Work Plan

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Focused Remedial Investigation Alcan Aluminum Corporation Site #828005 Pittsford, New York

Alcan Aluminum Corporation
Cleveland, Ohio

July 1990

O'BRIEN & GERE

WORK PLAN

FOCUSED REMEDIAL INVESTIGATION
ALCAN ALUMINUM SITE #828005
PITTSFORD, NEW YORK

ALCAN ALUMINUM CORPORATION
CLEVELAND, OHIO

JULY 1990

O'BRIEN & GERE ENGINEERS, INC.
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SECTION 1 - INTRODUCTION

1.01 Site Description and History

The Alcan Aluminum Site #828005, formerly known as the Jarl Extrusions, Inc. site, is presently owned by Alcan Aluminum Corporation. The site is located on Linden Avenue in Pittsford, New York. Figure 1 illustrates the location of the site with respect to local physical and cultural features. The site is bordered on the south by vacant lots, several light industrial facilities to the west, a tributary of Irondequoit Creek and a wood lot to the north, and the Siquismondi Landfill to the east. Surface water emanating from the area around the site eventually flows north to Irondequoit Creek, which flows north into Lake Ontario.

Jarl Extrusions, Inc., formerly utilized two surface impoundments for waste water retention from a metal finishing facility (Figure 2). An estimated 200,000 gallons per year of wastewater, generated from the processing plant, was pumped to each impoundment via underground pipes. Historical data indicate the facility began operations in 1953. However, no information is available on the construction of the lagoons. Historic aerial photographs received from the U.S. Department of Agriculture Soil Conservation Service (1971) and U.S. Geologic Survey (1958, 1963, 1966, 1976 and 1980) suggest that they were located in an area of natural depressions and were active between 1963 and 1976. In 1980, the impoundments were backfilled, graded and seeded.

A verbal account by a former plant employee estimated 1460 gallons per day of wastewater with an approximate 15% solids content was pumped into the lagoon over a period of 13 years. A volume of sludge solids of 5200 cubic yards was calculated based on these data. This volume assumes facility operations 365 days of the year. Actual operation is approximately 250 days per year, which would result in a volume of sludge solids of 3500 cubic yards.

In addition, wastewater from the chemical conversion coating of aluminum was discharged to the impoundments. While this material is estimated to have represented a very small fraction of the overall volume of wastewater discharged, there is no indication that, if any sludges were produced during this process, they were deposited anywhere on the site.

The test borings and the test pits performed in the former impoundments provided data which is consistent with this estimate. Due to the variable thickness of the sludge in the impoundments and being mixed with soil, the above estimate provides the best possible estimate of the volume of sludge which may have accumulated in the impoundments.

The test pits excavated in and around the former impoundments do not indicate the presence of substantial amounts of waste sludge in this area, as the visible deposits found were generally in thin layers (from 0.5 to 6 inches thick). The results of EP Toxicity analyses on samples of the black impoundment deposits did not exceed the criteria for a characteristic hazardous waste, as these deposits contain no detectable concentrations of leachable heavy metals (Jarl Extrusions Inc. Site Investigation, March 1986). These tests did not address the concern about the possible listed hazardous waste from non-specific sources (F019).

1.02 Previous Studies

A previous investigation for metal contaminants within the surface impoundments was conducted by LaBella Associates, P.C., in July 1982 entitled "Abandoned Waste Lagoon Study". The LaBella report indicated that greater than 99.7% of the total chromium from the waste sludge samples collected is in the trivalent state. In addition, EP Toxicity tests revealed the samples contain less than detectable values for total leachable chromium, silver, cadmium, arsenic, barium, mercury and selenium. The results of the LaBella report are provided in the Jarl Extrusions Inc. Site Investigation Report dated March 1986 by O'Brien & Gere Engineers, Inc.

In 1984, at the request of the New York State Department of Environmental Conservation (NYSDEC), NUS Corporation, a USEPA contractor, inspected the site and collected four soil samples, two sediment samples, two surface water samples, and conducted analyses to evaluate the concentration of metal contaminants within and in the vicinity of the site. Although the results of the sample analyses revealed elevated levels of chromium, nickel, copper, cadmium, zinc and lead, the samples were collected from tributaries and drainage ditches located downgradient of the site and the adjacent Susquimondi Landfill. Therefore, the results may not be representative of former on-site activities.

Between February 1985 and March 1986, O'Brien & Gere Engineers, Inc., conducted a site investigation at the facility to locate the two former waste water impoundments and evaluate their impact on the site soils and local ground water.

To accomplish these objectives, the following work tasks were conducted:

a. Background Information and Aerial Photograph Review

b. Geophysical Surveys (Electromagnetic and Electrical Resistivity)

c. Soil Boring and Ground Water Monitoring Well Installation

d. Hydraulic Conductivity Tests

e. Ground Water Sampling and Analysis

f. Surface Impoundment Test Pits

In March 1986, the site investigation was completed and a report entitled Jarl Extrusions, Inc. Site Investigation was submitted to the New York State Department of Environmental Conservation (NYSDEC). The report summarized the site investigation and recommended several additional rounds of ground water sampling and analysis.

The following text provides a brief discussion of the work tasks including the results as reported in the March 1986 Report.

a. <u>Background Information and Aerial Photograph Review</u>

Available literature and information on the local hydrogeology and site use, including aerial photographs were reviewed. Aerial photographs from 1938 through 1951 indicate that the Jarl site was an open pasture until after 1951. The 1966 aerial photos illustrate the building complex and two shallow waste water impoundments. The impoundments appear to be 5 to 10 feet deep. The surface impoundments were originally constructed within the native soils. When abandoned, the impoundments were apparently covered with the originally excavated soils (LaBella, 1982). There is not indication that the sludges were removed prior to backfilling. The 1980 aerial photos illustrate that the former impoundments were backfilled and graded. Figure 2 illustrates the site including the approximate horizontal extent of the impoundments based on the review of the aerial photographs.

b. Geophysical Surveys

An electromagnetic survey conducted over the site identified the variable nature of the shallow unconsolidated deposits (Figure 3). The electromagnetic variations provided no indication of the locations of the former surface impoundments. Therefore, it can be concluded that the accumulated impoundment deposits do not provide a conductivity anomaly sufficient to be distinguished from variations in native soil conductivity. The elevated readings observed in isolated areas along the east and northern boundaries of the site may be attributed to pipes or other features associated with the former impoundments buried within the subsurface.

The electrical resistivity survey confirmed that the natural subsurface stratigraphy is consistent with the soil borings performed during the investigation. Figure 2 illustrates the locations of the resistivity soundings. Generally, the sandy soil between 5 and 10 feet thick was recognized as a higher resistive layer. A 10 to 20 feet thick clayey silt layer beneath the sandy soil was recognized as a low resistive layer. Beneath the clayey silt, a significant thickness of a higher resistive layer corresponds to the unsaturated sand identified in boring B1. Additionally, the survey did not detect any evidence of the former surface impoundments. The fact that neither geophysical survey delineated the horizontal or vertical extent of the impoundments suggests that variations in the natural subsurface conductivities exceed any variation due to the presence of waste sludges within the former lagoon impoundments.

c. Ground Water Monitoring Well Installations

Five soil borings, completed as two inch I.D. PVC ground water monitoring wells, were drilled on the site (Figure 2). Monitoring well locations were selected to provide upgradient and downgradient monitoring locations outside the perimeter of the former waste water impoundments. The review of background information, maps, aerial photographs and geophysical surveys provided the information upon which monitoring well locations were selected.

The test soil borings (Figure 4) revealed the surface materials are comprised of brown fine silty sand. This layer varies from approximately 5 feet thick on the southwestern side of the site to approximately 8 feet thick on the northeastern site. The bottom ¼ to 1 foot of this layer is saturated. Clayey silt to silty clay layers approximately 10 to 20 feet thick underlie the silty sand surface deposit. The monitoring wells were installed predominantly within the clayey silt unit.

Figure 5 indicates that ground water flows towards the northwest. This apparent flow direction is not considered representative due to the vertical hydraulic gradients. The true horizontal ground water flow direction is probably toward the north and northeast, given the regional topography.

Based on ground water elevation measurements collected in July 1985 and available site data, the principal zone of ground water saturation occurs within the clayey silt unit. Since the summer months, i.e. periods of low precipitation and ground water recharge, are typically a period of low ground water elevations, it is likely that a greater thickness of ground water saturation exists in the silty sand during winter and spring months. Deep soil boring B-1 revealed that, coarse grained sand and gravel deposits beneath the clayey silt are unsaturated to a depth of about 65 feet below the ground surface. The low permeable clayey silts are causing a perched ground water condition at the site. Although wells B-4 and B-5 were set within the clayey silt saturated zone, the lack of water in the wells during the three sampling events suggests a downward vertical flow potential. The vertical flow potential is attributed to a ground water discharge boundary created by a deep ravine located immediately north of the site. In addition, this vertical flow potential may bias the horizontal flow determination, since the ground water elevation in the wells will equilibrate with the lowest hydraulic head intercepted by the well.

Wells were not installed to define the vertical hydraulic potential or to evaluate potential vertical transport of site ground water parameters.

d. Hydraulic Conductivity Tests

In-situ permeability tests conducted in three of the five monitoring wells indicated the horizontal hydraulic conductivity of the clayey silt ranges between 4×10^{-6} cm/sec to 4×10^{-7} cm/sec (8×10^{-2} to 8×10^{-3} gpd/ft^2).

e. Ground Water Sampling and Analysis

As part of the site investigation (OB&G March 1986), ground water samples were obtained from four of the five monitoring wells on two occasions in July 1985. In October 1985, insufficient water existed in wells B3, B4 and B5 to collect samples. Therefore, no samples were analyzed.

Ground water samples were filtered in the laboratory and analyzed for total chromium, hexavalent chromium, nickel, copper, cadmium, zinc, mercury, and lead. The analyses for chromium, nickel, copper, and zinc were selected based on the known processes and materials used at the facility. Analyses for mercury, lead and cadmium were included due to their occurrence in samples split with NUS Corporation in September, 1984, although Jarl Extrusions has no record of using these metals at the facility. Additionally, total organic halogen (TOX) analyses were performed on unfiltered samples.

f. Surface Impoundment Test Pits

Fifteen test pits were excavated in October 1985 to determine whether residual material from the former surface impoundments exists in the soil and to collect soil samples for analyses. The test pits were excavated and backfilled by a backhoe at locations shown on Figure 4. The test pit locations were selected based on the review of aerial photographs to provide sampling locations both within and outside the former surface impoundments. Several selected soil samples of the site soil and of the black and white impoundment deposits were submitted to the laboratory for analyses of total chromium, copper, cadmium, zinc, lead and aluminum. Analyses of selected samples of these variable deposits revealed the total chromium concentration is two order of magnitude higher than the background. Lead showed a two to three fold increase as compared to background levels. Copper increased approximately two fold over background in the white deposits, and an order of magnitude over background in the black deposits. Although aluminum exists at significant levels in all samples, it is attributed to the fact that sand and clay soils typically contain high levels of aluminum or that non-visible deposits of aluminum from the wastewaters may exist in the site soils. There is approximately a two fold increase in aluminum concentrations between the background samples and the black deposits whereas the white deposits contain about a five fold increase in aluminum. The results of the soil analyses are provided in Table 1.

The results of the EP Toxicity test on the black impoundment deposits from test pit #5 indicated no detectable concentrations of leachable heavy metals.

In summary, the March 1986 report on the site investigation provided the following conclusions:

1. The test pits excavated at the site indicate that the former waste water impoundments contain residues from their past use;
2. The study and prior tests on the impoundment deposits indicated that the majority of the total chromium detected in the samples consisted of trivalent chromium, not hexavalent chromium;
3. EP Toxicity tests on the impoundment deposits indicate that the impoundment residues do not meet the criteria for a characteristic hazardous waste. The EP Toxicity tests did not

address the concern about the possible presence of a listed hazardous waste;

4. The volume and/or nature of the residual impoundment deposits do not permit these deposits to be distinguished from the background soils by the accepted geophysical techniques used in the study; however conductivity highs detected along the northern and eastern sides of the site may represent pipes or features associated with the former impoundments;
5. Ground water occurrence and flow at the site are controlled by both surface topography and the geology beneath the site. Within the clayey silt unit, the zone of first encountered ground water, a vertical flow potential exists due to the presence of a nearby ground water discharge boundary, a ravine, and the presence of coarser more permeable deposits beneath the clayey silt. This vertical flow potential has an impact on the ground water elevations measured in the wells.
6. The available information indicates that the horizontal component of ground water flow is toward the north and northwest.
7. The calculated hydraulic conductivity of the clayey silts ranges from 4×10^{-6} to 4×10^{-7} cm/sec.
8. The two rounds of ground water sampling did not provide duplicate results.

Since the March 1986 Report, ground water samples have been collected on five separate occasions -- March 21, 1986, October 16, 1986, April 15, 1987, June 2, 1987, and December 29, 1987. The results of these monitoring events are presented in Table 1. These ground water samples were analyzed by up to three different laboratories, which included NYSDEC analyzed samples. These samples were typically turbid and as such were analyzed as both unfiltered and filtered samples. To date, chromium, copper and aluminum have been documented in some of the monitoring wells. Hexavalent chromium, nickel, zinc, lead, mercury and cadmium have been detected, however detection has either been sporadic or not detected by all of the laboratories.

Based on the presence of unstabilized sludge from the chemical conversion of aluminum and the exceedances of ground water and drinking water standards, the NYSDEC considered the site a threat to the environment. Given this determination, in 1988 the NYSDEC required a site assessment (RI) and reclassified the site as a 2 on the Registry of Inactive Hazardous Waste Sites.

In April 1989, O'Brien & Gere Engineers, Inc. met with representatives from the NYSDEC and Alcan Aluminum Corporation, the present owners of the site, to discuss the status of the Jarl Extrusions Inc., site. During the meeting it was decided to conduct a focused Remedial Investigation (RI) pursuant to an Administrative Consent Order to address the concerns of the state regarding inconsistent performance of the shallow wells, evaluating any impact on the deep ground water zone, characterizing the vertical extent of the surface impoundments, and the use of Contract Laboratory Procedures (CLP).

The following text provides the details of the proposed focused RI work plan. This is a focused RI in that the scope of the work task reflects those areas of concern identified by the NYSDEC in the letter of August 19, 1988.

SECTION 2 - REMEDIAL INVESTIGATION PLANS AND MANAGEMENT

2.01 Project Work Plan

The work plan for the focused RI is included in Sections 3 through 6 as Work Tasks 1 through 4 of this document. This work plan has been prepared based on USEPA guidelines provided in Guidance for Conducting Remedial Investigation and Feasibility Studies under CERCLA (1988) and discussions with representatives of NYSDEC. The Project Schedule is included as Figure 7.

2.02 Project Management

A project management team has been assembled to implement and coordinate the site investigation. The project management team is provided in the QAPP (Appendix B). Progress reports will be submitted by the project manager to Alcan Aluminum Corporation and the NYSDEC on a monthly basis. At a minimum, the progress reports will address the following: (1) status of work at the site and progress to date, (2) problems encountered during the reporting period which affect the project schedule, (3) actions being taken to correct problems, (4) activities planned for the next month, and (5) any changes in key personnel.

2.03 Health & Safety Plan

A site Health & Safety Plan has been developed for the focused RI investigation in accordance with federal regulations 29 CFR 1910. The plan has been developed and shall be certified by a certified health and safety professional having at least three years of experience in the preparation of Health and Safety Plans for inactive hazardous waste sites. The plan specifies the protective measures used by investigators and site visitors to minimize exposure to hazardous materials present at the site. The Health and Safety Plan is included as Appendix A.

2.04 Sampling Plan

The site specific sampling plan prepared for the Jarl Extrusions Site has been prepared and is included in Section 3 & 4 as part of Work Task 1 & 2 of this work plan. The sampling plan provides the number, location and types of samples to be collected including the analytical methods proposed. Procedures for monitoring well installation, soil borings, sample collection and handling are included in the Quality Assurance Project Plan (QAPP).

2.05 Quality Assurance Plan

A site specific Quality Assurance Project Plan (QAPP) has been prepared and is included as Appendix B. This plan is consistent with the guidelines provided in USEPA documents entitled "Interim Guidelines and Specifications for preparing Quality Assurance Project Plans" (1980) and "Data Quality Objectives for Remedial Response Activities" (1987) regarding the preparation of quality assurance project plans. The plan addresses the following points:

1. Quality Assurance (QA) objectives for measurement data, in terms of precision, accuracy, completeness, representativeness, and comparability.
2. sampling procedures
3. sample custody

4. calibration procedures, references, and frequency
5. internal Quality Control (QC) checks and frequency
6. QA performance audits, system audits, and frequency
7. QA reports to management
8. preventative maintenance procedures and schedule
9. specific procedures to be used to routinely assess data precision, representativeness, comparability, accuracy, and completeness of specific measurements parameters involved, and
10. corrective action.

SECTION 3 - WORK TASK 1 - HYDROGEOLOGIC INVESTIGATION

3.01 Background Review

A detailed background information review was completed as part of the initial site investigation for the Jarl Extrusions Site. Included in this review were historic aerial photographs taken in 1938, 1951, 1966 and 1980 including data collected during previous investigations at the site. As part of the work effort associated with the focused RI study, all of the data pertaining to the site have been reviewed in detail. If new information regarding these sites is obtained after submittal of this work plan, it will be modified as necessary based on the information. Any changes in the work plan as presented in this document will be submitted to NYSDEC for approval prior to initiating the field work.

3.02 Geophysical Surveys

Electromagnetic and electrical resistivity surveys were conducted on the site during the completion of the initial site investigation to assist in determining the areal extent and thickness of the former waste impoundments. The results of these surveys are discussed in detail in the March 1986 Report - Jarl Extrusions, Inc. Site Investigation and in summary in Section 1.02 - Previous Studies of this work plan. In general, while the data assisted in delineating the natural subsurface stratigraphy, the geophysical surveys did not detect evidence of the former surface impoundment wastes. The electromagnetic survey did detect two conductivity highs on the north and east side of the site which may be associated with the former impoundments.

Additional geophysical testing is not proposed as the horizontal extent of the surface impoundments is known and former geophysical testing was not successful in further defining the waste materials. Therefore the previous delineation of the surface impoundments will provide the basis for future investigatory work tasks.

3.03 Surface Impoundment Waste and Soil Characterization

Fifteen test pits excavated within the area of the surface impoundments during the initial site investigation in October 1985, provided an evaluation the horizontal extent of the surface impoundments. Many of the excavations revealed a granular black, white, and gray waste/sludge deposit. The deposits were found interlayered within the silt and sand approximately three feet below the ground surface. Laboratory analysis of various samples revealed total chromium lead, copper and aluminum as the only heavy metals with concentrations above background as discussed in Section 1.02 - Previous Studies of this report. A detailed discussion of the soil/sludge sampling and analysis may be found in the March 1986 Report - Jarl Extrusions, Inc. Site Investigation. The test pits were not successful in fully characterizing the vertical extent.

To further define the vertical extent of the surface impoundment sludges, six test soil borings will be drilled and sampled continuously using hollow stem augers and split spoon samplers. Sampling will continue approximately four feet into the native sediments beneath the former impoundments, an estimated depth of sixteen feet. Three borings shall be installed within each of the two former lagoons as illustrated in Figure 6.

In the two areas (located along the east and north boundaries of the site) which revealed high conductivity data, limited manual excavation by shovel will be conducted in an effort to reveal pipes or other features associated with the former impoundments. One soil sample will be collected, with NYSDEC concurrence, from each excavation for analysis.

Two background soil samples will be collected for analysis. One will be collected in the vicinity of well B-1, and the second sample will be collected from the existing soil mound located along the western edge of the property. Sample locations will be agreed to with the NYSDEC field representative.

To address concerns regarding reported overflows or spillages from the former impoundments, up to six surface soil samples will be collected for analysis within the gully/stream located north of the site. These samples will be collected up slope from any landfill waste. These soil samples will be analyzed and compared to the two background soil samples and two soil samples collected from the areas with high electromagnetic data.

Soil samples will be collected in accordance with the procedures outlined in the QAPP (Appendix B) and retained for laboratory analysis.

3.04 Ground Water Monitoring Well Installations

Five shallow ground water monitoring wells, B-1 through B-5, were installed within the site during the initial site investigation in October 1985, to provide information on the direction of shallow ground water flow and provide ground water sampling locations. Monitoring well B-1 was installed upgradient of the site whereas the remaining four wells B-2 and B-5 installed in downgradient locations (Figure 4). Each well was screened within the shallow zone of first encountered ground water. Wells were not installed within the deeper saturated zone.

Monitoring wells B-4 and B-5 frequently lacked a sufficient volume of water to permit sampling and hydraulic conductivity tests. Therefore, in an attempt to provide additional shallow downgradient sampling points, three additional shallow wells are proposed for installation at a depth of approximately twenty feet. One shallow well will be installed between existing wells B-4 and B-5, a second along the eastern side of the site, and the third well will be installed along the western side of the former impoundment area. Each well shall be installed a minimum of 10 feet into first encountered ground water using hollow stem augers and continuous split spoon sampling. The well locations and interval at which the well screen is installed shall be in concurrence with a representative of the NYSDEC.

In addition, five deep ground water monitoring will be installed at a depth of approximately seventy-five feet below the surface within the deeper saturated zone to evaluate the ground water conditions and identify whether the site may have impacted the deeper ground water zone. Two deep well will be installed upgradient of the site adjacent to monitoring wells B-1 and B-2, whereas the remaining deep wells will be installed downgradient of the site adjacent to wells B-3, B-4, and B-5. The deep wells will be installed approximately 10 feet into the first encountered deep water zone or at the top of a confining layer whichever is shallower. Drilling and sampling will proceed a minimum of five feet into any encountered confining layer to verify its vertical extent.

The monitoring wells will be installed and developed in accordance with the procedures outlined in the QAPP (Appendix B). Figure 6 illustrates the approximate location of each existing and proposed monitor well installation.

Upon completion of the well installations, the location and elevation of each monitor well will be surveyed. Each well location will then be plotted on a site map for use in evaluating the elevation, flow direction, flow rate of the shallow and deep ground water zones, including preparation of a report document. The elevations of all well casings will be established to within 0.01 feet based on a USGS datum. Additionally, ground water elevations in each well will be measured quarterly to identify the low water/dry conditions and high water/wet conditions.

Hydraulic conductivity tests will be performed on each of the newly installed ground water monitoring wells in accordance with the procedures outlined in the QAPP (Appendix B). In addition, the hydraulic conductivity test results from the existing wells will be re-evaluated for comparative purposes. The test results will assist in an evaluation of the horizontal hydraulic conductivity of the screened ground water zone and rate of ground water movement.

3.05 Water Budget

In an effort to evaluate the amount of ground water recharging and discharging from the site, a water budget will be calculated. Rainfall will be based on historic information available from the Greater Rochester Area International Airport. Assumptions for runoff coefficients and infiltration will be based on the surface soil characteristics at the site.

SECTION 4 - WORK TASK 2 - SAMPLING AND ANALYSIS

The following sections describe the sampling and analysis to be performed for the focused RI. Table 3 summarizes the number of samples to be collected and analyses which will be performed. The laboratory selected to conduct the analyses will meet the QA/QC guidelines requirements specified by the NYSDEC.

4.01 Surface Impoundment Waste and Soil

To characterize the waste material within the surface impoundments, soil samples will be collected in six soil borings (Section 3.03). The borings will extend to approximately four feet into the underlying nature materials, an estimated depth of sixteen feet. Soil samples will be collected in accordance with ASTM Method D-1586-84. Each sample will be visually described and field screened using a photoionization detector by the supervising hydrogeologist. Soil boring locations will be selected in the field with the concurrence of the NYSDEC field representative. A minimum of one waste/sludge sample from each boring will be selected for laboratory analysis. As necessary, additional samples will be selected from the borings so that two samples of each visually different waste material encountered are submitted for laboratory analysis. The samples selected for laboratory analysis will be agreed to with the NYSDEC field representative. The waste/sludge samples will be analyzed for Target Compound List (TCL) volatiles, TCL metals, hexavalent chromium, boron, phenols, fluoride, cyanide, sulfate and chloride. In addition, Toxicity Characteristic Leaching Procedure (TCLP) tests will be conducted for chromium, mercury and lead. One composite waste/sludge sample will be submitted for analysis for all TCL parameters. The volatile sample for the composite sample will not be composited, rather it will be selected, with NYSDEC concurrence, from the waste/sludge samples. Contract Laboratory Protocols (CLP) will be followed for the above analysis. Some analytical procedures, such as TCLP tests, are not subject to CLP. One travel blank, field duplicate, laboratory spike and laboratory duplicate will be included with the samples in accordance with the procedures outlined in the QAPP.

Ten surface soil samples will be collected from the site. Two samples will be collected from a background location, two samples will be collected from the locations of the electromagnetic highs and six samples will be collected in the gullys north of the former surface impoundment locations and upslope from any landfill waste. These samples will be submitted to the laboratory for analysis for TCL volatiles, TCL metals, hexavalent chromium, boron, phenols, fluoride, cyanide, sulfate and chloride. CLP will be followed for the analyses.

Monitoring well borings will be continuously sampled during drilling. Each soil sample will be visually described by the supervisory hydrogeologist and screened using a photoionization detector. Should evidence of contamination be identified, the soil sample will be subject to laboratory analysis for the parameters identified above for soil samples.

The surface impoundment samples will be transported to OBG Laboratories, Inc. for analysis. Chain-of-custody documents will be initiated at the time of sample collection and maintained throughout transportation to the laboratory.

4.02 Ground Water

Ground water samples will be collected from each of the existing and newly installed monitoring wells on two occasions. The dates on which these samples will be collected will be selected to represent high ground water/wet and low ground water/dry conditions. Ground water elevations in all wells will be measured quarterly in order to identify the high water/wet and low water/dry conditions. The procedures for sample collection are provided in the QAPP (Appendix B). Ground water samples collected from each well during the first round will be analyzed for TCL volatiles, TCL metals, hexavalent chromium, boron, phenols, fluoride, cyanide, sulfates, and chloride per NYS CLP procedures.

The analytical parameters for the second sampling event will be based on the results of the first sampling round as well as waste/sludge analytical results and previous ground water results. Second round analytical procedures will not be per CLP, but will include detection limits which are equal to or lower than New York State Class GA ground water standards or guidance values. The analytical parameters for the second round will be approved by the NYSDEC prior to sample collection. If the turbidity of the ground water samples is less than 50 NTUs, then only unfiltered samples will be analyzed. If the ground water sample turbidity is greater than 50 NTUs, then both unfiltered and filtered samples will be analyzed. The collected samples will be placed in coolers and transported to OBG Laboratories Inc. for analysis. Chain-of-custody documents will be initiated at the time of sample collection and maintained throughout transportation to the laboratory. The results of the laboratory analyses will be presented in the Remedial Investigation report.

4.03 Surface Water

Given the presence of landfill material between the site and the nearby surface water, no surface water or sediment sampling will be performed. Potential past overflows or discharges from the surface impoundments will be addressed through the collection of soil samples discussed in Section 3.03.

4.04 Air

A program of air monitoring will be implemented on-site to:

1. evaluate the potential for air transport of site contaminants in volatile and fugitive dust emissions for use in the Public Health and Environmental Evaluation (PHEE), and
2. use as a guide in the selection and modification of required levels of personal protection on-site.

A conservative approach will be taken in the sampling setup, e.g. samples will be collected so as to approximate "worst case" on-site conditions. To accomplish this, air samples will be collected over an 8 hour period during the first day of intrusive site activity within the surface impoundments. It is expected that under these circumstances, volatile and fugitive dust emissions from the site will be at a maximum.

Details of the air monitoring program are presented in the QAPP (Appendix B). A general outline of these activities follows. The site investigation will be conducted at three locations (upwind, on-site, and downwind) within the project area. Samples will be collected over an 8 hour workday. The following sampling/analytical methods will be employed:

Analyte	Sampling Media	Method
Volatile Organics	Activated charcoal sorbent tubes	NIOSH Methods 1501 and 1003
Metals	Filter Cartridge	NIOSH Method 7300

An effort will be made to obtain the analytical results from initial samples in as short a time period as possible. This will allow for the most effective application of the data toward the modifications of 1) the scope of on-site activities, and 2) the level of personal protection required for on-site workers. Modifications to the air monitoring program will only be executed to the extent that the data generated remains of sufficient quality and quantity for use in the PHEE. Analyses will be completed by an approved NYSDEC laboratory. Chain of custody documents will be initiated at the time of sample collection and maintained throughout transportation to the laboratory. The results of the laboratory analyses will be presented in the Remedial Investigation report.

SECTION 5 - WORK TASK 3 - HAZARD RANKING AND QUALITATIVE RISK ASSESSMENT

5.01 Hazard Ranking Score

The EPA Hazard Ranking System (HRS; Revised Edition, December 23, 1988) will be utilized in evaluating the site to reassess it's position on the State Priority List.

As described in 40 CFR Part 300, a Hazard Ranking System evaluates the relative threat of a site over five pathways; ground water, surface water, air, direct contact, and fire and explosion. The intent of the system is to evaluate the threat posed by the site in comparison to other sites. The HRS uses a structured value approach to scoring sites. As such, the evaluation is accomplished through assigning a score to each of the pathways mentioned above. The first three of these pathways reflect the risk from migration of hazardous substances from the site. The last two pathways, direct contact and fire and explosion, may be used to determine if the potential risk is so acute that emergency actions are required. These last two pathways are not used in calculating the score for a site.

For the purpose of this proposal, the site will be assessed using the scoresheets provided with the current Hazard Ranking System, which was updated in December 1988. These sheets are completed using information currently available on the site or, if necessary, through further on-site investigation. For each pathway, a score is assigned for observed releases, route characteristics, containment, waste characteristics, and potential targets. The individual scores for these items are then combined to produce a final score for each route. These route scores are then combined using a squared route function. The effect of combining the route scores by this means is to emphasize the primary (highest scoring) route. This final score will then be compared against a cut-off score of 28.5. In the event that the site scores a 28.5 or higher, it will be further evaluated for a position in the Superfund Program.

The Hazard Ranking System was designed as a quick screening procedure to identify waste sites for inclusion on the USEPA National Priorities List for further evaluation and possible remediation under the Superfund Program. This system will be used as a preliminary technique for assessing whether the site represents a potential hazard to humans.

5.02 Qualitative Risk Assessment

The Hazard Ranking Score (HRS) provides a measure of the relative risk rather than absolute risk. Therefore, a HRS may not provide an accurate assessment of the actual risk to a receptor by a particular site. In such cases, a public health and environmental evaluation which compliments and expands upon the initial objective of the HRS is required. The objective of this evaluation is to review all available information in order to ascertain whether existing and future receptors could be adversely affected by exposure to on-site materials. The public health and environmental evaluation will be designed to address the following objectives:

1. Formulation of a series of scenarios representing possible situations under which a receptor could experience exposure to materials currently within the site; and

2. Identification of further efforts and a means by which subsequent investigations, if necessary, can be conducted.

This task will be achieved by performing a "qualitative" and endangerment assessment of the site. Information gained through an investigation of the site in combination with existing data will form the base on which to perform this preliminary evaluation.

The Superfund Public Health Evaluation Manual, October 1986, and Superfund Exposure Assessment Manual, April 1988, will be used as guidance documents for conducting the health evaluation. These documents describe the EPA accepted protocols and procedures which are required to conducting a technically defensible risk assessment.

The proposed risk assessment would consist of 6 components as outlined in the Superfund Public Health Evaluation Manual. These are:

1. Selection of Indicator Chemicals. In order to decrease the time required to conduct an assessment on a large number of compounds, chemicals posing the greatest potential public health threat will be identified. Those chemicals which represent the most toxic, mobile, and persistent substances will be selected as site indicators.
2. Estimation of Exposure Point Concentrations of Indicator Chemicals. This section would estimate the baseline environmental concentrations of indicator chemicals so that the extent and duration of human exposure in the absence of any remedial action can be determined.
3. Comparison to Accepted Criteria. The predicted or measured exposure point concentrations for each site parameter are first compared to established standards for the protection of

human health. Drinking water maximum contaminant levels (MCLs), National Ambient Air Quality Standards (NAAQS), federally-approved state water quality standards developed under the Clean Water Act (e.g., New York State ambient surface water quality standards), USEPA Health Advisories (SNARLS: Suggested No Adverse Impact Levels), and USEPA ambient water quality criteria (AWQC) are often used as criteria for evaluating target concentration levels.

4. Estimation of Chemical Intakes. An estimate of the chronic or subchronic chemical intake from air, surface water, ground water and soil would be determined in humans to assess the cumulative exposure through these media.
5. Toxicity Assessment. The specific toxicity of indicator chemicals would be investigated for use in the determination of quantitative risk.
6. Risk Characterization. An estimate of the cumulative risk as related to non-carcinogenic or potentially carcinogenic chemicals would be developed.

In general, a risk assessment as described above can be divided into two main sections, a qualitative and quantitative assessment. The qualitative assessment will be carried out by evaluating the following three critical components and their combined ability to promote exposures:

1. the chemical and toxicological nature of the waste "source",
2. the ability of mobile source components to be transported via the air, direct contact, surface water and ground water transport routes,and

3. the existence of potential human and wildlife receptors within the influence of each of the potential transport routes.

The evaluation will be based on current conditions and projected future conditions under the "no action" alternative, using realistic assumptions. The product of this evaluation will be a set of potential exposure scenarios. If these scenarios are found to represent no potential hazards, no further site investigation activities will take place. If these scenarios are found by Alcan or the NYSDEC to represent a potential hazard, then the quantitative risk assessment will be completed.

Should the quantitative risk assessment be required the assessment will be completed as follows:

The second phase of the risk assessment will be a quantitative estimation of the magnitude of selected complete exposure scenarios and the human health risks associated with those exposures. This approach is consistent with procedures and guidelines presented in the USEPA Risk Assessment Guidance for Superfund, Volume 1, Human Health Evaluation Manual (Part A) (USEPA 1989a). The approach and procedures in a quantitative risk assessment are discussed in further detail in the following section.

A quantitative risk assessment will be carried out for selected complete exposure pathways at the site. The first step will involve: 1) selection of chemicals to serve as indicators of contamination; 2) measurement or estimates of exposure point concentrations at receptor locations; and 3) the comparison of predicted or measured exposure point concentrations with values established for the protection of human health, to establish whether the waste represents an unacceptable risk to human health.

Selection of indicator chemicals for use in the quantitative analysis will be based on a waste characterization which considers 1) the nature and history of the waste material and 2) the environmental dynamics, toxicology, and residue levels of the waste's constituents. Exposure point concentrations will then be established for each selected indicator chemical. Site-specific monitoring data for each indicator chemical and conservative modelling procedures depicting "reasonable worst case" scenarios will be used in this process. The risks associated with potential exposures to site-related chemicals will be quantified for receptors of concern. Noncarcinogenic health effects will be evaluated by comparing calculated intakes with appropriate RFDs established for the protection of human health. For carcinogenic health effects, the incremental cancer risk associated with exposure to chemicals of concern will be calculated using USEPA-established slope factors.

To assess the risk posed by multiple chemicals, a hazard index approach will be used to calculate the total noncarcinogenic health risks associated with the site. The hazard index is the sum of the ratio of intake to RFD for each chemical of concern. In general, a hazard index of less than unity (one) indicates that adverse health effects are not expected to occur.

SECTION 6 - WORK TASK 4 - DATA EVALUATION AND REMEDIAL INVESTIGATION REPORT

Following completion of the hydrogeologic site investigation as outlined in Work Tasks 1 through 3, a report will be prepared presenting the results of the RI. The report will describe the field sampling activities, present the hydrogeologic and analytical data and include the site investigation analyses.

The following specific information will be included:

- a survey and a resultant plot plan of site sample locations, including established on-site benchmarks;
- a summary of all environmental conditions, including, but not limited to: site drainage, land use, soil conditions, hydrogeologic characteristics, surface and ground water quality, and air quality; along with any maps, tables, graphics, and any other appropriate means of presenting all information;
- all data collected during the Remedial Investigation and/or used in preparing the Report, including but not limited to: soil boring logs, well data, and the results of chemical analyses performed on samples obtained during the Remedial Investigation; said data will be presented in tabulated and/or graphic form where appropriate;
- summary tables of all previous analytical data collected at the site;
- a determination of the types and quantities of hazardous and other wastes present as well as the areal and vertical extent

of such wastes, which determination shall result in the preparation of a waste location map;

- an evaluation of the vertical hydraulic gradient based on the ground water monitoring well nests;
- a study and evaluation of the hydrogeologic conditions at and the site including a site ground water budget to evaluate the amount of ground water recharging and discharging from the site;
- a determination of the nature and extent of actual and potential release and migration of hazardous and industrial wastes from the site through ground water, air, and soil to areas at and in the vicinity of the site and further off-site;
- a determination of the areal and vertical extent to which ground water, air, soil and sediment have been, are being, or may be contaminated by hazardous or industrial wastes;
- an assessment of the results of the Remedial Investigation and a determination of the current or potential impacts of any threat to the environment or public health which exists, or may exist in the future, at and in the vicinity of the site as a result of the wastes disposed of at the site;
- references to all scientific or technical literature used in the preparation of the Report;
- names, titles and disciplines of all professionals engaged in the preparation of the Report; and

The completed report will be submitted to NYSDEC within 90 days of completion of the Remedial Investigation for review and comments in accordance with the attached project schedule (Figure 7).

Tables

TABLE 1 (Continued)
GROUNDWATER QUALITY ANALYSIS DATA
ALCAN ALUMINUM SITE # 828005
PITTSFORD, NEW YORK

Parameters (mg/l)

Well No.	Cr	CrHex	Ni	Cu	Cd	Zn	Hg	Pb	Al	pH lab
B-5 (Well Dry during all previous sampling events)										
4/15/87	0.02	--	LT 0.01	LT 0.01	LT 0.01	LT 0.01	LT 0.0005	LT 0.01	0.04	6.8 F
4/15/87**	0.019	--	LT 0.050	0.0040	LT 0.010	0.027	LT 0.00050	LT 0.0050	0.22	--
4/15/87 (DEC)UF	0.014	0.016	LT 0.040	LT 0.025	LT 0.005	0.039	LT 0.00020	LT 0.005	0.852	--
4/15/87 (DEC)	0.015	0.011	LT 0.040	LT 0.025	LT 0.005	0.014	LT 0.00020	LT 0.005	0.608	--
6/2/87	0.01	LT 0.01	LT 0.01	LT 0.01	0.01	0.01	LT 0.0005	LT 0.01	LT 0.01	--
6/2/87 UF	0.18	LT 0.01	0.17	0.21	0.01	0.08	LT 0.0005	0.06	0.02	7.5
6/2/87**	0.020	0.013	LT 0.040	0.012	LT 0.010	LT 0.010	LT 0.00020	0.016	1.24	--
6/2/87**UF	0.046	0.014	LT 0.040	0.044	LT 0.010	0.064	LT 0.00020	0.120	6.27	--
6/2/87(DEC)UF	--	0.011	--	--	--	--	--	--	--	--
12/29/87	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry
4/7/88	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry
NYS Groundwater Standard Class GA	--	0.05	--	1.0	0.01	5.0	0.002	0.025	--	6.5 - 8.5

LT - Less Than

* - Well B-4 did not contain a sufficient water volume to allow proper purging prior to sampling. Therefore, these results may not be indicative of actual groundwater quality.

DUP - Duplicate sample collected

** - General Testing Corporation

F - Measured in Field

DEC - NYSDEC Split

UF - Unfiltered Sample

TABLE 1 (Continued)
GROUNDWATER QUALITY ANALYSIS DATA
ALCAN ALUMINUM SITE # 828005
PITTSFORD, NEW YORK

Parameters (mg/l)

Well No.	Cr	CrHex	Ni	Cu	Cd	Zn	Hg	Pb	Al	pH lab
B-4										
7/5/85*	LT 0.01	LT 0.01	0.06	0.07	LT 0.01	0.23	0.0013	LT 0.01	--	--
7/23/85*	1.0	LT 0.01	1.1	1.54	0.05	54.0	0.0020	0.99	--	--
3/21/86	LT 0.01	LT 0.01	LT 0.01	LT 0.01	LT 0.01	0.02	LT 0.0005	LT 0.01	LT 0.01	8.1
3/21/86 Dup.	LT 0.01	LT 0.01	0.03	LT 0.01	LT 0.01	LT 0.01	LT 0.0005	LT 0.01	LT 0.01	8.1
10/16/86	LT 0.01	--	--	LT 0.01	LT 0.01	LT 0.01	--	--	LT 0.1	7.5 F
10/16/86**	LT 0.005	--	--	LT 0.005	LT 0.01	LT 0.01	--	--	LT 0.1	--
4/15/87	--	--	--	--	--	--	--	--	--	8.2 F
4/15/87**	0.0050	--	LT 0.050	0.0096	LT 0.010	LT 0.010	LT 0.00050	LT 0.0050	0.16	--
4/15/87 (DEC)UF	LT 0.010	0.010	LT 0.040	LT 0.025	LT 0.005	0.039	LT 0.00020	0.014	6.230	--
6/2/87	0.01	--	0.01	0.01	0.01	0.02	LT 0.0005	LT 0.01	--	--
6/2/87UF	0.01	--	0.01	0.02	0.01	0.03	LT 0.0005	LT 0.01	--	--
6/2/87**	0.0093	--	LT 0.040	0.021	LT 0.010	LT 0.010	LT 0.00020	0.0064	1.21	--
6/2/87**UF	0.0089	--	LT 0.040	0.024	LT 0.010	LT 0.010	LT 0.00020	0.014	1.23	--
6/2/87(DEC)UF	--	--	--	--	--	--	--	--	--	--
12/29/87	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry
4/7/88 UF	LT 0.01	***	0.02	LT 0.01	LT 0.01	0.02	LT 0.0005	0.02	4.2	***
NYS Groundwater Standard Class GA	--	0.05	--	1.0	0.01	5.0	0.002	0.025	--	6.5 - 8.5

LT	- Less Than
*	- Well B-4 did not contain a sufficient water volume to allow proper purging prior to sampling. Therefore, these results may not be indicative of actual groundwater quality.
DUP	- Duplicate sample collected
**	- General Testing Corporation
F	- Measured in Field
DEC	- NYSDEC Split
UF	- Unfiltered Sample
***	- Insufficient Water in Well

TABLE 1 (Continued)
GROUNDWATER QUALITY ANALYSIS DATA
ALCAN ALUMINUM SITE # 828005
PITTSFORD, NEW YORK

Parameters (mg/l)

Well No.	Cr	CrHex	Ni	Cu	Cd	Zn	Hg	Pb	Al	pH lab
B-3										
7/5/85	LT 0.01	LT 0.01	0.05	0.02	LT 0.01	0.07	LT 0.0005	LT 0.01	--	--
7/23/85	0.56	LT 0.01	1.10	0.90	0.04	1.5	0.0012	0.46	--	--
3/21/86	LT 0.01	LT 0.01	0.02	0.12	LT 0.01	0.02	0.0005	LT 0.01	8.2	9.4
10/16/86	0.01	--	--	0.02	LT 0.01	LT 0.01	--	--	LT 0.1	8.3 F
10/16/86**	0.17	--	--	0.033	LT 0.01	LT 0.01	--	--	0.43	--
4/15/87	0.06	--	LT 0.01	0.05	LT 0.01	LT 0.01	0.0009	0.03	0.10	9.0 F
4/15/87**	0.072	--	LT 0.050	0.050	LT 0.010	LT 0.010	LT 0.00050	LT 0.0050	1.59	
4/15/87 (DEC)UF	0.068	0.077	LT 0.040	0.061	LT 0.005	0.037	0.00060	LT 0.005	8.120	--
4/15/87 (DEC)	0.053	0.039	LT 0.040	0.053	LT 0.005	0.028	0.00051	LT 0.005	5.530	--
6/2/87	0.05	LT 0.01	0.03	0.10	LT 0.01	0.03	0.0010	LT 0.01	LT 0.01	--
6/2/87UF	0.08	LT 0.01	0.05	0.11	LT 0.01	0.04	0.0010	0.04	LT 0.01	8.9
6/2/87**	0.055	0.025	LT 0.040	0.082	LT 0.010	0.014	LT 0.00020	0.0093	3.06	--
6/2/87**UF	0.057	0.024	LT 0.040	0.101	LT 0.010	0.017	LT 0.00020	0.012	3.37	--
6/2/87(DEC)UF	--	0.023	--	--	--	--	--	--	--	--
12/29/87	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry
4/7/88	LT 0.01	LT 0.01	LT 0.01	0.01	LT 0.01	LT 0.01	--	LT 0.01	LT 0.01	9.0
4/7/88 UF	LT 0.01	LT 0.01	LT 0.01	0.01	LT 0.01	LT 0.01	0.0007	LT 0.01	LT 0.01	8.9 F
4/7/88*	0.014	LT 0.010	LT 0.040	0.032	LT 0.010	LT 0.010	LT 0.0020	LT 0.0050	0.78	
4/7/88**	LT 0.010	LT .0.10	LT 0.040	0.015	LT 0.010	LT 0.010	LT 0.00020	LT 0.0050	0.18	
NYS Ground Water Standard Class GA	--	0.05	--	1.0	0.01	5.0	0.002	0.025	--	6.5 - 8.5

LT - Less Than
* - Well B-4 did not contain a sufficient water volume to allow proper purging prior to sampling. Therefore, these results may not be indicative of actual ground water quality.
DUP - Duplicate sample collected
** - General Testing Corporation
F - Measured in Field
DEC - NYSDEC Split
UF - Unfiltered Sample

TABLE 1 (Continued)
GROUNDWATER QUALITY ANALYSIS DATA
ALCAN ALUMINUM SITE # 828005
PITTSFORD, NEW YORK

Parameters (mg/l)

Well No.	Cr	CrHex	Ni	Cu	Cd	Zn	Hg	Pb	Al	pH lab
B-2										
7/5/85	LT 0.C	LT 0.01	0.05	0.02	LT 0.01	LT 0.01	0.0056	LT 0.01	--	--
7/23/85	0.35	LT 0.01	0.26	0.27	0.02	0.60	0.0007	0.05	--	--
3/21/86	0.21	LT 0.01	LT 0.01	LT 0.01	LT 0.01	LT 0.01	LT 0.0005	LT 0.01	LT 0.01	9.1
10/16/86	0.07	--	--	LT 0.01	LT 0.01	LT 0.01	--	--	LT 0.1	7.3 F
10/16/86**	0.075	--	--	LT 0.005	LT 0.01	LT 0.01	--	--	LT 0.1	--
4/15/87	0.11	--	LT 0.01	LT 0.01	LT 0.01	LT 0.01	LT 0.0005	LT 0.01	0.05	7.9 F
4/15/87**	0.155	--	LT 0.050	0.0025	LT 0.010	LT 0.010	LT 0.0005	LT 0.0050	0.15	--
4/15/87 (DEC)UF	0.150	0.129	LT 0.040	LT 0.025	LT 0.005	0.012	LT 0.00020	LT 0.005	0.577	--
6/2/87	0.01	LT 0.01	LT 0.01	LT 0.01	LT 0.01	LT 0.01	LT 0.0005	LT 0.01	LT 0.01	--
6/2/87UF	0.38	LT 0.01	0.01	0.11	0.01	0.04	0.0010	0.03	LT 0.01	9.0
6/2/87**	0.0096	LT 0.010	LT 0.040	0.0080	LT 0.010	LT 0.010	LT 0.00020	LT 0.0050	0.39	--
6/2/87**UF	0.067	LT 0.010	LT 0.040	0.032	LT 0.010	LT 0.010	0.00062	0.014	3.32	--
6/2/87**UF DUP	0.018	LT 0.010	LT 0.040	0.0078	LT 0.010	LT 0.010	LT 0.00020	LT 0.0050	1.83	--
6/2/87(DEC)UF	--	LT 0.010	--	--	--	--	--	--	--	--
12/29/87	0.013	LT 0.01	LT 0.01	LT 0.01	LT 0.01	LT 0.01	LT 0.0005	LT 0.01	LT 0.01	--
12/29/87 UF	0.017	LT 0.01	LT 0.01	LT 0.01	LT 0.01	LT 0.01	LT 0.0005	LT 0.01	LT 0.01	8.8
12/29/87(DEC)UF	0.0359	0.0178	--	LT 0.01	--	0.0144	--	LT 0.005	--	--
12/29/87**	0.0285	0.027	LT 0.040	0.0095	LT 0.010	LT 0.010	0.00020	LT 0.0050	0.25	--
12/29/87**UF	0.0366	0.027	LT 0.040	0.0081	LT 0.010	LT 0.010	LT 0.00020	LT 0.0050	0.75	--
4/7/88	0.07	LT 0.01	LT 0.01	LT 0.01	LT 0.01	LT 0.01	LT 0.0005	LT 0.01	LT 0.01	8.0
4/7/88 UF	0.07	LT 0.01	LT 0.01	LT 0.01	LT 0.01	LT 0.01	LT 0.0005	LT 0.01	LT 0.01	8.7 F
4/7/88**	0.066	LT 0.046	LT 0.04	0.0055	LT 0.010	LT 0.010	LT 0.00020	LT 0.0050	0.95	
4/7/88 UF**	0.055	0.034	LT 0.04	0.0050	LT 0.050	LT 0.010	LT 0.00020	LT 0.0050	LT 0.01	
NYS Groundwater Standard Class GA	--	0.05	--	1.0	0.01	5.0	0.002	0.025	--	6.5 - 8.5

LT - Less Than
* - Well B-4 did not contain a sufficient water volume to allow proper purging prior to sampling. Therefore, these results may not be indicative of actual groundwater quality.
DUP - Duplicate sample collected
** - General Testing Corporation
F - Measured in Field
DEC - NYSDEC Split
UF - Unfiltered Sample

TABLE 1
GROUNDWATER QUALITY ANALYSIS DATA
ALCAN ALUMINUM SITE # 828005
PITTSFORD, NEW YORK

Parameters (mg/l)

Well No.	Cr	CrHex	Ni	Cu	Cd	Zn	Hg	Pb	Al	pH lab
B-1										
7/5/85	LT 0.01	LT 0.01	0.07	0.02	LT 0.01	0.10	LT 0.0005	LT 0.01	--	--
7/23/85	0.02	LT 0.01	LT 0.01	0.03	LT 0.01	0.02	LT 0.0005	LT 0.01	--	--
3/21/86	LT 0.01	LT 0.01	0.03	LT 0.01	LT 0.01	LT 0.01	LT 0.0005	0.03	0.5	7.8
3/21/86 Dup.	0.06	LT 0.01	LT 0.01	LT 0.01	LT 0.01	0.03	LT 0.0005	LT 0.01	1.9	7.5
10/16/86	LT 0.01	--	--	LT 0.01	LT 0.01	LT 0.01	--	--	LT 0.1	6.5 F
10/16/86**	LT 0.005	--	--	LT 0.005	LT 0.01	LT 0.01	--	--	LT 0.1	--
4/15/87	LT 0.01	--	LT 0.01	LT 0.01	LT 0.01	LT 0.01	LT 0.0005	LT 0.01	0.04	6.8 F
4/15/87**	LT 0.0050	--	LT 0.050	0.0026	LT 0.01	LT 0.010	LT 0.0050	LT 0.0050	LT 0.01	--
4/15/87 (DEC)UF	LT 0.010	0.011	LT 0.040	LT 0.025	LT 0.005	0.020	LT 0.00020	LT 0.005	0.784	--
6/2/87	LT 0.01	LT 0.01	LT 0.01	LT 0.01	LT 0.01	0.02	LT 0.0005	LT 0.01	LT 0.01	--
6/2/87 UF	0.01	LT 0.01	0.02	LT 0.01	LT 0.01	0.02	LT 0.0005	LT 0.01	0.04	7.3
6/2/87**	LT 0.0050	LT 0.010	LT 0.040	0.0054	LT 0.010	LT 0.010	LT 0.00020	LT 0.0050	0.29	--
6/2/87**UF	0.012	LT 0.010	LT 0.040	0.010	LT 0.010	LT 0.010	LT 0.00020	0.010	1.14	--
6/2/87(DEC)UF	--	0.015	--	--	--	--	--	--	--	--
12/29/87	LT 0.01	LT 0.01	LT 0.01	LT 0.01	LT 0.01	LT 0.01	LT 0.0005	LT 0.01	0.013	--
12/29/87 UF	LT 0.01	LT 0.01	LT 0.01	LT 0.01	LT 0.01	LT 0.01	LT 0.0005	LT 0.01	0.075	7.3
12/29/87(DEC)UF	0.0475	0.0205	--	0.0269	--	0.0783	--	0.016	--	--
12/29/87**	0.0057	LT 0.010	LT 0.040	0.0092	LT 0.010	LT 0.010	LT 0.00020	LT 0.0050	0.14	--
12/29/87**UF	0.0064	0.015	LT 0.040	0.019	0.012	LT 0.010	LT 0.00020	0.0060	1.31	--
4/7/88	LT 0.01	LT 0.01	0.01	LT 0.01	LT 0.01	LT 0.01	LT 0.0005	LT 0.01	LT 0.01	8.0
4/7/88 UF	LT 0.01	LT 0.01	0.01	LT 0.01	LT 0.01	LT 0.01	LT 0.0005	LT 0.01	LT 0.01	7.1 F
4/7/88**	0.0[illegible]6	0.046	LT 0.04	0.0055	LT 0.010	LT 0.010	LT 0.00020	LT 0.0050	0.95	
4/17/88 UF**	0.055	0.034	LT 0.04	0.0050	LT 0.010	LT 0.010	LT 0.00020	LT 0.0050	LT 0.01	
NYS Groundwater Standard Class GA	--	0.05	--	1.0	0.01	5.0	0.002	0.025	--	6.5 - 8.5

LT - Less Than

* - Well B-4 did not contain a sufficient water volume to allow proper purging prior to sampling. Therefore, these results may not be indicative of actual groundwater quality.

