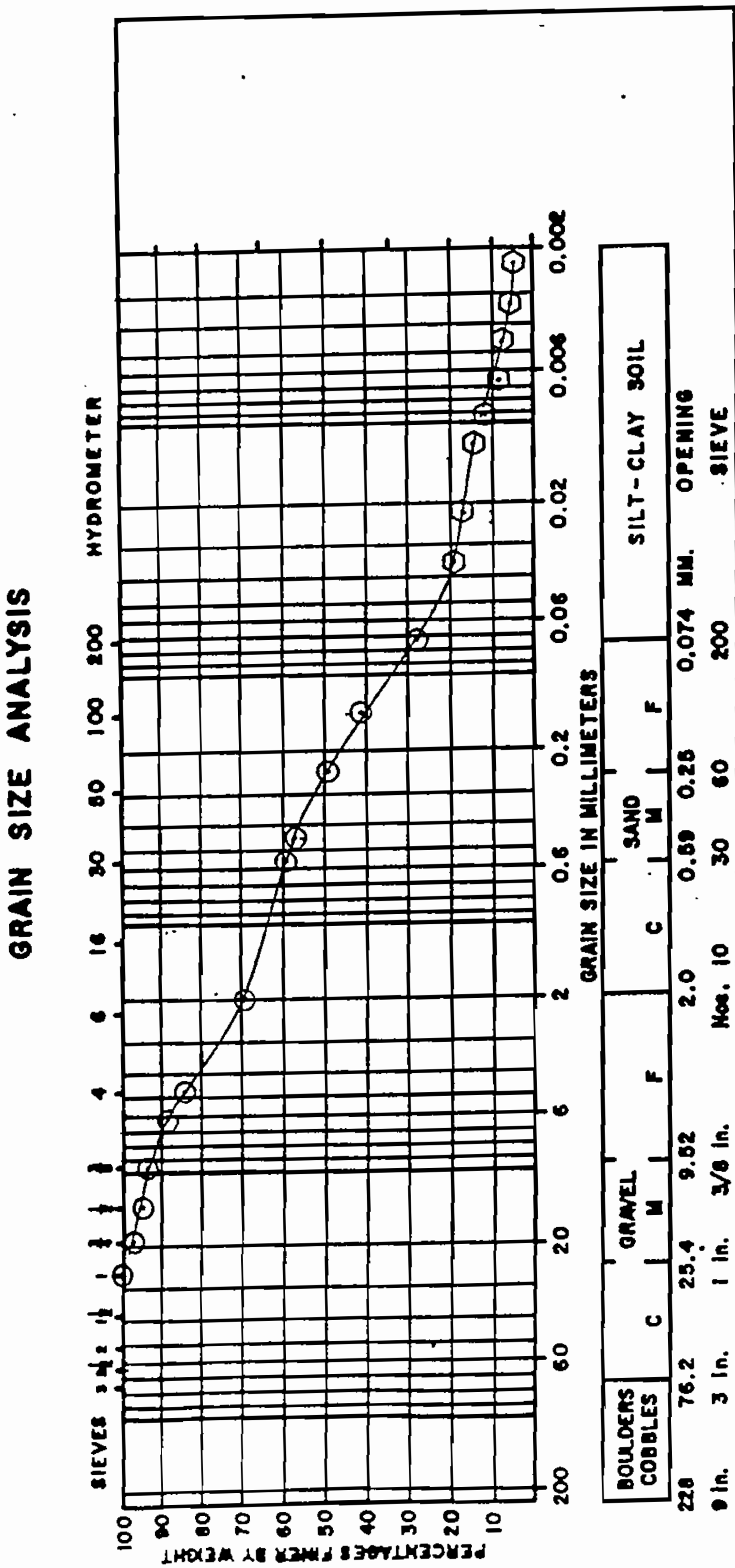
JOB NO. L-89024

REPORT NO. 4

parratt wolff inc

FISHER RD., EAST SYRACUSE N.Y 13057
TELEPHONE AREA CODE 315/437-1429

JOB NO. L-89024
REPORT NO. 5




Sample – BP-7A

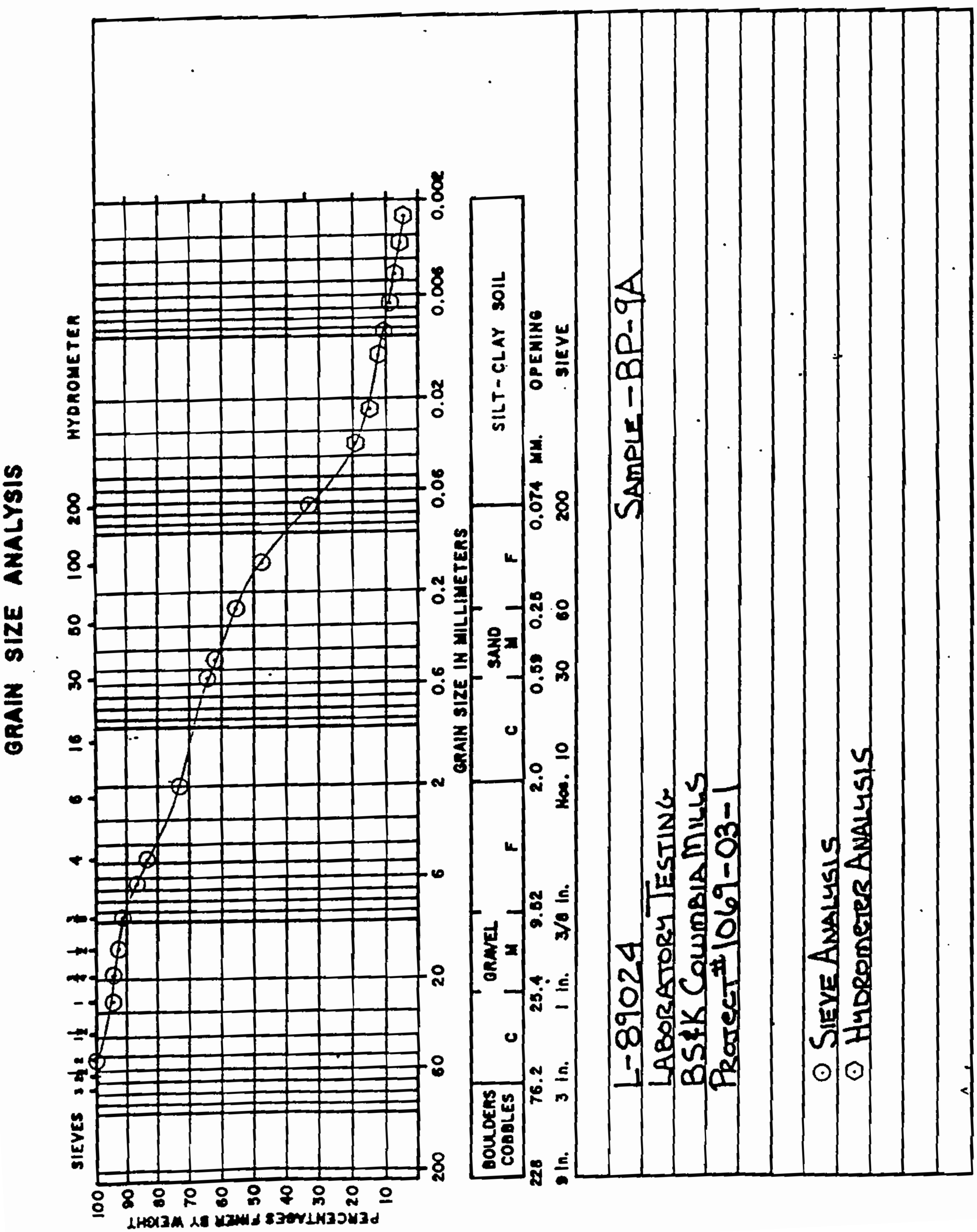
L-89024
Laboratory Testing
BS&K Columbia Mills
Project # 1069-03-1

⊙ Sieve Analysis
⊙ Hydrometer Analysis

parratt wolff inc

FISHER RD., EAST SYRACUSE N.Y 13057
TELEPHONE AREA CODE 315/437-1429

JOB NO. L-89024
REPORT NO. 6



parratt wolff inc
FISHER RD., EAST SYRACUSE, N.Y. 13057
TELEPHONE AREA CODE 315/437-1429
FAX 315/437-1770

February 1, 1990

Malcolm Pirnie
7481 Henry Clay Boulevard
Liverpool, New York 13088

Attention: Mr. Dave Knutsen

Re: L-90012
Laboratory Testing
Columbia Mills
Minetto, New York

Gentlemen:

Enclosed are the results of eight Sieve and Hydrometer Analyses performed at your request on soil samples delivered to our office from and for the above project.

Thank you for this opportunity to work with you.

Very truly yours,

PARRATT - WOLFF, INC.

Donald P. Blasland, SET
V.P. - Laboratory Manager
DPB/ar
encs:

parratt wolff inc
FISHER RD., EAST SYRACUSE, N.Y. 13057
TELEPHONE AREA CODE 315/437-1429

Project No. L-90012

Project Title Columbia Mills, Minetto, New York

## Sieve Analysis ASTM D422

| Sample | | Sieve Size - Percent Passing Sieve | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 2" | 1" | 3/4" | 1/2" | 3/8" | 1/4" | #4 | #10 | #30 | #40 | #60 | #100 | #200 |
| #1-P-7, P-8 and B-10S | | -- | -- | -- | -- | -- | -- | 100 | 99.8 | 99.1 | 98.9 | 98.0 | 94.1 | 77.0 |
| #2-B-11D 9'-11' | | -- | 100 | 97.5 | 95.0 | 94.6 | 94.5 | 94.3 | 93.6 | 93.3 | 93.1 | 92.2 | 90.2 | 82.5 |
| #3-B-19D 8'-14' | | 100 | 94.4 | 94.4 | 92.4 | 91.9 | 89.6 | 87.2 | 82.3 | 77.7 | 76.8 | 73.0 | 57.0 | 32.5 |
| #4-P-9 and P-10 | | 100 | 96.7 | 90.3 | 86.1 | 83.5 | 78.6 | 75.0 | 67.5 | 61.2 | 60.0 | 56.2 | 47.5 | 32.1 |
| * #5A-B-12S 6'-9' | | -- | -- | -- | -- | -- | 100 | 99.8 | 99.5 | 98.7 | 98.7 | 97.4 | 95.4 | 86.1 |
| * #5B-B14S 10'-11.9' | | -- | -- | 100 | 97.4 | 97.4 | 95.4 | 94.1 | 90.8 | 85.6 | 83.9 | 77.3 | 67.1 | 53.4 |
| * #7-B-12S and B-13D 0'-4' | | 100 | 93.2 | 92.3 | 88.5 | 85.9 | 82.7 | 80.3 | 73.7 | 68.1 | 66.7 | 62.9 | 51.9 | 33.4 |
| #8-B-20S 4'-10' | | 100 | 97.3 | 97.3 | 91.3 | 86.9 | 83.7 | 80.5 | 74.1 | 67.7 | 65.8 | 58.4 | 41.6 | 24.3 |

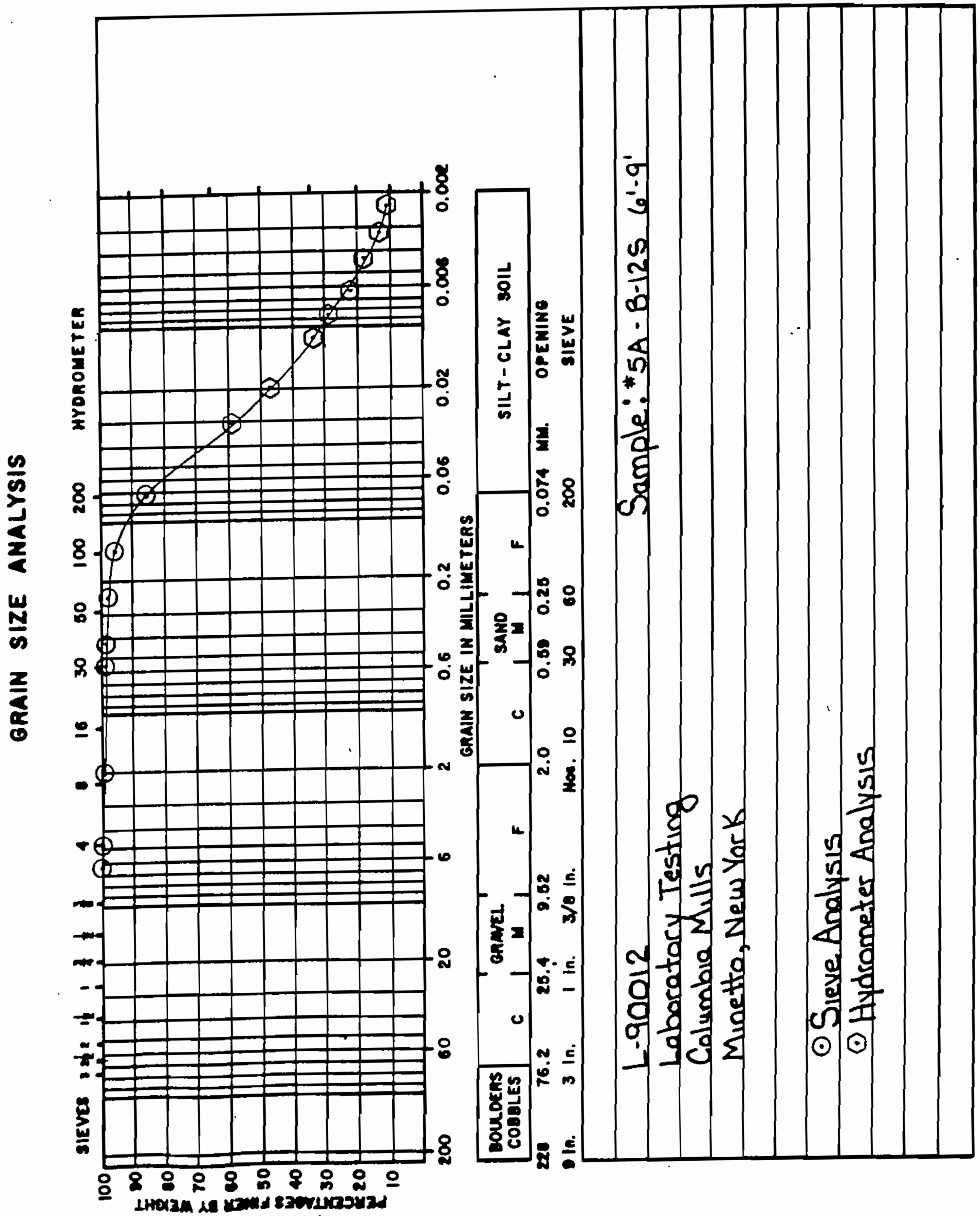
Remarks:

