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Alcatel
NCD 003 185 238

ALCATEL
NETWORK SYSTEMS

2912 Wake Forest Rd.
Raleigh, NC 27609
(919) 850-6000

RECEIVED
MAR 26 1996
HAZARDOUS WASTE

March 26, 1996

Mr. Tom Walker
NCDEHNR Hazardous Waste Section
401 Oberlin Road, Suite 150
Raleigh, NC 27605

Subject: Transmittal of RFI
Areas of Concern 1 and 2
Alcatel Network Systems
Raleigh, North Carolina
NCD 003 185 238

Dear Mr. Walker:

Enclosed please find three copies (two volumes each) of the RFI for our Wake Forest Road facility. If any questions arise regarding this submittal, do not hesitate to contact me at (919) 850-6248 or Hank Lyon of National Environmental Technologies, Inc. at (910) 392-1747 x23.

Sincerely,

ALCATEL NETWORK SYSTEMS, INC.

Dikran V. Kabbendjian

Dikran Kabbendjian
Manager
Environmental, Health and Safety

DK/hl

Enclosures (3)

CERTIFICATION OF RCRA FACILITY INVESTIGATION

Alcatel Network Systems, Inc.
Wake Forest Road
Raleigh, North Carolina

RECEIVED
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HAZARDOUS WASTE

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

Date: 3-26-96

Signature: _____

DIRECTOR, HUMAN RESOURCES
Title

RCRA FACILITY INVESTIGATION
FOR AOC #1 AND AOC #2

ALCATEL NETWORK SYSTEMS, INC.
2912 WAKE FOREST ROAD
RALEIGH, NORTH CAROLINA 27609

NCD 003 185 238

VOLUME 1 of 2

Prepared for:

ALCATEL NETWORK SYSTEMS, INC.
2912 Wake Forest Road
Raleigh, North Carolina 27609

Prepared by:

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Project No. 058010

February 1996

EXECUTIVE SUMMARY

Alcatel Network Systems (Alcatel) Raleigh, North Carolina facility is located at 2912 Wake Forest Road. The facility has been in operation since 1958 under various ownerships and conducting various operations, including electroplating and printed circuit board manufacturing. Historical RCRA permitted operations included the storage of hazardous wastes and the drying of dewatered wastewater treatment sludge. A wastewater treatment plant operated on site from 1978 to 1991, treating 200,000 to 350,000 gallons per day of aqueous wastes. Currently, the facility's function is limited to research/development and administration.

During the operational history of the facility, releases of specific volatile organic compounds (VOCs) and metals occurred. A previously conducted RCRA Facility Assessment (RFA) identified several solid waste management units (SWMUs) and two areas of concern (AOCs). As of this writing, all previously identified SWMUs have been closed and several voluntary cleanup operations have been completed in AOC #1 (Drainage system alleyway). Although both AOCs are addressed in this report, most effort has been directed towards satisfying data deficiencies associated with AOC #2 (former printed circuit board manufacturing area).

AOC #1 is located in an alleyway on the north side of the main building while AOC #2 is located within the footprint of the main building. A RCRA Facility Investigation Workplan (RFI Workplan) was submitted to the North Carolina Department of Environment, Health, and Natural Resources (NCDEHNR) in October 1994 and subsequently approved by letter dated July 14, 1995. This document detailed a plan for completing previously initiated assessment of suspected soil and ground water contamination at the facility.

During pre-acquisition auditing on the neighboring Keebler property, regulated constituents were discovered in the ground water. In response to this finding and in a cooperative effort with the adjacent landowner, Alcatel initiated voluntary ground water assessment activities prior to the approval of the RFI Workplan by NCDEHNR. These voluntary actions were conducted in

accordance with the established RFI Workplan and its addendums. During the assessment, Alcatel installed an additional 12 ground water monitoring wells on the Alcatel facility and on the Keebler property (adjacent to the south).

The ground water investigation resulted in the delineation of a VOC constituent plume spanning three distinct hydrolithologic units. The VOC plume within the saprolite occupies approximately 9.75 acres and within the weathered and competent bedrock comprises approximately 10.50 acres. Evaluation of core and drilling data indicates that the vertical extent of the aquifer, and VOC plume, is less than 100 feet below grade. In one boring, no water was discovered between a depth 80 and 150 feet. The most transmissive hydrolithologic unit is the partially weathered rock zone spanning approximately 15 feet between the saprolite and competent bedrock.

A soil investigation was conducted beneath the floor of Alcatel's main building to determine if a continuing source of regulated constituents was present. Sampling concentrated in areas near the current and former outside building walls and former plating trenches. Other than trace amounts, no VOCs were detected in AOC #2 soil samples and low concentrations of copper and lead were detected in selected soil samples. Evaluation of metals sampling data indicates low concentrations of copper and lead occur within the halo of previously remediated areas of AOC #1. Further remedial excavation of soil contamination is not anticipated.

