REPORT NO. 124

ASSESSMENT OF THE IMPACT OF NON-POINT SOURCE POLLUTION ON THE GROUND WATER IN THE DISTRICT OF COLUMBIA (GROUP A WELLS)

PROJECT PLAN

Amendment No. 89g-89-WHB01-91-01

Dr. H.M. Watt
Project QA Officer

ASSESSMENT OF THE IMPACT OF NON-POINT SOURCE POLLUTION ON THE GROUND WATER IN THE DISTRICT OF COLUMBIA (GROUP A WELLS)

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Dr. H.M. Watt
Project Officer

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I. PROJECT NAME:

Assessment of the Ground Water in the District of Columbia (Group A Wells)

II. PROJECT REQUESTED BY:

City of the District of Columbia
Department of Consumer and Regulatory Affairs
Environmental Regulation Administration
2100 Martin Luther King, Jr., Ave, SE, Suite 203
Washington, DC 20020
Ph. (202) 404-1120

III. DATE OF REQUEST:

10 September 1991 (Amended Agreement signed by DCRA)

IV. DATE OF PROJECT INITIATION:

15 January 1992 (Amended Agreement signed by WRRC)

V. PROJECT OFFICER:

Dr. H.M. Watt, Principal Investigator DC
Water Resources Research Center
University of the District of Columbia 4200
Connecticut Ave, NW, MB 5004
Washington, DC 20008
Ph. (202) 673-3442

VI. QUALITY ASSURANCE OFFICERS

1.	Overall Project:	Dr. H.M. Watt
2.	Well Installation:	Prof. J. O'Connor Dept. of Env. Science, UDC 4200 Connecticut Ave, NW Washington, DC 20008 Ph. (202) 282-7380
3.	Sampling & Analysis:	Dr. A. Montaser Dept. of Chemistry, GWU 725 21st Street, NW Washington, DC 20052 Ph. (202) 994-6480

VII. PROJECT DESCRIPTION

A. BACKGROUND

The Ground Water Resources Assessment Study (GWRAS) consists of three phases. The purpose of Phase I was to evaluate existing and historical data in order to provide background information characterizing the nature and extent of the ground water resources in the District including land use, geology, hydrology etc. The background study has been completed and a draft submitted to DCRA in January 1991. A brief summary of the results is provided below.

The District lies in a Fall Zone. This natural zone is a boundary between the Piedmont Plateau and the Atlantic Coastal Plain Physiographic Provinces. The Coastal Plain aquifers are extremely productive and occur as three types: perched watertable, unconfined, and confined aquifers. The natural chemistry of the Coastal Plain ground water is suitable for many uses although slightly high in iron and sulfur. The Piedmont yields relatively small quantities of groundwater.

The preliminary evaluation of background data for the District has indicated that since the mid 1960's three major engineering efforts have disrupted and altered the natural ground water regime. Firstly, the burial of all utility lines and the associated trenching diverts and ponds ground water. Second is the dewatering during construction of the METRO Subway system in five crisscross lines through the city. Third is the highrise construction especially in the downtown corridor. It is estimated that in the 1980's over a million gallons per day were discharged into the storm sewer system from downtown construction activities without regard for quality or treatment. Also, dewatering has been poorly monitored in the district.

Land use is extremely critical for controlling contaminant migration. There are many physical hazards associated with the District's ground water such as landslides and subsidence, leaks from sewer pipelines and from domestic water supply pipes. Also, contamination of the ground water may occur from small scale urban agricultural activities such as maintenance of golf courses, landscape gardens, street tree spraying, and irrigation. It is believed that the numerous urban activities might have had a

Based on the results of this initial investigation, a network of monitoring wells will be installed and sampled during Phase II. The monitoring wells are the first of their kind in the District and fulfill part of federal and state water quality control requirements. Using information provided from these sites, ground water flow and transport will be modeled with a previously selected public domain model. Phase III will consist of the final assessment of ground water conditions in the District of Columbia.

Following the completion of Phase I, the study objective was amended to include an investigation of possible impact of nonpoint source pollution on the ground water (see Amendment No. 89g89-WHB01-91-01).

The investigation will proceed on two levels: The Group A wells will serve to initially assess the quantity and quality of ground water within the main geological formations generally, while the Group B wells will be used to gather information on non-point source pollution and pesticide effects specifically. This project plan covers the Group A wells.

B. OBJECTIVE AND SCOPE STATEMENT

The objective of this study is to collect enough data of sufficient quality to enable the District of Columbia to achieve its goal of better protecting and managing the ground water resources of the District (see Grant No. 89g-89-WHB01). This document describes the scope of work, quality assurance/quality control plan and data management plan for phases II and III of the study.

1. Well Installation

The scope of this study is comprised of 1) well installation, 2) ground water sampling & analysis, and 3) modeling of ground water flow and contaminant transport. These are discussed in detail in the following sections.

Five wells shall be installed at three different locations in order to assess the ground water resources in the District by determining the quantity and quality of the ground water within the main geological formations in the District of Columbia.

2. Ground Water Sampling and Analysis

In order to obtain initial information on the quality of the District's ground water, water samples from each well will be analyzed for a variety of parameters (see Parameter Table, section VII.F.). The sampling during Phase II shall be comprised of two water samples for each of the Group A wells.

During Phase III, which will be initiated after a letter to proceed has been received, two water samples will be taken from each of the Group A wells. Based on the results from previous analyses, the list of parameters will be revised to exclude

elements or compounds not previously detected.

All procedures during ground water sampling and analysis will be documented and a report will be provided.

3. Modeling

A three-dimensional ground water flow and contaminant transport model shall be selected so that it is applicable to the specific conditions of the District of Columbia and, shall reflect, among other characteristics, the land use, geology, topography and soil characteristics of the District. The model report shall include delineation of currently available data and future data needs for the calibration, verification and operation of the model. The model shall be IBM-PC compatible. All procedures used during the selection process will be documented and a report on modeling will be provided.

C. DATA USAGE

Data acquired during the course of this study will include EPA's "Minimum Set of Data Elements for Ground Water Quality" (Appendix 1). They will be used in the assessment of ground water resources in the District of Columbia and constitute the initial data base for future *monitoring* programs. Data may also be used to support District of Columbia water quality standards and to provide input for the national ground water data repository as well as the state water quality assessment program.

D. MONITORING NETWORK DESIGN AND RATIONALE

The rationale in designing the monitoring network was to 1) conceptualize the aquifer media, 2) identify aquifer parameters, and 3) assess ground water quality generally and with respect to the impact of non-point source pollution. The network design has the following three aspects: 1) site selection, 2) well installation, and 3) survey control.

1. Site Selection and Justification

Following is a preliminary description of the selected sites, which will be expanded as soon as the site permitting process has been completed and the specific well locations have been chosen.

The purpose of the Group A Wells is to assess the quality and quantity of ground water within the District's main geological formations. Based on the background report, the main formations were identified as 1) the fractured flow system of the Piedmont region in the northwest of the city, 2) the perched water tables in recent terrace deposits, and 3) the interstate confined aquifer

of the Potomac Group, which constitutes a sole source aquifer for Maryland. Consequently, well locations were selected to reflect these distinctly different provinces.

Well #	Location	Phvsioaraphy	Depth (ft)
MW-1	Dalecarlia Pkwy, NW	Piedmont	< 100
MW-2	Ft. Dupont, SE	Coastal Plain	200-300
MW-3	NY & 1st, NW	Perched water	< 30
MW-4	"	"	< 60
MW-5	"	"	< 90

Appendix 2 depicts the well locations within the District as well as preliminary site sketches showing proposed well locations. The cluster arrangement at NY & 1st St. is to capture seperate perched water tables expected at the site.

2. Well Installation

All wells will be installed by Geomatrix, Inc.. Construction procedures will be in accordance with EPA Publication 600/4-89/034 "Handbook of Suggested Practices for the Design and Installation of Ground Water Monitoring Wells".

The construction sequence will be as follows:
- Drill 8 to 10 inch borehole to the required depth
- Install a schedule 40 PVC well screen with .020 inch slots (length 10 feet, diameter 4 inches)
- Attach schedule 40 PVC casing to the screen to a length of 2 feet above ground surface
- Gravel or sand pack the annulus space between borehole and PVC to at least 3 feet above the top of the screen - Place at least 2 feet of bentonite pellets above the gravel/sand pack
- Grout the remaining annulus space with cement-bentonite grout
- Install protective well cover with lock

Soil borings taken by Geomatrix will be used to determine lithologic units as well as to detect any contamination that may have occurred at the site. The samples will be taken continuously until the water table is reached, then at five foot intervals depending on field conditions or at each lithologic change. All soil samples will be screened for petroleum hydrocarbons at the site using a PID (Photo Ionization Detector).

The drilling methods used will vary depending on the location and the type of the well to be constructed. Group A wells will be constructed using one of the following methods, depending on field

conditions: the mud rotary method, the air rotary method, and the hollow stem auger method. Appendix 3 shows the generic well design that will be the basis for all monitoring wells, but modified according to field conditions. The design for each well will be described in detail in the "Well Drilling and Field Operations Report".

At least one complete set of static water level measurements will be taken in all new wells using appropriate measuring devices such as M-scope and steel tape. Measuring point for water level measurements, unless otherwise noted, shall be the top of the actual well casing. The measuring point elevation shall be leveled to the nearest 0.01 foot by a qualified surveyor or estimated as accurately as possible using available data.

Subsequent to well installation and development, aquifer tests will be conducted at each site to determine the hydraulic characteristics of the aquifers. The tests will be performed according to standard procedures.

Ground water sampling and analysis will begin after well installation and development.

Any deviations from approved specifications, techniques and methodologies in this project plan shall receive prior approval from DCRA/ERA.

3. Survey Control

A topographic survey will be performed by a licensed surveyor provided by Geomatrix, Inc. Vertical elevations will be referenced to a USGS bench mark. Horizontal elevations will be referenced to District of Columbia Plane coordinates. The survey will provide:

- various on-site features, e.g. buildings etc.
- locations of the new monitoring wells
- ground surface elevation around each well
- elevation of each inner well casing without the protective cap

E. MONITORING PARAMETERS AND FREQUENCY OF COLLECTION

Location	Type of Sample	Sample Matrix	Parameter Groups	Frequency
All wells (Phase II)	Bailer	Ground water	Indicator/ Routine Herbicides Pesticides	2x a year
All wells (Phase III)	Bailer	Ground water	Indicator/ Routine Inorganics Semi-Volatiles Volatiles	2x a year

A complete list of parameters in each group is provided in the parameter table below.

F. PARAMETER TABLE

Parameter	Container	Preservation	Holding Times
Routine/Indicator Parameters			
pH	100 ml P,G	None required	Analyze immed.
temperature	"	"	"
conductivity	"	cool 4 C	28 days
color	"	"	48 hours
TDS	"	"	"
TOC	500 ml P,G	cool 4 C & H_2SO_4 to pH < 2	28 days
TOX	1000 ml G	"	14 days
COD	"	"	28 days
Inorganics			
Ag, As, Ba, Be, Ca, Cd, Cu, Fe, Hg, K, Mg, Na, Ni, Pb, Sb, Se, Tl	1000 ml P,G	HNO to pH < 2	6 months
Cr IV	250 ml P,G	cool 4 C	24 hours
Cl	250 ml P,G	None required	28 days
Cn	"	cool 4 C NaOH to pH > 12	14 days
Fl	"	None required	28 days
NO_3	"	cool 4 C	48 hours
SO_4	"	cool 4 C	28 days
NH_3	"	cool 4 C	28 days
PO_4	"	H_2SO_4 to pH < 2 "	"
Semi-Voltile Organics			
see Attachment 4	1000 ml G & C	cool 4 C 0.008% Na S O	7 days until extraction
Volatile Organics			
see Attachment 4	40 ml G & S	cool 4 C 0.008% Na S O pH to 4-5	14 days until extraction
Pesticides			
see Attachment 4	1000 ml G & C	cool 4 C pH 5-9	40 days after/ 7 days until extraction
Herbicides			
see Attachment 4	1000 ml G & C	cool 4 C	40 days after/ 7 days until extraction

P= polyethylene
G= glass
C= Teflon-lined cap

Appendix 4 lists the organic parameters with their corresponding CAS Numbers. Following initial analysis, parameters not detected will be dropped from subsequent analysis.

VIII. PROJECT FISCAL INFORMATION

ITEM	COST ($)
Project Planning	1,500
QAPjP Modification	1,500
Well Installation	59,000
Sampling & Analysis	23,000
Modeling	20,000
Report Preparation	4,500
Overhead	18,000
Miscellaneous	3,000
Total	130,500
DCRA	123,370
WRRC Fund Matching	7,130

IX. SCHEDULE OF TASKS AND PRODUCTS

TASK/ PRODUCT	1992 1 2 3 4 5 6 7 8 9 10 11 12	1993 1 2 3 4 5 6 7 8 9 10 11 12
Project Initiation	x	
Project Plan Review Final	-->x x	
Site Permitting	-------->x	
Well Installation	- ->x	
Sampling & Analysis	x x	x x
Well Drilling & Field Operations Report Submission Review Final	 x ->x x	
Modeling Report Submission Review Final	 x ->x x	
Sampling & Analysis Report Submission Review Final		 x x ->x ->x x x
Interim- Project Report		x
Project Report Review		->x
Final Project Report		x

X. PROJECT ORGANIZATION AND RESPONSIBILITY

A. WELL INSTALLATION OPERATIONS AND QA/QC

Well installation will be performed by Geomatrix, Inc.
Dr. Kobina Atobrah will be responsible for well installation procedures as well as the corresponding data processing activities. Mr. Donald A. Jackson will be in-house QA/QC officer for both well installation and data quality. For WRRC, final QA/QC will be performed by Prof. James V. O'Connor of the University of the District of Columbia.

Address:	Dr. K. Atobrah GEOMATRIX, Inc. Kenilworth Ave, Suite 100 Riverdale, MD 20737	Prof. J.V. O'Connor Dept. of Environm. Sc. (UDC) 4200 Connecticut Ave, NW Washington, D.C. 20008
Ph.:	(301) 779-5302	(202) 282-7380

B. SAMPLING OPERATIONS AND QA/QC

Sampling operations and the corresponding data processing activities will be performed by Gascoyne Laboratories, Inc. (see Appendix 5, Capabilities and Qualifications Statement). In-house QA/QC Officer is Dr. Irving M. Kipnis. For WRRC, Dr. Akbar Montaser of George Washington University will be responsible for both sampling QA/QC and data quality.

Address:	Dr. I.M. Kipnis GASCOYNE LABS, Inc. 2101 Van Deman St. Baltimore, MD 21224	Dr. A.Montaser Dept. of Chemistry (GWU) 25 21st Street, NW Washington, DC 20052
Ph.:	(410) 633-1800	(202) 994-6480

C. LABORATORY ANALYSIS AND QA/QC

Gascoyne Laboratories, Inc. will perform laboratory analyses with the corresponding data processing activities. QA/QC will be according to in-house Standard Operating Procedures under the supervision of Dr. Irving M. Kipnis, Chief QA/QC Officer. For WRRC, Dr. Akbar Montaser of George Washington University will be the overall QA/QC officer for laboratory analysis and data quality.