Prewashed ASTM C-117
Yes X No
Performed By RGC

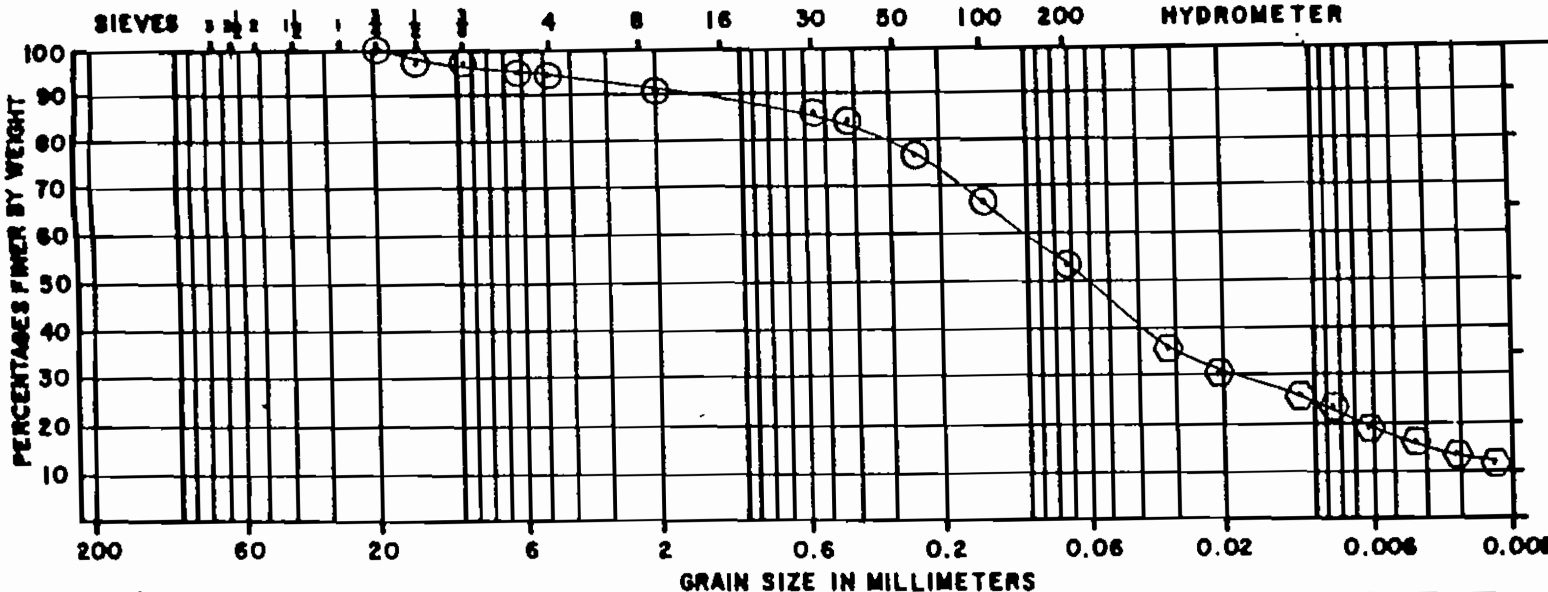
parratt wolff inc

FISHER RD., EAST SYRACUSE N Y 13057
TELEPHONE AREA CODE 315/437 1429

JOB NO. L-90012
REPORT NO. 5



# GRAIN SIZE ANALYSIS




| BOULDERS COBBLES | GRAVEL C | GRAVEL M | GRAVEL F | SAND C | SAND M | SAND F | SILT-CLAY SOIL |
|---|---|---|---|---|---|---|---|

228 76.2 25.4 9.52 2.0 0.59 0.25 0.074 MM. OPENING

9 In. 3 In. 1 In. 3/8 In. Nos. 10 30 60 200 SIEVE

L-90012
Laboratory Testing
Columbia Mills
Minetto, New York

Sample: #5B-B-14S 10'-11.9'

⊙ Sieve Analysis
⊙ Hydrometer Analysis

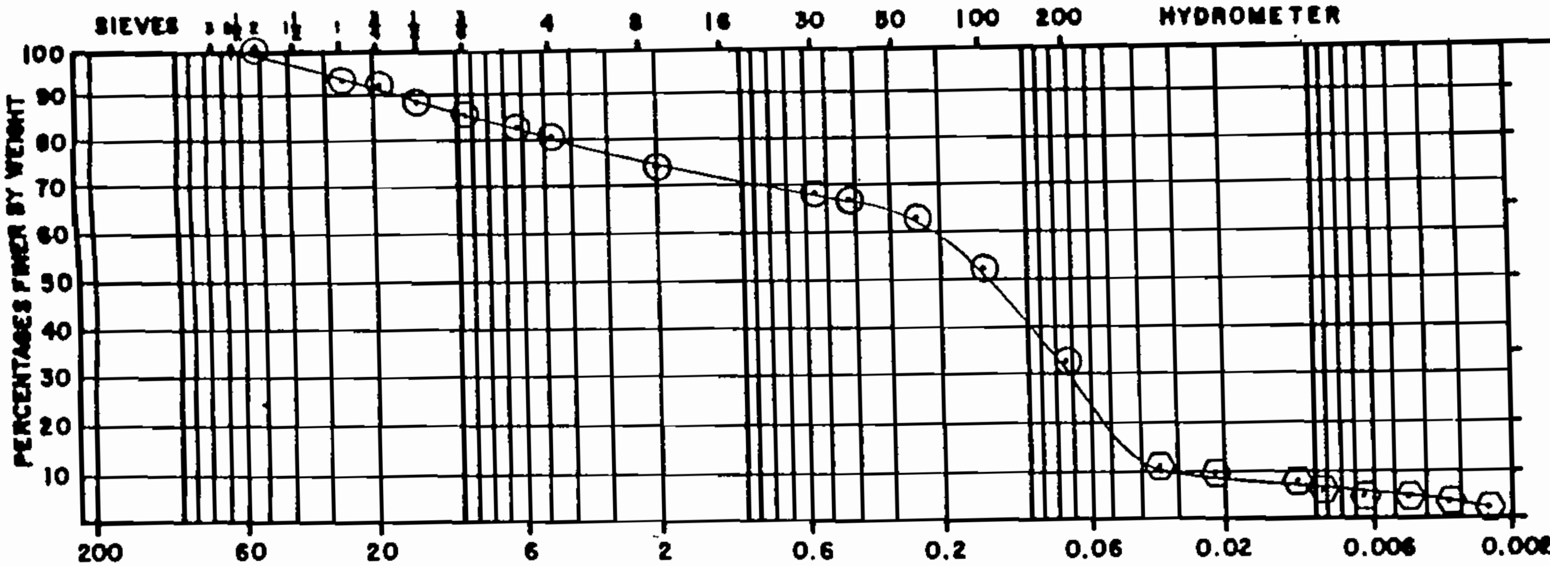

parratt wolff inc
FISHER RD. EAST SYRACUSE N.Y. 13057
TELEPHONE AREA CODE 315/437 1429


JOB NO. L-90012
REPORT NO. 6

parratt wolff inc
FISHER RD. EAST SYRACUSE N.Y 13057
TELEPHONE AREA CODE 315/437 1429

JOB NO. L-90012
REPORT NO. 7

# GRAIN SIZE ANALYSIS




| BOULDERS COBBLES | GRAVEL C | GRAVEL M | GRAVEL F | SAND C | SAND M | SAND F | SILT-CLAY SOIL |
|---|---|---|---|---|---|---|---|

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 228 | 76.2 | 25.4 | 9.52 | 2.0 | 0.59 | 0.25 | 0.074 | MM. | OPENING |
| 9 In. | 3 In. | 1 In. | 3/8 In. | Nos. 10 | 30 | 60 | 200 | | SIEVE |

L-90012
Laboratory Testing
Columbia Mills
Minetto, New York

Sample: #7 - B-12S + B-13D 0'-4'

⊙ Sieve Analysis
⊙ Hydrometer Analysis

# APPENDIX B
## Preliminary Screening Tables

COLUMBIA MILLS
PRELIMINARY SCREENING RESULTS
REMEDIATION OF TEST PIT AREA 3 SOILS
VOLATILE ORGANICS

| Remedial Alternative | Effectiveness | | | | | | | | Implementability | | | | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Protection of Community -Short Term | Environmental Impacts -Short Term | Implementation Time | Permanence Of Alternative | Lifetime Of Remedial Action | Waste Left Onsite | Control Adequacy and Reliability | TOTAL (Max = 25) | Technical Feasibility | Administrative Feasibility | Availability of Services & Materials | TOTAL (Max = 15) | (Max = 40) |
| No Action | 0 | 0 | 2 | 0 | 0 | 2 | 0 | 4 | 8 | 2 | 3 | 13 | 17 |
| Vertical Barrier-Slurry Wall | 4 | 0 | 2 | 0 | 4 | 2 | 0 | 12 | 5 | 1 | 3 | 9 | 21 |
| Excavation/On Site Disposal | 0 | 4 | 2 | 0 | 4 | 2 | 1 | 13 | 5 | 0 | 3 | 8 | 21 |
| Excavation/Off Site Disposal | 0 | 3 | 2 | 0 | 4 | 4 | 4 | 17 | 6 | 0 | 3 | 9 | 26 |
| Vapor Extraction/Ground Water Extraction | 3 | 4 | 2 | 5 | N/A | 4 | 4 | 22 | 8 | 1 | 3 | 12 | 34 |
| Bioremediation (In-Situ) | 0 | 4 | 2 | 5 | N/A | 4 | 4 | 19 | 6 | 1 | 3 | 10 | 29 |
| Soil Washing (In-Situ) | 0 | 3 | 2 | 5 | N/A | 4 | 4 | 18 | 6 | 1 | 3 | 10 | 28 |
| Excavation/Spread Out (Aerate) | 0 | 3 | 0 | 5 | N/A | 4 | 4 | 16 | 6 | 0 | 3 | 9 | 25 |
| Excavate/Low Temperature Incineration | 0 | 3 | 2 | 5 | N/A | 2 | 3 | 15 | 6 | 1 | 3 | 10 | 25 |

N/A - Not Applicable

Test Pit 3 Area - VOCs
No Action

4
13

Table 4-1

SHORT-TERM/LONG-TERM EFFECTIVENESS
(Maximum Score = 25)

| Analysis Factor | Basis for Evaluation During Preliminary Screening | | | Score |
|---|---|---|---|---|
| 1. Protection of community during remedial actions. | ° Are there significant short-term risks to the community that must be addressed? (If answer is no, go to Factor 2.) | Yes | ✓ | 0 |
| | | No | | 4 |
| | ° Can the short-term risk be easily controlled? | Yes | | 1 |
| | | No | ✓ | 0 |
| | ° Does the mitigative effort to control short-term risk impact the community life-style? | Yes | ✓ | 0 |
| | | No | | 2 |
| Subtotal (maximum = 4) | | | | |
| 2. Environmental Impacts | ° Are there significant short-term risks to the environment that must be addressed? (If answer is no, go to Factor 3.) | Yes | ✓ | 0 |
| | | No | | 4 |
| | ° Are the available mitigative measures reliable to minimize potential impacts? | Yes | | 3 |
| | | No | ✓ | 0 |
| Subtotal (maximum = 4) | | | | |
| 3. Time to implement the remedy. | ° What is the required time to implement the remedy? | $\leq$ 2yr. | ✓ | 1 |
| | | > 2yr. | | 0 |
| | ° Required duration of the mitigative effort to control short-term risk. | $\leq$ 2yr. | ✓ | 1 |
| | | > 2yr. | | 0 |
| Subtotal (maximum = 2) | | | | |
| 4. Permanence of the remedial alternative. | ° Will the remedy be classified as permanent in accordance with Section 2.1(a), (b), or (c). (If answer is yes, go to Factor 6.) | Yes | | 5 |
| | | No | ✓ | 0 |
| Subtotal (maximum = 5) | | | | |

Table 4-1 (continued)

SHORT-TERM/LONG-TERM EFFECTIVENESS
(Maximum Score = 25)

| Analysis Factor | Basis for Evaluation During Preliminary Screening | | | Score |
|---|---|---|---|---|
| 5. Lifetime of remedial actions. | ° Expected lifetime or duration of of effectiveness of the remedy. | 25-30yr. | | 4 |
| | | 20-25yr. | | 3 |
| | | 15-20yr. | | 2 |
| | | < 15yr. | ✓ | 0 |
| Subtotal (maximum = 4) | | | | |
| 6. Quantity and nature of waste or residual left at the site after remediation. | i) Quantity of untreated hazardous waste left at the site. | None | | 3 |
| | | < 25% | | 2 |
| | | 25-50% | | 1 |
| | | ≥ 50% | ✓ | 0 |
| | ii) Is there treated residual left at the site? (If answer is no, go to Factor 7.) | Yes | | 0 |
| | | No | ✓ | 2 |
| | iii) Is the treated residual toxic? | Yes | | 0 |
| | | No | | 1 |
| | iv) Is the treated residual mobile? | Yes | | 0 |
| | | No | | 1 |
| Subtotal (maximum = 5) | | | | |
| 7. Adequacy and reliability of controls. | i) Operation and maintenance required for a period of: | < 5yr. | | 1 |
| | | > 5yr. | ✓ | 0 |
| | ii) Are environmental controls required as a part of the remedy to handle potential problems? (If answer is no, go to "iv") | Yes | ✓ | 0 |
| | | No | | 2 |
| | iii) Degree of confidence that controls can adequately handle potential problems. | Moderate to very confident | | 1 |
| | | Somewhat to not confident | ✓ | 0 |
| | iv) Relative degree of long-term monitoring required (compare with other remedial alternatives evaluated in the Detailed Analysis). | Minimum | | 2 |
| | | Moderate | | 1 |
| | | Extensive | ✓ | 0 |
| Subtotal (maximum = 5) | | | | |
| TOTAL (maximum = 25) | | | | |

IF THE TOTAL IS LESS THAN 10, PROJECT MANAGER MAY REJECT THE REMEDIAL ALTERNATIVE FROM FURTHER CONSIDERATION.

