Ground Water Sampling and Analysis Plan
City of Statesville
Third Creek Monofill
Statesville, North Carolina
May 8, 1995

Prepared for

The City of Statesville
Statesville, North Carolina

Prepared by

Aquaterra, Inc.
Greensboro, North Carolina

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May 8, 1995

Mr. Joe Hudson
Water/Wastewater Treatment Department
The City of Statesville
Post Office Box 1111
Statesville, North Carolina 28677-1111

Reference: Ground Water Sampling and Analysis Plan
Third Creek Monofill
City of Statesville
Statesville, North Carolina
Aquaterra Job No. 5302100

Dear Mr. Hudson:

Aquaterra, Inc., (Aquaterra) is pleased to submit the attached *Ground Water Sampling and Analysis Plan* for the Third Creek Monofill site in Statesville, North Carolina. The document outlines the sampling procedures and analytical methods to be used during the quarterly sampling events required in the Administrative Order on Consent issued by the North Carolina Department of Environment, Health, and Natural Resources (NCDEHNR), Division of Solid Waste Management (DSWM) and signed on March 8, 1995, by the City of Statesville.

If you have any questions regarding this sampling and analysis plan, please call me at (910) 852-5003.

Sincerely,

AQUATERRA, INC.

Susan Kite

Susan Kite, P.G.
Senior Project Manager

Kirk B. Pollard

Kirk B. Pollard, P.G.
Senior Project Manager

cc: Mr. Douglas D. Vaughn, P.E.-Pierson & Whitman
Mr. George House-Brooks, Pierce, McLendon, Humphrey & Leonard, L.L.P.
Mr. Dan Biur, Acting Chief-NCDEHNR, DSWM

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1 Introduction

The following *Ground Water Sampling and Analysis Plan* (SAP) is for the City of Statesville's Third Creek Monofill hazardous waste management unit (HWMU) at the Third Creek Waste Water Treatment Plant (WWTP) facility located in Statesville, North Carolina (see Figure 1). This SAP is in response to the March 8, 1995, Administrative Order on Consent (AOC) issued by the North Carolina Department of Environment, Health, and Natural Resources (NCDEHNR), Division of Solid Waste Management (DSWM), Hazardous Waste Section (HWS). The SAP provides a brief site history, describes the geologic and hydrogeologic setting, outlines the procedures for sampling and analysis, and presents the schedule for reporting.

Future post-closure care and assessment sampling will be conducted according to this plan.

1.1 Site History

The City of Statesville operates a waste water treatment plant at its Third Creek Facility located in Statesville, North Carolina. The site operates under an NPDES permit (Permit No. 0020591) and a non-discharge permit (Permit No. WQ004040). Concerns of elevated concentrations of cadmium in the treatment system were raised in 1993. The non-discharge permit was modified to allow the removal and landfilling of over 20 years of accumulated solids from Aeration Basins 1 and 2 and the Digester in an effort to reduce the amount of cadmium in the waste water treatment system. The sludge was placed in eight landfill trenches on property near the waste water treatment plant. Subsequent sampling of the landfilled sludge identified cadmium levels in excess of the regulatory limit for cadmium according to the toxicity characteristic leaching procedure (TCLP).

Based upon this investigation and the laboratory analytical results, NCDEHNR, DSWM issued an AOC that was signed by the City of Statesville on March 8, 1995. Following the signing of the AOC, the City of Statesville contracted Aquaterra, Inc., (Aquaterra) to prepare, submit, and conduct a *Phase I Subsurface Characterization Work Plan* to address the requirements of the Order.

The primary objective of the subsurface characterization activities was to determine the subsurface conditions at the site, including determining the ground water flow direction. The characterization activities included the installation of four borings in the surficial aquifer, and one boring advanced to auger refusal. In addition, four shallow ground water monitoring wells were installed and sampled. Aquaterra completed the subsurface characterization activities in mid-April 1995.

1.2 Overview of the Ground Water Sampling and Analysis Plan

The purpose of this *Ground Water Sampling and Analysis Plan* is to establish the standard operational procedure to monitor ground water conditions prior to and following closure of the HWMU (former sludge disposal area) and during further assessment activities. This SAP includes the procedures for sample collection, sample preservation, analytical procedures, and chain-of-custody control. The following are the six key components of the SAP:

- Ground Water Monitoring System
- Ground Water Sample Collection
- Sample Preservation and Handling
- Chain-of-Custody Control
- Analytical Procedures
- Sample Collection Schedule

1.3 Physical Setting

The Third Creek facility is located near the City of Statesville in Iredell County, North Carolina. The site is situated on a dirt road that intersects Third Creek Road southeast of Statesville. The site is bordered to the north by pasture land, to the south by Third Creek, to the east by residential property, and to the west by wooded land.