Address:	Dr. I.M. Kipnis GASCOYNE LABS, Inc. 2101 Van Deman St. Baltimore, MD 21224	Dr. A. Montaser Dept. of Chemistry (GWU) 725 21st Street, NW Washington, DC 20052
Ph.:	(410) 633-1800	(202) 994-6480

D. DATA PROCESSING ACTIVITIES, OA/OC AND QUALITY REVIEW

Data processing activities, QA/QC and data quality review will be performed by the individuals named under the respective tasks in A, B and C above.

E. PERFORMANCE AND SYSTEMS AUDITING

Gascoyne Labs, Inc. has extensive experience in both sampling and analysis of ground water. In-house performance and system audits are performed by laboratory managers and QA/QC officers in order to assess the effectiveness of their QA/QC plans. Chief of QA/QC operations is Dr. Irving M. Kipnis (see sections X.B. and X.C. above). Additionally, the quality of Gascoyne's analytical performance and systems is assessed during state certification procedures (see Appendix 5). Occasional audits will be performed unannounced by Dr. A. Montaser of GWU. Initial inspection of the laboratories by Dr. Wm. Schmidt of GWU (representing Dr. A. Montaser) and Dr. H.M. Watt of WRRC took place on 3 March 1992.

F. OVERALL PROJECT COORDINATION AND OA/OC

Overall project coordination and QA/QC rests with the D.C. Water Resources Research Center. The day-to-day coordination activities are handled by Ms. J. Schneider (Project Coordinator), while final authority rests with the Center's director, Dr. H.M. Watt (Principal Investigator).

Address: Dr. H.M. Watt
Ms. J. Schneider
D.C. Water Resources Research Center
4200 Connecticut Ave, NW
Washington, DC 20008
Tel.: (202) 673-3442

The attached organizational chart (Appendix 6) illustrates the relationships among the individuals and the organizations involved in the project.

XI. DATA QUALITY REQUIREMENTS AND ASSESSMENTS

- see laboratory QA/QC (Appendix 7) -

XII. SAMPLING PROCEDURES

Sampling operations will be performed by the fully equipped, certified and experienced sampling teams of GASCOYNE LABS, Inc. Standard operational procedures for collection of ground water samples will be followed including documentation, storage, preservation, and transport to the analytical laboratory.
The techniques used are based on EPA guidelines, described in the Handbook for Sampling and Sampling Preservation of Water and Wastewater (EPA 600-4-82-029) and Test Methods for Evaluating Solid Wastes (EPA SW-846, 3rd Edition).

Pertinent on-site observations such as condition of wells, weather conditions etc. will be recorded. Calibration, usage, and maintenance of field equipment will be logged along with the documentation for the collection process. A minimum of three volumes of water will be removed prior to sample collection. Depth to water measurements will be conducted before and after purging and at the time of sampling. pH, conductivity and temperature will be measured at the collection site during flushing and at the time of sampling. Ground water samples will be collected from the monitoring wells using appropriate sampling devices such as bailers or pumps. The delivery channels and lifting mechanisms for wells will be selected to yield water retaining its underground state. Samples will be collected in the proper containers, which, together with the necessary preservatives, will be provided by the laboratory conducting the analyses. Specific sampling containers, preservation techniques and sample holding times are shown in the Parameter Table, Section VII, F above. Cross-contamination will be avoided by cleaning the equipment between wells. Samples will be sealed and tagged for transport to the laboratory.

XIII. SAMPLE CUSTODY PROCEDURES

Sampling will be performed by the Gascoyne Labs, Inc. field personnel according to standard operating procedures. The contract laboratory has designed a Chain-of-Custody form which is completed for each sample or case of samples received (see Appendix 7). It documents where the sample originated, who authorized and who performed the transmittals, how and when the sample was received, and who received the sample. The form so provides space for recording other pertinent information such as types and conditions of containers, and preservative techniques used. This form must be signed by the individual designated as sample custodian. The facility is secured with access limited to authorized employees and with an electronic security system that is monitored 24 hours a day. Samples are stored away from sources of laboratory contamination such as solvents, standards, and other potentially hazardous samples.

XIV. CALIBRATION PROCEDURES AND PREVENTIVE MAINTENANCE

Instrumental quality assurance refers to the maintenance, calibration, and verification of the sophisticated scientific instruments used at the laboratory as well as the field equipment used during well installation and sampling. Wherever action possible, all crucial equipment is maintained under an extended warranty or service contract plan to ensure the highest level of "up-time". All scientific instruments are maintained under strict programs of preventative/ routine maintenance in accordance with manufacturers' recommendations. All calibration and maintenance procedures are documented in equipment log books. Field and laboratory equipment will be calibrated and maintained according to in-house SOPs, where further information is provided (see also Appendix 7).

XV. DOCUMENTATION, DATA REDUCTION, AND REPORTING

A. WELL INSTALLATION

Documentation during well installation and aquifer testing will include 1) a lithologic log (grain size, porosity, permeability), 2) a well development record of yield estimate, well ID, ground elevation, elevation of screen settings, length of well casing, water elevation and 3) an aquifer test data sheet

The data reduction process may include complete analysis, graphic representation or other methods that aid in the conceptualization of aquifer conditions for ground water assessment and modeling.

A report on field operations and well installation will be provided upon completion of those tasks. In addition to the records named above, it will include the well descriptors listed in EPA's "Minimum Set of Data Elements for Ground Water Quality" (Well Identifier, Well Use, Depth of Well at Completion, Screened/Open Interval and Type of Log) as a separate record. The survey report will also be included, indicating latitude, longitude, method used, altitude, method used, state FIPS and county FIPS.

B. GROUND WATER SAMPLING AND ANALYSIS

Documentation during sampling and analysis will include 1) sampling logs, 2) chain-of-custody forms, and 3) laboratory log (methods, data validation etc).

All methods or procedures to be utilized will be fully described or referenced to published protocols. A list will be maintained of all reagents, apparatus, and equipment used, along with a full description of the set-up and any operating conditions or parameters. Results of any equipment checks or preliminary test results will also be noted.

Data acquired during analysis will contain the signature of the operator (s), the date, theoperating parameters of the equipment, and reference to the analytical method and sample preparation procedures. For computer- generated data, which do not allow for such entries, the information shall be recorded in the equipment use logbook, dated and referenced to the data file.

To ensure data reliability, all steps involved in data reduction and reporting will be closely monitored and reviewed. This review generally has three aspects. The first is laboratory record keeping. Laboratory notebooks are continuously maintained with complete information. In addition, a sequential list of all measurements actually observed or made is recorded. For the GC/MS system, all raw data acquired during sample analysis are archived on magnetic tape, stored, and referenced in the appropriate logbook. All analytical runs are listed according to sample identification number. Other pertinent information regarding the sample analysis is also recorded. Data are carefully labeled and filed. This is referenced in the laboratory notebooks, even when ultimately stored on magnetic tape.

Calculations performed and/or formulas employed are also documented in the laboratory notebook or filed in the case file for future reference. These notebooks also refer to the particular analysis and record the dates of the analysis, with the analyst's signature. Any printouts or other hard copy data are also attached. All computer generated data must also be signed and dated by the analyst(s). Names and initials entered by the

computer onto data cannot substitute for the analyst's signature. It should be noted that record integrity is always maintained. All lab and calculation notebooks, all instrument charts, magnetic tape or printouts, and all laboratory management review and QA/QC logs are maintained in files.

The final aspect of data handling assurance is that associated with report formats. All data transmittals are in report form with accompanying appendices where needed or desired, i.e., hard copies and magnetic tape, etc.The reports contain references to methods utilized, problems encountered, solutions developed, and parameter values using appropriate units and significant figures.

A report on sampling and analysis procedures will be provided upon completion of those tasks. In addition to the records named above, it will include the sample descriptors listed in EPA's "Minimum Set of Data Elements for Ground Water Quality" (Sample Identifier, Depth to Water, Constituent/ Parameter measured, Concentration/Value, Quality Assurance Indicators, Analytical Results Qualifier) as a separate record.

XVI. DATA VALIDATION

A. WELL INSTALLATION

All data generated in the field will be compiled and checked for errors. For the well construction process, these data will include well construction details, water level measurements, geophysical and geotechnical information. D. Jackson of Geomatrix, Inc. and Prof. O'Connor of UDC will be responsible for data validation (see Sections X.A. and X.D.)

B. GROUND WATER SAMPLING & ANALYSIS

During analysis, spikes, method blanks, calibration blanks, independent reference standard, calibration standards etc. will be applied to assure data quality.

After analytical and calculation data are completed by the laboratory analyst, the data is received by the Laboratory Director. These are reviewed for completeness of information, spot checked for calculation error, and actual measurement data is checked for discrepancies. QA/QC measured values are reviewed and submitted to Dr. I.M. Kipnis, Chief Quality Assurance Officer, for adjustment of control charts. All other data or instrument information is also reviewed in this procedure. If no problems are found, the analyst is given preliminary approval for that particular data. If discrepancies are found, the analyst is

immediately contacted, the analyses halted, and the situation reviewed by the laboratory director, the analyst, and the Project Manager.

XVII. PERFORMANCE AND SYSTEM AUDITS

Gascoyne Labs, Inc. have extensive experience both in sampling and analysis of ground water. In-house performance and systems audits are carried out to assess the effectiveness of the QA/QC program. Additionally, their analytical performance and systems are assessed during state certification procedures (see Qualifications and Capabilities Statement, Attachment 5). Unannounced system audits will also be conducted occasionally by Dr. C. Wade of UDC and Dr. A. Montaser or Dr. Wm. Schmidt of GWU. The initial inspection of the laboratories by Dr. Schmidt and Dr. Watt took place on 3 March 1992.

XVIII. CORRECTIVE ACTION

Corrective action within Gascoyne Labs, Inc. is the responsibility of Dr. I.M. Kipnis, Chief of QA/QC.

Each project within Gascoyne includes provisions for written requirements that establish and maintain channels for QA/QC reporting and feedback to the appropriate management authority to ensure that early and effective corrective action can be taken when data quality falls below required standards.

Corrective action is minimized through the implementation of the routine internal program controls prior to an adverse program impact. Examples of these controls, which have been delineated in the QA/QC plan and Gascoyne's SOPs include:

- Predetermined limits for each measurement system to indicate when corrective action is required.
- An established procedure for each system to identify the corrective action which will be taken when the warning or control limits are exceeded.
- For each measurement system, the designation of the level within the organization responsible for taking corrective action, and also the level within the organization responsible for approving the corrective action.

XIX. REPORTING

A. PROGRESS REPORTS

Progress Reports will be submitted quarterly starting on 15 April 1992. The reports will include an assessment of the project status in relation to the schedule, results of ongoing activities, problems anticipated, etc.

B. WELL DRILLING AND FIELD OPERATIONS REPORT

The report shall include detailed information on field operations and well development, including well logs, any physical and chemical analysis results of selected lithologic samples, results of slug tests and/or pumping tests with their analysis, and ground water level measurements. It will include the well descriptors listed in EPA's "Minimum Set of Data Elements for Ground Water Quality" (Well Identifier, Well Use, Depth of Well at Completion, Screened/Open Interval and Type of Log) as a separate record. The survey report will also be included, indicating latitude, longitude, method used, altitude, method used, state FIPS and county FIPS.

Any deviations from approved specifications, techniques and methodologies in the work plan shall receive prior approval from DCRA and the reasons for the deviations noted and included *in* the report.

C. MODELING

The model report shall include delineation of currently available data and future data needs for the calibration, verification and operation of the model. Also to be included are the computer codes of the model to be operated *on* an IBM compatible system with an MS-DOS operating system, *including* all computer data files utilized in the calibration and verification of the model (if applicable), delivered on 5.5" floppy disks, and full documentation of the model.

D. SAMPLING AND ANALYSIS_ REPORT PHASE II

Documentation during Phase II sampling and analysis will include 1) sampling logs, 2) chain-of-custody forms, and 3) laboratory log (methods, results, data validation etc) for the analysis of ground water for pesticides and herbicides.

A report on sampling and analysis procedures will be provided upon completion of those tasks. In addition to the records named above, it will include the sample descriptors listed in EPA's

"Minimum Set of Data Elements for Ground Water Quality" (Sample Identifier, Depth to Water, Constituent/ Parameter measured, Concentration/Value, Quality Assurance Indicators, Analytical Results Qualifier) as a separate record.

E. SAMPLING AND ANALYSIS REPORT PHASE III

Documentation during Phase III sampling and analysis will include 1) sampling logs, 2) chain-of-custody forms, and 3) laboratory log (methods, results, data validation etc) for the analysis of ground water for indicator and routine parameters, inorganics, semi-volatiles and volatiles.

A report on sampling and analysis procedures will be provided upon completion of those tasks. In addition to the records named above, it will include the sample descriptors listed in EPA's "Minimum Set of Data Elements for Ground Water Quality" (Sample Identifier, Depth to Water, Constituent/ Parameter measured, Concentration/Value, Quality Assurance Indicators, Analytical Results Qualifier) as a separate record.

F. FINAL REPORT

The report shall incorporate all of the results of the work under this grant, including the amendments. It should also contain suggestions for ground water management and use in the District including provisions for long term monitoring of the quality and quantity of the District's ground water.