DUP - Duplicate sample collected

** - General Testing Corporation

F - Measured in Field

DEC - NYSDEC Split

UF - Unfiltered Sample

TABLE 2

SURFACE IMPOUNDMENT SOIL ANALYSIS DATA

ALCAN ALUMINUM SITE # 828005
PITTSFORD, NEW YORK

Sample Location	Depth (ft)	Description	Parameters (mg/kg) Cr	Cu	Cd	Zn	Pb	Al	Pcts Solids
1	5-6	soil	24	18	LT 1	62	8	10,300	81.4
15	5-6	soil	21	22	2	60	9	10,100	77.5
4	6-7	black deposits (distinct odor)	4,500	297	2	73	30	21,200	31.6
5	7-8	black deposits (distinct odor)	5,600	312	LT 1	79	29	22,300	25.3
7	1.5	white deposits	3,600	38	2	110	17	49,000	55.7
9	2.5	white deposits	4,100	39	2	86	18	57,000	56.8
10	7	black deposits	2,280	148	LT 1	63	19	16,000	63.1

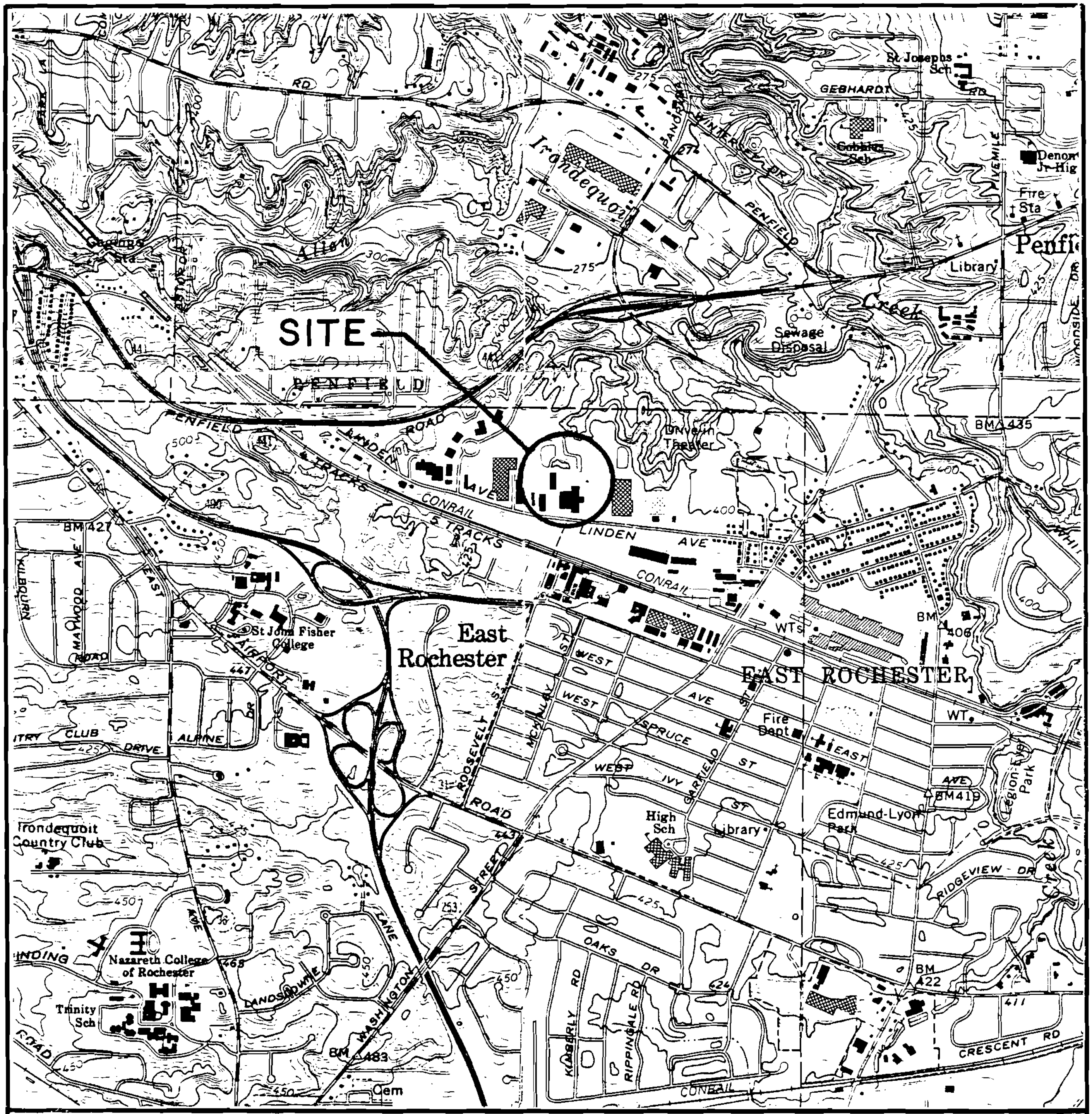
TABLE 3

SAMPLES AND ANALYSIS
ALCAN ALUMINUM SITE #828005
PITTSFORD, NEW YORK

Sample Matrix	Estimated No. Samples	Analyses
Surface Impoundment Waste	16	TCL metals, TCL volatile organics, hexavalent chromium, boron, phenols, fluoride, sulfate, chloride, percent solids, cyanide, and Toxicity Characteristic Leaching Procedures for chromium, mercury, lead
Surface Impoundment Waste	1	All TCL parameters
Surface Soil Samples	10	TCL metals, TCL volatile organics, Hexavalent chromium, boron, phenols, fluoride, cyanide, sulfate, and chloride
Ground Water (1st sampling event)	13 filtered 13 unfiltered	TCL metals, TCL volatile organics, hexavalent chromium, boron, phenols, fluoride, cyanide, sulfates, and chloride
Ground Water (2nd sampling event)	13 filtered 13 Unfiltered	Based upon results of 1st sampling event
Air	14	TCL metals and volatile organics

NOTE: The number of QAQC samples shall be as specified in the QAPP - Appendix B

FIGURE 1



ALCAN ALUMINUM CORPORATION
ALCAN ALUMINUM SITE # 828005
PITTSFORD, NEW YORK

SITE LOCATION MAP

0 2000 4000

SCALE IN FEET

ADAPTED FROM 7.5 MIN. U.S.G.S. QUAD. MAP, FAIRPORT, NEW YORK

7/17/90

3057.032.130

8.5X11

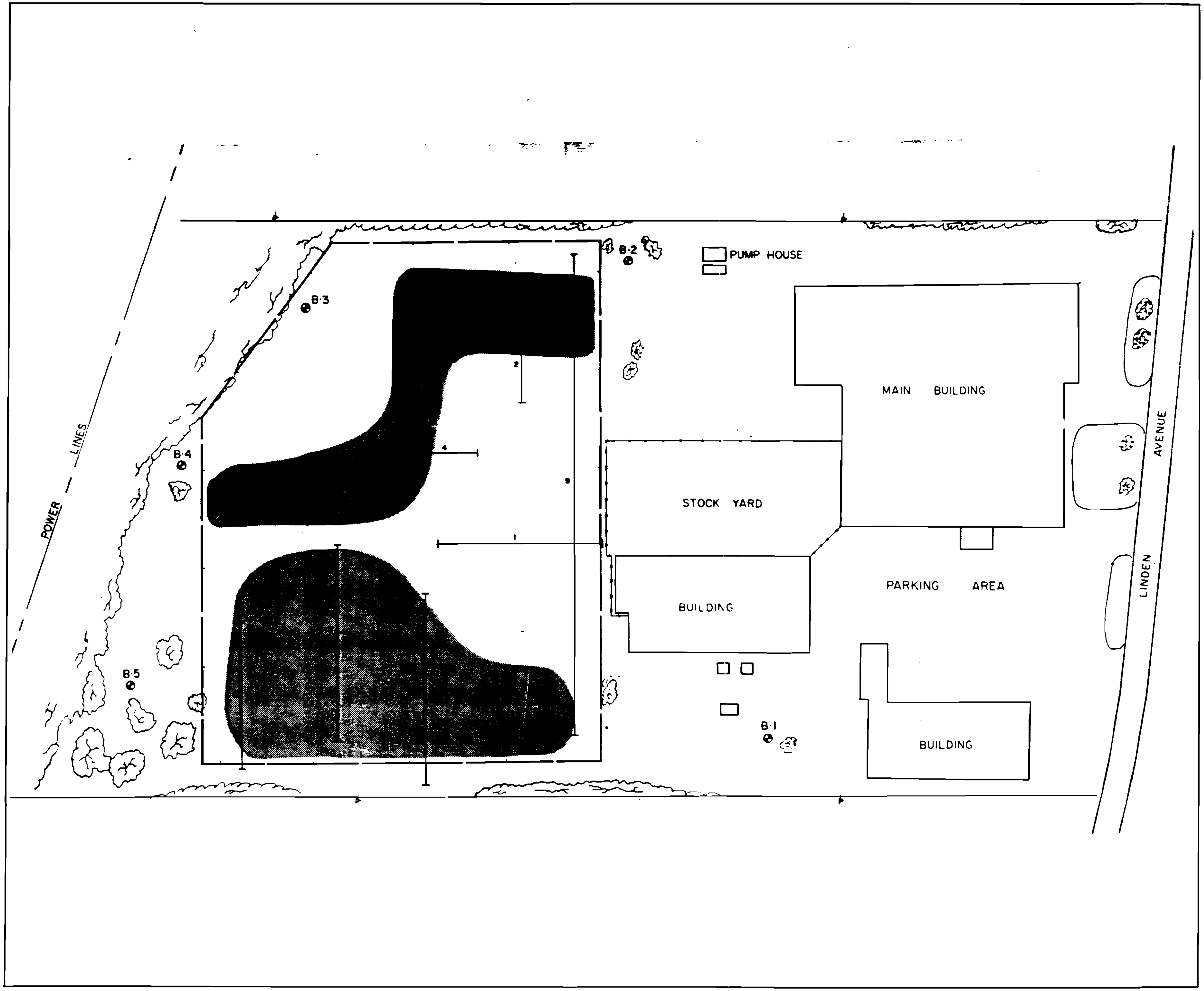
O'BRIEN & GERE

FIGURE 2

ALCAN ALUMINUM CORPORATION

ALCAN ALUMINUM SITE # 828005
PITTSFORD, N.Y.

SURFACE IMPOUNDMENTS MAP



LEGEND

- B-2 ⊗ MONITOR WELL
- —— —— GEOPHYSICAL GRID
- ▨ FORMER WATER IMPOUNDMENTS AS INDICATED BY AERIAL PHOTOS
- ├──┤ RESISTIVITY LINE

N

SCALE
50 0 50 100
1" = 50'

BUILDING AND WELL LOCATIONS ARE APPROXIMATE.
BASE MAP DRAWN FROM U.S.D.A. AIR PHOTO NO. 36055, 6/80

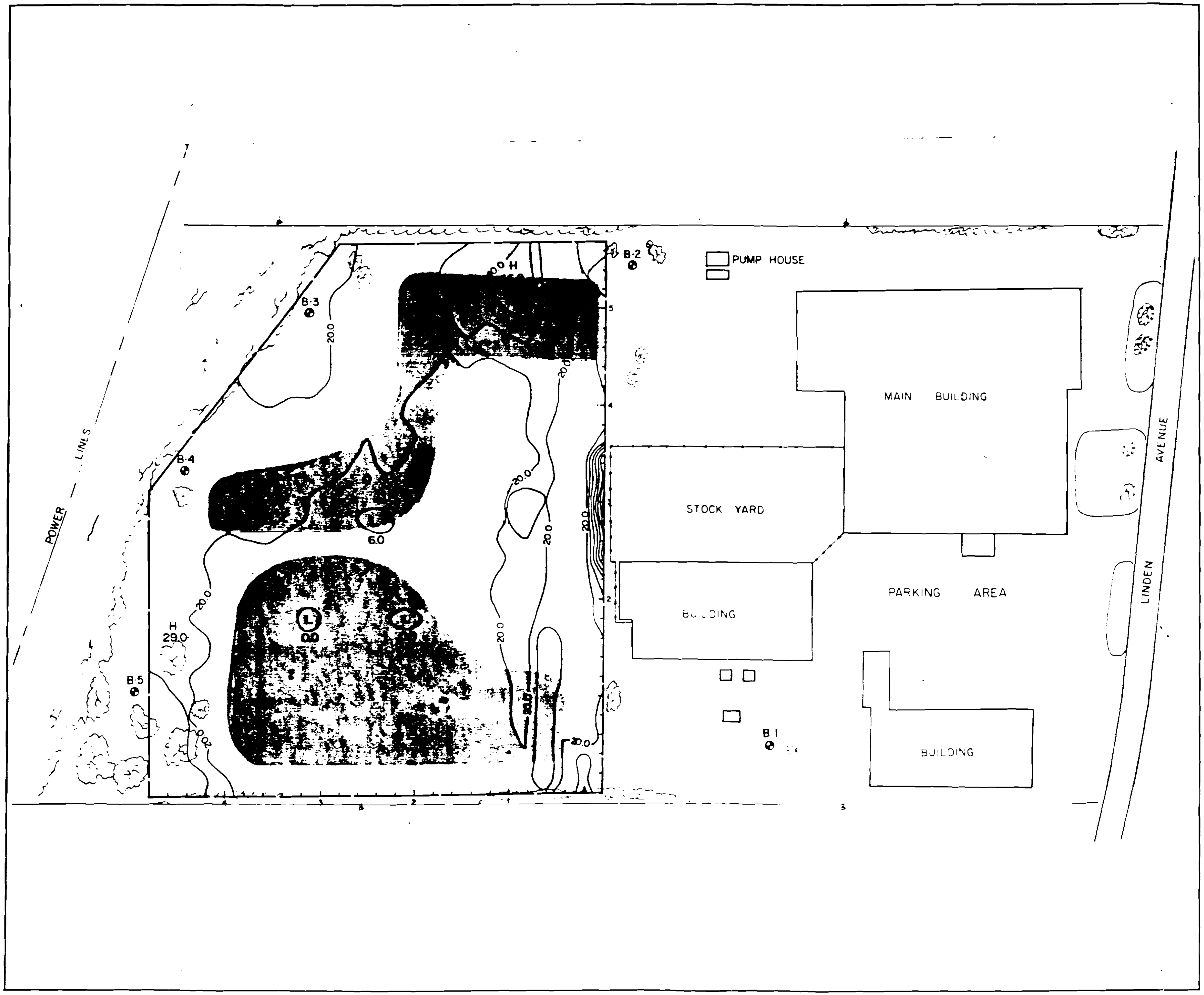
O'BRIEN & GERE

FIGURE 3

ALCAN ALUMINUM CORPORATION

ALCAN ALUMINUM SITE # 828005
PITTSFORD, N.Y.

ELECTROMAGNETIC SURVEY



LEGEND

B-2 ⊕	MONITOR WELL
─┼─┼─	GEOPHYSICAL GRID
▨	FORMER WATER IMPOUNDMENTS AS INDICATED BY AERIAL PHOTOS
∿10.0	CONDUCTIVITY CONTOURS IN MILLIMHOS PER METER

N

SCALE

1" = 50' 50 0 50 100

BUILDING AND WELL LOCATIONS ARE APPROXIMATE,
BASE MAP DRAWN FROM U.S.D.A AIR PHOTO NO. 36055, 6/80

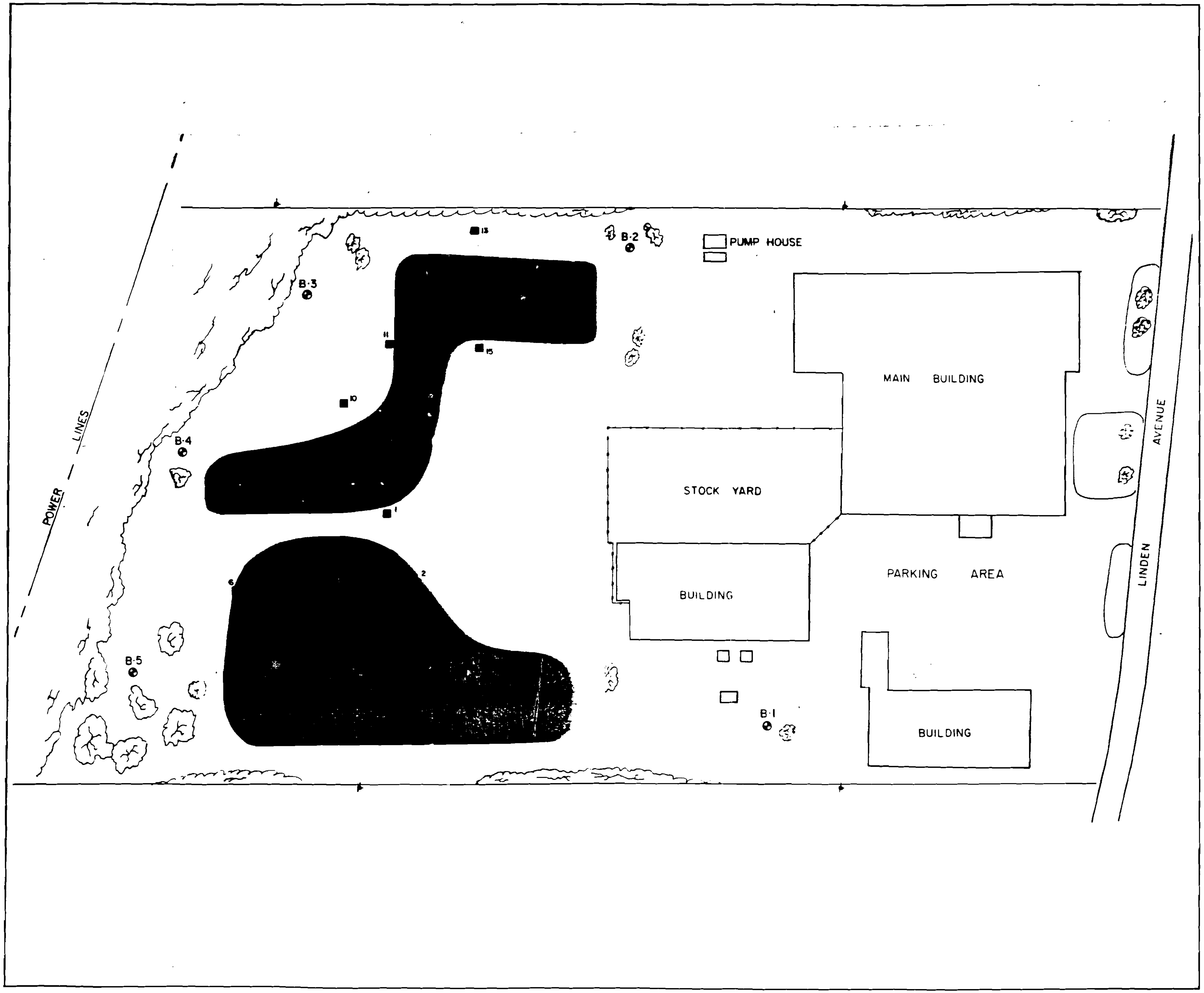
O'BRIEN & GERE

FIGURE 4

ALCAN ALUMINUM CORPORATION

ALCAN ALUMINUM SITE # 828005
PITTSFORD, N.Y.

TEST PIT LOCATION MAP



LEGEND

B·2 ● MONITOR WELL

■ TEST PIT LOCATION

▨ FORMER WATER IMPOUNDMENTS AS INDICATED BY AERIAL PHOTOS

N

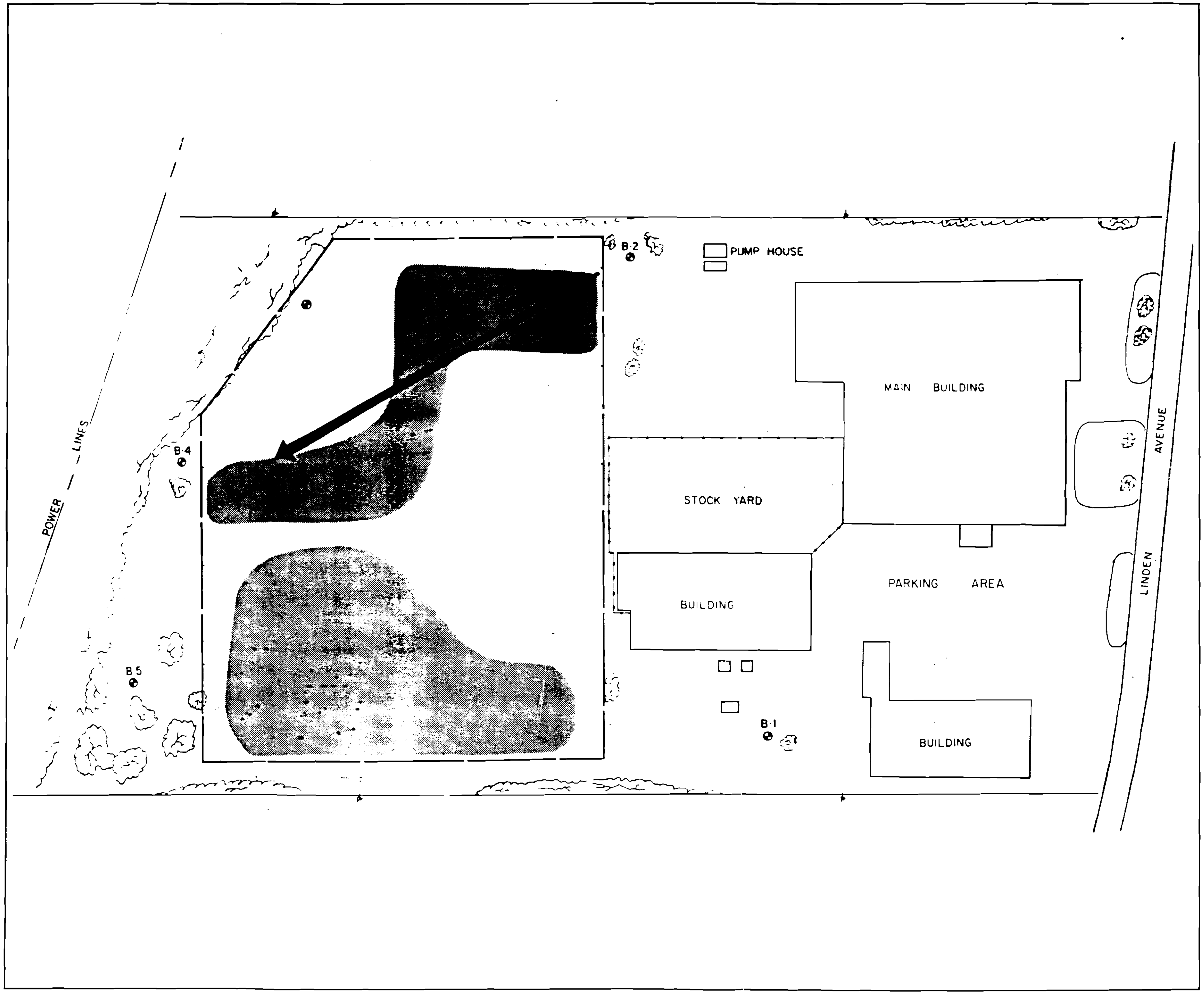
SCALE

1" = 50' 50 0 50 100

BUILDING AND WELL LOCATIONS ARE APPROXIMATE,
BASE MAP DRAWN FROM U.S.D.A. AIR PHOTO NO 36055, 6/80

O'BRIEN & GERE

FIGURE 5



ALCAN ALUMINUM CORPORATION

ALCAN ALUMINUM SITE # 828005
PITTSFORD, N.Y.

GROUNDWATER FLOW MAP

LEGEND

B·2 ●	MONITOR WELL
——— ———	GEOPHYSICAL GRID
▨	FORMER WATER IMPOUNDMENTS AS INDICATED BY AERIAL PHOTOS

N

SCALE
1" = 50'
50 0 50 100

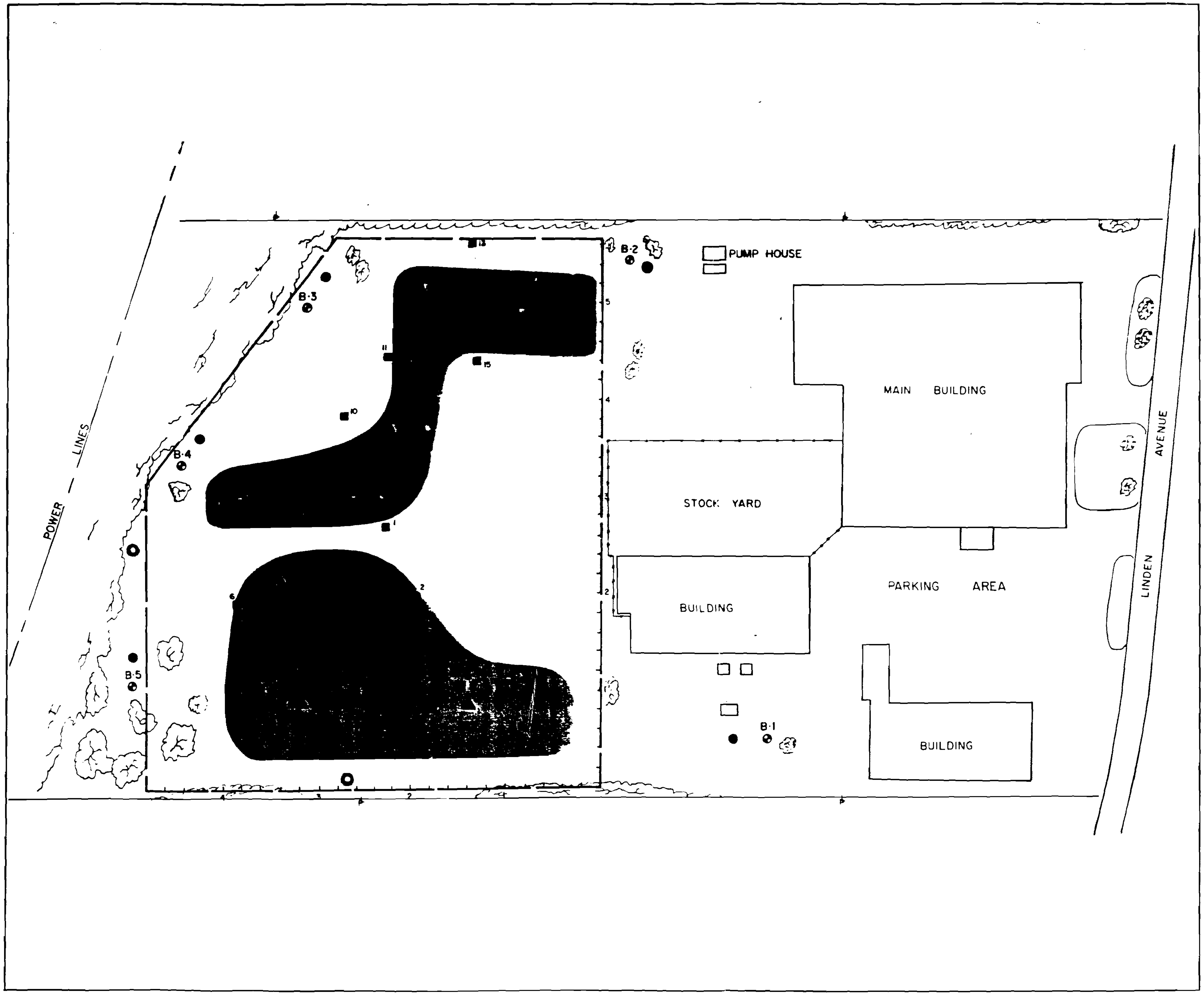
BUILDING AND WELL LOCATIONS ARE APPROXIMATE,
BASE MAP DRAWN FROM U.S.D.A. AIR PHOTO NO. 36055. 6/80

O'BRIEN & GERE

FIGURE 6

ALCAN ALUMINUM CORPORATION

ALCAN ALUMINUM SITE # 828005
PITTSFORD, N.Y.



LOCATION OF PROPOSED SHALLOW AND DEEP GROUNDWATER MONITOR WELLS AND SOIL BORINGS

LEGEND

B-2 ⊘	MONITOR WELL (EXISTING SHALLOW)
— —	GEOPHYSICAL GRID
▨	FORMER WATER IMPOUNDMENTS AS INDICATED BY AERIAL PHOTOS
▲	SOIL BORINGS (PROPOSED)
●	MONITOR WELL (PROPOSED DEEP)
○	MONITOR WELL (PROPOSED SHALLOW)

N

SCALE
1" = 50' 50 0 50 100

BUILDING AND WELL LOCATIONS ARE APPROXIMATE.
BASE MAP DRAWN FROM USDA AIR PHOTO NO. 36055, 6/80

O'BRIEN & GERE

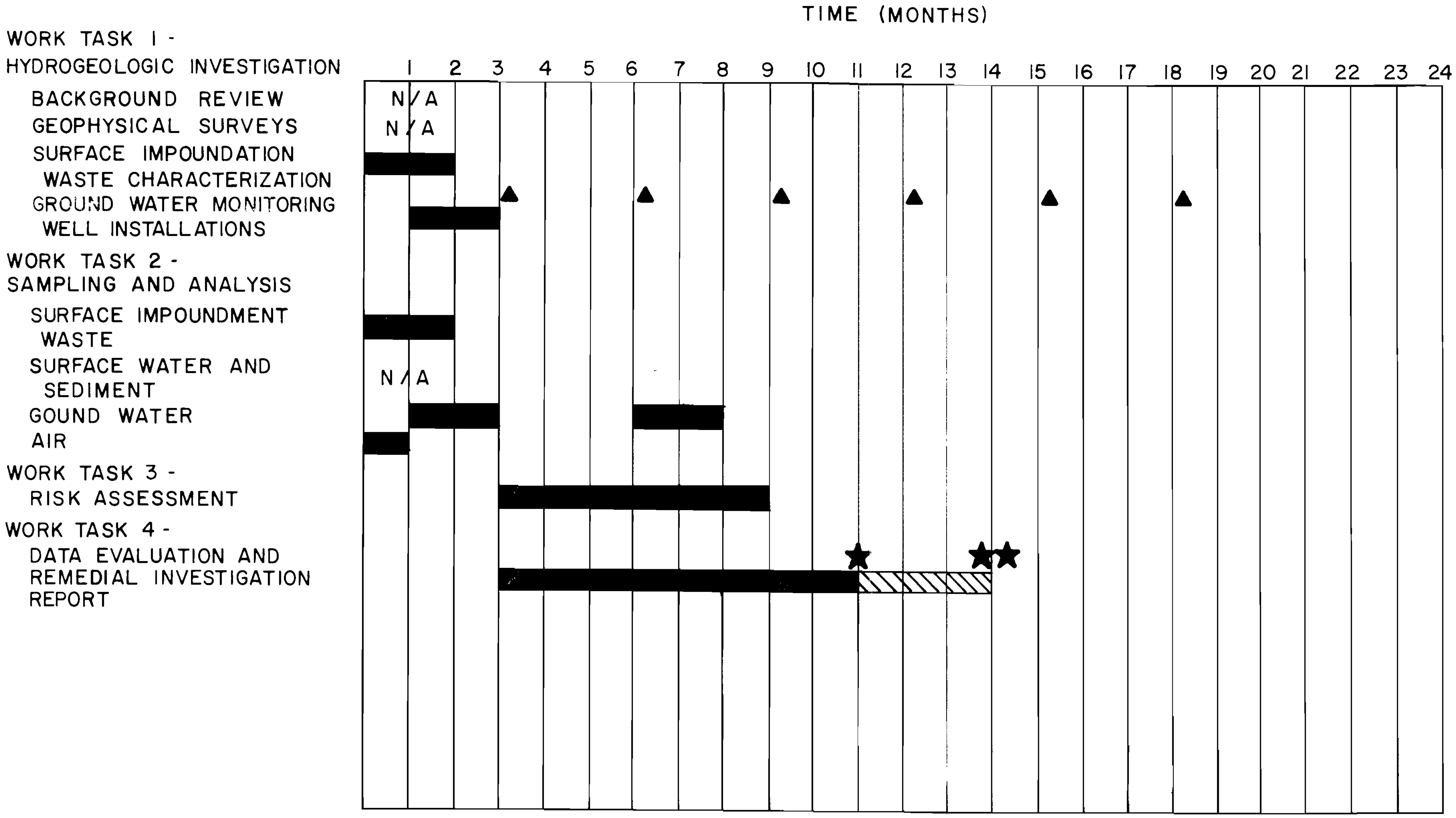
FIGURE 7

ALCAN ALUMINUM CORPORATI

JARL EXTRUSION SITE
PITTSFORD, N.Y.

PROJECT SCHEDULE

(ASSUMES NO NYSDEC DISAPPROVAL OF REPORTS)



NOTE:

N/A NOT APPLICABLE

▲ QUARTERLY GROUND WATER ELEVATION MEASUREMENT

★ SUBMIT RI REPORT WITHIN 90 DAYS OF RI COMPLETION

★★ IF DISAPPROVED BY NYSDEC, REVISE AND RESUBMIT RI REPORT WITHIN 45 DAYS OF DISAPPROVAL NOTICE.

LEGEND

■ WORK TIME FOR TASK

▨ NYSDEC REVIEW

Appendices

APPENDIX A

HEALTH AND SAFETY PLAN
FOR
FOCUSED REMEDIAL INVESTIGATION

ALCAN ALUMINUM SITE #828005
PITTSFORD, NEW YORK

JULY 1990

O'BRIEN & GERE ENGINEERS, INC.
5000 BRITTONFIELD PARKWAY
SYRACUSE, NEW YORK 13221

HEALTH AND SAFETY PLAN

Focused Remedial Investigation/Feasibility Study

Alcan Aluminum Site #828005

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HEALTH AND SAFETY PLAN

Focused Remedial Investigation/Feasibility Study

Alcan Aluminum Site #828005

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(Continued)

Page

SECTION 6 - SITE OPERATING PROCEDURES (Continued)

SECTION 1 - INTRODUCTION

This document serves as the Site Health and Safety Plan (HSP) for all site activities to be conducted at the Alcan Aluminum site #828005, located on Linden Ave. in Pittsford, NY, east of Rochester. The area of study including the site is approximately 20 acres. The property is currently owned by Alcan Aluminum Corporation. The former owner of the property is Jarl Extrusions, Inc. The area of study involves two surface impoundments formerly used by Jarl Extrusions for waste water retention from a metal finishing facility. The impoundments were active between 1963 and 1976. The impoundments were backfilled, graded and seeded in 1980.

Previous investigations of contaminants within the impoundments and the associated ground water were conducted by LaBella Associates, in 1982, by NUS Corporation in 1984, and by O'Brien & Gere Engineers, Inc. in 1985-86 and 1988. In April 1989, Alcan Aluminum Corporation, representatives from the New York State Department of Environmental Conservation (NYSDEC) and O'Brien and Gere Engineers decided to conduct a Focused Remedial Investigation/Feasibility Study (RI/FS) to address the concerns of the DEC.

This Health and Safety Plan is based on the Work Plan addressing the activities to be conducted under the RI/FS for the site. These include the installation, development and sampling of one shallow and four deep ground water monitoring wells. These are intended to yield a clearer definition of the shallow and deep aquifers underlying the site. Also included in the work efforts is the collection of three test borings from each of the two former waste lagoons, for a total of six soil borings. These are intended to more accurately determine the depth of the sludge in the former impoundments.

The intent of this HSP is to provide the minimum health and safety requirements and general procedures to be met by O'Brien and Gere employees while conducting these activities. Accordingly, it includes the responsibilities, training requirements, protective equipment, and standard operating procedures necessary to minimize unsafe conditions and exposures to contaminants greater than established action levels while workers, official visitors, and company representatives are on-site. The HSP also provides for the protection of the nearby community during site activities. The HSP will be discussed with all site personnel and will be available on-site for employee inspection. A qualified on-site Safety and Health Officer will be designated to implement the HSP for all on-site activities.

SECTION 2 - HEALTH AND SAFETY PLAN SUMMARY AND SITE HAZARD OVERVIEW

2.01 General

Based on information from previous studies, sample results and EP Toxicity tests indicate that the buried sludge material is does not exceed the criteria for characteristic hazardous waste (LaBella study). Test pits (OBG 1985-86 study), verified the presence of residues from past use in the locations of the former impoundments. Ground water analyses were inconclusive in determining the presence of volatile organic materials in the ground waters. Repeated soil samples have revealed the presence of elevated (2 - 10 times above background) levels of tri-valent chromium, lead, aluminum and copper.

Due to the potential for hazardous materials residuals to be contained in isolated areas of the site, and the stance of the NYSDEC regarding the status of the site, this Health and Safety Plan is in accordance with OSHA regulations mandated in 29 CFR 1910.120 ("Hazardous Waste Operations and Emergency Response").

The HSP covers all phases of the intended RI operations, including:

- Work practices
- Hazard identification
- Established work zones
- Level of personal protective equipment for each task
- Entry and exit routes
- Decontamination procedures
- Emergency response

2.02 Personal Protective Equipment

The primary exposure pathway to contaminants of concern (chromium III, lead, aluminum and copper) at the site is from inhalation of potentially contaminated soil dust particles. Thus personal protection will focus on minimizing the generation of airborne soil particulate matter. Where this cannot be achieved by engineering controls, respiratory protection will be used.

It is anticipated that site operations will be conducted using Level D and modified Level D protection (see Section 5). Protective equipment measures are based on specific work activities. It should be emphasized that the level of protection is subject to immediate change by the Site Supervisor or the Site Safety and Health Officer based on continued observations and hazard evaluation.

2.03 Monitoring Well Installation and Soil Borings

The primary health concern during this work involving sub-surface disturbance is the inhalation of contaminated soil particles under dry, dusty conditions. The major safety concerns relate to operations around heavy equipment and noise levels generated by the drill rig which could potentially damage workers' hearing and interfere with communication.

2.04 Ground Water Sampling

No major health hazards associated with waste materials are anticipated during this activity, based on previous information.

2.05 Personnel Monitoring

During extreme weather conditions, workers will be continually observed (through the buddy system and by on-site supervisors) for signs of heat stress, cold stress, and other adverse health effects. For monitoring for heat stress, one or more of the following techniques should be used, particularly if semi-impermeable protective clothing (e.g., tyvek^R suits) are required.

- Heart rate (pulse) will be measured at the end of a rest period. The pulse at this time should not exceed 110 beats per minute. If the pulse is higher, the next work period will be shortened by 33%, while the length of the rest period stays the same. If the pulse rate is higher than 110 beats per minute at the end of the next rest period, the following work cycle should also be shortened by 33%.
- Body temperature should be measured orally with a clinical thermometer at the end of the resting period. Oral temperature at this time should not exceed 99.6 degrees F. If it does, the next work period should be shortened by 33%, while the length of the rest period stays the same. If the oral temperature exceeds 100.6 degrees F at the end of the next period, the worker should remove the semi-impermeable garment. Work in such garments should not be resumed until the oral temperature has dropped to 98.6 degrees F.

SECTION 3 - RESPONSIBILITIES

3.01 On-Site Organization

In order to maximize the efficiency of site activities and maintain a strong commitment to worker safety, an organizational structure that supports the overall objectives of the project has been developed. Key personnel for the site are the Project Manager, On-Site Supervisor, Site Safety and Health Officer, and Safety designees. The specific duties of each officer are described below.

3.01.01 Project Manager

The Project Manager is responsible for overseeing the overall management of the RI. He/she coordinates between office and field personnel and manages administrative requirements. Guy A. Swenson, CPG is the Project Manager for this investigation.

3.01.02 Site Supervisor

The Site Supervisor assumes responsibility over all site activities, including the direction of on-site safety personnel to ensure the safety of the site. For this project, the Site Supervisor is also the Site Geologist. The Site Geologist is responsible for overseeing that ground water monitoring well installation and sampling procedures, including decontamination and documentation, are conducted properly. The Site Supervisor for this project will be designated at a later date, under the direction of Guy Swenson of O'Brien & Gere Engineers.

3.01.03 Site Safety and Health Officer/Safety Designees

A Site Health and Safety Officer (SHSO) or designee will be present at the site to enforce the HSP during all phases of on-site activity. The SHSO assigned to the RI will also participate in site activities, in so much as it does not interfere with his/her health and safety responsibilities. The SHSO has the authorization to stop site activities upon a determination of a dangerous situation (e.g. adverse weather conditions). Authorization to proceed with work must come from the SHSO. The SHSO will initiate all contact with support facilities and personnel during emergency response.

3.02 Subcontractors Responsibilities

Subcontractors performing work at the site will be required to demonstrate conformance with Federal, State, and local statutes, ordinances and regulations. Subcontractors will identify an individual responsible for enforcement of health and safety regulations for each of their personnel, subcontractors, and consultants. This person will report to the SHSO.

In accordance with the OSHA's Hazardous Waste Operations regulations, the subcontractor is responsible for ensuring that each employee participates in a medical program, is in acceptable health (see Section 9), and has completed the required 40-hour training for health and safety at hazardous waste operations (see Section 4). The subcontractor must submit a written statement on behalf of each employee who is to be on-site as proof of that employee's participation in the required programs.

SECTION 4 - TRAINING

4.01 General

All project personnel, including employees of O'Brien and Gere Engineers, Inc., contractors and subcontractors, must participate in a 40-hour training program to comply with OSHA CFR 1910.120(e), "Hazardous Waste Operations and Emergency Response".

Before beginning site operations, briefings and safety meetings will be held with field personnel to explain and discuss site-specific health and safety matters. A preliminary safety meeting between O'Brien and Gere and the subcontractor's personnel will also be held before any field activity is started. The initial briefing will discuss potential hazards which may be encountered, site safety, and the emergency response plan (Section 8).

The Site Supervisor and/or HSO will for be responsible for briefing the subcontractor's personnel on potential on-site contamination, site safety, and the emergency response plan.

SECTION 5 - PERSONAL PROTECTIVE EQUIPMENT

5.01 Levels of Protection

The selection of personal protective equipment is based on EPA Levels of Protection guidance. Based on information from previous studies, Level D and Modified Level D protection have been chosen for the investigatory work on the site. However, an upgrade to Level C protection, including respiratory protective equipment, will be made if dry, dusty conditions indicative of airborne contaminated soil particulates or significant on-site contamination is found while work is underway. Personal protective equipment describing Level D, Modified Level D and Level C are summarized below. The levels applicable to specific site activities follow in Section 5.2 and 5.3.

5.01.01 Level D Protection

Level D protection consists basically of a work uniform and includes the following:

1. Coveralls over work clothes
2. Gloves (optional)
3. Safety glasses or chemical splash goggles where flying objects or splashing hazardous liquids are present
4. Steel-toed boots
5. Hard hat
6. Hearing protection (optional)

5.01.02 Modified Level D Protection

Modified Level D consists of additional contact protection, as follows:

1. Disposable, chemical resistant coveralls with hood (e.g. Tyvek^R, or equivalent), over work clothes
2. Inner gloves (latex "medical" gloves)
3. Outer gloves (rubber, neoprene, or nitrile)
4. Steel-toed boots
5. Rubber over-boots
6. Hard hat
7. Safety glasses or chemical splash goggles where flying objects or splashing hazardous liquids are present
8. Hearing protection (optional)
9. Duct tape connecting gloves and boots to suit.

5.01.03 Level C Protection

Sufficient equipment will be available on-site to upgrade to this level of protection, if necessary. Level C protection consists of Modified Level D, with the addition of respiratory protection, as follows:

1. Half-face, air-purifying respirator with high efficiency particulate cartridges (MSHA/NIOSH approved)
2. Disposable, chemical resistant coveralls with hood (e.g. Tyvek, or equivalent), over work clothes
3. Inner gloves (latex "medical" gloves)
4. Outer gloves (rubber, neoprene, or nitrile)
5. Steel-toed boots
6. Rubber over-boots

7. Hard hat
8. Safety glasses or chemical splash goggles where flying objects or splashing hazardous liquids are present
9. Hearing protection (optional)
10. Duct tape connecting gloves and boots to suit.

An appropriate level of personal protection is mandated according to work tasks which are to be performed at the site, as follows.

5.02 Levels of Protection for Monitoring Well Installation and Sampling

Personnel engaged in monitoring well installation and sampling will be required to wear Level D protection. However, if dry, dusty conditions indicative of potential airborne contamination develop, or significant contamination is encountered during these activities, the HSO will call for an upgrade to level C protection for all on-site personnel.

In addition, an exclusion zone and support zone will be established with a corresponding upgrade to Level C protection. The exclusion zone will encompass 50 feet in all directions from the well installation. The support zone will be considered as any area outside of the exclusion zone.

5.03 Levels of Protection for Test Borings

Modified Level D is to be worn for activities involved in the soil borings through the impounded sludge materials. Appropriate zones will be established for Modified Level D work, as it is to be for Level C work.

5.04 Emergency Equipment

The following emergency equipment will be on-site during field operations:

- Fire Extinguishers.

  Class ABC fire extinguisher(s) will be readily available on-site throughout the investigation. The fire extinguisher(s) will be kept with the field crew during any drilling activity.

- First Aid Kits.

  An industrial first aid kit with sufficient supplies for three people will be kept in the support area.

- Communications.

  Emergency telephone numbers are included in Section 8.01. These numbers will be readily available to the field crew. Emergency communication will be discussed in the safety meeting prior to initiating the field work. The location of the telephone closest to the site will be identified to each member of the field crew.

SECTION 6 - SITE OPERATING PROCEDURES

6.01 Initial Site Surveillance

An initial site surveillance is not required, as all necessary information is contained in previous reports and studies.

6.02 Hazard Assessment

Based on previous information, the likelihood of exposure to contaminants appears minimal. However, as discussed in Section 2.2, situations or conditions may develop which may result in potential inhalation exposure to airborne metal contaminants existing at greater than background concentrations.

6.02.01 Metal Contaminants

Metals which may be on-site are tri-valent chromium, lead, aluminum and copper. These are presumably the residuals from the metal finishing sludges disposed of in the impoundments between 1963 and 1976.

Protective measures, such as using a water spray as dust control on all open surfaces (or other feasible engineering controls), or protective equipment (HEPA air-purifying respirators), should be adequate to prevent the inhalation of contaminated dust.

6.02.01.1 Chromium

Chromium compounds act as allergens in some workers, and may cause dermatitis to exposed skin. The known toxic effects of chromium are due to hexavalent chromium, which has not been identified in significant quantities on this site. A PEL of 1 mg/cubic meter has been established for chromium metal and insoluble salts.

6.02.01.2 Lead

Toxic systemic effects following inhalation or ingestion of lead include fatigue, headaches, aching bones, and decreased appetite. These symptoms are usually reversible.

6.02.01.3 Aluminum

Aluminum is not generally regarded as an industrial poison, although inhalation of finely divided powders has been linked to chronic pulmonary fibrosis. Chronic exposures are not a concern for these work efforts.

6.02.01.4 Copper

Systemic effects associated with the ingestion of copper involve nausea and vomiting.

6.03 Work Zones

The following work zones are to be established on-site whenever Modified Level D or Level C is enacted on the site:

- Exclusion Zone (Work Zone, Contaminated Zone)
- Decontamination Zone
- Support Zone

These zones are established to control the spread of contamination from the Exclusion Zone.

The Support Zone is the center of administrative and support functions. It will consist of trailers, vehicles, emergency communication, first aid supplies and other equipment necessary to conduct field activities. The personnel of this zone are responsible for alerting the proper agencies in the event of an emergency. The Support Zone should be located upwind from the work site.

The Decontamination Zone is a physical boundary which separates the support zone from the Exclusion Zone. A contamination control line is identified between the support zone and the decontamination zone. Two access control points through which personnel will enter and exit the site is also identified. The Decontamination Zone includes a number of stations at which employees decontaminate their field equipment and personal protective equipment.

The Exclusion Zone is separated from the Decontamination Zone by a distinct "hot line". The Exclusion Zone is the area of actual site activity. Personal working in the Exclusion Zone must wear the mandated level of protection.

At this site, the establishment of specific zones is presently applicable only during soil boring activities. If hazardous conditions develop while performing monitoring well operations (i.e., an upgrade to Level C is mandated) however, the three required zones will be developed accordingly. The zones will be marked by appropriate flags and stakes; personnel will also be briefed about activities and protective equipment for each zone.

6.04 Standard Procedures for Site Work

The following items are requirements to protect the health and safety of field workers and will be discussed in the safety briefing prior to initiating work at the site.

- A buddy system will be used. During site operations, each worker will consider himself as a safety backup to his partner. Visual contact between buddies will be maintained at all times while on-site.
- Hand signals will be established to maintain communication.
- Off-site personnel will provide emergency assistance. All personnel will be aware of dangerous situations that may develop.
- Eating, drinking, chewing gum or tobacco, smoking, or any practice that increases the probability of hand-to-mouth transfer and ingestion of hazardous material is prohibited at the site.
- Prescription drugs will not be taken by personnel where the potential for contact with toxic substances exist, unless specifically approved by a qualified physician. Alcoholic beverage intake is prohibited during the work day at the site.
- No facial hair, which interferes with the satisfactory fit of respiratory protection, is allowed on personnel required to wear such equipment (under Level C conditions). Each staff member will be fit-tested for respirators by the Health and Safety Officer using an approved technique prior to arriving at the site. Respirators will be available on-site in the event

that upgrading to Level C is necessary. Respirators and spare cartridges will be available on-site in a support vehicle.