2 Ground Water Monitoring System

2.1 Hydrogeologic Setting

The site is located in the Piedmont physiographic province of North Carolina. The surrounding topography consists of rolling land with broad ridges. The surficial geology consists of residual soils that have weathered in place from the underlying bedrock. A review of the Geologic Map of North Carolina (1985) indicates the site is located in the Charlotte Belt and is underlain by a fine grained biotite gneiss that is massive to strongly foliated with minor layers of amphibolite and muscovite schist.

2.2 Ground Water

The ground water underlying the Third Creek Monofill facility is typical of shallow aquifers within the Piedmont physiographic region of North Carolina. Unconfined water table conditions exist across the site. Under these conditions, the water table surface is in equilibrium with the atmosphere, with no confining units present between the water table and ground surface. Recharge to the water table occurs through direct infiltration of precipitation. Discharge from the aquifer occurs at topographic and hydrogeologic lows where the water table and surface water bodies are in contact.

Aquaterra installed four shallow ground water monitoring wells (MW-5, MW-6, MW-7, MW-8) at the site to determine ground water flow direction, to characterize ground water impact, determine vertical and horizontal extent of impact, identify

migration of hazardous substances, and assess adverse effects or risks, if any, associated with the presence of identified contaminants at the site. In addition to these four monitoring wells, four other monitoring wells (MW-1, MW-2, MW-3, MW-4) were installed previously (see Figure 2).

All monitoring wells installed by Aquaterra were constructed in accordance with the requirements of NCDEHNR, Division of Environmental Management (DEM). The top of the inner casing of each well has been surveyed to establish the vertical elevation relative to a fixed reference datum (see Table 1). Each well is provided with a protective outer casing and lock to prevent inadvertent entry into the well.

The most recent set of ground water levels was completed on May 2, 1995. Based upon the data generated as part of that sampling effort, the direction of ground water flow appears to be to the southwest, responding to an average horizontal hydraulic gradient of approximately 0.016 foot per foot (see Figure 3).

In addition to the four ground water monitoring wells, Aquaterra installed one soil boring to auger refusal, which occurred at 86 feet below grade. Please refer to Aquaterra's *Phase I Subsurface Characterization Report* (GR5057), dated May 5, 1995.

3 Ground Water Sample Collection

3.1 Review of the Sampling Plan

This SAP will be reviewed by the sampling team and site manager prior to collecting ground water samples. The team and site manager will develop a schedule as to which monitoring wells will be sampled and which samples will be duplicated. The correct number of sample containers will be secured and labelled prior to each field sampling event.

3.2 Ground Water Sample Collection Log Book

A ground water sample log book will be maintained at the facility to document each sampling event. The following field observations will be documented in the log book for each well:

- well number
- sample date
- name(s) of the people present
- weather conditions
- unusual site conditions (e.g., damaged well casings, well cover missing)
- total well depth below the measuring point
- depth to the water level below the measuring point
- height of water column
- well diameter
- well volume
- amount of water removed during purging
- number of well volumes purged

- equipment used for purging
- sample collection time and date
- equipment used for sample collection
- field parameters (pH, specific conductance, temperature)
- types and numbers of sample containers filled at each well and any special handling procedures

3.3 Water Level Measurements

Prior to well purging or sampling of any well on-site, water level measurements to the nearest 0.01 foot will be recorded for all wells on-site. In addition, the total depth of each well will be measured to the nearest 0.01 foot. An electronic water level meter will be used to determine the depth from the measuring point (i.e., top of the casing) to the water level. Water level measurements will first be obtained from monitoring wells historically exhibiting the lowest concentrations and will proceed to those wells exhibiting increasing concentrations. Prior to measuring water levels, those wells equipped with air tight caps on the inner casing will have the caps removed in sufficient time to allow the equilibration of the water in the well.

After the water levels are measured, the electric probe and first few feet of cable will be wiped with a phosphate-free, low-residue laboratory soap. The equipment will then be rinsed with distilled water and dried with a clean paper towel. All sampling personnel will wear protective/nonreactive vinyl gloves throughout the water level monitoring procedures.

3.4 Well Purging

A dedicated Teflon bailer, new disposable bailer, or a submersible pump will be used to purge each monitoring well of a minimum of three well volumes, or to dryness, prior to sampling. Wells constructed in low hydraulic conductivity silts and clays will be gently purged so as not to disturb the silts and clays, which could produce a turbid ground water sample. When using a dedicated bailer for purging, the bailer will be lowered gently into the water column to purge the upper portion of the column. Once purging has been completed, pH, conductivity, and temperature will be measured and recorded.