APPENDIX I

EPA MINIMUM SET OF DATA ELEMENTS FOR GROUND WATER QUALITY

- **Minimun Set of Data-Elements for Ground -Water-Quality**

General Descriptor:

1. Data Sources

Geographic Descritptors:

2 Latitude

3. Longitude

4. Method Used to Determine Latitude and Longitude

5. Attitude

6. Method Used to Determine Attitude

7.State FIPS

8. County FIPS

Well Descriptors:

9. Well Identifier

10. Well Use

11. Depth of Well at Completion

12. Screened/Open Interval

13. Type of Log

Sample Descriptors:

14. Sample Identifier

15. Depth to Water

I6. Constituent or Parameter Measured 17. Concentration/Value

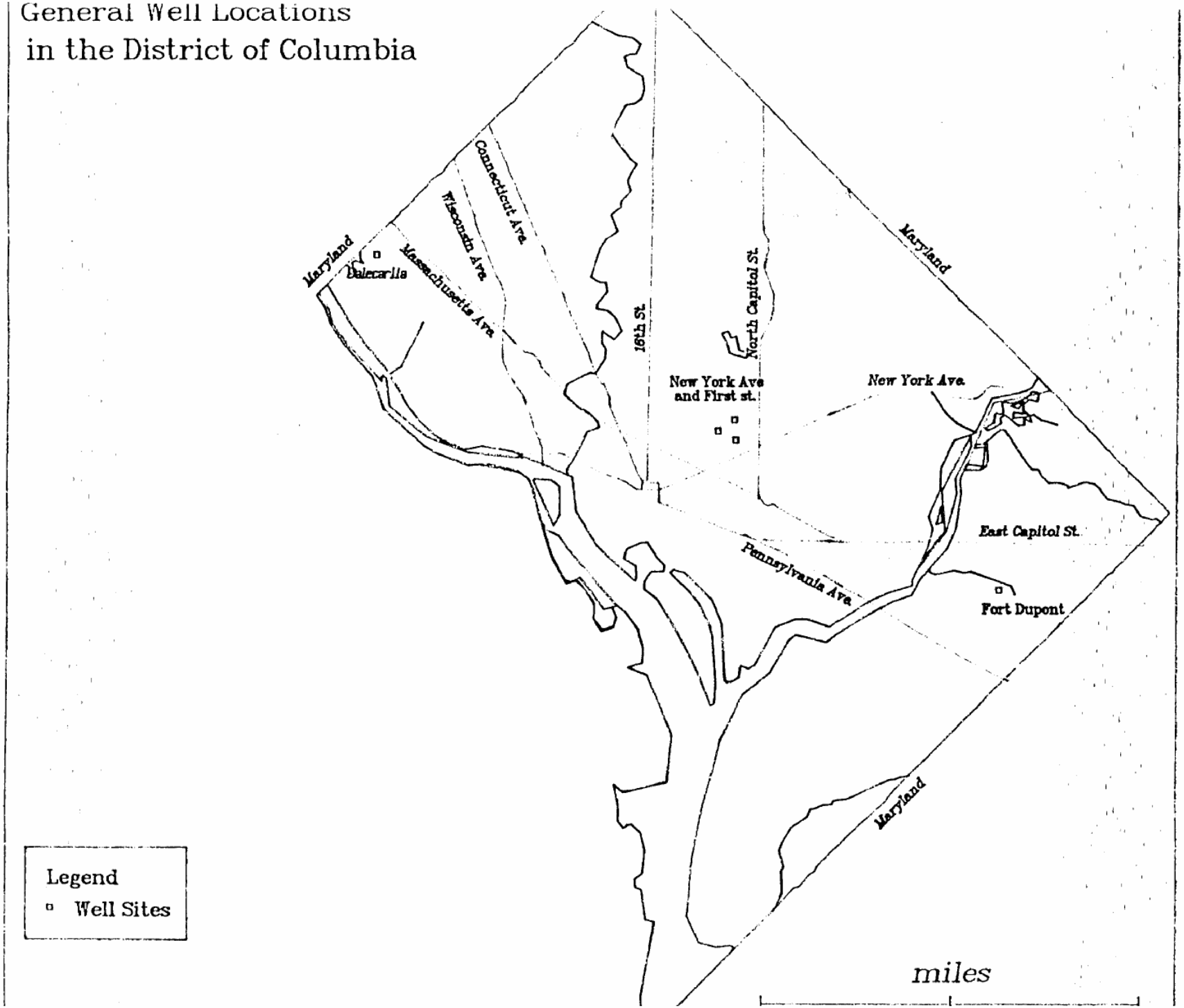
18. Quality Assurance Indicators

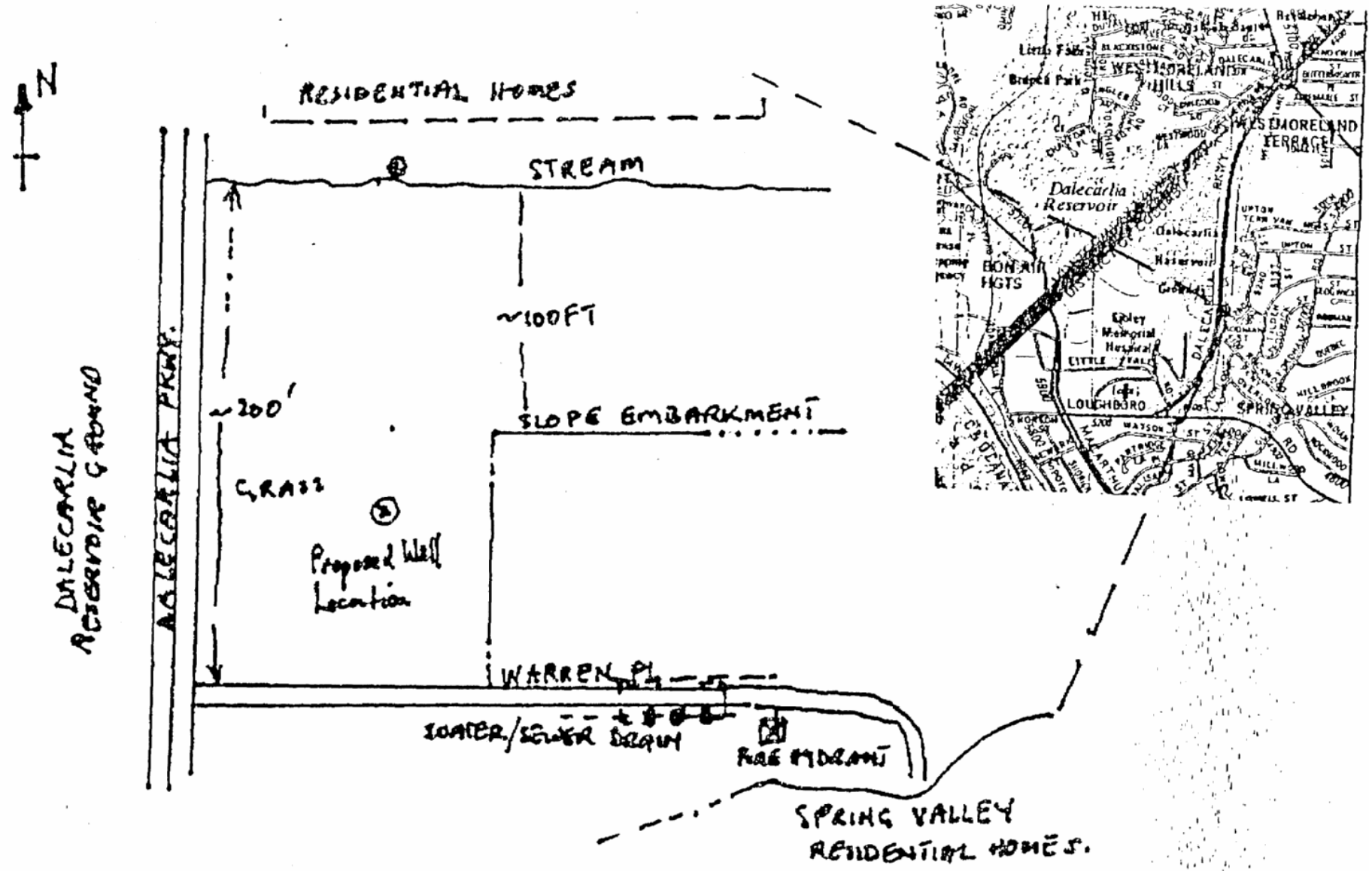
19. Analytical Results Qualifier

APPENDIX II

SUGGESTED WELL LOCATIONS

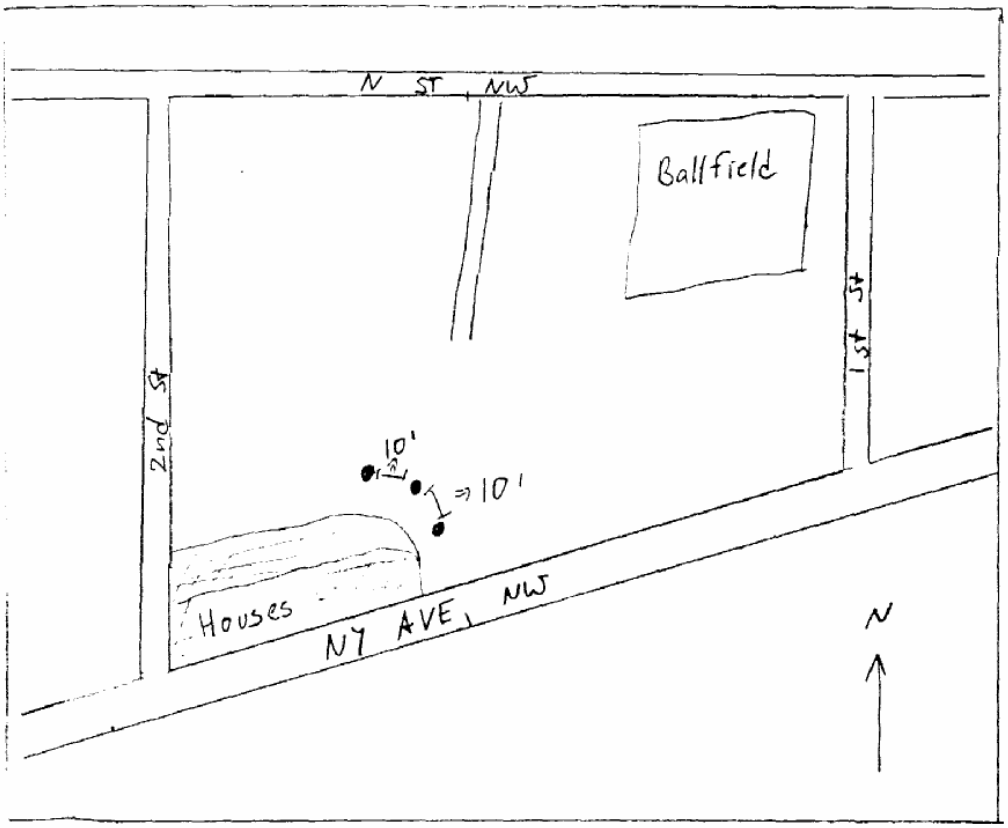
General Well Locations in the District of Columbia



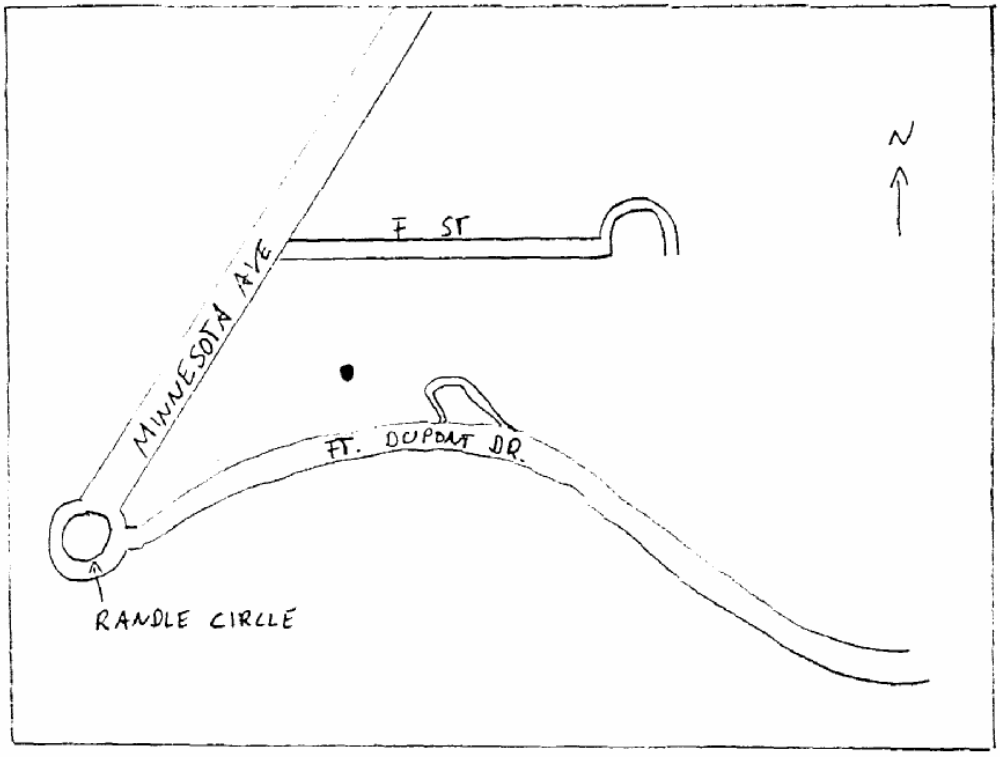


SITE MAP FOR WELL LOCATION:
DALECARLIA PKWY, WASH. DC.

NOT TO SCALE



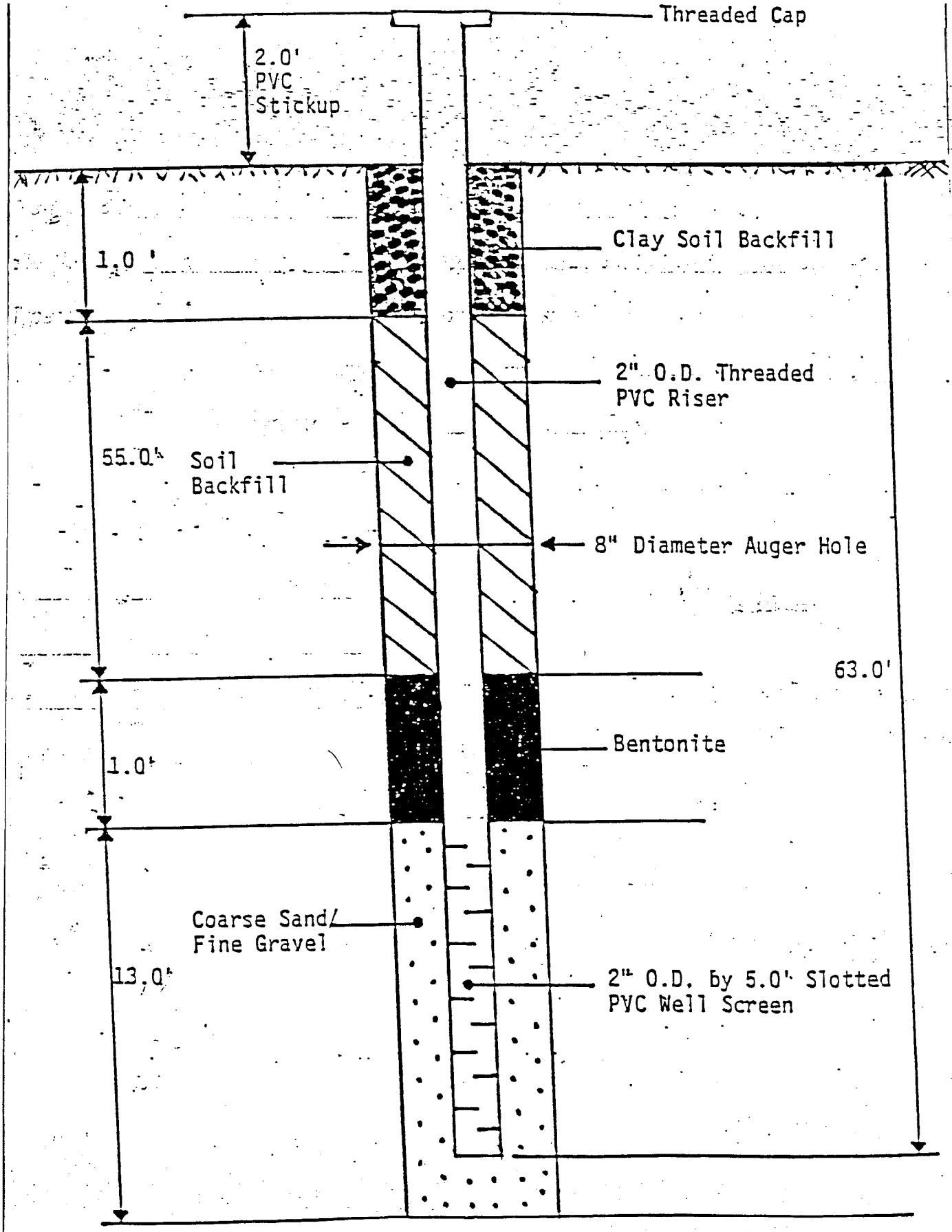
NY AVE & 1st St, NW



Ft. DUPONT, SE

APPENDIX III

DESIGN SKETCH FOR A GROUND WATER MONITORING WELL


Threaded Cap
2.0'
PVC
Stickup
1.0'
Clay Soil Backfill
2" O.D. Threaded
PVC Riser
55.0'
Soil
Backfill
8" Diameter Auger Hole
63.0'
1.0'
Bentonite
Coarse Sand/
Fine Gravel
13.0'
2" O.D. by 5.0' Slotted
PVC Well Screen

APPENDIX IV

LIST OF ORGANIC PARAMETERS

Table - 1
Semi-Volatiles Organics to be Analyzed .