As a result of the off-site migration of the VOC plume, interim corrective measures (ICM) will be pursued to mitigate further down gradient movement of the plume. This effort will initially ensue on a voluntary basis.

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- WEGS Environmental Cleanup Area No. 2 Addendum, March 1991
- NET Phase I Soil and Groundwater Impact Assessment, February 1991
- WEGS Area No. 4 Soil Sampling, June 1991
- NET Ground Water Investigation, August 1993
- NET Ground Water Investigation, October 1993
- S&ME Soil Sampling Results, April 1995

1.0 INTRODUCTION

1.1 Facility Description

The Alcatel Network Systems (Alcatel) facility is located at 2912 Wake Forest Road in Raleigh, Wake County, North Carolina. The facility is located in an industrial park setting near the intersection of Wake Forest Road and the Raleigh Belt-Line (I-440). The facility is situated on a 24-acre site which consists of a 234,000 ft^2 main building, storage and maintenance buildings, security buildings, parking lots, and landscaped "natural" areas. Within the main building, research and development, sales and marketing, purchasing and accounting, information systems, administration, and a cafeteria occupy the majority of the space. A ***Topographic Location Map*** of the facility and the ***Alcatel and Keebler Site Map*** are included in the Appendix (see **Figures**).

The Kellogg Corporation, a division of ITT, began operation of the facility in 1958. At that time, electronic and telecommunications equipment were produced. At a later date the name of the facility was changed to ITT; however, it continued manufacturing electronic and telecommunications equipment. In 1987, Alcatel Network Systems Corporation purchased the property. Electroplating operations were conducted at the facility as part of the process for manufacturing printed circuit boards. In 1990, as a result of corporate re-structuring, the name was changed to Alcatel NA Network Systems Corporation and changed again to Alcatel Network Systems, Inc., its current name. During its history, several additions have been made to the main building, as shown on the drawing titled ***Building Additions Diagram*** (see **Figures**).

During the latter years, when the facility conducted manufacturing processes, a wastewater pretreatment plant (WWTP) was in operation at the site. Beginning in 1978, the WWTP treated 200,000 to 350,000 GPD of aqueous wastes from: printed circuit board

manufacturing, non-contact cooling/heating water, air compressor condensate, and cooling tower water. Treated effluent generated by the WWTP was discharged to the City of Raleigh's publicly owned treatment works (POTW). Dewatered metal hydroxide sludges from the WWTP were stored in roll-off containers used solely for that purpose.

As a variety of chemicals were utilized in the manufacturing process, Alcatel obtained a RCRA permit to store the following hazardous wastes at the site: F001, F002, F005, F006, F008, D001, D002, and D008. As authorized by the permit, these wastes were kept in 55 gallon containers which were stored on two uncovered pads at the site. The permit also authorized the drying of dewatered wastewater treatment sludge by evaporation during storage in a roll-off container located on the former sludge treatment container storage pad. In addition to roll-off containers and drums, in-ground holding tanks received aqueous tin, lead, copper, chromium, nickel, mineral acids, caustics, and ammonium bifluoride wastes from the printed circuit board manufacturing processes. Those wastes were then treated through the wastewater treatment plant, along with the rinse waters from the printed circuit board manufacturing process.

The printed circuit board manufacturing operations at Alcatel ceased in 1990. At that time, all circuit board manufacturing equipment was decontaminated and sold. Currently, the operation of the facility is limited to research/development and administration. Structures associated with the manufacturing process, such as holding tanks and plating trenches, were decontaminated and decommissioned following the shut-down of manufacturing operations. The WWTP was also closed and decontaminated in 1991. The former WWTP equalization basin was converted into a chilled water storage tank unit which is currently used as part of the facility HVAC system. The remaining WWTP

equipment was dismantled, the area was decontaminated, and a level concrete floor was poured over the existing floor. The area was converted for use as a maintenance area.

1.2 Description of Areas of Concern

Two AOCs, designated AOC #1 and AOC #2, are listed in the RCRA permit for the Alcatel facility. AOC #1 is located in an alleyway on the north side of the main building. AOC #2 is the former printed circuit board manufacturing area, located within the main building. Characteristics of each AOC are provided below.

1.2.1 AOC #1

Prior to the termination of circuit board manufacturing operations, a concrete drainage system was constructed in the alleyway behind the main building. This system was designed for the collection and treatment of stormwater runoff. During construction of the new system, soil impacted by volatile organic compounds and metals was discovered beneath the old asphalt. The investigation which ensued identified distinct soil impact areas that are now referred to as AOC #1.