The purging procedure will continue until indicator parameters (i.e., pH, specific conductance, temperature) have stabilized. Stabilization consists of three consecutive readings taken at approximately 5-minute intervals where the parameter values are within 10 percent of each other. Well water stabilization will be documented in the log book.

All water purged from the monitoring wells will be containerized in unlined 55-gallon drums on-site that will be labeled with the date, contents, and well number(s).

Disposal of the purge water will be based upon the analytical data obtained from the sampled wells. If the results reveal hazardous constituents, the material will be properly disposed of, or treated and disposed of, in an approved manner.

3.5 Decontamination of Sampling Equipment

Dedicated Teflon bailers used to purge and sample monitoring wells will be properly etched for identification, laboratory decontaminated, wrapped in aluminum foil, and sealed in a polyethylene bag at the laboratory. Therefore, field decontamination of dedicated bailers should not be necessary. New disposable bailers used for purging and sampling will be discarded following use.

Submersible pumps used for purging and sampling will be decontaminated between each well by inserting the pump in a tap water/laboratory grade soap mixture, pumping and recycling the mixture through the pump for a period of about 10-minutes, then inserting the pump in a deionized or distilled water rinse and allowing the pump to recycle the water for a period of about 5-minutes. The outside of the pump and tubing will be rinsed with deionized or distilled water as it is lowered into the well.

3.6 Well Sampling

The following sections discuss the required equipment and details of well sampling. Based on historical analytical results, sampling of wells will begin with the least contaminated and then proceed to the remaining wells in order of increasing contaminant concentration.

3.6.1 Required Equipment and Materials

The following equipment and materials will be used to sample the monitoring wells:

- safety glasses
- vinyl gloves
- Teflon bailers, disposable bailers, or submersible pump
- nylon cord
- field log book
- sample bottles
- temperature/pH/conductivity meter
- labels and permanent marking pen
- knife
- plastic sheeting

3.6.2 Procedure for Collection of Ground Water Samples

The following procedure will be used to collect ground water samples:

1. Plastic sheeting with a hole cut in the center will be placed over the well casing and lowered to ground surface to prevent the bailer cord and sampling equipment from contacting the ground during sampling.

2. Closed top Teflon bailers, or new disposable bailers, with new nylon cord will be used to sample the shallow wells. Bailers will be lowered slowly into the well so as not to cause excessive aeration.

Protective/nonreactive vinyl gloves or equivalent will be worn wher sampling the well. Sample parameters listed in their order o collection are listed below in Section 3.6.3.

In those wells sampled with a submersible pump, a 2-inch Grundfos Rediflow-2 brand pump will be used. This pump has controls to vary the flow and is capable of pumping at the low flow rates required by EPA for ground water sampling. The pump will be gently lowered into the well to approximately the mid-point of the well screen and allowed to pump at approximately 0.25 or less gallons per minute for sampling purposes.

3. Samples collected for volatile organic compound (VOC) analysis will be collected in glass vials with a Teflon covered septum top. The samples will be collected with no headspace in order to prevent volatilization. If no preservative is used, the samples for VOC analysis will be analyzed within 1 week of collection. Samples collected for VOCs and metals will not be filtered.

3.6.3 Order of Sample Collection

Samples should be collected in the order of volatilization sensitivity. The recommended order of sample collection for common parameters is as follows:

- VOCs
- total organic halogens (TOX)
- total organic carbon (TOC)
- semivolatile organic compounds (SVOCs)
- herbicides/pesticides
- total metals
- field parameters (pH, temperature, specific conductance)

3.6.4 Well Sampling Data

The following will be recorded for each well in the sample collection log book:

- sample time and date
- equipment used to sample
- field parameters (e.g., pH, specific conductance, temperature)
- analytical method, order of sample collection, type of container, and preservative (if any)

4 Sample Preservation and Handling

4.1 Sample Containers

The sample containers used for each analysis are outlined in Table 2. Metals will be collected in polyethylene containers with polypropylene caps, or in glass. Organics will be collected in glass bottles with fluorocarbon resin-lined caps. The containers will be cleaned by the laboratory based on the analyte of interest. Sample containers for metals will be cleaned as follows: thoroughly washed with nonphosphate detergent and tap water, and rinsed with (1:1) nitric acid, tap water, (1:1) hydrochloric acid, tap water, and, finally, distilled water. The cleaning procedure for organic bottles is as follows: washing with nonphosphate detergent in hot water, rinsing with tap water, distilled water, acetone, and, finally, with pesticide grade hexane. Glass bottles may be baked in a muffle furnace at 400^{o}C for 15 to 30 minutes to remove organic deposits. Glassware will be sealed and stored in a clean environment immediately after drying or cooling to prevent any accumulation of dust or other contaminants.

