

**WORK PLAN FOR SOIL GAS SURVEY
TEXACO SERVICE STATION
TUTU, ST. THOMAS, U.S. VIRGIN ISLANDS**

October 14, 1987

Prepared for:

TEXACO CARIBBEAN, INC.

Prepared by:

GEOSCIENCE CONSULTANTS, LTD.

HEADQUARTERS
500 Copper Avenue, NW
Suite 200
Albuquerque, New Mexico 87102
(505) 842-0001
FAX (505) 842-0595

WESTERN REGION OFFICE
5000 Birch Street
West Tower, Suite 3000
Newport Beach, CA 92660
(714) 476-3650

EASTERN REGION OFFICE
1109 Spring Street
Suite 706
Silver Spring, Maryland 20910
(301) 587-2088
FAX (301) 587-2086

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1.0 DESCRIPTION OF WORK

1.1 BACKGROUND

Texaco Caribbean, Inc., has requested Geoscience Consultants, Ltd. (GCL) to examine the possibility of hydrocarbon releases and potential migration pathways for any such releases from underground storage tanks which have been in use at the Texaco service station in Tutu, St. Thomas, U. S. Virgin Islands, by performing a soil gas survey on and adjacent to the service station site.

Texaco Caribbean, Inc. and GCL have contacted the U.S. Environmental Protection Agency Region II (EPA) Project Manager, Charles Dolan, and the Project Officer at Camp, Dresser & McKee Federal Programs Corporation (CDM-FPC), Robert D. Goltz. GCL has discussed the principles upon which the technical approach and work schedule presented in this work plan are based. It is our understanding that all parties are presently in agreement with the concepts and schedule presented herein.

1.2 HYDROGEOLOGIC SETTING

The Tutu service station is located on the lower slopes along the east side of a valley in the east-central portion of St. Thomas. Topographic considerations and limited water level data indicate that the water table at the site slopes to the southwest. However, the direction of local ground water flow may be strongly affected by fracture orientation in the volcanic bedrock underlying the site. Depth to ground water in the Tillett water well, located 250 feet south of the Tutu station, is reported to be about 20 feet, with drawdown to about 40 feet below land surface when the well is pumped and during dry periods. Examination of outcrops exposed on the west side of the valley, about 700 feet from the service station, indicates that depth to bedrock may vary from about 1 foot to 20 feet or more locally. Although no lithologic log is presently available for the Tillett well, it is reported to be cased to a depth of 20 feet below the surface, with open hole below that to the total depth of 100 feet. It is therefore likely that bedrock lies within 20 feet of the surface at the site.

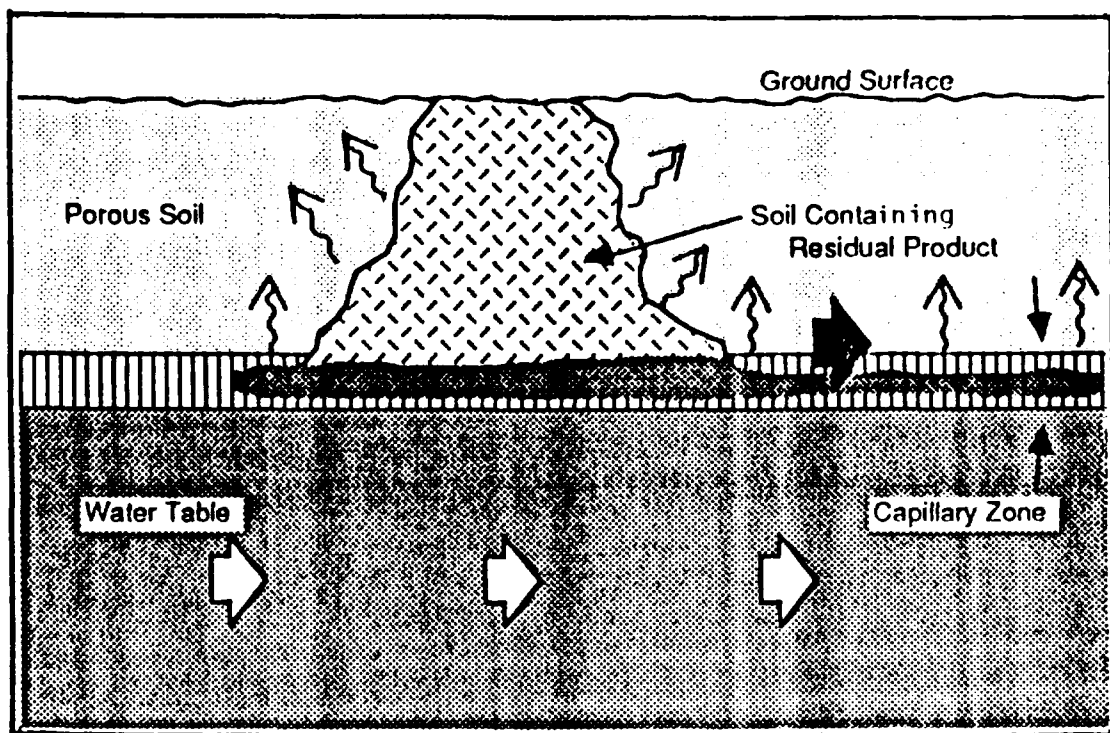
1.3 PURPOSE AND METHODOLOGY OF SOIL GAS INVESTIGATION

The purpose of the proposed soil gas survey is to determine whether there is evidence for subsurface hydrocarbons at the Texaco service station, and, if such hydrocarbons are identified, to determine their areal extent.