Table 4-2

IMPLEMENTABILITY
(Maximum Score = 15)

| Analysis Factor | Basis for Evaluation During Preliminary Screening | | | Score |
|---|---|---|---|---|
| 1. Technical Feasibility | | | | |
| a. Ability to construct technology. | i) Not difficult to construct. No uncertainties in construction. | | ✓ | 3 |
| | ii) Somewhat difficult to construct. No uncertainties in construction. | | | 2 |
| | iii) Very difficult to construct and/or significant uncertainties in construction. | | | 1 |
| b. Reliability of technology. | i) Very reliable in meeting the specified process efficiencies or performance goals. | | | 3 |
| | ii) Somewhat reliable in meeting the specified process efficiencies or performance goals. | | ✓ | 2 |
| c. Schedule of delays due to technical problems. | i) Unlikely | | ✓ | 2 |
| | ii) Somewhat likely | | | 1 |
| d. Need of undertaking additional remedial action, if necessary. | i) No future remedial actions may be anticipated. | | | 2 |
| | ii) Some future remedial actions may be necessary. | | ✓ | 1 |
| **Subtotal (maximum = 10)** | | | | |
| 2. Administrative Feasibility | | | | |
| a. Coordination with other agencies. | i) Minimal coordination is required. | | ✓ | 2 |
| | ii) Required coordination is normal. | | | 1 |
| | iii) Extensive coordination is required. | | | 0 |
| **Subtotal (maximum = 2)** | | | | |
| 3. Availability of Services and Materials | | | | |
| a. Availability of prospective technologies. | i) Are technologies under consideration generally commercially available for the site-specific application? | Yes | ✓ | 1 |
| | | No | | 0 |
| | ii) Will more than one vendor be available to provide a competitive bid? | Yes | ✓ | 1 |
| | | No | | 0 |

Table 4-2 (continued)

IMPLEMENTABILITY
(Maximum Score = 15)

| Analysis Factor | Basis for Evaluation During Preliminary Screening | | | Score |
|---|---|---|---|---|
| b. Availability of necessary equipment and specialists. | i) Additional equipment and specialists may be available without significant delay. | Yes | ✓ | 1 |
| | | No | | 0 |

**Subtotal (maximum = 3)**

**TOTAL (maximum = 15)**

**IF THE TOTAL IS LESS THAN 8, PROJECT MANAGER MAY REJECT THE REMEDIAL ALTERNATIVE FROM FURTHER CONSIDERATION.**

Test Pit 3 Area VOCs
Vertical Barriers / Slurry Walls

(12)
9

Table 4-1

SHORT-TERM/LONG-TERM EFFECTIVENESS
(Maximum Score = 25)

| Analysis Factor | Basis for Evaluation During Preliminary Screening | | | Score |
|---|---|---|---|---|
| 1. Protection of community during remedial actions. | ° Are there significant short-term risks to the community that must be addressed? (If answer is no, go to Factor 2.) | Yes<br>No | <br>✓ | 0<br>4 |
| | ° Can the short-term risk be easily controlled? | Yes<br>No | | 1<br>0 |
| | ° Does the mitigative effort to control short-term risk impact the community life-style? | Yes<br>No | | 0<br>2 |
| **Subtotal (maximum = 4)** | | | | |
| 2. Environmental Impacts | ° Are there significant short-term risks to the environment that must be addressed? (If answer is no, go to Factor 3.) | Yes<br>No | ✓<br> | 0<br>4 |
| | ° Are the available mitigative measures reliable to minimize potential impacts? | Yes<br>No | <br>✓ | 3<br>0 |
| **Subtotal (maximum = 4)** | | | | |
| 3. Time to implement the remedy. | ° What is the required time to implement the remedy? | ≤ 2yr.<br>> 2yr. | ✓<br> | 1<br>0 |
| | ° Required duration of the mitigative effort to control short-term risk. | ≤ 2yr.<br>> 2yr. | ✓<br> | 1<br>0 |
| **Subtotal (maximum = 2)** | | | | |
| 4. Permanence of the remedial alternative. | ° Will the remedy be classified as permanent in accordance with Section 2.1(a), (b), or (c). (If answer is yes, go to Factor 6.) | Yes<br>No | <br>✓ | 5<br>0 |
| **Subtotal (maximum = 5)** | | | | |

Table 4-1 (continued)

SHORT-TERM/LONG-TERM EFFECTIVENESS
(Maximum Score = 25)

| Analysis Factor | Basis for Evaluation During Preliminary Screening | | | Score |
|---|---|---|---|---|
| 5. Lifetime of remedial actions. | ° Expected lifetime or duration of of effectiveness of the remedy. | 25-30yr. | ✓ | 4 |
| | | 20-25yr. | | 3 |
| | | 15-20yr. | | 2 |
| | | < 15yr. | | 0 |
| Subtotal (maximum = 4) | | | | |
| 6. Quantity and nature of waste or residual left at the site after remediation. | i) Quantity of untreated hazardous waste left at the site. | None | | 3 |
| | | < 25% | | 2 |
| | | 25-50% | | 1 |
| | | ≥ 50% | ✓ | 0 |
| | ii) Is there treated residual left at the site? (If answer is no, go to Factor 7.) | Yes | | 0 |
| | | No | ✓ | 2 |
| | iii) Is the treated residual toxic? | Yes | | 0 |
| | | No | | 1 |
| | iv) Is the treated residual mobile? | Yes | | 0 |
| | | No | | 1 |
| Subtotal (maximum = 5) | | | | |
| 7. Adequacy and reliability of controls. | i) Operation and maintenance required for a period of: | < 5yr. | | 1 |
| | | > 5yr. | ✓ | 0 |
| | ii) Are environmental controls required as a part of the remedy to handle potential problems? (If answer is no, go to "iv") | Yes | ✓ | 0 |
| | | No | | 2 |
| | iii) Degree of confidence that controls can adequately handle potential problems. | Moderate to very confident | | 1 |
| | | Somewhat to not confident | ✓ | 0 |
| | iv) Relative degree of long-term monitoring required (compare with other remedial alternatives evaluated in the Detailed Analysis). | Minimum | | 2 |
| | | Moderate | | 1 |
| | | Extensive | ✓ | 0 |
| Subtotal (maximum = 5) | | | | |
| TOTAL (maximum = 25) | | | | |

IF THE TOTAL IS LESS THAN 10, PROJECT MANAGER MAY REJECT THE REMEDIAL ALTERNATIVE FROM FURTHER CONSIDERATION.

Table 4-2

**IMPLEMENTABILITY**
(Maximum Score = 15)

| Analysis Factor | Basis for Evaluation During Preliminary Screening | | | Score |
|---|---|---|---|---|
| 1. <u>Technical Feasibility</u> | | | | |
| a. Ability to construct technology. | i) Not difficult to construct. No uncertainties in construction. | | ___ | 3 |
| | ii) Somewhat difficult to construct. No uncertainties in construction. | | ___ | 2 |
| | iii) Very difficult to construct and/or significant uncertainties in construction. | | ✓ | 1 |
| b. Reliability of technology. | i) Very reliable in meeting the specified process efficiencies or performance goals. | | ___ | 3 |
| | ii) Somewhat reliable in meeting the specified process efficiencies or performance goals. | | ✓ | 2 |
| c. Schedule of delays due to technical problems. | i) Unlikely | | ___ | 2 |
| | ii) Somewhat likely | | ✓ | 1 |
| d. Need of undertaking additional remedial action, if necessary. | i) No future remedial actions may be anticipated. | | ___ | 2 |
| | ii) Some future remedial actions may be necessary. | | ✓ | 1 |
| **Subtotal (maximum = 10)** | | | | |
| 2. <u>Administrative Feasibility</u> | | | | |
| a. Coordination with other agencies. | i) Minimal coordination is required. | | ___ | 2 |
| | ii) Required coordination is normal. | | ✓ | 1 |
| | iii) Extensive coordination is required. | | ___ | 0 |
| **Subtotal (maximum = 2)** | | | | |
| 3. <u>Availability of Services and Materials</u> | | | | |
| a. Availability of prospective technologies. | i) Are technologies under consideration generally commercially available for the site-specific application? | Yes<br>No | ✓<br>___ | 1<br>0 |
| | ii) Will more than one vendor be available to provide a competitive bid? | Yes<br>No | ✓<br>___ | 1<br>0 |

Table 4-2 (continued)

**IMPLEMENTABILITY**
(Maximum Score = 15)

| Analysis Factor | Basis for Evaluation During Preliminary Screening | | | Score |
|---|---|---|---|---|
| b. Availability of necessary equipment and specialists. | i) Additional equipment and specialists may be available without significant delay. | Yes | ✓ | 1 |
| | | No | | 0 |

**Subtotal (maximum = 3)**

**TOTAL (maximum = 15)**

**IF THE TOTAL IS LESS THAN 8, PROJECT MANAGER MAY REJECT THE REMEDIAL ALTERNATIVE FROM FURTHER CONSIDERATION.**

Test Pit 3 Area VOCs
Excavation/on-site disposal

Table 4-1

13
8

## SHORT-TERM/LONG-TERM EFFECTIVENESS
(Maximum Score = 25)

| Analysis Factor | Basis for Evaluation During Preliminary Screening | | | Score |
|---|---|---|---|---|
| 1. Protection of community during remedial actions. | ° Are there significant short-term risks to the community that must be addressed? (If answer is no, go to Factor 2.) | Yes | ✓ | 0 |
| | | No | | 4 |
| | ° Can the short-term risk be easily controlled? | Yes | | 1 |
| | | No | ✓ | 0 |
| | ° Does the mitigative effort to control short-term risk impact the community life-style? | Yes | ✓ | 0 |
| | | No | | 2 |
| Subtotal (maximum = 4) | | | | |
| 2. Environmental Impacts | ° Are there significant short-term risks to the environment that must be addressed? (If answer is no, go to Factor 3.) | Yes | | 0 |
| | | No | ✓ | 4 |
| | ° Are the available mitigative measures reliable to minimize potential impacts? | Yes | | 3 |
| | | No | | 0 |
| Subtotal (maximum = 4) | | | | |
| 3. Time to implement the remedy. | ° What is the required time to implement the remedy? | ≤ 2yr. | ✓ | 1 |
| | | > 2yr. | | 0 |
| | ° Required duration of the mitigative effort to control short-term risk. | ≤ 2yr. | ✓ | 1 |
| | | > 2yr. | | 0 |
| Subtotal (maximum = 2) | | | | |
| 4. Permanence of the remedial alternative. | ° Will the remedy be classified as permanent in accordance with Section 2.1(a), (b), or (c). (If answer is yes, go to Factor 6.) | Yes | | 5 |
| | | No | ✓ | 0 |
| Subtotal (maximum = 5) | | | | |

Table 4-1 (continued)

SHORT-TERM/LONG-TERM EFFECTIVENESS
(Maximum Score = 25)

| Analysis Factor | Basis for Evaluation During Preliminary Screening | | | Score |
|---|---|---|---|---|
| 5. Lifetime of remedial actions. | ° Expected lifetime or duration of of effectiveness of the remedy. | 25-30yr. | ✓ | 4 |
| | | 20-25yr. | | 3 |
| | | 15-20yr. | | 2 |
| | | < 15yr. | | 0 |
| Subtotal (maximum = 4) | | | | |
| 6. Quantity and nature of waste or residual left at the site after remediation. | i) Quantity of untreated hazardous waste left at the site. | None | | 3 |
| | | < 25% | | 2 |
| | | 25-50% | | 1 |
| | | ≥ 50% | ✓ | 0 |
| | ii) Is there treated residual left at the site? (If answer is no, go to Factor 7.) | Yes | | 0 |
| | | No | ✓ | 2 |
| | iii) Is the treated residual toxic? | Yes | | 0 |
| | | No | | 1 |
| | iv) Is the treated residual mobile? | Yes | | 0 |
| | | No | | 1 |
| Subtotal (maximum = 5) | | | | |
| 7. Adequacy and reliability of controls. | i) Operation and maintenance required for a period of: | < 5yr. | | 1 |
| | | > 5yr. | ✓ | 0 |
| | ii) Are environmental controls required as a part of the remedy to handle potential problems? (If answer is no, go to "iv") | Yes | ✓ | 0 |
| | | No | | 2 |
| | iii) Degree of confidence that controls can adequately handle potential problems. | Moderate to very confident | ✓ | 1 |
| | | Somewhat to not confident | | 0 |
| | iv) Relative degree of long-term monitoring required (compare with other remedial alternatives evaluated in the Detailed Analysis). | Minimum | | 2 |
| | | Moderate | | 1 |
| | | Extensive | ✓ | 0 |
| Subtotal (maximum = 5) | | | | |
| TOTAL (maximum = 25) | | | | |

IF THE TOTAL IS LESS THAN 10, PROJECT MANAGER MAY REJECT THE REMEDIAL ALTERNATIVE FROM FURTHER CONSIDERATION.