AOC #1 is located in the alleyway on the north side of the main building, as shown on the drawing titled ***Location of Impacted Areas*** (see **Figures**). Previous uses of this area have included waste and chemical storage; the area has also been the location of holding tanks for process materials. A WWTP was formerly located on the eastern end of the alleyway. The storage areas for wastes and process materials, as well as the WWTP, have been decontaminated and closed since decommissioning of the former manufacturing process. Previous environmental investigations in this area identified four areas (Area 1, Area 2,

Area 3, and Area 4) which have exhibited soil contamination. Previous studies also included the installation of two ground water monitoring wells in the alleyway.

Area 1 was an area approximately 15' by 14' (see the drawing titled ***RFI Area 1***, in **Figures**) located along the main building, approximately mid-way in the drainage alleyway. Area 2 was an area approximately 40' by 20', as shown on the Westinghouse Environmental and Geotechnical Services, Inc. (WEGS) diagram titled ***Area No. 2*** (see **Figures**), located along the former process sump, on the east end of the alleyway. Within these areas, soil contaminated by copper and lead was identified and excavated. The contamination has been attributed to leaks in subsurface process lines located in the areas. Approximately 277 tons of soil have been excavated from the two areas as part of a voluntary remediation effort. The excavated soil was shipped to GSX in Pinewood, SC, for disposal.

Area 3 was located on the western end of the alleyway and covers an area of approximately 30' by 10' as shown on the drawing titled ***RFI Area 3*** (see **Figures**). Soil sampling from this area indicated the presence of volatile organic compounds (VOCs). Specifically, the chlorinated compounds: 1,1,1 Trichloroethane (TCA), 1,1,2 Trichloroethane (2-TCA), 1,1 Dichloroethane (DCA), 1,2 Dichloroethane (2-DCA), 1,1 Dichloroethene (DCE), and Tetrachloroethene (PCE) were detected in varying concentrations. Approximately 92 tons of soil were excavated from this area during remedial efforts. The excavated soil was shipped to GSX in Pinewood, SC for disposal.

Area 4 was located in the central portion of the alleyway and measures approximately 30' by 25', as shown on the WEGS diagram titled ***Area No. 4*** (see **Figures**). This area was the former location of a chemical processing shed. Soil and asphalt samples collected in this area contained extractable lead at concentrations below regulatory limits. To date, no soil and/or asphalt have been excavated from this area.

Additional assessment work was conducted in the vicinity of the facility's former wastewater treatment plant, located at the extreme eastern end of AOC #1. During decommissioning of the treatment plant and prior to converting the plant's equalization basin to its current use a chilled water holding tank, monitoring wells MW-6 through MW-9 were installed to determine if a release had occurred from the treatment plant basin. Examination of basin and monitoring well chemical data has indicated that no impact has occurred.

Remedial efforts have been successful in the removal of contaminated soil from AOC #1. Confirmatory samples collected following excavation activities in Area 1, Area 2, and Area 3 verified the effectiveness of the remedial effort. As no process, chemical, or waste storage areas remain active within Areas 1-4 and in consideration of analytical results from previous investigations, no additional investigative activities were designated for AOC #1 during this investigation. Results of previous investigations are appended to this report and will be referenced in **Section 4.0**.

1.2.2 AOC #2

AOC #2 is the former printed circuit board manufacturing area, located within and beneath the main building. During previous manufacturing operations, electroplating and chemical plating processes were conducted in this area. The process incorporated coated, concrete, in-ground trenches which acted as conduit for rinse water and as secondary containment for process piping. These trenches were located in the floor of the building, within the area designated ***Former Printed Circuit Board Area*** as shown on the drawing of the same title (see **Figures**). TCA was used in this area for the cleaning of printed circuit boards. A distillation unit (still), used to purify TCA, was also located in this area.

All process areas (troughs, distillation equipment, etc.) and/or chemical/waste storage areas which formerly operated in this area have been decontaminated and decommissioned. The former process trenches were thoroughly decontaminated and the concrete was examined for evidence of corrosion and/or deterioration. Deteriorated concrete was removed and wipe tests were performed to determine if process chemicals had penetrated into the concrete. The results of these tests were negative, and the trenches were filled with concrete. The area is now used for office and laboratory space, and as a print shop.

Previous environmental investigations around the facility and beneath the floor of the former manufacturing area have identified VOCs in the soil and at the water table. Specifically, the compounds TCA, 2-TCA, DCA, 2-DCA, DCE, PCE, Trichloroethene (TCE), Trichlorofluoromethane (TCFM), Benzene and Chloroform have been detected in ground water samples. These compounds were not present in soil samples with the exception of one sampling location where 1,1 DCE was

detected near the water table. Copper was detected in both soil and ground water samples; however, concentrations were generally at or near assumed background levels. The drawing titled ***Laboratory Analytical Results (Sept. 1993)*** (see **Figures**) gives the concentrations of compounds detected during previous investigations.