During subsurface migration of any petroleum release from an underground storage tank, hydrocarbons can be expected to move downward to the water table and then be carried in the upper part of the shallowest aquifer in the direction of local ground water flow (Figure 1-1). Soil containing hydrocarbons will yield high values of total hydrocarbons, benzene and toluene when vapor extracted from the soil zone is analyzed for these components. Additionally, volatilization of low-molecular-weight hydrocarbons transported with ground water produces relatively high hydrocarbon concentrations in soil gas from the zone above the hydrocarbon plume, often allowing efficient mapping of the plume extent by the use of a systematic soil gas sampling program.

The soil gas survey to be performed in the Tutu station area will:

- determine whether there is evidence for a product release at the Texaco service station, based on soil gas values at the site; and
- if a hydrocarbon plume or hydrocarbons contained in soil are identified, define the extent of the existing hydrocarbons and the probable future transport directions.



 Vapor movement from zones of soil and
ground water containing hydrocarbons

FIGURE 1-1

SCHEMATIC ILLUSTRATION SHOWING SUBSURFACE VAPOR AND
HYDROCARBONS RESULTING FROM A PRODUCT RELEASE

(Adapted From: Underground Storage Tank Corrective
Action Technologies, EPA/625/6-87-015, January 1987)

2.0 STATEMENT OF WORK

In order to determine the range and spatial distribution of hydrocarbons present in the soil at the Tutu service station site, GCL proposes to implement a phased approach which includes:

- Phase 1: Soil gas sampling and analysis on a grid encompassing the service station area
- Phase 2: Extension of the sampling grid beyond the station boundaries to determine whether values of hydrocarbons found on the station site differ significantly from those found up-gradient (hydrologically) and downgradient from the site
- Phase 3: Further extension of the sampling grid, if needed, to define the areal extent of any defined hydrocarbon plume or hydrocarbons contained in a bedrock fracture zone if either is identified during the first two phases of site work.

The soil gas sampling program may be terminated at the end of Phase 1 if it is determined to the satisfaction of Texaco Caribbean, Inc. that there is no evidence of hydrocarbons at the Tutu station, or that further soil-gas sampling would not be productive.

A detailed list of tasks to be accomplished under the contract is presented in Section 3.0 of this work plan. Submittal of the final project report is scheduled for December 23, 1987. This schedule is based on a planned start-up date of November 2, 1987, for field work at the Tutu site, and is therefore dependent on approval of this Work Plan and the associated QAPP no later than October 26, 1987.

3.0 TECHNICAL APPROACH

The technical approach for this project has been developed by GCL with significant input from Texaco Caribbean, Inc. A site visit was performed by Texaco Caribbean, Inc. and GCL personnel during late September, 1987. The program is designed to permit accomplishment of project tasks in a logical sequence, while retaining the flexibility for field decisions as to the necessity for implementation of subsequent task phases.

The technical approach has been divided into nine tasks. Through these tasks, site-specific geologic data will be developed, a soil-gas sampling grid will be put in place, soil gas will be sampled and analyzed on site for specific hydrocarbons which may be indicative of petroleum presence in the subsurface. Further soil-gas sampling and analysis will be conducted, as needed, based on results from earlier phases of the program and a final report will be prepared describing and illustrating the results of the program. Tasks 01, 03 and 04 have been completed. Task 02 is ongoing and will carry on throughout the project.

The nine tasks are listed below:

- Task 01 Work Plan Development
- Task 02 Management and Coordination
- Task 03 Preliminary Site Investigation
- Task 04 Preparation of QAPP
- Task 05 Soil Gas Sampling and Analysis
- Task 06 Hydrogeologic Site Characterization
- Task 07 Data Analysis and Interpretation
- Task 08 Preparation of Technical Report
- Task 09 Quality Assurance/Quality Control

In order to successfully carry out this project within the scheduled time frame, the GCL Program Manager and Project Director will maintain the

necessary close communication with Texaco Caribbean, Inc. to assure that efforts are coordinated and each task is completed according to the Work Plan. Any necessary "mid-course" corrections in strategies will be examined carefully, and will be documented and coordinated with Texaco Caribbean, Inc.

3.1 TASK 01 WORK PLAN DEVELOPMENT

Through meetings and telephone conversations, Texaco Caribbean, Inc. and GCL project staff have established the basic guidelines and objectives for the proposed study of hydrocarbon values in soil gas. Texaco Caribbean, Inc. and GCL representatives have met in the field to evaluate and refine the technical approach and its specific application at the Tutu site. The deliverable for Task 01 is this work plan. The work plan may be revised as appropriate to assure that the proposed technical approach meets the objectives and specifications of the project as defined by Texaco Caribbean, Inc.

3.2 TASK 02 MANAGEMENT AND COORDINATION

This task will be the primary responsibility of the GCL Program Manager and will, in general, consist of providing the interface between the technical execution of the work tasks and administration and planning. The specific activities to be performed under this task are:

- direct contact with Texaco Caribbean, Inc. to ensure that tasks are being performed in a timely manner,
- assurance that team staff and resources are provided so that the project tasks are completed on schedule,
- initiating changes to the work plan as necessary by monitoring the schedule of deliverables,
- ensuring that quality control and quality assurance measures are monitored and implemented,
- providing an overview of project schedule and scope.

The management and coordination task will ensure that Texaco Caribbean, Inc. has the direct access to GCL management necessary to insure that this project is successfully executed.