Table 4-2

IMPLEMENTABILITY
(Maximum Score = 15)

| Analysis Factor | Basis for Evaluation During Preliminary Screening | | Score |
|---|---|---|---|
| 1. Technical Feasibility | | | |
| a. Ability to construct technology. | i) Not difficult to construct. No uncertainties in construction. | ___ | 3 |
| | ii) Somewhat difficult to construct. No uncertainties in construction. | ___ | 2 |
| | iii) Very difficult to construct and/or significant uncertainties in construction. | ✓ | 1 |
| b. Reliability of technology. | i) Very reliable in meeting the specified process efficiencies or performance goals. | ___ | 3 |
| | ii) Somewhat reliable in meeting the specified process efficiencies or performance goals. | ✓ | 2 |
| c. Schedule of delays due to technical problems. | i) Unlikely | ___ | 2 |
| | ii) Somewhat likely | ✓ | 1 |
| d. Need of undertaking additional remedial action, if necessary. | i) No future remedial actions may be anticipated. | ___ | 2 |
| | ii) Some future remedial actions may be necessary. | ✓ | 1 |
| **Subtotal (maximum = 10)** | | | |
| 2. Administrative Feasibility | | | |
| a. Coordination with other agencies. | i) Minimal coordination is required. | ___ | 2 |
| | ii) Required coordination is normal. | ___ | 1 |
| | iii) Extensive coordination is required. | ✓ | 0 |
| **Subtotal (maximum = 2)** | | | |
| 3. Availability of Services and Materials | | | |
| a. Availability of prospective technologies. | i) Are technologies under consideration generally commercially available for the site-specific application? | Yes ✓<br>No ___ | 1<br>0 |
| | ii) Will more than one vendor be available to provide a competitive bid? | Yes ✓<br>No ___ | 1<br>0 |

Table 4-2 (continued)

**IMPLEMENTABILITY**
(Maximum Score = 15)

| Analysis Factor | Basis for Evaluation During Preliminary Screening | | | Score |
|---|---|---|---|---|
| b. Availability of necessary equipment and specialists. | i) Additional equipment and specialists may be available without significant delay. | Yes | √ | 1 |
| | | No | | 0 |

**Subtotal (maximum = 3)**

**TOTAL (maximum = 15)**

**IF THE TOTAL IS LESS THAN 8, PROJECT MANAGER MAY REJECT THE REMEDIAL ALTERNATIVE FROM FURTHER CONSIDERATION.**

Test Pit 3 Area - VOCs
Excavation/off-site disposal

Table 4-1

SHORT-TERM/LONG-TERM EFFECTIVENESS
(Maximum Score = 25)

17
9

| Analysis Factor | Basis for Evaluation During Preliminary Screening | | | Score |
|---|---|---|---|---|
| 1. Protection of community during remedial actions. | ° Are there significant short-term risks to the community that must be addressed? (If answer is no, go to Factor 2.) | Yes | ✓ | 0 |
| | | No | | 4 |
| | ° Can the short-term risk be easily controlled? | Yes | | 1 |
| | | No | ✓ | 0 |
| | ° Does the mitigative effort to control short-term risk impact the community life-style? | Yes | ✓ | 0 |
| | | No | | 2 |
| Subtotal (maximum = 4) | | | | |
| 2. Environmental Impacts | ° Are there significant short-term risks to the environment that must be addressed? (If answer is no, go to Factor 3.) | Yes | ✓ | 0 |
| | | No | | 4 |
| | ° Are the available mitigative measures reliable to minimize potential impacts? | Yes | ✓ | 3 |
| | | No | | 0 |
| Subtotal (maximum = 4) | | | | |
| 3. Time to implement the remedy. | ° What is the required time to implement the remedy? | ≤ 2yr. | ✓ | 1 |
| | | > 2yr. | | 0 |
| | ° Required duration of the mitigative effort to control short-term risk. | ≤ 2yr. | ✓ | 1 |
| | | > 2yr. | | 0 |
| Subtotal (maximum = 2) | | | | |
| 4. Permanence of the remedial alternative. | ° Will the remedy be classified as permanent in accordance with Section 2.1(a), (b), or (c). (If answer is yes, go to Factor 6.) | Yes | | 5 |
| | | No | ✓ | 0 |
| Subtotal (maximum = 5) | | | | |

Table 4-1 (continued)

**SHORT-TERM/LONG-TERM EFFECTIVENESS**
(Maximum Score = 25)

| Analysis Factor | Basis for Evaluation During Preliminary Screening | | | Score |
|---|---|---|---|---|
| 5. Lifetime of remedial actions. | ° Expected lifetime or duration of of effectiveness of the remedy. | 25-30yr. | ✓ | 4 |
| | | 20-25yr. | | 3 |
| | | 15-20yr. | | 2 |
| | | < 15yr. | | 0 |
| Subtotal (maximum = 4) | | | | |
| 6. Quantity and nature of waste or residual left at the site after remediation. | i) Quantity of untreated hazardous waste left at the site. | None | | 3 |
| | | ≤ 25% | ✓ | 2 |
| | | 25-50% | | 1 |
| | | ≥ 50% | | 0 |
| | ii) Is there treated residual left at the site? (If answer is no, go to Factor 7.) | Yes | | 0 |
| | | No | ✓ | 2 |
| | iii) Is the treated residual toxic? | Yes | | 0 |
| | | No | | 1 |
| | iv) Is the treated residual mobile? | Yes | | 0 |
| | | No | | 1 |
| Subtotal (maximum = 5) | | | | |
| 7. Adequacy and reliability of controls. | i) Operation and maintenance required for a period of: | < 5yr. | ✓ | 1 |
| | | > 5yr. | | 0 |
| | ii) Are environmental controls required as a part of the remedy to handle potential problems? (If answer is no, go to "iv") | Yes | ✓ | 0 |
| | | No | | 2 |
| | iii) Degree of confidence that controls can adequately handle potential problems. | Moderate to very confident | ✓ | 1 |
| | | Somewhat to not confident | | 0 |
| | iv) Relative degree of long-term monitoring required (compare with other remedial alternatives evaluated in the Detailed Analysis). | Minimum | ✓ | 2 |
| | | Moderate | | 1 |
| | | Extensive | | 0 |
| Subtotal (maximum = 5) | | | | |
| TOTAL (maximum = 25) | | | | |

IF THE TOTAL IS LESS THAN 10, PROJECT MANAGER MAY REJECT THE REMEDIAL ALTERNATIVE FROM FURTHER CONSIDERATION.

Table 4-2

IMPLEMENTABILITY
(Maximum Score = 15)

| Analysis Factor | Basis for Evaluation During Preliminary Screening | | | Score |
|---|---|---|---|---|
| 1. Technical Feasibility | | | | |
| a. Ability to construct technology. | i) Not difficult to construct. No uncertainties in construction. | | ___ | 3 |
| | ii) Somewhat difficult to construct. No uncertainties in construction. | | ___ | 2 |
| | iii) Very difficult to construct and/or significant uncertainties in construction. | | ✓ | 1 |
| b. Reliability of technology. | i) Very reliable in meeting the specified process efficiencies or performance goals. | | ___ | 3 |
| | ii) Somewhat reliable in meeting the specified process efficiencies or performance goals. | | ✓ | 2 |
| c. Schedule of delays due to technical problems. | i) Unlikely | | ___ | 2 |
| | ii) Somewhat likely | | ✓ | 1 |
| d. Need of undertaking additional remedial action, if necessary. | i) No future remedial actions may be anticipated. | | ✓ | 2 |
| | ii) Some future remedial actions may be necessary. | | ___ | 1 |
| **Subtotal (maximum = 10)** | | | | |
| 2. Administrative Feasibility | | | | |
| a. Coordination with other agencies. | i) Minimal coordination is required. | | ___ | 2 |
| | ii) Required coordination is normal. | | ___ | 1 |
| | iii) Extensive coordination is required. | | ✓ | 0 |
| **Subtotal (maximum = 2)** | | | | |
| 3. Availability of Services and Materials | | | | |
| a. Availability of prospective technologies. | i) Are technologies under consideration generally commercially available for the site-specific application? | Yes | ✓ | 1 |
| | | No | ___ | 0 |
| | ii) Will more than one vendor be available to provide a competitive bid? | Yes | ✓ | 1 |
| | | No | ___ | 0 |

Table 4-2 (continued)

**IMPLEMENTABILITY**
(Maximum Score = 15)

| Analysis Factor | Basis for Evaluation During Preliminary Screening | | | Score |
|---|---|---|---|---|
| b. Availability of necessary equipment and specialists. | i) Additional equipment and specialists may be available without significant delay. | Yes | √ | 1 |
| | | No | | 0 |

**Subtotal (maximum = 3)**

**TOTAL (maximum = 15)**

**IF THE TOTAL IS LESS THAN 8, PROJECT MANAGER MAY REJECT THE REMEDIAL ALTERNATIVE FROM FURTHER CONSIDERATION.**

Test Pit 3 Area - VOCs
Vapor Extraction / Ground Water Extraction

Table 4-1

SHORT-TERM/LONG-TERM EFFECTIVENESS
(Maximum Score = 25)

| Analysis Factor | Basis for Evaluation During Preliminary Screening | | | Score |
|---|---|---|---|---|
| 1. Protection of community during remedial actions. | ° Are there significant short-term risks to the community that must be addressed? (If answer is no, go to Factor 2.) | Yes | ✓ | 0 |
| | | No | | 4 |
| | ° Can the short-term risk be easily controlled? | Yes | ✓ | 1 |
| | | No | | 0 |
| | ° Does the mitigative effort to control short-term risk impact the community life-style? | Yes | | 0 |
| | | No | ✓ | 2 |
| Subtotal (maximum = 4) | | | | |
| 2. Environmental Impacts | ° Are there significant short-term risks to the environment that must be addressed? (If answer is no, go to Factor 3.) | Yes | | 0 |
| | | No | ✓ | 4 |
| | ° Are the available mitigative measures reliable to minimize potential impacts? | Yes | | 3 |
| | | No | | 0 |
| Subtotal (maximum = 4) | | | | |
| 3. Time to implement the remedy. | ° What is the required time to implement the remedy? | ≤ 2yr. | ✓ | 1 |
| | | > 2yr. | | 0 |
| | ° Required duration of the mitigative effort to control short-term risk. | ≤ 2yr. | ✓ | 1 |
| | | > 2yr. | | 0 |
| Subtotal (maximum = 2) | | | | |
| 4. Permanence of the remedial alternative. | ° Will the remedy be classified as permanent in accordance with Section 2.1(a), (b), or (c). (If answer is yes, go to Factor 6.) | Yes | ✓ | 5 |
| | | No | | 0 |
| Subtotal (maximum = 5) | | | | |

Table 4-1 (continued)

SHORT-TERM/LONG-TERM EFFECTIVENESS
(Maximum Score = 25)

| Analysis Factor | Basis for Evaluation During Preliminary Screening | | Score |
|---|---|---|---|
| 5. Lifetime of remedial actions. | ° Expected lifetime or duration of of effectiveness of the remedy. | 25-30yr.____ | 4 |
| | | 20-25yr.____ | 3 |
| | | 15-20yr.____ | 2 |
| | | < 15yr.____ | 0 |
| Subtotal (maximum = 4) | | | |
| 6. Quantity and nature of waste or residual left at the site after remediation. | i) Quantity of untreated hazardous waste left at the site. | None ____ | 3 |
| | | < 25% ✓ | 2 |
| | | 25-50% ____ | 1 |
| | | ≥ 50% ____ | 0 |
| | ii) Is there treated residual left at the site? (If answer is no, go to Factor 7.) | Yes ____ | 0 |
| | | No ✓ | 2 |
| | iii) Is the treated residual toxic? | Yes ____ | 0 |
| | | No ____ | 1 |
| | iv) Is the treated residual mobile? | Yes ____ | 0 |
| | | No ____ | 1 |
| Subtotal (maximum = 5) | | | |
| 7. Adequacy and reliability of controls. | i) Operation and maintenance required for a period of: | < 5yr. ✓ | 1 |
| | | > 5yr. ____ | 0 |
| | ii) Are environmental controls required as a part of the remedy to handle potential problems? (If answer is no, go to "iv") | Yes ✓ | 0 |
| | | No ____ | 2 |
| | iii) Degree of confidence that controls can adequately handle potential problems. | Moderate to very confident ✓ | 1 |
| | | Somewhat to not confident ____ | 0 |
| | iv) Relative degree of long-term monitoring required (compare with other remedial alternatives evaluated in the Detailed Analysis). | Minimum ✓ | 2 |
| | | Moderate ____ | 1 |
| | | Extensive ____ | 0 |
| Subtotal (maximum = 5) | | | |
| TOTAL (maximum = 25) | | | |

IF THE TOTAL IS LESS THAN 10, PROJECT MANAGER MAY REJECT THE REMEDIAL ALTERNATIVE FROM FURTHER CONSIDERATION.

Table 4-2

IMPLEMENTABILITY
(Maximum Score = 15)

| Analysis Factor | Basis for Evaluation During Preliminary Screening | | | Score |
|---|---|---|---|---|
| 1. Technical Feasibility | | | | |
| a. Ability to construct technology. | i) Not difficult to construct. No uncertainties in construction. | | ✓ | 3 |
| | ii) Somewhat difficult to construct. No uncertainties in construction. | | | 2 |
| | iii) Very difficult to construct and/or significant uncertainties in construction. | | | 1 |
| b. Reliability of technology. | i) Very reliable in meeting the specified process efficiencies or performance goals. | | | 3 |
| | ii) Somewhat reliable in meeting the specified process efficiencies or performance goals. | | ✓ | 2 |
| c. Schedule of delays due to technical problems. | i) Unlikely | | | 2 |
| | ii) Somewhat likely | | ✓ | 1 |
| d. Need of undertaking additional remedial action, if necessary. | i) No future remedial actions may be anticipated. | | ✓ | 2 |
| | ii) Some future remedial actions may be necessary. | | | 1 |
| **Subtotal (maximum = 10)** | | | | |
| 2. Administrative Feasibility | | | | |
| a. Coordination with other agencies. | i) Minimal coordination is required. | | | 2 |
| | ii) Required coordination is normal. | | ✓ | 1 |
| | iii) Extensive coordination is required. | | | 0 |
| **Subtotal (maximum = 2)** | | | | |
| 3. Availability of Services and Materials | | | | |
| a. Availability of prospective technologies. | i) Are technologies under consideration generally commercially available for the site-specific application? | Yes | ✓ | 1 |
| | | No | | 0 |
| | ii) Will more than one vendor be available to provide a competitive bid? | Yes | ✓ | 1 |
| | | No | | 0 |

Table 4-2 (continued)

**IMPLEMENTABILITY**
(Maximum Score = 15)

| Analysis Factor | Basis for Evaluation During Preliminary Screening | | | Score |
|---|---|---|---|---|
| b. Availability of necessary equipment and specialists. | i) Additional equipment and specialists may be available without significant delay. | Yes | ✓ | 1 |
| | | No | | 0 |

**Subtotal (maximum = 3)**

**TOTAL (maximum = 15)**

**IF THE TOTAL IS LESS THAN 8, PROJECT MANAGER MAY REJECT THE REMEDIAL ALTERNATIVE FROM FURTHER CONSIDERATION.**

Test Pit 3 Area - VOCs
Bioremediation

Table 4-1

SHORT-TERM/LONG-TERM EFFECTIVENESS
(Maximum Score = 25)