Semi volatiles	CAS Number (*)
o-Cresol	95-48-7
m-Cresol	108-39-4
p-Cresol	106-44-5
Cresol	1319-77-3
1,4-Dichlorobenzene	106-46-7
2,4-Dinitrotoluene	121-14-2
Hexachloro-1,3-butadiene	87-68-3
Hexachloroethane	67-72-1
Nitrobenzene	98-95-3
Pentachlorophenol	87-86-5
Pyridine	110-86-1
2,4,5-Trichlorophenol	95-95-4
2,4,6-Trichlorophenol	88-06-2

Table - 2
Volatile Organics to be Analyzed

Volatiles	CAS Number(*)
Benzene	71-43-2
Carbon tetrachloride -	56-23-5
Chlorobenzene	108-90-7
Chloroform	67-66-3
1,2-Dichloroethane	107-06-2
1,1-Dichloroethylene	75-35-4
Methyl ethyl ketone	78-93-3
Tetrachloroethylene	127-18-4
Trichloroethylene	79-01-6
Vinyl Chloride	75-01-4

Table - 3
Pesticides to be Analyzed

Chlordane	57-74-9
Endrin	72-20-8
Heptachlor	76-44-8
Heptachlor Epoxide	1024-57-3
Lindane	58-89-9
Methoxychlor	72-43-5
Toxaphene	8001-35-2
Dieldrin	60-57-1
Methoxychlor	72-43-5
alpha-Chlordane	5103-71-9
gamma-Chlordane	5103-74-2
Isofenphos	
Dimethylamine salt of Dicamba	124-40-3
2,4 Dichlorophenoxyacetic acid	94-75-7
2-(2-Methyl-4 choraphenoxy) propionic acid	79-09-4
Alachlor	
Atrazine	
Chlorpyrifos	

Table - 4

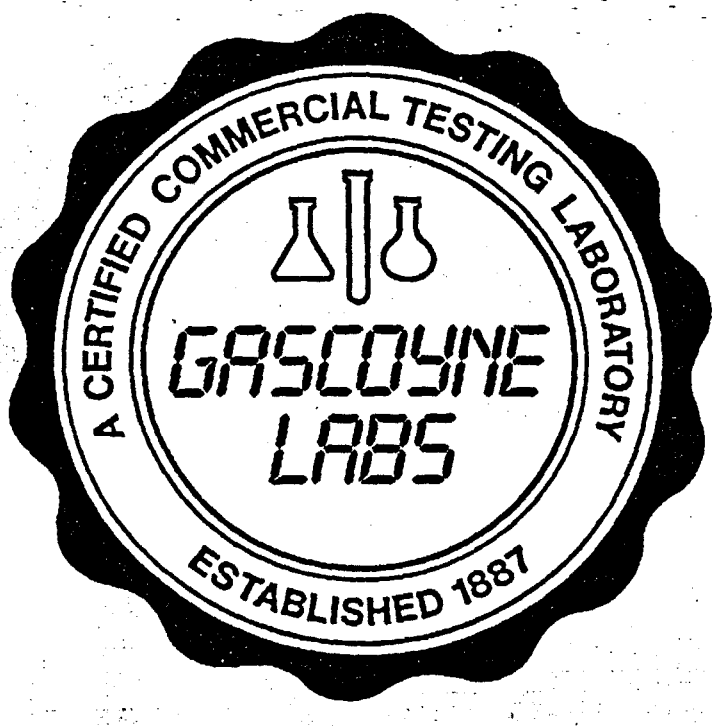
Herbicides to be Analyzed

Herbicides	CAS Number(*)
1,4-D	94-75-7
2,4,5-TP (Silvex)	

CAS: Chemical Abstract Service identifier assigned by the American Chemical Society.

APPENDIX V

EXCERPTS FROM THE STATEMENT OF CAPABILITIES AND QUALIFICATIONS (GASCOYNE LABORATORIES, INC.)



COMPANY DESCRIPTION

CAPABILITIES AND QUALIFICATIONS

GASCOYNE LABORATORIES, INC.

2101 Van Deman Street
Baltimore, Maryland
(301) 285-8510

Telephone No:
(301) 285-8510

FAX No:
(301) 285-0815

Gascoyne Laboratories, Inc. is a full service chemical testing laboratory with State of he Art Instrumentation to perform Chemical and Microbiological analyses of a wide variety of materials.

Complete Testing Services

Air Monitoring
Air Sampling
Analysis for Asbestos - Metals - Organics

Bioassay - Toxicity Testing
Acute test with fathead minnow, daphnia magna and other species. Microtox Toxicity - rapid economical.

Drinking Water
Field Sampling and Analysis
Analysis for: Metals - Organics - Bacteria
Primary and Secondary EPA requirements

Field Sampling
Fully equipped mobile units
Drinking Water - Groundwater - Sediment - Soil
Wastewater - Sludge - Sediment - Hazardous Waste

Food - Meat Products
Certified by the USDA
Analysis for Protein - Fat - Salt - Moisture
Nutrients - Pesticides

Gas Chromatography-Mass Spectroscopy
Priority Pollutants - Volatiles - Semi Volatiles - PCBs
Total Toxic Organics - Hazardous Substance List

Groundwater
Field Sampling and Analysis
Inorganics - Organics - Bacteria - RCRA Testing
Priority Pollutants - Total Organic Halides (TOX)
Total Organic Carbon (TOC)

Hazardous Waste Analysis
Field Sampling and Analysis
RCRA Tests - EP Toxicity - Corrosivity - Ignitability - Reactivity
Waste Identification Level I and Level II - PCBs - BTUs

Industrial Hygiene
Air Sampling and Analysis
Asbestos - Organic Solvents - Metals

Lube Oil/Petroleum Analysis
Physical and Chemical Testing - Viscosity - Distillation Trace
Metals - PCBs - Flash Point - Wear Metals Glycols - BTUs

Microbiological Testing
Bacteriological analysis of Drinking Water
Wastewater - Groundwater - Food

Priority Pollutants
Asbestos - Cyanide - Phenols - Metals
Volatiles, Acid Extractables, Base Neutrals, Pesticides/PCBs

Soil/Sediment/Sludge
Field Sampling and Analysis - Physical and Chemical
Composition - Inorganics - Organics - Microbiological Testing

TCLP (Toxicity Characteristic Leaching Procedure)
Non-Volatiles - Herbicides - Metals - Pesticides - Semi-Volatile
Volatiles - Including zero headspace extraction

Trace Metals - percent, ppm and ppb levels
Atomic Spectroscopy - Atomic Absorption
Zeeman Furnace - Atomic Absorption
Inductively Coupled Plasma Spectroscopy (ICP)

Pickup Service - Gascoyne pickup service is available in the Baltimore-Washington area.

Certifications

Gascoyne is certified by the United States Department of Agriculture, and State governments of Maryland, Virginia, Pennsylvania, Delaware and New Jersey and The American Industrial Hygiene Association.

Memberships

American Council of Independent Laboratories/The American Chemical Society/American Association of Laboratory Accreditation/Association of Official Analytical Chemists/American Society for Testing and Materials/Society for Applied Spectroscopy/American Industrial Hygiene Association/Pennsylvania Association of Accredited Environmental Laboratories.

2101 Van Deman Street Holabird Industrial Park Baltimore, MD 21224-6697

	AIHA	Delaware	Maryland	New Jersey	Pennsylvania	Virginia	West Virginia
Total Trihalomethanes	NA	X	X	X	X	X	X
8 Regulated Volatiles	NA	X	X	X	X	X	X
36 Un-regulated Volatiles	NA	X	X	X	X	X	X
Pesticides	NA	X	X	X	X	X	X
Herbicides	NA	X	X	X	X	X	X
Metals	X	X	X	X	X	X	X
Microbiological	NA	X	X	X	X	X	X
Nitrate	NA	X	X	X	X	X	X
Nitrite	NA	NA	NA	X	NA	X	NA
Fluoride	NA	X	X	X	X	X	X
Corrosivity	NA	X	NA	NA	X	X	NA
pH	NA	NA	NA	X	X	X	NA
Sodium	NA	NA	NA	_X	X	X	NA
Turbidity	NA	NA	NA	X	NA	NA	NA
Cyanide	NA	NA	NA	NA	NA	X	NA
Sulfate	NA	NA	NA	X	NA	X	NA
Alkalinity	NA	NA	NA	X	X	X	NA
Total Dissolved Solids	NA	NA	NA	X	X	X	NA
Calcium	NA	NA	NA	NA	X	X	NA
Chlorinated Solvents	X	NA	NA	NA	NA	NA	NA
Aromatic Solvents	X	NA	NA	NA	NA	NA	NA

NA - Certification for this parameter is NOT AVAILABLE from Certifying Agency.

AIHA American Industrial Hygiene Association - Certification No: 427
State of Delaware -
State of Maryland - Certificate No: 109
State of New Jersey - Certification No: 60637
Commonwealth of Pennsylvania - Certification No: 68-339

North Carolina - Gascoyne is in the process of obtaining certification from the State of North Carolina. We anticipate being certified for the same parameters as the State of New Jersey.

GASCOYNE LABORATORIES, INC .CERTIFIED PARAMETERS AND METHODOLOGY
DRINKING-WATER

STATE OF MARYLAND

INORGANIC CONTAMINANTS -	METHODOLOGY
TRACE METALS	
Arsenic	EPA 206.2
Barium	EPA 200.7
Cadmium	EPA 213.2
Chromium	EPA 218.2
Lead	EPA 239.2
Mercury	EPA 245.1
Selenium	EPA 270.2
Silver	EPA 272.2
NITRATE/FLUORIDE	
Nitrate	EPA 353.2
Fluoride	EPA 340.2

ORGANIC CONTAMINANTS

ORGANIC CHLORINATED HYDROCARBONS	EPA 600/4-81-053
CHLOROPHENOXYS	EPA 600/4-81-053
TOTAL TRIHALOMETHANES	EPA 501.1/ 524.1/ 524.2
VOLATILE ORGANIC CHEMICALS	EPA 502.1/503.1/524.2

GASCOYNE LABORATORIES, INC. CERTIFIED PARAMETERS AND METHODOLOGY
DRINKING WATER

COMMONWEALTH-OF VIRGINIA

INORGANIC CONTAMINANTS	METHODOLOGY
SODIUM/CORROSIVITY	
Alkalinity	EPA310.2
PH	EPA 150.1
Total Dissolved Solids	
Calcium	EPA 215.1
Sodium	EPA 273.1
TRACE METALS	
Antimony	EPA 204.1
Arsenic	EPA 206.2
Barium	EPA 200.7
Beryllium	EPA 210.2
Cadmium	EPA 213.2
Chromium	EPA 218.2
Copper	EPA 220.2
Lead	EPA 239.2
Mercury	EPA 245.1
Nickel	EPA 249.2
Selenium	EPA 270.2
Silver	EPA 272.2
Thallium	EPA 279.2
NITRATE/FLUORIDE	
Nitrate	EPA 353.2
Nitrite	EPA 354.1
Fluoride	EPA 340.2
CYANIDE	
Cyanide	EPA 335.2
SULFATE	
Sulfate	EPA 375.1

ORGANIC CONTAMINANTS

PESTICIDES	EPA 600/4-81-053
Endrin	
Lindane	
Methoxyohlor	
Toxaphene	

GASCOYNE LABORATORIES, INC. CERTIFIED PARAMETERS AND METHODOLOGY
DRINKING WATER

COMMONWEALTH OF VIRGINIA

HERBICIDES	EPA 600/4-81-053
2,4-D	
2,4,5-TP (silvex)	
TOTAL TRIHALOMETHANES	EPA 524.2
Chloroform	
Bromoform	
Bromodichloromethane	
Dibromochloromethane	
VOLATILE ORGANIC CHEMICALS	EPA 502.1/503.1/524.2
Group 1:	
Benzene	
Carbon Tetrachloride	
1,4-dichlorobenzene	
1,2-dichloroethane	
1,1-dichloroethylene	
1,1,1-trichloroethane	
Trichloroethylene	
Group 2:	EPA 524.2
Vinyl Chloride	

QUALITY CONTROL/QUALITY ASSURANCE SUMMARY

I. Quality Objective

It is the objective of Gascoyne Laboratories, Inc. to maintain a program to assure that data generated meet the high standards for reliability of laboratory data As set by the various certifying bodies.

II. Quality Policies

Gascoyne Laboratories adheres to a strict Quality Control/Quality Assurance Program. This program includes set procedures for chain-of-custody, spiking of sample, duplicate analyses, check sample analyses and the use of approved methods.

III. Quality Plan

The plan to achieve the Quality objective through implementation of the quality policies is to insure that laboratory practices are in agreement with the contents of the quality control/quality assurance program as stated in the manual.

IV. Quality Organization - See Company Organizational Chart

V. Field Sampling Procedures

The highest quality in an analysis is insignificant if the sample being analyzed is not representative of the article to be tested. Therefore, it is important to collect proper samples and ensure that they maintain the characteristics of the sample source by the use of appropriate sampling and preservation techniques. Since the results of analysis performed on these samples is potential evidence in legal proceedings, it is critical that the sampling be performed correctly, and documented thoroughly. The techniques used are based on Environmental Protection Agency guidelines, described in the Handbook for Sampling and Sampling Preservation of Water and Wastewater, (EPA-600-4-82-029), and Test Methods for Evaluating Solid Wastes (EPA SW-846, Third Edition.)