3.3 TASK 03 PRELIMINARY SITE INVESTIGATION

The preliminary site investigation allows for optimization of resources during operation of the soil gas survey by identifying in advance the limitations and special requirements which may be imposed by the topographic, geologic, hydrologic and cultural conditions of the site. This preliminary site investigation has been conducted by the GCL Project Director, in conjunction with Texaco Caribbean, Inc. staff. This work plan incorporates site-specific requirements based on the results of the preliminary site investigation, as follows:

- Rocky soil and fill material beneath much of the area to be examined will limit the depth of penetration which can generally be achieved by soil gas probes. The survey will be limited to depths of about 5 or 10 feet below the ground surface.
- Movement of ground water and, possibly, of soil gas is probably controlled, or at least influenced by, fracture systems in the volcanic bedrock underlying the Tutu site. Orientation of the dominant fracture systems was considered in establishment of the proposed sampling grids. Limited analysis of fracture system orientation during the initial visit indicated that, if a hydrocarbon release from the Texaco station has occurred and has reached ground water, it can be expected to move primarily in a southward or westward direction. These directions are therefore of primary concern in establishment of sampling grids needed to determine the extent of any potential hydrocarbon migration.
- Establishment of the sampling grids was affected by numerous existing structures. It was necessary to offset some grid points in order to provide adequate areal coverage within the limitations imposed by these cultural features.
- The cooperation of several property owners will be required if it is found necessary to establish sampling points off of Texaco property. Texaco Caribbean, Inc. will use its best efforts to obtain the necessary cooperation of these owners in allowing entry and sampling operations on their property.

3.4 TASK 04 PREPARATION OF QAPP

Prior to conducting the soil gas survey, GCL will prepare and submit a Quality Assurance Project Plan (QAPP) to monitor the quality of the work products. Task 04 consists of the QAPP preparation and has been completed. The QAPP is being submitted concurrently with this work plan to expedite EPA review and approval thus facilitating a prompt initiation of Task 05, scheduled for November 2, 1987. The Quality Assurance Project Plan comprises the documentary record detailing the sampling methodology, QA/QC procedures and data presentation and evaluation techniques to be employed during the field data collection, analysis and report preparation portions of the program. The QAPP is based on the requirements outlined in the Interim Guidelines and Specifications for Preparing Quality Assurance Project Plans (EPA-600/4-83-004, February 1983), and will be reviewed and approved by Texaco Caribbean, Inc. before commencement of the field work.

3.5 TASK 05 SOIL GAS SAMPLING AND ANALYSIS

As described in Section 2.0, the soil gas sampling and analysis program will consist of a phased approach, in which the need for subsequent work elements will be established by the results of earlier phases. The work planned at Tutu will consist of three phases, of which the second and third phases will be implemented only if they are found to be necessary.

During all phases of work, soil gas samples will be analyzed using a gas chromatograph (GC) owned and operated by Tracer Research Corporation (TRC) of Tucson, Arizona. The gas chromatograph is equipped with detectors capable of identifying total and aromatic hydrocarbons, using flame ionization (FID) and photo ionization (PID) techniques. A dual-channel integrator permits simultaneous operation of the FID and PID detectors.

The sampling and analysis will be conducted in accordance with standardized procedures which have been used by GCL and TRC at numerous sites. Soil gas samples are collected by driving a 2-cm diameter hollow galvanized steel probe to the appropriate depth, either by hand or with a

pneumatic driver, and evacuating 5 to 10 liters of soil gas from immediately above the drive point with a vacuum pump. A syringe is inserted through the silicone evacuation line to collect a 10-milliliter gas sample for immediate on-site analysis. The GC equipment will be operated by an experienced TRC chemist. Analyses to be made at each sample point will consist of:

- total hydrocarbons
- benzene
- toluene.
- ethylbenzene
- xylenes

Procedures to be followed will be identical to those described in the Standard TRC Method of Operation for Soil Gas Analyses (Appendix B), except that it will be necessary to remove the GC from the TRC van and set it up either in the office of the Tutu station or in a van to be rented on St. Thomas.

The three proposed phases of work to be conducted at Tutu are as follows:

Phase 1:

This phase will consist of soil gas sampling on the Tutu station property. Sample points will be placed in a grid on approximately 50-foot centers, with points located along all parts of the site perimeter (Figure 3-1). Additionally, at least two points will be located about 100 feet east of the station site (uphill and probably hydrologically upgradient) to serve as background points for evaluation of whether there are significant subsurface hydrocarbons at the station. Samples will be taken from depths of 5 and 10 feet at each point, if possible, so that it can be determined whether there is a significant change in soil gas values with depth.