- Work areas for various operational activities (equipment testing, decontamination) will be established as necessary.
- Work areas and decontamination procedures have been established based on prevailing site conditions and are subject to change if conditions change.
- No personnel will be admitted to the site without the proper safety equipment and training.
- All personnel must comply with established safety procedures. Any staff member who does not comply with safety policy, as established by the Health and Safety Officer or the Project Manager, will be dismissed from the site.
- Any medical emergency supercedes routine safety requirements.
- The Health and Safety Officer will make regular safety inspections of the site to ensure that operations are being conducted according to established site operating procedures.

6.04.01 Before Leaving the Field Office

A) Review site information

- Expected hazards
- Special conditions
- Sampling procedures
- Location of telephones and emergency equipment
- Emergency medical information
- Level of personnel protection required

B) Check safety gear and equipment. The following equipment will be used at the site, or will be available for issue, depending on site-specific conditions. The safety gear and equipment will be available on-site in a support vehicle.

- Coveralls, possibly disposable Tyvek^R suits
- Hard hat
- Ziplock baggies, quart and gallon size, to keep spare equipment clean
- Gloves (Leather)
- Inner Boots (Steel toe)
- Safety glasses or chemical splash goggles
- Half face air-purifying respirator with high-efficiency particulate cartridges
- Fire extinguisher
- First aid kit
- Copy of Health and Safety Plan
- Duct tape
- Trash barrel for return transportation of contaminated gear and equipment
- Extra respirator cartridges

6.04.02 Before Entering Site

A) No eating/drinking/smoking except away from the work area. Use good sanitary practices and wash hands and face thoroughly before eating/drinking/smoking.

B) Drink some salt replacement fluids, especially during hot weather conditions, and have such drinks available in support area.

C) Place sample containers in field sample carrier (backpacks or carrier). Do not place containers or equipment on potentially contaminated surfaces.

D) Check location of emergency telephone(s).

E) Check alternate safety gear.

- Respirator (test even if you are not going to wear it immediately).
- Goggles or safety glasses

F) Check gear for rips/tears/malfunctions or obvious signs of deterioration.

G) Setup buddy system prior to proceeding.

H) Preliminary site survey.

- Characterize physical conditions of site.
- Use as much excess caution as possible.

I) Use Caution - go slowly

6.04.03 While On-Site

A) No eating/drinking/smoking.

B) If any gear or equipment damage develops, immediately repair or replace.

C) If you experience any physical discomfort, abnormalities, or lightheadedness - stop work, inform your buddy, and go back to the designated support zone.

SECTION 7 - SITE AIR MONITORING

Field activities associated with the Remedial Investigation may cause potentially hazardous conditions, such as through the release of hazardous substances. These substances may be in the form of vapors, dusts, or mists that can enter the body through ingestion, inhalation, adsorption and direct contact. Monitoring of these substances will be performed to ensure appropriate personal protective measures are employed during site activities.

The following describes the monitoring parameters to be evaluated during the Remedial Investigation. Recommended instruments to be used are also provided in the discussion. Instruments to be used during site activities will meet the established requirements set forth by OSHA, MSHA, NIOSH, and state agencies where applicable. Table 1 lists the activities and the associated site monitoring.

Organic Vapor Concentrations - will be monitored at fifteen minute intervals during specified activities listed in Table 1, using an organic vapor meter model 128 (FID), TIP II (PID) or HNU P1101. The instrument used will be calibrated according to the manufacturer's instructions using a benzene, toluene, xylene, standard. Other activities not otherwise specified in Table 1 can be monitored hourly for level criteria for upgrading or downgrading protective equipment and in implementing additional precautions or procedures. A backup organic vapor meter will be present throughout site activities in the event of an instrument malfunction. If organic vapor concentrations exceed those listed in Table 2, a Draeger Hand pump and a chemical specific detector tube for benzene will be employed to quantify compound concentrations.

Real tiny fugitive dust monitoring will be conducted using a RAM-1 dust monitor. Monitoring will be performed in accordance with the protocols outlined in <u>TAGM - Fugitive Dust Suppression and Particulate Monitoring Program at Inactive Hazardous Waste Sites</u>. An action level of 150 ug/M^3 will be used, however, dust suppression techniques will be employed upon readings of greater than 100 ug/M^3.

Site monitoring will be conducted by or under the supervision of, the Health & Safety Coordinator. Readings obtained will be recorded in a dedicated site notebook by the Project Supervisor or designee. The Health & Safety Coordinator will maintain all monitoring instruments throughout the site investigation to ensure their reliability and proper operation.

SECTION 8 - ACTION LEVELS

Action levels have been established for activity cessation, site evacuation, emergency response, and determination of personal protection levels. Table 3 lists action levels, airborne concentrations, and associated personal protection levels. Section 7 discusses the minimal personal protection required for specified site activities. Changes to these specified levels are dependent on the results of air monitoring, as described below.

Note that these action levels are for monitoring in the breathing space of workers on the site. The action levels are based on the 1990 Permissible Exposure Limits (PELs) as determined by OSHA for the specific compounds detected during on-site monitoring.

The approach for air monitoring is as follows:

1. The direct-reading PID will be calibrated to most accurately reflect the scope of volatiles identified.
2. Using the PID, work activities will be monitored for organic vapors.
3. Where/when organic vapors are detected with the PID, selected Draeger tubes will be used to identify the presence/absence of benzene. Action levels would then follow the first column of Table 3. The presence of benzene is an important criteria for action levels due to its PEL of 1 ppm.
4. If non-benzene vapors cannot be identified, the third column of Table 3 will be used.

5. Personal monitoring will serve as a back-up to the direct reading instrument data and provide qualitative and quantitative exposure data for the workers most at risk.

Monitoring for organic vapors will be performed at the start of every activity, and every fifteen minutes thereafter until the activity is complete.

A water spray will be applied as a control measure upon fugitive dust readings of greater than 100 ug/M^3. If a water spray can not be applied, additional personal monitoring will be undertaken to assure correct personal protective measures are being taken. Respirators will be donned if fugitive dust reading exceed 150 ug/M^3.

SECTION 9 - DECONTAMINATION

All personnel in Modified Level D or Level C must complete the appropriate decontamination procedures prior to leaving the site in a manner consistent with actual site conditions. A decontamination area will be set up at the entry and exit point, adjacent to the work area. Receptacles will be provided for all disposable clothing and materials.

Wash tubs containing a detergent-water solution or an appropriate decon solution (see below) and soft-bristle brushes will be used to decontaminate reusable personnel protective clothing and boots. Following the detergent-water washing, an intermediate rinse will be applied when applicable. Clean, potable water will be used for the final rinsing.

Containment and disposal of all decontamination wash and rinse waters will be in accordance with the applicable federal, State and/or local regulations.

Each individual shall conduct proper personal hygiene which may include washing any exposed skin prior to eating, smoking or leaving the site, consistent with site conditions.

9.01 Level D Decontamination Procedures

A minimum decontamination for the Level D site work will consist of cleaning boots and gloves before leaving the site to prevent spreading the contamination that may exist at the site.

9.02 Modified Level D and Level C Decontamination Procedures

Personnel wearing protective clothing must use the the following decontamination procedures when exiting the site.

Station 1: Equipment Drop

All equipment used on-site will be placed onto a plastic drop cloth, i.e tools, containers, clipboards.

Station 2: Outer Garment, Boot and Glove Wash and Rinse

Wash with detergent water and rinse with copious amounts of water in tubs or pools.

Station 3: Cartridge or Mask Change (for Level C)

At this station, a worker who has left the site to change the respiratory cartridge may do so and return to the site.

Station 4: Outer Glove, Boot and Garment Removal

Remove tape and discard in plastic-lined container. Remove outer gloves and boots and stage for re-use or packing. Tyveks are removed and deposited in a plastic lined container.

Station 5: Respirator Removal (for Level C)

The respirator is removed while avoiding touching the face with fingers. The respirator is to be cleaned with soap and water by decontamination personnel. A non-alcohol disinfectant wipe will be used for normal daily disinfection. At least once a month respirators will be disinfected/sterilized by soaking them 10-30 minutes in CIDEX or a comparable disinfecting solution. Thoroughly rinse respirator with distilled water, rub dry, wipe with disinfectant wipes, and store in a baggie. Personnel with respiratory tract infections, should disinfect their respirator at least weekly, and daily, if possible.

Station 6: Field Wash

Wash hands and face.

9.03 Heavy Equipment Decontamination Procedures

Depending on site conditions, heavy equipment may have to be decontaminated prior to leaving the site. This will include manual removal of gross contamination with hand held equipment (shovels), followed by a steam or high pressure wash, paying particular attention to tracks, wheels, and undercarriages.

SECTION 10 - EMERGENCY RESPONSE PLAN

8.01 Emergency Telephone Numbers

Ambulance	911
Police	(716) 586-4399
Fire Department	911
Rochester General Hospital	
- emergencies	(716) 338-2300
- general info	(716) 338-4528
Monroes County Department of Health	(716) 274-6067
(for after hours emergency) -	(716) 428-7200*
O'Brien & Gere Engineers, Inc.	(315) 451-4700
Project Manager	
- Guy A. Swenson	
- Robert Foresti	
NYS Department of Environmental Conservation	
Region 8 (Avon, NY)	(716) 226-2466

*Ask to leave a message for Roger C297.

10.02 Hospital

Directions to the hospital are as follows:

- Turn left out of the facility onto Linden Ave.
- Turn right onto Washington St.
- Go several blocks, turn right onto Airport Ave.
- Take entrance ramp onto 490 West
- Follow signs to 590 North
- Exit at signs for "Route 104" and "Hospital"

- Go straight, then turn left onto Portland Ave. (follow signs for hospital)
- Hospital is on right, at 1425 Portland Ave.
- Figure 1 illustrates the location and route to the hospital from the site.

10.03 Accidents/Injuries

Depending on the severity of the injury, treatment may be given at the site by trained personnel or by emergency response personnel. The victim may also require transport to the hospital.

In life threatening situations, care must begin without considering decontamination. Outside protective clothing can be removed if it does not cause delays or aggravate the problem. Respirators must always be removed. Normal decontamination procedures should be followed whenever possible. Clean water (preferably deionized) will be available on-site for use in emergency eye washing.

The Health and Safety Officer shall notify the Project Manager in the Syracuse Office of any accident/incident as soon as the incident has been brought under control. It will be the responsibility of the Health and Safety Officer to investigate thoroughly the details of any accident or injury. Based on his/her findings, corrective actions will be recommended for field procedures to prevent recurrence of the incident.

10.04 Fire

The potential for fire is significant at many hazardous waste sites. Fire extinguishers (Class ABC) will be kept on each drill rig.

10.05 Site Evacuation

10.05.01 Stages of Evacuation

Three stages of evacuation have been determined:

- withdraw from the immediate work area
- withdraw from the site
- withdraw from the area

10.05.02 Withdrawal From the Work Area (Exclusion Zone)

Withdrawal to a safe upwind location will be required if any of the following occur:

- If concentrations of volatile organics, combustible, or toxic gases exceed 5 ppm above background levels or 20% of the lower explosive limit, the site will be evacuated or personal protective equipment will be upgraded to Level C. (These conditions are not anticipated at this site).
- Occurrence of a minor incident: field operations will resume after first aid and/or decontamination procedures have been administered.
- Equipment malfunctions.

10.05.03 Evacuation of the Site

The site will be evacuated in the following cases:

- Explosive levels of combustible gases exceed 20 % LEL
- A major accident or injury occurs
- Fire and/or explosion occurs
- If measured organic levels of an unknown contaminant exceed 5 ppm as measured on a PID meter, the site will be evacuated.

10.05.04 Third Party Safety

Only authorized workers related to the project field work will be allowed in work areas or areas containing potentially hazardous materials or conditions.

SECTION 11 - MEDICAL PROGRAM

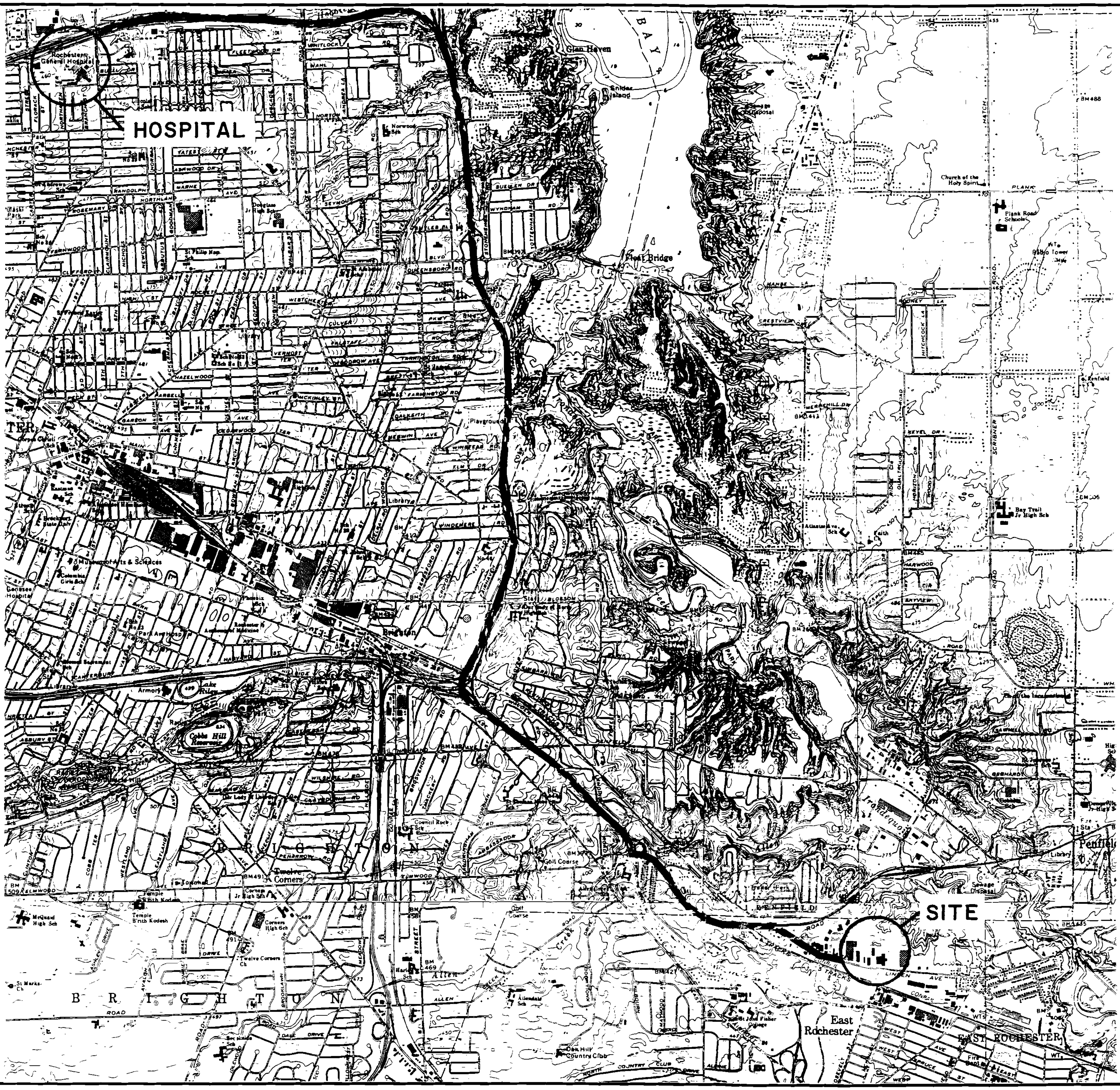
11.01 General

All personnel working on-site must participate in an annual medical examination prior to the start of on-site operations. This must be in accordance with OSHA's regulations in 29 CFR 1910.120 (f). The test included in O'Brien & Gere's medical surveillance program are listed below for reference. The actual content of the physical examination must be determined by a physician familiar with the patients' work and these regulations.

FIGURE I

ALCAN ALUMINUM CORPORATION
ALCAN ALUMINUM SITE # 828005
PITTSFORD, NEW YORK

HOSPITAL LOCATION MAP



9/24/90

LEGEND

▬ ROUTE FROM SITE TO HOSPITAL

0 2000 4000
SCALE IN FEET

O'BRIEN & GERE
ENGINEERS, INC.
Syracuse New York

11X17 1 3057.032.130

APPENDIX B

QUALITY ASSURANCE PROJECT PLAN (QAPP)
FOR
FOCUSED REMEDIAL INVESTIGATION
ALCAN ALUMINUM SITE #828005
PITTSFORD, NEW YORK

JULY 1990

O'BRIEN & GERE ENGINEERS, INC.
5000 BRITTONFIELD PARKWAY
SYRACUSE, NEW YORK 13221

QUALITY ASSURANCE PROJECT PLAN

Focused Remedial Investigation/Feasibility Study

Alcan Aluminum Site #828005

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QUALITY ASSURANCE PROJECT PLAN

Focused Remedial Investigation/Feasibility Study

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QUALITY ASSURANCE PROJECT PLAN

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Alcan Aluminum Site #828005

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SECTION 1 - INTRODUCTION

1.01 General

The following Quality Assurance Project Plan (QAPP) has been prepared for the Remedial Investigation/Feasibility Study of the Alcan Aluminum Site #828005, formerly Jarl Extrusions site, surface impoundments. It was prepared in accordance with U.S. EPA's "Interim Guidelines and Specifications for Preparing Quality Assurance Project Plans", QAM-005/80, 29 December 1980. This QAPP addresses sampling efforts associated with the installation of monitoring wells, soil borings, and related sampling tasks described in the Work Plan. The analytical methods have been selected to reflect the disposal practices at the impoundments and sampling results obtained during previous site studies.

1.02 Site History

The former Jarl Extrusions site is located on Linden Avenue, Pittsford, New York (Figure 1 of the Work Plan). The site is bordered on the south by vacant lots, to the west by several light industrial facilities, a wood lot to the north, and the Siquismondi Landfill to the east.

From 1963 to 1976, Jarl Extrusions used two surface impoundments at the northern portion of the property to retain wastewater from a metal plating facility (refer to Figure 2 of the Work Plan). Approximately 200,000 gallons of wastewater were pumped via underground piping to the impoundments annually during this period. Sludge solids are estimated at 5200 cubic yards based on information supplied in the

Workplan (Section 1). Aerial photographs of the area suggest the impoundments were located in natural depressions. In 1980, the impoundments were backfilled, graded and seeded.

The impoundments are currently designated as Class 2 by the State of New York, Department of Environmental Conservation (DEC). The Class 2 designation indicates that the site poses a significant threat to the environment and /or the public health. Consequently, a focused Remedial Investigation/Feasibility Study (RI) will be conducted to collect additional data (RI).

1.03 Previous Study Results

In July 1982, LaBella Associates, P.C., Rochester, New York, conducted a field exploration and sampling program to assess the composition of the impoundment sludges. Sludge samples were analyzed for pH, moisture content, total chromium and hexavalent chromium. Extraction Procedure Toxicity (EP Toxicity) tests were also conducted on the material to assess its hazardous waste characteristics. The results indicated that the material had a pH ranging from 7.4 to 11.0, a total chromium content of 11.6 to 22,150 mg/l and non-detectable levels of leachable metals. Greater than 99% of the total chromium was believed to be in the trivalent as opposed to the hexavalent state.

NUS Corporation, under contract to the United States Environmental Protection Agency, inspected the site and performed a limited amount of sampling in 1984. NUS Corporation obtained four soil samples, two sediment samples and two surface water samples from the site and the site vicinity at this time. Sample results indicated the presence of chromium, nickel, copper, cadmium, zinc and lead.

O'Brien & Gere Engineers, Inc. conducted a site investigation between February, 1985 and March, 1986 to delineate the boundaries of the impoundments and evaluate their possible impact on nearby soils and the local groundwater regime. A report, summarizing the investigation and recommending additional groundwater analysis, was prepared and submitted to the DEC in 1986. A discussion detailing the work efforts, site hydrology, and soils/sludge analysis associated with this program is presented on pages 4 to 10 of the Work Plan.

Since the March 1986 report, ground water samples have been collected on five separate occasions. The results of these sampling events are presented in Table 1 of the Work Plan.

Based on the presence of unstabilized sludge from the chemical conversion of aluminum and the exceedances of ground water and drinking water standards, the NYSDEC considered the site a threat to the environment. Given this determination, the NYSDEC required a site assessment (RI/FS) and reclassified the site as a 2 on the Registry of Inactive Hazardous Waste Sites.

In April 1989 O'Brien & Gere Engineers, Inc. met with representatives from the NYSDEC and Alcan Aluminum Corporation, the present owners of the site, to discuss the status of the Jarl Extrusions Inc., site. During the meeting it was decided to conduct a focused remedial investigation and feasibility study (RI/FS) pursuant to an Administrative Consent Order to address the concerns of the state regarding inconsistent performance of the shallow wells, evaluating any impact on the deep ground water zone, characterizing the vertical extent of the surface impoundments, and the use of Contract Laboratory Procedures (CLP) laboratory procedures.

SECTION 2 - PROJECT ORGANIZATION AND RESPONSIBILITY

While all personnel involved in the investigation and in the generation of data are implicitly a part of the overall project and quality assurance program, certain individuals have specifically designated responsibilities. Within O'Brien & Gere, these are the Project Manager, the Quality Assurance Coordinator, the Field Operations Manager, and the Field Geologists and Environmental Technicians. OBG Laboratories, Syracuse, New York will provide all analytical services for the investigation. Specific laboratory personnel with quality assurance/quality control re-responsibilities include the Laboratory Quality Assurance Coordinator and Laboratory Sample Custodian. Figures B-1 and B-2 illustrate key project personnel and OBG Laboratories organizational format, respectively. Attachment 2 presents resumes of key project personnel.

2.01 Project Manager/Quality Assurance Officer

Mr. Guy A. Swenson, CPG, is Project Manager for the Jarl Extrusions RI/FS. The Project Manager will maintain routine contact with the investigation's progress, regularly review the project schedule, and review all major work elements prior to submittal. In addition to his other duties, Mr. Swenson will serve as Quality Assurance Officer (QAO) for this investigation, with the responsibility of administering the day-to-day activities of all work to be conducted including that of subcontractor personnel. The Project Manager will oversee scheduling and budgeting, and serves as the primary contact with state, local and federal agencies. As the Project Quality Assurance Officer, Mr.

Swenson has primary responsibility for project quality assurance activities. These responsibilities include coordinating the development, evaluation, and documentation of the Quality Assurance Project Plan and procedures appropriate to the investigation. It is a major responsibility of the Quality Assurance Officer to ensure that all personnel have a good understanding of the project quality assurance plan, an understanding of their respective roles relative to one another, and an appreciation of the importance of their roles to the overall success of the program.

2.02 Quality Assurance Coordinator

Jeffrey E. Banikowski, of O'Brien & Gere Engineers, Inc., will serve as Quality Assurance Coordinator and is responsible for overall project quality assurance. Mr. Banikowski will review project plans and revisions to the plans to assure proper quality assurance is maintained throughout the RI. He will meet frequently with the Project Quality Assurance Officer to review quality assurance activities. In addition, Mr. Banikowski will be responsible for performance and systems audits, data processing activities, data processing quality control and data quality review.

Mr. Banikowski will also serve as the manager of environmental chemistry evaluations for the project and be responsible for reviewing chemical data, validating laboratory analytical data, and coordinating the efforts between O'Brien & Gere Engineers, Inc. and OBG Laboratories, Inc.

2.03 Field Operations Manager/Project Geologist

Mr. Robert J. Foresti, has been assigned the responsibilities of Field Operations Manager/Project Geologist. The Field Operations Manager/Project Geologist reports directly to the Project Manager and is immediately responsible for the day-to-day activities of O'Brien & Gere field personnel. In this capacity, the Field Operations Manager/Project Geologist is responsible for day-to-day quality assurance project activities and reports directly to the Project Manager concerning the maintenance of the Quality Assurance Project Plan. Further responsibilities include the initialing and accuracy verification of field notebooks, driller's logs, chain-of-custody records, sample labels, and other field-related documentation. The Field Operations Manager will be responsible for contacting the NYSDEC field representative a minimum of once a week during field activities to determine whether the NYSDEC has identified problems in the execution of this work plan. Should problems arise the Field Operations Manager should maintain daily contact with the NYSDEC representative until the problem is resolved.

2.04 Site Geologists and Environmental Technicians

Ground water, soil, and air sampling tasks required by this investigation will be conducted by experienced geologists and/or environmental technicians. Their responsibilities will include the documentation of the proper sample collection protocols, sample collection, field measurements, equipment decontamination, and chain-of-custody documentation. The on-site geologist and/or environmental technician will be responsible for contacting the on-site NYSDEC representative daily during site activities to determine whether the NYSDEC has identified problems in the execution of the work plan. Problems should be presented to the Field Operations Manager daily.

2.05 OBG Laboratories Quality Assurance Coordinator

Mr. David R. Hill (Vice-President) will serve as OBG Laboratories, Inc. Quality Assurance Coordinator and will, therefore, be responsible for all laboratory quality assurance and quality control activities associated with the project. The specific duties of the Laboratory Quality Assurance Coordinator include ensuring that analyses are conducted within the appropriate holding times and laboratory custody procedures are followed. Moreover, the Laboratory Quality Assurance Coordinator monitors daily precision and accuracy records, maintains detailed copies of all procedures, reschedules analyses based upon unacceptable data accuracy or precision, and identifies and implements corrective actions necessary to maintain quality assurance standards. Mr. Hill or his assignee will conduct initial validations and assessments of analytical results and report the findings directly to the Quality Assurance Coordinator.

2.06 Laboratory Sample Custodian

Ms. Wendy Smith will serve as project Laboratory Sample Custodian for OBG Laboratories, Inc. The Sample Custodian's responsibilities include ensuring proper sample entry and sample handling procedures by laboratory personnel.

2.07 Data Validator

Mr. Michael Caputo of O'Brien & Gere Engineers, Inc. will serve as the manager of environmental chemistry for the project and be responsible for reviewing chemical data, validating laboratory analytical data, and coordinating the efforts between O'Brien & Gere Engineers, Inc. and OBG Laboratories, Inc.

SECTION 3 - QUALITY ASSURANCE OBJECTIVES FOR MEASUREMENT DATA IN TERMS OF PRECISION, ACCURACY, REPRESENTATIVENESS, COMPARABILITY, AND COMPLETENESS

3.01 Overall Project Objectives

Data Quality Objectives (DQO) are quantitative and qualitative statements specifying the quality of the environmental data required to support the decision-making process. DQO define the total uncertainty in the data that is acceptable for each specific activity during the investigation. This uncertainty includes both sampling error and analytical error. Ideally, the prospect of zero uncertainty is the intent; however, the variables associated with the process (field and laboratory) inherently contribute to the uncertainty of the data. It is the overall objective to keep the total uncertainty within an acceptable risk that will not hinder the intended use of the data. In order to achieve this objective, specific data quality requirements such as detection limits, criteria for accuracy and precision, sample representativeness, data compatibility and data completeness will be specified. The overall objectives and requirements will be established such that there is a high degree of confidence in the measurements. The data collected during the course of the investigation will be used to answer the following questions:

1. Are contaminants present or absent? (qualitatively)
2. If contaminants are present, what are the types or classes?
3. What quantities (concentrations) of contaminants are present (quantitative)?
4. What are the environmental/public health factors?

5. What are the source pathway contaminant characteristics with respect to migration?

Soil and ground water samples will be collected and analyzed to answer these questions.

As stated earlier, the parameters that will be used to specify data quality requirements and to evaluate the analytical system performance are method detection limits, precision, accuracy, representativeness, completeness and comparability (PARCC parameters). PARCC parameter definitions are presented in Table B-1.

3.02 Field Investigation Quality Objective

The objective with respect to the field investigation is to maximize the confidence in the data in terms of PARCC parameters and detection limits.

In terms of precision and accuracy, Section 10 presents the frequency with which field duplicates, travel blanks, and matrix spikes will be collected such that a specific degree of precision and accuracy can be calculated. The data quality objective for field duplicates is to achieve precision equal to or greater than the control limits specified in Tables B-6 and B-7.

Precision will be calculated as relative percent difference (RPD) if there are only two (2) analytical points, and relative standard deviation (RSD) if there are more than two (2) analytical points. The submission of travel blanks will provide a check with respect to accuracy. Although accuracy is best assessed by evaluating the results of blanks, blanks do not monitor analyte losses. The submission of blanks will, however, monitor contaminants introduced with the sampling process, preservation, handling, shipping, and the analytical process. The data quality objective for travel blanks is to have concentrations below the organic and inorganic detection limits. In the event that the blanks are contaminated and/or poor field duplicate precision is obtained, the associated data will be qualified as described in Section 13. Through the submission of field QC samples the distinction can be made between laboratory problems, sampling technique, and sample matrix variability.

Precision and accuracy for field pH and conductivity are dependent on the type and condition of the instrument used and the care taken in the standardization and operation. The precision and accuracy objectives for the instrumentation used are as follows:

- pH precision will be ± 0.3 pH standard units. PH accuracy will be ± 0.3 pH standard units.
- Conductivity precision will be ± 3 umhos/cm on the 500 umhos/cm range, ± 25 umhos/cm on the 5000 umhos/cm range, and ± 250 umhos/cm on the 50000 umhos/cm range. Accuracy for the conductivity measurements is a function of the conductivity reading for the probe and instrument combined.

To assure sample representativeness, all sample collection will be performed in strict accordance with EPA-recommended procedures for collection and preservation; with EPA-recommended holding times specified in EPA 600/4-79-020 (Methods for Chemical Analysis of Water and Wastes) and the Federal Register, 26 October 1984 (40 CFR Part 136); and with the specific test methods (SW-846) which OBG Laboratories is operating under.

The data quality objective for the completeness of data with respect to the sampling (field investigation) is 100%. Although this goal appears rather ambitious, it can be attained. In the event 100% is not obtained, the effect of the uncollected data will be evaluated by the Project Manager or Quality Assurance Project Manager as to its impact (if any) on the project objectives. Corrective actions will be initiated to resolve any data gaps from the original objectives, found as a result of less than 100% data completeness. Every effort will be made to obtain valid data for all sampling points, particularly those classified as critical points. In this regard, the critical point samples which are identified will necessarily be selected as will subsequent QC samples (duplicate and matrix spikes) at the frequency specified in Section 10.

In order to establish a degree of comparability such that observations and conclusions can be directly compared with all historical data, O'Brien & Gere Engineers will use standardized methods of field analysis, sample collection, holding times and preservation. In addition, field conditions will be considered as well as sampling in order to attain a high degree of data comparability.

3.03 Laboratory Data Quality Objectives

The laboratory will demonstrate analytical precision and accuracy by the analysis of laboratory duplicates and matrix spike duplicates. Precision will also be demonstrated (as well as instrument stability) by comparison of response factors for calibration standards. Laboratory accuracy will be demonstrated by the addition of surrogate and matrix spike compounds. Accuracy will be presented as percent recovery. Precision will be presented as relative percent difference (RPD), relative standard deviation (RSD), or percent difference (PD), whichever is applicable to these type of QC samples. Laboratory blanks will also demonstrate accuracy with respect to the analyses. The frequency of laboratory duplicates, matrix spikes and laboratory blanks are specified in Section 10.

The analysis laboratory will be expected to process (purge, extract or digest) an aliquot of sample such that the analytical results will provide a high degree of representation with respect to the sampling point. In addition, OBG Laboratories will be expected to document all analytical problems encountered during the course of the investigation. This will enable O'Brien & Gere Engineers to achieve a 100% completeness goal through a phased sampling approach. Further, the laboratory will be required to provide all necessary data packages to ensure that analytical methods, parameters, and reporting units are compatible with other existing data.

3.04 Criteria Objectives

The quantitative objectives (criteria) that O'Brien & Gere Engineers will require for both field and laboratory accuracy and precision are outlined in Section 8.

OBG Laboratories will be expected (as an ideal objective) to report the method detection limits (MDL) for all samples in the appropriate statistical reporting units for all analyses as stated in either SW-846 or EPA 600/4-79-020. However, it should be noted that actual detection limits are sample specific and depend on variables such as dilution factors, sample matrices and the specific analyte. The handling of data reported at or near the MDL will be done cautiously since the stated data quality objectives for accuracy and precision may not "translate" well in some situations. The NYSDEC will be informed if the contract laboratory is unable to meet CLP detection limits. The concurrance of the NYSDEC will be obtained if a detection limit will not be obtained.

3.05 Data Management Objectives

It is a data management objective that all aspects of the investigation from sample design, collection, shipment, analysis use/decisions, etc. be performed in conjunction with rigorous QA/QC documentation. The specific details of this documentation can be found throughout this document and the associated Work Plan.

It is expected that by the design of separate data quality requirements for field sampling and laboratory analysis, clear distinctions can be made such that any problems found in the system can be isolated with respect to the cause. Conversely, the data quality requirements are also designed to provide an indication of the variability inherent to the overall system.

Through the use of a phased approach to sampling, analysis, data assessment (data review), data qualification, and feedback, the overall data management objective is to provide a complete database with a high degree of confidence that will thoroughly characterize the environmental media collected at the site.

SECTION 4 - DRILLING AND SAMPLING PROTOCOL FOR TEST SOIL BORINGS AND GROUND WATER MONITORING WELL INSTALLATIONS

4.01 Test Soil Boring Installation Procedures

4.01.01 Drilling/Sampling Procedures

Test borings shall be completed using the hollow stem auger drilling method method to a depth specified by the supervising geologist. The minimum inside diameter of the augers shall be 4 inches.

Subsurface soil samples shall be collected continuously to a depth specified by the supervising geologist. The sampling method employed shall be ASTM D-1587-84/Split Barrel Sampling using either a standard 2 feet long, 2 in. outside diameter split spoon sampler with a 140 lb. hammer or a 3 in. outside diameter sampler with a 300 lb. hammer. Upon retrieval of the sampling barrel, the collected sample shall be placed in glass jars and labelled, stored on site.

A geologist will be on site during the drilling operations to fully describe each soil sample including 1) Soil type, 2) color, 3) percent recovery, 4) moisture content, 5) odor and 6) miscellaneous observations such as organic content. The supervising geologist will be responsible for retaining a representative portion of each sample in a one pint glass jar labeled with: 1) the site; 2) the boring number; 3) the interval sample/interval preserved; 4) the date; and, 5) the time of sample collection.

The drilling contractor will be responsible for obtaining accurate and representative samples, informing the supervising geologist of changes in drilling pressure, keeping a separate general log of soils encountered including blow counts (i.e. the number of blows from a soil sampling drive weight (140 pounds), driving the split spoon sampler in 6-inch increments and installing monitoring wells to levels directed by the geologist following specifications further outlined in this protocol.

4.01.02 Unconsolidated Monitoring Well Installation Procedures

The shallow monitoring wells will be constructed of ten (10) feet of 2 inch ID, 0.010 inch slot size, flush threaded joint, Schedule 40 PVC well screen, and a riser casing that will extend from the screened interval to 2-3 ft above existing grade. However, the screen slot size selected for the deep wells will be based upon the grain size of the sediments encountered during the drilling and sampling work effort and in concurrence with the NYSDEC field representative.

The monitoring well installation method for 2 inch wells installed within unconsolidated sediments shall be to place the screen and riser assembly into the augers once the screen interval has been selected. At that time a size #0 washed silica sand pack will be placed using the tremie method around the well screen and extended a minimum of 2 feet above the top of the well screen followed by a minimum of 6 inches of a finer sand pack. Above the sand pack a minimum of 3 feet of a bentonite pellet seal will then be added to the annulus between the casing and the inside of the auger by the tremie method. Cement/Bentonite grout will continue to be added above the bentonite pellet seal by the tremie method during the extraction of the augers until the entire aquifer thickness has been sufficiently sealed off from horizontal and/or vertical flow above the screened interval. During placement of the sand pack and bentonite pellets, frequent measurements will be made to check the height of the sand pack and thickness of the bentonite by a weighted tape measure.

A vented protective steel casing shall be installed over the PVC well casing, extended 3 feet below grade and 2-3 feet above grade secured by a cement seal. The protective casing shall have a minimum one-quarter inch weep hole drilled into the casing at least 6 inches above the ground surface/concrete seal. The concrete seal shall extend laterally at least 1 foot in all directions from the protective casing and shall slope gently away to drain water away from the well. The concrete seal shall be a minimum of 4 inches in thickness. A vented steel cap will be fitted on the protective casing. The cap shall be constructed so it may be secured with a steel lock.

A typical monitoring well diagram is attached (Figure B-3). The on-site geologist shall specify the monitoring well design to the Drilling Contractor before installation, including measure and record the length and quantity of material placed in each borehole.

4.02 Well Development Protocol

All monitoring wells will be developed or cleared of all fine grained materials and sediments that have settled in or around the well during installation to ensure the screen is transmitting representative portions of the ground water. The development will be by one of two methods:

pumping or bailing ground water from the well until it yields relatively sediment free water.

In pumping or bailing, a decontaminated pump or bailer will be used following procedures outlined in the decontamination protocol. Ground water will be pumped from the top of the water column using a pump or bailed using a stainless steel bailer. If a pump is selected, over pumping shall be avoided by monitoring the water level to avoid pumping the well dry. Clean plastic will be placed on the ground to avoid surface contamination and new polypropylene rope on the bailer will be used for each well. Pumping or bailing will cease when pH, conductivity, and temperature stabilize and the turbidity has been reduced to below 50 NTU's. Termination of development prior to meeting these requirements will occur only with concurrence by a representative of the NYSDEC.

4.03 Hydraulic Conductivity Tests

The tests will be performed by removing water from the monitoring well in order to create a sufficient hydraulic gradient between the monitoring well and aquifer. The rate of change in water levels will be recorded and analyzed using Hvorslev's or Papadopulos' method.

If no significant drawdown can be obtained by removing water from the monitoring well an Enviro-Labs Model DL-120-MCP pressure transducer system will be utilized. This test will involve inserting a teflon rod into the well in order to create a positive potential between the well and aquifer. After the Enviro-Labs system records the response to the positive potential, the teflon rod will be removed in order to create a negative hydraulic potential between the well and aquifer.

The rate of ground water recovery will then be recorded using the Environ-Labs system. The data collected from both the positive displacement (slug) and negative displacement will be analyzed using Hvorslev's or Papadopolous' method.

Equipment which comes in contact with the ground water will be decontaminated in accordance with the equipment decontamination procedures specified in Section 4.04 of this QAPP.

4.04 Equipment Decontamination Procedures

Sediment sampling equipment and ground water sampling equipment (i.e., bladder pump) shall be decontaminated to prevent cross-contamination between wells and soil borings. The decontamination procedure shall be the following:

a. wash and scrub with a low phosphate detergent
b. potable/tap water rinse
c. rinse with 1% HNO
d. potable/tap water rinse
e. an acetone or methanol rinse followed by a hexane rinse (pesticide grade)
f. deionized water rinse, and
g. air dry

Soil sampling equipment such as split-barrel samplers shall be decontaminated with soapy water and deionized water and/or steam cleaned between samples during the drilling and sampling of each boring.

Ground water sampling equipment such as bladder pump tubing and/or bailers shall be rinsed with soapy water and deionized water prior to use. Tubing used in one well shall not be reused in another well.

Well casing and screen shall be steam cleaned prior to installation to ensure that any possible contaminants have been removed. The well materials shall be placed upon clean polyethylene sheeting to keep the possibility of contamination to a minimum.

Drill equipment which comes in contact with the soil shall be steam cleaned before use and between boreholes. This shall include drill rods, augers, drill bits, and shovels including any other large piece of equipment utilized.

Water and waste generated during the decontamination process shall be containerized in 55 gallon drums to prevent contaminants from reentering the sediments and ground water.

SECTION 5 - SAMPLING PROCEDURES

The sampling procedures used by O'Brien & Gere are presented in the following subsections. These procedures have been standardized to allow applicability to a wide type of environmental investigations. Sampling procedures associated with the ground water and soil at the Jarl Extrusion site will be conducted as outlined below. Applicable containers, preservation and holding times for each analytical method and matrix type are summarized in Table B-2.

5.01 Ground Water Sampling Procedures

The general site-specific protocols for the Jarl Extrusions site are presented in this section.

5.01.01 Preparation for Sampling

Preparation for sampling includes the acquisition of all necessary monitoring equipment and site-specific information to perform the required monitoring. Prior to initiating any ground water sampling activities, a complete round of depth to water level measurements will be measured to the nearest 0.01 ft.

Total well depths (Table B-3) necessary to calculate the required purge volumes will be tabulated following completion of the well installations.

5.01.02 Well Evacuation

Monitoring wells will be evacuated/purged using a bladder pump until a minimum of three well volumes equivalent to the amount of water within the well is removed. The volume of water purged from each well will be documented. Water purged from each shallow well will be disposed of upon the surface within close proximity (20 feet) of the point from where it was generated. The disposed purge water will not be allowed to flow into any surface water body or well casing. Water purged from the deep wells will be containerized in 55 gallon drums to prevent it from entering the surface aquifer.

Either a submersible pump, bladder pump, positive displacement pump, foot valve pump, or bailer will be used to evacuate the monitoring wells. Pump placement depth will be dependent on well yields. High yielding wells will necessitate placement of the pump intake at the top of the water column. Low well yields require pump placement to be at the bottom of the well. Proper pump placement will ensure complete and proper evacuation. Upon completion of the required purge volume, the pumping system will be removed from the well. Wells that are inaccessible with the pump system will be hand bailed using a bottom-loading stainless steel bailer.

5.01.03 Sample Acquisition

Prior to obtaining ground water samples for laboratory analysis, all monitoring wells must be developed as described in the Well Development Protocol (Section 4.03). Following the well evacuation/purging process, a bladder pump will be used to collect ground water samples for transfer into the proper sample containers (Table B-2). If well yields are low at the site, the samples will be collected as the well recovers and provides a sufficient volume for sample collection. Temperature, pH, and specific conductance shall be conducted first followed by volatile organics, semi-volatile organics, total metals, dissolved metals, phenols, cyanide, sulfate, chloride, turbidity, and nitrates. The sampling procedure is outlined below.

Sampling Procedures -

1. Identify the well and record the location on the Ground Water Sampling Field Log or in a field notebook.
2. Put on a new pair of disposable gloves.
3. Cut a slit in the center of a clean plastic sheet, and slip it over the well creating a clean surface onto which the sampling equipment can be positioned.
4. Clean all meters, tools, equipment, etc., before placing on the plastic sheet.
5. Disposable shoe covers should be placed over the samplers shoes to prevent potential contamination from dirty shoes contacting the plastic sheet. Do not kick, transfer, drop, or in any way let soils or other materials fall onto this plastic sheet unless it comes from inside the well.
6. Remove the well cap, and plug placing both on the plastic sheet.
7. Using an electric well probe, measure the depth to the water table and the bottom of the well. Record this information in the Ground Water Sampling Field Log or field notebook.

8. Clean the well depth probe with a low phosphate detergent and rinse it with deionized water after use.
9. Compute the volume of water in the well, and record this volume on the Field Log or field notebook.
10. Attach enough polypropylene rope to a bailer to reach the bottom of the well, and lower the bailer slowly into the well making certain to submerge it only far enough to fill one-half full. The purpose of this is to recover any oil film, if one is present on the water table.
11. Pull the bailer out of the well keeping the polypropylene rope on the plastic sheet. Empty the ground water from the bailer into a glass quart container and observe its appearance. NOTE: This sample will not undergo laboratory analysis, and is collected to observe the physical appearance of the ground water.
12. Record the physical appearance of the ground water on the Ground Water Sampling Field Log.
13. Prepare the bladder pump for operation.
14. Lower the pump to immediately below the water level and pump the ground water into a graduated pail. Pumping should continue until sufficient well volumes have been removed or the well is pumped dry. If the well is pumped dry, allow sufficient time for the well to recover before proceeding with Step 16. Record this Information on the Ground Water Sampling Field Log.
15. Remove the sampling bottles from their transport containers, and prepare the bottles for receiving samples.

Inspect all labels to ensure proper sample identification. Sample bottles should be kept cool with their caps on until they are ready to receive samples. Arrange the sampling containers to allow for convenient filling.

16. After filling, return each sampling bottle to its proper transport container. NOTE: While filling the sample vial designated for volatiles, ensure that the submersible pump intake is located at a sufficient depth below the surface of the water to ensure air is not introduced while filling the vials.
17. If the sample bottles cannot be filled quickly, keep them cool with the caps on until they are filled. NOTE: Samples must not be allowed to freeze.
18. Record the physical appearance of the ground water observed during sampling on the Ground Water Sampling Field Log or field notebook.
19. Begin the Chain of Custody Record. A separate form is recommended for each well with the required analysis listed individually.
20. Remove the pump from the well and decontaminate the pumps and necessary tubing both internally and externally as specified in Section 4.04 of this QAPP.
21. Replace the well plug, and lock the well protection assembly before leaving the well location.
22. Place the gloves, towels, and plastic sheet into a plastic bag for disposal.

5.02 Split Spoon Soil Sampling

A minimum of one split spoon soil sample will be selected at a depth specified by the on-site geologist. The representative sample will be placed in a laboratory supplied one pint glass bottle with a Teflon lined enclosure using a clean stainless steel spatula or spoon and placed in a cooler for transport to the OBG Labs. Physical observation and field screening with a photoionization device will be used to aid in the selection of samples whereas the on-site geologist will describe each soil sample including 1) Soil type, 2) color, 3) percent recovery, 4) moisture content, 5) odor and 6) miscellaneous observations such as organic content and/or the presence of waste materials.

5.03 Air Sampling

This section of the QAPP, in conjunction with the Work Plan, provides a detailed reference to be used in the collection of air samples at the Jarl Extrusions site. Air monitoring will be carried out in association with ongoing field activities in order to approximate "worst case" conditions.

Sample locations

Three locations (upwind, on-site, and downwind) will be selected for air monitoring based upon wind direction at the time of setup. Exact locations will be modified so as to best capture any volatile or fugitive dust emissions from centers of site activity.

Samples will be collected over an 8-hour period. Throughout this period, field personnel will note wind direction and speed at least once per hour. Should a substantial and sustained change in predominant wind direction be observed (±90 degrees), the site air monitoring specialist may elect to alter the position of sample locations to best reflect upwind and downwind conditions.

Sampling media/analyses

The following methods will be employed for air sample collection and analysis:

Analysis	Sampling Media	Method	Holding Time
Halogenated Hydrocarbons	Charcoal Sorbent Tubes	NIOSH 1003	14 days
Aromatic Hydrocarbons	Charcoal Sorbent Tubes	NIOSH 1501	14 days
Metals	Filter Cassette	NIOSH 7300	none

Table B-5 provides a listing of the volatile organic compounds (VOCs) and metals applicable to NIOSH methods 1003, 1501 and 7300 as well as their method detection limits.

Results will be evaluated against the published Permissible Exposure Limits (PELs) under OSHA and the Threshold Limit Values (TLVs) recommended by the ACGIH (American Conference of Governmental Industrial Hygienists) as well as other pertinent guidelines and human health criteria to assess the possible risk, if any, posed by detectable levels of airborne contaminants found during the air monitoring program. If necessary modifications to the Health and Safety Plan will be made based on these results.

5.03.01 QA/QC samples

A.) Duplicate samples

In order to evaluate the precision of the sampling method, one duplicate sample will be collected for each analytical method. The duplicate shall be collected at an "on-site" sample location.

B.) Field/trip blanks

Field/trip blanks will be included at a rate of 1 per sample shipment per analytical method. These samples consist of an assembled sampling train with all appropriate filters or sorbent tubes, opened and immediately capped in-field. The field/trip blank serves to assess 1) the residual levels of compounds present on the sampling media prior to sample collection, and 2) the degree of contamination, if any, accrued by the media during sample handling and shipment.

5.03.02 Sample Setup

Sample trains will be set up in-field immediately prior to sampling. Sample pumps (SKC or equivalent personal sampling pumps) will be pre-calibrated to prescribed flow rates under the supervision of a Certified Industrial Hygienist. Pumps to be used for hydrocarbon (charcoal tube) sampling will be calibrated to approximately 100 cc/min. Pumps to be used for metals sampling by method 7300 will be calibrated to a rate of approximately 3 liters (3000 cc's) per minute. Exact flow rates will be documented on each pump.

Seals on appropriate filters or sorbent tubes will be broken immediately prior to use and the media connected to pumps via Tygon tubing. Sampling pumps will be programmed to operate for an eight hour continuous sampling period and then fastened to support stakes with rope or wire.

The following information shall be included in the field log for each sampling pump employed: Serial number of pump, sampling media, flow rate, I.D. number (filter cassette) or tube lot (sorbent tubes), time on, and site location (upwind, on-site, downwind).

Samples shall be recovered as soon as possible after the sampling period has completed. Exact time of sample recovery will be noted in the field log in addition to any modifications or deviations from the sampling design noted during the day. Filter cassettes will be labeled, capped and placed in labeled zip-lock plastic bags. Sorbent tubes will be capped and placed in labelled septum sealed vials. Information contained on the sample labels shall include: Sample I.D., sampler initials, date, period of sampling (minutes), flow rate (cc's/minute), and required analytical methods. All samples will be packed in coolers at 4 degrees C for shipment to the laboratory.

5.04 Decontamination Protocols

Decontamination procedures will be applicable to all drilling and sampling activities. Drilling and well construction equipment mobilized to the site will receive an initial decontamination. Decontamination will be conducted in accordance with the procedures outlined in Section 4.04 of the this QAPP and to the satisfaction of the supervising geologist.

5.05 Sample Preparation and Preservation

Two rounds of ground water samples will be collected from all new and previously install monitoring wells based on elevated (wet) and depressed (dry) water table conditions. For each round of metals analysis, one sample will be unfiltered and preserved to a pH less than 2 using nitric acid and the other field filtered through a 0.45 um membrane (cellulose ester) filter prior to preservation to a pH less than 2. The pH will be checked in the field.

Table B-2 lists the proper container materials, volume requirement, and preservation needed for ground water, soil and air analyses necessary for the site investigation. Samples requiring refrigeration for preservation will be immediately transferred to coolers packed with ice or ice packs. All samples will be shipped within 24 hours of being collected. Proper chain-of-custody documentation will be maintained as discussed in Section 6 of this QAPP.

SECTION 6 - SAMPLE CUSTODY

The primary objective of sample custody procedures is to create an accurate written record which can be used to trace the possession and handling of all samples from the moment of their collection, through analysis, until their final disposition. Sample custody for samples collected during this investigation will be maintained by the Field Operations Manager (FOM) or the field personnel collecting the samples. The FOM or field personnel are responsible for documenting each sample transfer and maintaining custody of all samples until they are delivered to the laboratory.

Sample bottles needed for a specific sampling task will be relinquished by the FOM to the sampling team after the FOM has verified the integrity of the bottles and assured that the proper bottles have been assigned to the task to be conducted.