VI. Sample Receipt and Handling

Samples are delivered to the laboratory in four different ways with complete documentation:

1. Gascoyne Laboratories Field Operations Department.
2. Gascoyne Laboratories pick up service.
3. Client drop off at the laboratory or branch office.
4. Delivery services - e.g. UPS, Federal Express, Us Postal Service, Courier Services.

VII. Chain-of-Custody/Sample-Control

The results of the analysis of samples collected by or submitted to Gascoyne Laboratories -may become evidence in a court action-or bear on the health and well being of individuals or the environment. Recognizing that these results may be come evidence, it is critical to document and demonstrate that the integrity and condition of the sample were maintained and that the sample(s) are representative of the source.

The Gascoyne SAMPLE CONTROL/CHAIN-OF-CUSTODY form is designed to.-track and document the generation and transfer of a sample or group of samples through sample disposal.

VIII. Facilities and Instruments

In 1987 the laboratory moved into its new, modern office/laboratory complex just off Interstate 95. The laboratory is now in the process of expanding into a 10,000 square foot facility near by.

Gascoyne Laboratories, Inc., has the latest state-of-theart instrumentation including: Atomic Absorption Spectroscopy,`Fourier Transform Spectroscopy (FTIR), Gas Chromatography, Inductively Coupled Plasma (ICP), Laboratory Information Management System, Lachat Auto Analyzer System, Mass Spectroscopy, Parr Calorimeters, TOC/TOX Analyzer, Zero Headspace Extractors, Zymark Turbo Vap, etc.

IX. Preventive Maintenance

In order to provide high quality data, it is important for all equipment to be in satisfactory operating condition. To this end, Gascoyne Laboratories performs preventive maintenance as recommended by the manufacturers of the equipment in use in the laboratories and field operations.

X. Equipment Calibration

All equipment must be properly calibrated before collecting data or analyzing samples. Without acceptable calibration data, it is impossible to demonstrate that the data produced by the analytical procedure is valid.

XI. Analytical Methods

Analytical methods when used properly should provide reliable information about the composition and nature of the samples being tested. In order for this information to be of value, the methods used should have several attributes:

1. should give-evidence of presence of the analyte
2. should-separate rate the analyte from interferences
3 . should be consistent with the level of analyte expected
4. should be consistent with the sample matrix ,
5. should have the required accuracy and precision
6. should have the required lower limit of detection
7. should be available in written form
8. should be "rugged" i.e. not sensitive to minor
9. changes in variables, analysts, or laboratory should meet any regulatory requirements pertaining to the sample

XII. Standards and Reagents

Materials (chemical reagents, solvents, gases, etc.) are available in many grades of purity. In order to produce high quality, reproducible data, it is necessary to obtain materials of the appropriate quality required for the analyses to be performed. It is important to insure that the quality of reagents used for specific procedures are consistent from purchase to purchase.

XIII. Document Control and Recordkeeping

Gascoyne Laboratories, Inc., performs sampling and analysis in order to determine the condition, hazard or quality of a large variety of materials. The data generated from these operations and reports thereof are Gascoyne's only product. Since this information is potential evidence in legal proceedings, it is important that integrity and confidentiality be maintained.

XIV. Data Validation

The assembled report is reviewed by the Laboratory Manager or Laboratory Director for final approval. This review includes a check of the reasonableness of the results in terms of expected concentrations, regulatory standards, consistency with data between departments, etc. The Laboratory Manager or Director will also update the LIMS system checking the departmental verifications for any notes or considerations that need to be evaluated and translated into notes on the final report, and then verifying, reporting, and invoicing the job.

XV. Quality Control

There are a number of quality control tools that are used at Gascoyne Laboratories in order to determine whether data being generated is of satisfactory quality and within prescribed requirements for accuracy and precision. These tools are as listed: Blanks (Field, Trip, Equipment, Method, and Instrument), Spiked Samples,

Calibration Standard, Calibration Check, Matrix Spikes, Duplicate Samples _ (Matrix; _Spike Duplicate, Field _- Duplicate) and Surrogate Standards. Other quality control procedures used are-Method Detection Limits determinations, Precision and Accuracy Statements, Control Charts, and participation in Inter/Intra Laboratory testing.

XVI. Audits and Corrective Actions

Audits are conducted to verify `compliance by Gascoyne Laboratories, Inc., with the policies and procedures: specified in the Quality Control/Quality Assurance, Manual. Any non-conformance noted is to be documented, 'corrected and action taken to prevent recurrence.

In any system, occasional problems and malfunctions will occur. It is important to minimize the occurrence of these incidents through proper care, well delineated procedures, and rapid response to deviations from standard conditions.

XVII. Quality Assurance Reports to Management

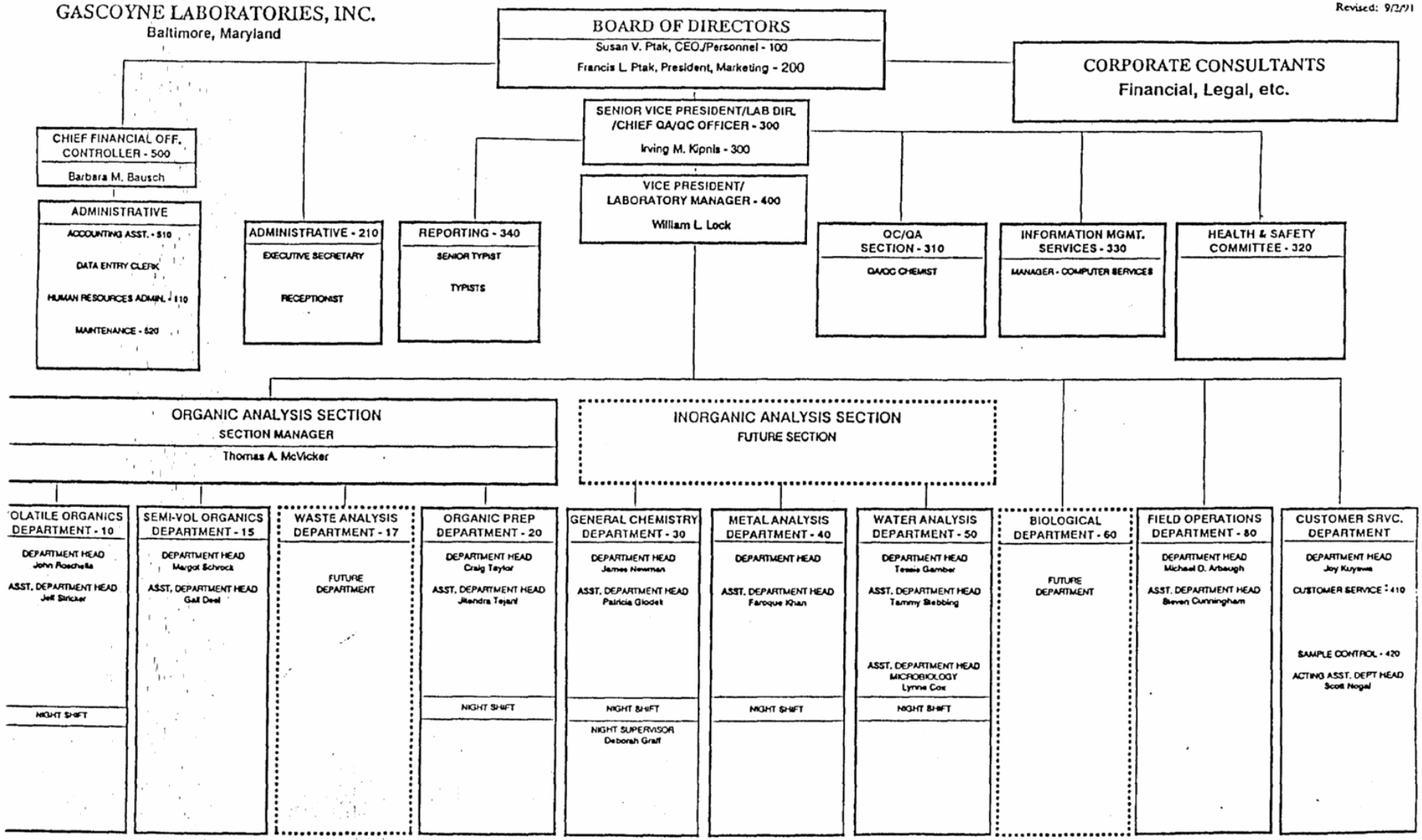
Each month the Laboratory Director makes a summary report to the President. The report contains the following minimum *information:*

1. The occurrence and results of any audits/inspections.
2. A copy of the monthly non-conformance log.
3. Discussion of correction actions taken.
4. Results of any performance samples.
5. Any actions affecting certifications/ accreditation.

GASCOYNE LABORATORIES, INC.

Baltimore, Maryland

Revised: 9/2/91

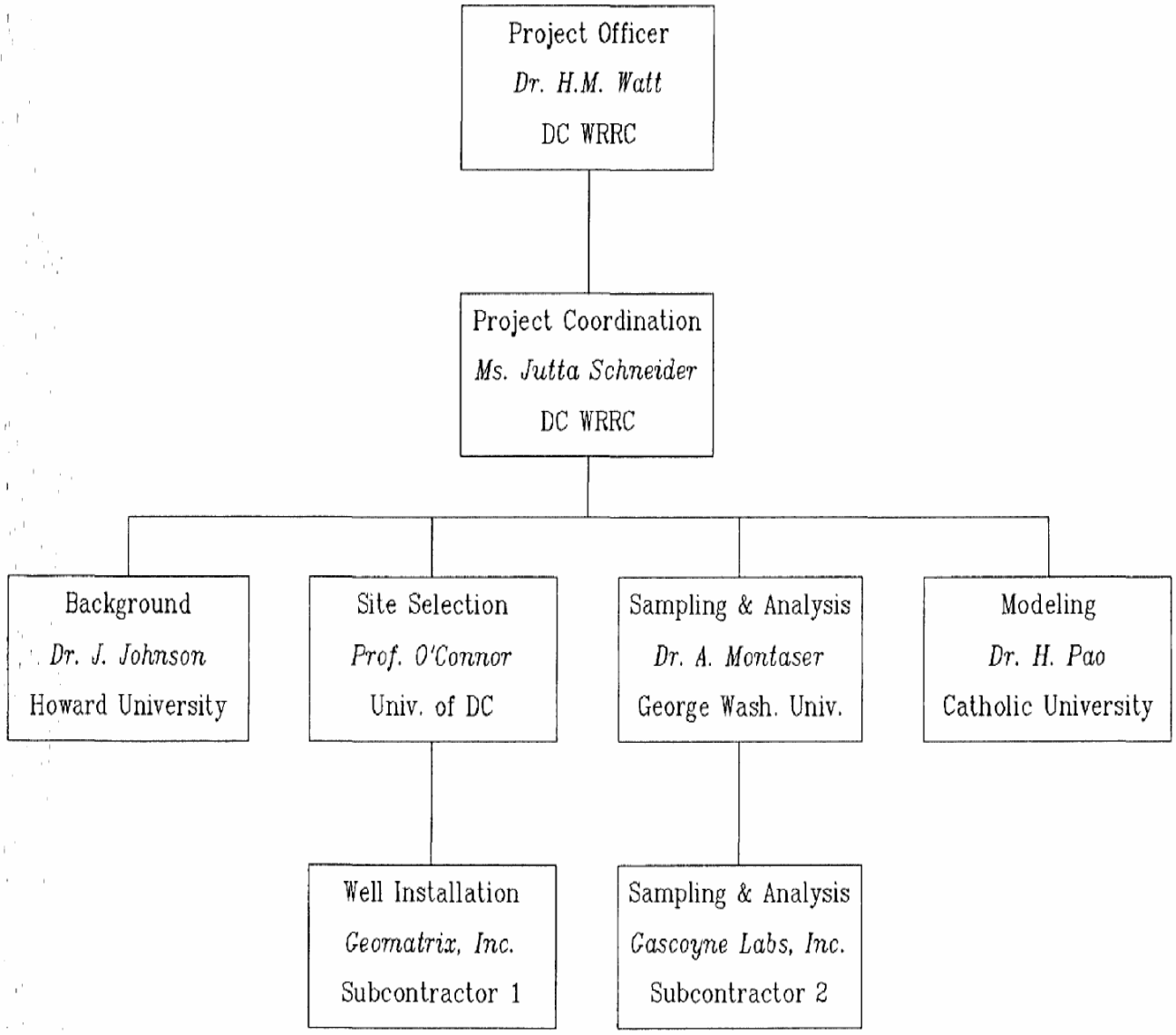


Total Number of Employees: 80

APPENDIX V1

ORAGANIZATIONAL CHART

ORGANIZATIONAL CHART



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APPENDIX VII

EXCERPTS FROM THE LABORATORY QA/QC PLAN (GASCOYNE LABORATORIES, INC.)

QUALITY ASSURANCE/QUALITY CONTROL PROGRAM

GASCOYNE LABORATORIES, INC.

2101 Van Deman Street

Baltimore, Maryland

(301) 285-8510

QUALITY POLICIES

In order to meet the quality objective set forth above, Gascoyne Laboratories, Inc., will conform to the following policies:

(1) To obtain and maintain certifications and accreditations to demonstrate Gascoyne's competence and allow Gascoyne Laboratories, Inc., to perform tests covered by these programs.

(2) To maintain an organization of well qualified and properly trained personnel who are knowledgeable in and follow Gascoyne's prescribed procedures and policies. Personnel are to be trained and qualified in order to perform specific tests.

(3) To maintain adequate facilities (physical plant and instrumentation) to allow personnel to perform chemical tests properly in a safe environment.

(4) To obtain, maintain, and calibrate equipment *and* instrumentation as required to accurately and efficiently carry out chemical tests as prescribed in test methods in use at Gascoyne.

(5) To collect and receive samples under strict chain of-custody procedures adhering to proper sample preservation and collection techniques.

(6) To purchase, use, or prepare appropriate reagents and standards. When possible these should be ACS grade, spectroquality, or traceable to NBS standards.

(7) To use, adapt, or develop "rugged" analytical methods. Whenever available EPA, ASTM, AOAC, NIOSH, Standard Methods or other recognized and accepted methods should be used.

(8) To establish minimum levels of quality of laboratory data (accuracy and precision) whenever not specified by the analytical methods or a regulatory body.

(9) To maintain clear, complete and accurate records of all. laboratory data and to issue accurate reports thereof to clients on their designated representative.

(10) To perform quality control checks on instruments, methods and analysts in -order to rapidly detect errors and ˉprevent recurrence. This will be accomplished_ through-the-use - of.standards,.blanks, replicates, and spiked samples to check accuracy, precision and matrix effects. Results will be monitored with control charts for rapid detection. Corrective action must be taken and documented whenever a process is outside of the specified control limits.

(11) To monitor competence of personnel and adequacy of the quality control program through intralaboratory efforts (blind spikes, data audits and system audits) and interlaboratory testing programs (USEPA WS and WP studies, NIOSH, PAT, Analytical Products Group PET program, USDA performance samples, and "round-robins" with other cooperating laboratories.)