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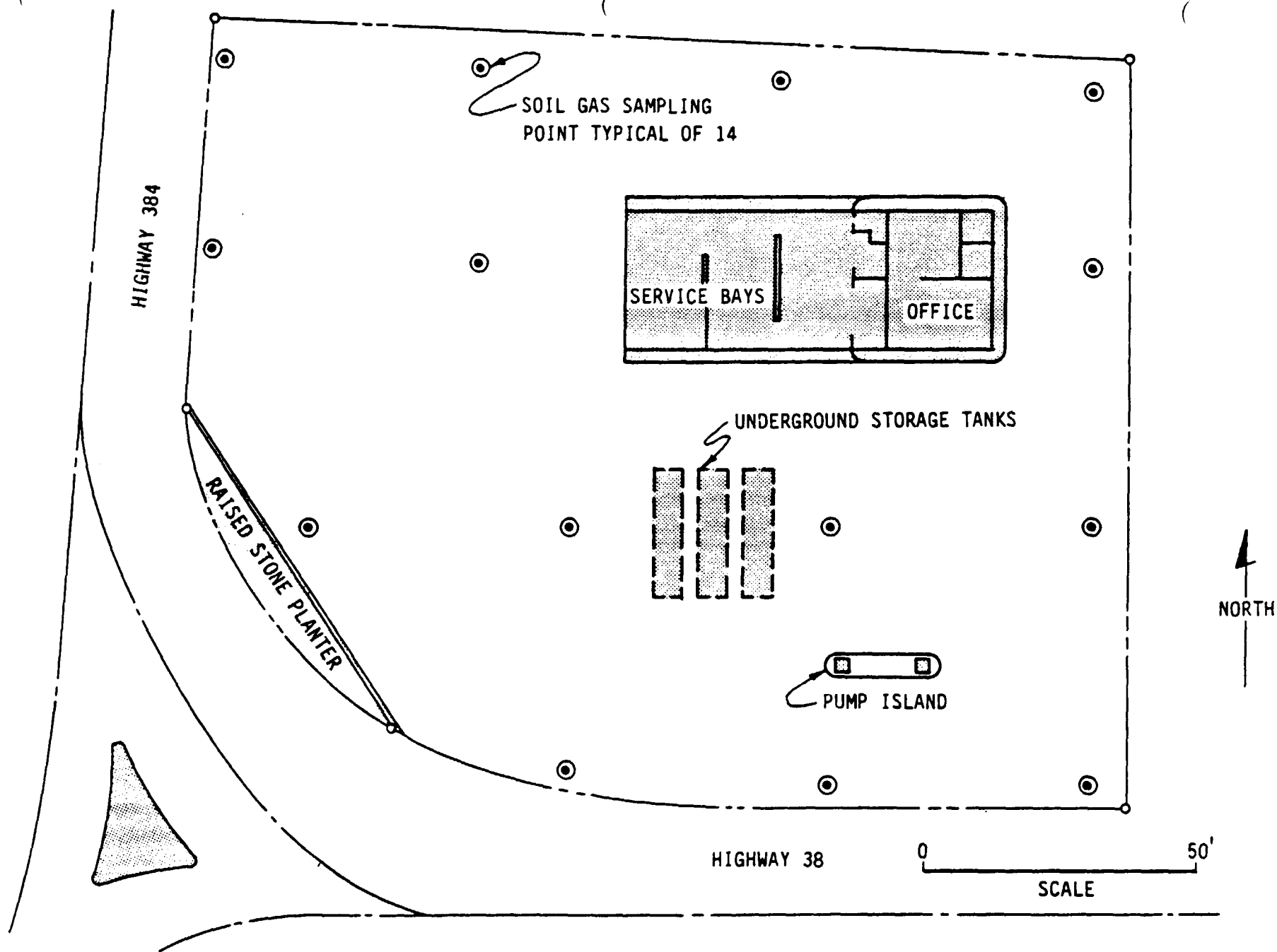


FIGURE 3-1
TENTATIVE LOCATIONS OF SOIL GAS SAMPLING POINTS ON TEXACO STATION SITE, TUTU (PHASE 1)

Phase 2:

This phase of the investigation will be conducted only if significant hydrocarbon concentrations are found at the Tutu station during Phase 1. Significant hydrocarbon concentrations will be considered to exist if, in any of the samples taken at the station and analyzed during Phase 1:

- total hydrocarbons are found to exceed 50,000 ug/l (micrograms per liter), or
- either benzene or toluene is found to exceed 1,500 ug/l, or
- values of hydrocarbons detected on the station property exceed those found in background locations by a factor of 3 or more.

During Phase 2, should it be required, the sampling grid established during Phase 1 will be extended southward to the southeast side of Highway 38 (Figure 3-2). At least one line of sample points will be extended southward or south-southwestward to a point where background levels of hydrocarbons are observed. A grid of lines extending east- and westward on 50-, 100-, or 200- foot centers, as considered appropriate on the basis of field data, will be established to define the extent of any hydrocarbon plume which may be detected. Intermediate points in the grid will be established as necessary for adequate plume definition. Samples for on-site analysis will be taken from a depth of 10 feet below the ground surface if feasible. If that depth cannot be consistently attained, a shallower depth will be used.

Phase 3:

If data developed during either Phase 1 or Phase 2 indicate that hydrocarbons have potentially migrated southwestward across the intersection of Highway 38 and Highway 384, a soil gas sampling grid will be established in the parking lot of the shopping center on the west side of the intersection (Figure 3-2). This sampling grid will be based on 100-foot centers and will be oriented with one axis approximately