Benzene has only been detected in one sample during one sampling event at a concentration of 2.5 ug/L. Due to this frequency, the low concentration, and the lack of an apparent source, benzene is thought to be a laboratory artifact, and not clearly present in ground water beneath the Alcatel facility. To date, no soil or ground water remedial actions have been conducted within AOC #2.

2.0 ENVIRONMENTAL SETTING

2.1 Regional Geology and Hydrogeology

Wake County is located within the northeastern portion of the Piedmont physiographic province of North Carolina. The regional terrain is generally rolling, with elevations ranging between 200 and 500 feet above mean sea level (MSL) within the county. The topography is dissected by dendritic streams which allow for relatively good drainage.

The Piedmont physiographic province is comprised of several somewhat parallel metamorphic "belts." The metamorphic belts are areas of regionally metamorphosed rocks which have been delineated and characterized based on their metamorphic grade. Wake County resides within a high grade metamorphic zone known as the Raleigh Metamorphic Belt, or the Raleigh Terrane. The region is bounded on the west by rocks of the Carolina Slate Belt, and on the east by rocks of the eastern Slate Belt. The Raleigh Terrane is comprised primarily of medium to high grade, mica schists and felsic gneisses. Local granitoid intrusions are also common in the region (Stoddard, et.al., in Wright and Zullo, 1991).

The Piedmont is characterized by a soil veneer derived from weathered bedrock, or saprolite, which overlies competent bedrock. The thickness of the saprolitic soil varies considerably between locations, but is generally thicker in areas where topographic slope is low, and infiltration from precipitation is abundant. Competent bedrock occurs at varying depths below the saprolite, and is typically fractured by jointing and/or faulting. Joints are most prevalent at shallow depths where overburden pressures are minimal, whereas faults extend to considerable depths.

The primary mode of ground water storage within the saprolite is between the intergranular pore spaces, while storage within the bedrock occurs largely within the fracture system. Ground water recharge to the saprolite and bedrock is generally accomplished by infiltration from precipitation, with surplus conditions beginning in the Autumn and continuing through Winter. Discharge of stored water occurs primarily as baseflow into surface water bodies. Movement of stored ground water varies considerably with rock type and the degree of weathering. Common hydraulic conductivity values for saprolite range from less than one to several feet per day; values for fractured rock vary greatly.

2.2 Site Geology and Hydrogeology

The soil and unconsolidated materials beneath the facility have been documented as being a residuum of a granitic protolith, with thicknesses varying from approximately 3.5 to greater than 20 feet. Typically, the soils are soft to very dense, white to red-brown, clayey to silty, very fine sands. They are typified as containing abundant mica particles, prevalent white quartz and feldspar rich zones, local abundance of coarse fragments, and dark brown mottles. Generally, the soils are classified as ML and SM under the Unified Soil Classification system.

Three hydrolithologic zones have been identified at the site. The first zone is a highly weathered saprolite material consisting of silt, sand, and clay sized particles. The second zone discontinuously underlies the first zone, and is comprised of partially weathered bedrock (PWR). The third unit is bedrock, consisting of a fractured metamorphic bedrock comprised of zones of granite, pegmatoidal granite, and gneiss.

Thirty-three ground water monitoring wells have been installed at the site. Seventeen wells are located on the Alcatel property, and 16 are located on the Keebler property immediately south of the Alcatel facility. Static ground water level measurements have been taken in each well at various times in order to determine head distributions and the direction of ground water flow. Consistently, the direction of ground water flow within the saturated zone has been toward the west-southwest, along a relatively uniform gradient.

Ground water flow in the bedrock unit is generally to the southwest, with an apparent "trough" in the potentiometric surface beneath the main building. Vertical ground water flow is typical of a recharging area, with an upward gradient existing local to the stream which transects the western portion of the study area.

2.3 Topography and Surface Water Hydrology

The area immediately surrounding the Alcatel facility is characterized by moderate to steep slopes. To the north, east, and south of the facility, the natural grade slopes moderately toward the south and southwest. To the west of the facility (across Wake Forest Road), the natural grade steepens and slopes toward the east. The topography of the site and surrounding properties has been extensively modified by construction and landscaping activities. Area and facility topography are shown on the drawings titled ***Area Topography*** and ***Facility Topography*** (see **Figures**).

An unnamed gaining perennial stream traverses the western portion of the facility. The stream begins approximately 4,000 feet up-gradient of the facility and discharges approximately 2,500 feet down-gradient into Crabtree Creek. The baseflow of the unnamed stream is attributed to shallow ground water discharge. Discharge from storm

sewers and runoff from parking areas, as well as natural overland flow during precipitation events, also contribute water to the stream. The direction of water flow in the unnamed stream is towards the south. At its confluence with Crabtree Creek, the direction of stream flow changes to the southeast. The unnamed stream and Crabtree Creek are the only two ground water receptors in close proximity to the study area.