4.2 Sample Preservation

Preservatives are added to a sample container to retard biological action, to retard hydrolysis, and to reduce sorption effects. Preservation techniques are limited to pH control, chemical addition, refrigeration, and protection from light. The preservation methods are outlined in Table 2.

4.3 Special Handling Considerations

Samples will not be filtered in the field before addition of preservatives. Samples will be transferred from the bailer or pump directly to the laboratory containers. Field logs and laboratory analysis reports will denote the presence of headspace in the sample containers at the time of receipt by the laboratory as well as the time the sample was first transferred to the sample container from the bailer. Bottles for VOCs will contain no headspace after filling.

5 Chain-of-Custody Control

5.1 Sample Labels

Field personnel will affix legible labels to each sample container before the ground water sampling event. The labels will be sufficiently durable to remain legible even when wet and will contain the following information:

- place of collection
- sample identification
- date and time of collection
- parameter(s) for which the container is required
- type of preservative
- name of collector

5.2 Chain-of-Custody Record

A chain-of-custody form will be completed to establish the documentation necessary to trace sample possession from the time of collection to the completed analysis (see Appendix A). A chain-of-custody record will be generated for each sampling event and for each analytical laboratory, if samples are delivered to more than one. The following information will be entered on the chain-of-custody:

- sample and well identification
- date and time of sample collection
- signature of sample collector, transporter, and laboratory person receiving sample
- inclusive dates of possession
- number of containers
- parameters requested for analysis
- field observations
- laboratory number
- special requests

5.3 Transportation to Analytical Laboratory

After each well location has been sampled, the samples will be transferred in a cooler. The samples will be chilled to approximately 4°C by placing crushed ice on the samples. The samples will be transported to the analytical laboratory after the completion of the sampling event. In accordance with EPA protocols, the samples will be relinquished to laboratory personnel with the time, date, and signature recorded on the chain-of-custody form. A copy of the form is shown in Appendix A.

6 Analytical Procedures

6.1 Analytical Methods

At the laboratory, all samples will be analyzed to EPA methods specified in *Test Methods for Evaluating Solid Wastes,* SW-846, 3rd Edition. The laboratory will clearly state if a deviation from the specified method occurred and the reasons for the deviation. Table 2 lists the methods to be used for analysis.

6.2 Records

Records of ground water analysis will include the methods employed, extraction date, digestion date, date of actual analysis, the concentration detected, the units of concentration, and the detection limits. Data from samples that are not analyzed within recommended holding times will be considered suspect. New samples will be collected from the source that corresponds with the suspect data to confirm the concentration of the original analysis. Any deviation from the listed methodologies will be explained and supported with sufficient information to ensure that the quality of the results meets the performance specifications of the referenced method.

6.3 Quality Assurance Program

The Quality Assurance (QA) programs used for ground water will consist of different travel blanks, duplicate samples, field blanks, and split samples as required by DSWM. The definition of each of these terms follows.

Travel blanks are defined as distilled and deionized, analyte-free water that is supplied by the laboratory in the appropriate sample container, treated (if preservatives are used), and handled in the same manner as the samples. The travel blanks can be indicators of any contamination that may have occurred in transport or in the laboratory.

Duplicate samples are defined as multiple samples that are identical. These samples must be collected at the same time, from exactly the same location, using the same sampling apparatus. Also, these samples should be collected in identical containers that have been similarly prepared and filled to the same volume. Duplicate samples are preserved and handled in identical fashion.

Field blanks are defined as distilled and deionized, analyte-free water that is collected in the field, containerized, treated (if preservatives are used), and handled in the same manner as other samples. The field blanks can be indicators of any atmospheric or sampling equipment contamination that may be present.

Finally, split samples are not planned for the program unless requested by DSWM, the analytical laboratory results become suspect, or unexpected contaminants are detected. A split sample is an aliquot of a collected sample that will be analyzed by a different method or another qualified laboratory to verify the original data.

7 Schedule for Sample Reporting

7.1 Dates

Samples will be collected from the listed monitoring wells at the Third Creek Monofill facility on a quarterly basis (March, June, September, December). DSWM will be notified at least 5 working days before each sampling event.