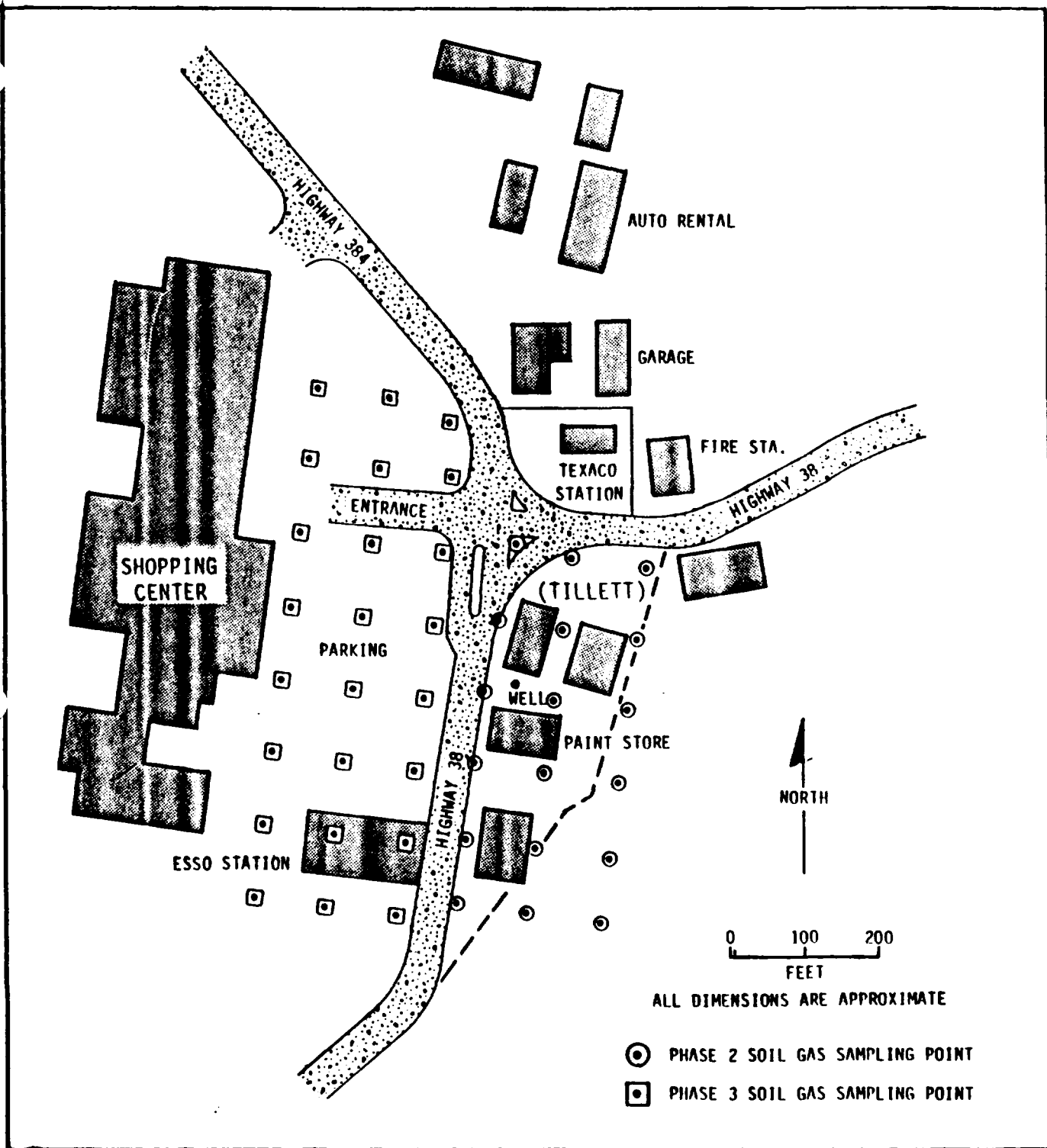


FIGURE 3-2
APPROXIMATE ORIENTATION AND DIMENSIONS OF SOIL
GAS SAMPLING GRIDS FOR PHASE 2 AND 3, TUTU AREA.

parallel to the known south-southwestward fracture system. The grid will be sampled and analyzed in the same manner as the grids established in Phases 1 and 2, using the same depth below ground level which was used in Phase 2. This grid will be continued southward and westward as necessary until locations are found where hydrocarbon concentrations are equal to background levels, thus defining the extent of any hydrocarbon plume.

3.6 TASK 06 HYDROGEOLOGIC SITE CHARACTERIZATION

Concurrently with implementation of the soil gas survey, the on-site GCL hydrogeologist will make observations on local lithology, soils, bedrock fracture orientations, depths to bedrock where it is encountered during driving of sampling probes, degree of weathering of the bedrock, depth to ground water, slope of the ground water table, and any other factors which may be relevant to movement of hydrocarbons in the subsurface. These observations will be recorded and used in potential modifications of the planned soil gas sampling grid, and in evaluation of the final project results.

3.7 TASK 07 DATA ANALYSIS AND INTERPRETATION

Data analysis and interpretation will be performed simultaneously with the field work, so that appropriate orientation and extension or reduction of the sampling grids can be accomplished based on results of previous sampling and analysis. Initial data reduction and mapping of soil gas concentrations will be performed by field personnel on site. Data will also be transmitted to the GCL Albuquerque office on a daily basis so that the Program Manager will have adequate information to assist field personnel in decisions relating to any necessary changes in sampling strategy.

3.8 TASK 08 PREPARATION OF TECHNICAL REPORT

Upon completion of the soil sampling and site investigations to be conducted under Tasks 03 through 07, GCL will prepare a final report discussing the results of the investigations. The report will include, as a minimum, a presentation of the soil gas values encountered during the investigation (total hydrocarbons, benzene, toluene, ethylbenzene and

xylenes) in tabular form and in figures illustrating the spatial orientation of the values and of any hydrocarbon plume which may be identified. Any other observations relative to contaminant migration pathways, potential or actual, and other pertinent hydrogeologic observations may also be included, if appropriate.

Specific items to be included in the report are:

- a base map of the Tutu area showing distribution of soil gas sampling points;
- soil gas hydrocarbon values plotted on the base map, and contoured as appropriate to delineate any hydrocarbon plumes or flow paths identified during the study;
- tables listing all soil gas hydrocarbon values determined during the study; and
- maps or graphs showing relationship of hydrocarbon values in soil gas to estimated ground water flow directions or bedrock fracture system geometry.

Based on the planned field work start-up date of November 2, 1987, the planned completion date for the report is December 23, 1987.

3.9 TASK 09 QUALITY ASSURANCE AND QUALITY CONTROL

GCL's QA Officer for this project, Randall T. Hicks, has reviewed this work plan for QA requirements and will maintain QA oversight throughout the duration of the project. GCL's work on this assignment will be conducted in accordance with GCL's existing QA guidelines and the project-specific QAPP which is being submitted simultaneously with this work plan. Activities defined in this work plan may be the subject of a systems audit conducted by Texaco Caribbean, Inc. to verify GCL's adherence to the QAPP.

4.0 PERFORMANCE SCHEDULE AND SCHEDULE OF DELIVERABLES

The schedule for the project is shown in Figure 4-1 and the deliverable date schedule is included as Figure 4-2.