Several surface water features are located in the region. These features include streams, ponds, stormwater detention basins, lakes, and rivers. The City of Raleigh (which includes the Alcatel facility) relies on surface water for the potable public water supply. Falls Lake Reservoir, located approximately 16 miles north of the site, is the source for the public water supply. Additionally, no water supply wells are reported within a two mile radius of the site.

2.4 Climate

The Raleigh area is characterized by a humid, subtropical climate with mild Winter and warm Summer seasons. Typically, July is the warmest month and January is the coldest month, with mean monthly temperatures of 77.7° F and 39.6° F, respectively. The annual mean humidity is 70%, with humidity values typically being higher in the Summer and Fall months.

Average monthly precipitation varies by season. Historically, the month with the greatest precipitation is August with an average 4.44 inches, while the month with the least precipitation is October with an average 2.73 inches. The normal mean annual precipitation is 41.76, and the 10-year, 24-hour storm event for this area produces approximately 5.50 inches of rainfall. Snowfall has been documented to occur between the months of November through April, with a mean annual snowfall of 7.20 inches.

3.0 METHODS OF INVESTIGATION

This section describes RFI methodology employed for areas deficient or void of pre-existing assessment data. The information obtained from these methods is intended to augment results of previous voluntary assessment actions performed at the site. Further reference to previous investigative work is addressed in Section 4.0.

3.1 Soil Investigation

During the months of May and June 1995, a soil investigation was conducted beneath Alcatel's main building. Ten soil borings were advanced beneath the floor of the main building to depths of approximately 11 feet below grade, or to auger refusal, whichever was encountered first. Soil borings were concentrated in two areas: in the area along the exterior wall of the original 1958 building (vicinity of SBR-1), and in the vicinity of former plating trenches (SBR-7 and 9). Please reference the ***Soil Sampling Locations*** drawing (see **Figures**).

The sample collection procedure was similar for each boring. First, an electric rotary hammer or jackhammer was used to cut a small hole in the concrete floor. A clean, stainless steel hand auger was then used to advance the boring and to facilitate sample collection. Borings were identified by the convention "SBR-1, 2, 3 ..." with the sample identification suffixes "A", "B", and "C" corresponding to the following depths below grade:

A) 1-2 ft	**B) 4-5 ft**	**C) 9-10 or 10-11 ft**

Samples obtained from the boring for monitoring well MW-13s were identified with suffixes "A" and "B" corresponding to the following depths below grade:

A) 4-5 ft	**B) 9-10 ft**

Upon retrieval, the samples were split into two aliquots. The first aliquot was placed in labelled, laboratory supplied containers, and maintained on ice pending selection for possible laboratory analysis. The second aliquot was placed into clean, plastic, zip-lock bags, evacuated of air and maintained on ice pending field analysis. In accordance with the RFI Workplan, all soil samples were field analyzed for pH and the presence of organic vapors. Soil pH was determined using SW-846 Method 9045. To screen for the presence of organic vapors, a measure of soil was placed in a clean, plastic zip-lock bag and allowed to volatilize in direct sunlight or a heated area for approximately ten minutes. An organic vapor analyzer (OVA) was then used to screen the headspace in the sample bags for organic vapors. All field analytical results are summarized in ***Table 1*** included in the Appendix (see **Tables**).

The following samples were selected for laboratory analysis: MW-13sA, MW-13sB, SBR-1A, SBR-1C, SBR-2A, SBR-3A, SBR-3C, SBR-4A, SBR-4C, SBR-5, SBR-6, SBR-7, SBR-8A, SBR-8B, SBR-9A, and SBR-9C. Auger refusal was encountered at depths of approximately five feet below grade in borings SBR-5, 6, and 7. As a result, laboratory soil samples were composited using soil collected from the "A" and "B" depth intervals in these borings.

Samples selected for laboratory analysis were placed in labelled, laboratory supplied containers, maintained on ice, and delivered to Paradigm Analytical Laboratories, Inc. (PAL) in Wilmington, NC. The samples were analyzed for volatiles by SW-846 Method 8260, and copper and lead by Method 6010. Laboratory analytical results are summarized in ***Table 2*** (see **Tables**). Complete analytical reports, including Chain of Custody records, are included in **Appendix A**.

The hand auger was decontaminated following the procedures outlined in the RFI Workplan. All soil cuttings were containerized in 55 gallon drums and temporarily stored on site. Following completion of the borings, the boreholes were backfilled with mixture of Portland cement and bentonite, with the exception of one borehole which was converted to a monitoring well (MW-13s). Following the insertion of well construction materials, the top 12 inches were repaired with a concrete mixture of Portland cement and clean filter sand.