Sample bottles and preservatives will be supplied by OBG Laboratories, Inc. A self-adhesive sample label will be affixed to each container before sample collection. At a minimum, the sample tag will contain:

- Client
- Job name
- Sample identification station number (place of sampling)
- Date and time collected
- Sampler's signature
- Testing required
- Preservatives added
- Matrix Type

- Grab or Composite

Immediately after sample collection, the sample will be placed in an insulated cooler for delivery to the laboratory within 24 hours. O'Brien & Gere field chain-of-custody records (Figure B-4) completed at the time of sample collection will accompany the samples inside the cooler for delivery to the laboratory. The forms will include the project name, sampling station number, and sample location. These record forms will be sealed in a ziplock plastic bag and taped to the inside of the cooler lid to protect them against moisture. Each cooler will contain sufficient ice and/or ice packs to ensure that proper temperature of approximately 4°C is maintained, and will be packed in a manner to prevent damage to sample containers. The shipping container will be secured with nylon strapping tape and custody sealed before shipment. The custody seals (Figure B-5) will be placed on the containers so they cannot be opened without breaking the seal. The samples will be properly relinquished on the field chain-of-custody record by the sampling team to the FOM. The FOM will then, in turn, deliver the samples to Federal Express (or a similar courier service) for transport to OBG Laboratories. When routine sampling is performed and the FOM is not present, custody will be relinquished by the responsible field personnel.

Federal Express (or a similar courier service) will relinquish samples to the OBG Laboratories Sample Custodian. Upon receiving the samples, the sample custodian will inspect the condition of the custody seal and samples, compare the information on the sample label against the field Chain-of-Custody record, assign an OBG Laboratories control number, and log the control number into the OBG Laboratories computer sample inventory system. OBG Labs will maintain custody of samples as described in the above sections.

When samples requiring preservation by either acid or base are received at the laboratory, the pH will be measured and documented. The Laboratory Sample Custodian will then store the sample in a secure sample storage cooler at 4°C and maintain custody until assigned to an analyst for analysis.

The Laboratory Sample Custodian will note any damaged sample containers or discrepancies between the sample label and information on the field Chain-of-Custody record when logging in the sample. This information will be communicated to the FOM or field personnel so proper action can be taken. The chain-of-custody form will be signed by both the relinquishing and receiving parties each time the sample changes hands, and the reason for transfer indicated.

A serially numbered internal chain-of-custody form will be used by OBG Laboratories to document sample possession from the Laboratory Sample Custodian to Analysts and final disposition. The chain-of-custody information will be supplied with the analytical reports for inclusion in the document control file.

SECTION 7 - CALIBRATION PROCEDURES AND FREQUENCY

7.01 Field Equipment Calibration, References and Frequency

All field equipment used during this project will be calibrated and operated in accordance with manufacturer's instructions. Any field equipment used during this project that is not covered by the investigator's standard operating procedures will have a specific calibration and operation instruction sheet prepared for it.

A. General standards may be grouped into two classifications: primary and secondary. Primary standards include United State Pharmaceutical (USP), National Bureau of Standards (NBS), American Society for Testing and Materials (ASTM) materials, and certain designated EPA reference materials. All other standards are to be considered secondary.

B. Testing

  1. Primary: No testing is necessary. Do not use if there is any physical indication of contamination or decomposition (i.e. partially discolored, etc.).
  2. Secondary: Examine when first received either by comparison to an existing primary, or comparing known physical properties to literature values. The less stable standards will be rechecked at appropriate intervals, usually six months to one year.

C. Records

  1. A records book will be maintained for each grouping of standards (i.e. pesticides, metals, etc.)
  2. The record kept for each standard will include:

a. Name and date received

b. Source

c. Code or lot number

d. Purity

e. Testing data including all raw work and calculations

f. Special storage requirements

g. Storage location

3. These records will be checked periodically as part of the Laboratory Controls Review.

7.02 Laboratory Equipment

A. General

1. Each major piece of analytical laboratory instrumentation used on this project is documented and on file with the analytical laboratory.
2. A form is prepared for each new purchase and old forms are kept for litigation purposes when an instrument is replaced.
3. Equipment calibration and frequency will be performed according to the method involved.

B. Testing

1. Each form details both preventative maintenance activities and the required QA testing and monitoring.
2. In the event the instrument does not perform within the limits specified on the monitoring form, the Laboratory Manager will be notified and a decision made as to what action to take.
3. If repair is deemed necessary, an "out of order" sign will be placed in the instrument until repairs are effected.

7.03 Instrument Records

The laboratory is subdivided into several sections which are directed by a section leader. The responsibility of each section leader is to monitor daily operations and answer technical questions. Secondarily, section leaders have project responsibility which includes review of the finished product. The operators of the systems have the responsibility to complete the logbooks for the section leader or program manager review.

Additionally, a bound notebook will be kept with each instrument, requiring calibration, to record all activities associated with a maintenance, QA monitoring and repairs program. These records will be checked during periodic equipment review.

7.04 Field Calibration

In addition to the laboratory analyses conducted during the course of this investigation, field measurements of pH, specific conductance, turbidity, and temperature will be taken for all surface and ground water samples. Where necessary, a photoionization detection meter will be used to measure volatile organics in air or soils.

The frequency of field calibration procedures will, at a minimum, include the following:

- The pH, turbidity and specific conductance meters will be calibrated at a minimum of once daily and documented in a calibrator's field book. Calibration will be checked as necessary to insure proper measurements are taken.
- pH meters will be calibrated using specific techniques according to the manufacturer's instructions and two standard

buffer solutions (either 4, 7, or 10) obtained from chemical supply houses. The pH values of these buffers will be compensated for temperature according to the values supplied on the manufacturer's bottle label. The temperature (measured as below) at which the sample pH was measured will then be used to compensate for temperature on the meter.

- Turbidity meters will be calibrated using the techniques outlined in the manufacturer's instruction manual and two standards (either a 25, 50, or 75 NTU solution).
- Temperature measurements will be performed using field thermometers (Thomas Science No. 9329A10).
- Specific conductance meters will be calibrated using a 1413.0 umho (KCl) solution prepared by OBG Laboratories according to Standard Methods of the Analysis of Water and Wastewater, 16th Edition, 1985-Method 205, 3b, page 79. At temperatures other than 25 degrees C, the temperature correction values outlined in Table B-4 will followed.

7.05 Preventative Maintenance

Preventative maintenance procedures will be carried out on field equipment in accordance with the procedures outlined by the manufacturer's equipment manuals. Maintenance activities involving field equipment will be recorded in a field log book. Preventative maintenance procedures for laboratory analytical instrumentation will be carried out in accordance with the manufacturer's specifications and OBG Laboratories standard operating procedures.

SECTION 8 - ANALYTICAL PROCEDURES

U.S. Environmental Protection Agency Target Compound List (TCL) parameters and CLP criteria applicable to groundwater samples are presented in Table B-6. This table also includes analytical detection limits and audit, frequency, and control limits. Table B-7 identifies use of non-CLP methods applicable to ground water (nitrates, sulfates and chlorides) as well as soils (metals analyses) and air (VOCs and metals). Non-CLP methods were drived from the following documents: Test Methods for Evaluating Solid Waste", U.S. EPA, SW-846, November, 1986, 3rd. edition and the "NIOSH Manual of Analytical Methods", U.S. DHHS, February, 1984. State contract laboratory protocols were obtained from NYSDEC Analytical Services Protocol, September 1989. Sampling and holding time requirements, along with an analytical method reference can be found in Table B-2.

The analytical methods which are to be used for the analyses of the sample media collected at the Alcan Aluminum Co. Site #828005 were chosen to reflect process methods, those parameters identified during previous investigations and meet the project DQO. The selected methods are applicable to ground water and soil samples.

SECTION 9 - DATA REPORTING, VALIDATION, AND REDUCTION

9.01 General

Data reporting and validation practices will be followed to ensure that raw data are not altered and an audit trail is developed for those data which require reduction. Field data, such as those generated during field measurements, observations and field instrument calibrations, will be entered directly into a bound field notebook. Each project team member will be responsible for proofing all data transfers made, and the Field Operations Manager will frequently proof data transfers.

OBG Laboratories will be responsible for data reduction and preliminary data validation. The Project Quality Assurance Manager will review the laboratory data package and prepare a validation summary for final approval by the Project Manager.

9.02 Reporting

The analytical data report for all sample matrices will include the following information:

- Date of sampling;
- Description of samples;
- Indication of analytical method used;
- Analytical results of all samples plus trip blank, field blank and method blank;
- Results of 5% duplicates and spike analysis
- Method detection limits and precision and accuracy statements for parameters analyzed;

- copy of completed chain-of-custody;
- notebook accountability record;
- copies of GC chromatograms and GC/MG spectral printouts.

As specified by the NYSDEC, CLP reporting will constitute 100% of the data. NYSDEC forms will be used such as Sample Preparation and Analytical Summary forms (Attachment 3), case narratives, non-conformance summaries, and lab chronicies. In both cases, the data report forms will be securely bound and all pages will be sequentially numbers. The original and one copy of the final report will be provided to NYSDEC CLP reporting. Data will also be delivered on diskette.

Review and cross checking procedures will be per standard operating procedures of the laboratory and will ensure that the raw data and calculation results are properly, completely, and accurately transferred to the reporting format used by the Laboratories' CLP program.

9.03 OBG Laboratories - Data Handling and Reduction

OBG Laboratories, Inc. will be performing analyses on the environmental samples. The following data handling procedures are employed at OBG Laboratories, Inc.

A. Gas Chromatography/Mass Spectrometry: 1) A Hewlett-Packard Model 5987A GC/MS equipped with a Tekmar Model 400 Dynamic Head Space concentrator and a RTE6 VM Operating System and, 2) a 5996 HP GC/MS with a 7672A HP Auto Sampler and a RTE6 VM Operating System are used for positive identification and quantification of volatile organics and sample extracts. Both instruments use an aquarius software package for data reduction. Output from the GC/MS units is processed for presentation in three formats:

1) A real-time total multiple ion mass chromatogram.
2) A post-run investigation report containing the following:
    a. Retention time
    b. Response factor
    c. Primary, secondary and tertiary ion with their correspondings abundance
    d. Quantitation ion
    e. Reference library name
    f. Concentration
3) A visual comparison of the subject mass spectral output to the library compound. The post integration report contains the following:
    1) Listing of all compounds.
    2) Relative retention times.
    3) Relative response factor to their internal standards. Quality Assurance/Quality Control data such as resolution and calibration standards and DFTPP spectra are also processed and stored in the above manner.

B. Gas Chromatography: A Hewlett-Packard Model 5880A Gas Chromatograph (GC) equipped with an Electron Capture Detector and a 7673A H.P. Auto injection system is used for positive identification and quantification of sample extracts.

Output from the GC unit is processed for presentation in two forms:

1) A real time chromatogram

2) A post-run integration report containing the following:

   a. Retention time

   b. Response factors calculated from standards

   c. Surrogate standard reservoir

   d. Listing of all positively identified compounds

Quality Assurance/Quality Control data such as spikes, spike duplicates, and calibration curves are also processed and stored in post integration reports.

C. Trace Metals: A Varian model 575 Atomic Absorption Spectrophotometer (AA) and Perkin-Elmer Model 3030B Atomic Absorption Spectrophotometer with an HGA600 furnace are used for the low level detection of metals by conventional flame and graphite furnace techniques.

The atomic absorption spectrophotometer for inorganic pollutants is calibrated using appropriate calibrating standards and blanks. The calibrations are checked by analyzing synthetic standards at five different concentration levels.

The results are used to generate standard curves by least squares fit of the data via computer programs. The deviation of the standards from the least squares fit (standard curves) and the standard deviation of the fit are printed on the daily printout and the data stored accordingly in appropriate computer bases. If deviations from accepted values occur, analysis of sample and instrumental calibrations are repeated. Standard curves are generated regularly.

D. Spectrophotometry: Spectrophotometric instruments are initially calibrated with commercially available standards. To verify the initial calibration, EPA knowns are analyzed and must be within ±10% of the true value. At a frequency of 10% a continuing calibration standard is analyzed and quantitated. In the continuing calibration standard is not within 10% the instrument is recalibrated and the previous 10 samples are reanalyzed. The chemist documents any excursions and continuing calibration on the bench analysis log.

OBG Labs group leaders will check and validate all data generated by their group as specified in Attachment 1. The QAO (Quality Assurance Objectives) of the laboratory will provide a signed document verifying the validation of the data.

Upon receipt of OBG Labs Analysis Reports and associated data packages, laboratory analyses will be validated by O'Brien & Gere's Quality Assurance Coordinator by reviewing the laboratory quality control data, laboratory method blanks, trip blanks, agreement between samples and duplicates, and surrogate and spike recovery data.

The analytical data obtained during the course of the investigation for ground water will be reported as ug/L (ppb). Laboratory data for soil analyses will be reported as ug/kg on a dry weight basis. Analyses conducted in association with the investigation will be reported utilizing OBG Laboratories level two data package. Table B-8 lists the deliverables that are included in the OBG Labs data package.

The validation program will incorporate a tracking and filing system for documents generated during the investigation. Documents accounted for in this aspect of the validation program will include items such as log books, field data records, correspondences, chain-of-custody records, analytical reports, photographs, computer disks, and reports. The Project Manager is responsible for maintaining a central file in which documents are inventoried. The raw data generated during field operations will be filed to eliminate or correct errors arising from the transfer of data.

To avoid errors in the transfer of data, copies of raw data from the field notebooks, and the data as received from the laboratory, will be entered into a data file and assigned an appropriate document control identification number. The data file will serve as the ultimate archive for all information and data generated during this investigation.

The documentation of sample collection will include the use of bound field log books in which the information on sample collection will be entered in indelible ink. Enough information will be given to reconstruct the sampling event, including: site name (top of each page), sample identification, brief description of sample, date and time of collection, sampling methodology, field measurements and observations, and sampler's initials (bottom of each page, and dated).

9.04 Data Validation

Prior to submittal of the data to the Project Manager for his review, data will be validated by O'Brien & Gere Engineers, NYSDEC approved data validators. The Project QA/QC Officer will review the Laboratory QA/QC report and documentation and compare the performance to the requirements of the protocols and program objectives. A data validation report will be generated and incorporated into the RI report.

The requirements to be checked for the validation of volatile and semi-volatile organics analyses data are as follows:

1. Holding Times
2. GC/MS Tuning
3. Calibration
4. Blanks
5. Surrogate Recovery
6. Matrix Spike/Matrix Spike Duplicate
7. Field Duplicates
8. Internal Standards Performance
9. TCL Compound Identification
10. Compound Quantitation and Reported Detection Limits
11. Tentatively Identified Compounds
12. System Performance
13. Overall Assessment of Data for a Case

The requirements to be checked for the validation of metals and cyanide analyses data are as follows:

1. Holding Times
2. Calibration
3. Blanks
4. ICP Interference Check Samples ("ICS")
5. Laboratory Control Sample ("LCS")
6. Duplicate Sample Analysis
7. Matrix Spike Sample Analysis
8. Furnace Atomic Absorption QC
9. ICP Serial Dilution
10. Sample Result Verification
11. Field Duplicates
12. Overall Assessment of Data for a Case

The results of the data validation culminate in a data usability report which flags any and all problems and makes recommendations as to the usability of related data.

SECTION 10 - INTERNAL QUALITY CONTROL CHECKS

10.01 Laboratory Internal Quality Control Checks

OBG Laboratories Internal Quality Control Checks will meet or exceed analytical QC requirements set forth by U.S. EPA approved methodologies (e.g. "Test Methods for Evaluating Solid Wastes", U.S. EPA, SW-846, 1986, 3rd edition). These QC checks will be a continuation of O'Brien & Gere's Field Internal Quality Control Checks presented below. Quality Control and program sampling frequencies are summarized in Table B-9.

10.02 Field Internal Quality Control Checks

Field Internal Quality Control Checks will be utilized during this investigation through the use of the following:

- Trip Blanks - These blanks consist of ultrapure, deionized water contained in appropriate sample containers with any preservatives required for the analysis. These blanks will be provided by OBG Labs. They will accompany the samplers during the sampling process and will serve as a QC check on container cleanliness, external contamination, and the analytical method. Trip blanks will be submitted once per day per analysis type for samples involving ground water.
- Field Equipment Rinse Blanks - These blanks will consist of demonstrated analyte free water passed through sampling equipment and collected in appropriate containers. These blanks will verify decontamination of sampling equipment and eliminate the possibility of cross-contamination. Equipment

blanks will be collected once daily per analysis type for each type of sampling equipment used.

- Duplicate Samples - Duplicate samples will be collected to allow determination of analytical repeatability. One duplicate sample in every twenty (20) ground samples collected, and one in every twenty (20) soil or sediment samples, will be collected and submitted for analysis.
- Matrix Spike Sample - A matrix spike sample will also be submitted as a QC check. These will be collected at the same frequency as stated above for the duplicate samples. These will allow recovery rates of compounds (the spike and/or surrogate spike compounds defined in the organic and inorganic methods) to be determined for matrix effects specific to the study site through the addition of known concentrations of compounds into the sample (by OBG Labs at the laboratory) and then performing the analysis.

Matrix spike/matrix spike duplicate sample aliquots will be acquired for ground water by providing triple the necessary sample volume. Matrix spike/matrix spike duplicate sample aliquots for soil analyses will placed in a one liter sample container and split from the designated sample location at the laboratory. The laboratory will select aliquots that are as homogeneous with respect to on another as possible to avoid precision problems related from sample inhomogeneity. The specific sample location which will be used for matrix spikes and duplicates will be chosen by the Field Operations Manager with direction from the Quality Assurance Coordinator.

SECTION 11 - PERFORMANCE AND SYSTEM AUDITS

11.01 On-Site Audit

An on-site system audit will be performed during major field activities to review all field-related quality assurance activities. The system audit will be conducted by O'Brien & Gere's Quality Assurance Coordinator.

Specific elements of the on-site audit include the verification of:

- Completeness and accuracy of sample Chain-of-Custody forms, including documentation of times, dates, transaction descriptions, and signatures.
- Completeness and accuracy of sample identification labels, including notation of time, date, location, type of sample, person collecting sample, preservation method used, and type of testing required.
- Completeness and accuracy of field notebooks, including documentation of times, dates, drillers names, sampling method used, sampling locations, number of samples taken, name of person collecting samples, types of samples, results of field measurements, soil logs, and any problems encountered during sampling.
- Adherence to health and safety guidelines outlined in the Site Health and Safety Plan including wearing of proper protective clothing.
- Adherence to decontamination procedures outlined in Section 4 of this QAPP, including proper decontamination of pumps and pump tubing, bailers, and soil sampling equipment.

- Adherence to sample collection, preparation, preservation, and storage procedures.

11.02 Laboratory Audit

11.02.01 OBG Laboratories Internal Laboratory Audits

OBG Labs performs regular systems and performance audits. O'Brien & Gere's Quality Assurance Coordinator will also conduct a system audit of the laboratory once during the project to evaluate whether proper quality assurance measures are being incorporated into the sample handling and analysis. Table B-10 lists the checklist that will be used for the system audit.

11.02.02 O'Brien & Gere's Performance Audit of OBG Laboratories

Results of both the field and laboratory audit will be submitted to O'Brien & Gere's Project Manager and Quality Assurance Coordinator for review and incorporation into the status reports prepared by O'Brien & Gere. If the results of the audit necessitate further action, the Project Manager will be notified of such and will be appraised of any action taken.

SECTION 12 - PREVENTIVE MAINTENANCE

12.01 Laboratory Maintenance

The standard operating procedures employeed by OBG Labs include preventive maintenance for all analytical instruments and equipment to minimize downtime. Maintenance activities by the laboratory or professional sources are carried out in accordance with manufacturer's recommendations and specifications, and are documented by detailed entries in appropriate log books. Spare parts are kept on-hand in inventory and replaced as necessary by the laboratory group leaders.

12.02 Field Maintenance

O'Brien & Gere's field equipment is maintained regularly according to the manufacturer's specifications. When damaged equipment or equipment in need of repair is returned to the equipment warehouse, it is appropriately flagged for the required maintenance. This process assures only operable and maintained equipment enters the field. Routine daily maintenance procedures conducted in the field will include:

- Removal of surface dirt and debris from exposed surfaces of the sampling equipment and measurement systems.
- Cleaning of filters in the organic vapor analyzer.
- Storage of equipment away from the elements.
- Daily inspections of sampling equipment and measurement systems for possible problems (e.g. cracked or clogged lines or tubing or weak batteries).
- weekly calibration of field instrumentation.

Spare and replacement parts stored in the field to minimize downtime include:

- Appropriate size batteries
- Locks
- Additional equipment as necessary for the field tasks.
- Extra sample coolers and packing material
- Additional supply of health and safety equipment (i.e. respirator cartridges, boots, gloves, Tyvek type suits, etc.)
- Additional equipment as necessary for the field tasks

SECTION 13 - SPECIFIC ROUTINE PROCEDURES USED TO ASSESS DATA PRECISION, ACCURACY, AND COMPLETENESS

13.01 O'Brien & Gere's Data Quality Assessment

O'Brien & Gere's Quality Assurance Coordinator will review and validate all data as they are received. These validated data will then be incorporated into the next report to be submitted.

The data will be checked by OBG Labs prior to its release to O'Brien & Gere Engineers. The main objective of O'Brien & Gere's Quality Assurance Coordinator will be to insure that errors have not been made. This will be accomplished by checking all quality assurance precision and accuracy data and insuring that data packages are complete with information such as:

- Title page
- Chain-of-custody records
- Analytical reports
- Quality control data summary
- Chromatograms
- Methodology summary
- Calibration data

Quality control summary forms will be checked to the specified limits in the required methods. If outliers exist, it will be determined what corrective measures were used to locate the problem or determine if it was sample matrix interference. The following documents will be used in support of the data quality assessment review:

- EPA Region III Data Validation Checklist

- EPA 600/4-79-019, "Handbook for Analytical Quality Control in Water and Wastewater Laboratories".
- Technical Directive Document No. HQ-8410-01, "Laboratory Data Validation Functional Guidelines for Evaluating Organic Analyses".
- EPA 600/479-020, "Methods for Chemical Analysis of Water And Wastes".
- Federal Register, Friday, October 26, 1984.
- CLP - Statement of Work 7/87.
- NIOSH "Manual of Analytical Methods", U.S. DHHS, February, 1984.

13.02 Field Data Quality Assessment

To ensure that all field data are collected accurately and correctly, specific written instructions will be issued to all personnel involved in field data acquisition by the Project Manager. The Quality Assurance Coordinator will then review the field books used by project personnel to ensure that all tasks were performed as specified in the instructions.

All raw data and reduced data will be submitted by project personnel to the Quality Assurance Coordinator for review. The Quality Assurance Coordinator will then submit these data to the Project Manager for use after all aspects of the data have been approved, initialed, and dated by the Quality Assurance Coordinator. Equations, calculations, data transfers, consistent units and significant figures will all be subject to this quality assurance review.

SECTION 14 - CORRECTIVE ACTION

Corrective action procedures that might be implemented from audit results or upon detection of data unacceptability will be developed on a case-by-case basis. Prior to any deviation from the agreed QA/QC protocols specified in this work plan, DEC must be notified such that an agreement can be reached on the corrective action. Generally, the following actions may be taken:

1. The reason for the unacceptable data point(s) will be determined as follows:
   a. Precision
      i. The analyst
      ii. Nature of the sample
      iii. Glassware contamination
   b. Accuracy
      i. The analyst
      ii. Glassware contamination
      iii. Contaminated reagents
      iv. Instrument problems
      v. Sample interference with spiked material
2. The corrective actions to be taken may include:
   - Reanalyzing samples if holding times have not been exceeded.
   - Altering field or handling procedures.
   - Resampling.
   - Using a different batch of sample containers.
   - Recommending an audit of laboratory procedures.

- Accepting data with know levels of uncertainty.
- Discarding data.

Problems encountered during the study affecting quality assurance will be reported on a Corrective Action Form. The Project Manager and the OBG Labs QA Coordinator will be responsible for initiating the corrective actions in the field and laboratory, respectively, in a timely manner. The Project Manager will report to the Quality Assurance Coordinator on the corrective actions taken, the outcome of these actions, and their effect on data produced. Corrective actions will be discussed in the quality assurance report to management described in Section 15.

SECTION 15 - QUALITY ASSURANCE REPORTS TO MANAGEMENT

The Project Manager, in conjunction with the Quality Assurance Coordinator, will submit, in the investigation reports, summaries of all applicable quality assurance activities. These summaries will contain at least the following types of information.

- The status and coverage of various laboratory and field quality assurance project activities
- Data quality controls including assessment of: accuracy, precision, completeness, representativeness, and comparability.
- Significant quality assurance problems discovered, corrective actions taken, progress and improvements, plans, and recommendations for further implementation or updating of the investigative QAPP.
- Any significant irregularities noted in the field notebook during the sampling procedure.
- Results of performance and system audits, if conducted.
- A discussion of the QA/QC data as it relates to the data quality objectives of the investigation and the interpretation of the results of the field investigation.

TABLE B-1

DEFINITIONS OF DATA QUALITY PARAMETERS

- Precision - a measure of the reproducibility of measurements under a given set of conditions.
- Accuracy - a measure of the bias that exists in a measurement system.
- Representativeness - the degree to which sample data accurately and precisely represent selected characteristics.
- Completeness - a measure of the amount of the valid data obtained from the measurement system compared to the amount that is required.
- Comparability - a measure of confidence with which data set can be compared to another.

TABLE B - 2 SAMPLE CONTAINER REQUIREMENTS PRESERVATION AND HOLDING TIMES

Sample Fraction (Method)	Sample Matrix	Sample Preservation	Holding Time	Container
Inorganics (CLP, Non-CLP[1])	Soil	Cool, 4°C	6 months (CLP metals) 24 hours (Cr+6) 14 Days (cyanide) 28 Days (others)	(1) 8 oz wide-mouth glass jar w/ teflon lined lid.
Volatile Organics (CLP)	Soil	Cool, 4°C	10 days	(2) 40 ml vials w/ Teflon lined caps.
Inorganics (CLP, Non-CLP[1])	Water	Cool, 4°C (HNO_3 to pH <2), (NaOH to pH>12 Cyanide)	As for soils	(1) 1000 ml plastic bottles w/teflon liners.
Volatile Organics (CLP)	Water	Cool, 4°C (HCl to pH <2)	10 days	(2) 1 liter amber glass w/ teflon lined cap.
Semi-Volatile Organics/PCBs (CLP)	Water	Cool, 4°C	5 days to extraction	(4) 1 liter glass bottles with poly cap.
Inorganics (7300)	Air	Cool, 4°C	6 months	0.2 micron particulate filter.
Volatile Organics (1003,1051)	Air	Cool, 4°C	10 days	charcoal tube: seal and store in friction top can with 2 inches of GAC beneath retaining screen.
Trip blank (CLP-Volatiles)	Water	Cool, 4°C	10 days	40 ml glass vials w/teflon liners.
Reinsate blanks (CLP)	Water	Cool, 4°C (HNO3 to pH <2 for metals)	10 days	metals: 1000ml plastic bottles w/teflon liners VOA: 40ml glass vials.
EPTox (1310)	Water	Cool, 4°C	6 months	1000 ml plastic bottles w/ teflon lined caps.

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[1] Non-CLP Methods:
7196
212.3
9065
340.2
375.3
325.2
335.1

Sources: Test Methods for Evaluating Solid Waste, U.S. EPA, SW-846, November, 1986, 3rd edition.

NIOSH Manual of Analytical Methods, U.S. DHHS, February, 1984.

TABLE B-3

JARL EXTRUSIONS SITE

WELL No.	Total* Depth (feet)
MW-1	
MW-2	
MW-3	
MW-4	
MW-5	
MW-6	
MW-7	
MW-8	
MW-9	
MW-10	

*All wells are 2" diameter
Monitoring wells 1 through 5 are existing wells

TABLE B-4

CONDUCTIVITY TEMPERATURE CORRECTIONS
FOR 1,413 UMHOS/CM CONDUCTIVITY STANDARD

Temperature, °C	umhos/cm
4	914.0
5	932.7
6	951.7
7	971.1
8	991.0
9	1,011.9
10	1,031.8
11	1,052.9
12	1,074.3
13	1,096.3
14	1,118.7
15	1,141.5
16	1,167.5
17	1,193.6
18	1,219.9
19	1,246.4
20	1,273.0
21	1,299.7
22	1,326.6
23	1,353.6
24	1,380.8
25	1,408.1
26	1,436.5
27	1,463.2
28	1,490.9
29	1,518.7
30	1,546.7

TABLE B-5
Detection Limits for
NIOSH Methods 1003, 1501, and 7300

Method 1003 Halogenated Volatile Compounds	Air (mg/sample)
Benzyl chloride	0.01
Bromoform	0.01
Carbon tetrachloride	0.01
Chlorobenzene	0.01
Chlorobromomethane	0.01
Chloroform	0.01
1,2-Dichlorobenzene	0.01
1,4-Dichlorobenzene	0.01
1,1-Dichloroethane	0.01
trans-1,2-Dichloroethylene	0.01
hexachloroethane	0.01
trans-1,3-Dichloropropylene	0.01
1,1,2,2-Tetrachloroethane	0.01
1,1,1-Trichloroethane	0.01

Method 1501 Aromatic Volatile Organics	Air mg/sample
Benzene	.001 to .01
p-tert-butyltoluene	.001 to .01
Cumene	.001 to .01
Ethyl Benzene	.001 to .01
methylstyrene	.001 to .01
Styrene	.001 to .01
Vinyltoluene	.001 to .01
Xylene	.001 to .01

Elements Method 7300	Air ug/sample
Aluminum	5.0
Arsenic	10.0
Beryllium	0.1
Cadmium	0.1
Calcium	10.0
Chromium	0.5
Cobalt	0.5
Copper	0.1
Iron	0.5
Lead	0.5
Magnesium	10.0
Manganese	0.5
Nickel	0.5

Elements Method 7300	Air ug/liter
Selenium	10.0
Silver	0.1
Sodium	10.0
Thallium	5.0
Zinc	0.1

TABLE B-6

ANALYTICAL METHODS AND DATA QUALITY REQUIREMENTS
CLP TCL VOLATILES - MATRIX: AQUEOUS

CHEMICAL COMPOUND*	QUANTITATION LIMIT +	AUDIT	FREQUENCY	CONTROL LIMITS	METHOD
	µg/L				
chloromethane	10	SEE BELOW**	SEE BELOW**	SEE BELOW**	SEE BELOW++
bromomethane	10	"	"	"	"
vinyl chloride	10	"	"	"	"
chloroethane	10	"	"	"	"
methylene chloride	5	"	"	"	"
acetone	10	"	"	"	"
carbon disulfide	5	"	"	"	"
1,1-dichloroethene	5	"	"	"	"
1,1-dichloroethane	5	"	"	"	"
1,2-dichloroethene	5	"	"	"	"
chloroform	5	"	"	"	"
1,2-dichloroethane	5	"	"	"	"
2-butanone	10	"	"	"	"
1,1,1-trichloroethane	5	"	"	"	"
carbon tetrachloride	5	"	"	"	"
vinyl acetate	10	"	"	"	"
bromodichloromethane	5	"	"	"	"
1,2-dichloropropane	5	"	"	"	"
c-1,3-dichloropropene	5	"	"	"	"
trichloroethene	5	"	"	"	"
dibromochloromethane	5	"	"	"	"
1,1,2-trichloroethane	5	"	"	"	"
benzene	5	"	"	"	"
t-1,3-dichloropropene	5	"	"	"	"
bromoform	5	"	"	"	"
4-methyl-2-pentanone	10	"	"	"	"
2-hexanone	10	"	"	"	"
tetrachloroethene	5	"	"	"	"
toluene	5	"	"	"	"
1,1,2,2-tetrachloroethane	5	"	"	"	"
chlorobenzene	5	"	"	"	"
ethyl benzene	5	"	"	"	"
styrene	5	"	"	"	"
xylenes (total)	5	"	"	"	"

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

* U.S.EPA Contract Laboratory Program Statement of Work For Organics Analysis Multi-media Multi-concentration. 10/86. Revised: 1/87, 2/87, 7/87, 2/88. IFB-W802035 D1, IFB W802036 D1, IFB W802081 D1.

**Frequency tables are on the following page.

++Refer to Table B6 for U.S. EPA method numbers.

TABLE B-6 Continued

ANALYTICAL METHODS AND DATA QUALITY REQUIREMENTS
CLP TCL VOLATILES - MATRIX: AQUEOUS

AUDIT	FREQUENCY	CONTROL LIMITS
Surrogate Spike	All samples and blank (including MS/MSD).	Recovery limits within those of Table 4.2, Exhibit E
MS/MSD	1 per case or 1 in 20 of similar concentration/matrix.	Recovery limits within those of Table 5.2, Exhibit E
Calibration Continuing	Each 12 hours	Minimum RF 0.300; must be less than 25% difference for any check compound. Table 2.2, also E-15 to E-17, Sections 2.6 - 2.7.
Method Blank	1 in 20, provided by sampling crew	Less than 5 times CRQL for methylene chloride, acetone, toluene, and 2-butanone Less than CRQL for all other TCL compounds
Replicate	1 in 20, provided by sampling crew	±20% PRE waters
MS Tuning	Every 12 hours.	BFB key ions and abundance criteria must be met for all 9 ions. Table 1.1, Exhibit E
Calibration Verification	Once	Five concentrations - linear range volatiles 20 - 200 mg/L. See Part 2, E-12 to E-15, Sections 2 - 2.5.

TABLE B-6 Continued

ANALYTICAL METHODS AND DATA QUALITY REQUIREMENTS

CLP TCL VOLATILES - MATRIX: SOLIDS

CHEMICAL COMPOUND*	QUANTITATION LIMIT +	AUDIT	FREQUENCY	CONTROL LIMITS	METHOD
	µg/kg				
chloromethane	10	SEE BELOW**	SEE BELOW**	SEE BELOW**	SEE BELOW++
bromomethane	10	"	"	"	"
vinyl chloride	10	"	"	"	"
chloroethane	10	"	"	"	"
methylene chloride	5	"	"	"	"
acetone	10	"	"	"	"
carbon disulfide	5	"	"	"	"
1,1-dichloroethene	5	"	"	"	"
1,1-dichloroethane	5	"	"	"	"
1,2-dichloroethene	5	"	"	"	"
chloroform	5	"	"	"	"
1,2-dichloroethane	5	"	"	"	"
2-butanone	10	"	"	"	"
1,1,1-trichloroethane	5	"	"	"	"
carbon tetrachloride	5	"	"	"	"
vinyl acetate	10	"	"	"	"
bromodichloromethane	5	"	"	"	"
1,2-dichloropropane	5	"	"	"	"
c-1,3-dichloropropene	5	"	"	"	"
trichloroethene	5	"	"	"	"
dibromochloromethane	5	"	"	"	"
1,1,2-trichloroethane	5	"	"	"	"
benzene	5	"	"	"	"
t-1,3-dichloropropene	5	"	"	"	"
bromoform	5	"	"	"	"
4-methyl-2-pentanone	10	"	"	"	"
2-hexanone	10	"	"	"	"
tetrachloroethene	5	"	"	"	"
toluene	5	"	"	"	"
1,1,2,2-tetrachloroethane	5	"	"	"	"
chlorobenzene	5	"	"	"	"
ethyl benzene	5	"	"	"	"
styrene	5	"	"	"	"
xylenes (total)	5	"	"	"	"
					"

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

Medium Soil/Sediment Contract Required Quantitation Limits (CRQL) for Volatile Compounds are 125 times the individual Low Soil/Sediment CRQL. 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.

* U.S.EPA Contract Laboratory Program Statement of Work For Organics Analysis Multi-media Multi-concentration. 10/86. Revised: 1/87, 2/87, 7/87, 2/88. IFB-W802035 D1, IFB W802036 D1, IFB W802081 D1.

**Frequency table is on the following page.

++Refer to Table B6 for U.S. EPA method numbers.

TABLE B-6 Continued

ANALYTICAL METHODS AND DATA QUALITY REQUIREMENTS
CLP TCL VOLATILES - MATRIX: SOLIDS

AUDIT	FREQUENCY	CONTROL LIMITS
Surrogate Spike	All samples and blank (including MS/MSD).	Recovery limits within those of Table 4.2, Exhibit E
MS/MSD	1 per case or 1 in 20 of similar concentration/matrix.	Recovery limits within those of Table 5.2, Exhibit E
Calibration Continuing	Each 12 hours	Minimum RF 0.300; must be less than 25% difference for any check compound. Table 2.2, also E-15 to E-17, Sections 2.6 - 2.7.
Method Blank	1 in 20, provided by sampling crew	Less than 5 times CRQL for methylene chloride, acetone, toluene, and 2-butanone Less than CRQL for all other TCL compounds
Replicate	1 in 20, provided by sampling crew	±50% PRE soils
MS Tuning	Every 12 hours.	BFB key ions and abundance criteria must be met for all 9 ions. Table 1.1, Exhibit E
Calibration Verification	Once	Five concentrations - linear range volatiles 20 - 200 mg/L. See Part 2, E-12 to E-15, Sections 2 - 2.5.

TABLE B-6 Continued

ANALYTICAL METHODS AND DATA QUALITY REQUIREMENTS
CLP TCL SEMI-VOLATILES - MATRIX: AQUEOUS

CHEMICAL COMPOUND*	QUANTITATION LIMIT +	AUDIT	FREQUENCY	CONTROL LIMITS	METHOD
	μg/L				
phenol	10	SEE BELOW	SEE BELOW	SEE BELOW	SEE BELOW++
bis(2-chloroethyl) ether	10	"	"	"	"
2-chlorophenol	10	"	"	"	"
1,3-dichlorobenzene	10	"	"	"	"
1,4-dichlorobenzene	10	"	"	"	"
benzyl alcohol	10	"	"	"	"
1,2-dichlorobenzene	10	"	"	"	"
2-methylphenol	10	"	"	"	"
bis(2-chloroisopropyl) ether	10	"	"	"	"
4-methylphenol	10	"	"	"	"
N-nitroso-di-n-propylamine	10	"	"	"	"
hexachloroethane	10	"	"	"	"
nitrobenzene	10	"	"	"	"
isophorone	10	"	"	"	"
2-nitrophenol	10	"	"	"	"
2,4-dimethylphenol	10	"	"	"	"
benzoic acid	50	"	"	"	"
bis(2-chloroethoxy)methane	10	"	"	"	"
2,4-dichlorophenol	10	"	"	"	"
1,2,4-trichlorobenzene	10	"	"	"	"
naphthalene	10	"	"	"	"
4-chloroaniline	10	"	"	"	"
hexachlorobutadiene	10	"	"	"	"
4-chloro-3-methylphenol	10	"	"	"	"
2-methylnaphtalene	10	"	"	"	"
hexachlorocyclopentadiene	10	"	"	"	"
2,4,6-trichlorophenol	10	"	"	"	"
2,4,5-trichlorophenol	50	"	"	"	"
2-chloronaphthalene	10	"	"	"	"
2-nitroaniline	50	"	"	"	"
dimethyl phthalate	10	"	"	"	"
acenaphthylene	10	"	"	"	"
2,6-dinitrotoluene	10	"	"	"	"
3-nitroaniline	50	"	"	"	"
acenaphthene	10	"	"	"	"
2,4-dinitrophenol	50	"	"	"	"
4-nitrophenol	50	"	"	"	"
dibenzofuran	10	"	"	"	"
2,4-dinitrotoluene	10	"	"	"	"
diethyl phthalate	10	"	"	"	"
4-chlorophenyl phenyl ether	10	"	"	"	"
fluorene	10	"	"	"	"
4-nitroaniline	50	"	"	"	"
4,6-dinitro-2-methylphenol	50	"	"	"	"
N-nitrosodiphenylamine	10	"	"	"	"
4-bromophenyl phenyl ether	10	"	"	"	"
hexachlorobenzene	10	"	"	"	"
pentachlorophenol	50	"	"	"	"
phenanthrene	10	"	"	"	"
anthracene	10	"	"	"	"
di-n-butylphthalate	10	"	"	"	"
fluoranthene	10	"	"	"	"
pyrene	10	"	"	"	"

ANALYTICAL METHODS AND DATA QUALITY REQUIREMENTS
CLP TCL SEMI-VOLATILES - MATRIX: AQUEOUS

CHEMICAL COMPOUND*	QUANTITATION LIMIT +	AUDIT	FREQUENCY	CONTROL LIMITS	METHOD
butyl benzyl phthalate	10	SEE BELOW	SEE BELOW	SEE BELOW	SEE BELOW++
3,3'-dichlorobenzidine	20	"	"	"	"
benzo(a)anthracene	10	"	"	"	"
chrysene	10	"	"	"	"
bis(2-ethylhexyl)phthalate	10	"	"	"	"
di-n-octyl phthalate	10	"	"	"	"
benzo(b)fluoranthene	10	"	"	"	"
benzo(k)fluoranthene	10	"	"	"	"
benzo(a)pyrene	10	"	"	"	"
indeno(1,2,3-c,d)pyrene	10	"	"	"	"
dibenzo(a,h)anthracene	10	"	"	"	"
benzo(g,h,i)perylene	10	"	"	"	"

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

* U.S.EPA Contract Laboratory Program Statement of Work For Organics Analysis Multi-media Multi-concentration. 10/86. Revised: 1/87, 2/87, 7/87, 2/88. IFB W802035 D1, IFB W802036 D1, IFB W802081 D1.
WA87-K238.

++Refer to Table B6 for U.S. EPA method numbers.

AUDIT	FREQUENCY	CONTROL LIMITS
Surrogate Spike	All samples and blank (including MS/MSD).	Recovery limits within those of Table 4.2, Exhibit E
MS/MSD	1 per case or 1 in 20 of similar concentration/matrix.	Recovery limits within those of Table 5.2, Exhibit E
Calibration Continuing	Each 12 hours	Minimum RF 0.05; must be less than 25% difference for any check compound. Table 2.3, also #-32 to E-35, Sections 2.6 - 2.7
Method Blank	1 per extraction group	Less than 5 times CRQL of the phthalate esters. Less than CRQL for all other TCL compounds.
MS Tuning	Each 12 hours.	DFTPP key ions & abundance criteria must be met for all 13 ions Table 1.2, Exhibit E.
Calibration Verification	Once	Five concentrations - linear range 20 - 160 ng. Four concentrations - nine compounds (See Section 2.1.1.) 50 - 160 ng/L. See Part 2, E-30 to E-32, Sections 2 - 2.5.

TABLE B-6 Continued

ANALYTICAL METHODS AND DATA QUALITY REQUIREMENTS
CLP TCL SEMI-VOLATILES - MATRIX: SOLIDS

CHEMICAL COMPOUND*	QUANTITATION LIMIT + µg/kg**	AUDIT	FREQUENCY	CONTROL LIMITS	METHOD
phenol	330	SEE BELOW	SEE BELOW	SEE BELOW	SEE BELOW++
bis(2-chloroethyl) ether	330	"	"	"	"
2-chlorophenol	330	"	"	"	"
1,3-dichlorobenzene	330	"	"	"	"
1,4-dichlorobenzene	330	"	"	"	"
benzyl alcohol	330	"	"	"	"
1,2-dichlorobenzene	330	"	"	"	"
2-methylphenol	330	"	"	"	"
bis(2-chloroisopropyl)ether	330	"	"	"	"
4-methylphenol	330	"	"	"	"
N-nitroso-di-n-propylamine	330	"	"	"	"
hexachloroethane	330	"	"	"	"
nitrobenzene	330	"	"	"	"
isophorone	330	"	"	"	"
2-nitrophenol	330	"	"	"	"
2,4-dimethylphenol	330	"	"	"	"
benzoic acid	600	"	"	"	"
bis(2-chloroethoxy)methane	330	"	"	"	"
2,4-dichlorophenol	330	"	"	"	"
1,2,4-trichlorobenzene	330	"	"	"	"
naphthalene	330	"	"	"	"
4-chloroaniline	330	"	"	"	"
hexachlorobutadiene	330	"	"	"	"
4-chloro-3-methylphenol	330	"	"	"	"
2-methylnaphtalene	330	"	"	"	"
hexachlorocyclopentadiene	330	"	"	"	"
2,4,6-trichlorophenol	330	"	"	"	"
2,4,5-trichlorophenol	600	"	"	"	"
2-chloronaphthalene	330	"	"	"	"
2-nitroaniline	600	"	"	"	"
dimethyl phthalate	330	"	"	"	"
acenaphthylene	330	"	"	"	"
2,6-dinitrotoluene	330	"	"	"	"
3-nitroaniline	600	"	"	"	"
acenaphthene	330	"	"	"	"
2,4-dinitrophenol	600	"	"	"	"
4-nitrophenol	600	"	"	"	"
dibenzofuran	330	"	"	"	"
2,4-dinitrotoluene	330	"	"	"	"
diethyl phthalate	330	"	"	"	"
4-chlorophenyl phenyl ether	330	"	"	"	"
fluorene	330	"	"	"	"
4-nitroaniline	600	"	"	"	"
4,6-dinitro-2-methylphenol	600	"	"	"	"
N-nitrosodiphenylamine	330	"	"	"	"
4-bromophenyl phenyl ether	330	"	"	"	"
hexachlorobenzene	330	"	"	"	"
pentachlorophenol	600	"	"	"	"
phenanthrene	330	"	"	"	"
anthracene	330	"	"	"	"
di-n-butylphthalate	330	"	"	"	"
fluoranthene	330	"	"	"	"
pyrene	330	"	"	"	"

TABLE B-6 Continued
ANALYTICAL METHODS AND DATA QUALITY REQUIREMENTS
CLP TCL SEMI-VOLATILES - MATRIX: SOLIDS

CHEMICAL COMPOUND*	QUANTITATION LIMIT +	AUDIT	FREQUENCY	CONTROL LIMITS	METHOD
butyl benzyl phthalate	330	SEE BELOW	SEE BELOW	SEE BELOW	SEE BELOW++
3,3'-dichlorobenzidine	660	"	"	"	"
benzo(a)anthracene	330	"	"	"	"
chrysene	330	"	"	"	"
bis(2-ethylhexyl)phthalate	330	"	"	"	"
di-n-octyl phthalate	330	"	"	"	"
benzo(b)fluoranthene	330	"	"	"	"
benzo(k)fluoranthene	330	"	"	"	"
benzo(a)pyrene	330	"	"	"	"
indeno(1,2,3-c,d)pyrene	330	"	"	"	"
dibenzo(a,h)anthracene	330	"	"	"	"
benzo(g,h,i)perylene	330	"	"	"	"

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

* U.S.EPA Contract Laboratory Program Statement of Work For Organics Analysis Multi-media Multi-concentration. 10/86. Revised: 1/87, 2/87, 7/87, 2/88. IFB W81213SD1, W802036D1, IFB W802036 D1.

**Medium Soil/Sediment Contract required Quantitation Limits (CRQL) for Semi-volatile Compounds are 60 times the individual Low Soil/Sediment CRQL.

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.

++Refer to Table B6 for U.S. EPA method numbers.

AUDIT	FREQUENCY	CONTROL LIMITS
Surrogate Spike	All samples and blank (including MS/MSD).	Recovery limits within those of Table 4.2, Exhibit E
MS/MSD	1 per case or 1 in 20 of similar concentration/matrix.	Recovery limits within those of Table 5.2, Exhibit E
Calibration Continuing	Each 12 hours	Minimum RF 0.05; must be less than 25% difference for any check compound. Table 2.3, also #-32 to E-35, Sections 2.6 - 2.7
Method Blank	1 per extraction group	Less than 5 times CRQL of the phthalate esters. Less than CRQL for all other TCL compounds.
MS Tuning	Each 12 hours.	DFTPP key ions & abundance criteria must be met for all 13 ions Table 1.2, Exhibit E.
Calibration Verification	Once	Five concentrations - linear range 20 - 160 ng. Four concentrations - nine compounds (See Section 2.1.1.) 50 - 160 ng/L. See Part 2, E-30 to E-32, Sections 2 - 2.5.

TABLE B-6 Continued

ANALYTICAL METHODS AND DATA QUALITY REQUIREMENTS
CLP METALS - MATRIX: AQUEOUS

CHEMICAL COMPOUND*	QUANTITATION LIMIT +	AUDIT	FREQUENCY	CONTROL LIMITS	METHOD
	µg/L				
aluminum	200	SEE BELOW	SEE BELOW	SEE BELOW	SEE BELOW++
antimony	60	"	"	"	"
arsenic	10	"	"	"	"
barium	200	"	"	"	"
beryllium	5	"	"	"	"
cadmium	5	"	"	"	"
calcium	5000	"	"	"	"
chromium	10	"	"	"	"
cobalt	50	"	"	"	"
copper	25	"	"	"	"
iron	100	"	"	"	"
lead	3	"	"	"	"
magnesium	5000	"	"	"	"
manganese	15	"	"	"	"
mercury	0.2	"	"	"	"
nickel	40	"	"	"	"
potassium	5000	"	"	"	"
selenium	5	"	"	"	"
silver	10	"	"	"	"
sodium	5000	"	"	"	"
thallium	10	"	"	"	"
vanadium	50	"	"	"	"
zinc	20	"	"	"	"
cyanide	10	"	"	"	"
					"

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* U.S.EPA Contract Laboratory Program Statement of Work For Inorganics Analysis Multi-media Multi-concentration. SOW NO. 788. DP00205R1, D900206R1, D900207R1.

+ Subject to the Restrictions specified in the first page of Part G, Section IV of Exhibit D (Alternate Methods - Catastrophic Failure) any analytical method specified in SOW Exhibit D may be utilized as long as the documented instrument or method detection limits meet the Contract Required Detection Limit (CRDL) requirements. Higher detection limits may only be used in the following circumstances:

If the sample concentration exceeds 5 times the detection 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 Detection Limit. This is illustrated in the example below:

For lead:
Method in use = ICP
Instrument Detection Limit (IDL) = 40
Sample concentration = 220
Contract Required Detection Limit (CRDL) = 5

The value of 220 may be reported even though instrument detection limit is greater than CRDL. The instrument or method detection limit must be documented as described in Exhibit E.

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

++Refer to Table B6 for U.S. EPA method numbers.

TABLE B-6 Continued

ANALYTICAL METHODS AND DATA QUALITY REQUIREMENTS
CLP METALS - MATRIX: AQUEOUS

AUDIT	FREQUENCY	CONTROL LIMITS
Calibration Verification	Calibrated daily and each time instrument is set up; verify at at a frequency of 10% or every 2 hr, whichever is greater.	Within ±10% of true value for all except tin and mercury (±20% of true value).
Calibration Blank	During calibration at a frequency of 10% during run and at end of run.	No more than CRDL.
Preparation Blank	1 per batch of samples digested or 1 in 20 whichever is greater	No more than CRDL.
Spiked Sample Analysis	1 per group of similar concentration and matrix, 1 per case of samples, or 1 in 20, whichever is greater.	Within ±25% recovery unless SSR exceeds SR by a factor of 4 or more
Duplicate Sample Analysis	Same as spiked sample analysis.	±20% RPD for values 5X CRDL or more ±CRDL for samples less than 5X CRDL
Lab Control Sample (aqueous)	1 for each procedure for each case of samples received; 1 in 20 or 1 per batch digested, whichever is greater.	Within 80-120% recovery

Dissolved Metals: Those constituents (metals) which will pass through a 0.45µ membrane filter.

Field Filtration Protocol:
An aliquot of sample will be passed through a 0.45µ membrane filter by one of the following methods:
1) Plastic syringe equipped with a filter holder (Swinnex Filter Holder).
2) Hand vacuum pump and a 500 ml side arm, glass filtration flask.
3) Bench top (electric) filtration system.

•Standards and samples will be matrix-matched to the concentration of the mineral acid.

•Calibration curves, continuing calibration and corrective measures records will be documented.

•One medium range internal synthetic standard will be analyzed to verify calibration and will be within ±10% of true value

•Furnace work will require duplicate analysis of each sample to verify recovery of spiked material. If recoveries are within ±10%, methods of addition will not be required. If outside this criterion, methods of standard addition will be required.