If necessary, ground water sampling conducted as part of on-going ground water assessment activities will be performed periodically during each successive phase of ground water assessment.

7.2 Sampling Locations

The sampling locations for the post-closure ground water monitoring program will include wells MW-5 through MW-8, with ground water elevations collected from wells MW-1 through MW-8. If additional ground water monitoring wells are required or if wells have been properly abandoned, then this SAP will be amended to reflect the changes.

7.3 Analytical Parameters

Monitoring wells MW-5 through MW-8 will be analyzed for the parameters listed below. Modifications to the list of parameters is subject to the approval of the DSWM.

RCRA Primary Metals

Arsenic
Barium
Cadmium
Chromium
Lead
Mercury
Selenium
Silver

Other Metals

Iron
Manganese
Sodium

Other Parameters

Fluoride
Nitrate
Sulfate
Chloride
Phenols
Radium
Gross Alpha
Gross Beta

Organics

Volatile Organic Compounds (VOCs)
Total Organic Halogens
Total Organic Carbon

Field Parameters

pH
Specific Conductance
Temperature

Herbicides/Pesticides

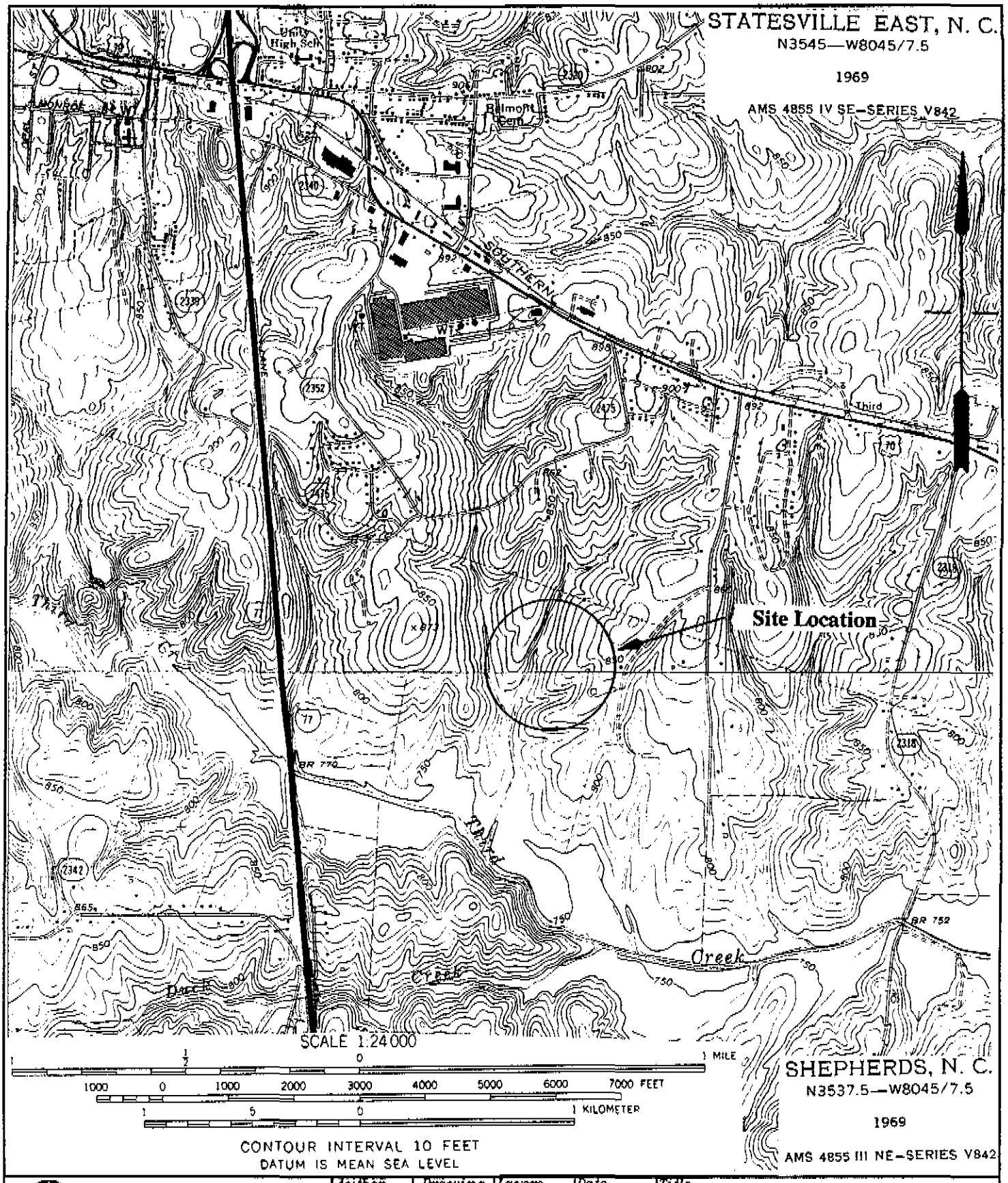
Endrin
Lindane
Methoxychlor
Toxaphene
2,4-D
2,4,5-TP Silvex