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| Analysis Factor | Basis for Evaluation During Preliminary Screening | | | Score |
|---|---|---|---|---|
| 1. Protection of community during remedial actions. | ° Are there significant short-term risks to the community that must be addressed? **(If answer is no, go to Factor 2.)** | Yes<br>No | ✓<br>___ | 0<br>4 |
| | ° Can the short-term risk be easily controlled? | Yes<br>No | ___<br>✓ | 1<br>0 |
| | ° Does the mitigative effort to control short-term risk impact the community life-style? | Yes<br>No | ✓<br>___ | 0<br>2 |
| **Subtotal (maximum = 4)** | | | | |
| 2. Environmental Impacts | ° Are there significant short-term risks to the environment that must be addressed? **(If answer is no, go to Factor 3.)** | Yes<br>No | ___<br>✓ | 0<br>4 |
| | ° Are the available mitigative measures reliable to minimize potential impacts? | Yes<br>No | ___<br>___ | 3<br>0 |
| **Subtotal (maximum = 4)** | | | | |
| 3. Time to implement the remedy. | ° What is the required time to implement the remedy? | ≤ 2yr.<br>> 2yr. | ✓<br>___ | 1<br>0 |
| | ° Required duration of the mitigative effort to control short-term risk. | ≤ 2yr.<br>> 2yr. | ✓<br>___ | 1<br>0 |
| **Subtotal (maximum = 2)** | | | | |
| 4. Permanence of the remedial alternative. | ° Will the remedy be classified as permanent in accordance with Section 2.1(a), (b), or (c). **(If answer is yes, go to Factor 6.)** | Yes<br>No | ✓<br>___ | 5<br>0 |
| **Subtotal (maximum = 5)** | | | | |

Table 4-1 (continued)

SHORT-TERM/LONG-TERM EFFECTIVENESS
(Maximum Score = 25)

| Analysis Factor | Basis for Evaluation During Preliminary Screening | | | Score |
|---|---|---|---|---|
| 5. Lifetime of remedial actions. | ° Expected lifetime or duration of of effectiveness of the remedy. | 25-30yr. | | 4 |
| | | 20-25yr. | | 3 |
| | | 15-20yr. | | 2 |
| | | < 15yr. | | 0 |
| Subtotal (maximum = 4) | | | | |
| 6. Quantity and nature of waste or residual left at the site after remediation. | i) Quantity of untreated hazardous waste left at the site. | None | | 3 |
| | | ≤ 25% | ✓ | 2 |
| | | 25-50% | | 1 |
| | | ≥ 50% | | 0 |
| | ii) Is there treated residual left at the site? (If answer is no, go to Factor 7.) | Yes | | 0 |
| | | No | ✓ | 2 |
| | iii) Is the treated residual toxic? | Yes | | 0 |
| | | No | | 1 |
| | iv) Is the treated residual mobile? | Yes | | 0 |
| | | No | | 1 |
| Subtotal (maximum = 5) | | | | |
| 7. Adequacy and reliability of controls. | i) Operation and maintenance required for a period of: | < 5yr. | ✓ | 1 |
| | | > 5yr. | | 0 |
| | ii) Are environmental controls required as a part of the remedy to handle potential problems? (If answer is no, go to "iv") | Yes | ✓ | 0 |
| | | No | | 2 |
| | iii) Degree of confidence that controls can adequately handle potential problems. | Moderate to very confident | ✓ | 1 |
| | | Somewhat to not confident | | 0 |
| | iv) Relative degree of long-term monitoring required (compare with other remedial alternatives evaluated in the Detailed Analysis). | Minimum | ✓ | 2 |
| | | Moderate | | 1 |
| | | Extensive | | 0 |
| Subtotal (maximum = 5) | | | | |
| TOTAL (maximum = 25) | | | | |

IF THE TOTAL IS LESS THAN 10, PROJECT MANAGER MAY REJECT THE REMEDIAL ALTERNATIVE FROM FURTHER CONSIDERATION.

Table 4-2

IMPLEMENTABILITY
(Maximum Score = 15)

| Analysis Factor | Basis for Evaluation During Preliminary Screening | | | Score |
|---|---|---|---|---|
| **1. Technical Feasibility** | | | | |
| a. Ability to construct technology. | i) Not difficult to construct. No uncertainties in construction. | | | 3 |
| | ii) Somewhat difficult to construct. No uncertainties in construction. | | | 2 |
| | iii) Very difficult to construct and/or significant uncertainties in construction. | | ✓ | 1 |
| b. Reliability of technology. | i) Very reliable in meeting the specified process efficiencies or performance goals. | | | 3 |
| | ii) Somewhat reliable in meeting the specified process efficiencies or performance goals. | | ✓ | 2 |
| c. Schedule of delays due to technical problems. | i) Unlikely | | | 2 |
| | ii) Somewhat likely | | ✓ | 1 |
| d. Need of undertaking additional remedial action, if necessary. | i) No future remedial actions may be anticipated. | | ✓ | 2 |
| | ii) Some future remedial actions may be necessary. | | | 1 |
| **Subtotal (maximum = 10)** | | | | |
| **2. Administrative Feasibility** | | | | |
| a. Coordination with other agencies. | i) Minimal coordination is required. | | | 2 |
| | ii) Required coordination is normal. | | ✓ | 1 |
| | iii) Extensive coordination is required. | | | 0 |
| **Subtotal (maximum = 2)** | | | | |
| **3. Availability of Services and Materials** | | | | |
| a. Availability of prospective technologies. | i) Are technologies under consideration generally commercially available for the site-specific application? | Yes | ✓ | 1 |
| | | No | | 0 |
| | ii) Will more than one vendor be available to provide a competitive bid? | Yes | ✓ | 1 |
| | | No | | 0 |

Table 4-2 (continued)

**IMPLEMENTABILITY**
(Maximum Score = 15)

| Analysis Factor | Basis for Evaluation During Preliminary Screening | | | Score |
|---|---|---|---|---|
| b. Availability of necessary equipment and specialists. | i) Additional equipment and specialists may be available without significant delay. | Yes | ✓ | 1 |
| | | No | | 0 |

**Subtotal (maximum = 3)**

**TOTAL (maximum = 15)**

**IF THE TOTAL IS LESS THAN 8, PROJECT MANAGER MAY REJECT THE REMEDIAL ALTERNATIVE FROM FURTHER CONSIDERATION.**

Test Pit 3 Area - VOCs
Soil Washing

18
16

Table 4-1

SHORT-TERM/LONG-TERM EFFECTIVENESS
(Maximum Score = 25)

| Analysis Factor | Basis for Evaluation During Preliminary Screening | | | Score |
|---|---|---|---|---|
| 1. Protection of community during remedial actions. | ° Are there significant short-term risks to the community that must be addressed? (If answer is no, go to Factor 2.) | Yes | ✓ | 0 |
| | | No | | 4 |
| | ° Can the short-term risk be easily controlled? | Yes | | 1 |
| | | No | ✓ | 0 |
| | ° Does the mitigative effort to control short-term risk impact the community life-style? | Yes | ✓ | 0 |
| | | No | | 2 |
| Subtotal (maximum = 4) | | | | |
| 2. Environmental Impacts | ° Are there significant short-term risks to the environment that must be addressed? (If answer is no, go to Factor 3.) | Yes | ✓ | 0 |
| | | No | | 4 |
| | ° Are the available mitigative measures reliable to minimize potential impacts? | Yes | ✓ | 3 |
| | | No | | 0 |
| Subtotal (maximum = 4) | | | | |
| 3. Time to implement the remedy. | ° What is the required time to implement the remedy? | ≤ 2yr. | ✓ | 1 |
| | | > 2yr. | | 0 |
| | ° Required duration of the mitigative effort to control short-term risk. | ≤ 2yr. | ✓ | 1 |
| | | > 2yr. | | 0 |
| Subtotal (maximum = 2) | | | | |
| 4. Permanence of the remedial alternative. | ° Will the remedy be classified as permanent in accordance with Section 2.1(a), (b), or (c). (If answer is yes, go to Factor 6.) | Yes | ✓ | 5 |
| | | No | | 0 |
| Subtotal (maximum = 5) | | | | |

Table 4-1 (continued)

SHORT-TERM/LONG-TERM EFFECTIVENESS
(Maximum Score = 25)

| Analysis Factor | Basis for Evaluation During Preliminary Screening | | Selection | Score |
|---|---|---|---|---|
| 5. Lifetime of remedial actions. | ° Expected lifetime or duration of of effectiveness of the remedy. | 25-30yr. | | 4 |
| | | 20-25yr. | | 3 |
| | | 15-20yr. | | 2 |
| | | < 15yr. | | 0 |
| Subtotal (maximum = 4) | | | | |
| 6. Quantity and nature of waste or residual left at the site after remediation. | i) Quantity of untreated hazardous waste left at the site. | None | | 3 |
| | | < 25% | ✓ | 2 |
| | | 25-50% | | 1 |
| | | ≥ 50% | | 0 |
| | ii) Is there treated residual left at the site? (If answer is no, go to Factor 7.) | Yes | | 0 |
| | | No | ✓ | 2 |
| | iii) Is the treated residual toxic? | Yes | | 0 |
| | | No | | 1 |
| | iv) Is the treated residual mobile? | Yes | | 0 |
| | | No | | 1 |
| Subtotal (maximum = 5) | | | | |
| 7. Adequacy and reliability of controls. | i) Operation and maintenance required for a period of: | < 5yr. | ✓ | 1 |
| | | > 5yr. | | 0 |
| | ii) Are environmental controls required as a part of the remedy to handle potential problems? (If answer is no, go to "iv") | Yes | ✓ | 0 |
| | | No | | 2 |
| | iii) Degree of confidence that controls can adequately handle potential problems. | Moderate to very confident | ✓ | 1 |
| | | Somewhat to not confident | | 0 |
| | iv) Relative degree of long-term monitoring required (compare with other remedial alternatives evaluated in the Detailed Analysis). | Minimum | ✓ | 2 |
| | | Moderate | | 1 |
| | | Extensive | | 0 |
| Subtotal (maximum = 5) | | | | |
| TOTAL (maximum = 25) | | | | |

IF THE TOTAL IS LESS THAN 10, PROJECT MANAGER MAY REJECT THE REMEDIAL ALTERNATIVE FROM FURTHER CONSIDERATION.

Table 4-2

## IMPLEMENTABILITY
(Maximum Score = 15)

| Analysis Factor | Basis for Evaluation During Preliminary Screening | | Score |
|---|---|---|---|
| 1. Technical Feasibility | | | |
| a. Ability to construct technology. | i) Not difficult to construct. No uncertainties in construction. | ___ | 3 |
| | ii) Somewhat difficult to construct. No uncertainties in construction. | ___ | 2 |
| | iii) Very difficult to construct and/or significant uncertainties in construction. | ✓ | 1 |
| b. Reliability of technology. | i) Very reliable in meeting the specified process efficiencies or performance goals. | ___ | 3 |
| | ii) Somewhat reliable in meeting the specified process efficiencies or performance goals. | ✓ | 2 |
| c. Schedule of delays due to technical problems. | i) Unlikely | ___ | 2 |
| | ii) Somewhat likely | ✓ | 1 |
| d. Need of undertaking additional remedial action, if necessary. | i) No future remedial actions may be anticipated. | ✓ | 2 |
| | ii) Some future remedial actions may be necessary. | ___ | 1 |
| **Subtotal (maximum = 10)** | | | |
| 2. Administrative Feasibility | | | |
| a. Coordination with other agencies. | i) Minimal coordination is required. | ___ | 2 |
| | ii) Required coordination is normal. | ✓ | 1 |
| | iii) Extensive coordination is required. | ___ | 0 |
| **Subtotal (maximum = 2)** | | | |
| 3. Availability of Services and Materials | | | |
| a. Availability of prospective technologies. | i) Are technologies under consideration generally commercially available for the site-specific application? | Yes ✓ | 1 |
| | | No ___ | 0 |
| | ii) Will more than one vendor be available to provide a competitive bid? | Yes ✓ | 1 |
| | | No ___ | 0 |

Table 4-2 (continued)

**IMPLEMENTABILITY**
(Maximum Score = 15)

| Analysis Factor | Basis for Evaluation During Preliminary Screening | | | Score |
|---|---|---|---|---|
| b. Availability of necessary equipment and specialists. | i) Additional equipment and specialists may be available without significant delay. | Yes | ✓ | 1 |
| | | No | ___ | 0 |

**Subtotal (maximum = 3)**

**TOTAL (maximum = 15)**

**IF THE TOTAL IS LESS THAN 8, PROJECT MANAGER MAY REJECT THE REMEDIAL ALTERNATIVE FROM FURTHER CONSIDERATION.**

Test Pit 3 Area VOCs
Excavation / Soil Aeration

169

Table 4-1

SHORT-TERM/LONG-TERM EFFECTIVENESS
(Maximum Score = 25)

| Analysis Factor | Basis for Evaluation During Preliminary Screening | | | Score |
|---|---|---|---|---|
| 1. Protection of community during remedial actions. | ° Are there significant short-term risks to the community that must be addressed? (If answer is no, go to Factor 2.) | Yes | ✓ | 0 |
| | | No | | 4 |
| | ° Can the short-term risk be easily controlled? | Yes | | 1 |
| | | No | ✓ | 0 |
| | ° Does the mitigative effort to control short-term risk impact the community life-style? | Yes | ✓ | 0 |
| | | No | | 2 |
| Subtotal (maximum = 4) | | | | |
| 2. Environmental Impacts | ° Are there significant short-term risks to the environment that must be addressed? (If answer is no, go to Factor 3.) | Yes | ✓ | 0 |
| | | No | | 4 |
| | ° Are the available mitigative measures reliable to minimize potential impacts? | Yes | ✓ | 3 |
| | | No | | 0 |
| Subtotal (maximum = 4) | | | | |
| 3. Time to implement the remedy. | ° What is the required time to implement the remedy? | ≤ 2yr. | | 1 |
| | | > 2yr. | ✓ | 0 |
| | ° Required duration of the mitigative effort to control short-term risk. | ≤ 2yr. | | 1 |
| | | > 2yr. | ✓ | 0 |
| Subtotal (maximum = 2) | | | | |
| 4. Permanence of the remedial alternative. | ° Will the remedy be classified as permanent in accordance with Section 2.1(a), (b), or (c). (If answer is yes, go to Factor 6.) | Yes | ✓ | 5 |
| | | No | | 0 |
| Subtotal (maximum = 5) | | | | |