•For chromium analysis, a nitrous oxide flame will be used.

TABLE B-6 Continued

ANALYTICAL METHODS AND DATA QUALITY REQUIREMENTS
CLP METALS - MATRIX: SOLIDS

CHEMICAL COMPOUND*	QUANTITATION LIMIT +	AUDIT	FREQUENCY	CONTROL LIMITS	METHOD
	mg/kg				
aluminum	40.	SEE BELOW	SEE BELOW	SEE BELOW	SEE BELOW++
antimony	12.	"	"	"	"
arsenic	2.	"	"	"	"
barium	40.	"	"	"	"
beryllium	1.0	"	"	"	"
cadmium	1.	"	"	"	"
calcium	1000.	"	"	"	"
chromium	2.	"	"	"	"
cobalt	10.	"	"	"	"
copper	5.	"	"	"	"
iron	20.	"	"	"	"
lead	0.6	"	"	"	"
magnesium	1000.	"	"	"	"
manganese	3.	"	"	"	"
mercury	0.1	"	"	"	"
nickel	8.	"	"	"	"
potassium	1000.	"	"	"	"
selenium	1.	"	"	"	"
silver	2.	"	"	"	"
sodium	1000.	"	"	"	"
thallium	2.	"	"	"	"
vanadium	10.	"	"	"	"
zinc	4.	"	"	"	"
cyanide	1.	"	"	"	"

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* U.S.EPA Contract Laboratory Program Statement of Work For Inorganics Analysis Multi-media Multi-concentration. SOW NO. 788. D900205R1, D900206R1, D900207R2.

**Subject to the Restrictions specified in the first page of Part G, Section IV of Exhibit D (Alternate Methods - Catastrophic Failure) any analytical method specified in SOW Exhibit D may be utilized as long as the documented instrument or method detection limits meet the Contract Required Detection Limit (CRDL) requirements. Higher detection limits may only be used in the following circumstances:

If the sample concentration exceeds 5 times the detection 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 Detection Limit. This is illustrated in the example below:

For lead:
Method in use = ICP
Instrument Detection Limit (IDL) = 40
Sample concentration = 220
Contract Required Detection Limit (CRDL) = 5

The value of 220 may be reported even though instrument detection limit is greater than CRDL. The instrument or method detection limit must be documented as described in Exhibit E.

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

++Refer to Table B6 for U.S. EPA method numbers.

TABLE B-6 Continued

ANALYTICAL METHODS AND DATA QUALITY REQUIREMENTS
CLP METALS - MATRIX: SOLIDS

AUDIT	FREQUENCY	CONTROL LIMITS
Calibration Verification	Calibrated daily and each time instrument is set up; verify at at a frequency of 10% or every 2 hr, whichever is greater.	Within ±10% of true value for all except tin and mercury (±20% of true value).
Calibration Blank	During calibration at a frequency of 10% during run and at end of run.	No more than CRDL.
Preparation Blank	1 per batch of samples digested or 1 in 20 whichever is greater	No more than CRDL.
Spiked Sample Analysis	1 per group of similar concentration and matrix, 1 per case of samples, or 1 in 20, whichever is greater.	Within ±25% recovery unless SSR exceeds SR by a factor of 4 or more
Duplicate Sample Analysis	Same as spiked sample analysis.	±20% RPD for values 5X CRDL or more ±CRDL for samples less than 5X CRDL
Lab Control Sample (soils)	Once a month for each of the procedures (applied) to solid sample analysis.	Within recovery of ±35% or within established control limits

- Standards and samples will be matrix-matched to the concentration of the mineral acid.

- Calibration curves, continuing calibration and corrective measures records will be documented.

- One medium range internal synthetic standard will be analyzed to verify calibration and will be within ±10% of true value

- Furnace work will require duplicate analysis of each sample to verify recovery of spiked material. If recoveries are within ±10%, methods of addition will not be required. If outside this criterion, methods of standard addition will be required.

TABLE B-6 Continued

ANALYTICAL METHODS AND DATA QUALITY REQUIREMENTS
CLP TCL PCBs - MATRIX: AQUEOUS

CHEMICAL COMPOUND	METHOD	QUANTITATION LIMIT	AUDIT	FREQUENCY	CONTROL LIMITS	
	(CLP)	ppb+	SEE BELOW	SEE BELOW	SEE BELOW	SEE BELOW++
Aroclor 1016	WA 87-K*	0.5	"	"	"	"
Aroclor 1221	WA 87-K*	0.5	"	"	"	"
Aroclor 1232	WA 87-K*	0.5	"	"	"	"
Aroclor 1242	WA 87-K*	0.5	"	"	"	"
Aroclor 1248	WA 87-K*	0.5	"	"	"	"
Aroclor 1254	WA 87-K*	1.0	"	"	"	"
Aroclor 1260	WA 87-K*	1.0	"	"	"	"

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

* U.S.EPA Contract Laboratory Program Statement of Work For Organics Analysis Multi-media Multi-concentration. 10/86. Revised: 1/87, 2/87, 7/87. IFB-WA-87K236, IFB WA-87K237, IFB WA-87K238.

++Refer to Table B6 for U.S. EPA method number.

AUDIT	FREQUENCY	CONTROL LIMITS
Retention Time Windows	Once per 24 hours	4,4'-DDT must have retention time greater than or equal to 12 minutes on packed column, less than 2% shift on packed and .3% for capillary column.
Evaluation Mixtures A,B, & C	Once per 72 hours.	% RSD for aldrin, endrin, and heptachlor epoxide must be less than or equal to 10%.
Column Breakthrough	Once per 72 hours.	Must not exceed 20% - if greater remedial action is required.
Standard Mix	Once per 72 hours then intermittently throughout analysis	Calculated factors must not exceed 15% difference for the quantitation run nor 20% difference for confirmation run during 12-hr period. Deviation greater than or equal to 15% requires reanalysis.
Confirmation Analysis	Once per 72 hours.	Separation should be greater than or equal to 25% resolution between peaks.
Reagent Blank	1 per case or 5% of sample shipment.	Less than 5x CRDL for solvents, less than CRDL for all others.
Surrogate Spike	All samples and blank (including MS/MSD).	Recovery limits within those of Table 4.2, Exhibit E WA 87-J001 (10/86).
MS/MSD	1 per case or 1 in 20 of similar concentration/matrix.	Must fall within limits of Table 5.2, Exhibit E WA 87-J001 (10/86).

TABLE B-6 Continued

ANALYTICAL METHODS AND DATA QUALITY REQUIREMENTS
CLP TCL PCBs+ - MATRIX: SOLIDS

CHEMICAL COMPOUND	METHOD	QUANTITATION LIMIT	AUDIT	FREQUENCY	CONTROL LIMITS	
	(CLP)	ppb**	SEE BELOW	SEE BELOW	SEE BELOW	SEE BELOW++
Aroclor 1016	WA 87-K*	80.0	"	"	"	"
Aroclor 1221	WA 87-K*	80.0	"	"	"	"
Aroclor 1232	WA 87-K*	80.0	"	"	"	"
Aroclor 1242	WA 87-K*	80.0	"	"	"	"
Aroclor 1248	WA 87-K*	80.0	"	"	"	"
Aroclor 1254	WA 87-K*	160.0	"	"	"	"
Aroclor 1260	WA 87-K*	160.0	"	"	"	"

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

++See next page.

* U.S.EPA Contract Laboratory Program Statement of Work For Organics Analysis Multi-media Multi-concentration. 10/86. Revised: 1/87, 2/87, 7/87. IFB-WA-87K236, IFB WA-87K237, IFB WA-87K238.

**Medium Soil/Sediment Contract Required Quantitation Limits (CRQL) for Pesticide/PCB TCL compounds are 15 times the individual Low Soil/Sediment CRQL. 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.

++Refer to Table B6 for U.S. EPA method number.

AUDIT	FREQUENCY	CONTROL LIMITS
Retention Time Windows	Once per 24 hours	4,4'-DDT must have retention time greater than or equal to 12 minutes on packed column, less than 2% shift on packed and .3% for capillary column.
Evaluation Mixtures A,B, & C	Once per 72 hours.	% RSD for aldrin, endrin, and heptachlor epoxide must be less than or equal to 10%.
Column Breakdown	Initially after approx. 18 hr and every 10 samples thereafter	Must not exceed 20% - if greater remedial action is required.
Standard Mix	Initially, then alternate standard mixes A and B every 10 samples.	Calculated factors must not exceed 15% difference for the quantitation run nor 20% difference for confirmation run during 12-hr period. Deviation greater than or equal to 15% requires reanalysis.
Confirmation Analysis	After every positive result on initial column	Separation should be greater than or equal to 25% resolution between peaks.
Reagent Blank	1 per case or 5% of sample shipment.	Less than 5x CRDL for solvents, less than CRDL for all others.
Surrogate Spike	All samples and blank (including MS/MSD).	Recovery limits within those of Table 4.2, Exhibit E WA 87-J001 (10/86).
MS/MSD	1 per case or 1 in 20 of similar concentration/matrix.	Must fall within limits of Table 5.2, Exhibit E WA 87-J001 (10/86).

TABLE B-6 Continued
Control Limits
Cyanide: Water Matrix
U.S. EPA Methods 335.2

AUDIT	FREQUENCY	CONTROL LIMIT
Calibration	Five point curve analyzed monthly, continuing calibration analyzed every tenth sample.	Continuing calibration within 15% of curve.
Reagent Blank	1 in 10 or with every batch	Less than the detection limit.
Matrix Spike Analysis	1 in 20 samples	Recovery limits 74% - 119%
Duplicate Sample Analysis	1 in 10 samples	RPD limits +/-20%
Reference Sample	1 in 10 samples	Recovery limits 78% - 117%
Detection Limit	On-going	.01 ppm

TABLE B-6 Continued

Control Limits
Chloride: Water Matrix
U.S. EPA Methods 325.2

AUDIT	FREQUENCY	CONTROL LIMIT
Calibration	Five point curve analyzed monthly, continuing calibration analyzed every tenth sample.	Continuing calibration within 15% of curve.
Reagent Blank	1 in 10 or with every batch	Less than the detection limit.
Matrix Spike Analysis	1 in 20 samples	Recovery limits 85% - 122%
Duplicate Sample Analysis	1 in 10 samples	RPD limits +/- 20%
Reference Sample	1 in 10 samples	Recovery limits 74% - 109%
Detection Limit	On-going	1 ppm

TABLE B-6 Continued

Control Limits
Sulfate: Water Matrix
U.S. EPA Methods 375.3

AUDIT	FREQUENCY	CONTROL LIMIT
Calibration	Five point curve analyzed monthly, continuing calibration analyzed every tenth sample.	Continuing calibration within 15% of curve.
Reagent Blank	1 in 10 or with every batch	Less than the detection limit.
Matrix Spike Analysis	1 in 20 samples	Recovery limits 27% - 162%
Duplicate Sample Analysis	1 in 10 samples	RPD limits +/- 20%
Reference Sample	1 in 10 samples	Recovery limits 84% - 116%
Detection Limit	On-going	2 ppm

TABLE 8-6 Continued
Control Limits
Flouride: Water Matrix
U.S. EPA Methods 340.2

AUDIT	FREQUENCY	CONTROL LIMIT
Calibration	Five point curve analyzed monthly, continuing calibration analyzed every tenth sample.	Continuing calibration within 15% of curve.
Reagent Blank	1 in 10 or with every batch	Less than the detection limit.
Matrix Spike Analysis	1 in 20 samples	Recovery limits 80% - 127%
Duplicate Sample Analysis	1 in 10 samples	RPD limits +/-20%
Reference Sample	1 in 10 samples	Recovery limits 85% - 121%
Detection Limit	On-going	1 ppm

TABLE B-6 Continued

Control Limits
Nitrate: Water Matrix
U.S. EPA Methods 352.1

AUDIT	FREQUENCY	CONTROL LIMIT
Calibration	Five point curve analyzed monthly, continuing calibration analyzed every tenth sample.	Continuing calibration within 15% of curve.
Recent Blank	1 in 10 or with every batch	Less than the detection limit.
Matrix Spike Analysis	1 in 20 samples	Recovery limits 60% - 137%
Duplicate Sample Analysis	1 in 10 samples	RPD limits -11% - 21%
Reference Sample	1 in 10 samples	Recovery limits 76% - 123%
Detection Limit	On-going	0.01 ppm

TABLE B-7
NON-CLP ANALYTICAL METHODOLOGIES
ALCAN ALUMINUM SITE # 828005, SOIL AND GROUND WATER SAMPLES

Parameter	Matrix	Method
Cr+6	Soil/Water	(A) 7196
Boron	Soil/Water[1]	(B) 212.3
Phenol	Soil/Water	(A) 9065
Fluoride	Soil/Water	(B) 340.2
Sulfates	Soil/Water	(B) 375.3
Chlorides	Soil/Water	(B) 325.2
Cyanide	Soil/Water	(B) 335.1
EPTox Metals	Water	(A) 1310

1. The Contract Laboratory must document the modification of EPA test methods for soil analysis.

A - Test Methods for Evaluating Solid Waste (SW-846), Third Edition, 1986.

B - Methods for Chemical Analyses of Water and Wastes, EPA 600/4-79-020, March, 1983.

TABLE B - 8
FREQUENCY OF QUALITY CONTROL SAMPLES

Matrix	*Estimated No. Samples	Sample Fraction/Applicable Reference No.	Travel Blanks	Rinsate Blanks	Duplicates	Matrix Spike	Matrix Spike Duplicate
Surface Impd. Wastes	16	TCL-CLP Metals, Cr+6, Boron, Phenol, Sulfate, Chloride, Cyanide, Fluoride.	-	2	2	2	2
Surface Impd. Wastes	16	TCL-CLP volatiles	2	-	2	2	2
Surface Impd. Wastes	16	TCLP Cr+6, Hg, Pb	-	-	2	2	2
Soil	10	TCL-Metals Cr+6, Boron, Phenol Sulfate, Chloride, Cyanide, Fluoride.	-	1	1	1	1
Soil	10	TCL-CLP Volatile Orgaincs	1	-	1	1	1
Ground Water	26**	TCL-CLP Metals, Cr+6	-	3	3	3	3
Ground Water	13	TCL-CLP Volatile Organics	2	-	2	2	2
Ground Water	13	Boron, Phenol, Sulfate, Chloride, Nitrates, Cyanide, Fluoride. Sulfates-EPA 375.3, Chlorides-325.2	-	2	2	2	2
Air	7	TCL Metals-7300 (NIOSH)	1	-	1	-	-
Air	7	Organics-1003,1051 (NIOSH)	1	-	1	-	-
Surface Impnd. Wastes	1 comp.	TCL-CLP Metals	-	1	1	1	1
Surface Impnd. Wastes	1	TCL-CLP Volatile Organics	1	-	1	1	1
Surface Impnd. Wastes	1 comp.	TCL-CLP SemiVolatiles/PCBs	-	1	1	1	1

* The specific location of each sample is to be determined at the time of sampling in a location agreed upon by the NYSDEC and the Project Manager.

** Includes 13 filtered and 13 unfiltered samples.

Two sample rounds are anticipated. The analytes for the second round may vary depending on the first round sample results.

TABLE B - 9
O'BRIEN & GERE'S SYSTEM AUDIT CHECKLIST
For OBG LABORATORIES

1. Chain-of-Custody
   - Log-In Procedures Evaluated
   - Sample Custodian is Assigned and Oversee Sample Transfer
   - Sample Routing and Pickup is Documented and Accounted for
   - Separate Area for Sample Storage and Maintained in Locked Storage

II. Sample Preparation
   - Correct Sample Preparation Procedures are Followed
   - Areas Designed for Sample Preparation (Organic and Inorganic)
   - Holding Times Maintained

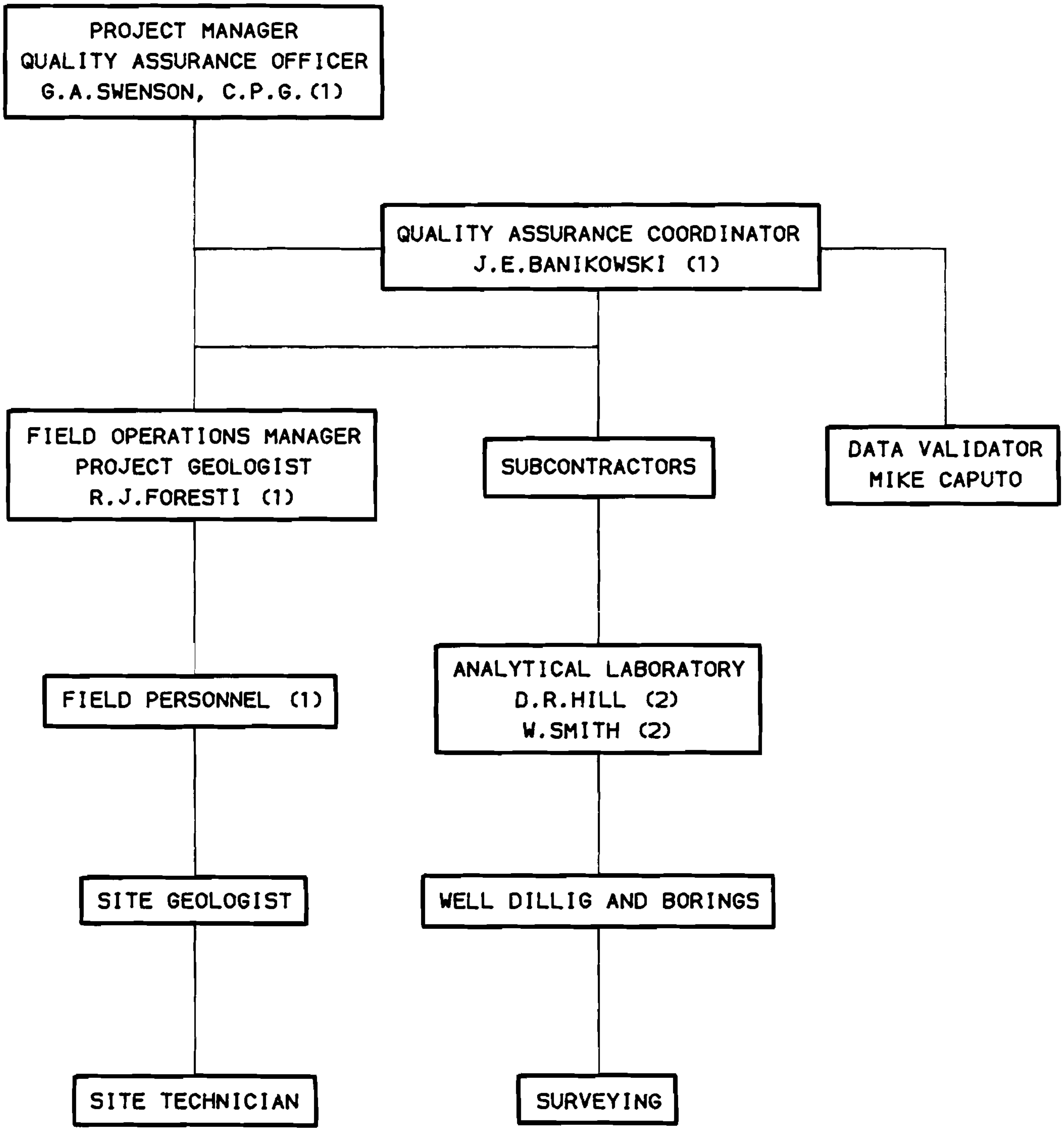
III. QA/QC Procedures
   - Procedures are Being Followed According to Methods Specified
   - Data Validation and Reduction Processes Reviewed by Group Leaders
   - Proper Documentation of QA Procedures
   - Internal QC Maintained
   - Data Transfers and Reporting Checked by Group Leaders
   - Awareness of Personnel of QA Requirements

IV. Equipment Maintenance
   - Maintenance Logs are Up-to-Date
   - Instrumentation is in Repair
   - Reasonable Spare Parts are on Hand

V. Miscellaneous
   - Overall Housekeeping in Order
   - Certification Up-to-Date

FIGURE 1

PROJECT ORGANIZATION CHART



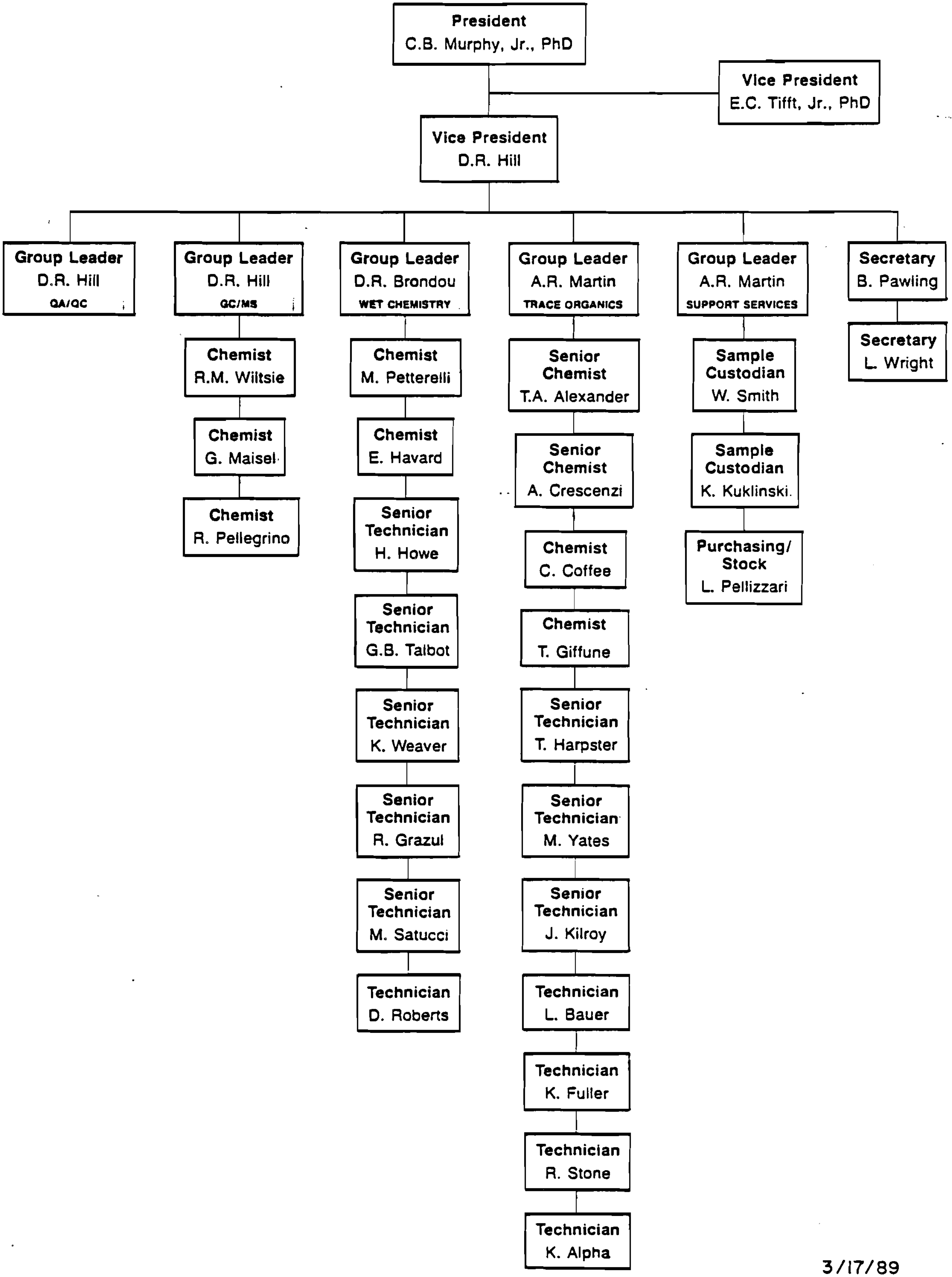
(1) O'BRIEN AND GERE ENGINEERS, INC.
(2) OBG LABORATORIES, INC.

ALCANALUM1 3057.032.130 7/18/90

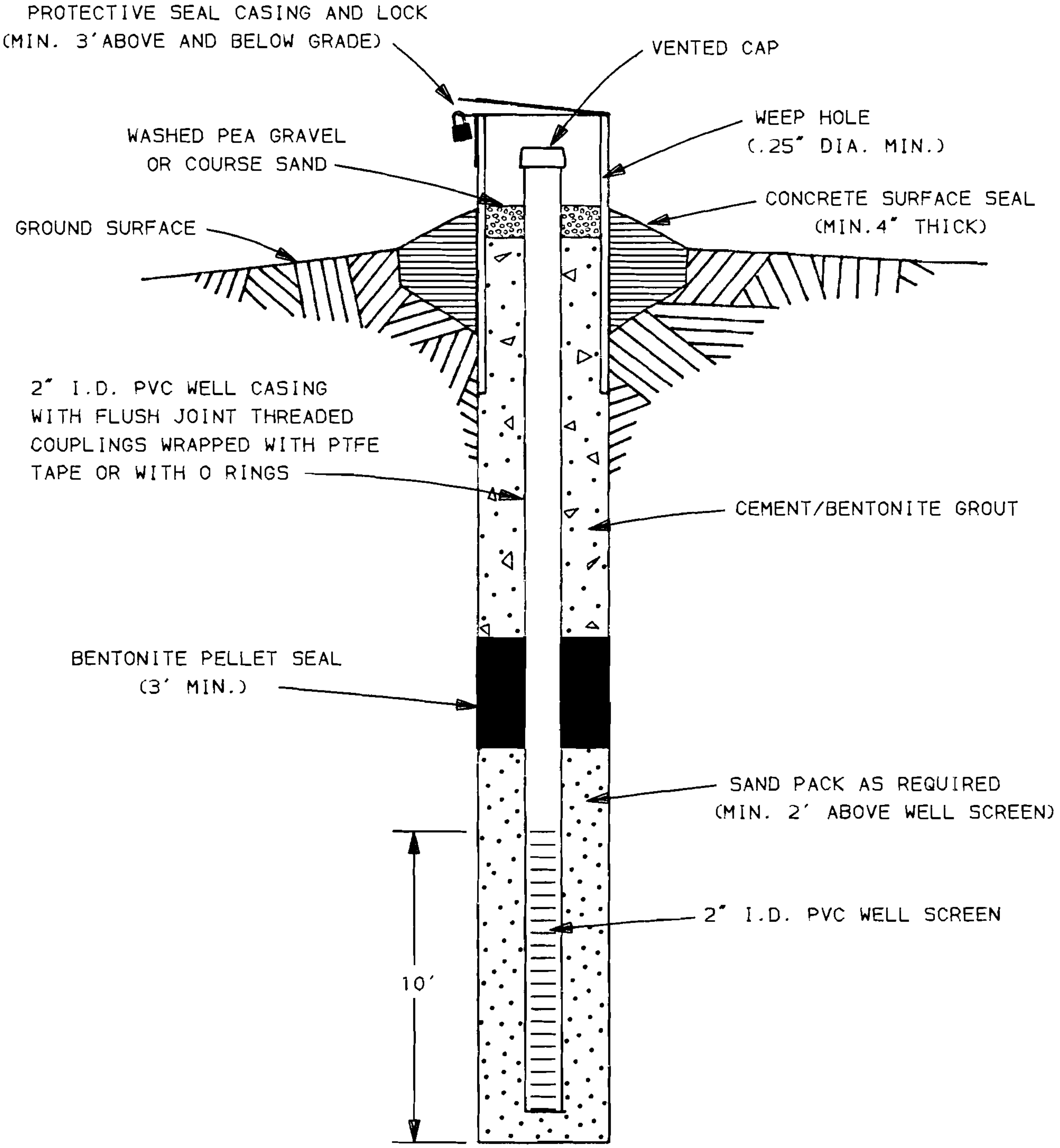
O'BRIEN & GERE

LABORATORY ORGANIZATION CHART

FIGURE B-2



3/17/89



TYPICAL OVERBURDEN MONITORING WELL

NOT TO SCALE

WELL-4/18/90 3057.032.130 7/18/90

FIGURE B-4

OBG
LABORATORIES, INC.

CHAIN OF CUSTODY RECORD

SURVEY	SAMPLERS: (Signature)

STATION NUMBER	STATION LOCATION	DATE	TIME	SAMPLE TYPE			SEQ. NO.	NO. OF CONTAINERS	ANALYSIS REQUIRED
				Water		Air			
				Comp.	Grab.				

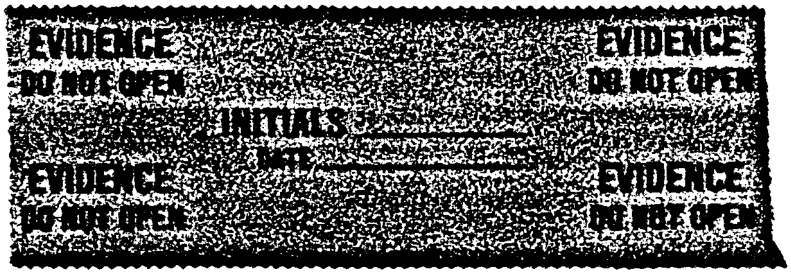
Relinquished by: (Signature)		Received by: (Signature)	Date/Time
Relinquished by: (Signature)		Received by: (Signature)	Date/Time
Relinquished by: (Signature)		Received by: (Signature)	Date/Time
Relinquished by: (Signature)		Received by Mobile Laboratory for field analysis: (Signature)	Date/Time
Dispatched by: (Signature)	Date/Time	Received for Laboratory by:	Date/Time
Method of Shipment:			

OBG Laboratories, Inc.
Box 4942 / 1304 Buckley Road / Syracuse, New York 13221 / (315) 457-1494

FIGURE B-5

CHAIN-OF-CUSTODY

EVIDENCE TAPE



ATTACHMENT 1

ANALYTICAL SERVICES QA/QC DESCRIPTION OF POLICY AND PROGRAM

Analytical Services

Quality Assurance/
Quality Control

Description of Policy and Programs

OBG
LABORATORIES, INC.

TABLE OF CONTENTS

I. O'BRIEN AND CERE LABORATORY

Introduction

For several years the O'Brien and Cere laboratory has been involved in the physico-chemical and microbiological analyses of environmental contaminants for federal, state, municipal and industrial clients. The laboratory has analyzed over 10,000 samples for over 100,000 parameters on an annual basis. The organic and inorganic pollutants occur in several matrices, i.e., potable water, industrial and domestic wastewater, hazardous waste, sludges, sediment, biological tissue, solid, air, etc. The ability to accurately characterize the chemical pollutants in these matrices is paramount.

In this document concepts are presented to outline the laboratory program purpose, policies, organization and operations established to support physico-chemical analyses conducted under USEPA compliance. Implementation of this program will better insure the validity of the data acquisition, and, therefore, will provide a more reliable foundation on which to base decisions. The principles and procedures used are the result of considerations of the general operations and trends in the field of analytical chemistry, analytical instrumentation, statistical quality control techniques, and previous experiences in the laboratory programs conducted under USEPA, local and state government compliance.

Laboratory Policy

The management of O'Brien & Gere's Laboratory is firmly committed to the Quality Assurance/Quality Control (QA/QC) program depicted in this manual. The program has been implemented and is maintained to assure any data reported by the laboratory are of known and documented quality commensurate with their intended use. The technical personnel who contribute to all or any portion of the laboratory analyses follow the procedures delineated in this manual.

The QA/QC manual is an integral part of a generalized representation of our Good Laboratory Practice program. It is primarily intended to set control guidelines and direction for all the physico-chemical and microbiological measurements performed by the laboratory. The contents of this manual will be re-evaluated yearly by the QA/QC group leader, and if necessary, revisions will be made, and/or the QA/QC program expanded.

A supplementary laboratory manual dealing with specific technical areas has been written and is available to all laboratory personnel. The laboratory manual is reviewed and approved by the QA/QC, Trace Organics and Wet Chemistry group leaders and management prior to distribution to the laboratory staff.

Quality Control Program Objectives

The primary objective of the O'Brien & Gere Laboratory QA/QC program is to assure the precision and accuracy of all data generated by the laboratory personnel. That is, the data is of known and documented quality.

The QA/QC guidelines are implemented in support of the laboratory surveillance programs and analyses efforts. They reflect the best cost effective effort, and are used to assess, ensure and document that all data collected, stored, reported or used by the laboratory are scientifically valid, defensible and of known precision and accuracy.

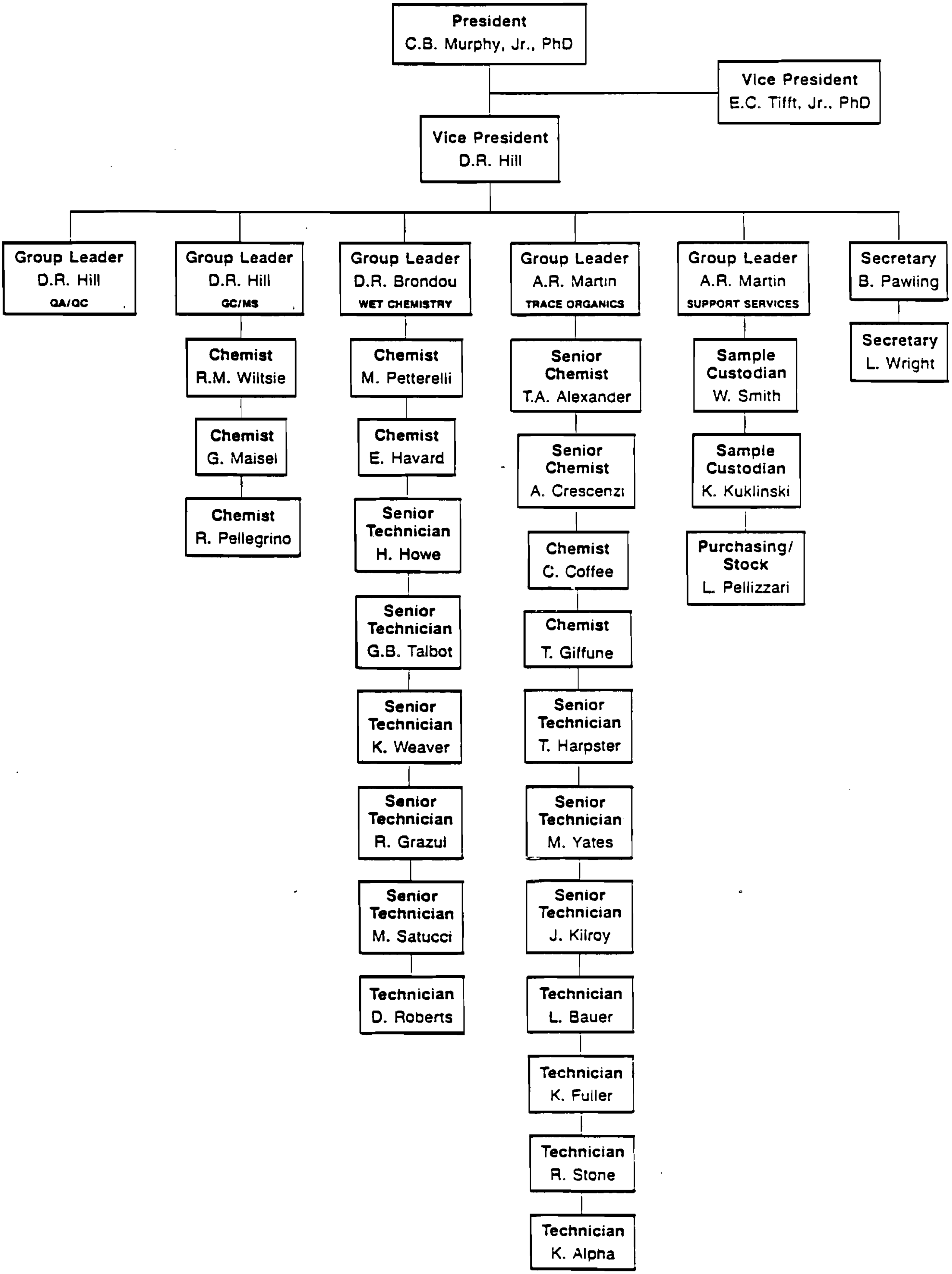
The major effort of the QA/QC program will be to develop a workable day-to-day "QA/QC model", and thus provide the detailed control charts and control limits to measure the laboratory daily performance. The QA/QC activities shall be carried out in accordance with EPA, state and local government mandates. The implementation, coordination and supervision of these procedures will provide the customer with the quality assurance (QA) activities associated with good laboratory practices.

Personnel and Organization

Any organization consists of a number of people whose skills and delegated responsibilities assure the quality of the ultimate product, i.e. analytical services. QA/QC procedures commence when the sample is first collected, and continues until the final product is in the client's hand. An organizational chart of the laboratory technical staff is included in Figure 1 to serve as a frame of reference for all QA/QC procedures.

The Laboratory Manager is responsible for he overall administration of the analytical operations at O'Brien & Gere. The section group leaders handle the day to day scheduling and operation, and report to the manager. Together with the group leaders they review

LABORATORY ORGANIZATION CHART



and approve all policies concerning their specific areas of responsibility.

The QA/QC group leader is responsible for the implementation, monitoring and supervision of the QA/QC program. He assures that the program is conducted in strict adherence to procedures and requirements outlined in this manual. He reports to the Laboratory Manager, and interacts daily with other group leaders and laboratory staff. His duties include:

1. Develops and implements new QA/QC programs, including statistical techniques and procedures.
2. Conducts regular inspections and audits of analytical procedures.
3. Daily monitors accuracy and precision and implements correction measures if "out of control".
4. Maintains copies of all procedures routinely used in the laboratory measurements.
5. Informs management of the status of the QA/QC program by annual status reports.
6. Coordinates and conducts investigations of any customer complaints regarding quality.
7. Reschedule any analysis based on poor accuracy or precision data.

The section group leaders are responsible for the day to day operation and technical questions concerning analytical protocol and together with the QA/QC group leader:

1. Maintain and increase the technical skills of the laboratory technical personnel to achieve optimum quality results.

2. Approve analytical methods, sampling procedures, special QA/QC procedures, and any subsequent revisions in analytical procedures used in their respective areas.
3. Approve completed work.

Technical Training

All personnel involved in any function affecting data quality (sample collection, analysis, data reduction, and quality assurance) have sufficient technical training (in their appointed positions) to contribute to the reporting of complete and high quality data. The training is achieved through: a) On-the-job training, b) Short-term courses (one week or less), and c) Long-term courses (one semester or longer).

Short and long term courses are available through universities, colleges, and technical schools in statistics, analytical chemistry, and other disciplines. In addition, short-term courses are provided by commercial training organizations, manufacturers of equipment and others.

The trainee and/or analyst performance is evaluated by providing unknown samples for analysis. An unknown, as defined here, is a sample whose concentration is known to the QA/QC group leader or other group leaders but is unknown to the trainee or analyst. Proficiency is judged in terms of accuracy.

II. GENERAL FACILITIES AND EQUIPMENT

The laboratory is located in the corporate headquarters of O'Brien & Gere in Syracuse, The laboratory maintains a staff of sixteen chemists, biologists and technicians. As many as ten temporary and part-time personnel have been used to meet peak demands. The staff maintains a constant awareness of state-of-the art techniques in environmental analysis through its review of literature. The laboratory has 3700 square feet to utilize for the preparation and analysis of samples and 1200 square feet for receiving and storage of reagents.

The laboratory's involvement in a variety of programs has provided the necessary experience in microbiological, inorganic contaminants and trace organic identification and quantification. Particular expertise has been developed in the area of hazardous waste identification and trace organics analysis including priority pollutants and PCB's. A brief description of available instrumentation, computer services, sample storage and receiving follows.

Laboratory Instrumentation

The following analytical instrumentation is located in the Syracuse office and has been used on a number of major analytical programs:

(a) Hewlett Packard 5993B Gas Chromatograph/Mass Spectrometer Data System - for the low level identification of organic priority pollutants and other compounds. The unit _ equipped with a dual disc, 32K computer and 9-track magnetic tape.

(b) Hewlett Packard 5880A - Gas Chromatograph equipped with dual electron capture detectors. The fully automated system has capabilities for both packed and capillary column work. The system can operate unattended around the clock to provide rapid turnaround of results.

(c) Tracor Model MT220 gas chromatograph equipped with electron capture and dual flame ionization. The unit is interfaced to a Hewlett Packard Model 3380 S integrator.

(d) Two Tracor Model 550 gas chromatographs, both equipped with Hall electrolytic conductivity detectors, linearized electron capture detectors, and photoionization detectors interfaced to Hewlett Packard Model 3390 integrators.

(e) Due to the highly specialized procedures for cleaning glassware used in the low level analysis of halogenated organics and other substances, a sonic cleaner is utilized. Additionally, a complete glassware supply including Soxhlet extractors, separatory funnels, flasks and chromatographic columns is maintained.

(f) Two Technicon AutoAnalyzers, single and dual channel, for the automated determination of nutrients and other inorganic parameters.

(g) Perkin-Elmer Model 290B Atomic Absorption Spectrophotometer for the determination of metals by flame techniques.

(h) Varian Model 575 Atomic Absorption Spectrophotometer for the low-level detection of metals by conventional flame and graphite furnace (flameless) techniques.

(i) Beckman Model 915 Total Organic Carbon Analyzer, for the determination of organic, inorganic or total carbon.

(j) Dohrman Model DX-20 Total Organic Halide Analyzer, and Model MCTS 20/30 Elemental Analyzer for the determination of chlorine and sulfur in environmental samples.

(k) Bausch & Lomb Model 340 colorimeter, used for those colorimetric procedures not performed on the AutoAnalyzers.

(l) DuPont Model 760 Luminescence Biometer for the determination of adenosine triphosphate (ATP).

(m) Orion Model 4 Specific Ion Meter.

(n) Mettler Model HE10 Electronic Semi-Micro Balance.

(o) Hiack Particle Counter for the determination of particle sizes in water ranging from 0.5m to 300m.

(p) A walk-in refrigerator for storage of samples prior to analysis.

The laboratory also maintains a wide range of the usual supporting equipment such as pH meters, analytical balances, ovens and incubators, refrigerators and hood space.

Computer Services

The hardware which serves as the foundation of the firm's computer facilities has been responsible for the ability of the O'Brien & Gere laboratory to store and retrieve all data for individual clients.

The quantity of data has led to the development and utilization of a computer-based data management system. Samples are logged in, analyses are scheduled and output is received, all via time-shared or batch computer programs. One of the benefits of this system is that turnaround time has been reduced to a practical minimum. Data can be reported in a variety of formats. The standard computer output includes sample identification and various test results. A variety of statistical and modeling programs are available for the evaluation and interpretation of data.

III. GENERAL CONSIDERATIONS

Maintenance

A preventative maintenance schedule on all instruments, balances, and equipment requiring maintenance is followed. All maintenance, whether performed by the laboratory or other professional sources, is documented in appropriate log books. Entries are made each time maintenance is performed and include the reason for maintenance, what was performed, by whom, and the dates and initials of the analyst in charge during the maintenance.

Calibration

Thermometers needed for critical temperature determination and control are calibrated against an NBS thermometer on site once a year. Analytical balances are professionally calibrated and cleaned once a year and checked with Class S weights daily by analysts who routinely use the balances. Calibration data are entered into a specific calibration notebook, which is kept with the equipment being calibrated. When the balances are professionally calibrated, a document stating the specific balance (model and serial number), its location, and the data calibrated is provided by the company or individual providing such service.

Reagent Quality

The quality of reagents and instrument readings are maintained by the following procedures:

(a) Reagents for quantitative purposes are ACS analytical quality grade or better.

(b) Each sample is collected in a new container to minimize contamination. This rule does not apply to bacteriological samples for which sterilized glass bottles are used, or trace organic samples for which solvent rinsed glass bottles are used.

(c) Distilled deionized water with a conductivity not more than 1.5 micromho/cm is used in the preparation of all reagents and for final rinses. The conductivity is measured daily and recorded in the quality control log. The pH is also checked daily and the values recorded.

(d) All volumetric glassware is National Bureau of Standards Class A grade or better.

(e) All glassware is cleaned and rinsed with distilled water and visually inspected before use. Any volumetric glassware found to be etched or cracked is discarded.

(f) The operating temperatures of all ovens, incubators, water baths and refrigerators are recorded daily in the quality control log.

(g) All reagents are discarded after a set interval which has been established and recorded in the Laboratory Handbook.

(h) The date a prepared reagent is made is entered into the Reagent Log and initialed by the preparer. Therefore, the results which have been affected by a contaminated or otherwise improper reagent can be easily determined. These results are either recalculated or discarded and the analysis may be repeated if possible. Reagent containers are also dated when new solutions are prepared and are initialed. These procedures are followed for all (even daily) preparations.

(i) The pH meter is checked with three buffers (4.0, 7.0 and 10.0) and the results are recorded in the quality control log.

Safety

A safety manual is issued to all laboratory personnel and describes safety policies, procedures and guidelines. Although laboratory workers are trained to be cautious in handling toxic or dangerous materials, they have confidence in the safety features built into their working area, thus enhancing the reliability of their performance.

Audits and Inspections

The Quality Assurance program is audited weekly for overall adherence to the guidelines and procedures outlined in this manual. The QA/QC group leader is responsible for scheduling and ensuring that each audit occurs.

Monthly meetings are scheduled between the QA/QC group leader and manager of Analytical Services to thoroughly discuss the program. Any corrective action required is monitored and ensured by the QA/QC group leader.

IV SAMPLE COLLECTION AND TRACKING

Valid representative samples of environmental matrices are collected through well defined sampling protocols. The sampling may be performed by the laboratory sampling team, or the customer who then assumes responsibility for properly obtaining, handling, preserving and shipping the sample.

Sample Collection and Handling

A well defined sampling protocol must ensure that:

a. sampling team members are competent and qualified
b. proper sampling methods are used
c. equipment is accurately calibrated
d. all samples are properly handled to prevent contamination
e. samples analyzed are actually the samples collected under reported conditions.

For these reasons, samples are kept in secure places from time of collection until they are analyzed. It is the joint responsibility of the group leader and sampling team leader to ensure that approved methods are used, and it is the responsibility of each sampling technician to assure that the equipment is accurately calibrated.

Chain of Custody

The laboratory sampling protocol generally follows a chain of custody procedure. The procedure creates an accurate, written, legally defensible document that can be used to trace possession of sample from its collection through analysis and final disposal.

The basic elements in the chain-of-custody phase of our QA/QC program are:

1. Sample collection and handling
2. Sample analysis
3. Preparation and filing of test report

These measures are documented by the chain of custody form (Figure 2) signed by all handlers of the sample(s). As defined here, a sample is "in custody" if it is:

a. in actual physical possession, or
b. in view after being in physical possession, or
c. in a locked repository, or
d. in a secure, restricted area.

Analysis, Preparation and Filing of Test Report

A critical concern of QA/QC program is the maintenance of sample and data base integrity and the timely preparation of data reports. The data management program allows for the identification of samples and the maintenance of the discrete character of the data generated by each respective sample. This system is a unique advantage over manual methods and has permitted the laboratory to successfully tabulate data involving high numbers of samples and multiple analyses. The system may be divided into the following phases:

1. sample identification -- as each sample enters the laboratory, it is assigned a unique access number found on a sample identification ticket. This identifier permits the discrete organization of all information and data relating to that sample, whether for analytical

FIGURE 2

CHAIN OF CUSTODY RECORD

SURVEY	SAMPLERS: (Signature)

STATION NUMBER	STATION LOCATION	DATE	TIME	SAMPLE TYPE			SEQ. NO.	NO. OF CONTAINERS	ANALYSIS REQUIRED
				Water		Air			
				Comp.	Grab.				

Relinquished by: (Signature)	Received by: (Signature)	Date/Time
Relinquished by: (Signature)	Received by: (Signature)	Date/Time
Relinquished by: (Signature)	Received by: (Signature)	Date/Time
Relinquished by: (Signature)	Received by Mobile Laboratory for field analysis: (Signature)	Date/Time

Dispatched by: (Signature)	Date/Time	Received for Laboratory by:	Date/Time

Method of Shipment:

identification purposes, reference in paper-copy records and correspondence, or computer storage and recall.

2. data organization -- in a preliminary planning phase of any analytical investigation involving the laboratory, a computer codification format can be established which can serve as the basis for storage and retrieval of data. This format is characterized by the categorization of samples, with any type of identification permissible for the classification. The categories may be based on any similarities (or dissimilarities) in the total volume of samples.

The storage and retrieval of quality control sample data is also managed with the laboratory's computer-based data management system. Samples are tagged and data is input, stored and retrieved as with any routine project samples. This has been made possible by the use of a unique quality control project number by which such data may be identified.

V. METHODS AND PROCEDURES

The laboratory analyzes a variety of matrices for a number of different environmental constituents of concern. Therefore, several documents are referenced which include the procedures employed. The following list itemizes the most widely used documents:

1. Standard Methods for the Examination of Water and Wastewater.
2. Methods for Chemical Analysis of Water and Wastewater.
3. ASTM Annual Book of Standards.
4. Code of Federal Regulations.
5. NIOSH Manual of Analytical Methods.
6. Test Methods for Evaluating Solid Waste, Physical/Chemical Methods.

When analyzing samples by the above standardized methods, the accuracy or precision of the data generated by the laboratory is determined through analysis of replicates, spiked samples, synthetic reference standard samples, and/or field or laboratory blanks along with each set of samples. Any interferences are identified and documented.

In general, the methods accuracy is determining by spiking the sample matrix with the analyte at a minimum of three concentration levels. The range of the spiking levels is selected to bracket the concentration of interest. Percent recoveries of the spikes are calculated and are compared with synthetic standards. The methods precision is determined by analyzing a minimum of three replicates at each spiking level. The precision is evaluated by calculating the standard derivation.

The data generated is, whenever possible, input into the laboratory base data management system. Analyst's work sheets are filed for one year as a temporary record. When approved and signed, data reports and pertinent information are reported to the customer.

VI. INTRALABORATORY QA/QC PROGRAM

A quality control program is a systematic attempt to assure the precision and accuracy of analyses by detecting and preventing recurrency of errors, or measuring the degree of error inherent in the proven methods used. By identifying the sources of errors confidence in the precision and accuracy of analytical results can be established and improvements in the analytical methods made. To ensure the precision and accuracy of a result our quality control program requires the measurement and analysis of spiked samples, duplicate samples, synthetic standards and blanks.

Duplicate samples are used to provide assurance that the procedure is under control and to determine the statistical limit of uncertainty (i.e., precisions). Synthetic standards and spiked samples are used to determine the quantification of the laboratory accuracy.

In general, our quality control program incorporates the concepts of: a) calibration to attain accuracy, b) replication to establish precision limits, and c) correlation of quantitatively related tests (synthetic standards and spikes) to confirm accuracy.

The overall effectiveness of the program is dependent upon the evaluation of: a) equipment and instruments, b) current state of the art, c) precision of the analytical method itself, d) expected ranges of analytical results, e) control charts to determine trends as well as gross errors, f) data sheets and laboratory procedures adopted for control of sample integrity, g) quality control results on a daily as well as on varying time frames.

Definitions of Basic Terms

Before we discuss the standard operating practice for the QA/QC program some definitions are in order. These are:

1. Reagent Blank - The reagent (or method) blank is an aliquot of pure, organic free water (or organic reagents) used in the analysis of samples. It is generated by passing the clean matrices through the entire analytical procedure (including all glassware and other materials that come into contact with the sample). These blanks are analyzed along with the samples to verify that: a) qualitatively, no false positives occur, and b) quantitatively, concentrations are accurate and do not reflect contamination.