3.2 Monitoring Well Installation

Prior to this investigation, twelve monitoring wells (MW-1s through MW-12s) existed on the Alcatel property and none on the adjacent Keebler property. Coincidental to this investigation, eleven monitoring wells were installed on the Keebler property by Aquaterra during pre-acquisition auditing activities. The discovery of VOCs in Keebler's ground water prompted the submittal of an addendum to Alcatel's RFI Workplan, resulting in the installation of four monitoring wells (all on the Keebler property) in addition to the seven originally planned. All previous and new well installation activities ultimately resulted a total of 33 monitoring wells installed on the combined properties, 18 of which are associated with the Alcatel property and 15 with the Keebler property.

Two recovery wells were installed during the RFI activities, RW-1 and RW-2. RW-1 was originally intended to be constructed as a deep monitoring well; however, due to high water yielding conditions in the partially weathered rock and the risks associated with grouting surface casing in this zone, this well was completed as a six-inch I.D. recovery well. Recovery well RW-2 was installed for aquifer pump testing.

Complete construction details are depicted on the ***Boring Logs and Well Construction Records*** included in **Appendix B**. Well completion data (ground elevations, screen lengths, etc.) are summarized on ***Table 3*** (see **Figures**).

Wells installed by Alcatel during this investigation are shown by the table below. The type of construction and the property location are provided in parentheses.

MW - 2d (Type III/Alcatel)	MW - 3d (Type III/Alcatel)
MW - 4d (Type III/Alcatel)	MW - 7d (Type III/Alcatel)
MW - 13s (Type II/Alcatel)	MW - 8sk (Type II/Keebler)
MW - 8dk (Type III/Keebler)	MW - 9sk (Type II/Keebler)
MW - 9dk (Type III/Keebler)	MW - 12dk (Type III/Keebler)
RW - 1 (Type II/Alcatel)	RW - 2 (Type II/Keebler)

Wells within the study area are identified by well function, number, depth, and property location codes (e.g. MW-2s, MW-12dk). The following convention has been used:

Well Function: "MW" denotes Monitoring Well
"RW" denotes Recovery Well

Well Number: 1, 2, 3, 4 ... 13.

Well Depth: "s" - shallow well screen usually set in unconsolidated material
"i" - intermediate well screen set in PWR or upper fractured rock
"d" - deep well screen set in fractured rock

Location: "k" denotes Keebler property; the lack of a property code indicates the well is on Alcatel property.

The three Type II (shallow) monitoring wells were installed near the water table within the unconsolidated materials (saprolite). MW-13s was installed inside Alcatel's main building using a stainless steel hand auger. MW-8sk and MW-9sk were installed with a

power drilling rig using hollow-stem augers. Soil samples were collected during drilling operations in order to classify the soils which were encountered. Split-spoon samplers were used to collect samples during power drilling rig operations, while grab samples of cuttings were obtained from the hand augered borehole. All shallow wells were constructed of two-inch, Schedule 40 PVC manufactured screen and casing. The wells were completed with locking caps, and flush-mount bolt-down covers.

Borings for the two Type II recovery wells (RW-1 and RW-2) were advanced using air percussion drilling techniques (air hammer) and were screened in the saprolite and weathered/highly fractured rock zones. Fluid returns generated during drilling indicated the transition between saprolite and hard rock was highly productive, with instantaneous yields of RW-1 reaching 100 gallons per minute (GPM). These wells were constructed of six-inch, Schedule 40 PVC manufactured screen and casing. The wells were completed with locking caps, and flush-mount bolt-down covers.

Each of the seven Type III monitoring wells were installed within the competent bedrock. The initial boreholes for these wells were advanced using an air hammer to depths approximately two feet below the top of competent bedrock. A six-inch Schedule 40 PVC surface casing was then set and grouted into place. An exception to this was well MW-12dk, in which a six-inch carbon steel surface casing was used due to heaving unconsolidated material just above the bedrock surface. Surface casing grout was allowed to cure for 12 to 24 hours. A 5.25-inch air hammer was then used to advance a borehole into the fractured bedrock. Well screens spanned 10-30 feet to assure intersection with water bearing fractures. The wells were constructed of two-inch Schedule 40 PVC

manufactured screen and casing. Each well was completed with a locking cap and flush-mount bolt-down cover.

Yields in the fractured rock were noted to drop off significantly at depths greater than 40 feet below grade. Yields on the order of one to five GPM were typical during drilling operations where water bearing fractures were intersected.

All cuttings and fluids generated during drilling operations were containerized and temporarily stored on site. Containment basins were constructed in the decontamination area and around the boreholes for the air hammered wells. Decontamination water, as well as fluids generated during drilling, were captured within these basins and subsequently containerized. At the completion of drilling activities, the containment basins were dismantled, and all material (plastic, etc.) which had come into contact with potentially contaminated media were containerized.