The project schedule depends upon initiation of field work on November 2, 1987. Approval of the Work Plan and Quality Assurance Project Plan one week before that date (by October 26, 1987) will be necessary to assure timely completion of the project.

GANTT CHART REPORT - Current Date: 10-06-87

TUTU SOIL GAS STUDY

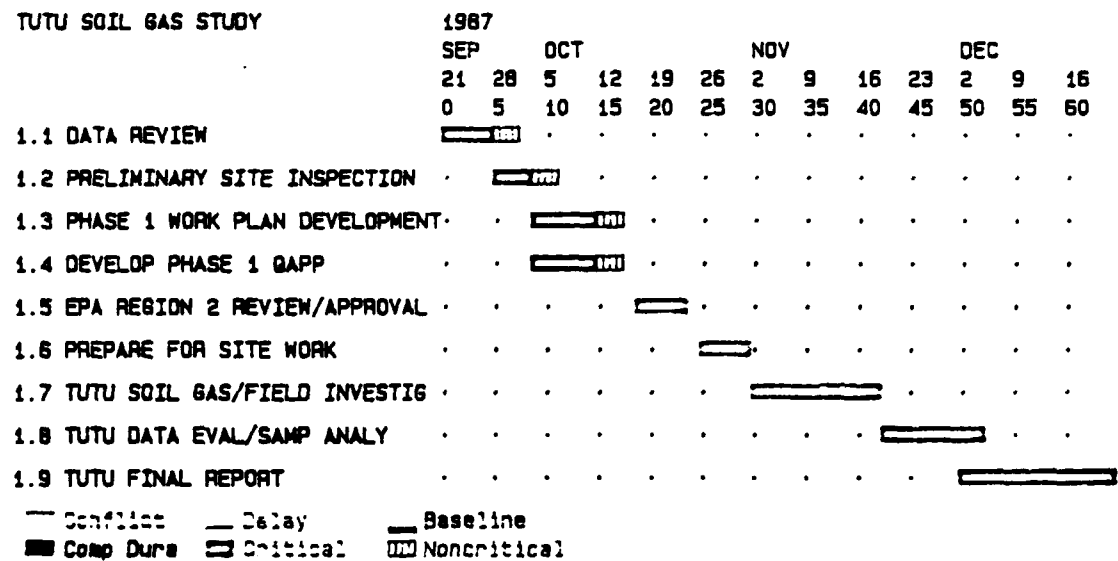


FIGURE 4-1 PERFORMANCE SCHEDULE - TUTU SOIL GAS SURVEY

FIGURE 4-2

SCHEDULE OF DELIVERABLES - INTERCAR SOIL GAS SURVEY

Program Manager: Alberto A. Gutierrez, CPGS
Project Director: John L. Appel
Date: October 8, 1987
Firm: Geoscience Consultants, Ltd.

<u>PROJECT DELIVERABLES</u>	<u>INITIAL TEXT TO DPNR*/EPA**</u>	<u>RECEIPT OF TECHNICAL COMMENTS</u>	<u>FINAL</u>
1. Work Plan	10/16/87	10/23/87	10/28/87
2. QAPP	10/16/87	10/23/87	10/28/87
3. Final Report	1/8/88	N/A	N/A

*DPNR = Virgin Islands Department of Planning and Natural Resources

**EPA = U.S. Environmental Protection Agency, Region II

5.0 STAFFING AND SUBCONTRACTING

5.1 STAFFING

The execution of the work tasks described in this work plan will be accomplished using the following GCL staff:

Program Manager:	Alberto A. Gutierrez, CPGS
Project Director:	John L. Appel
QA Officer:	Randall T. Hicks, CPGS
Technical Review Committee:	Claude A.J. Schleyer, PE
	Russell E. Erbes MS
On-Site Hydrogeologist:	B. Virginia Nicholas

The Program Manager will provide management, task coordination, and communications with Texaco Caribbean, Inc. The Project Director will provide management at the task level to complete the project on schedule. Resumes for all members of the GCL project staff are provided in Appendix A.

5.2 SUBCONTRACTING - SOIL GAS ANALYTICAL SERVICES

Subcontract services will be required to perform the on-site soil gas analyses at Tutu. Tracer Research Corporation (TRC) of Tucson, Arizona, is uniquely qualified to perform the soil gas sampling and analysis required for this project. GCL has been associated with TRC on numerous other jobs and has been thoroughly satisfied with their quality of work, timeliness of performance and cost effectiveness. GCL is confident that TRC will provide adequate equipment and suitable operational expertise for the collection of accurate and complete data during conduction of the soil gas survey.

The on-site TRC analyst has not yet been selected, and will be dependent on scheduling of TRC equipment and personnel. A resume listing qualifications of the TRC analyst will be supplied to Texaco Caribbean, Inc., as soon as the selection is made.

TEXC/TUTU.PLN

APPENDIX A

**RESUMES OF GCL STAFF
FOR TUTU SOIL GAS SURVEY**

ALBERTO A. GUTIERREZ, CPGS
President
Geoscience Consultants, Ltd.