2. Field Blanks - These are water blanks sent from the laboratory to the sampling site and are returned to be analyzed in the same manner as the samples. If the samples are to be analyzed for purgeable organics, the analysis of field blanks provide a check on possible contamination of the samples by permeation of volatiles through the septum seal. If positive interferences occur the analytical results are rejected unless sufficient data can be obtained from these blanks to allow correction of results.

3. Duplicates - Duplicates are the result of splitting a field sample into equal amounts and are treated throughout as two unique samples. The results of duplicate (or replicate) analyses provide information on the overall precision of the analytical methodology. Quantitative results are obtained by calculating the relative percent difference (RPD) for each analyte in the sample matrix.

4. Spike - Spikes are the result of the addition of a known amount of analyte to a sample or a blank. The analytical results yield

a quantitative measure of accuracy (spiked blanks) or percent recovery (spiked samples). The measured accuracy reflects the best result which can be expected, whereas the percent recovery reflects matrix effects upon the analytical method accuracy.

Because several different environmental matrices are analyzed (e.g., potable water, effluent and influent waters, process wastes, sludges, etc.), two spiking levels are necessary when analyzing different samples. Relatively clean samples are spiked at detection limit and 10 times the detection limit for each component. Highly polluted samples are spiked at 100 times the detection limit for each component. Ideally, the spike should be 50 - 100% of the original concentration of each analyte in the sample matrix. If the added spike is less than 10% of the sample result, the data are questionable and statistically unacceptable.

5. Surrogate Spike - These are the result of the addition of known amounts of standards to every sample prior to the analysis. The standards are chemically similar to the compounds in the fraction being analyzed. In addition, some standards added have compounds which are not likely to be found in environmental samples. The analyses of surrogate spikes provide quality control on every sample by constantly monitoring unusual matrix effects, gross sample processing errors, etc. These spikes are not used as internal standards for quantitation.

6. Reference Standard (reference audits) - These are the analysis of independently prepared standard solutions or synthetic standards. Two types of standards are used, i.e., a) internal reference standard solutions (synthetic standards prepared in-house), and b) external

reference standard solutions obtained from outside sources (i.e., primarily EPA).

The external audits samples are used for monitoring the complete analytical method. These samples are introduced at the onset of the procedure (typically extractions) and carried through the entire analysis.

The internal standard audits are used to verify the "accuracy" of quantitative instrument calibration. All standard solutions are prepared by the QA/QC group leader and are submitted blind for analyses. The analyst analyzes the solutions as discrete samples and a percent recovery or percent error is calculated. Errors greater than 5% are carefully investigated and differences resolved through proper action.

Guidelines for Evaluating the QA/QC Program

This section defines the QA/QC program for the analysis of environmental pollutants, i.e., the analysis of trace organics by gas chromatographic (GC) and GC/MS techniques, and analysis of inorganic pollutants by wet techniques and atomic absorption (AA), etc. The QC program for the analysis of trace organics by GC and GC/MS is different due to the unique nature of the analytical problems addressed by the GC/MS methodology. Therefore, the QC requirements for these two techniques will be addressed separately. A description of the QC program follows.

1. Gas Chromatography

In general, when GC methodologies are used the specific analyte or class of analyte is known. As a result a more specific, less generalized QC program can be defined. For example, accuracy data can be collected prior to analysis of actual samples, and often previous QC data for a particular analyses is available.

The QC program outlined below depicts the procedures used to determine the quality of the data generated in the trace organics analyses. The steps monitored include extractions, concentration, qualitative and quantitative analyses and confirmation.

a) Method Verification

The methods are validated before they are used in routine analysis of samples. Method validation includes analysis of reagent blanks, blanks spiked with compound(s) of interest, analytical standards and standard mixtures. The results from these analysis approximate the best data to be expected from the method.

The extraction and concentration steps are validated by spiking a minimum of 2 blank samples with the same matrix as the sample of interest. The concentration of the analyte used for the spiking is 10 times the detection limit. The accuracy (or percent recovery) of the method is calculated by:

$$\text{ACCURACY} = \frac{\text{(spiked sample result)}}{\text{spike added}} \times 100$$

and is recorded on transcription sheets and is assigned a unique QC number. The data is then logged and stored in the computer.

b) Instrument Calibration and Performance

To insure good analytical data the analytical instruments are calibrated prior to sample analysis by analyzing three standards of analyte which span the suspected concentration range of the analyte in the sample. The performance of the instruments are checked by analyzing a standard mixture. If the retention time or area counts vary more than 10% from previous calibration the standard mix is reanalyzed. If the deviation is still more than 10%, a new standard mix is analyzed. If the new standard mix still yields greater than 10% deviation, instrument malfunction is suspected and proper action is taken to resolve the problem.

Routine Analysis

The quality of the analytical data generated during routine analyses is monitored by the following:

1) Contamination from reagents and glassware is identified by analyzing a reagent blank. One reagent blank is prepared for every 20 or fewer samples analyzed (or when a new lot of reagent is used in the analysis).

2) The analytical method accuracy is determined by spiking a known amount of analyte into a sample and blank. The percent recoveries are then calculated. The amount of analyte recovered from the blank indicates the best result which can be expected from the method. The amount of analyte recovered from a sample reflects matrix effects upon the accuracy of the method. Two spikes are prepared for every 20 or fewer samples analyzed.

3) The analytical method precision is determined by analyzing equal amounts of a split sample. Ideally, the analytical results will be identical; however, differences occur due to variations in the procedure. A quantitative measure of these differences is assessed by calculating the relative percent differences (RPD) for each analyte in the matrix and the results compared.

In general, one duplicate is analyzed for every 20 or fewer samples, and the performance of the analytical instrument verified. Whenever possible identification is confirmed by a second procedure.

GC and GC/MS Characterization of Trace Organics

The requirments for the characterization of trace organics analyses include: 1) the identification and quantitation of unknown pollutants, 2) the specific detection of selected groups of pollutants (i.e., Priority Pollutants by GC/MS), and 3) other analyses requiring GC/MS for identification, verification and/or quantitation. A summary of the required audits is given in Table I. The performance and calibration of the GC and GC/MS systems are monitored and maintained on a regular basis by the procedures and methods discussed below.

TABLE I. SUMMARY OF SAMPLE ANALYSIS AUDITS REQUIRED FOR THE CHARACTERIZATION AND QUANTITATION OF TRACE ORGANICS

AUDIT	AUDIT
Spike	Mass Spectrometer:
Reagent Blank	mass calibration
Duplicate Sample Analysis	response calibration
Standard Mix	standards
Reference Standard	Computer Match
Standards and Calibration Curve	Reference Spectra Comparison
GC Retention Times	Completeness and Accuracy
GC Peak measurement calculation	

1. Calibration of GC/MS System

At the beginning of each day the GC/MS system is calibrated and tuned by examining the mass spectrum of decafluorotriphenylphosphine (DFTPP) or 4-bromofluorobenzene (BFB). The details are discussed below.

a. Base/Neutrals (and Acids or Pesticide) Fractions

The analysis of 50 nanograms of DFTPP is carried out daily by direct injection into the GC inlet. The resulting mass spectrum is then examined. The requirement is that the mass spectrum of 50 nanograms DFTPP must meet the specification of the key ions and ion abundance criteria listed in Table II.

b. Volatile (Purgeable) Fraction

The analysis of 20 nanograms of BFB is carried out by direct injection into the GC/MS. The requirement is that the mass spectrum of 20 nanograms BFB must meet the prescribed specifications of the key ions and ion abundance criteria listed in Table II.

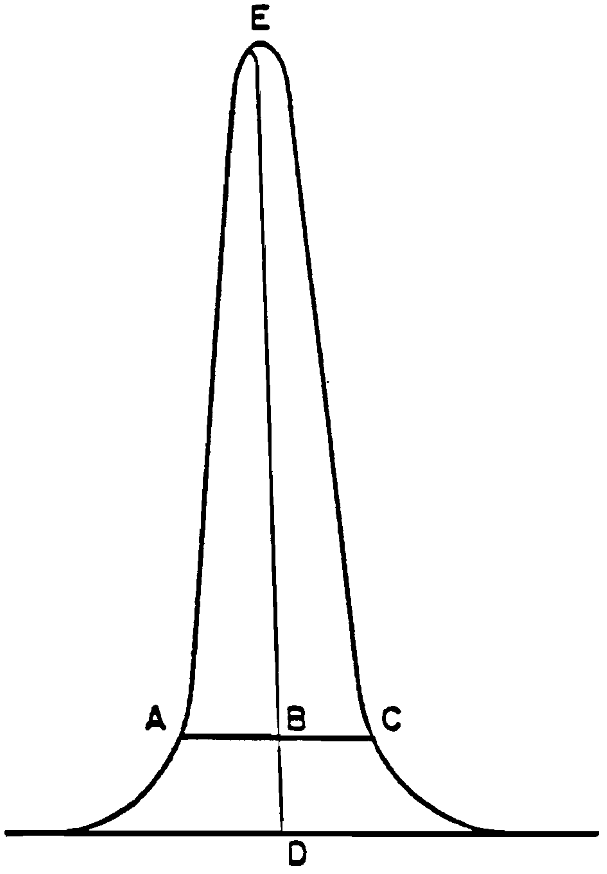
2. GC Column Performance Check

The GC columns performance are checked at the beginning of each day that samples are analyzed. For base/neutrals and acid fractions the columns performance are monitored by injecting 100 nanograms (ng) of benzidine and pentachlorophenol, respectively. For purgeables the column is checked by injecting 20 ng of BFB. Performance acceptance is based on calculations of tailing factors (see Table III).

TABLE II. KEY IONS AND ION ABUNDANCE CRITERIA FOR DFTPP AND BFB

DFTPP		BFB	
MASS	ION ABUNDANCE CRITERIA	MASS	ION ABUNDANCE CRITERIA
51	30-60% of mass 198	50	20-40% of mass 95
68	less than 2% of mass 69	75	50-70% of mass 95
70	less than 2% of mass 69	95	base peak, 100% relative abundance
127	40-60% of mass 198	96	5-9% of mass 95
197	less than 1% of mass 198	173	less than 1% of mass 95
198	base peak, 100% relative abundance	174	70-90% of mass 95
199	5-9% of mass 198	175	5-9% of mass 95
275	10-30% of mass 198	176	70-90% of mass 95
365	greater than 1% of mass 198	177	5-9% of mass 95
441	less than mass 443		
442	greater than 40% of mass 198		
443	17-23% of mass 442		

TABLE III   EXAMPLE CALCULATION OF TAILING FACTOR



TAILING FACTOR = (BC/AB)

Example calculation:
Peak Height = DE = 100 mm
10% Peak Height = BD = 10 mm
Peak Width at 10% Peak Height = AC = 23 mm
AB = 11 mm
BC = 12 mm
Therefore: Tailing Factor = (12/11) = 1.1

Wet Chemistry and Bacteriology

The quality of the analytical data generated from inorganic and microbiological analyses of environmental contaminants are monitored as follows:

1. Wet Chemical Instrumental Methods

The atomic absorption (AA) spectrophotometer and AutoAnalyzer are calibrated using appropriate calibrating standards and blanks. The calibrations are checked by analyzing synthetic standards at five different concentration levels. The results are used to generate standard curves by least squares fit of the data via computer programs. The deviation of the standards from the least squares fit (standard curves) and the standard deviation of the fit are printed on the daily printout and the data stored accordingly in appropriate computer data bases. If deviation from accepted values occur analyses of sample and instrumental calibrations are repeated. Standard curves are generated regularly.

For colorimetric analyses that do not use the standard curve program, one or more standards are analyzed with each group of samples. The results are compared to generally accepted criteria, i.e., percent recovery (or percent error) and relative percent error.

Spectrophotometric instruments are checked by comparing the gain settings or percent transmittance for known (synthetic) standards to previous values. This monitoring method shows any decrease in sensitivity or other systematic effects in performance.

The conductivity meter is checked each time a group of samples is analyzed. The conductance of a standard solution is entered in the quality control log. In addition, the cell constant is checked annually by measuring the electrical conductivity of potassium chloride reference solution. The results are also entered in the quality control log book.

2. Bacteriology Techniques

Quality control extends to all aspects of the bacteriological laboratory. The date of preparation of media and the various solutions used in analysis are recorded in the quality control log together with any information which may be important to its preparation such as pH, lot or control number, manufacturer and concentration. In addition, random samples of prepared media are incubated under the same conditions as unknown samples to insure the maintenance of sterility during preparation and use.

The efficiency of autoclave sterility is monitored by the monthly use of Kilit ampules (BBL), a suspension of _Bacillus stearothermophilus_ spores. The sterility of rinse water is checked periodically by the filtration and incubation of a reagent blank (sterile rinse water).

As part of the overall quality control program, the bacteriological quality of the distilled deionized water supply of the laboratory is monitored weekly. Samples for the standard plate count are taken from the water system prior to entry to the deionization cartridge (following distillation), after deionization and from the storage tank. The results are recorded in the quality control log. Additionally, the Suitability Test as described in Standard Methods is performed on a yearly basis by an outside laboratory qualified to undertake this testing. Bacteriological samples are included in the duplicate analyses program described in the chemical section.

Humidity checks are performed monthly on Standard Plate Count petri dishes to determine percent moisture loss upon incubation.

VII. INTERLABORATORY QUALITY CONTROL

To indicate how well our laboratory is performing by comparison with other laboratories performing similar work, O'Brien & Gere Laboratory participates in a variety of proficiency and roundrobin tests. Successful performance in the proficiency analyses of samples results in the laboratory certification.

Certification

The U.S. Environmental Protection Agency certifies state laboratories to conduct their own intrastate program of certification for the proficiency of private laboratories in potable water analysis. The EPA only certifies private laboratories directly in those states which have not assumed primacy. In New York State, the certifying agency is the NYS Department of Health. The firm's laboratory was one of the first participants in the New York State program and has been certified for chemical, atomic absorption, bacteriological and gas chromatographic analysis of potable water since 1974. Laboratory certification has been extended to the State of Massachusetts and interm states in the State of New Jersey for potable water and wastewater testing requirements.

In addition, the laboratory participates in the round robin analyses of reference samples supplied by the EPA and in the analysis of commercially available reference samples.

VIII. DEFINITIONS OF STATISTICAL TERMS

The following statistical term definitions are used to identify statistical reports and evaluations:

a. Accuracy and Precision - Accuracy is a measure of the nearness of an analytical result, or a set of results, to the true value. It is usually expressed in terms of error, bias, or percent recovery (PR).

Normally the term "accuracy" is used synonymously with "percent recovery". It describes either the recovery of a synthetic standard of known value, or the recovery of known amount of analyte (spike) added to a sample of known value. The percent recovery (PR) or "accuracy" can be calculated by using:

1. standards: $PR = (\text{observed value}/\text{true value}) \times 100$

2. spikes: $$PR = \frac{(\text{conc. spike} + \text{sample}) - \text{sample}}{\text{conc. spike}} \times 100$$

Precision refers to the agreement or reproducibility of a set of replicate results among themselves without assumption of any prior information as to the true result. It is usually expressed in terms of the deviation, variance, or range. Good precision often is an indication of good accuracy, however, one can obtain good precision with poor accuracy if systematic (determinate) errors are present in the method or instrument used. Systematic errors are either positive or negative in sign. Other analytical errors are indeterminate (random) errors. These are inherent in the analytical methods due to uncertainties in measurements.

b. Average - The average or arithmetic mean ($\bar{X}$) of a set of n values (Xi) is calculated by summing the individual values and dividing by n:

$$\bar{X} = \left[\sum_{i=1}^{n} X_i\right] / n$$

c. Range - The range (R_i) is the difference between the highest and lowest value in a group. For n sets of duplicate values (X_2, X_1) the range (R_i) of the duplicates and the average range ($\bar{R}$) of the n sets are calculated by:

$$R_i = \left| X_2 - X_1 \right|$$

and

$$\bar{R} = \left[\sum_{i=1}^{n} R_i\right] / n$$

d. Standard Deviation and Variation - The standard deviation (S) of a sample of n results is the most widely used measure to described the dispersion of a data set. It is calculated by using the equation

$$S = \sqrt{\frac{\sum_{i=1}^{n} (X_i - \bar{X})^2}{n-1}}$$

where $\bar{X}$ is the average of the n results and X_i is the value of result i. Normally, $\bar{X} \pm S$ will include 68% and $\bar{X} \pm 2S$ about 95% of the data in a normal distribution curve.

The variance is equal to S^2. The relative standard deviation (RSD) or coefficient of variation (CV) is the standard deviation divided by the mean and multiplied by 100, i.e.,

$$CV = 100S/\bar{X}$$

It is interesting to note that the precision is increased (value of S reduced) by increasing the number of duplicate analysis. The greater the number of replicate analysis, the greater the statistical confidence that the true mean lies within certain limits about the experimental mean.

e. Standard Calibration Curves - standard calibration curves are widely used in the analysis of inorganic pollutants. These curves are generated from the results of analyses of three or more standard solutions of known concentration and a blank. Typically, they are plots of the instrument response versus concentration. A plot is defined as linear, i.e., obeys the linear equation $Y=a + bX$, if the correlation coefficient (R) calculated from the linear regression analysis is 0.996 or greater.

The intercept (a), slope (b) and correlation coefficients (R_c) can be calculated from:

$$a = \frac{\Sigma X^2 \Sigma Y^2 - \Sigma X \Sigma Y}{n\Sigma X^2 - (\Sigma X)^2}$$

$$b = \frac{n\Sigma XY - \Sigma X \Sigma Y}{n\Sigma X^2 - (\Sigma X)^2}$$

$$R_c = \frac{\Sigma(X_i - \overline{X})^2 (Y_i - \overline{Y})^2}{\sqrt{\Sigma(X_i - \overline{X})^2 \, \Sigma(Y_i - \overline{Y})^2}}$$

We fit the analytical data to a linear regression analysis by using a computer program.

f. Absolute and Relative Errors - An absolute error is the difference between the experimental result and the true value. The relative error is the absolute error divided by the true value and multiplied by 100 to yield the percent relative error (PRE). When the true value is not known, the PRE is a measure of the difference (range) of a replicate analysis divided by the mean of the replicate value and multiplying by 100. That is, for duplicates

$$\text{PRE} = \frac{100\,|X_2 - X_1|}{(X_2 + X_1)/2} = \frac{100\,|X_2 - X_1|}{\overline{X}_j}$$

g. Skewness and Kurtosis - Skewness and kurtosis are the numbers used to understand the shape of a given curve. Our groups are data bases of spikes, duplicates, and knowns. The data points in these groups should fall within a normal curve. Aberrations from the normal curve are detected in values of skewness and kurtosis.

Skewness defines the symmetry of a curve. A symmetrical curve must have a skewness of zero. Positive or negative values denote lack of symmetry. Kurtosis defines the peakedness of a curve. A normal distribution curve will have a kurtotic value of 3. Peaked curves will have values greater than three, and broad flat curves will have values less than 3. These values are monitored by the QA/QC group leader. When aberrant values are noted, the interpretation is usually related to very high or low QC values entering data bases or the persistence of patterns of consistently high or low QC values. It is the QA/QC coordinator's responsibility to research the causes of excessive values and patterns and, where possible, rectify the analytical conditions leading to them.

References

1) "Handbood for Anayltical Quality Control in Water and Wastewater Laboratories," March, 1979 (EPA-600/4-79-019)

2) "Manual of Analytical Quality Control for Pesticides and Related Compounds in Human and Environmental Samples," January, 1979 (EPA-600/1-79-008)

IX. STATISTICAL QUALITY CONTROL AND THE "DAILY QC MODEL"

Random (indeterminate) and systematic (determinate) errors are inherent in all analytical methods due to uncertainties in measurements. The measurement of physico-chemical and microbiological properties of pollutants in various environmental matrices involve uncertainties which cannot be entirely eliminated. The errors in these measurements, however, can be reduced to tolerable limits by examining and controlling the significant variables.

Additional errors, often unrecognized, are introduced by interfering chemical reactions and other undesirable physico-chemical effects. In many instances absolute values cannot be attained directly.

Although uncertainties cannot be reduced to zero, they can be minimized by using available statistical methods. Estimates of the accuracy (probable "true value") and precision (range of measurement error) can be made for the various analytical methodologies by analyzing blanks, duplicates, spikes and synthetic standards. After sufficient QC data are collected various statistical methods are used to evaluate the quality of data by calculating control and warning limits. A discussion of the statistical methods used follows.

Control Charts

Control charts provide the necessary tool for detecting quality variations in the various analytical methodologies used for the quantitation of environmental pollutants. They are a continuous graphic indication of the state of an analytical procedure with respect to quality, and assist in deciding when and how to take corrective action. The QC charts are generated for each pollutant from the statistical evaluation of QC data. A minimum of 15 duplicates and spiked samples and/or synthetic standard analyses are required to generate a control chart.

The control limits (CL) on QC charts are paramount criteria for assessing the significance of variations in the analytical results. For instance, when the plotted QC indicators (i.e., percent recoveries, relative percent error, etc.) fall within these limits, the analytical methodologies used are under "control". If, however, a QC indicator value falls outside the CL's, there is an indication that some assignable cause is present which has thrown the system "out of control". Thus, control limits can be considered warning or action limits. They enable us to detect deviations in analytical procedures, and therefore, take corrective action before producing erroneous results (or results which exceed the absolute maximum tolerable limits).

Common practice set warning limits (WL) at ± 2 standard (S) deviations (95% confidence level of the normal distribution curve) and control limits (CL) at ±3S limits (99.7% confidence level of the normal distribution curve) on each side of the mean. The CL and WL are calculated from the QC data of duplicates analyses by using the equations and statistical factors listed in Table IV. These CL's and WL's include approximately the entire data set under "in control" conditions, and are equivalent to the commonly used ± 3S and ± 2S limits, respectively. The qualitative relationship between upper and lower control limits, upper and lower warning limits, and the mean is shown in Figure 3.

TABLE IV STATISTICAL FACTORS AND EQUATIONS FOR CALCULATING QC (X BAR AND R) CHART LINES[1]

Observations in Subgroup (n)	Factor			
	A_2	d_2	D_3	D_4
2	1.88	1.13	0	3.27
3	1.02	1.69	0	2.58
4	0.73	2.06	0	2.28
5	0.58	2.33	0	2.12
6	0.48	2.53	0	2.00
7	0.42	2.70	0.08	1.92
8	0.37	2.85	0.14	1.86

Upper control limit for $\bar{X} = UCL_{\bar{X}} = <\bar{X}> + A_2\bar{R}$

Lower control limit for $\bar{X} = LCL_{\bar{X}} = <\bar{X}> - A_2\bar{R}$

Upper warning limit for $\bar{X} = UWL_{\bar{X}} = <\bar{X}> + (2/3)\ A_2\bar{R}$

Lower warning limit for $\bar{X} = LWL_{\bar{X}} = <\bar{X}> - (2/3)\ A_2\bar{R}$

Upper control limit for $R = UCL_R = D_4\bar{R}$

Lower control limit for $R = LCL_R = D_3\bar{R}$

Upper Warning Limit for $R = UWL_R = \bar{R} + (2/3)(D_4\ \bar{R} - \bar{R})$

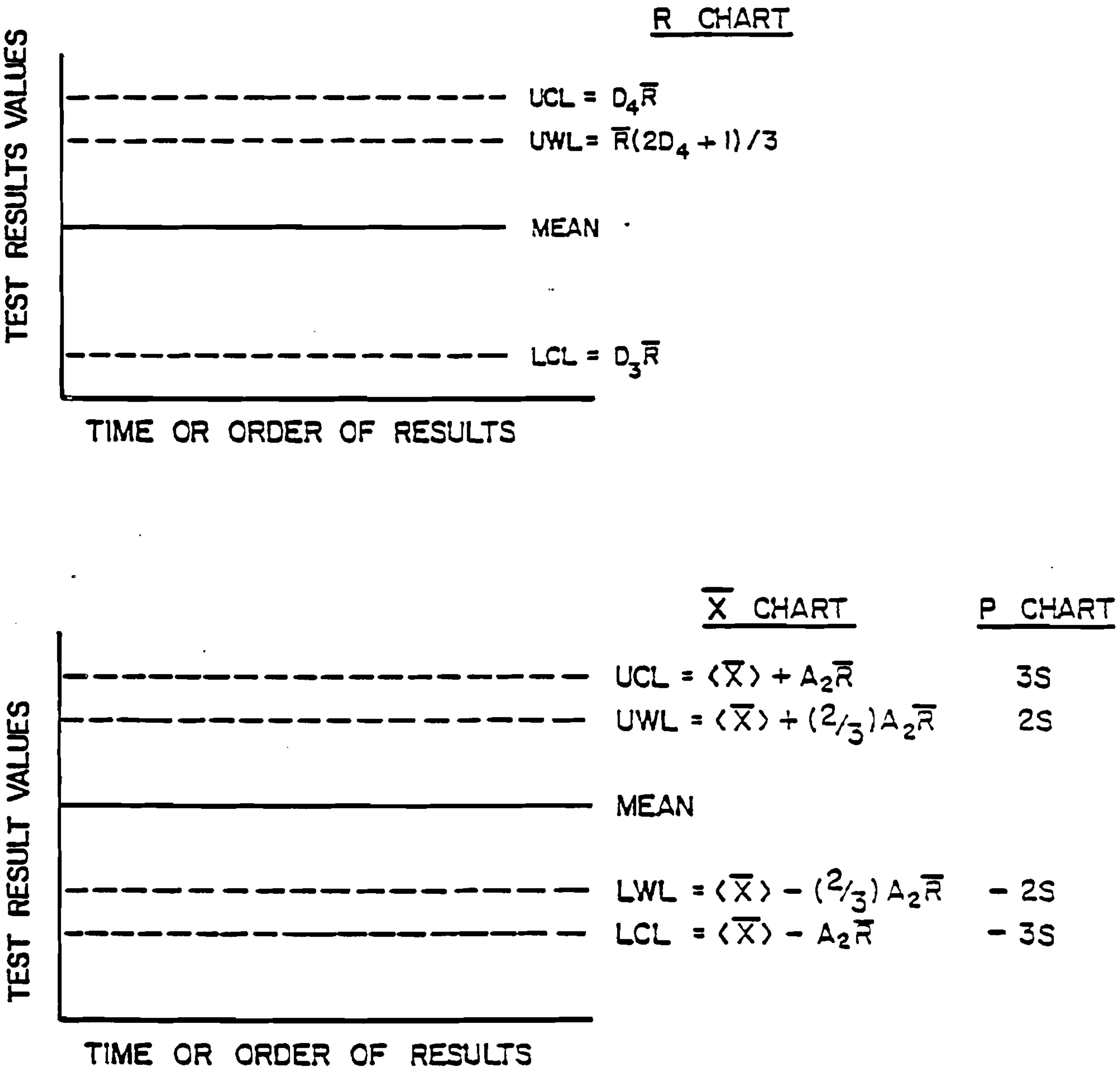
$= \bar{R}\ (2\ D_4 + 1)/3$

---

[1] Taken from (1) "Handbook for Analytical Quality Control in Water and Wastewater Laboratories", March, 1979 (EPA-600/4-79-019); and (2) C. Samson, P. Hart and C. Rubin, "Fundamentals of Statistical Quality Control", Addison-Wesley (Massachusetts, 1970), p. 40.

FIGURE 3

ESSENTIALS OF CONTROL CHARTS



Statistical Calculations

The statistical techniques used in generating the data for $\bar{X}$ and R QC charts involves complex mathematics. The short cut methods for calculating the $\bar{X}$ and R limits are based on the equations listed in Table IV. The statistical factors A_2, D_3, D_4, etc. have been calculated by statisticians such that the CL limits involve a maximum risk of making an error only 0.1% to 0.3%. Thus, when the QC charts indicate that the analytical system is "out of control" 997 times out of 1,000 it is likely that something has actually gone wrong and corrective actions are needed. The factors are calculated to yield 3S limits. Examples of QC data and the statistical techniques used to calculate precision and accuracy QC charts follow.

Precision QC Charts ($\bar{X}$ and R Charts)

These charts are developed by using a minimum of 15 to 25 QC data results on duplicate analyses. Once these data have been collected over an extended period of time the warning and controlling limits on the QC charts are calculated by using the equations and statistical coefficients listed in Table IV. The procedure used follows:

(1) For each duplicate sample analysis calculate the range ($R_i = |X_2 - X_1|$) and the average ($\bar{X}_j = (X_2 + X_1)/2$) of the concentration of the duplicate set.

(2) Calculate the relative percent range (R^1_j) defined as

$$R^1_j = PRE/100 = R_i/\bar{X}_j$$

where PRE is the relative error defined in Section VIII.

(3) Calculate the mean ($\bar{R}^1$) relative range by summing the R^1_j values and divide by the total number (n) of duplicate sets, e.g.,

$$\bar{R}' = \left[\sum_{j=1}^{n} R_j\right] / n$$

(4) Calculate the grand average $<\bar{X}>$, i.e., the average of the average of n sets of duplicate averages $\bar{X}_j$ by using:

$$<\bar{X}> = \left[\sum_{j=1}^{n} \bar{X}_j\right] / n$$

(5) Calculate the warning and control limits for R and $\bar{X}$ (see Table IV) by using:

For R:

$UCL = D_4\ \bar{R}^1 = 3.27\ \bar{R}^1$

$LCL = D_3\ \bar{R}^1 = 0$

$UWL = \bar{R}^1\ (2D_4 + 1)/3 = 2.51\ \bar{R}^1$

For $\bar{X}$:

$UCL = <\bar{X}> + A_2\bar{R} = <\bar{X}> + 1.88\ \bar{R}$

$LCL = <\bar{X}> - A_2\bar{R} = <\bar{X}> - 1.88\ \bar{R}$

$UWL = <\bar{X}> + (2/3)\ A_2\bar{R} = <\bar{X}> + 1.25\ \bar{R}$

$LWL = <\bar{X}> - (2/3)\ A_2\bar{R} = <\bar{X}> - 1.25\ \bar{R}$

where for duplicates $D_3 = 0$, $D_4 = 3.27$, and $A_2 = 1.88$ (Table IV); UCL and LCL are the upper and lower control limits, respectively; and UWL and LWL are the upper and lower warning limits. The WL's and CL's correspond, respectively, to the 95% (2S) and 99.7% (3S) confidence limits of a normal distribution curve.

(6) Graph the $\bar{R}^1$, UCL, LCL and UWL on the QC charts with appropriate scales which allow additions of new results (Figure 3) and the individual (R^1_j) QC data results.

(7) Graph the $<\bar{X}>$, UCL, LCL, UWL, and LWL on the QC charts with appropriate scales which allow additions of new results and individual ($\bar{X}_j$) QC data.

(8) If QC values are "out of control", i.e., lie outside the control limits, take appropriate corrective action.

Accuracy QC Charts (P Charts)

The P charts are the same as the $\bar{X}$ and R charts since their function is to enable us to detect changes in the laboratory daily performance of analyses and take corrective action. The P QC charts utilize the sigma (i.e., standard deviation, S) as a quantitative measure of the degree of variations in the analytical methodologies.

The accuracy of the laboratory analytical methodologies is monitored via the analysis of various spiked samples and/or audits of synthetic standards. Spiked samples are also analyzed vis a vis field samples and the percent recovery calculated. Once a minimum of 15 QC recovery data have been collected over a period of time the warning and controlling limits are calculated and P charts developed. The procedure used follows:

(1) For each spiked sample analyzed calculate the percent recovery (PR) using the equations given in Section VIII.

(2) Calculate the mean percent recovery ($\bar{PR}$) by summing the total number of PR's and divide by n (see Section VIII).

(3) Calculate the standard deviation (S) from the percent recoveries (see Section VIII).

(4) Calculate the warning (WL) and control (CL) limits by using:

$$CL = \text{mean} \pm 3S$$

$$WL = \text{mean} \pm 2S$$

where CL and WL denote, respectively, the upper and lower control limits, and the upper and lower warning limits; S the standard deviation; and mean the average percent recovery ($\overline{PR}$) for n spiked samples or synthetic standards. The WL and CL on the accuracy charts (similar to the precision charts) correspond, respectively, to the 95% and 99.7% confidence limits of a normal distribution curve.

(5) Graph the mean, WL, CL and the individual (PR) QC data results on the accuracy chart using appropriate scales.

(6) If QC values lie outside the control limits, the analytical method is "out of control" and appropriate corrective actions are taken.

The "Daily QC Model"

The "Daily QC Model" comprises two unique activities of our QA/QC program, i.e., the data management and monitoring specific statistical programs of data management systems on a daily basis. The salient features of the programs are discussed below.

1. Data Management

Integral to the laboratory's QA/QC program is the management of data generated from specified quality control procedures. These procedures are designed to monitor all laboratory analyses and ultimately, to ensure the highest possible quality of results. As previously mentioned, the duplicate, the spiked recovery, the synthetic known and the blank(s) are the analytical tools used to monitor the precision and accuracy of analytical methods. Recall:

(a) duplicate analyses monitor analytical method precision,

(b) spiked samples and synthetic knowns monitor analytical accuracy, and

(c) analyses of blanks account for possible sources of contamination.

The data produced from these tests is maintained via a quality control data management system which has the dual function of relating QA/QC data to analytical performance on a daily as well as varying time frames.

The key to the management of QA/QC data in the laboratory is the Firm's Honeywell X560 computer. Quality control computer programs allow for the calculations, storage, segregation, interpretation, monitoring and retrieval of each bit of QA/QC information. A discrete system of sample identification is used which allows the computer to perform these functions automatically. Each QA/QC sample is assigned a specific code identifying it as a blank, duplicate, spike or synthetic known sample. The code identifiers place each QC value in an appropriate data base which provides a permanent record of each and every quality control sample. These data base are then used as the starting point of various statistical analyses of QC data which aid in understanding the developed analytical information.

Specific statistical programs are available for the various types of QA/QC samples, and generate precision (X bar and R) and accuracy (P bar) quality control charts. These charts provide the graphic

TABLE V. SUMMARY OF VARIOUS QA/QC ITEMS ON DAILY COMPUTER PRINTOUT

ITEM	INFORMATION
CONTROL CHARTS	X Bar and R Charts (precision) P Charts (accuracy)
TABLES	Blanks Duplicates (Percent Relative Error) Spikes (Percent Recovery) Synthetic Standards (Percent Error)
WARNING PROGRAM	Outliers on all QC Data Base Mean and Standard Deviation Upper and Lower Warning and Control Limits
STATISTICS	Average, Mean and Standard Deviation Upper and Lower Warning and Control Limits Skewness and Kurtosis Percent Relative Error Percent Recovery Percent Error

improves the sensitivity of our QC program to our analyses. The earlier errors are detected and corrected, the less time is required to deliver valid results to a client.

A summary of the various QC activities and statistical calculations found in the daily printout is given in Table V. If OC values are found to lie outside the control limits, corrective actions are taken to bring the analytical method "under control". The various corrective actions are delineated in Table VI.

3. Other QA/QC Functions

A further ramification of the QA/QC computer management system is the historical evaluations afforded through data storage. Data may be retrieved over long varying time frames providing solid estimates of performance limits for any given analytical parameter. By the same token knowledge of performance limits and the factors that establish them should allow for the improvement of analyses as these factors are identified and removed. Such review is used in the evaluation of new techniques, instruments, and analysts when comparisons are made to the established quality control data bases.

To assist in evaluation and historical review a statistical package is available for measuring the variability of any given data over varying time frames. The Peursonian coefficient of skewness is utilized to quantify variability of percent recoveries, duplicate ratios, and percent of unknown values.

Automatic storage of data, generation of control charts, and data examination through statistics are the tools used to manage the quality control data. The goal of the data management system is a sensitive quality control program which will allow accurate decision making processes and continuous quality of analytical results.

X. FOR THE CLIENT

The overall importance of our quality control program to the client lies in the fact that we are able to guarantee a certain level of confidence in our analyses. This confidence is expressed through our statistics. As mentioned earlier, we have established our acceptability limits to be plus or minus three times the standard deviation of the mean of the quality control values in each data base. Assuming that the values in the data bases describe a normal distribution, it is known that 99% of the values will fall within the range described by 3 standard deviations of the mean of the distribution. There exists a probability of .99 that any data point will be (plus or minus) 3 times the standard deviation of the mean. This may be described as the 99% confidence interval. We may state, therefore, with 99% certainty, that our quality control data will fall within acceptable limits. As we use quality control data to determine the validity of analyses of client samples, the same confidence interval may be ascribed to such data. The client must be aware, however, that the limits of acceptability are based upon the actual quality control data itself. That data derived from quality control analyses directly reflects the variability of the test. The limits, therefore, will vary as the test varies. Accordingly, the confidence interval of 99% will depict a different range in concentration for each test. The use of the confidence interval provides us with a method of checking the quality of our data and providing the client with some guarantee of validity.

The other facet of our operation which must be described is the ability to adapt our quality control options to the client's specific needs. Quality control parameters, blanks, spiked samples, duplicates, and the analysis of knowns may increase or decrease in frequency according to the client's wishes. If, for example, there is a concern over contamination, a client may wish to increase the number of blanks from one per ten client samples to two per set. The same applies to spikes, duplicates, and knowns.

If requested, graphs of all quality control data and lists of the statistical information can be made available. The graphs include sample numbers, mean, warning limits and control limits for acceptability (see Figures 6 and 7). The graphs may be formulated to include any desired number of data points for each of the quality control parameters. Statistical lists for data groups include the mean, standard deviation, median, coefficient of skewness and measures of kurtosis. These values can also be modified to comprise varying groups of data points. The variation is related to the time frame the client may wish to relate the data to provide the best description of the validity of analyses on his samples.

APPENDIX

KEY FOR DAILY QUALITY CONTROL REPORT

PROJECT NO:	denotes client and parameters tested.
SAMPLE:	denotes O'Brien & Gere sample ticket number.
MATE:	client sample that was spiked or duplicated.
TYPE:	Quality control sample type as: 1 - blank sample 3 - denotes duplicate 50 - chemistry spike 51 - trace organics spike 40 - EPA known concentration
QC VALUE:	value obtained for QC sample as blank value, duplicate ratio, percent recoveries for spiked and known samples.
L, WARNING:	lower warning limit as (-2) times the standard deviation of the mean of the last 25 samples.
U, WARNING:	upper warning limit as (+2) times the standard deviation of the mean of the last 25 samples.
SIZE:	number of values in data base.
COMMENTS:	as written.

Appendices

TABLE VI
DECISION MAKING PROCESS FOR QA/AC PROTOCOL AND ANALYSIS OF SAMPLES

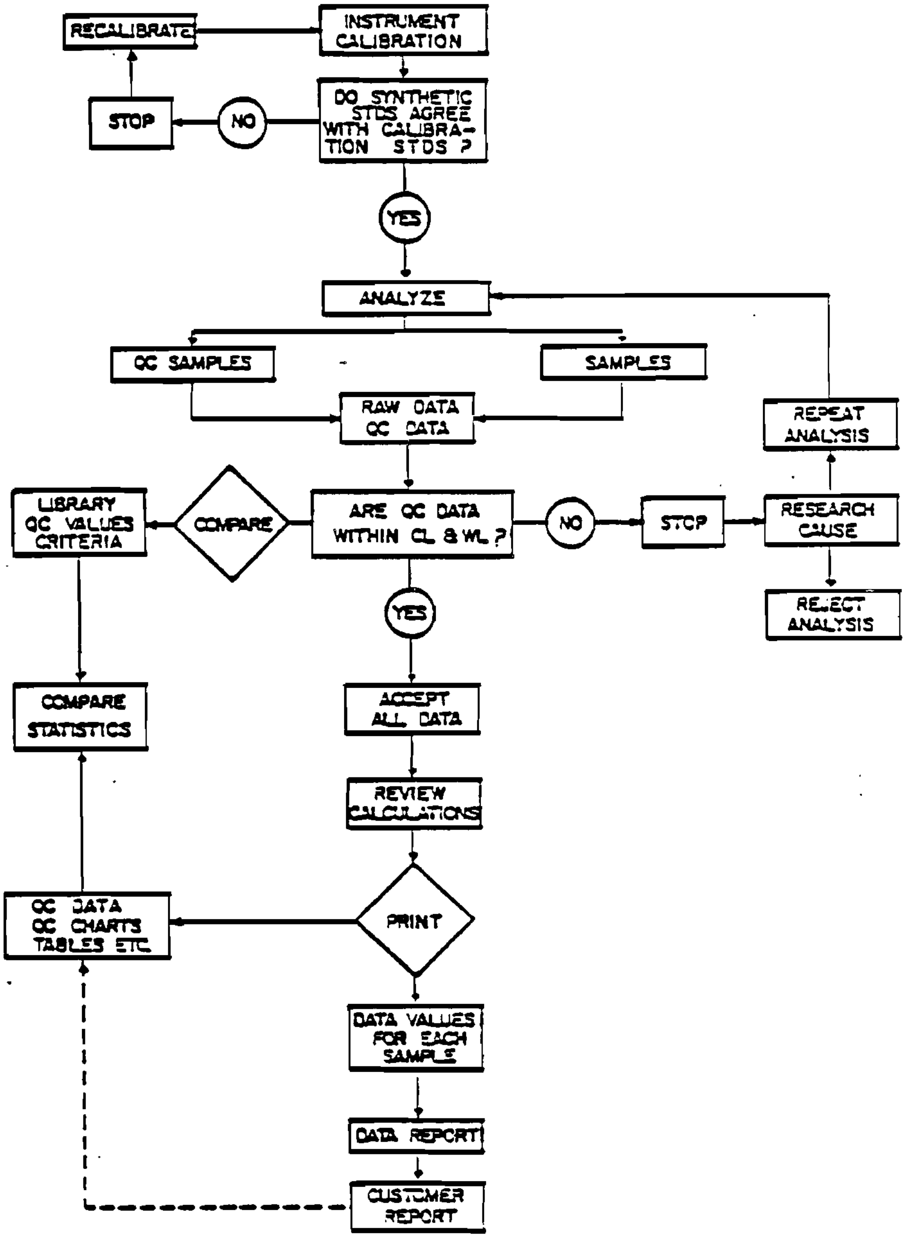


TABLE VII

SPIKED RECOVERIES DATA BASE FOR GENERATING CONTROL CHARTS & STATISTICS

```
HG              DATABASE SIZE IS 25   NUMBER OF SAMPLES ARE 54

FIELD  SAMPLE    VALUE
-------------------------
  1    64261   107.000
  2    64456   100.000
  3    64362   110.000
  4    64398   100.000
  5    64322   100.000
  6    66507   124.000
  7    81628   107.000
  8    19683    67.000
  9    82504   112.000
 10    83870    95.000
 11    81075    93.000
 12    90035   104.440
 13    91773   124.000
 14    94289   122.000
 15    95283    80.000
 16    92510    98.000
 17    97001    82.000
 18    97055   106.000
 19    97253   120.000
 20    77906    96.000
 21    98469    98.000
 22    98743   118.000
 23    99151   105.000
 24     2409   129.000
 25     2410   103.000
 26    28598    84.711
 27    28833   100.000
 28    38710    86.364
 29    39461    73.333
 30    39629    96.000
 31    39653    90.625
 32    21292    99.160
 33    21310   125.000
 34    21741    69.841
 35    22011    96.061
 36    88265    95.522
 37    22504   131.657
 38    22611    97.222
 39    14622    82.759
 40    26661   104.687
 41    38006    80.202
 42    30037   108.333
 43    30035   103.448
 44    35971    89.756
 45    30999    95.455
 46     5590   123.529
 47     7507    80.851
 48     7547    71.897
 49    17107   109.091
 50    17514    88.462
 51    17521    94.667
 52    17831   111.755
 53    [illegible]   [illegible]
```

```
BENZ            DATABASE SIZE IS 25   NUMBER OF SAMPLES ARE 45

FIELD  SAMPLE    VALUE
-------------------------
  1    29830   109.677
  2    23250    87.000
  3    44382    99.000
  4     5593    97.500
  5    43077   100.000
  6     5718   120.000
  7     5716   100.000
  8     9646    94.500
  9     9651   105.000
 10     9665    92.000
 11    17041   104.065
 12    17062    89.000
 13    17356    95.500
 14    17410    83.333
 15    17411    90.244
 16    17585   105.000
 17    17586   105.000
 18    17688   105.000
 19    17767   100.000
 20    17774   102.000
 21    17857    77.419
 22    17875    87.948
 23    17930    99.500
 24    18104   102.000
 25    18107   105.000
 26    18125    88.599
 27    18170   105.000
 28    18234    80.645
 29    18236    84.691
 30    18203    93.000
 31    18366   105.000
 32    18464   105.000
 33    18472   105.000
 34    50629    91.667
 35    50648   100.000
 36    50789    91.667
 37    50824   108.333
 38    50869   100.000
 39    50867   100.000
 40    50942   100.000
 41    50943   105.000
 42    51035   105.000
 43    51049   100.000
 44    51051   105.000
 45    51079    91.667
```

[illegible]

FIELD	SAMPLE	VALUE
1	[illegible]	101.000
2	[illegible]	[illegible]
3	[illegible]	[illegible]
4	[illegible]	[illegible]
5	[illegible]	116.000
6	70897	113.000
7	[illegible]	[illegible]
8	[illegible]	[illegible]
9	[illegible]	[illegible]
10	[illegible]	[illegible]
11	[illegible]	120.000
12	[illegible]	[illegible]
13	[illegible]	[illegible]
14	[illegible]	[illegible]
15	[illegible]	114.000
16	[illegible]	[illegible]
17	[illegible]	101.000
18	[illegible]	111.000
19	[illegible]	[illegible]
20	[illegible]	[illegible]
21	[illegible]	[illegible]
22	[illegible]	[illegible]
23	[illegible]	[illegible]
24	[illegible]	[illegible]
25	[illegible]	[illegible]
26	[illegible]	[illegible]
27	[illegible]	[illegible]
28	[illegible]	[illegible]
29	[illegible]	[illegible]
30	[illegible]	[illegible]
31	[illegible]	[illegible]
32	[illegible]	[illegible]
33	[illegible]	[illegible]
34	[illegible]	[illegible]
35	[illegible]	[illegible]
36	[illegible]	[illegible]
37	[illegible]	[illegible]
38	[illegible]	[illegible]
39	[illegible]	[illegible]
40	[illegible]	[illegible]
41	[illegible]	[illegible]
42	[illegible]	[illegible]
43	[illegible]	[illegible]
44	[illegible]	[illegible]
45	[illegible]	[illegible]
46	[illegible]	[illegible]
47	[illegible]	[illegible]
48	[illegible]	[illegible]
49	[illegible]	[illegible]
50	[illegible]	[illegible]
51	[illegible]	[illegible]
52	[illegible]	[illegible]
53	[illegible]	[illegible]
54	20670	101.000
55	21689	94.000
56	86918	101.000
57	[illegible]	[illegible]
58	89675	105.000
59	89182	58.000
60	88915	105.000
61	87445	103.000
62	82481	101.000
63	89100	105.000
64	89652	99.000
65	94625	126.000
66	94674	131.000
67	41561	118.000
68	41557	136.000
69	88024	125.000
70	85080	114.000
71	95155	126.000
72	94963	120.000
73	94976	111.000
74	95412	111.000
75	95565	113.000
76	95466	125.000
77	95500	110.000
78	95572	116.000
79	95778	110.000
80	95820	96.000
81	95871	108.000
82	95956	114.000
83	96225	103.000
84	96230	109.000
85	96251	105.000
86	96497	85.000
87	[illegible]	[illegible]
88	96888	[illegible]
89	97014	[illegible]
90	97182	[illegible]
91	[illegible]	[illegible]
92	97412	113.000
93	97714	[illegible]
94	[illegible]	[illegible]
95	[illegible]	[illegible]
96	98143	121.000
97	98215	[illegible]
98	[illegible]	[illegible]
99	[illegible]	[illegible]
100	[illegible]	[illegible]
101	98876	[illegible]
102	98571	[illegible]
103	[illegible]	[illegible]
104	[illegible]	[illegible]
105	98817	107.000
106	[illegible]	121.000
107	51294	92.000
108	29950	129.000
109	2412	77.000
110	2383	115.000
111	98880	113.000
112	2409	86.000
113	2412	86.000
114	2409	136.000
115	99339	114.000
116	28104	98.238
117	28277	80.000
118	28369	97.561
119	28487	115.789
120	28635	99.598
121	28847	102.915
122	30623	97.872
123	33064	99.759
124	36685	99.099
125	37106	105.556
126	39268	112.195
127	39520	101.125
128	39870	100.000
129	39959	107.352
130	21162	103.226
131	21515	95.652
132	21641	91.298
133	21857	[illegible]
134	88134	106.977
135	88258	104.504
136	88499	90.411
137	88459	102.532
138	88606	101.761
139	88762	107.071
140	22371	[illegible]
141	22429	106.456
142	22630	106.567
143	11031	100.000
144	[illegible]	100.000
145	40851	85.341
146	40850	[illegible]
147	40847	96.141
148	[illegible]	[illegible]
149	[illegible]	[illegible]
150	[illegible]	100.000
151	40845	98.536
152	[illegible]	100.000
153	40843	[illegible]
154	[illegible]	[illegible]
155	40841	[illegible]
156	[illegible]	[illegible]
157	[illegible]	[illegible]
158	40838	[illegible]
159	40837	112.500
160	40834	107.143
161	40855	105.882
162	40851	111.500
163	40833	103.438
164	40852	102.703
165	40831	94.737
166	40830	105.747
167	40829	102.703
168	40828	105.263
169	23519	103.125
170	36723	[illegible]
171	37917	97.500
172	37769	100.813
173	40283	[illegible]
174	51498	102.703
175	67826	95.238
176	31073	98.091
177	45425	101.266
178	35804	96.774
179	7591	98.925
180	9586	104.167
181	9587	92.398
182	17061	101.031
183	17375	103.704
184	17541	102.692
185	17569	80.000
186	95676	118.000
187	29653	111.000
188	50601	100.000
189	50606	114.286
190	51103	100.000