Table 4-1 (continued)

SHORT-TERM/LONG-TERM EFFECTIVENESS
(Maximum Score = 25)

| Analysis Factor | Basis for Evaluation During Preliminary Screening | | | Score |
|---|---|---|---|---|
| 5. Lifetime of remedial actions. | ° Expected lifetime or duration of of effectiveness of the remedy. | 25-30yr. | ____ | 4 |
| | | 20-25yr. | ____ | 3 |
| | | 15-20yr. | ____ | 2 |
| | | < 15yr. | ____ | 0 |
| Subtotal (maximum = 4) | | | | |
| 6. Quantity and nature of waste or residual left at the site after remediation. | i) Quantity of untreated hazardous waste left at the site. | None | ____ | 3 |
| | | ≤ 25% | ✓ | 2 |
| | | 25-50% | ____ | 1 |
| | | ≥ 50% | ____ | 0 |
| | ii) Is there treated residual left at the site? (If answer is no, go to Factor 7.) | Yes | ____ | 0 |
| | | No | ✓ | 2 |
| | iii) Is the treated residual toxic? | Yes | ____ | 0 |
| | | No | ____ | 1 |
| | iv) Is the treated residual mobile? | Yes | ____ | 0 |
| | | No | ____ | 1 |
| Subtotal (maximum = 5) | | | | |
| 7. Adequacy and reliability of controls. | i) Operation and maintenance required for a period of: | < 5yr. | ✓ | 1 |
| | | > 5yr. | ____ | 0 |
| | ii) Are environmental controls required as a part of the remedy to handle potential problems? (If answer is no, go to "iv") | Yes | ✓ | 0 |
| | | No | ____ | 2 |
| | iii) Degree of confidence that controls can adequately handle potential problems. | Moderate to very confident | ✓ | 1 |
| | | Somewhat to not confident | ____ | 0 |
| | iv) Relative degree of long-term monitoring required (compare with other remedial alternatives evaluated in the Detailed Analysis). | Minimum | ✓ | 2 |
| | | Moderate | ____ | 1 |
| | | Extensive | ____ | 0 |
| Subtotal (maximum = 5) | | | | |
| TOTAL (maximum = 25) | | | | |

IF THE TOTAL IS LESS THAN 10, PROJECT MANAGER MAY REJECT THE REMEDIAL ALTERNATIVE FROM FURTHER CONSIDERATION.

Table 4-2

IMPLEMENTABILITY
(Maximum Score = 15)

| Analysis Factor | Basis for Evaluation During Preliminary Screening | | Score |
|---|---|---|---|
| 1. Technical Feasibility | | | |
| a. Ability to construct technology. | i) Not difficult to construct. No uncertainties in construction. | | 3 |
| | ii) Somewhat difficult to construct. No uncertainties in construction. | | 2 |
| | iii) Very difficult to construct and/or significant uncertainties in construction. | ✓ | 1 |
| b. Reliability of technology. | i) Very reliable in meeting the specified process efficiencies or performance goals. | | 3 |
| | ii) Somewhat reliable in meeting the specified process efficiencies or performance goals. | ✓ | 2 |
| c. Schedule of delays due to technical problems. | i) Unlikely | | 2 |
| | ii) Somewhat likely | ✓ | 1 |
| d. Need of undertaking additional remedial action, if necessary. | i) No future remedial actions may be anticipated. | ✓ | 2 |
| | ii) Some future remedial actions may be necessary. | | 1 |
| **Subtotal (maximum = 10)** | | | |
| 2. Administrative Feasibility | | | |
| a. Coordination with other agencies. | i) Minimal coordination is required. | | 2 |
| | ii) Required coordination is normal. | | 1 |
| | iii) Extensive coordination is required. | ✓ | 0 |
| **Subtotal (maximum = 2)** | | | |
| 3. Availability of Services and Materials | | | |
| a. Availability of prospective technologies. | i) Are technologies under consideration generally commercially available for the site-specific application? | Yes ✓ | 1 |
| | | No | 0 |
| | ii) Will more than one vendor be available to provide a competitive bid? | Yes ✓ | 1 |
| | | No | 0 |

Table 4-2 (continued)

IMPLEMENTABILITY
(Maximum Score = 15)

| Analysis Factor | Basis for Evaluation During Preliminary Screening | | | Score |
|---|---|---|---|---|
| b. Availability of necessary equipment and specialists. | i) Additional equipment and specialists may be available without significant delay. | Yes | ✓ | 1 |
| | | No | | 0 |

Subtotal (maximum = 3)

TOTAL (maximum = 15)

**IF THE TOTAL IS LESS THAN 8, PROJECT MANAGER MAY REJECT THE REMEDIAL ALTERNATIVE FROM FURTHER CONSIDERATION.**

Test Pit 3 Area - VOCs
Excavation / Low Temp. Incineration

Table 4-1

15
12

SHORT-TERM/LONG-TERM EFFECTIVENESS
(Maximum Score = 25)

| Analysis Factor | Basis for Evaluation During Preliminary Screening | | | Score |
|---|---|---|---|---|
| 1. Protection of community during remedial actions. | ° Are there significant short-term risks to the community that must be addressed? (If answer is no, go to Factor 2.) | Yes | ✓ | 0 |
| | | No | | 4 |
| | ° Can the short-term risk be easily controlled? | Yes | | 1 |
| | | No | ✓ | 0 |
| | ° Does the mitigative effort to control short-term risk impact the community life-style? | Yes | ✓ | 0 |
| | | No | | 2 |
| Subtotal (maximum = 4) | | | | |
| 2. Environmental Impacts | ° Are there significant short-term risks to the environment that must be addressed? (If answer is no, go to Factor 3.) | Yes | ✓ | 0 |
| | | No | | 4 |
| | ° Are the available mitigative measures reliable to minimize potential impacts? | Yes | ✓ | 3 |
| | | No | | 0 |
| Subtotal (maximum = 4) | | | | |
| 3. Time to implement the remedy. | ° What is the required time to implement the remedy? | ≤ 2yr. | ✓ | 1 |
| | | > 2yr. | | 0 |
| | ° Required duration of the mitigative effort to control short-term risk. | ≤ 2yr. | ✓ | 1 |
| | | > 2yr. | | 0 |
| Subtotal (maximum = 2) | | | | |
| 4. Permanence of the remedial alternative. | ° Will the remedy be classified as permanent in accordance with Section 2.1(a), (b), or (c). (If answer is yes, go to Factor 6.) | Yes | ✓ | 5 |
| | | No | | 0 |
| Subtotal (maximum = 5) | | | | |

Table 4-1 (continued)

SHORT-TERM/LONG-TERM EFFECTIVENESS
(Maximum Score = 25)

| Analysis Factor | Basis for Evaluation During Preliminary Screening | | Score |
|---|---|---|---|
| 5. Lifetime of remedial actions. | ° Expected lifetime or duration of of effectiveness of the remedy. | 25-30yr. ____ | 4 |
| | | 20-25yr. ____ | 3 |
| | | 15-20yr. ____ | 2 |
| | | < 15yr. ____ | 0 |
| Subtotal (maximum = 4) | | | |
| 6. Quantity and nature of waste or residual left at the site after remediation. | i) Quantity of untreated hazardous waste left at the site. | None ____ | 3 |
| | | < 25% ✓ | 2 |
| | | 25-50% ____ | 1 |
| | | ≥ 50% ____ | 0 |
| | ii) Is there treated residual left at the site? (If answer is no, go to Factor 7.) | Yes ✓ | 0 |
| | | No ____ | 2 |
| | iii) Is the treated residual toxic? | Yes ✓ | 0 |
| | | No ____ | 1 |
| | iv) Is the treated residual mobile? | Yes ✓ | 0 |
| | | No ____ | 1 |
| Subtotal (maximum = 5) | | | |
| 7. Adequacy and reliability of controls. | i) Operation and maintenance required for a period of: | < 5yr. ✓ | 1 |
| | | > 5yr. ____ | 0 |
| | ii) Are environmental controls required as a part of the remedy to handle potential problems? (If answer is no, go to "iv") | Yes ✓ | 0 |
| | | No ____ | 2 |
| | iii) Degree of confidence that controls can adequately handle potential problems. | Moderate to very confident ✓ | 1 |
| | | Somewhat to not confident ____ | 0 |
| | iv) Relative degree of long-term monitoring required (compare with other remedial alternatives evaluated in the Detailed Analysis). | Minimum ____ | 2 |
| | | Moderate ✓ | 1 |
| | | Extensive ____ | 0 |
| Subtotal (maximum = 5) | | | |
| TOTAL (maximum = 25) | | | |

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IF THE TOTAL IS LESS THAN 10, PROJECT MANAGER MAY REJECT THE REMEDIAL ALTERNATIVE FROM FURTHER CONSIDERATION.

Table 4-2

IMPLEMENTABILITY
(Maximum Score = 15)

| Analysis Factor | Basis for Evaluation During Preliminary Screening | | | Score |
|---|---|---|---|---|
| 1. <u>Technical Feasibility</u> | | | | |
| a. Ability to construct technology. | i) Not difficult to construct. No uncertainties in construction. | | ___ | 3 |
| | ii) Somewhat difficult to construct. No uncertainties in construction. | | ___ | 2 |
| | iii) Very difficult to construct and/or significant uncertainties in construction. | | ✓ | 1 |
| b. Reliability of technology. | i) Very reliable in meeting the specified process efficiencies or performance goals. | | ___ | 3 |
| | ii) Somewhat reliable in meeting the specified process efficiencies or performance goals. | | ✓ | 2 |
| c. Schedule of delays due to technical problems. | i) Unlikely | | ___ | 2 |
| | ii) Somewhat likely | | ✓ | 1 |
| d. Need of undertaking additional remedial action, if necessary. | i) No future remedial actions may be anticipated. | | ✓ | 2 |
| | ii) Some future remedial actions may be necessary. | | ___ | 1 |
| **Subtotal (maximum = 10)** | | | | |
| 2. <u>Administrative Feasibility</u> | | | | |
| a. Coordination with other agencies. | i) Minimal coordination is required. | | ___ | 2 |
| | ii) Required coordination is normal. | | ✓ | 1 |
| | iii) Extensive coordination is required. | | ___ | 0 |
| **Subtotal (maximum = 2)** | | | | |
| 3. <u>Availability of Services and Materials</u> | | | | |
| a. Availability of prospective technologies. | i) Are technologies under consideration generally commercially available for the site-specific application? | Yes | ✓ | 1 |
| | | No | ___ | 0 |
| | ii) Will more than one vendor be available to provide a competitive bid? | Yes | ✓ | 1 |
| | | No | ___ | 0 |

Table 4-2 (continued)

**IMPLEMENTABILITY**
(Maximum Score = 15)

| Analysis Factor | Basis for Evaluation During Preliminary Screening | | | Score |
|---|---|---|---|---|
| b. Availability of necessary equipment and specialists. | i) Additional equipment and specialists may be available without significant delay. | Yes | √ | 1 |
| | | No | | 0 |

**Subtotal (maximum = 3)**

**TOTAL (maximum = 15)**

**IF THE TOTAL IS LESS THAN 8, PROJECT MANAGER MAY REJECT THE REMEDIAL ALTERNATIVE FROM FURTHER CONSIDERATION.**

# *APPENDIX C*
## *Detailed Analysis Tables*

VAPOR EXTRACTION/
GROUNDWATER EXTRACTION
7/1/85

Table 5-2

**SHORT-TERM EFFECTIVENESS**
(Relative Weight = 10)

| Analysis Factor | Basis for Evaluation During Detailed Analysis | | | Weight |
|---|---|---|---|---|
| 1. Protection of community during remedial actions. | ° Are there significant short-term risks to the community that must be addressed? (If answer is no, go to Factor 2.) | Yes | ✓ | 0 |
| | | No | | 4 |
| | ° Can the risk be easily controlled? | Yes | ✓ | 1 |
| | | No | | 0 |
| | ° Does the mitigative effort to control risk impact the community life-style? | Yes | | 0 |
| | | No | ✓ | 2 |
| Subtotal (maximum = 4) | | | | |
| 2. Environmental Impacts | ° Are there significant short-term risks to the environment that must be addressed? (If answer is no, go to Factor 3.) | Yes | | 0 |
| | | No | ✓ | 4 |
| | ° Are the available mitigative measures reliable to minimize potential impacts? | Yes | | 3 |
| | | No | | 0 |
| Subtotal (maximum = 4) | | | | |
| 3. Time to implement the remedy. | ° What is the required time to implement the remedy? | ≤ 2yr. | ✓ | 1 |
| | | > 2yr. | | 0 |
| | ° Required duration of the mitigative effort to control short-term risk. | ≤ 2yr. | ✓ | 1 |
| | | > 2yr. | | 0 |
| Subtotal (maximum = 2) | | | | |
| TOTAL (maximum = 10) | | | | |

Table 5-3

## LONG-TERM EFFECTIVENESS AND PERMANENCE
(Relative Weight = 15)

| Analysis Factor | Basis for Evaluation During Detailed Analysis | | | Weight |
|---|---|---|---|---|
| 1. Permanence of the remedial alternative. | ° Will the remedy be classified as permanent in accordance with Section 2.1(a), (b), or (c). (If answer is yes, go to Factor 3.) | Yes | ✓ | 5 |
| | | No | | 0 |
| Subtotal (maximum = 5) | | | | |
| 2. Lifetime of remedial actions. | ° Expected lifetime or duration of of effectiveness of the remedy. | 25-30yr. | | 4 |
| | | 20-25yr. | | 3 |
| | | 15-20yr. | | 2 |
| | | < 15yr. | | 0 |
| Subtotal (maximum = 4) | | | | |
| 3. Quantity and nature of waste or residual left at the site after remediation. | i) Quantity of untreated hazardous waste left at the site. | None | | 3 |
| | | ≤ 25% | ✓ | 2 |
| | | 25-50% | | 1 |
| | | ≥ 50% | | 0 |
| | ii) Is there treated residual left at the site? (If answer is no, go to Factor 4.) | Yes | | 0 |
| | | No | ✓ | 2 |
| | iii) Is the treated residual toxic? | Yes | | 0 |
| | | No | | 1 |
| | iv) Is the treated residual mobile? | Yes | | 0 |
| | | No | | 1 |
| Subtotal (maximum = 5) | | | | |
| 4. Adequacy and reliability of controls. | i) Operation and maintenance required for a period of: | < 5yr. | ✓ | 1 |
| | | > 5yr. | | 0 |
| | ii) Are environmental controls required as a part of the remedy to handle potential problems? (If answer is no, go to "iv") | Yes | ✓ | 0 |
| | | No | | 2 |
| | iii) Degree of confidence that controls can adequately handle potential problems. | Moderate to very confident | ✓ | 1 |
| | | Somewhat to not confident | | 0 |
| | iv) Relative degree of long-term monitoring required (compare with other remedial alternatives evaluated in the Detailed Analysis). | Minimum | ✓ | 2 |
| | | Moderate | | 1 |
| | | Extensive | | 0 |
| Subtotal (maximum = 5) | | | | |
| TOTAL (maximum = 15) | | | | |