QUALIFICATIONS SUMMARY

EDUCATION M.S. - Geology, University of New Mexico, 1980 (Cum Laude)
B.S. - Geomorphology, University of Maryland, 1977 (Cum Laude)

REGISTRATIONS AIPG Certified Professional Geological Scientist, No. 6461
Registered Professional Geologist, State of Arizona,
No. 18002
California Registered Professional Geologist, No. 4373

As president of GCL, Mr. Gutierrez is responsible for overall management and quality assurance. Mr. Gutierrez has over twelve years experience in hydrogeology and environmental regulatory compliance. As a registered professional hydrogeologist, he has successfully managed and implemented many large hazardous waste management and remedial action programs involving several subcontractors and extensive negotiations with Federal and State regulatory agencies. His technical specialty is hydrogeology for hazardous waste management. Mr. Gutierrez has served as an expert witness in the fields of hydrogeology for hazardous waste management and water resource development for both private and governmental clients in both State and Federal courts. Mr. Gutierrez also currently serves on the five-member New Mexico Environmental Improvement Board which is responsible for overseeing the development and implementation of all environmental regulations in New Mexico. His many publications include papers in various professional journals on hydrology, toxins in ground water and hazardous waste management. A brief list of his recent accomplishments at GCL include:

- o Design of a computer modeling study of potential ground water contamination from oil/water disposal pits.
- o Management of a multi-million dollar remedial investigation and ground water monitoring program for a complex hazardous waste management facility. This program included analysis of site hydrogeology, monitor well design installation, complete remedial investigation and feasibility study.
- o Preparation of a hydrogeological report on hazardous waste treatment facility, design pump tests for low-permeability zones, calculation of potential contaminant toxic material transport rates.
- o Design and development of a comprehensive program to assess environmental risks through risk assessments and audits for over 100 private industrial, research and government clients.
- o Developed ground water quality assessment program for a hazardous waste surface impoundment at a CERCLA site. The program included design and installation of monitor wells, development of sampling and analysis protocol, computer modeling of contaminant plume migration and design of remedial action alternatives.

JOHN L. APPEL
Senior Hydrogeologist
Geoscience Consultants, Ltd.

QUALIFICATIONS SUMMARY

EDUCATION B.S. - Geology, University of New Mexico, 1981
M.A. - English, University of New Mexico, 1974
Extensive graduate study in the fields of hydrology,
geomorphology, and remote sensing.

Mr. Appel is a specialist in the application of remote sensing to hydrogeology, land use, and geological environment definition. Additionally, Mr. Appel provides hazardous waste sampling, monitor well installation and RCRA inspection skills.

Mr. Appel has extensive experience in geomorphology, remote sensing and hydrology. He is currently conducting work on determining erosion rates and sediment delivery from aerial photographs. Mr. Appel is also presently conducting studies in water resource development and contamination problems, and on closure plans for hazardous waste sites.

In the areas of hydrology and waste management, Mr. Appel has conducted hydrological and geological surveys of numerous sites for preparation of New Mexico discharge plans, RCRA permits/compliance, and remedial action programs. He has conducted sampling programs to delineate soil and water contamination and remedial action program design. He is familiar with all EPA/CERCLA chain-of-custody procedures, sampling protocols, and analytical parameters.

Some of Mr. Appel's accomplishments at GCL include:

- o Isotopic analysis of ground water resources.
- o Geomorphologic study involving sediment-transport and erosion responses to changes in land use patterns.
- o Supervision of field drilling and sampling activities on several RCRA compliance projects.
- o Ground-water monitoring well design, installation, and sampling.
- o Composite sampling and analysis program development and execution
- o NPDES sampling and analysis
- o Closure plans for hazardous waste facilities and CERCLA sites.

RANDALL T. HICKS, CPGS
Vice-President
Technical Services
Geoscience Consultants, Ltd.

QUALIFICATIONS SUMMARY

EDUCATION M.S. - Geology, University of New Mexico, 1981
B.S. - Geology, Beloit College, 1975

REGISTRATIONS AIPG Certified Professional Geological Scientist, No. 6777
Registered Professional Geologist, State of Arizona, No. 19483

Mr. Hicks is a Certified Professional Geological Scientist specializing in hydrogeology, ground-water monitoring programs, contaminant transport in the unsaturated zone, and geochemistry. Mr. Hicks has directed projects involving the design and installation of waste management systems for many large industrial clients ranging from fiberboard manufacturers to oil refineries.

Prior to joining GCL, Mr. Hicks was employed as a Supervising Geohydrologist in the permitting section of the New Mexico Environmental Improvement Division. There, he conducted geohydrologic evaluations of uranium tailings facilities, hazardous waste sites, RCRA and CERCLA sites, municipal wastewater treatment plants, and other facilities.

Mr. Hicks has published a number of papers on waste management, hydrogeology, geochemistry, and ground water contamination. He is the co-author of the 1981 Underground Injection Control Regulations for the State of New Mexico. His recent technical work at GCL includes:

- o Analysis of the transport of organic solvents in the unsaturated zone beneath hazardous waste storage tanks.
- o Design and supervision of the installation of ground-water monitoring networks at hazardous waste treatment facilities; these programs involved development of several contingency plans to manage difficult drilling and well development problems.
- o Development of a hydrocarbon recovery system for a refinery. Because this site was adjacent to a potential CERCLA site, attention to detail on all work elements was critical.
- o Preparation of hydrogeologic assessments of over 70 disposal sites for oil/water wastes. Detailed ground-water monitoring networks were developed at several of these sites.
- o Development and implementation of a soil-gas evaluation program to determine the extent of potential contamination at a hazardous waste surface impoundment. Results of the survey were used to determine location of soil sampling boreholes.

CLAUDE A. J. SCHLEYER, PE
Director of Engineering Services
Geoscience Consultants, Ltd.

QUALIFICATIONS SUMMARY

EDUCATION M.S. - Civil Engineering, University of Michigan, 1968
B.S. - Civil Engineering, University of Texas, 1962
B.A. - Liberal Arts, Abilene Christian University, 1960

REGISTRATIONS Registered Professional Engineer: Ohio, New Mexico and
Arizona

Mr. Schleyer has over twenty years of experience in civil engineering and related fields. He serves GCL in the capacity of Director of Engineering Services and environmental engineer for various water treatment projects and manages process technology and pilot studies for GCL's industrial clients. These projects include water resource development, wastewater lagoons, evaporation ponds, waste management structures and ground water reclamation systems. Additionally, Mr. Schleyer is responsible for the development of wastewater sampling programs for GCL clients and the development of specialized equipment and instruments required for specific jobs.