QUALITY PLAN

(1) Maintain a complete, up-to-date manual that describes the quality control/quality assurance program in sufficient detail to insure that all *personnel* have a clear understanding of the program and their responsibilities within the program.

(2) Make the quality manual available to all employees and laboratory inspectors. The manual will be available to clients upon request.

(3) Insure that laboratory practices are in agreement with the contents of the quality control/quality assurance program as stated-in the manual.

(4) Audit the quality control program to assure compliance. Audits will consist of system audits, data audits and performance evaluation samples (interlaboratory and intralaboratory).

V. FIELD SAMPLING PROCEDURES (techniques, preservations)

The highest quality in an analysis is insignificant if the sample being analyzed is not representative of the article to be tested. Therefore, it is important to collect proper samples and ensure that they maintain the characteristics of the sample source by the use of appropriate sampling and preservation techniques. Since the results of analysis performed on these samples is potential evidence in legal proceedings, it is critical that the sampling be performed correctly, and documented thoroughly. The techniques used are based on Environmental Protection Agency guidelines, described in the Handbook for Sampling and Sample Preservation of Water and Wastewater, (EPA-600-4-82-029), and Test Methods for Evaluating Solid Wastes (EPA SW-846, Third Edition.)

GROUNDWATER MONITORING PROCEDURES

A. Containers

1. Without exception, all sample bottles will be new. A representative sample of each lot of containers is checked .for possible contamination.

2. Coliform bacteria - new sterile containers are to be used (e.g. NASCO whirl-pak, catalog NO B1040 or Falcon).

3. Volatile Vials (VOA) - new bottles that are sealed and have been factory pre-cleaned.

B. Sample Integrity

1. Trip blanks are taken to test for cross contamination during transport.

2. Field blanks are taken for volatiles, or other parameters, when there is possible environmental contamination due to the surrounding atmosphere or condition of sampling equipment.

C. Preparation of Site and Preliminary Documentation

1. Make any notations on field report of unusual conditions, i.e., condition of well casings, cap and surrounding area.

2.- Complete the following items on field report:
   a. Date
   b. Time Starting/Finishing
   c. Well Identification
   d. Site Location
   e. Diameter of Well Casing
   f. Bailer Identification

3. Prior to commencing any sampling work, skirt well with plastic sheets to protect spills from re-entering ground surfaces if required. Revised 11/19/91

4. After sampling, obtain names, titles and affiliations of anyone witnessing sampling.

Determine Volume of Water in the Well

1. Remove cap from well casing

2. Drop the line of the electronic depth to water meter and measure in tenths of a foot from top of PVC casing, record on field report.

3. Determine the depth to the well bottom from the top of the PVC casing and record on the field report.

4. Calculate the volume of water in the well and record on the field report.

5. Calculate the minimum volume of water (in gallons) needed to be removed from the well.

(Note: Some wells have very slow recharge rates; if the well is bailed to dryness without appreciable recharge, the well should be allowed to recharge for twenty-four (24) hours, then sampled.

Flushing of the Well:

1. Manual Bailing

a. After determining volume of water in the well, use a clean, or dedicated PVC bailer and new polypropyl rope to bail the required amount of water from the well. During.this process, the rope or bailer should not be allowed to touch the ground.

b. Observations:

1. pH
2. Specific Conductivity
3. Temperature
4. Color
5. Odor

should be determined on the water from the first bailer, and then from each casing volume equivalent of water removed. A minimum of three casing volumes should removed. Continue bailing until the pH, specific conductivity and temperature readings remain constant* or until a maximum of five casing volumes of water are removed from the well. These readings should be repeated after the sample has been collected and labeled as "Sample Reading". Specific conductivity and pH meters must be calibrated in the field each day of use.

* Reading will be considered to be constant when the pH does not vary more than ± 0.2 pH units and the specific conductance stays within ± 10% of successive samples.

c. At this time the sample (-s)- may be collected using the PVC or Teflon bailer

d After sampling the- rope shall be discarded and the bailer stored until it-can be thoroughly-cleaned.

2. Mechanical (Submersible) Pumping

a. Lower the pump to approximately five (5) feet below the surface of the water.

b. Reset the Flow Rate Meter an begin to pump.

c. Take readings of:

1. pH
2. Specific Conductivity
3. Temperature
4. Color
5. Odor

from the first discharge and from each casing volume. Specific conductivity and pH meters must be calibrated in the field each day of use.

d. When readings become constant and a minimum of three casing volume or a maximum of five casing volumes have been removed, shut off and remove the pump.

e. Use a clean PVC bailer and rope to remove one gallon
of water to rinse the bailer, then collect the sample and take sample readings.

FILTERING AND PRESERVATION OF SAMPLES

A. Use a Nalgene Disposable Filtration apparatus with prefilter and a 0.45 micron final filter.

B. Filter sample, then if clogged, discard the filter and use a new final filter.

C. Preserve with an appropriate reagent (See tables at the end of this section).

D. Bottles are pre-labeled to indicate the necessity for filtering and or preservation.

E. Complete all label information.

F. Cool immediately in an ice-packed cooler.

DOCUMENTATION

Field and well reports. are to be filled out completely.- Data is to be entered as soon as the observations are made in order to avoid errors of omission. Examples of field reports follow this page.

SITE PLANS AND INFORMATION MANUALS

Site monitoring information manuals are created for sites as needed or upon request. These manuals will contain information regarding past sampling history special QA/QC requirements' and maps of the site. These manuals will be kept by the Department Head of Field Sampling.

SITE PLANS

Sampling plans will be prepared for sites upon request. Plans will usually conform to Chapter 9 of the Solid Waste Manual SW-846. Third Edition, Volume II.

CLEANING OF BAILERS

For those sites where periodic sampling is done dedicated bailers will be kept for each well. If the bailers do not remain on site (in well) they will be thoroughly cleaned after leaving the site and the job is complete. This will be accomplished by:

1. Dismantling the bailer.
2. Scrubbing with soapy water.
3. Rinsing with tap water.
4. Rinsing with soapy water.
5. Rinsing with tap water.
6. Rinsing with deionized water.
7. Rinsing with nitric acid.
8. Rinsing with deionized water.
9. Air dry for 15 minutes.

VI. SAMPLE RECEIPT AND HANDLING

Samples are delivered to-the laboratory in several different ways:

1. Gascoyne Laboratories Field Sampling Department.
2. Gascoyne Laboratories pick up service.
3. Client drop off at the laboratory or branch office.
4. Delivery services - e.g. UPS, Federal Express, US Postal Service, Courier Services.

1. Gascoyne Laboratories Field Sampling Department - Most of the samples delivered by the Field Sampling Department have been collected, preserved and refrigerated on site as described in the previous section of this manual. In the course of their duties, they may also be requested to deliver samples by clients or to pick up samples at other locations on their travel route.

It is the responsibility of the Field Sampling Department to properly label samples on generation and initiate a chain of-custody form. Samples are to be placed in coolers packed with ice in order to bring the temperature to 4°C as rapidly as possible. Samples are to be kept on ice until delivery to the laboratory. Sample delivery should be accomplished as soon as possible.

Sample labels should contain the sample type, client name, site, sample identification, date and time of collection, preservatives used, tests to be performed, and the name or initials of the person collecting the sample. The recommended label is shown below.

[ ] 100 [ ] 300 [ ] 400 [ ] 500 [ ] 50

FIELD SAMPLE

[ ] GROUND WATER Q SURFACE WATER

[ ] DRINKING WATER [ ] SOIL
[ ] INFLUENT [ ] EFFLUENT
[ ] GRAB [ ] COMPOSITE

CLIENT
SITE WELL NO.
ID

TAKEN BY DATE TIME
PRESERVATIVE: [ ] NONE [ ] COOL 4°C
H_2S0, !•I HCL HNO, NaOH
FILTERED NOT FILTERED TEFLON LINER

ANALYSIS:

VII. CHAIN-OF-CUSTODY/SAMPLE CONTROL

Chain-of-Custody

The .results of the analysis ¯of samples collected by or submitted to Gascoyne Laboratories may become-evidence in a court action or bear on the health and well being of individuals or the environment. Recognizing that these results may be come evidence, it is critical to document and demonstrate that the integrity *and* condition of the sample were maintained and that the sample (s) are representative of the source. To this end, the following chain-of-custody procedures are observed:

A sample is considered to be in custody if it is:

1. In the possession of an individual.
2. Locked in a secure area or vehicle.
3. In the Gascoyne Laboratory Facility in one of the secure areas (laboratories or sample control).

The Gascoyne SAMPLE CONTROL/CHAIN-OF-CUSTODY form (sample follows this page) is designed to track and document the generation and transfers of a sample or group of samples through sample disposal.

These forms are initiated by a sampler, the Gascoyne Driver or a client.

In the center block of the form there are seven sets of lines to allow for multiple transfers of a sample. At each transfer, the person generating or relinquishing the sample should sign their name, company name, date and time. The individual receiving the sample will then sign to complete the transfer.

In the large upper block, information about the client and job is printed by the Radian SAM (LIMS) system at sample login. The information contained in this block includes:

Client Name and Client Code
Work order number (job code, report number) a unique number which has 7 digits, two for the year, 2 for the month, and a 3 digit sequence number.
Number of samples
Sample description (WORK ID)
Date received
Date due
Date printed (Login date)
Priority status
Tests to be performed (SAM test codes)
Appropriate comments

SAMPLE CONTROL/CHAIN OF CUSTODY

Gascoyne Laboratories, Inc.
Baltimore, MD 21224-6697

BALTIMORE
(301) 285-8510
FAX
(301) 285-0815

DATE PRINTED: **12/07/89 08:39:24**

ORDER #	#SPLS	CLIENT	COMPANY	PRIORITY
89-12-126	2	DUMMY	CLIENT NAME	NO
WORK ID			**REC'D**	**DATE DUE**
WASTEWATER SAMPLES			12/06/89	12/20/89

TESTS

BTEX_W CN_AQR PP_M_M TPH_LR VER_10 VER_30 VER_40 VER_50

COMMENTS

CHAIN OF CUSTODY

Relinquished by	Affiliation	Date	Time	Received By
Client Employee	Client Name	12/6/89	3:40 PM	GLI Sample Control
GLI Sample Control	Gascoyne	12/6/89	4:45 PM	Chemist

SAMPLE PLACED IN STORAGE: Chemist (Signature) Date: 12/15/89 Time: 3:30 PM

SAMPLE(S) CONDITION

	As Received at Lab.	As Received at Dept.	At Time of Testing
1. Sample is in proper container	☒ Yes ☐ No ☐ N/A	☒ Yes ☐ No ☐ N/A	☐ Yes ☐ No ☐ N/A
2. Sample has been preserved	☐ Yes ☐ No ☐ N/A	☐ Yes ☒ No ☐ N/A	☐ Yes ☒ No ☐ N/A
3. Max. holding time not exceeded	☒ Yes ☐ No ☐ N/A	☒ Yes ☐ No ☐ N/A	☐ Yes ☐ No ☐ N/A
4. Sample has been refrigerated	☒ Yes ☐ No ☐ N/A	☒ Yes ☐ No ☐ N/A	☐ Yes ☐ No ☐ N/A
5. Container is free of headspace	☒ Yes ☐ No ☐ N/A	☒ Yes ☐ No ☐ N/A	☐ Yes ☐ No ☐ N/A
6.	☐ Yes ☐ No ☐ N/A	☐ Yes ☐ No ☐ N/A	☐ Yes ☐ No ☐ N/A

ADDITIONAL COMMENTS: pH of cyanide sample <10 - not preserved on receipt at dept 50

BTEX VOA not preserved at time of analysis - dept 10

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Report Number: 89-12-126

Sample Numbers: Outfall 001

AMPLE PREPARATION FOR:	ANALYST	DATE
CBs / Pesticides / Herbicides		
cids / Base Neutrals		
OA / Purgeables		
P TOX / TCLP		
evel I / Level II	Technician	12/7/89
Metals		
OD / COD / Coliform		
OC / CN / Phenols (distillation)	Technician	12/8/89
Other extractions for TPH	Technician	12/8/89

AMPLE ANALYSIS FOR:	ANALYST	DATE
CBs / Pesticides / Herbicides		
cids / Base Neutrals		
OA / Purgeables	Chemist	12/10/89
evel I / Level II		
etals	Chemist 1/Chemist 2	12/11 - 12/13/89
DH / S		
OD / COD / Coliform		
OC / CN / Phenols	Chemist	12/14/89
OG / TKN / P / TPH / NH_3	Chemist	12/11/89
H / Flashpoint		
eactivity (S & CN)		
cidity / Alkalinity		
her		

12-88

Intradepartmental use is tracked on the reverse side of the Laboratory chain-of-custody form. Chemists are to initial and date their handling of the .samples for the-purposes of preparation and/or analysis.

Upon completion of all analyses, an analyst will place the sample into storage for disposal, document the transfer and location of the sample on the front of the chain-of-custody form, and forward the form with all other paperwork, work sheets and raw data (not contained in a laboratory notebook) to the Department Head for review.

Samples placed in storage for disposal are retained a minimum of three weeks prior to disposing according to approved procedures.

Ultimately, chain-of-custody forms will be filed with all loose paper work and copies of the final report and invoice. Copies of chain-of-custody forms are supplied to clients upon request.

Client Chain-of-Custody Forms

Many clients have their own chain-of-custody forms. Use of these forms does not replace or eliminate the necessity for using the Gascoyne chain-of-custody form.

Gascoyne employees receiving samples will complete the client's chain-of-custody form and return it to the client. Copies of the client's form are to be kept in the Gascoyne records.

SAMPLE CONTROL

Sample Control is a critical operation as this department determines what work is to be performed on a given work order (sample or group of samples). If this is not done properly, the client's needs will not be met, or they will be only met with considerable perturbation of normal laboratory operations.

The Sample control chemist will receive samples from Field Sampling, Clients, the Gascoyne Driver or one of several courier or delivery services. It is this individual's responsibility to unpack the samples, check documentation, ensure chain-of-custody if followed as described in the previous section, and to note the condition of the samples on the bottom front of the chain-of custody form.

Immediately upon receipt of the samples, a Sample Control Chemist signs the chain-of-custody form and creates an open work order in the SAM (LIMS) system. This documents the arrival of the job at the laboratory pending login.

If the client request priority service, the Sample Control Chemist should complete the approval form and get the client's signature or approval over the telephone. If the priority service was not previously approved, the Sample Control Chemist should consult with the appropriate department heads.

Sample Login

Sample- Control Chemists will complete the open SAM work orders in order of priority (priority service and short holding times first) then order of arrival. This involves entering all the individual tests for each container (fraction). Sample numbers will be the work order number followed by a dash number and letter e.g. 89-11-473-2B would be the second (B) bottle of sample 2 for work order 89-11-473.