FIGURE 4

DAILY QUALITY CONTROL REPORT

(SEE KEY)

```
PROJECT NO.     SAMPLE      RATE  TYPE  DATE     UL VALUE  L. WARNING U. WARNING  SIZE          COMMENTS
----------------------------------------------------------------------------------------------------------------------------
1042- 97-510     18465        0    1    3/15/83
1042- 97-510     50585        0    1    3/16/83

1042- 97-510     50714        0    1    3/15/83

1042- 97-510     50783        0    1    3/15/83

1042- 97-510     50787        0    1    3/15/83

1042- 97-510     50790        0    1    3/16/83

1042- 97-510     50793        0    1    3/16/83                                      NO SCHEDULED ANALYSES

1042- 97-510     50795        0    1    3/16/83

1042- 97-510     50820        0    1    3/16/83                                      NO SCHEDULED ANALYSES

1042- 97-510     50840        0    1    3/16/83                                      NO SCHEDULED ANALYSES

1042- 97-510     50850        0    1    3/16/83

1042- 97-510     50851        0    1    3/17/83

1042- 97-510     50853        0    1    3/17/83

1042- 97-510     50866        0    1    3/18/83

1042- 97-510     50868        0    1    3/18/83

1042- 97-510     50883        0    1    3/21/83                                      NO SCHEDULED ANALYSES

1042- 97-510     50890        0    1    3/21/83

1042- 97-510     50891        0    1    3/21/83

1042- 97-510     50892        0    1    3/21/83

1042- 97-510     50897        0    1    3/21/83                                      NO SCHEDULED ANALYSES

1042- 97-510     50899        0    1    3/21/83

1042- 97-510     50900        0    1    3/21/83

1042- 97-510     50906        0    1    3/22/83
  BENZ             <1.                            1.000                       481
  CHCL3          <1.000                           1.000                       191
  FREON113       <1.000                           1.000                       593
  CL3CCH3        <1.000                           1.000                       608
  CCL4           <1.000                           1.000                        73
  BRCL2CH        <1.000                           1.000                       191
  CL3C2H         <1.000                           1.000                       609
  CLBR2CH        <1.000                           1.000                       191
  CHBR3         <10.000                          10.000                       190
  CL4C2          <1.000                           1.000                       603
  CH2CL2         <1.000                           1.000                       604
  TOLUENE        <1.000                           1.000                       482
  M-XYLENE       <1.000                           1.000                       473
  CLOROBZ        <1.000                           1.000                       171
  CL4C2H2        <1.000                           1.000                        66
  DCLTANII       <1.000                           1.000                       592
```

```
  D[illegible]I2          [illegible]00                                   1.000                    342
  DCLENI1         <1.000                                   1.000                     98
  ETHBENZ         <1.000                                   1.000                    342
  DCLENI2         <1.000                                   1.000                    316
  C2H5CL          <1.000                                   1.000                    315
  CH2CHCL         <1.000                                   1.000                    195
  XYLENES         <1.000                                   1.000                     66
  CH3CL           <1.000                                   1.000                     66
  CH3BR           <1.000                                   1.000                     66
  DCPANI2         <1.000                                   1.000                     66
  DCPENT13        <1.000                                   1.000                     66
  CL3C2112        <1.000                                   1.000                     66
  DCPENC13        <1.000                                   1.000                     66
  CLETHER        <10.000                                  10.000                     66

1042- 97-510       50907        0   1   3/22/83
  BENZ                2.                                   2.000                    482
  CHCL3           <1.000                                   1.000                    192
  FREON113        <1.000                                   1.000                    594
  CL3CCH3         <1.000                                   1.000                    609
  CCL4            <1.000                                   1.000                     74
  BRCL2CH         <1.000                                   1.000                    192
  CL3C2H          <1.000                                   1.000                    610
  CLBR2CH         <1.000                                   1.000                    192
  CHBR3          <10.000                                  10.000                    191
  CL4C2           <1.000                                   1.000                    604
  CH2CL2          <1.000                                   1.000                    605
  TOLUENE         <1.000                                   1.000                    483
  M-XYLENE        <1.000                                   1.000                    474
  CLOROBZ         <1.000                                   1.000                    172
  CL4C2H2         <1.000                                   1.000                     67
  DCETAN11        <1.00                                    1.000                    343
  DCETAN12        <1.000                                   1.000                    343
  DCLENI1         <1.000                                   1.000                    343
  ETHBENZ         <1.000                                   1.000                     99
  DCLENI2         <1.000                                   1.000                    343
  C2H5CL          <1.000                                   1.000                    317
  CH2CHCL         <1.000                                   1.000                    316
  XYLENES         <1.000                                   1.000                    196
  CH3CL           <1.000                                   1.000                     67
  CH3BR           <1.000                                   1.000                     67
  DCPANI2         <1.000                                   1.000                     67
  DCPENT13        <1.000                                   1.000                     67
  CL3C2112        <1.000                                   1.000                     67
  DCPENC13        <1.000                                   1.000                     67
  CLETHER        <10.000                                  10.000                     67
                                                                                        NO SCHEDULED ANALYSES
1042- 97-510       50913        0   1   3/22/83

1042- 97-510       50700      468   3   3/16/83
  CHCL3         <100.000                                                                < FLAG - SKIPPED
  FREON113       <10.000                                                                < FLAG - SKIPPED
  CCL4          <100.000                                                                < FLAG - SKIPPED
  BRCL2CH       <100.000                                                                < FLAG - SKIPPED
  CLBR2CH        <10.000                                                                < FLAG - SKIPPED
  CHBR3         <100.000                                                                < FLAG - SKIPPED
  CL4C2          <10.000                                                                < FLAG - SKIPPED
  CLOROBZ         <1.000                                                                < FLAG - SKIPPED
  CL4C2H2        <10.000                                                                < FLAG - SKIPPED
  CH3CL          <10.000                                                                < FLAG - SKIPPED
  CH3BR          <10.000                                                                < FLAG - SKIPPED
  DCPANI2        <10.000                                                                < FLAG - SKIPPED
  DCPENT13       <10.000                                                                < FLAG - SKIPPED
  CL3C2112       <10.000                                                                < FLAG - SKIPPED
```

```
   [illegible]C1-           [illegible]06                                           < [illegible]
   CLETHER         <[illegible]00.000                                          < FLAG - SKIPPED

1042- 97-510         50741     50686   3   3/16/83                               < FLAG - SKIPPED
   BOD5              <10.0

1042- 97-510         50791     50605   3   3/16/83

1042- 97-510         50817     50812   3   3/16/83                               NO SCHEDULED ANALYSES
1042- 97-510         50818     50660   3   3/16/83

1042- 97-510         50821     50660   3   3/16/83                               < FLAG - SKIPPED
   NO2N              <.01

1042- 97-510         50823       493   3   3/16/83
   BENZ              <10.                                                        < FLAG - SKIPPED
   CHCL3           <100.000                                                      < FLAG - SKIPPED
   FREON113        <100.000                                                      < FLAG - SKIPPED
   CCL4           <1000.000                                                      < FLAG - SKIPPED
   BRCL2CH        <1000.000                                                      < FLAG - SKIPPED
   CLBR2CH         <100.000                                                      < FLAG - SKIPPED
   CHBR3          <1000.000                                                      < FLAG - SKIPPED
   CLOROBZ          <10.000                                                      < FLAG - SKIPPED
   CL4C2H2         <100.000                                                      < FLAG - SKIPPED
   ETHBENZ          <10.000                                                      < FLAG - SKIPPED
   C2H5CL          <100.000                                                      < FLAG - SKIPPED
   CH2CHCL         <100.000                                                      < FLAG - SKIPPED
   CH3CL           <100.000                                                      < FLAG - SKIPPED
   CH3BR           <100.000                                                      < FLAG - SKIPPED
   DCPAN12         <100.000                                                      < FLAG - SKIPPED
   DCPENT13        <100.000                                                      < FLAG - SKIPPED
   CL3C2112        <100.000                                                      < FLAG - SKIPPED
   DCPENC13        <100.000                                                      < FLAG - SKIPPED
   CLETHER        <1000.000                                                      < FLAG - SKIPPED

1042- 97-510         50825       212   3   3/16/83

1042- 97-510         50827       212   3   3/16/83                               < FLAG - SKIPPED
   NO2N              <.01

1042- 97-510         50849       511   3   3/16/83
   BENZ             <100.                                                        < FLAG - SKIPPED
   CHCL3          <1000.000                                                      < FLAG - SKIPPED
   FREON113       <1000.000                                                      < FLAG - SKIPPED
   CCL4           <1000.000                                                      < FLAG - SKIPPED
   BRCL2CH        <1000.000                                                      < FLAG - SKIPPED
   CLBR2CH        <1000.000                                                      < FLAG - SKIPPED
   CHBR3         <10000.000                                                      < FLAG - SKIPPED
   CL4C2H2        <1000.000                                                      < FLAG - SKIPPED
   DCETAN11       <1000.000                                                      < FLAG - SKIPPED
   DCETAN12       <1000.000                                                      < FLAG - SKIPPED
   ETHBENZ         <100.000                                                      < FLAG - SKIPPED
   C2H5CL         <1000.000                                                      < FLAG - SKIPPED
   CH2CHCL        <1000.000                                                      < FLAG - SKIPPED
   CH3CL          <1000.000                                                      < FLAG - SKIPPED
   CH3BR          <1000.000                                                      < FLAG - SKIPPED
   DCPAN12        <1000.000                                                      < FLAG - SKIPPED
   DCPENT13       <1000.000                                                      < FLAG - SKIPPED
   CL3C2112       <1000.000                                                      < FLAG - SKIPPED
   DCPENC13       <1000.000                                                      < FLAG - SKIPPED
   CLETHER       <10000.000                                                      < FLAG - SKIPPED

1042- 97-510         50852      3892   3   3/17/83                               < FLAG - SKIPPED
   BENZ               <1.
```

```
        3             ,0                                                                    <     -    PED
     ONI13           .000                                                                   <     -    PED
     CCL4            <1.000                                                                 < FLAG - SKIPPED
     BRCL2CH         <1.000                                                                 < FLAG - SKIPPED
     CLBR2CH         <1.000                                                                 < FLAG - SKIPPED
     CHBR3          <10.000                                                                 < FLAG - SKIPPED
     CL4C2           <1.000                                                                 < FLAG - SKIPPED
     TOLUENE         <1.000                                                                 < FLAG - SKIPPED
     M-XYLENE        <1.000                                                                 < FLAG - SKIPPED
     CLOROBZ         <1.000                                                                 < FLAG - SKIPPED
     CL4C2H2         <1.000                                                                 < FLAG - SKIPPED
     ETHBENZ         <1.000                                                                 < FLAG - SKIPPED
     XYLENES         <1.000                                                                 < FLAG - SKIPPED
     CH3BR           <1.000                                                                 < FLAG - SKIPPED
     DCPAN12         <1.000                                                                 < FLAG - SKIPPED
     DCPENT13        <1.000                                                                 < FLAG - SKIPPED
     CL3C2112        <1.000                                                                 < FLAG - SKIPPED
     DCPENC13        <1.000                                                                 < FLAG - SKIPPED
     CLETHER        <10.000                                                                 < FLAG - SKIPPED

   1042- 97-510       50854       3858   3   3/18/83
     CHCL3           <1.000                                                                 < FLAG - SKIPPED
     CCL4            <1.000                                                                 < FLAG - SKIPPED
     BRCL2CH         <1.000                                                                 < FLAG - SKIPPED
     CLBR2CH         <1.000                                                                 < FLAG - SKIPPED
     CHBR3          <10.000                                                                 < FLAG - SKIPPED
     TOLUENE         <1.000                                                                 < FLAG - SKIPPED
     M-XYLENE        <1.000                                                                 < FLAG - SKIPPED
     CLOROBZ         <1.000                                                                 < FLAG - SKIPPED
     CL4C2H2         <1.000                                                                 < FLAG - SKIPPED
     DCETAN12        <1.000                                                                 < FLAG - SKIPPED
     CH3CL          <10.000                                                                 < FLAG - SKIPPED
     CH3BR          <10.000                                                                 < FLAG - SKIPPED
     DCPAN12         <1.000                                                                 < FLAG - SKIPPED
     DCPENT13        <1.000                                                                 < FLAG - SKIPPED
     CL3C2112        <1.000                                                                 < FLAG - SKIPPED
     DCPENC13        <1.000                                                                 < FLAG - SKIPPED
     CLETHER        <10.000                                                                 < FLAG - SKIPPED

   1042- 97-510       50856      18315   3   3/16/83
     AL                 <.1                                                                 < FLAG - SKIPPED

   1042- 97-510       50858        215   3   3/17/83                                        NO SCHEDULED ANALYSES
   1042- 97-510       50860      50660   3   3/17/83
     F                  <.10                                                                < FLAG - SKIPPED

   1042- 97-510       50862      18338   3   3/17/83

   1042- 97-510       50885        212   3   3/21/83

   1042- 97-510       50898       3902   3   3/21/83
     BENZ              <100.                                                                < FLAG - SKIPPED
     CHCL3         <1000.000                                                                < FLAG - SKIPPED
     FREON113      <1000.000                                                                < FLAG - SKIPPED
     CCL4          <1000.000                                                                < FLAG - SKIPPED
     BRCL2CH       <1000.000                                                                < FLAG - SKIPPED
     CLBR2CH       <1000.000                                                                < FLAG - SKIPPED
     CHBR3        <10000.000                                                                < FLAG - SKIPPED
     CL4C2         <1000.000                                                                < FLAG - SKIPPED
     CH2CL2        <1000.000                                                                < FLAG - SKIPPED
     TOLUENE        <100.000                                                                < FLAG - SKIPPED
     M-XYLENE       <100.000                                                                < FLAG - SKIPPED
     CLOROBZ        <100.000                                                                < FLAG - SKIPPED
     CL4C2H2       <1000.000                                                                < FLAG - SKIPPED
```

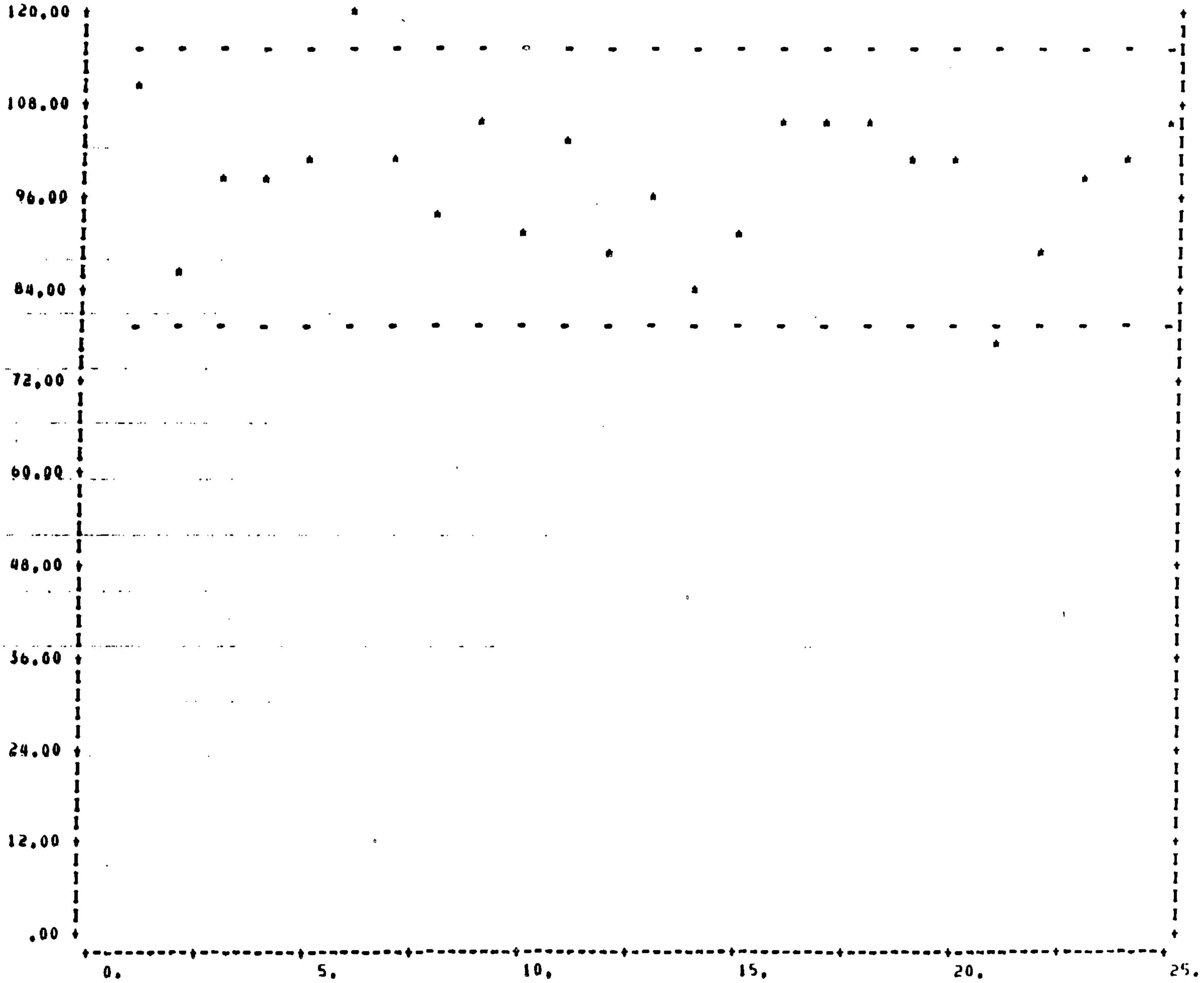
```
          DCETAN12        <1000.000                                                                      < FLAG - SKIPPED
          DCLEN12         <1000.000                                                                      < FLAG - SKIPPED
          ETHBENZ          <100.000                                                                      < FLAG - SKIPPED
          C2H5CL          <1000.000                                                                      < FLAG - SKIPPED
          CH2CHCL         <1000.000                                                                      < FLAG - SKIPPED
          XYLENES          <100.000                                                                      < FLAG - SKIPPED
          CH3CL           <1000.000                                                                      < FLAG - SKIPPED
          CH3BR           <1000.000                                                                      < FLAG - SKIPPED
          DCPAN12         <1000.000                                                                      < FLAG - SKIPPED
          DCPENT13        <1000.000                                                                      < FLAG - SKIPPED
          CL3C2112        <1000.000                                                                      < FLAG - SKIPPED
          DCPENC13        <1000.000                                                                      < FLAG - SKIPPED
          CLETHER        <10000.000                                                                      < FLAG - SKIPPED

        1042- 97-510          50901         50800   3   3/21/83
          BENZ                  <1.                                                                      < FLAG - SKIPPED
          CHCL3              <1.000                                                                      < FLAG - SKIPPED
          CCL4              <10.000                                                                      < FLAG - SKIPPED
          BRCL2CH           <10.000                                                                      < FLAG - SKIPPED
          CLBR2CH            <1.000                                                                      < FLAG - SKIPPED
          CHBR3             <10.000                                                                      < FLAG - SKIPPED
          M-XYLENE           <1.000                                                                      < FLAG - SKIPPED
          CLOROBZ            <1.000                                                                      < FLAG - SKIPPED
          CL4C2H2            <1.000                                                                      < FLAG - SKIPPED
          DCETAN12           <1.000                                                                      < FLAG - SKIPPED
          ETHBENZ            <1.000                                                                      < FLAG - SKIPPED
          DCLEN12            <1.000                                                                      < FLAG - SKIPPED
          C2H5CL             <1.000                                                                      < FLAG - SKIPPED
          CH2CHCL            <1.000                                                                      < FLAG - SKIPPED
          XYLENES            <1.000                                                                      < FLAG - SKIPPED
          CH3CL              <1.000                                                                      < FLAG - SKIPPED
          CH3BR              <1.000                                                                      < FLAG - SKIPPED
          DCPAN12            <1.000                                                                      < FLAG - SKIPPED
          DCPENT13           <1.000                                                                      < FLAG - SKIPPED
          CL3C2112           <1.000                                                                      < FLAG - SKIPPED
          DCPENC13           <1.000                                                                      < FLAG - SKIPPED
          CLETHER           <10.000                                                                      < FLAG - SKIPPED

        1042- 97-510          50902         18543   3   3/21/83                                          NO SCHEDULED ANALYSES
        1042- 97-510          50909           212   3   3/22/83
          NO2NO3                .45           .41                    1.103        .8154      1.3219    36

        1042- 97-510          50911           212   3   3/22/83
          NO2N                 <.01                                                                      < FLAG - SKIPPED

        1042- 97-510          50916           213   3   3/22/83
          ZN                    .33           .25                    1.320 *      .9379      1.1329    49

        1042- 97-510          50918           219   3   3/22/83
          CU                    .24           .24                    1.000        .9394      1.1100    45

        1042- 97-510          50788         50807  40   3/18/83

        1042- 97-510          50789         50629  40   3/16/83

        1042- 97-510          50807             0  40   3/16/83

        1042- 97-510          50824         50629  40   3/16/83

        1042- 97-510          50867         50869  40   3/22/83
          BENZ                   2.            2.                  100.000      78.6607    115.0226    39
          BENZ.F                 2.
          CL3CCH3             2.000         2.000                  100.000      71.9670    102.8464    39
          CL3CCH3.F           2.000
```

```
     2H            2000
     2H,F          .000
    CL4C2          2.000                              100.000       .0000       .0000   15
    CL4C2,F        2.000
    CH2CL2         2.000         2.000                100.000     75.9820    105.6501   31
    CH2CL2,F       2.000
    TOLUENE        2.000         2.000                100.000     77.4026    115.4676   39
    TOLUENE,F      2.000
    CLOROBZ        2.000         2.000                100.000     48.9895    128.4501   25
    CLOROBZ,F      2.000
    DCETAN11       2.000         2.000                100.000 *   78.4276     96.3720   27
    DCETAN11,F     2.000
    DCETAN12       2.000         2.000                100.000     52.9445    105.6725   33
    DCETAN12,F     2.000
    DCLEN11        2.000         2.000                100.000     69.3339    110.3648   33
    DCLEN11,F      2.000
    ETHBENZ        2.000         2.000                100.000     79.7258    107.1142   37
    ETHBENZ,F      2.000
    DCLEN12        2.000         2.000                100.000     73.1254    102.0690   31
    DCLEN12,F      2.000

1042- 97-510       50869             0  40   3/18/83

1042- 97-510       50645         50605  50   3/16/83

1042- 97-510       50667         17868  50   3/15/83                                                   QC FILT/UNFILT ANALYSIS NOT DONE
    TCOLI              C


1042- 97-510       50739         50650  50   3/16/83

1042- 97-510       50742         50686  50   3/16/83

1042- 97-510       50792         50604  50   3/16/83

1042- 97-510       50819         50660  50   3/16/83

1042- 97-510       50822         50660  50   3/16/83

1042- 97-510       50826           212  50   3/16/83

1042- 97-510       50828           212  50   3/16/83

1042- 97-510       50855         18173  50   3/16/83

1042- 97-510       50857           214  50   3/17/83

1042- 97-510       50859         18268  50   3/17/83

1042- 97-510       50861         50660  50   3/17/83

1042- 97-510       50863         18338  50   3/17/83

1042- 97-510       50893           213  50   3/21/83                                                   QC FILT/UNFILT ANALYSIS NOT DONE
    TC                61.

    TIC               52.                                                                              QC FILT/UNFILT ANALYSIS NOT DONE

    TOC                9.                                                                              QC FILT/UNFILT ANALYSIS NOT DONE

                                                                                                       NO SCHEDULED ANALYSES
1042- 97-510       50903           240  50   3/21/83
1042- 97-510       50904         18333  50   3/22/83
    HG                1.0           .5                         78.947     63.5830    128.5509   58
```

FIGURE 5

DAILY QUALITY CONTROL GRAPH

(SPIKED RECOVERIES)



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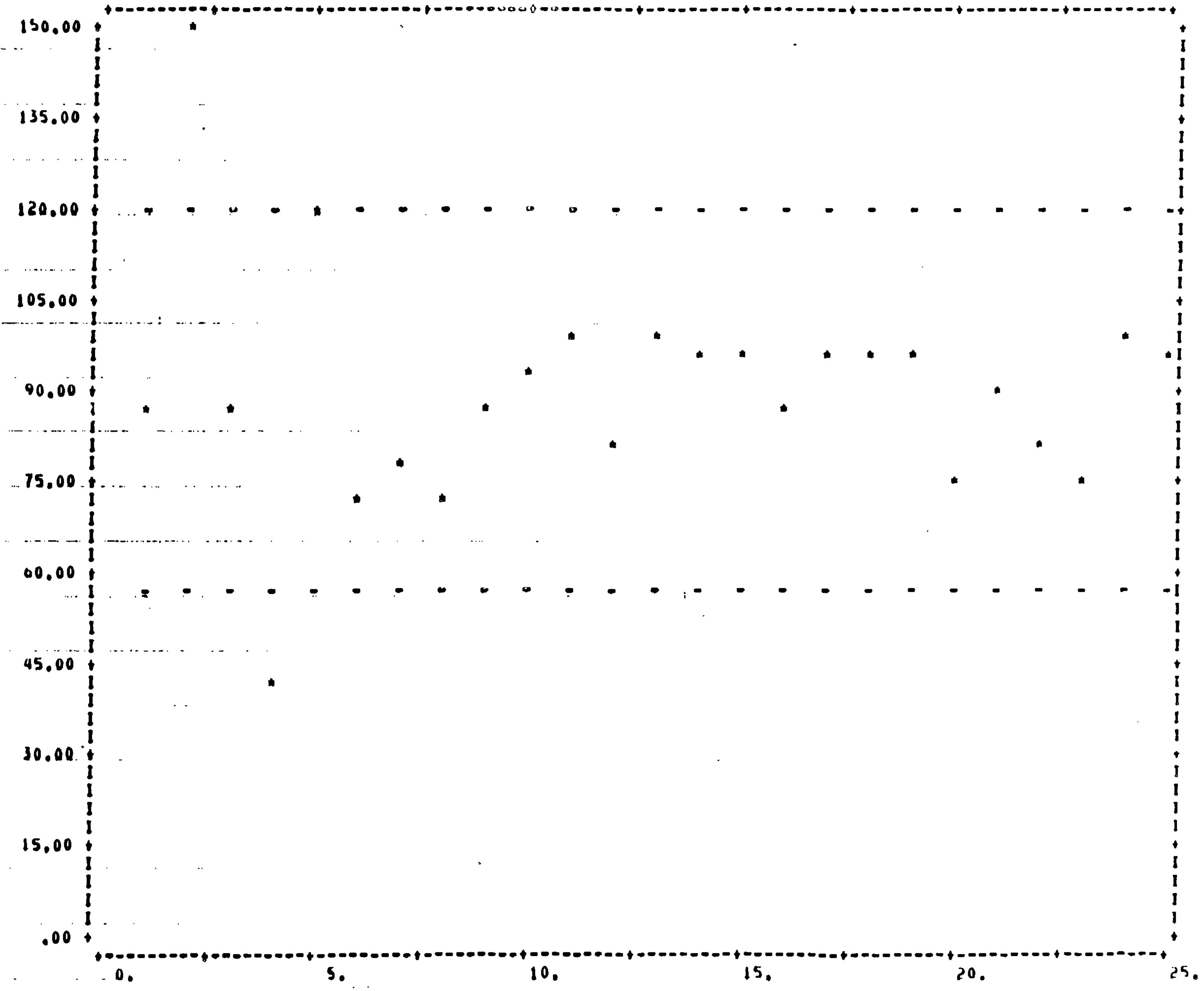

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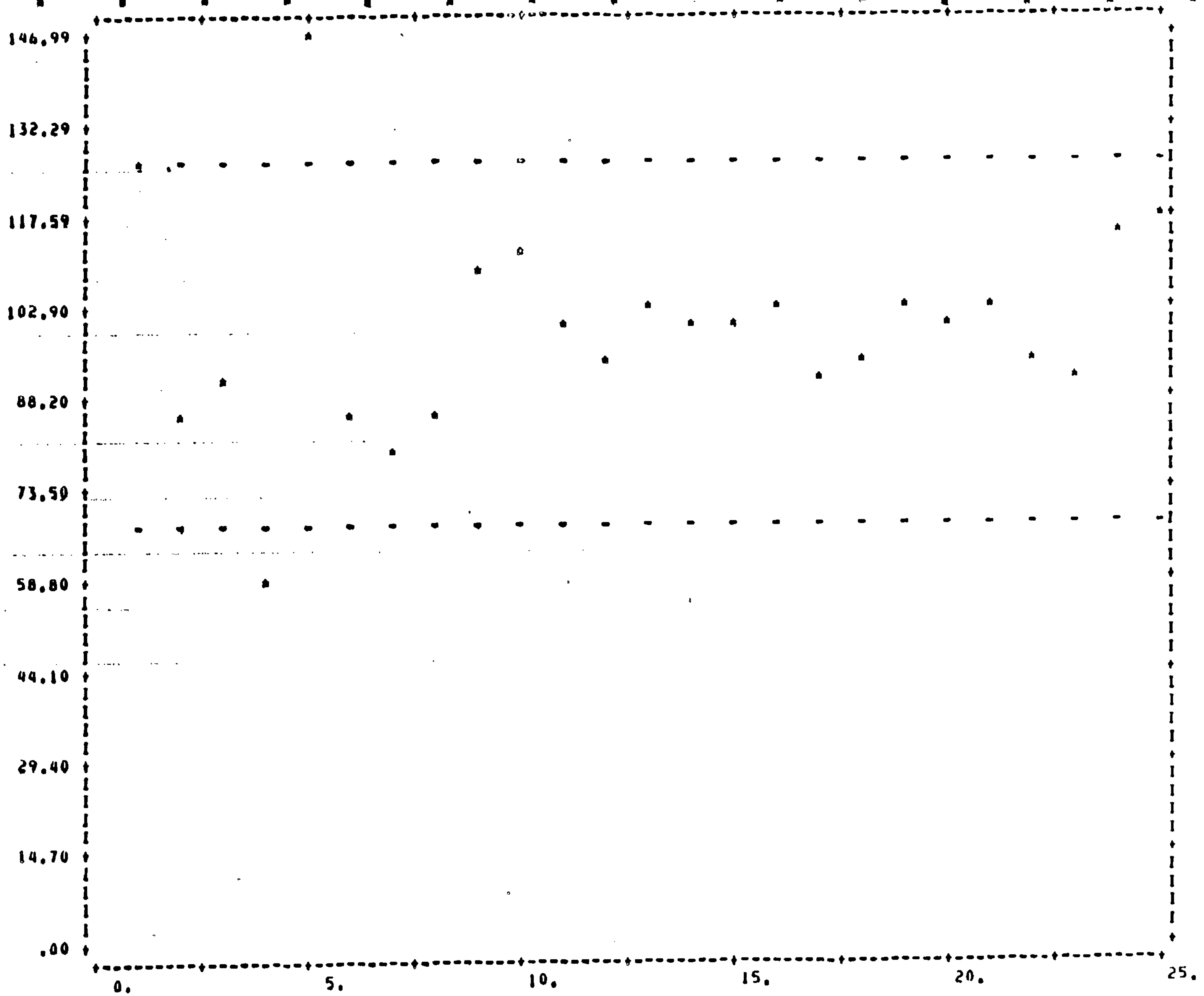

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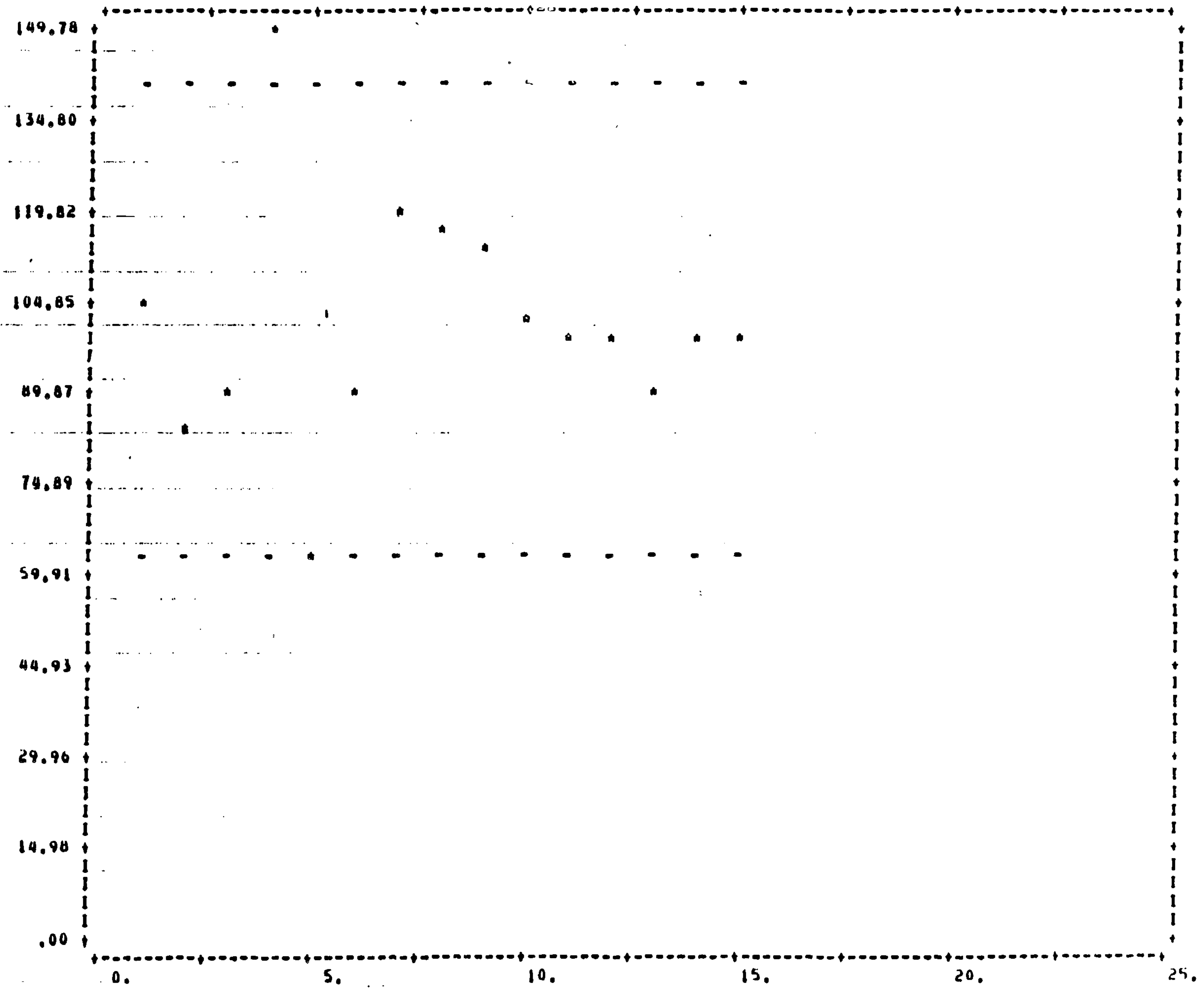
PENC RECI



CL4C2 SAMPLES 39705 THROUGH 50867

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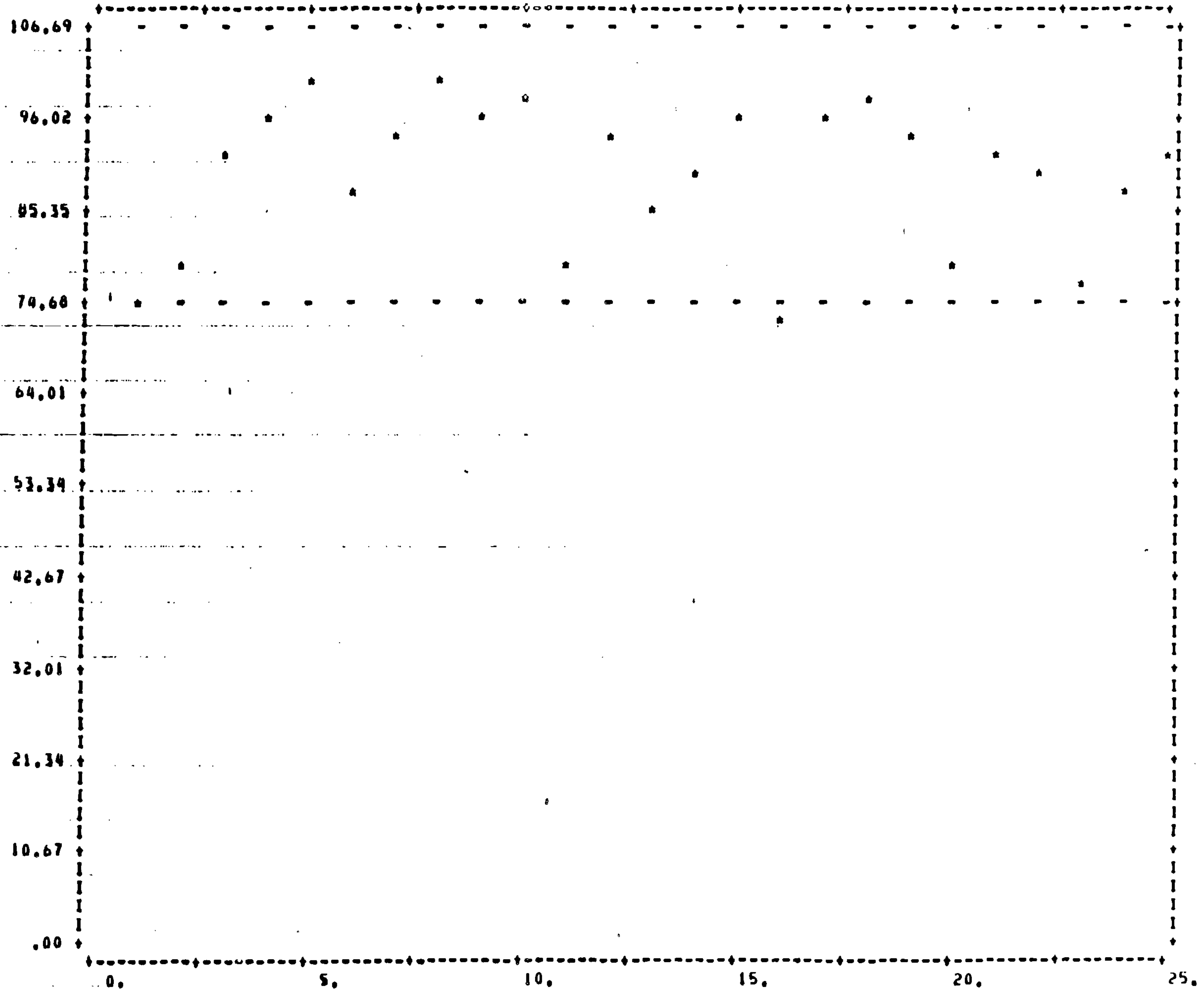
PER REC Y



CH2CL2 SAMPLES 23250 THROUGH 50867

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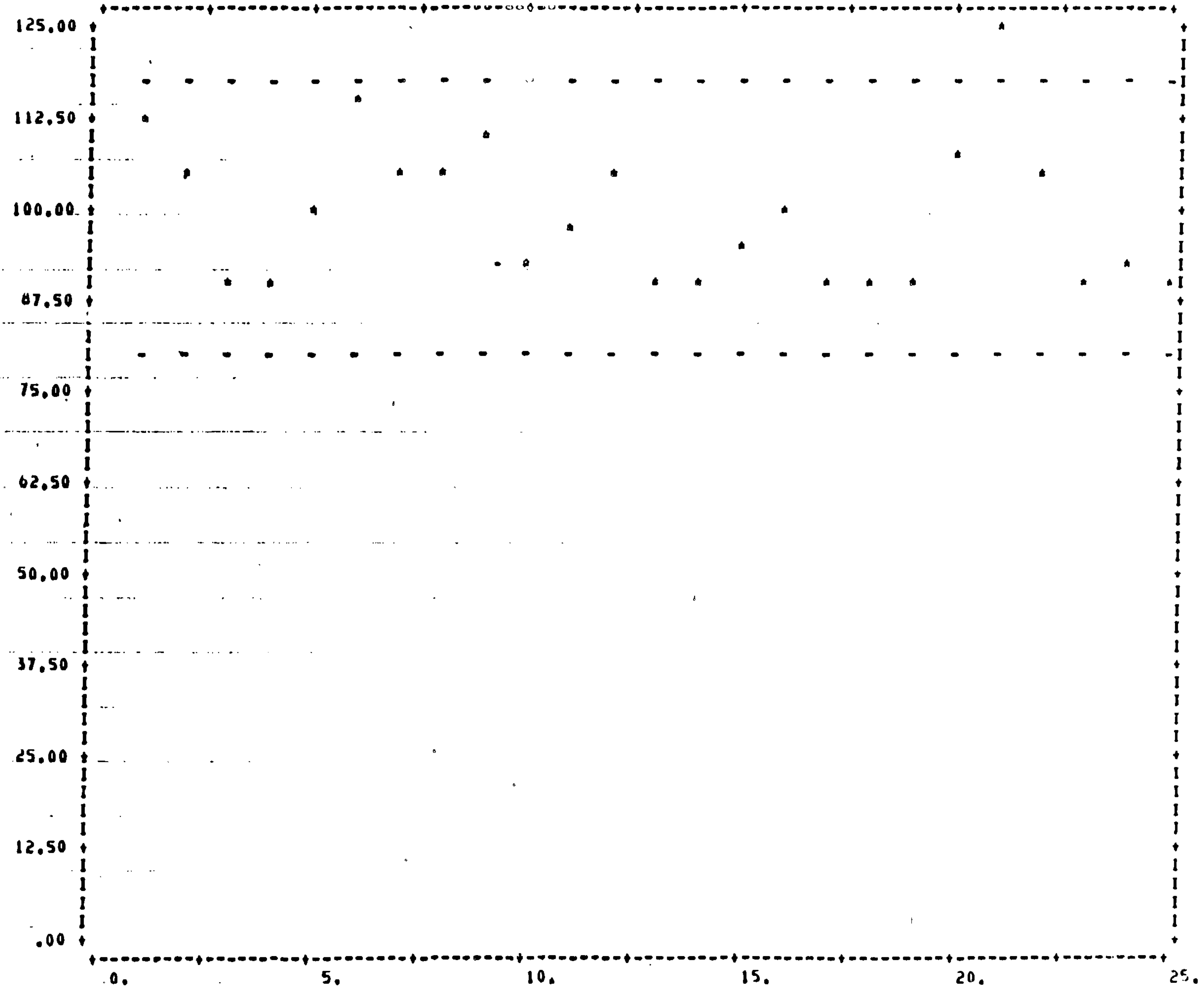
PER REC



TOLUENE SAMPLES 29830 THROUGH 50867

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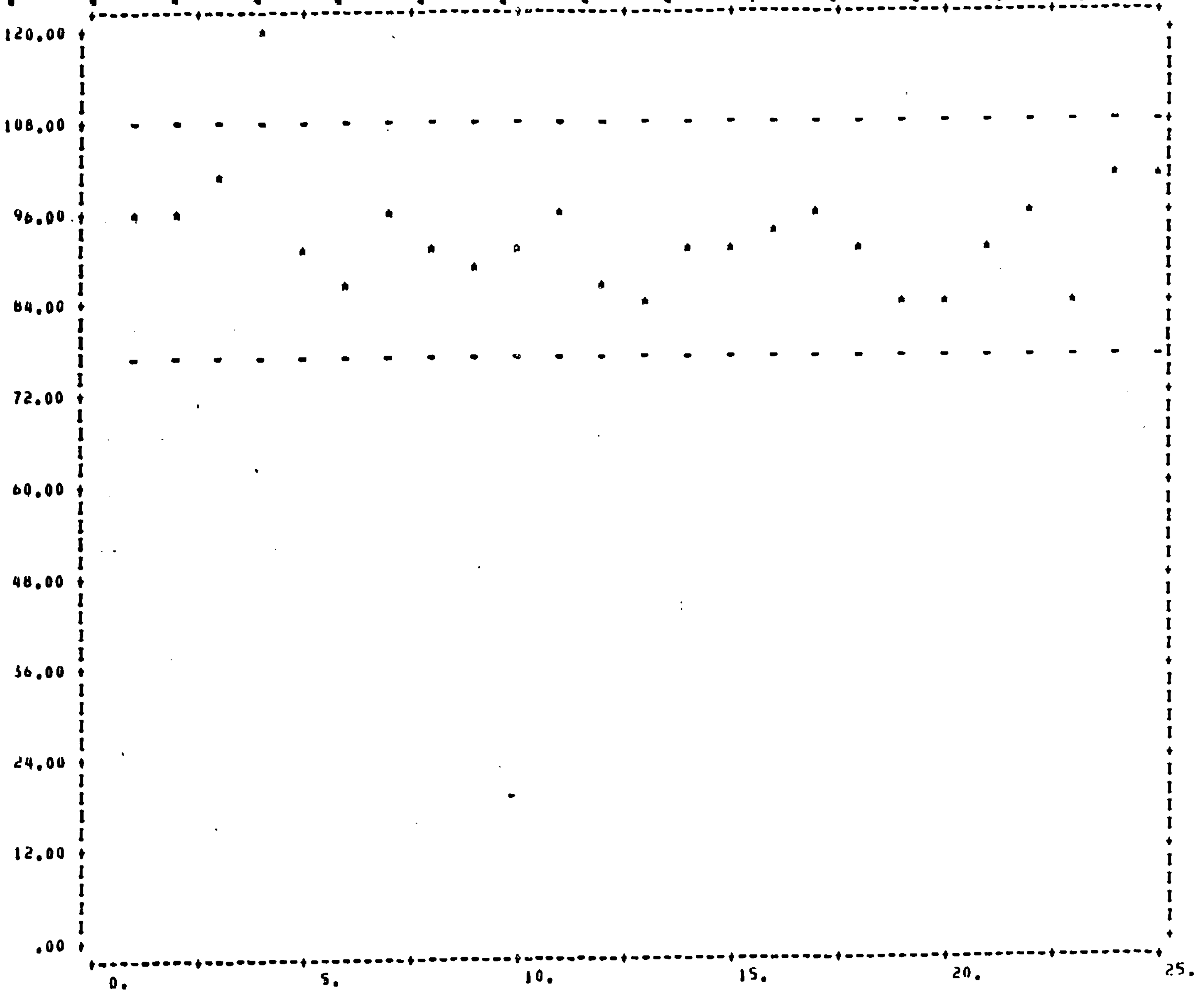

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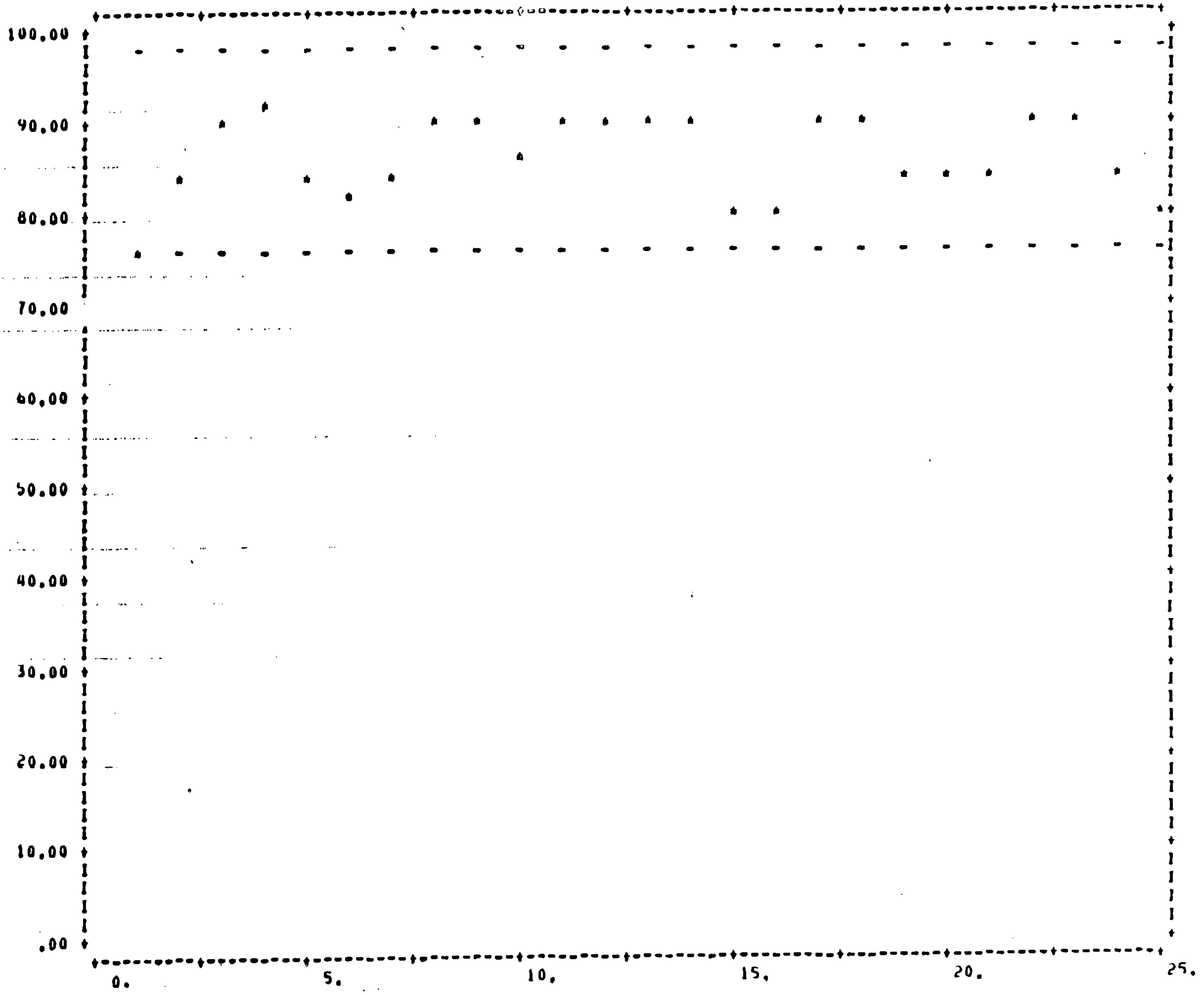
PEN REQ Y



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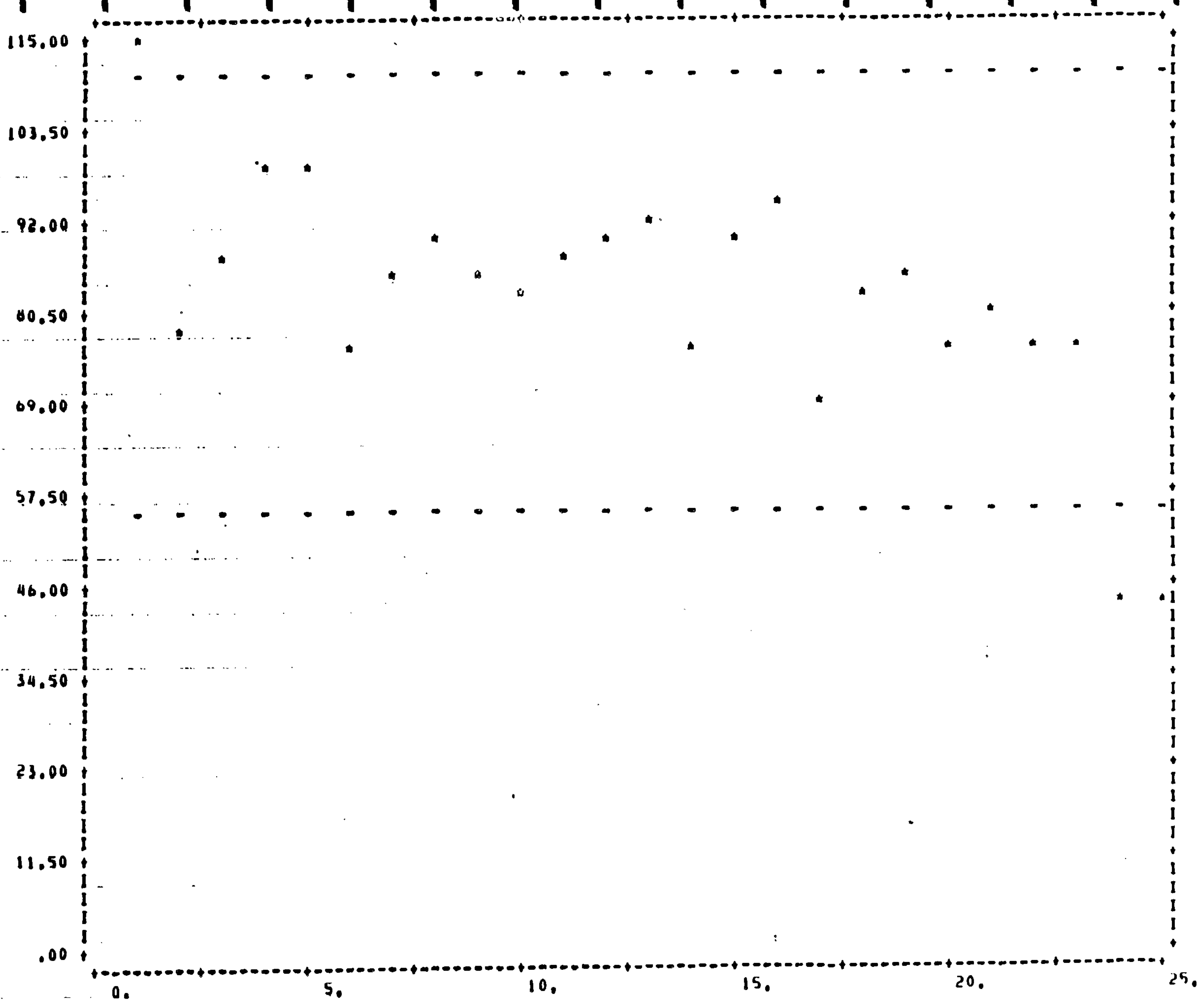