Monitoring wells sampled as part of on-going ground water assessment activities will be established in the appropriate ground water assessment plan that will typically include sampling for VOCs, SVOCs, metals, and field parameters only, unless otherwise requested by DSWM.

7.4 Submission of Reports

Reports of each quarterly sampling event will be submitted to DSWM within 30 days of the completion of the laboratory analysis. Each report will contain the field parameters, static water level measurements, water level elevations, sampling descriptions, analytical results, and conclusions and recommendations.

Ground water assessment reports will be submitted according to the schedule included in the respective ground water assessment work plan.



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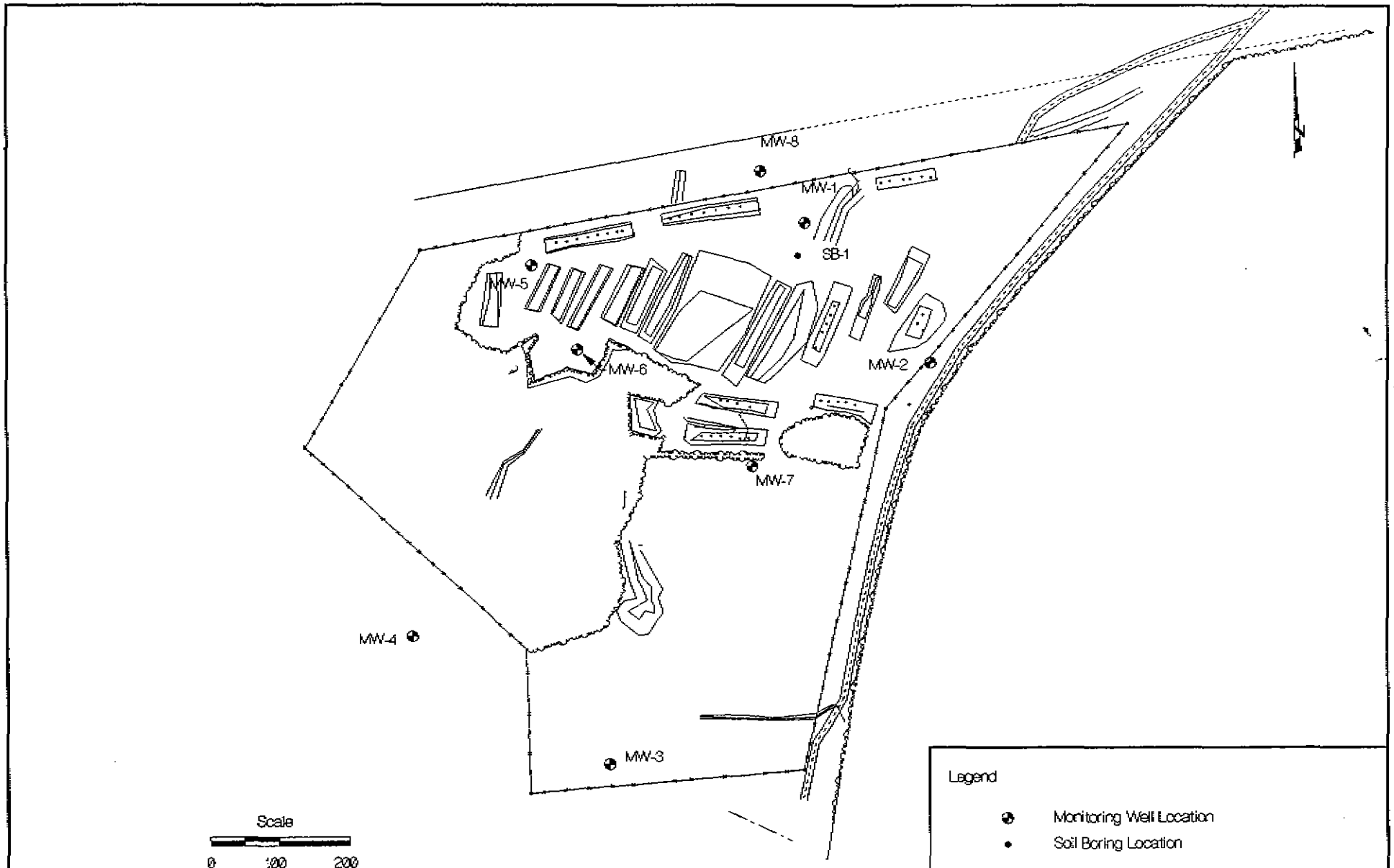
Author	Drawing	Layers	Date	Title
sk			4-07-95	Site Location Map
Job No.	Revision	Figure	Scale	Project
5302100		1	1:24,000	Third Creek Monofill Statesville, North Carolina