If there is any uncertainty as to the tests to be performed or the condition or amount of sample, the client is to be called to resolve the issue. Failure to contact the client will require the completion of the follow up form (sample attached). Periodic attempts to contact the client should be documented on the follow up form.

The "OPEN" command in SAM will result in the printing of a list of all open work orders (those that have not been completely logged in).

When all sample information is entered into SAM, the work order is "transmitted" - chain-of-custody, department paperwork, and bottle labels are printed. The paperwork is organized, labels attached to the containers and samples delivered to the laboratories observing chain-of-custody procedures.

Samples requiring “splitting” into aliquots for different departments is done in the Sample Control Hood following all Gascoyne safety rules.

Work Order Revision

The sample Control Department is responsible for rewriting work orders as required. This usually arises from the cancellation of testing by the client or the necessity of using alternative methods of analysis.

Sample Pickup

The Sample Control Department is responsible for scheduling pickups by the Gascoyne Driver, Field Sampling, or couriers.

SAMPLE CONTAINERS AND COOLERS

The Sample Control Department is responsible for maintaining and distributing clean, appropriate sample containers and sample coolers to clients.

Upon request, sample containers are to be prepared with proper preservatives. Distribution of sampling instructions and hazard warnings is also the responsibility of the Sample Control Department.

IX PREVENTIVE MAINTENANCE

In order to -provide high quality data, it is important for all equipment to be n satisfactory operating condition. To this end, Gascoyne Laboratories performs preventive maintenance as recommended by the manufacturers of the equipment in use in the laboratories and field operations.

Performing preventive maintenance and cleaning as required helps to insure that equipment will perform to specifications and will be in operation when needed to perform analyses in a timely manner.

Each operating department in Gascoyne keeps instrument logs to track the performance and maintenance history of all major pieces of equipment.

Spare parts are kept in inventory to allow for minor maintenance. Service contracts are maintained for all major instruments, balances, and critical equipment. The only exceptions to this policy is for those instruments for which the service contract fees are felt to be exorbitant and there is no redundant equipment available to insure that samples will be analyzed within holding times in the event of equipment failure. (For example, at times the ICP emission spectrophotometer has not been covered by service contract, but all work could be performed by flame or graphite furnace atomic absorption in the event of an extended outage.)

Balances -balances are the most critical instruments in the laboratory. If the measurement of the mass of a sample or standard were to be incorrect, the analysis would of necessity be in error. Therefore, the balances are under a service contract with American Scale and Equipment Co., Inc. which provides for service, cleaning, and field adjustment to manufacturer's specification every six months.

Other Equipment- other equipment maintained on service contract includes the GC/MS hardware and software, GCs, atomic absorption and emission apparatus, the PC network fileserver and other critical LIMS equipment, SAM LIMS software, FTIRs, etc. Some equipment such as the Lachat Quikchem apparatus for performing automated colorimetric analysis are covered by manufacturer service plans which call for shipping functioning loaner units by overnight express until the original unit is repaired.

COPIES OF CURRENT SERVICE AGREEMENTS ARE AVAILABLE ON REQUEST

Revised January 1992

X. EQUIPMENT CALIBRATION

All equipment must be properly -calibrated_ before collecting data or analyzing samples. Without acceptable calibration data, it is impossible to demonstrate that the data produced by the analytical procedure is valid.

All new or reconditioned equipment must be calibrated prior to use. After initial calibration, the equipment may be used after performing a calibration check if specified by the analytical method. For example, many drinking water methods allow analysis of samples after demonstrating that the calibration check sample is within ten per cent of the last calibration curve.

All calibration data is to be recorded in laboratory notebooks, calibration logs, of if the equipment produces hard copy, the output may be stored in a file or loose leaf binder.
Magnetic. tape records of calibration may also be appropriate for certain equipment.

Recognized calibration procedures should be employed whenever available. These include USEPA methods, ASTM methods, manufacturer's instructions, etc..

BALANCES - the most critical equipment for calibration are the analytical and toploading balances used in the laboratory. If these instruments are out of calibration, all sample weights and standard weights will be in error as will be the final analytical data. Balances should be checked daily against and internal calibration weight if the balance has one and checked weekly against a class S weight (NIST). The weekly checks with the class S weight should be recorded. Balances are inspected and serviced semiannually under the preventive maintenance contract. At that time the balance is checked to insure that it is operating to the manufacturer' specifications.

THERMOMETERS - thermometers are to be calibrated annually against an NBS (NIST) thermometer. The NBS thermometers are available in Dept. 500. Accurate thermometers are critical as many methods and results are temperature dependent. Furthermore, where appropriate, sample storage is refrigerated or temperature controlled. These temperatures must be accurate and recorded in the appropriate logs.

Revised January 1992

GAS CHROMATOGRAPHS AND GC,/ MASS SPECTROMETERS - GCs and GC/MS must be calibrated according to the EPA method being used for analysis. Instruments are not to be calibrated against one point. All calibration curves are to be three, five or-more points. From these curves appropriate response factors can be determined.

In addition to calibration for the analytes of interest, GC/MS. must be tuned to USEPA.specifications for p-bromofluorobenzene (BFB) or decafluorotriphenylphosphine (DFTPP). All tuning data is to be retained in hardcopy and on magnetic tape.

ATOMIC ABSORPTION SPECTROPHOTOMETERS - all flame and graphite furnace ΔAs are calibrated with multipoint calibrations. -.The Perkin Elmer 5000 ΔAs.are calibrated by reading the appropriate number of standards and using the results from linear regression to convert sample absorbances to concentrations. The instrument's internal conversion to concentration is not used as this is a one point calibration.

The newer computerized instrumentation (Perkin Elmer 5100 GFAA) has the capability of performing the proper multipoint calibrations and can be used to generate concentration data directly.

ATOMIC EMISSION SPECTROPHOTOMETERS - The Perkin Elmer Plasma II inductively coupled argon plasma spectrophotometer is computerized and has the appropriate algorithm for converting the absorbances from a multipoint calibration to concentration and may be used in this mode.

INFRARED SPECTROMETERS - the FTIR can be calibrated with polystyrene following the manufacturer's procedures.

pH METERS - pH meters are to be calibrated at pH 7 and pH 4 with the appropriate buffers, then a pH 10 buffer is to be read. Calibration is to be repeated if necessary. Buffers are not to be reused.

LACHAT QUIKCHEM ANALYZER - the autoanalyzer will calibrate it self against standards placed in the first positions of the autosampler. The calibration curve and the regression statistics are printed out and are to be saved.

BOMB CALORIMETER - the Parr isoperibol calorimeter is calibrated by analyzing a material of known heat of combustion e.g. benzoic acid to determine if results are in the acceptable range. Calibration is done according to the manufacturer's instructions.

CONDUCTANCE METERS - meters for determining specific conductance are calibrated by analyzing standards if known concentration and conductivity.

	ANALYTICAL TECHNIQUE (s)	DETECTION LIMIT	INSTRUMENT USED	REFERENCE
Molybdenum	A. A. Furnace	1 microgram/liter	P. E. Zeeman/5000	246.2
Nickel	A. A. Furnace	1 microgram/liter	P. E. Zeeman/5000	249.2
Palladium	A. A. Furnace	5 micrograms/liter	P. E. Zeeman/5000	253.2
Platinum	A. A. Furnace	20 micrograms/liter	P. E. Zeeman/5000	255.2
Potassium	A. A. Direct	10 micrograms/liter	P. E. 5000	258.1
Rhdoium	A. A. Furnace	5 micrograms/liter	P. E. Zeeman/5000	265.2
Selenium	A. A. Furnace	2 micrograms/liter	P.E. Zeeman/5000	270.2
Silicon	A. A. Direct	100 micrograms/liter	P. E. 5000	303.C
Silver	A. A. Furnace	0.2 micrograms/liter	P. E. Zeeman/5000	272.2
Sodium	A. A. Direct	2 micrograms/liter	P. E. 5000	273.1
Strontium	A. A. Furnace	1 microgram/liter	P.E. Zeeman/5000	Perkin-Elmer
Thallium	A. A. Furnace	1 microgram/liter	P.E. Zeeman/5000	279.2
Tin	A. A. Furnace	5 micrograms/liter	P.E. Zeeman/5000	282.2
Titanium	A. A. Furnace	10 micrograms/liter	P. E. Zeeman/5000	283.2
Vanadium	A. A. Furnace	4 micrograms/liter	P. E. Zeeman/5000	286.2
	A. A. Direct	5 micrograms/liter	P. E. 5000	289.1
NORGANIC NON-METALS				
Acidity	Titrimetric	1 mg/liter	Orion 901	305.1
Alkalinity	Titrimetric pH 4.5	1 mg/liter	Orion 901	310.1
Carbon Dioxide, Free	Titrimetric	5 mg/liter	Volumetric Glassware	406.B
Chloride	Titrimetric	1 mg/liter	Volumetric Glassware	325.3
Chlorine	Spectrophotometric	0.1 mg/liter	Lamotte Colorimeter	330.4
Cyanide	Spectrophotometric	0.01 mg/liter	B&L Spectronic 21	335.3
Fluoride	Specific Ion	0.05 mg/liter	Orion 901	340.2

ANALYTICAL PROCEDURES

PHYSICAL	ANALYTICAL TECHNIQUE (s)	DETECTION LIMIT	INSTRUMENT USED	EPA REFERENCE
Color	Platinum-Cobalt	1 unit	Color Comparator	110.2
Conductance, Specific	Wheatstone Bridge	0.01 units	YSI	120.1
Residue: -Filterable	Gravimetric, 103*C.	1 mg/liter	Analytical Bal.	160.1
-Non Filterable	Gravimetric, 103°C.	1 mg/liter	Analytical Bal.	160.2
-Total	Gravimetric, 103*C.	1 mg/liter.	Analytical Bal.	160.3
Temperature	Thermometric	0. 1 º C.	YSI	170.1
Turbidity	Nephelometric	0.02 units	HF DRT -'15	180.1

METALS				
Aluminum	A. A. Furnace	3 micrograms/liter	P.E. Zeeman/5000	202.2
Antimony	A. A. Furnace	3 micrograms/liter	P.E. Zeeman/5000	204.2
Arsenic	A. A. Furnace	1 microgram/liter	P.E. Zeeman/5000	206.2
Barium	A. A. Furnace	2 micrograms/liter	P.E. Zeeman/5000	208.2
Beryllium	A. A. Furnace	0.2 micrograms/liter	P.E. Zeeman/5000	210.2
Boron	A. A. Furnace	1 microgram/liter	P.E. Zeeman/5000	Perkin-Elme
Cadmium	A. A. Furnace	0.1 microgram/liter	P.E. Zeeman/5000	213.2
Calcium	A. A. Direct	10 micrograms/liter	P.E. 5000	215.1
Chromium	A.A. Furnace	1 microgram/liter	P.E. Zeeman/5000	218.2
Chromium,Hexavalent	B&L Spectronic 21	1 microgram/liter	Colorimetric	312. B
Cobalt	A. A. Furnace	1 microgram/liter	P.E. Zeeman/5000	219.2
Copper	A. A. Furnace	1 microgram/liter	P.E. Zeeman/5000	220.2
Gold	A. A. Direct	30 micrograms/liter	P. E. 5000	231.2
Iron	A. A. Furnace	1 microgram/liter	P.E. Zeeman/5000	236.1
Lead	A.A. Direct	10 micrograms/liter	P. E. 5000	239.2
Manganese	A. A. Direct	1 microgram/liter	P. E. 5000	317. A
Mercury	A. A. Furnace	0.2 micrograms/liter	P. E. Zeeman/5000	242.
	Cold vapor	1 microgram/liter	P. E. Zeeman/5000	243.2
				245. 1:

	ANALYTICAL TECHNIQUE(S)	DETECTION LIMIT	INSTRUMENT USED	REFERENCE
Nitrogen - TKN	Titrimetric	0.05 mg/liter	Buchi 315	351.3
- Ammonia	Titrim. Dist.	0.05 mg/liter	Buchi 315	350.2
- Nitrate	Ion Selec. Electrode	0.1 mg/liter	Buchi 315	EPA Approved
- Nitrite	Spectrophometric	0.01 mg/liter	B&L Spec.21	354.1
Oxygen, Dissolved	Membrane Electrode	0.05 mg/liter	Orion 231	360.1
Phosphorous, Total	Corlorimetric	0.01 mg/liter	B&L Spec.21	365.2
Phosphate, Total	Colorimetric	0.01 mg/liter	B&L Spec.21	365.2
Sulfate	Turbidimetric	1 mg/liter	B&L Spec.21	375.4
Sulfide	Dist. Colorimetric	0.1 mg/liter	B&L Spec.21	376.2
Sulfite	Titrimetric	3 mg/liter	-	377.1
BACTERIOLOGICAL				
Coliforms, Fecal	Mult. Tube Ferment.	2 org/100 ml.	-	Std. Meth.908C
Coliforms, Total	Mult. Tube Ferment.	2 org/100 ml.	-	Std. Meth.908A
Total Plate	Std. Plate Count	1 org/ml	-	Std. Meth.907A
Streptococcus, Fecal	Mult. Tube Fermen.	2 org/100ml	-	Std. Meth.910A
TOXICOLOGICAL				
Microtox	Bioassay	-	Microtox Toxicity Analyzer, Beckman Model 2055	
RADIOLOGICAL				
Gross Alpha Activity	Proportional Counting	2 pCi/liter	-	900.0*
Gross Beta Activity	Proportional Counting	3 pCi/liter	-	900.0*
Radium - 226	Radon Emanation	0.6 pCi/liter	-	903.1*
Radium -228	Precipitation	1.0 pCi/liter	-	904.0*
Total Radium		1 pCi/liter	-	901.0*

*EPA 600/4-80-032

ORGANICS	ANALYTICAL TECHNIQUE (s)	DETECTION LIMIT	INSTRUMENT USED	REFERENCE
Biochemical Oxygen Demand	5 Day, 20^0C.	0.1 mg/liter	Orion/Do Mod.	405.1
Chemical Oxygen Demand	Colorimetric Ampule	5 mg/liter	B&L Spec. 21	136.5
Oil & Grease	Gravimetric	2 mg/liter	Anal. Balance	413.1
Organic Carbon, Total	UV Oxidation	20 micrograms/liter	Sybron/Barn-stead Photochem	415.1
Organic Halogens, Total	DX-20	10 micrograms/liter	Envirotech/Dorhman	450.1
Phenols, Total Recoverable	4AAP Spectrophot.	10 micrograms/liter	B&L Spec. 21	420.1
Benzene	GC-P&T-FID	1 microgram/liter	P. E. Sigma Models	602
DDT	GC-EC	1 microgram/liter	P. E. Sigma Models	608
1,2-Dichloroethane	GC-P&T-HALL	1 microgram/liter	P. E. Sigma Models	601
Endrin	GC-EC	0,2 microgram/liter	P. E. Sigma Models	608
Ethvlbenzene	GC-P&T-FID	1 microgram/liter	P. E. Sigma Models	602
Methane	GC-EC	1 microgram/liter	P. E. Sigma Models	608
Methoxychlor	GC-EC	1 microgram/liter	P. E. Sigma Models	608
PCB's	Gc-EC	1 microgram/liter	P. E. Sigma Models	608
2,4,D	GC-EC	1 microgram/liter	P. E. Sigma Models	608
2,4,5,TP	GC-EC	1 microgram/liter	P. E. Sigma Models	608
Toluene	GC-P&T-FID	1 microgram/liter	P. E. Sigma Models	602
Toxaphene	GC-EC	.1 microgram/liter	P. E. Sigma Models	608
1,1,1-Trichloroethane	GC-P&T-HALL	1 microgram/liter	P. E. Sigma Models	601
Trichloroethylene	GC-P&T-HALL	1 microgram/liter	P. E. Sigma Models	601
Vinyl Chloride	GC-P&T-HALL	1 microgram/liter	P. E. Sigma Models	601
Xylenes	GC-P&T-FID	1 microgram/liter	P. E. Sigma Models	602

USEPA PRIORITY POLLUTANTS	ANALYTICAL TECHNIQUE (s)	DETECTION LIMIT	INSTRUMENT USED	REFERENCE
Volatiles	GC-P&T-MS	1 microgram/liter	-	601, 602, 60[illegible]
Acid Extractables	GC-MS	1 microgram/liter	-	625
Base/Neutral Extractables	GC-MS	1 microgram/liter	-	625
Pesticides	GC-MS	1 microgram/liter	-	608 ~~625~~

XV. QUALITY CONTROL

There are a number of quality control tools that are used at Gascoyne Laboratories in order to determine whether data being generated is of satisfactory quality and within prescribed requirements for accuracy and precision. These tools and the minimum frequency of use is described below.