All newly installed wells were developed by purging the wells of five well volumes or until turbidity stabilized. For the shallow wells, dedicated disposable bailers were used to develop the wells. Intermediate and deep wells were developed with a Brainard-Kilman (B-K) hand pump. The hand pump was decontaminated between wells by thoroughly washing the unit with Alconox soap, steam pressure washing, and a water rinse. All water generated during the development process was containerized and temporarily stored on site. Disposal of recovered materials is pending.

3.3 Well Sampling and Analysis

Ground water samples were collected from monitoring wells at the site to characterize ground water quality within the aquifer system. Samples were collected from the following monitoring wells:

ALCATEL PROPERTY

MW-1s	MW-2s	MW-2d	MW-3s	MW-3d	MW-4
MW-4d	MW-5s	MW-7s	MW-7d	MW-9s	MW-1
MW-11s	MW-12s	MW-13s			

KEEBLER PROPERTY

MW-1sk	MW-1ik	MW-2sk	MW-2ik	MW-3sk	MW-4sk
MW-5sk	MW-6sk	MW-6ik	MW-7sk	MW-7ik	MW-8sk
MW-8dk	MW-9sk	MW-9dk	MW-12dk		

Prior to sampling, at least three well volumes of water was purged from each well. For the shallow wells, purging was accomplished by bailing the wells using dedicated, PVC disposable bailers. For the deep wells, a B-K hand pump was utilized. The hand pump was thoroughly decontaminated between wells in accordance with the procedure described previously. All purge water was containerized and temporarily stored on-site.

The wells were allowed to recover overnight prior to sample collection. Dedicated disposable bailers were used to collect water samples from the wells. Clean, nylon line was attached to the bailers, and the bailers were slowly lowered into the well to a depth just beneath the surface of the water. The bailer was recovered and the sample was carefully decanted into the appropriate containers. Laboratory samples were decanted into

labelled, laboratory supplied containers and maintained on ice. Samples for field analysis were decanted into clean glassware and analyzed immediately. The in-field analysis consisted of measuring sample pH, temperature, and specific conductance, as well as noting the physical appearance of the sample. In-field analytical results are summarized in ***Table 4*** (see **Tables**).

Laboratory samples were shipped via overnight courier to PAL in Wilmington for analysis. The samples were analyzed for target volatiles (as specified by the Workplan) by SW-846 Method 8260, and for copper and lead by Method 6010. ***Table 5*** (see **Tables**) provides a historical summary of laboratory analytical results for each well. Complete analytical reports for sampling conducted during this investigation are included in **Appendix A.**

3.4 Stream Sampling

Surface water samples were collected from the unnamed stream which transects the western portion of the study area. Prior to sampling, the stream was examined for flow conditions, evidence of "seeps" along the banks of the stream and suitable locations of sampling points. Flow velocity measurements were also obtained at this time. Flow measurements were taken approximately 100 feet down stream of Outfall A as shown on the ***Water Table Surface Map*** **(see Figures)**. Additionally, Outfall A served as the general location for the up-gradient water quality sample (CS-1) while the down-gradient sample (CS-2) was collected from Outfall B.

Flow was measured by recording the length of time required for a float to travel a known distance over the deepest portion of the stream channel (highest velocity). The float was allowed to travel a distance of 45 feet on five successive runs. Elapsed time and the

resulting velocities are given by the following table. Baseflow discharge was calculated from velocity information and is further described in **Section 4.6**.

Run 1	1.52 min	29.61 ft/min
Run 2	1.47 min	32.14 ft/min
Run 3	1.40 min	32.14 ft/min
Run 4	1.47 min	30.61 ft/min
Run 5	1.28 min	35.16 ft/min

Water samples were collected up-gradient (CS-1) and down-gradient (CS-2) of the study area to determine if target constituents were being contributed to the stream during its flow across the property. Samples were collected at the water/air interface during low-flow (baseflow) conditions, and within the center of the channel. Samples were described as relatively clear with algae particles. Clean glassware was used to collect water samples. Upon acquisition, samples were carefully decanted into laboratory supplied sample containers, maintained on ice, and transported to PAL for laboratory analysis. Each sample was analyzed for volatiles by SW-846 Method 8260, and copper and lead by Method 6010. Samples were also field analyzed for temperature, pH, and specific conductivity. Field parameters are summarized in ***Table 6*** (see **Tables**). Laboratory analytical results are summarized in ***Table 7*** (see **Tables**). Complete laboratory analytical reports are included in **Appendix A**.

3.5 Aquifer Testing

Aquifer testing was performed on well RW-2 during the week of January 9, 1995. RW-2 was screened from 15 to 40 feet below grade within the site's "high yield" interval. This

interval spans approximately 30 feet and is composed of the entire PWR unit, the upper portion of the fractured rock, and the lower portion of the saprolite. Interpretation of boring logs, well development and aquifer test data indicates that this interval transmits most of the site's ground water. Although water exists intermittently in deeper fractures, yields within the fractured rock are significantly less.