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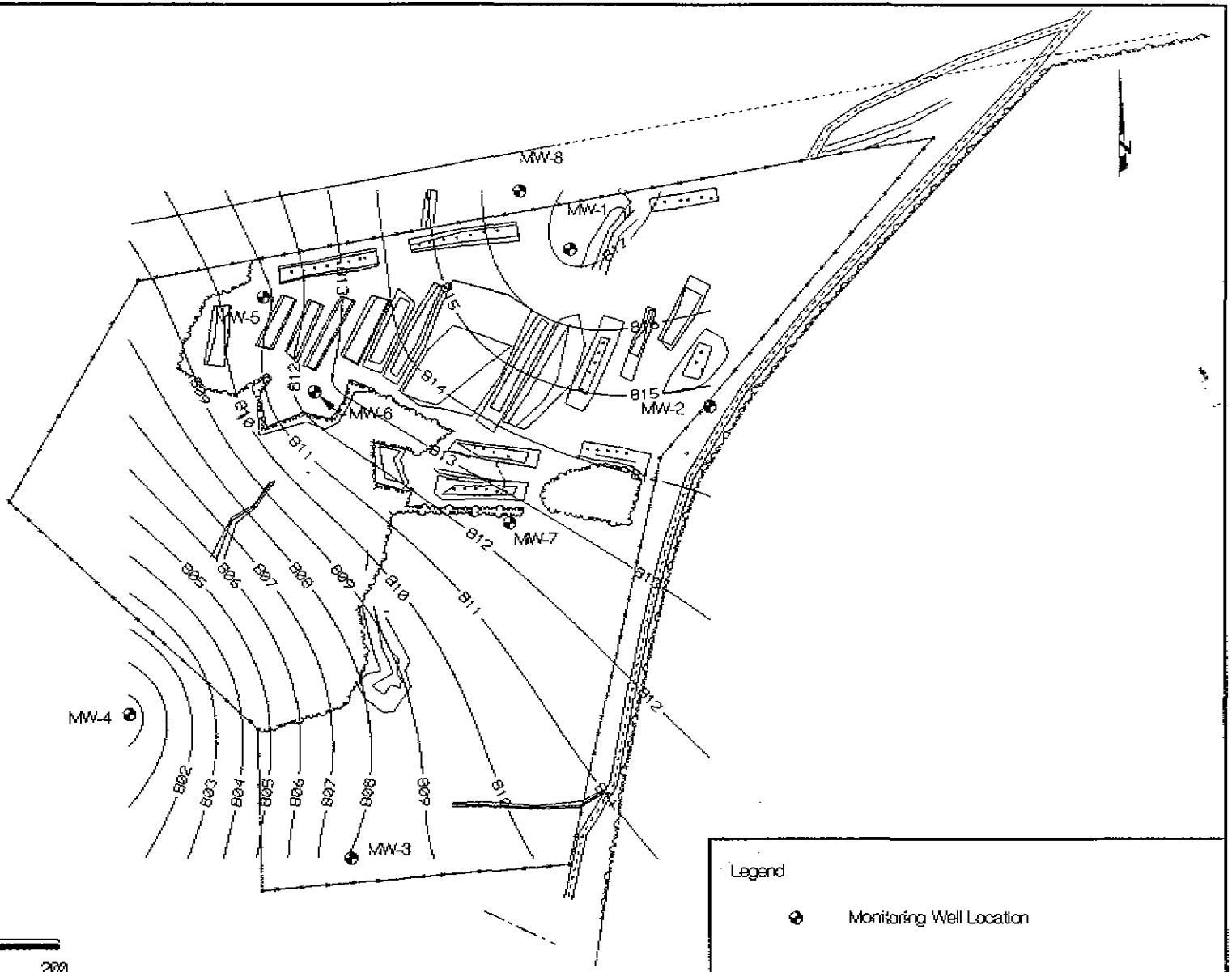
Author	Drawing	Layers	Date	Title
dg	53021-1	0,12,6	3-28-95	Site Map With Monitoring Well & Soil Boring Locations
Job No.	**Revision**	**Figure**	**Scale**	**Project**
5302100	0	2	1" = 200'	Third Creek Monofill Facility Statesville, North Carolina



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Author	Drawing	Layers	Date	Title
dg	5302-1	025	3-28-96	Ground Water Contour Map (From May 2, 1995 Data)
Job No.	**Revision**	**Figure**	**Scale**	**Project**
5302100	0	3	1" = 200'	Third Creek Monofill Facility Statesville, North Carolina

Table 1. Monitoring Well Elevations, Third Creek Monofill, Statesville, North Carolina.