## Table 5-4

### REDUCTION OF TOXICITY, MOBILITY OR VOLUME
(Relative Weight = 15)

| Analysis Factor | Basis for Evaluation During Detailed Analysis | | | Weight |
|---|---|---|---|---|
| 1. Volume of hazardous waste reduced (Reduction in volume or toxicity). | i) Quantity of hazardous waste destroyed or treated. | 100% | | 10 |
| | | 80-99% | ✓ | 8 |
| | | 60-80% | | 6 |
| | | 40-60% | | 4 |
| | | 20-40% | | 2 |
| | | < 20% | | 0 |
| | ii) Are there concentrated hazardous waste produced as a result of (i)? (If answer is no, go to Factor 2.) | Yes | ✓ | 0 |
| | | No | | 2 |
| | iii) How is the concentrated hazardous waste stream disposed? | On-site land disposal | | 0 |
| | | Off-site secure land disposal | | 1 |
| | | On-site or off-site destruction or treatment | ✓ | 2 |
| Subtotal (maximum = 12) (If subtotal = 12, go to 3) | | | | |
| 2. Reduction in mobility of hazardous waste. | i) <u>Method of Reduction</u> | | | |
| | - Reduced mobility by containment | | | 1 |
| | - Reduced mobility by alternative treatment technologies. | | ✓ | 3 |
| | ii) <u>Quantity of Wastes Immobilized</u> | ≤ 100% | ✓ | 2 |
| | | ≥ 60% | | 1 |
| | | < 60% | | 0 |
| Subtotal (maximum = 5) | | | | |
| 3. Irreversibility of the destruction or treatment of hazardous waste. | Completely irreversible | | ✓ | 3 |
| | Irreversible for most of the hazardous waste constituents. | | | 2 |
| | Irreversible for only some of the hazardous waste constituents | | | 1 |
| | Reversible for most of the hazardous waste constituents. | | | 0 |
| Subtotal (maximum = 3) | | | | |
| TOTAL (maximum = 15) | | | | |

Table 5-5

IMPLEMENTABILITY
(Relative Weight = 15)

| Analysis Factor | Basis for Evaluation During Detailed Analysis | | Weight |
|---|---|---|---|
| 1. Technical Feasibility | | | |
| a. Ability to construct technology. | i) Not difficult to construct. No uncertainties in construction. | ✓ | 3 |
| | ii) Somewhat difficult to construct. No uncertainties in construction. | | 2 |
| | iii) Very difficult to construct and/or significant uncertainties in construction. | | 1 |
| b. Reliability of technology. | i) Very reliable in meeting the specified process efficiencies or performance goals. | | 3 |
| | ii) Somewhat reliable in meeting the specified process efficiencies or performance goals. | ✓ | 2 |
| c. Schedule of delays due to technical problems. | i) Unlikely | | 2 |
| | ii) Somewhat likely | ✓ | 1 |
| d. Need of undertaking additional remedial action, if necessary. | i) No future remedial actions may be anticipated. | ✓ | 2 |
| | ii) Some future remedial actions may be necessary. | | 1 |
| **Subtotal (maximum = 10)** | **Minimum Required Score = 7** | | |
| 2. Administrative Feasibility | | | |
| a. Coordination with other agencies. | i) Minimal coordination is required. | | 2 |
| | ii) Required coordination is normal. | ✓ | 1 |
| | iii) Extensive coordination is required. | | 0 |
| **Subtotal (maximum = 2)** | | | |
| 3. Availability of Services and Materials | | | |
| a. Availability of prospective technologies. | i) Are technologies under consideration generally commercially available for the site-specific application? | Yes ✓ | 1 |
| | | No | 0 |
| | ii) Will more than one vendor be available to provide a competitive bid? | Yes ✓ | 1 |
| | | No | 0 |

Table 5-5 (continued)

**IMPLEMENTABILITY**
(Relative Weight = 15)

| Analysis Factor | Basis for Evaluation During Detailed Analysis | | | Weight |
|---|---|---|---|---|
| b. Availability of necessary equipment and specialists. | i) Additional equipment and specialists may be available without significant delay. | Yes | ✓ | 1 |
| | | No | | 0 |

Subtotal (maximum = 3)

TOTAL (maximum = 15)

6

Table 5-6

## COMPLIANCE WITH ARARS
(Relative Weight = 10)

| Analysis Factor | Basis for Evaluation During Detailed Analysis | | | Weight |
|---|---|---|---|---|
| 1. Compliance with chemical-specific ARARs. | Meets chemical specific ARARs such as groundwater standards. | Yes | ✓ | 2.5 |
| | | No | | 0 |
| 2. Compliance with action-specific ARARs. | Meets ARARs such as RCRA minimum technology standards. | Yes | ✓ | 2.5 |
| | | No | | 0 |
| 3. Compliance with location-specific ARARs. | Meets location-specific ARARs such as wild and scenic Rivers Act. | Yes | ✓ | 2.5 |
| | | No | | 0 |
| 4. Compliance with appropriate criteria, advisories and guidelines. | The alternative meets all relevant and appropriate Federal and State guidelines that are not promulgated. | Yes | ✓ | 2.5 |
| | | No | | 0 |

TOTAL (Maximum = 10)

Table 5-7

## PROTECTION OF HUMAN HEALTH AND THE ENVIRONMENT
(Relative Weight = 20)

| Analysis Factor | Basis for Evaluation During Detailed Analysis | | | Weight |
|---|---|---|---|---|
| 1. Use of the site after remediation. | Unrestricted use of the land and water. (If answer is yes, go to the end of the Table.) | Yes | | 20 |
| | | No | ✓ | 0 |
| TOTAL (Maximum = 20) | | | | |
| 2. Human health and the environment exposure after the remediation. | i) Is the exposure to contaminants via air route acceptable? | Yes | ✓ | 3 |
| | | No | | 0 |
| | ii) Is the exposure to contaminants via groundwater/surface water acceptable? | Yes | ✓ | 4 |
| | | No | | 0 |
| | iii) Is the exposure to contaminants via sediments/soils acceptable? | Yes | ✓ | 3 |
| | | No | | 0 |
| Subtotal (maximum = 10) | | | | |
| 3. Magnitude of residual public health risks after the remediation. | i) Health risk | ≤ 1 in 1,000,000 | ✓ | 5 |
| | ii) Health risk | ≤ 1 in 100,000 | | 2 |
| Subtotal (maximum = 5) | | | | |
| 4. Magnitude of residual environmental risks after the remediation. | i) Less than acceptable | | ✓ | 5 |
| | ii) Slightly greater than acceptable | | | 3 |
| | iii) Significant risk still exists | | | 0 |
| Subtotal (maximum = 5) | | | | |
| TOTAL (maximum = 20) | | | | |

BIOREMEDIATION

74.85

Table 5-2

**SHORT-TERM EFFECTIVENESS**
**(Relative Weight = 10)**

| Analysis Factor | Basis for Evaluation During Detailed Analysis | | | Weight |
|---|---|---|---|---|
| 1. Protection of community during remedial actions. | ° Are there significant short-term risks to the community that must be addressed? (If answer is no, go to Factor 2.) | Yes | ✓ | 0 |
| | | No | | 4 |
| | ° Can the risk be easily controlled? | Yes | | 1 |
| | | No | ✓ | 0 |
| | ° Does the mitigative effort to control risk impact the community life-style? | Yes | ✓ | 0 |
| | | No | | 2 |
| Subtotal (maximum = 4) | | | | |
| 2. Environmental Impacts | ° Are there significant short-term risks to the environment that must be addressed? (If answer is no, go to Factor 3.) | Yes | | 0 |
| | | No | ✓ | 4 |
| | ° Are the available mitigative measures reliable to minimize potential impacts? | Yes | | 3 |
| | | No | | 0 |
| Subtotal (maximum = 4) | | | | |
| 3. Time to implement the remedy. | ° What is the required time to implement the remedy? | ≤ 2yr. | ✓ | 1 |
| | | > 2yr. | | 0 |
| | ° Required duration of the mitigative effort to control short-term risk. | ≤ 2yr. | ✓ | 1 |
| | | > 2yr. | | 0 |
| Subtotal (maximum = 2) | | | | |
| TOTAL (maximum = 10) | | | | |

Table 5-3

## LONG-TERM EFFECTIVENESS AND PERMANENCE
(Relative Weight = 15)

| Analysis Factor | Basis for Evaluation During Detailed Analysis | | Weight |
|---|---|---|---|
| 1. Permanence of the remedial alternative. | ° Will the remedy be classified as permanent in accordance with Section 2.1(a), (b), or (c). (If answer is yes, go to Factor 3.) | Yes ✓ | 5 |
| | | No ____ | 0 |
| Subtotal (maximum = 5) | | | |
| 2. Lifetime of remedial actions. | ° Expected lifetime or duration of of effectiveness of the remedy. | 25-30yr.____ | 4 |
| | | 20-25yr.____ | 3 |
| | | 15-20yr.____ | 2 |
| | | < 15yr.____ | 0 |
| Subtotal (maximum = 4) | | | |
| 3. Quantity and nature of waste or residual left at the site after remediation. | i) Quantity of untreated hazardous waste left at the site. | None ____ | 3 |
| | | ≤ 25% ✓ | 2 |
| | | 25-50% ____ | 1 |
| | | ≥ 50% ____ | 0 |
| | ii) Is there treated residual left at the site? (If answer is no, go to Factor 4.) | Yes ____ | 0 |
| | | No ✓ | 2 |
| | iii) Is the treated residual toxic? | Yes ____ | 0 |
| | | No ____ | 1 |
| | iv) Is the treated residual mobile? | Yes ____ | 0 |
| | | No ____ | 1 |
| Subtotal (maximum = 5) | | | |
| 4. Adequacy and reliability of controls. | i) Operation and maintenance required for a period of: | < 5yr. ✓ | 1 |
| | | > 5yr. ____ | 0 |
| | ii) Are environmental controls required as a part of the remedy to handle potential problems? (If answer is no, go to "iv") | Yes ✓ | 0 |
| | | No ____ | 2 |
| | iii) Degree of confidence that controls can adequately handle potential problems. | Moderate to very confident ✓ | 1 |
| | | Somewhat to not confident ____ | 0 |
| | iv) Relative degree of long-term monitoring required (compare with other remedial alternatives evaluated in the Detailed Analysis). | Minimum ✓ | 2 |
| | | Moderate ____ | 1 |
| | | Extensive ____ | 0 |
| Subtotal (maximum = 5) | | | |
| TOTAL (maximum = 15) | | | |

Table 5-4

REDUCTION OF TOXICITY, MOBILITY OR VOLUME
(Relative Weight = 15)

| Analysis Factor | Basis for Evaluation During Detailed Analysis | | Weight |
|---|---|---|---|
| 1. Volume of hazardous waste reduced (Reduction in volume or toxicity). | i) Quantity of hazardous waste destroyed or treated. | 100% ____ | 10 |
| | | 80-99% ✓ | 8 |
| | | 60-80% ____ | 6 |
| | | 40-60% ____ | 4 |
| | | 20-40% ____ | 2 |
| | | < 20% ____ | 0 |
| | ii) Are there concentrated hazardous waste produced as a result of (i)? (If answer is no, go to Factor 2.) | Yes ____ | 0 |
| | | No ✓ | 2 |
| | iii) How is the concentrated hazardous waste stream disposed? | On-site land disposal ____ | 0 |
| | | Off-site secure land disposal ____ | 1 |
| | | On-site or off-site destruction or treatment ____ | 2 |
| Subtotal (maximum = 12) (If subtotal = 12, go to 3) | | | |
| 2. Reduction in mobility of hazardous waste. | i) Method of Reduction | | |
| | - Reduced mobility by containment | ____ | 1 |
| | - Reduced mobility by alternative treatment technologies. | ✓ | 3 |
| | ii) Quantity of Wastes Immobilized | ≤ 100% ✓ | 2 |
| | | ≥ 60% ____ | 1 |
| | | < 60% ____ | 0 |
| Subtotal (maximum = 5) | | | |
| 3. Irreversibility of the destruction or treatment of hazardous waste. | Completely irreversible | ✓ | 3 |
| | Irreversible for most of the hazardous waste constituents. | ____ | 2 |
| | Irreversible for only some of the hazardous waste constituents | ____ | 1 |
| | Reversible for most of the hazardous waste constituents. | ____ | 0 |
| Subtotal (maximum = 3) | | | |
| TOTAL (maximum = 15) | | | |

## Table 5-5

**IMPLEMENTABILITY**
(Relative Weight = 15)

| Analysis Factor | Basis for Evaluation During Detailed Analysis | | Weight |
|---|---|---|---|
| 1. Technical Feasibility | | | |
| a. Ability to construct technology. | i) Not difficult to construct. No uncertainties in construction. | ___ | 3 |
| | ii) Somewhat difficult to construct. No uncertainties in construction. | ___ | 2 |
| | iii) Very difficult to construct and/or significant uncertainties in construction. | ✓ | 1 |
| b. Reliability of technology. | i) Very reliable in meeting the specified process efficiencies or performance goals. | ___ | 3 |
| | ii) Somewhat reliable in meeting the specified process efficiencies or performance goals. | ✓ | 2 |
| c. Schedule of delays due to technical problems. | i) Unlikely | ___ | 2 |
| | ii) Somewhat likely | ✓ | 1 |
| d. Need of undertaking additional remedial action, if necessary. | i) No future remedial actions may be anticipated. | ✓ | 2 |
| | ii) Some future remedial actions may be necessary. | ___ | 1 |
| **Subtotal (maximum = 10)** | **Minimum Required Score = 7** | | |
| 2. Administrative Feasibility | | | |
| a. Coordination with other agencies. | i) Minimal coordination is required. | ___ | 2 |
| | ii) Required coordination is normal. | ✓ | 1 |
| | iii) Extensive coordination is required. | ___ | 0 |
| **Subtotal (maximum = 2)** | | | |
| 3. Availability of Services and Materials | | | |
| a. Availability of prospective technologies. | i) Are technologies under consideration generally commercially available for the site-specific application? | Yes ✓<br>No ___ | 1<br>0 |
| | ii) Will more than one vendor be available to provide a competitive bid? | Yes ✓<br>No ___ | 1<br>0 |