BLANKS

Blanks are artificial samples that are used to determine whether there has been contamination of samples, equipment or reagents. Analysis of a minimum of one blank sample per every twenty samples or per batch of samples is required. There are several types of blank samples that may be analyzed. The types of blank samples to be employed for a particular job or analytical method may vary.

Field Blank - A sample of reagent water or sampling medium (e.g. filter or absorption tube, etc.) that has been taken to the sampling site and exposed to the ambient air without actively exposing the material to sampling conditions. These samples will be used to determine the amount of background contamination that could arise from the sample being collected at the particular site.

Trip Blank - A sample of reagent water, etc. that accompanies a sampling crew to the sampling site and is carried back to the laboratory under the same storage conditions as the actual samples. The purpose of these samples is to assess the potential for cross contamination during sample shipment. A minimum of one trip blank per sampling event or per cooler is required for Gascoyne Laboratories Field Sampling Dept. Clients are encouraged to submit trip blanks as well.

Rinsate or Equipment Blanks - A sample of clean water or solvent that is used to rinse equipment before or between samples to determine the potential for contamination from sampling equipment. The number of rinsate blanks to be submitted should be determined by the sampling crew based upon potential for cross contamination at the site and whether disposable sampling equipment is being used (i.e. no reuse of sampling equipment).

Reagent or Method Blanks - A sample of reagent (D.I. or organopure) water or analytical medium (buffers, solvents, water with preservatives added, etc.) that is carried through the entire analytical process i.e. sample preparation (extraction, digestion) and analysis. Frequency of these samples is a minimum of one per twenty as described above.

Instrument Blanks -A sample of reagent water or solvent that is analyzed between samples to assess the potential for cross contamination in an analytical instrument or procedure. This sample is not carried through the- sample preparation portion of the analytical method. The frequency of analysis of instrument blanks is variable and is best determined by the analyst. For example, if a highly contaminated sample has been analyzed, instrument blanks should be analyzed until the analytical equipment fails to show any evidence of contamination. If a large number of samples that have no detectable contamination are analyzed, the necessity for instrument blanks is greatly reduced.

SPIKED (KNOWN OR-CHECK) SAMPLES/LABORATORY FORTIFIED BLANKS

Spiked samples, i. e. those having a known quantity of reagent are analyzed to determine the performance of a method, analyst, or the stability of an analyte in the sample matrix. There are several types of spiked samples. These are usually analyzed at a minimum frequency of one spike per twenty samples or one per batch. There are some procedures for which a spiked sample is not appropriate or available, but these cases are rare.

Calibration Standard - a sample containing a known quantity of analyte which is used in conjunction with standards of other concentrations to determine instrument response (a standard curve). The number of calibration standards to be used is method dependent. The most common number of standards used to generate a response curve is either three or five.

Calibration Check – a sample containing a known quantity of analyte which has been purchased or prepared from a different source than the samples used to calibrate the equipment or method. These are used to verify instrument response. These samples are not carried through the sample preparation portion of the analytical procedure. The normal frequency of analysis is at the beginning of an analytical run to verify that the instrument is still in calibration. For a large batch of samples the check sample should be analyzed at least once per twenty samples and should be the last sample analyzed as well. Purchased standards are available from Environmental Resource Associates, Analytical Products Group, Supelco, J.T. Baker, NIST, etc. (see Chap. XII).

Spiked or Check Samples /Laboratory Fortified Blanks - samples containing a known amount of analyte which are prepared by the analyst and carried through the entire analytical procedure to demonstrate the accuracy of the procedure. Spiked samples should be run with every batch of samples and at least one per twenty samples. Results should be within limits specified by the method or by the manufacturer for purchased check samples.

Matrix Spikes /Laboratory Fortified Samples - samples which are being analyzed or have been analyzed previously which have a separate aliquot taken and spiked with a predetermined quantity of analyte. After analysis, the results of the spiked and unspiked samples are compared to determine the analytical recovery of the spiked material. Failure to achieve the recovery specified in the method being used indicates an analytical problem or a matrix interference or incompatibility. In the event of insufficient spike recovery, the analysis should be repeated. Continued spike recovery problems should be noted on reports. In certain cases it will be necessary to analyze samples by the method of "Standard Addition" to assess matrix interferences.

Spike recoveries are calculated as follows:

$$\text{Recovery} = \frac{(\text{spike result} - \text{unspiked sample result})}{\text{spike amount}} \times 100\%$$

DUPLICATE SAMPLES

Samples are analyzed in duplicate to verify the precision of the analytical procedure. Duplicate samples should be analyzed with each batch of samples and at a minimum of one per twenty samples.

Duplicates - one sample prepared and analyzed twice in the laboratory. Duplicate analytical results are compared to determine if the repeatability is within the limits specified for the analytical procedure. The difference should not be significant compared to the magnitude of the result although this may be satisfactory for extremely low level analyses.

Matrix Spike Duplicates - this requires the analysis of three samples, the native sample, a matrix spike, and a second matrix spike or matrix spike duplicate. Each matrix spike should be compared separately to the original sample and recoveries calculated. This gives two checks on the accuracy of the method, and a check on the precision.

Field Duplicates - replicate samples are collected in the field or duplicate samples are submitted by a client. These are analyzed and the results compared to assess the precision of the entire sampling and analytical process. Duplicate analysis of one sample in the laboratory only tests the precision of the analytical procedure. Field duplicates are generally collected upon client request or at the rate of about one per twenty samples collected.

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SURROGATE STANDARDS

Surrogate compounds- are materials not usually expected to be found in environmental samples, but are expected to behave identically to an analyte of interest in the analytical process. Surrogates are often isotopic isomers of environmentally significant materials. These materials are added to a sample aliquot and carried through sample preparation and analysis. Satisfactory recoveries of these materials demonstrate that the analytical process is in control. Surrogate recoveries are calculated as follows:

$$\text{Surrogate Recovery} = \frac{\text{surrogate recovery}}{\text{surrogate amount}} \times 100\%$$

Surrogates are added to essentially all quantitative organic analyses. Some exceptions are Level II solvent screens, gas bags, and absorption tubes.

CALIBRATION

All equipment, methods, and procedures are to be calibrated prior to conducting analyses. Calibration policies are described in detail in Chap. X.

METHOD DETECTION LIMITS

Method detection limits are determined by obtaining the average result and standard deviation for at least seven blank samples and calculating the amount of material that would have to be present to exceed the 95% confidence limits for a blank sample. The procedure for determining MDLs can be found in the Federal Register 40 CFR 136 Appendix B October 26,1984 or in Appendix A of the EPA 600/4-82-057, Methods for Organic Chemical Analysis of Municipal and Industrial Wastewater. The latter follows this page. MDLs should be determined for all applicable methods (those with an instrumental response). The detection limits calculated by this procedure are usually not achievable in actual samples, but serve to demonstrate the ability of the laboratory to perform the method to the desired sensitivity.

PRECISION AND ACCURACY STATEMENTS

Known (spiked) samples should be analyzed several times by several analysts to determine the sample to sample and analyst to analyst variation for analytical procedures. This should be done at several concentrations of importance.

INTERLABORATORY TESTING

In order to demonstrate laboratory competence, qualify new analytical methods, and maintain certifications it is often necessary to analyze samples submitted to the laboratory by outside organizations or exchanged with other laboratories. Gascoyne Laboratories participates in many such programs.

EPA Performance Samples -the USEPA submits two series of performance samples to laboratories. The WP or water pollution series tests a laboratory's ability to analyze waste water samples. This series has recently been discontinued by the EPA due to budgetary restrictions. The WS or water supply series tests a laboratory's ability to analyze drinking water quality samples. This series is used by many states to obtain and maintain certification to analyze samples for drinking water. The States of Maryland, Pennsylvania, and New Jersey request that we submit our results for the latter samples. The State of Virginia requests copies of results at the time of recertification. This program is due to be cut back from two levels of each analyte to one level. The EPA also supplies DMRQA performance to holders of NPDES permits to demonstrate their competence to analyze wastewater samples under their permits. Those clients who submit their wastewater samples to Gascoyne for determination of their permit parameters will also forward their DMRQA samples to us. /

US Dept of Agriculture - the USDA submits meat samples monthly to Gascoyne and other certified laboratories for analysis.

AIHA/ NIOSH PAT - the American Industrial Hygiene Association funds the performance analytical testing or PAT program operated by the National Institute of Occupational Safety and Health. The samples submitted to the participation laboratories are used to assess competence to analyze industrial hygiene samples and is used by AIHA to qualify for and maintain accreditation.

State of New Jersey - the State of NJ uses the WS series for drinking water certification. NJ also certifies for the analysis of wastewater. For this purpose they use the result of the WP studies and they submit their own performance samples as well. The latter are usually WP samples from earlier studies.

APG PET Program - the Analytical Products Group supplies performance samples to customers and evaluates the results and reports back to participating laboratories. Gascoyne Laboratories subscribes to this program for internal evaluation of competence and to locate quality problems that need to be addressed. Although the EPA studies are supposed to be useful as tools to assess quality control programs, the lag between analysis of samples and the reporting of results (usually 6 months or more) is so long that it is often difficult to trace the cause of problems. The PET program reports are returned much more rapidly allowing the

laboratory to identify the cause of out of range results and correct the problems. These samples are analyzed quarterly.

INTRALABORATORY PERFORMANCE SAMPLES

In addition to the external programs, Gascoyne Laboratories has and internal program to assess the competence of the analysts. Samples are prepared by the Laboratory Director or his designate and submitted to the Sample Control Dept. for distribution to the laboratories. The Radian SAM LIMS system allows samples to be added to client work orders, be flagged as qc samples so that they are not billed, and not be identified to the analyst as a qc sample. This insures that the performance samples will not, get special treatment as formal performance samples do. Results are communicated to the analyst and his supervisor. Results for performance samples are tabulated for the various departments. Results on all of the above performance samples are considered in appraising the performance and determining the compensation of Dept. Heads and analysts.

CONTROL CHARTS

Control charts are very useful for rapidly determining whether an analytical process is in control. There are several such charts of use to analysts.

X-Charts - these charts plot the performance on check samples, spike recoveries, and surrogate recoveries versus date or sequence number. Results should fall within control limits specified by the supplier of commercial check samples, limits specified by the method, or those determined from the analysis of twenty or more samples. The value of charts over tables or checking against written control limits is the ability to see trends and bias in the results before the problem becomes severe enough to force the results beyond the control limits.

R-Charts - these charts plot the difference between duplicate sample results. Differences are plotted versus date or sequence number, the plot going from zero up as the absolute value of the difference between duplicates is plotted. The differences should be below the control limit determined for the procedure.

XVI AUDITS AND CORRECTIVE ACTIONS

AUDITS

Audits are conducted to verify compliance by Gascoyne Laboratories, Inc. with the policies and procedures specified in this manual. Any nonconformance noted is to be documented, corrected and action taken to prevent recurrence.

The laboratory is subject to several different kinds of audit:

1. Certifying/Accrediting Agencies - The various organizations that certify or accredit Gascoyne Laboratories, Inc. may conduct laboratory audits/inspections on either a periodic or random basis to verify that Gascoyne is complying with the inspecting organizations requirements and standards.

Gascoyne encourages and looks forward to these opportunities to demonstrate our competence and to learn and improve from the interaction and exchange of information with the site auditor.

2. Annual- Internal Audit - conducted for Gascoyne Laboratories, Inc. by an independent consultant who is a qualified professional with experience as a laboratory auditor.

3. Client Audits - Gascoyne Laboratories cooperates fully with clients who wish to inspect the laboratory or to conduct audits of the data generated for their samples.

4. Annual Self-Appraisal - The Laboratory Director will complete the Program Self-Appraisal checklist every January with the assistance of the Laboratory Manager and the Department Heads.

1. T.A. Ratliff, Jr. "Laboratory Quality Program Requirements, ASQC, Milwaukee, 1976. (Copy appended).

CORRECTIVE ACTIONS

In any system, occasional problems and malfunctions will occur. It is important to minimize the occurrence of these incidents through proper care, well delineated procedures, and rapid response to deviations from standard conditions.

Minor problems and their correction (such as failure of an instrument or a calibration) require no documentation (other than in appropriate log books) if correctable by minor maintenance (changing septa, liners, columns, etc.), or summoning a service engineer. It is imperative to correct these problems rapidly. Furthermore, it is required to post a sign on malfunctioning equipment to prevent others from generating erroneous data.

Upon discovery of any more significant incidence of noncompliance/nonconformance with -Gascoyne. Laboratories, Inc. quality policies and procedures. Gascoyne Noncompliance/ corrective action form (sample attached) must be completed

Any event outside of specified limits can trigger the corrective action process. The following activities are typical of those that would result in a corrective action:

1. Sampling
2. Sample receipt
3. Sample storage
4. Sample preparation and analysis
5. Computation
6. Instrument/equipment condition
7. Reporting
8. Performance sample results
9. Audits

The personnel with primary responsibility for detecting and reporting nonconformance are the Laboratory Director and Manager, the Department and Assistant Department Heads and Customer Service/QC personnel. Other employees may also initiate reports.

Reports will contain a description of what occurred, who (if anyone) was responsible, the corrective action being taken and the date completed. Reports are to be delivered to the Laboratory Director for approval and inclusion in the permanent file and log.