Well No.	Elevations of Screened Interval		Measuring Point Elevation (Top of Casing)
	Top	Bottom	
MW-1	800.80	790.80	860.08
MW-2	818.50	808.50	847.94
MW-3	800.70	790.70	823.85
MW-4	794.80	784.80	814.68
MW-5	818.80	808.80	847.16
MW-6	817.70	807.70	850.21
MW-7	812.10	802.10	847.70
MW-8	819.00	809.00	861.44

All elevations referenced to previously established MW-1 elevation.

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Table 2. Sample Containers, Preservatives, and Analytical Methods, Third Creek Monofill, Statesville, North Carolina.

Parameter	Sample Containers	Preservatives	Analytical Methods[a]
Arsenic	1000 ml P or G	HNO_3 to pH<2	7060
Barium	1000 ml P or G	HNO_3 to pH<2	6010,7080
Cadmium	1000 ml P or G	HNO_3 to pH<2	6010,7130
Chromium	1000 ml P or G	HNO_3 to pH<2	6010,7190
Iron	1000 ml P or G	HNO_3 to pH<2	6010
Lead	1000 ml P or G	HNO_3 to pH<2	7421
Manganese	1000 ml P or G	HNO_3 to pH<2	6010
Mercury	1000 ml P or G	HNO_3 to pH<2	7470
Selenium	1000 ml P or G	HNO_3 to pH<2	7740
Silver	1000 ml P or G	HNO_3 to pH<2	6010
Sodium	1000 ml P or G	HNO_3 to pH<2	6010
Volatile Organics (VOCs)	3-40 ml VOAs	HCL to pH<2	8240
Semivolatile Organics (SVOCs)	1000 ml Amber Glass	Refrigeration	8270
Total Organic Carbon (TOC)	100 ml P or G w/Teflon lined cap	Refrig/H_2SO_4 or HCl to pH<2	9060
Total Organic Halogens (TOX)	500 ml Amber Glass	Refrigeration	9020/9021
Herbicides/Pesticides	1000 ml Amber Glass	Refrigeration	8080/8150
Chloride	100 ml P or G	Refrigeration	9251/9252
Sulfate	100 ml P or G	Refrigeration	9036/9038
Nitrate	100 ml P or G	Refrigeration	9200
Phenols	1000 ml Amber Glass	Refrigeration	8040
Radium	1 gallon P or G	HNO_3 to pH<2	903.1
Gross Alpha	1 gallon P or G	HNO_3 to pH<2	900.0
Gross Beta	1 gallon P or G	HNO_3 to pH<2	900.0

[a] *Test Methods for Evaluating Solid Wastes, SW-846, 3rd Edition*

P = Plastic
G = Glass

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CHAIN-OF-CUSTODY RECORD
ANALYTICAL REQUEST

№ 3166

PROJECT NAME:

REPORT TO:

TURNAROUND: ☐ NORMAL ☐ 5-DAY ☐ OTHER (SPECIFY):

ADDRESS:

AFFILIATION/LOCATION:

REQUESTED DUE DATE:

JOB NUMBER:

PHONE:

P.O. # / BILLING REFERENCE:

SAMPLED BY (PRINT):

SAMPLER'S SIGNATURE:

SAMPLE ID	SAMPLE LOCATION	DATE	TIME	MATRIX			NUMBER OF CONTAINERS								ANALYSES REQUEST	REMARKS
				WATER	SOIL	OTHER	TOTAL	UNPRESERVED	H_2SO_4	HNO_3	HCl	N_aOH	pH < 2 OR > 12 Y	pH < 2 OR > 12 N		

ADDITIONAL COMMENTS:

RELINQUISHED BY / AFFILIATION	ACCEPTED BY / AFFILIATION	DATE	TIME	AIRBILL #

WHITE–LABORATORY REPORT COPY / **PINK**–LABORATORY COPY / **CANARY**–SAMPLER'S COPY