DCETAN12 SAMPLES 40299 THROUGH 50867

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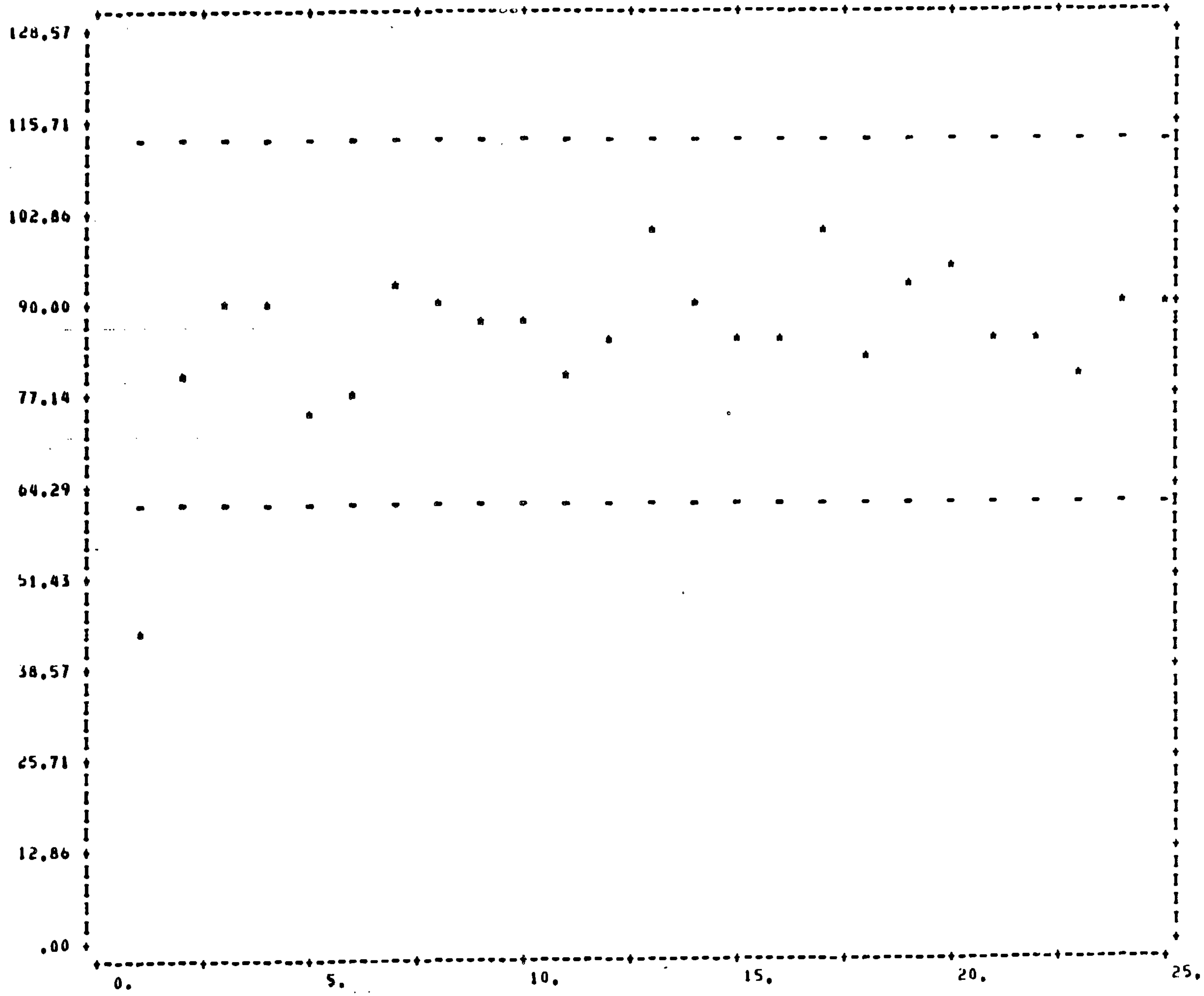

DCLENI1 SAMPLES 23250 THROUGH 50867

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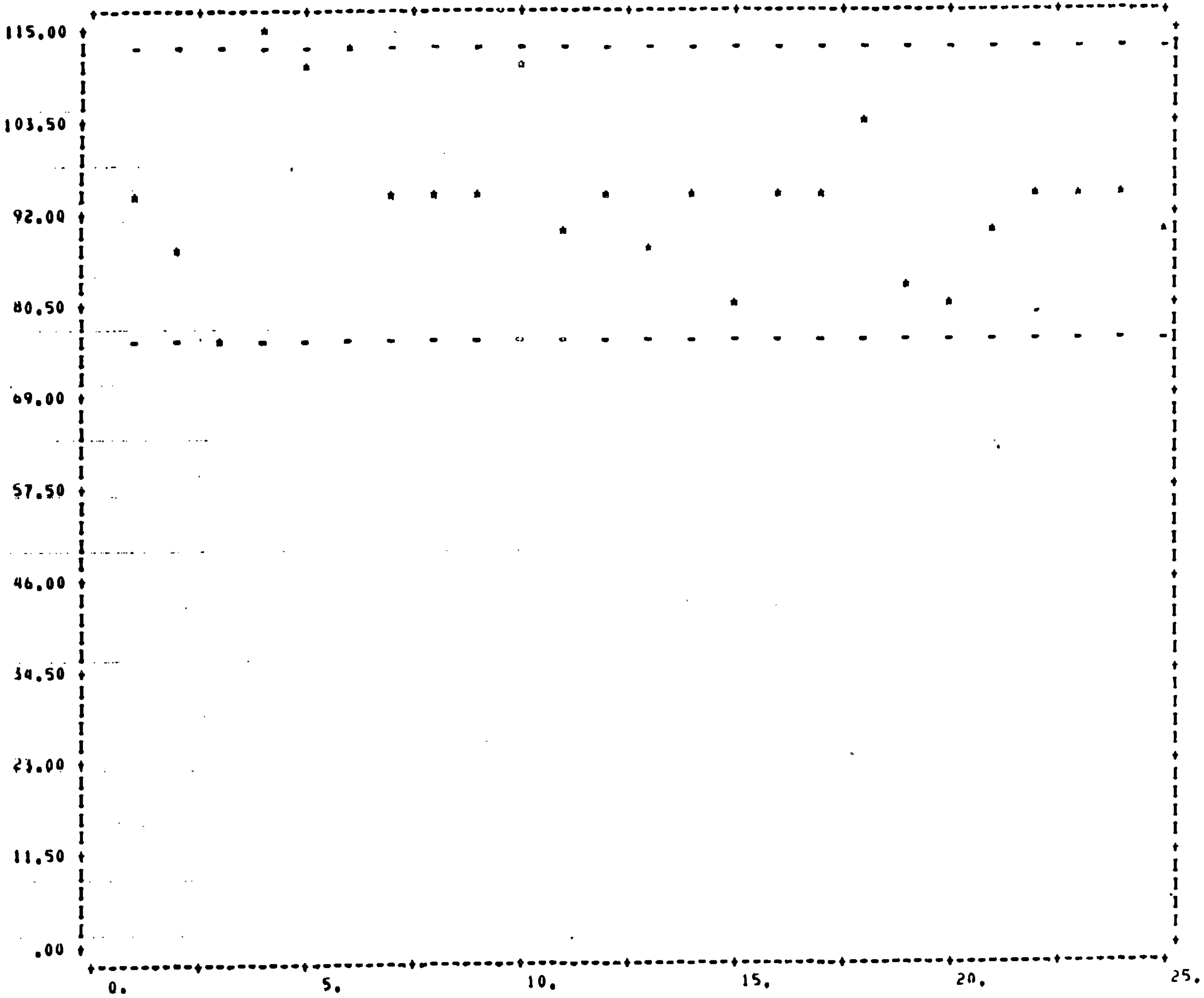

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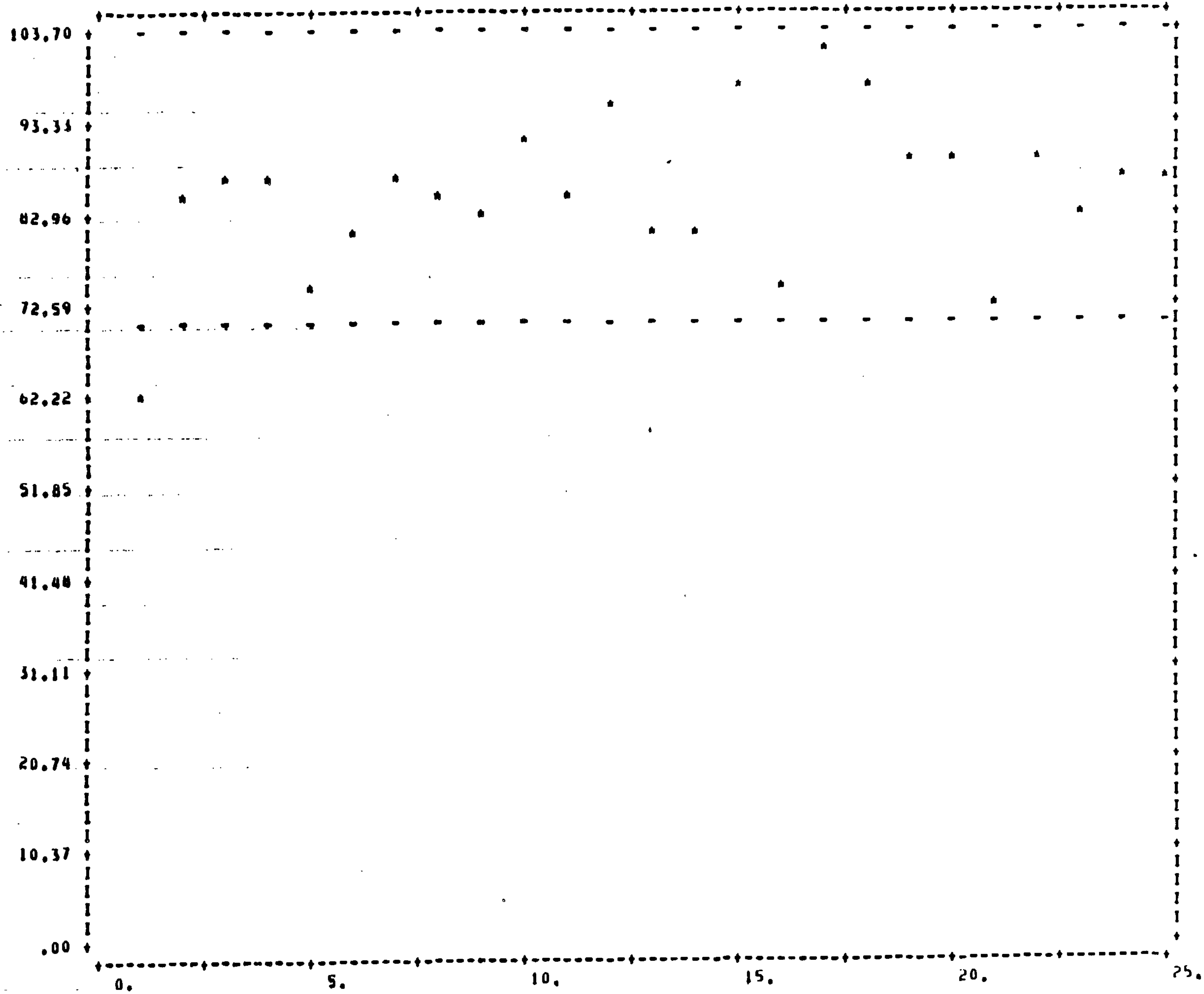

DCLEN12 SAMPLES 23250 THROUGH 50867

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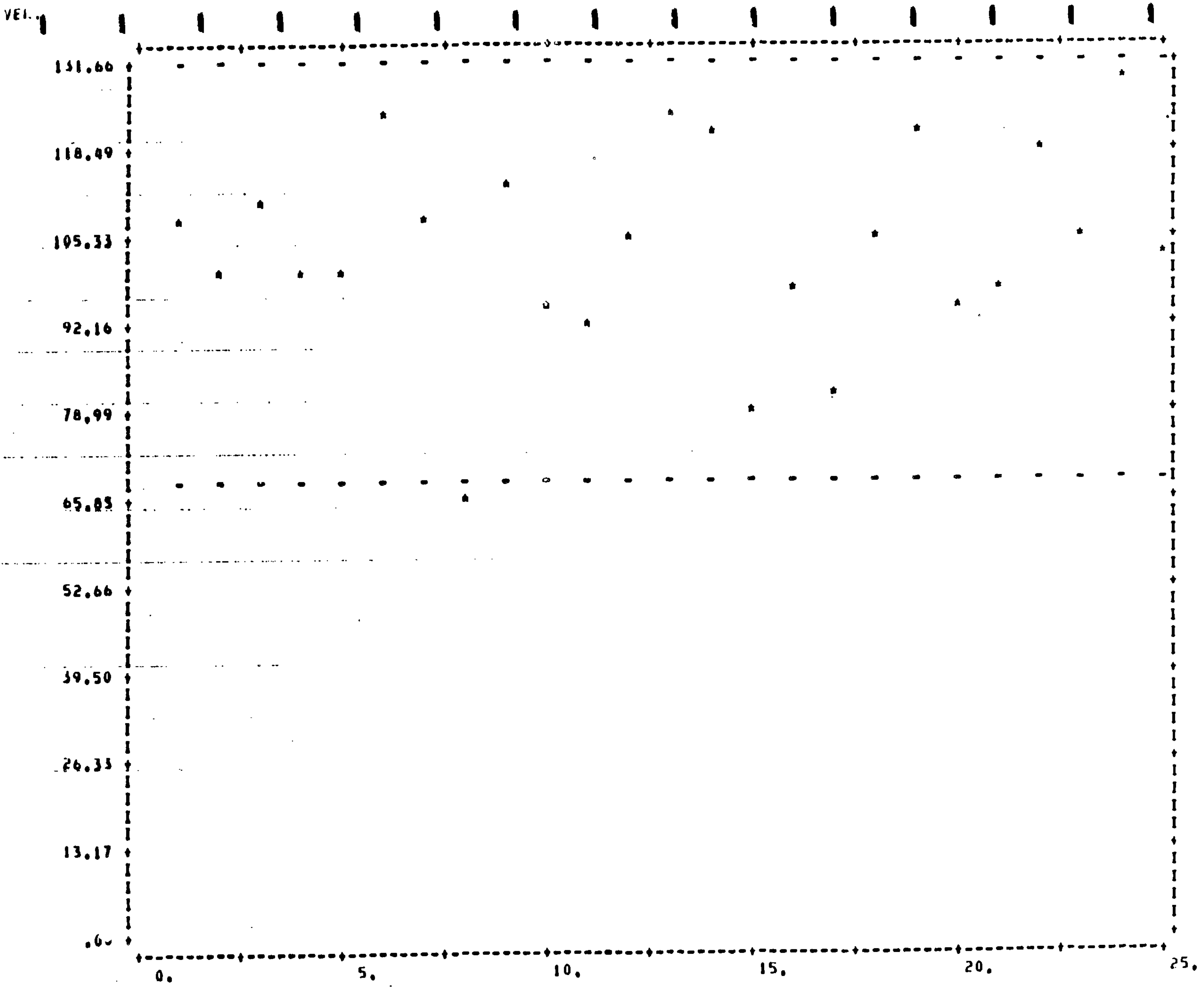

HG SAMPLES 64261 THROUGH 50904

(*) - QC VALUES (-) -WARNING LIMITS
MEAN = 99.1502 STANDARD DEVIATION = 15.7322
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ATTACHMENT 2

PERSONNEL RESUMES

GUY A. SWENSON, III, C.P.G.
MANAGING HYDROGEOLOGIST

BACKGROUND

Mr. Swenson joined O'Brien & Gere Engineers, Inc. in 1982 and was promoted to Manager in 1988. Prior to joining the Firm, he was a consultant for ground water and engineering firms in the Northeast and California, and was employed as a soils engineer in Alaska.

Fields of special competence include ground water resource evaluation for municipal or agricultural water supplies; ground water evaluations at hazardous waste sites; geophysical survey techniques including seismic refraction, electrical resistivity and electromagnetics; geologic mapping; and computer modeling of ground water flow and contaminant transport.

EDUCATION

Occidental College, 1974, BA/Geology
San Diego State University, 1981, MS/Geology
WSV/NWWA Summer Field Practice Program: Exploration Geophysics for Engineering and Hydrogeologic Applications I; August 1982
Butler University - Holcomb Research Institute; Basics of Modeling Ground Water Flow and Pollution; March 1983
Butler University - Holcomb Research Institute; USGS Modular Flow Model for Simulation of Ground Water Flow and Advective Transport; April 1990

PROFESSIONAL REGISTRATIONS

Certified Professional Geologist, #7574

PROFESSIONAL AFFILIATIONS

National Water Well Association
Geological Society of America
American Institute of Professional Geologists

EXPERIENCE

HAZARDOUS WASTE MANAGEMENT:

Experience includes site investigations and assessment, remedial design and risk assessment for industrial waste facilities, contaminant bases and petroleum hydrocarbon bases.

Seneca, Washington, Onondaga, Oswego, St. Lawrence, Broome, Cattaraugus, Steuben and Niagara Counties, New York; Union County, New Jersey; King George, Virginia and Monroe Counties, IN; and Ponce, Puerto Rico - Responsible for supervising and performing site investigations and hydrogeologic assessments of both active and closed municipal and industrial landfills. Activities included: the review of hydrogeologic literature and historic aerial photographs; geologic mapping; geophysical surveys; the installation of test borings and monitor wells; soil and ground water sampling; geologic evaluation of the sites; evaluations of the direction and rate of ground water flow; computer modeling of ground water flow and contaminant transport; and negotiations with regulatory agencies.

Somerset County, NJ; Summit County, OH; Ceical County, MD; and Monroe and Onondaga Counties, NY - Responsible for supervising and performing site investigations and hydrogeologic assessments of active and closed waste lagoons at industrial facilities. Activities included: the review of hydrogeologic literature and historic aerial photographs; geologic mapping; geophysical surveys; the installation of test borings and monitor wells; soil and ground water sampling; geologic evaluations of the sites; and evaluations of the direction and rate of ground water flows.

Somerset, Burlington, Essex, Gloucester and Middlesex Counties, NJ; Fredrick, Howard and Carrol County, MD; King George County, VA; Cortland, Chautauqua, Steuben, Schoharie, Jefferson, Broome, Onondaga, Oneida, Ulster and Monroe and Indiana Counties, New York; Cumberland and Madison County, IL; Pettis County, MO; Ponce Area, Puerto Rico; Gujarat State, India; Hamden and Norfolk Counties, MA; Philadelphia, Monroe Counties, PA; Livingston County, MI; Alameda County, CA - Responsible for development of, supervising and performing site investigations and hydrogeologic assessments of sites of organic and inorganic contaminant bases and disposal at both industrial and non-industrial facilities. Hydrogeologic environments have included unconsolidated glacial, fluvial and marine deposits and fractured bedrock and karst terrain. Activities included: the review of hydrogeologic literature and historic aerial photographs; geologic mapping; geophysical surveys; the installation of test borings and monitor wells; soil and ground water sampling; geologic evaluations of the site; evaluations of the direction and rate of ground water flow, ground water elevation monitoring, aquifer performance tests, computer modeling of ground water flow and contaminant transport; and negotiations with regulatory agencies.

Washington, Saratoga and Indiana Counties, NY and Somerset and Union Counties, NJ - Responsible for supervising and performing hydrogeologic evaluations and design of proposed passive in-place containment structures for municipal and industrial landfills. Activities included: the evaluation of the site hydrogeology for the suitability and effectiveness of passive in-place containment structures; ground water flow modeling of containment structures and negotiations with regulatory agencies.

Alameda County, CA; Cortland, Broome, Ulster, Chautauqua, Monroe and Oneida Counties, NY, Frederick and Howard Counties, MD; Tippecanoe, ID; Burlington and Morris Counties, NJ, and Norfolk County, MA - Responsible for supervising and performing hydrogeologic evaluations and design of proposed and existing ground water control/recovery systems. Activities included: the evaluation of the site hydrogeology for the implementation of ground water control/recovery systems; the hydrogeologic design of the control/recovery systems; ground water flow and contaminant transport modeling of proposed and existing systems; and negotiations with regulatory agencies.

Monroe and Seneca Counties, NY; Bedford County, TN; and Monroe County, PA - Conducted hydrogeologic evaluations and predictions for environmental assessments at industrial waste facilities and other properties. Activities included: evaluations and predictions of the direction and rate of ground water flow and contaminant transport; ground water flow and contaminant transport modeling; and negotiations with regulatory agencies.

Cortland, Niagara, Onondaga, Seneca Counties, NY - Responsible for developing work plan, conducting investigation, preparing report and evaluating remedial options for Remedial Investigation/Feasibility Studies. Activities included developing work plans, negotiating with regulatory agencies, implementation of site investigations, data interpretation and RI report preparation. The evaluation of remedial options for ground water, soil, and source control included ground water pumping, vacuum extraction, soil removal, and no action. Developed and implemented ground water modeling to assist in evaluations of contaminant migration and remedial options.

SPILL PREVENTION CONTROL AND COUNTERMEASURES:

Los Angeles and Alameda County, CA; Tippecanoe County, ID; Hamilton County, OH; Onondaga, Oneida, Chautauqua, Montgomery Counties, NY and Essex County, MA - Responsible for supervising and performing site investigations, hydrogeologic assessments and remedial design and implementation for petroleum hydrocarbon losses. Activities included: the review of hydrogeologic literature; geologic mapping; geophysical surveys; the installation of test pits, test borings and monitor wells; soil and ground water sampling; geologic evaluations of the sites; evaluations of the direction and rate of ground water and immiscible product flow; hydrogeologic design and implementation of product recovery systems; and negotiations with regulatory agencies.

ENVIRONMENTAL ASSESSMENT:

Experience includes performing hydrogeologic assessments under the NJ ECRA laws and hydrogeologic assessments of pesticide application.

Middlesex and Union Counties, NJ - Responsible for supervising and performing hydrogeologic environmental assessments (NJ ECRA) of industrial facilities. Activities included: the review of hydrogeologic literature; the installation of test borings and monitor wells; soil and ground water sampling; hydrogeologic evaluations of the sites; and negotiations with regulatory agencies.

Caroline and Dorchester Counties, MD - Responsible for supervising and performing an environmental assessment of pesticide applications. Activities included: the review of hydrogeologic and soils literature; the installation of test borings and monitor wells; soil and ground water sampling; and hydrogeologic evaluations of the test sites.

WATER RESOURCES:

Experience includes the evaluation of ground water resources and the design and implementation of ground water supply wells.

Kent County, DE; Onondaga, Cortland, Dutchess and Broome Counties, NY; and Jefferson County, PA - Evaluated ground water resources in unconsolidated deposits and bedrock for municipal water supplies and irrigation systems. Activities included review of aerial photographs, geophysical surveys, exploratory drilling, aquifer performance testing, computer modeling and the design of final production wells.

San Diego County, California and Baja, MX - Conducted an extensive study of a rural valley to provide a qualitative description of the ground water hydrology and geology. This study included the use of electrical resistivity surveys, aquifer performance tests, well logging, water chemistry, meteorological data, geologic mapping, literature research and remote sensed data.

New London County, CT - Conducted a seismic refraction survey to delineate bedrock topography for a proposed dam overflow channel.

Onondaga County, NY - Provided technical consulting for the installation of two 1,300 ft. salt brine wells for a local industry.

SOLID WASTE:

Experience includes hydrogeologic evaluations of proposed landfill sites.

Seneca, Tompkins, Cayuga, Dutchess and Orleans Counties, NY - Designed, managed and performed hydrogeologic evaluation of sites for proposed landfill. Activities included surface geophysical surveys, test pits, test borings and the installation of ground water observation wells. Data evaluation included determination of three dimensional ground water flow direction and rates, development of water budgets and chemical characterization of aquifers.

CONSTRUCTION INSPECTION:

Experience includes activities involved with the installation of the Trans Alaskan Oil Pipeline.

Trans Alaskan Oil Pipeline, Alaska - Soils engineer with the responsibility of inspecting the installation of vertical supports and authorizing field redesigns.

RESEARCH

Adirondacks, NY - Responsible for design and implementation of field study of pesticide and herbicide impact on ground water. Study involved installation of monitoring wells, in situ permeability tests, in situ tracer studies, and ground water and contaminant transport modeling.

PUBLICATIONS

Evaluation of Patapsco Aquifer Hydraulics by Tidal Fluctuation Responses. Bogardus, Peter, Swenson, Guy, and Mickam, James. Proceedings of Groundwater Issues and Solutions in the Potomac River Basin/Chesapeake Bay Region. March 1989.

Ground Water Models: Tracking Contaminant Migration. In Hazardous Waste Site Remediation - The Engineer's Perspective. Ed. O'Brien & Gere Engineers, Inc. Van Nostrand Reinhold Co. (New York, 1988).

Design and Evaluation of In-Place Containment Structures Utilizing Ground Water Cutoff Walls; Lynch, Edward R., Anagnost, Stephen W., Swenson, Guy A., and Lee, George W; Proceedings of the Fourth National Symposium and Exposition on Aquifer Restoration and Groundwater Monitoring; May 1984.

Post Construction Ground Water Hydraulics at Loeffel Site at Southern Rensselaer County, NY; Lee, George W., Bhatia, S.K., Swenson, Guy A., III, Clemence, S.P.; International Symposium on Case Histories in Geotechnical Engineering, April 1984.

Evaluations of Ground Water Hydraulics with Respect to Remedial Design, Blasland, Warren V., Jr., Lee, George W., Jr., Swenson, Guy A., III 4th National Conference on Management of Uncontrolled Hazardous Waste Sites, October 1983.

Upper Cretaceous Deep-Sea Fan Deposits, San Diego co-author; in Geological Excursions in The Southern California Area, Geological Society of America, 1979.

JEFFREY E. BANIKOWSKI
SENIOR PROJECT SCIENTIST

BACKGROUND

Mr. Banikowski joined O'Brien & Gere in 1988 following fifteen years of service with the Onondaga County Department of Health. He was promoted to Senior Project Scientist in 1989. Fields of special competence include environmental toxicology, risk assessments and public health evaluations, geologic and hydrogeologic research/investigation, statistics, indoor air monitoring, the implementation of hazardous waste sampling programs and radon mitigation and assessment.

EDUCATION

State University of New York at Fredonia, 1972, BS/Geology
Syracuse University, 1984, MS/Geology

CERTIFICATION

Certified as a Senior Public Health Sanitarian by the State of New York, Certificate #1526.

PROFESSIONAL AFFILIATIONS

Health Physics Society: Western New York Chapter

EXPERIENCE

GROUND WATER SAMPLING PROGRAMS:

Developed ground water evaluation program for Onondaga County, NY in conjunction with Syracuse University and the Central New York Environmental Management Council.

Initiated program to sample over two hundred private drinking water supplies situated in the vicinity of active and inactive landfills.

Performed ambient air monitoring for ammonia and hydrogen sulfide at the Allied-Signal waste beds in Camillus, NY in response to odor complaints. Determined health risk to area residents.

Established ground water and surface water sampling program on behalf of residents living near a former chemical recycling center in Pompey, NY. As a result, the Environmental Protection Agency established an emergency water supply for several residents and placed the center on the National Priorities List of hazardous waste sites.

Implemented a sampling program involving 45 private water supplies located around the Clay Landfill, Clay, NY following allegations of PCB laden material entering the waste stream. Presented findings to the Onondaga County Legislature. Consequently, a public water supply line was installed for the affected residential units.

EMERGENCY RESPONSE:

Liverpool High School, Liverpool, NY - Assisted in the closure and reopening of the High School following a herbicide spraying incident wherein 22 people required medical attention.

Amtrak, Minoa, NY - Coordinated with Chemtrek and local fire department to resolve problems associated with a tank car leaking fuming nitric acid.

Skaneateles Lake, Skaneateles, NY - Assisted NYS Department of Environmental Conservation in evaluating remedial alternatives after a truck overturned and released emulsified asphalt into Skaneateles Lake which provides water to the City of Syracuse.

Stanton Founderies, Solvay, NY - Evaluated health risk posed to workers following an acid spill inside a production facility.

Syroco Corporation, Van Buren, NY - Assessed source and impact of fumes creating noxious odors inside plant facility following its evacuation.

Prepared emergency response protocol to PCB ballast failures for use by local fire departments.

Developed procedure for removal of underground transformer located in a downtown building in the City of Syracuse.

Developed Division of Environmental Health, Onondaga County Department of Health Emergency Response Plan.

AIR MONITORING:

Designed and implemented a Radon Pilot Screening Program on behalf of the Onondaga County Department of Health. This program won recognition from the NY State and National Association of Counties as an innovative and model program for local health departments. Findings from the program were presented to the County Executive, New York State Department of Health, County Legislature, news media, Home Builders Association, and numerous civic groups by request.

North Area Garage Facility, North Syracuse, NY - Developed sampling program for airborne pollutants and made recommendations for ventilation and structural changes to the subject building which housed approximately 40 vehicles.

Administered a residential formaldehyde program on behalf of New York State in order to assess the short and long term retention of this chemical material in air following the installation of urea-formaldehyde foam insulation.

Fairmount Gardens Senior Citizen Center, Camillus, NY - Developed indoor air sampling program for formaldehyde and other aldehydes. Made recommendations for changes in the ventilation system and removal of source materials.

North Syracuse High School, North Syracuse, NY - Performed indoor air sampling related to the replacement of a hot-tar roof. Also, reviewed asbestos documentation to determine compliance with existing regulations and provided recommendations for additional work to the Superintendent of Schools.

HAZARDOUS WASTE INVESTIGATIONS:

Rockwell Plant Site, Syracuse, NY - Conducted oversight of Phase I and Phase II investigations conducted by a private consulting firm on behalf of the Onondaga County Department of Health and the NYS Department of Environmental Conservation.

Stauffer Chemical Corporation, Skaneateles Falls, NY - Reviewed interim clean-up measures and assisted the NYS Department of Health in assessing the health implications associated with an on-site landfill.

Maestri Waste Site, Lakeland, NY - Prepared bid specifications for the installation of monitoring wells, provided field oversight for all work activities, obtained ground water samples and soil samples; presented findings to Town Officials and members of the County Legislature.

Inventoried hazardous waste sites located in Onondaga County in conjunction with City-County Planning Agency.

Administered environmental lead program on behalf of Onondaga County for a period of two years.

Brookhurst, Casper, WY - Participated in soil-gas vapor survey.

Van Buren Landfill, Van Buren, NY - Developed criteria for a Phase II investigation prior to closure.

QUALITY ASSURANCE/QUALITY CONTROL (QA/QC) PLANS:

Blosenski Landfill, West Caln Township, PA - Prepared QA/QC Plan for pre-design activities associated with RI/FS.

Waldick Aerospace Devices, Wall Township, NJ - Prepared QA/QC Plan for the pre-design phase of the RI.

Fort Drum, Fort Drum, NY - Administered preparation of QA/QC Plan for RI/FS.

HEALTH AND SAFETY PLANS:

Keene Landfill, Parkersburg, WV - Prepared site Health and Safety Plan for drum disposal characterization and removal work.

Metaltec/Aerosystems, Sussex County, NJ - Prepared site Health and Safety Plan for workers engaged in the excavation and heat treatment of approximately 10,000 cubic yards of soil.

Fort Drum, Fort Drum, NY - Prepared Health and Safety Plan for RI/FS work activities.

Schilling Atlas Missile Sites 3,4,5,6,7, and 8, KS and MO - Wrote Health and Safety Plans for work associated with the evaluation of potential on-site chemical contamination.

Forbes Atlas Missile Sites 5 and 9, KS - Prepared Health and Safety Plans for the investigation of potential on-site chemical contamination.

Richards-Gebaur Air Force Base, Belton, MO - Developed Health and Safety Plans for an RI/FS related to five areas of potential chemical contamination.

PUBLICATIONS

Hand, Bryce M. and Banikowski, Jeffrey E., 1988, **Radon in Onondaga County, New York: Paleohydrogeology and redistribution of uranium in Paleozoic sedimentary rocks**, Journal of Geology, v. 16, p. 775-778.

Hand, Bryce M., and Banikowski, Jeffrey E., 1988, **Geologic factors affecting indoor radon in Onondaga County,** NY, Northeastern Geology Abstracts:Radon in the Northeast: Perspectives and Geologic Research, v. 10, no. 3, p. 176.

Hand, Bryce M., and Banikowski, Jeffrey E., 1988, **Radon in Onondaga County, New York: Cenozoic Redistribution of Uranium in Paleozoic Sediments**, EOS, Transactions of the American Geophysical Union, v. 69, no. 16, p. 359-360.

ROBERT J. FORESTI
PROJECT HYDROGEOLOGIST

BACKGROUND

Mr. Foresti joined O'Brien & Gere Engineers, Inc. in 1985 after having been employed for four years with a geological/environmental consulting firm. In 1987, he was promoted to Project Hydrogeologist. Mr. Foresti was an Adjunct Faculty Instructor at two local colleges for several years teaching environmental and physical geology.

Fields of special competence include surface and subsurface hydrogeologic and geologic investigations; groundwater resource evaluation for municipal, industrial, and agricultural water supplies; mining and reclamation; geophysics; geologic mapping; petrographic and stratigraphic analyses; and environmental impact analysis.

EDUCATION

Syracuse University, 1984, MS/Geology
State University of New York at Cortland, 1980, BS/Geology
Cayuga County Community College, 1977, AS/Mathematics & Science
Continuing education courses in Aquifer Analysis, Hydrogeology of Sedimentary Basins, and Ground Water Pollution and Hydrology.

PROFESSIONAL AFFILIATIONS

National Water Well Association

EXPERIENCE

MATERIAL SCIENCE RESEARCH:

Experience includes sample collection, evaluation, preparation and development of techniques for mineral and soil microfabric analyses. Representative projects include:

US Army Corps of Engineers, Philadelphia District - Preparation and mounting of vinyl floor tile samples in thin section from Walson Army Hospital at Fort Dix, New Jersey, for the identification and quantification of asbestos using standard petrographic techniques.

Syracuse University, Syracuse, NY - Conducted polyester impregnation of unconsolidated sediments and friable bedrock samples to facilitate thin section preparation and conduct mineral and microfabric analyses.

U.S. Bureau of Mines - Subsurface structural and hydrogeologic investigations utilizing a borehole camera to evaluate bedrock conditions within and proximate to abandoned underground coal mines.

HAZARDOUS WASTE MANAGEMENT:

Experience includes research, site investigation, planning, design, and implementation of hydrogeologic investigations for hazardous waste investigation and remediation projects. Representative projects include:

Cicero, NY - Ground water monitoring program to determine extent of contaminant migration in local aquifer.

Easton, MD - Collected and evaluated literature and field data to provide a qualitative description of the subsurface hydrogeology.

Marion, IL - Conducted geophysical investigation, supervised installation of ground water monitor wells; conducted soil and water sample collection to assess extent of hazardous waste contamination to comply with US Dept. of Interior and US EPA procedures.

Marquette, MI - Implemented ground water monitoring program to determine extent of contaminant migration from an abandoned chemical waste landfill for a chemical manufacturing industry.

Moorestown, NJ - Collected soil and water samples; supervised installation of ground water monitor wells to assess extent of chemical contamination of aquifer to comply with regulations of the New Jersey Department of Environmental Protection.

New Hartford, NY - Ground water monitoring program to determine extent of contaminant migration and development of a contaminant recovery system to comply with regulations of the New York State Department of Environmental Conservation.

Rochester, NY - Conducted soil and water sample collection, and installation of ground water monitor wells to assess the extent of hazardous waste contamination to comply with regulations of the New York State Department of Environmental Conservation.

Rochester, NY - Conducted geophysical investigation, installation of ground water monitoring wells, soil and water sampling to determine the presence and extent of hazardous waste contamination.

Tonawanda, NY - Conducted literature search, geophysics, and hydraulic conductivity testing to determine the subsurface hydrogeology.

WATER RESOURCES:

Experience includes research, planning, design and implementation of hydrogeologic investigations for water resource development. Representative projects include:

Boonville, NY - Evaluation of aquifer safe yield for a municipal water resource development project.

Syracuse, NY - Field geologist responsible for logging and monitoring the installation of deep brine wells for a local chemical manufacturing industry.

Camillus, NY - Conducted electrical resistivity and seismic refraction survey for a ground water exploration project.

ENVIRONMENTAL ASSESSMENT:

Experience includes research, site investigations, planning, design and implementation of environmental impact investigations. Representative projects include:

Syracuse, NY - Conducted investigation of the surficial and bedrock geology as part of environmental assessment to fulfill permit requirements of the New York State Public Service Commission for the development of a 283-megawatt cogeneration facility for Gas Alternatives Systems, Brooklyn, New York.

US Department of the Interior, Bureau of Mines - Surface and subsurface hydrogeologic and structural investigations to assess environmental effects of mine subsidence. Conducted field inspection and logging of drilling, bedrock, cores, piezometers, bedrock and mine conditions at U.S.B.M. projects throughout the Appalachian Coal Mining Region.

New York State Department of Environmental Conservation, Division of Minerals, Mining and Reclamation - Performed collation and analysis of mining and mineral data; assisted applicants in preparing mining and reclamation plans; assisted in enforcement and planning, public relations, environmental impact analyses, soil, bedrock and structural analyses.

MINERAL RESOURCES:

Experience includes research, site inspection, permitting, environmental assessment, contract administration and implementation of mineral resource investigations. Representative projects include:

Barrett Paving Materials, Inc., Syracuse, NY - Located and assessed the quality and quantity of mineral aggregate and prepared Mining and Reclamation plans to fulfill permit requirements of the New York State Department of Environmental Conservation.

Auburn Sand and Stone, Inc., Auburn, NY - Located and assessed the quality and quantity of mineral aggregate, fulfilled permit requirements for a Protected Wetland, and prepared Mining and Reclamation plans to fulfill permit requirements of the New York State Department of Environmental Conservation.

Santaro Construction Corp., Inc., Syracuse, NY - Prepared Mining and Reclamation plans for mining operations in Onondaga, Oswego, Cayuga and Cortland Counties to fulfill permit requirements of the NYSDEC.

Diamond Hill Enterprises, Inc., Camillus, NY - Conducted a geologic investigation of the bedrock geology to assess the volume of mineral aggregate, and prepare Mining and Reclamation plans to fulfill requirements of the NYSDEC.

Lewis, NY - Conducted a ground-based magnetometer survey to delineate anomalous magnetite/ilmenite rich gabbroic deposits.

SOLID WASTE:

Experience includes geologic and hydrogeologic evaluation of proposed and existing landfill sites. Representative projects include:

Tompkins County, NY - Conducted a hydrogeologic investigation of a proposed landfill site. Activities included geophysical surveys, test pit excavations, soil borings, groundwater monitor well installations, hydraulic conductivity testing, ground water sampling, geologic mapping, evaluation of direction and rate of groundwater flow, measurement of surface water/stream flow, water budget calculations, and an evaluation of the surface and groundwater chemistry.

PAPERS

Microfabric, Macrofabric and Microstructure Analysis of Till and the Pleistocene Geology of the Ilion Quadrangle, Western Mohawk Valley, New York (MS Thesis, 1984, Syracuse University, Syracuse, NY).

MICHAEL A. CAPUTO
SCIENTIST

BACKGROUND

Mr. Caputo joined O'Brien & Gere Engineers, Inc. in 1989 and presently works in the Environmental Toxicology Section. His responsibilities include performing health hazard evaluations and preparing Quality Control/Quality Assurance Plans and Design Specifications for work to be undertaken at hazardous waste sites. He also has expertise in environmental sampling protocols and field health and safety evaluation. In addition, Mr. Caputo performs data validations and usability studies to qualify analytical sample results according to various state and federal agency guidelines.

Prior to joining O'Brien & Gere, Mr. Caputo worked for NUS Corporation, Boston, MA. His responsibilities included the coordination of EPA Contract Lab Program (CLP) activities and managing site assessment projects. Mr. Caputo validated data packages and reviewed validations, as well as instructed employees in CLP data validation protocols. He also authored guidelines for an abbreviated CLP data validation protocol.

EDUCATION

Hobart and William Smith Colleges, 1983, BS/Chemistry
University of California at Davis, 1987, MS/Agricultural and Environmental Chemistry

SPECIALIZED TRAINING

Hazardous Waste Operations Training, 40 Hour OSHA Certification
Red Cross Advanced First Aid and CPR

EXPERIENCE

DATA VALIDATION:

Mr. Caputo has seven years of experience working and teaching in inorganic and organic research labs, and has worked as a research biochemist in a hospital biomedical lab. His work involved high pressure liquid chromatography, gas chromatography/mass spectrometry, atomic absorption spectrometry and wet chemistry.

Representative Site Assessment CLP data validation projects include: Annelli Property, Johnson Carlyle Machine Company, Posick Property, Wiremold Company, Highland Avenue Landfill, City of Lowell Landfill, J. and L. Vinagro Landfills, Washington Well #1, Nadeau Landfill and Wessner Landfill.

US Army Corps of Engineers, Richards-Gebaur Air Force Base - Prepared a Quality Control Data Validation Summary Report for data collected in connection with an RI/FS.

Cliffs-Dow Site - Prepared a CLP Data Validation report for data collected for almost 200 samples in connection with an RI prepared on behalf of a PRP.

Peter Cooper/Markham Site - Prepared a Data Validation/Data Usability Report for data collected in connection with a drum and contaminated soil removal project.

Ludlow Sanitary Landfill - National Priorities List Superfund Site - Prepared a Data Validation/Data Usability Report for data collected in connection with an RI/FS prepared on behalf of a PRP.

QUALITY ASSURANCE/QUALITY CONTROL:

Public Service Electric and Gas - Prepared a Quality Assurance Project Plan for an RI/FS of a former coal degasification plant.

US Army Corps of Engineers - Metaltec/Aerosystems National Priorities List Superfund site - Prepared construction specifications for a Chemical Quality Control Plan.

Allied-Signal Chemical Company - Semet Residue Ponds site - Prepared a Quality Assurance Project Plan for an RI/FS of a former wastewater lagoon area.

HEALTH HAZARD EVALUATIONS:

Ashland Chemical Company - Prepared a Site Safety and Health Plan for a subsurface hazardous waste investigation at an active chemical manufacturing plant.

City of Niagara Falls, NY - Prepared a Site Safety and Health Plan for a subsurface investigation in connection with a utility and road reconstruction in an area surrounded by several chemical manufacturing plants.

US Army Corps of Engineers - D'Imperio Property Site, National Priorities List Superfund - Prepared a Chemical Data Acquisition Plan for a pre-design bench scale wastewater treatment facility.

DAVID R. HILL
VICE PRESIDENT
OBG LABORATORIES, INC.

BACKGROUND

Mr. Hill joined O'Brien & Gere Engineers, Inc. in 1971 and was promoted to Manager of Analytical Services in 1981. In 1985, he became General Manager of OBG Laboratories, Inc., and in 1987 was promoted to Vice President. He provides technical expertise and management of projects involving the following areas: hazardous waste analytical protocol development; chain of custody; QA/QC; analysis of water and wastewater; and gas chromatographic analysis of organic compounds.

EDUCATION

Clarkson University, 1971, BS/Chemistry
Syracuse University, 1979, MS/Sanitary Science

PROFESSIONAL AFFILIATIONS

American Chemical Society
American Water Works Association
Member, Subcommittee on Phosphorus, Standard Methods for the Examination of Water and Wastewater, 16th edition.
Member, Subcommittee on Method 514, Purge and Trap and Method 506, TOX Standard Methods for the Examination of Water and Wastewater, 17th edition (in preparation).

EXPERIENCE

Responsible for financial and market efforts of analytical services; also for the supervision, coordination, scheduling and evaluation of data analyzed by a 20 member staff.

Mr. Hill's experience includes the supervision of projects dealing with the following: Organic characterization of a chemical waste pond for a chemical manufacturer; a ground water monitoring program for the analysis of hazardous wastes, volatile halogenated organics and aromatic hydrocarbons for a major manufacturer; analytical programs to support RCRA compliance; provision of analytical support for the identification of hazardous waste material for a metal manufacturer; and analysis of water, sediment and biological tissue samples for PCBs.

Mr. Hill designed OBG Laboratories and purchased instrumentation to provide the following capabilities: Gas chromatography/mass spectroscopy, automated instrumentation, microbiology, virology, atomic absorption, wet chemistry, specific ion electrode chemistry, NMR, ESR, quality control, methods development, infrared and ultraviolet spectroscopy, X-ray crystallography, electron microscopy; interpretation and review of analytical results; oversee a co-op program with area community colleges; oversee analysis of drinking water, wastewater, and industrial effluents; assist in the design of a computerbased laboratory data system; quantitative and qualitative analysis of chlorinated hydrocarbons; fingerprinting organics via liquid partioning and gas chromatographic analysis; proficient in analytical techniques for wastewater analysis.

In addition, he has directed the following specific projects:

Confidential - Ground water monitoring program to assess the extent of volatile halogenated organic contamination. Generation of 40-60 samples per week for three years.

USEPA - Supervise a contract laboratory program (CLP) for the analysis of dioxin samples from throughout the US.

Sangamo Weston, Inc. - Oversee the analytical portion of a remedial investigation at a USEPA Superfund site. Program generated over 500 samples for priority pollutants and dioxin analysis.

Schenectady Chemical, Schenectady, NY - Oversee analytical program for RCRA Part B permitting documentation.

Harter Secrest & Emery Attorneys, Rochester, NY - Direct analytical program in response to state marshall's investigation of alleged improper hazardous waste disposal.

New York State Department of Environmental Conservation - Spill prevention program - involves the fingerprinting of petroleum products in surface waters and potable water supplies to determine the possible source.

Confidential - Oversee hazardous waste analytical program which is on New York State Superfund list. Initially, indicator parameter will be analyzed to determine extent of contamination followed by more extensive characterization of soil and ground water from the site.

Department of Environmental Conservation, Syracuse, NY - Characterization of hazardous waste at fire demolition site. Immediate response needed due to public health concern.

Department of Environmental Conservation, Waterford Pilot Plant, Albany, NY - Analysis of water samples from the pilot plant for the treatment of halogenated organics, including PCBs, using granular activated carbon, macroreticular resins and filtration.

Monsanto Company - Collaborative testing program for evaluation of methods to analyze purgeable halogenated aliphatic and aromatic hydrocarbons. Methods 601, 602, 501.1 and 501.2.

Southwest Research Institute - Collaborative testing program for evaluation of methods for phthalate ester compounds. Method 606.

Onondaga County, NY - Combined sewer overflow characterization analysis; Onondaga Lake and Creek Monitoring analysis; Onondaga County Industrial Waste Study Analysis.

MANUSCRIPTS

Evaluation of New York Bight Lobsters for PCBs, DDT, Petroleum Hydrocarbons, Mercury and Cadmium. Hill, David R., Roberts, Alan E., Tifft, Edwin C. Jr., Bulletin of Environmental Contaminations and Toxicology 29, 711-718 (1982).

Studies of Certain Inorganic Nutrients in Cazenovia Lake. (Thesis) Hill, David R., Syracuse University, December 1979.

PUBLICATIONS

Characterization of Industrial Wastes by Evaluating BOD, COD and TOC. Hill, David R., Spiegel, Stuart J., Journal Water Pollution Control Federation, Vol. 52II, November 1980.

Loss of Polychlorinated Biphenyl Homologues During Chromium Trioxide Extraction of Fish Tissue. Hill, David R., Spiegel, Stuart J., Szelewski, Michael J., Tifft, Edwin C., Jr., Analytical Chemistry, 51:14, December 1979.

BOD, TOC and COD in Industrial Wastes. Hill, David R., Spiegel, Stuart J., Industrial Wastes, 21, November/December 1979.

A General Nutrient Evaluation of Cazenovia Lake. Hill, David R., 1977, (Lake Report 2), p. 80-88, Effler, S.W., Rand, M.E. (eds) Cazenovia Lake Study, 1 - Initiation Department of Civil Engineering, Syracuse University.

ATTACHMENT 3

NYSDEC REPORTING FORMS

ATTACHMENT

Matrix	Volatile Analysis Method # and Number of Samples	Metals Analysis Method # and Number of Samples	Base/Neutral/ Acid Extractables Method # and Number of Samples	Pesticide/PCB Method # and Number of Samples	Other
GROUNDWATER					
SOIL					
LEACHATE					
SLUDGE					
AIR					
FIELD BLANKS					
TRIP BLANKS					
DUPLICATES					
LABORATORY QA/QC					

NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION

SAMPLE IDENTIFICATION AND ANALYTICAL REQUIREMENT SUMMARY

Customer Sample Code	Laboratory Sample Code	Analytical Requirements*					
		*VOA GC/MS	*BNA GC/MS	*VOA GC	*PEST PCB	*METALS	*OTHER

* Check Appropriate Boxes

* CLP, Non-CLP
* HSL, Priority Pollutant

:DU,OPREP,1

NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONS.

SAMPLE PREPARATION AND ANALYSIS SUMMARY

ORGANIC ANALYSES

SAMPLE ID	MATRIX	ANALYTICAL PROTOCOL	EXTRACTION METHOD	AUXILARY CLEAN UP	DIL/CONC FACTOR

NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION

SAMPLE PREPARATION AND ANALYSIS SUMMARY
VOA
ANALYSES

SAMPLE ID	MATRIX	DATE COLLECTED	DATE REC'D AT LAB	DATE EXTRACTED	DATE ANALYZED

NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION

SAMPLE PREPARATION AND ANALYSIS SUMMARY
PESTICIDE/PCB
ANALYSES

SAMPLE ID	MATRIX	DATE COLLECTED	DATE REC'D AT LAB	DATE EXTRACTED	DATE ANALYZED

NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION

SAMPLE PREPARATION AND ANALYSIS SUMMARY

INORGANIC ANALYSES

SAMPLE ID	MATRIX	METALS REQUESTED	DATE RECEIVED	DATE DIGESTED	DATE ANALYZED

ATTACHMENT

Matrix	Volatile Analysis Method # and Number of Samples	Metals Analysis Method # and Number of Samples	Base/Neutral/ Acid Extractables Method # and Number of Samples	Pesticide/PCB Method # and Number of Samples	Other
GROUNDWATER					
SOIL					
LEACHATE					
SLUDGE					
AIR					
FIELD BLANKS					
TRIP BLANKS					
DUPLICATES					
LABORATORY QA/QC					

roup #	Date	CLP Year	Sample No.	Matrix	VOA Compliancy	BNA Compliancy	Pest/PCB Compliancy	Metals Compliancy	CN	Total Phenols	Page No. in the CLP	Non-Complian