Mr. Schleyer's prior experience includes an assignment to the government of Guyana through the World Health Organization, a program of the United Nations, serving as a consultant on water supply, waste disposal and environmental health matters. He provided training and technical assistance in the development, operation and maintenance of nationwide water and wastewater systems and in the reconstruction of the sewer system for the capitol city of Georgetown, Guyana. Mr. Schleyer also served as a consultant with the U.S. Public Health Service, Indian Health Service for over ten years. Services he provided included training of engineers with well drilling; water and waste system design and construction; and environmental control. He also served as environmental impact officer for the Indian Health Service preparing necessary statements and obtaining required clearances for construction projects. Mr. Schleyer also served as Assistant to the Chief Engineer of the U.S. Public Health Service, where he maintained liaison with all engineering programs of the service and served as Secretariat to the Conference of State Sanitary Engineers.

While assigned to the EPA Office of Solid Waste Management, Mr. Schleyer directed engineers in performing systems studies of solid waste management operations and devising improved methodologies. New methodologies developed under Mr. Schleyer's direction included design of collection systems based on time and motion studies and regression analysis. He also provided technical assistance to various city and state governments on planning and implementing improved solid waste management strategies.

RUSSELL E. ERBES, MS
Program Manager
Geoscience Consultants, Ltd.

QUALIFICATIONS SUMMARY

EDUCATION M.S. - Atmospheric Science, Colorado State University, 1978
B.S. - Physics, New Mexico Institute of Mining and Technology,
1969

SPECIALIZATION Hazardous Waste Management, Evaluation of Multi-Phase
Transport in Air and Porous Media, Scientific Assessment of RCRA, CERCLA, CAA and CWA Issues

As a Senior Program Manager for GCL, Mr. Erbes is responsible for numerous GCL programs including air toxics and modeling as well as several large RCRA unit closure and UST projects. Mr. Erbes has over 15 years experience in scientific work related to environmental media including air, water and solid waste. He has successfully managed complex technical and regulatory support programs related to hazardous waste disposal and site remediation in both soil and ground water. He has extensive experience in directing modeling programs related to air pollution as well as unsaturated and saturated zone flow. His technical specialty is in evaluating contaminant transport in environmental media and related regulatory issues. Mr. Erbes has served as an expert witness before numerous regulatory bodies as well as providing technical support at congressional hearings on air pollution issues. Before joining GCL, Mr. Erbes was the Director of Environmental Regulatory Programs for the Public Service Company of New Mexico (PNM) for 10 years. At PNM, he was responsible for all aspects of environmental permitting (air, water, solid and hazardous waste), compliance, impact assessment and auditing in all environmental media. A brief list of his recent accomplishments includes:

- o Chairman of WEST Associates Air Quality Task Force and Ad Hoc Acid Rain Assessment Task Force; Secretary of WEST Associates Management Committee; and Chairman of EPRI Environmental Physics and Chemistry Program Committee.
- o Project Manager for a remedial investigation and feasibility study related to leaking underground solvent storage tank.
- o Developed closure plans and associated alternate concentration limit (ACL) justifications associated with leaking underground storage tanks.
- o Program Manager for assessment of acid deposition in the western U.S. sponsored by WEST Associates. Program involved scientific assessment of atmospheric deposition in context of terrestrial and aquatic ecosystems. Management of program involved integrating scientific assessment with needs of public information and governmental affairs activities of WEST Associates members.

BARBARA VIRGINIA NICHOLAS
Hydrogeologist
Geoscience Consultants, Ltd.

QUALIFICATIONS SUMMARY

EDUCATION B.S.- Geology, University of Nevada Las Vegas, 1983

Ms. Nicholas specializes in utilizing hydrogeologic and geophysical methods to characterize subsurface ground-water contamination. She also possesses experience at conducting RCRA and CERCLA inspections, sampling, and data review/compilation.

Ms. Nicholas previously served as a Geologist for Lockheed Engineering and Management Services Corporation in Las Vegas, Nevada where she served as Site Coordinator for a geochemical and geophysical investigation under the Phase III Installation Restoration Program (IRP). She also participated in field characterization investigations of hazardous waste sites using state-of-the-art geophysical equipment and soil gas methodologies. Since joining GCL, Ms. Nicholas' accomplishments include:

- o Participation in ground-water and soil sampling surveys including sampling of evaporation ponds, wastewater streams, and stormwater outfalls for analysis of EPA, RCRA and NPDES parameters.
- o Supervision of the drilling and installation of RCRA-type monitor wells at various facilities in New Mexico.
- o Supervision of borehole soil sampling to define the extent of soil contamination near hazardous waste impoundments.
- o Evaluation of closure cost estimates for engineering feasibility and accuracy.
- o Design and implementation of a sampling strategy for a sludge surface impoundment.
- o Implementation of NPDES compliance projects.
- o Reduction of field data.

Ms. Nicholas main responsibility now lies with the EPA Technical Enforcement Support Contract (TES III). She has recently been involved with preparation of RCRA Comprehensive Ground Water Monitoring Evaluations (CME), RCRA Facility Assessments (RFA), CERCLA Preliminary Assessments (PA) and Site Inspections (SI). Additional TES projects include: CERCLA Remedial Action Oversight, Quality Assurance Reviews of analytical data from Contract Laboratories, preparation of a RI/FS cost estimate in accordance with EPA procedures and best available engineering practice.