Table 5-5 (continued)

IMPLEMENTABILITY
(Relative Weight = 15)

| Analysis Factor | Basis for Evaluation During Detailed Analysis | | | Weight |
|---|---|---|---|---|
| b. Availability of necessary equipment and specialists. | i) Additional equipment and specialists may be available without significant delay. | Yes | √ | 1 |
| | | No | | 0 |

Subtotal (maximum = 3)

TOTAL (maximum = 15)

6

Table 5-6

COMPLIANCE WITH ARARS
(Relative Weight = 10)

| Analysis Factor | Basis for Evaluation During Detailed Analysis | | | Weight |
|---|---|---|---|---|
| 1. Compliance with chemical-specific ARARs. | Meets chemical specific ARARs such as groundwater standards. | Yes | ✓ | 2.5 |
| | | No | ___ | 0 |
| 2. Compliance with action-specific ARARs. | Meets ARARs such as RCRA minimum technology standards. | Yes | ✓ | 2.5 |
| | | No | ___ | 0 |
| 3. Compliance with location-specific ARARs. | Meets location-specific ARARs such as wild and scenic Rivers Act. | Yes | ✓ | 2.5 |
| | | No | ___ | 0 |
| 4. Compliance with appropriate criteria, advisories and guidelines. | The alternative meets all relevant and appropriate Federal and State guidelines that are not promulgated. | Yes | ✓ | 2.5 |
| | | No | ___ | 0 |

TOTAL (Maximum = 10)

Table 5-7

## PROTECTION OF HUMAN HEALTH AND THE ENVIRONMENT
(Relative Weight = 20)

| Analysis Factor | Basis for Evaluation During Detailed Analysis | | | Weight |
|---|---|---|---|---|
| 1. Use of the site after remediation. | Unrestricted use of the land and water. (If answer is yes, go to the end of the Table.) | Yes | | 20 |
| | | No | ✓ | 0 |
| TOTAL (Maximum = 20) | | | | |
| 2. Human health and the environment exposure after the remediation. | i) Is the exposure to contaminants via air route acceptable? | Yes | ✓ | 3 |
| | | No | | 0 |
| | ii) Is the exposure to contaminants via groundwater/surface water acceptable? | Yes | ✓ | 4 |
| | | No | | 0 |
| | iii) Is the exposure to contaminants via sediments/soils acceptable? | Yes | ✓ | 3 |
| | | No | | 0 |
| Subtotal (maximum = 10) | | | | |
| 3. Magnitude of residual public health risks after the remediation. | i) Health risk | ≤ 1 in 1,000,000 | ✓ | 5 |
| | ii) Health risk | ≤ 1 in 100,000 | | 2 |
| Subtotal (maximum = 5) | | | | |
| 4. Magnitude of residual environmental risks after the remediation. | i) Less than acceptable | | ✓ | 5 |
| | ii) Slightly greater than acceptable | | | 3 |
| | iii) Significant risk still exists | | | 0 |
| Subtotal (maximum = 5) | | | | |
| TOTAL (maximum = 20) | | | | |

SOIL WASHING

7415

Table 5-2

SHORT-TERM EFFECTIVENESS
(Relative Weight = 10)

| Analysis Factor | Basis for Evaluation During Detailed Analysis | | | Weight |
|---|---|---|---|---|
| 1. Protection of community during remedial actions. | ° Are there significant short-term risks to the community that must be addressed? (If answer is no, go to Factor 2.) | Yes | ✓ | 0 |
| | | No | | 4 |
| | ° Can the risk be easily controlled? | Yes | | 1 |
| | | No | ✓ | 0 |
| | ° Does the mitigative effort to control risk impact the community life-style? | Yes | ✓ | 0 |
| | | No | | 2 |
| Subtotal (maximum = 4) | | | | |
| 2. Environmental Impacts | ° Are there significant short-term risks to the environment that must be addressed? (If answer is no, go to Factor 3.) | Yes | | 0 |
| | | No | ✓ | 4 |
| | ° Are the available mitigative measures reliable to minimize potential impacts? | Yes | | 3 |
| | | No | | 0 |
| Subtotal (maximum = 4) | | | | |
| 3. Time to implement the remedy. | ° What is the required time to implement the remedy? | ≤ 2yr. | ✓ | 1 |
| | | > 2yr. | | 0 |
| | ° Required duration of the mitigative effort to control short-term risk. | ≤ 2yr. | ✓ | 1 |
| | | > 2yr. | | 0 |
| Subtotal (maximum = 2) | | | | |
| TOTAL (maximum = 10) | | | | |

Table 5-3

## LONG-TERM EFFECTIVENESS AND PERMANENCE
(Relative Weight = 15)

| Analysis Factor | Basis for Evaluation During Detailed Analysis | | | Weight |
|---|---|---|---|---|
| 1. Permanence of the remedial alternative. | ° Will the remedy be classified as permanent in accordance with Section 2.1(a), (b), or (c). (If answer is yes, go to Factor 3.) | Yes | ✓ | 5 |
| | | No | | 0 |
| Subtotal (maximum = 5) | | | | |
| 2. Lifetime of remedial actions. | ° Expected lifetime or duration of of effectiveness of the remedy. | 25-30yr. | | 4 |
| | | 20-25yr. | | 3 |
| | | 15-20yr. | | 2 |
| | | < 15yr. | | 0 |
| Subtotal (maximum = 4) | | | | |
| 3. Quantity and nature of waste or residual left at the site after remediation. | i) Quantity of untreated hazardous waste left at the site. | None | | 3 |
| | | ≤ 25% | ✓ | 2 |
| | | 25-50% | | 1 |
| | | ≥ 50% | | 0 |
| | ii) Is there treated residual left at the site? (If answer is no, go to Factor 4.) | Yes | | 0 |
| | | No | ✓ | 2 |
| | iii) Is the treated residual toxic? | Yes | | 0 |
| | | No | | 1 |
| | iv) Is the treated residual mobile? | Yes | | 0 |
| | | No | | 1 |
| Subtotal (maximum = 5) | | | | |
| 4. Adequacy and reliability of controls. | i) Operation and maintenance required for a period of: | < 5yr. | ✓ | 1 |
| | | > 5yr. | | 0 |
| | ii) Are environmental controls required as a part of the remedy to handle potential problems? (If answer is no, go to "iv") | Yes | ✓ | 0 |
| | | No | | 2 |
| | iii) Degree of confidence that controls can adequately handle potential problems. | Moderate to very confident | ✓ | 1 |
| | | Somewhat to not confident | | 0 |
| | iv) Relative degree of long-term monitoring required (compare with other remedial alternatives evaluated in the Detailed Analysis). | Minimum | ✓ | 2 |
| | | Moderate | | 1 |
| | | Extensive | | 0 |
| Subtotal (maximum = 5) | | | | |
| TOTAL (maximum = 15) | | | | |

Table 5-4

REDUCTION OF TOXICITY, MOBILITY OR VOLUME
(Relative Weight = 15)

| Analysis Factor | Basis for Evaluation During Detailed Analysis | | | Weight |
|---|---|---|---|---|
| 1. Volume of hazardous waste reduced (Reduction in volume or toxicity). | i) Quantity of hazardous waste destroyed or treated. | 100% | | 10 |
| | | 80-99% | ✓ | 8 |
| | | 60-80% | | 6 |
| | | 40-60% | | 4 |
| | | 20-40% | | 2 |
| | | < 20% | | 0 |
| | ii) Are there concentrated hazardous waste produced as a result of (i)? (If answer is no, go to Factor 2.) | Yes | ✓ | 0 |
| | | No | | 2 |
| | iii) How is the concentrated hazardous waste stream disposed? | On-site land disposal | | 0 |
| | | Off-site secure land disposal | | 1 |
| | | On-site or off-site destruction or treatment | ✓ | 2 |
| 6 | | | | |
| Subtotal (maximum = 12) (If subtotal = 12, go to 3) | | | | |
| 2. Reduction in mobility of hazardous waste. | i) Method of Reduction | | | |
| | - Reduced mobility by containment | | | 1 |
| | - Reduced mobility by alternative treatment technologies. | | ✓ | 3 |
| | ii) Quantity of Wastes Immobilized | ≤ 100% | ✓ | 2 |
| | | ≥ 60% | | 1 |
| | | < 60% | | 0 |
| Subtotal (maximum = 5) | | | | |
| 3. Irreversibility of the destruction or treatment of hazardous waste. | Completely irreversible | | ✓ | 3 |
| | Irreversible for most of the hazardous waste constituents. | | | 2 |
| | Irreversible for only some of the hazardous waste constituents | | | 1 |
| | Reversible for most of the hazardous waste constituents. | | | 0 |
| Subtotal (maximum = 3) | | | | |
| TOTAL (maximum = 15) | | | | |

## Table 5-5

### IMPLEMENTABILITY
(Relative Weight = 15)

| Analysis Factor | Basis for Evaluation During Detailed Analysis | | | Weight |
|---|---|---|---|---|
| **1. Technical Feasibility** | | | | |
| a. Ability to construct technology. | i) Not difficult to construct. No uncertainties in construction. | | ___ | 3 |
| | ii) Somewhat difficult to construct. No uncertainties in construction. | | ___ | 2 |
| | iii) Very difficult to construct and/or significant uncertainties in construction. | | ✓ | 1 |
| b. Reliability of technology. | i) Very reliable in meeting the specified process efficiencies or performance goals. | | ___ | 3 |
| | ii) Somewhat reliable in meeting the specified process efficiencies or performance goals. | | ✓ | 2 |
| c. Schedule of delays due to technical problems. | i) Unlikely | | ___ | 2 |
| | ii) Somewhat likely | | ✓ | 1 |
| d. Need of undertaking additional remedial action, if necessary. | i) No future remedial actions may be anticipated. | | ✓ | 2 |
| | ii) Some future remedial actions may be necessary. | | ___ | 1 |
| **Subtotal (maximum = 10)** | **Minimum Required Score = 7** | | | |
| **2. Administrative Feasibility** | | | | |
| a. Coordination with other agencies. | i) Minimal coordination is required. | | ___ | 2 |
| | ii) Required coordination is normal. | | ✓ | 1 |
| | iii) Extensive coordination is required. | | ___ | 0 |
| **Subtotal (maximum = 2)** | | | | |
| **3. Availability of Services and Materials** | | | | |
| a. Availability of prospective technologies. | i) Are technologies under consideration generally commercially available for the site-specific application? | Yes | ✓ | 1 |
| | | No | ___ | 0 |
| | ii) Will more than one vendor be available to provide a competitive bid? | Yes | ✓ | 1 |
| | | No | ___ | 0 |

Table 5-5 (continued)

**IMPLEMENTABILITY**
(Relative Weight = 15)

| Analysis Factor | Basis for Evaluation During Detailed Analysis | | | Weight |
|---|---|---|---|---|
| b. Availability of necessary equipment and specialists. | i) Additional equipment and specialists may be available without significant delay. | Yes | ✓ | 1 |
| | | No | | 0 |

**Subtotal (maximum = 3)**

**TOTAL (maximum = 15)**

6

Table 5-6

COMPLIANCE WITH ARARS
(Relative Weight = 10)

| Analysis Factor | Basis for Evaluation During Detailed Analysis | | | Weight |
|---|---|---|---|---|
| 1. Compliance with chemical-specific ARARs. | Meets chemical specific ARARs such as groundwater standards. | Yes | ✓ | 2.5 |
| | | No | | 0 |
| 2. Compliance with action-specific ARARs. | Meets ARARs such as RCRA minimum technology standards. | Yes | ✓ | 2.5 |
| | | No | | 0 |
| 3. Compliance with location-specific ARARs. | Meets location-specific ARARs such as wild and scenic Rivers Act. | Yes | ✓ | 2.5 |
| | | No | | 0 |
| 4. Compliance with appropriate criteria, advisories and guidelines. | The alternative meets all relevant and appropriate Federal and State guidelines that are not promulgated. | Yes | ✓ | 2.5 |
| | | No | | 0 |

TOTAL (Maximum = 10)

Table 5-7

## PROTECTION OF HUMAN HEALTH AND THE ENVIRONMENT
(Relative Weight = 20)

| Analysis Factor | Basis for Evaluation During Detailed Analysis | | | Weight |
|---|---|---|---|---|
| 1. Use of the site after remediation. | Unrestricted use of the land and water. (If answer is yes, go to the end of the Table.) | Yes | | 20 |
| | | No | ✓ | 0 |
| TOTAL (Maximum = 20) | | | | |
| 2. Human health and the environment exposure after the remediation. | i) Is the exposure to contaminants via air route acceptable? | Yes | ✓ | 3 |
| | | No | | 0 |
| | ii) Is the exposure to contaminants via groundwater/surface water acceptable? | Yes | ✓ | 4 |
| | | No | | 0 |
| | iii) Is the exposure to contaminants via sediments/soils acceptable? | Yes | ✓ | 3 |
| | | No | | 0 |
| Subtotal (maximum = 10) | | | | |
| 3. Magnitude of residual public health risks after the remediation. | i) Health risk | ≤ 1 in 1,000,000 | ✓ | 5 |
| | ii) Health risk | ≤ 1 in 100,000 | | 2 |
| Subtotal (maximum = 5) | | | | |
| 4. Magnitude of residual environmental risks after the remediation. | i) Less than acceptable | | ✓ | 5 |
| | ii) Slightly greater than acceptable | | | 3 |
| | iii) Significant risk still exists | | | 0 |
| Subtotal (maximum = 5) | | | | |
| TOTAL (maximum = 20) | | | | |