A Grundfos Redi-flow 2 submersible pump was installed approximately one foot above the bottom of the screened interval in the well. Pressure transducers were installed in RW-2 (the pumping well), MW-2ik and RW-1 and were connected to a Hermit 2000C data logger. Water recovered during the test was routed through a totalizing flowmeter, two parallel 50 micron particulate filters, and two 55 gallon in-line low-pressure carbon vessels prior to discharge to the Raleigh POTW. In accordance with the requirements of the temporary discharge permit issued by the City of Raleigh, influent and effluent samples were collected at periodic intervals and analyzed using a field gas chromatograph. These samples monitored breakthrough of three targeted chlorinated compounds (1,1 DCE; 1,1,1 TCE; and PCE) between the carbon treatment units. Influent and effluent analytical results are summarized in ***Table 8*** (see **Tables**).

Aquifer testing consisted of a four-hour step-drawdown pumping test, followed by a 72-hour constant discharge aquifer test. The step-drawdown test was performed to determine the optimum pumping rate for the 72-hour test. During the step-test, the discharge of the pumping well was increased at various times and the drawdown response of the aquifer was measured. The step test indicated a discharge on the order of 7.5 gpm would produce a suitable drawdown (about 4 feet) and limit turbulent flow conditions during the 72-hour pump test. The aquifer was allowed to recover for twelve hours prior to commencement of the 72-hour pump test. Step test data has been purposely omitted from the Appendix.

The 72-hour pump test commenced at 11:12 am on January 10, 1995. In addition to wells RW-1, RW-2, and MW-2ik which were connected to the data logger, water levels were also routinely monitored by hand in wells MW-4d and MW-2sk. The test was concluded at 11:40 am on January 13, 1995. A total of 32,140 gallons of water was discharged during the aquifer testing. Aquifer test field data is included in **Appendix C**.

4.0 RESULTS OF INVESTIGATION

Findings of the RFI are presented in this section. As stated previously, this RFI is intended to augment findings of previous assessment and remedial efforts. Several voluntary actions have occurred at the facility, each of these actions is summarized below. As necessary, complete reports or pertinent portions thereof are included in the Appendix for clarification. Although results of this RFI are the focus of this section, previous information has been included where appropriate for explanation and understanding.

4.1 Summary of Previous Actions - AOC #1

During retrofit and construction of the drainage system alleyway, Alcatel discovered areas exhibiting soil discoloration and unusual odors. An investigation ensued which identified three locations of impacted soils. A fourth area was later identified during equipment dismantling activities. AOC #1 is defined by these four soil impact areas.

This section provides a summary of previous investigative and remedial work at the facility regarding AOC #1. Details of each previous phase are provided in the actual reports, located in **Appendix D**. These reports are also on file with NCDEHNR-DSM. Pursuant to the requirements of the RFI Workplan, these reports are incorporated in this RFI by reference.

4.1.1 AOC #1 Areas 1 and 2

Facility modifications and associated environmental sampling performed by Alcatel identified two areas where soil had been discovered with elevated levels of copper and lead. Voluntary remedial actions were pursued by Alcatel to remedy the condition. Westinghouse Environmental and Geotechnical Services, Inc. (WEGS) was contracted to perform the remedial activities. WEGS summarized their

remedial activities in three reports titled ***Environmental Cleanup Area No. 1***, ***Environmental Cleanup Area 2***, and ***Environmental Cleanup Area 2 Addendum*** (provided in **Appendix D**).

At both areas, no further remedial action was recommended due to the toxicity characteristic sampling results. A total of 277 tons of soil have been removed from Areas 1 and 2. Location diagrams, sampling results, and waste manifests for the removed soil are included in the referenced reports.

4.1.2 AOC #1 Area 3

Voluntary remedial action was taken by Alcatel to remove soil impacted by VOCs at Area 3. A total of 92 tons of impacted soil were removed and properly disposed as a result of this effort. In late 1990, National Environmental Technologies, Inc. (NET) was contracted by Alcatel to delineate any remaining soil containing VOCs in the vicinity of Area 3.

Additional VOC impacted soil was identified as a halo around the Area 3 excavation; however, due to the presence of foundation structures, these soils were inaccessible to further excavation. Additionally, the potential of leaching VOCs from the soil is reduced by the presence of concrete over the entire area. Subsequent remedial work at Area 3 has not been pursued due to the structural interferences and reduced leaching potential. Location diagrams, sampling results, and remedial data regarding Area 3 are included in NET's February 1991 report titled ***Phase I Soil and Groundwater Impact Assessment*** (**Appendix D**).

Additional sampling was performed concurrent with the Area 3 investigation to determine if VOCs were present at Areas 1 and 2 following the excavation activities mentioned above. Sampling results indicated VOCs are essentially absent from these areas. These sampling results are also included in the ***Phase I*** report referenced above.

4.1.3 AOC #1 Area 4

Area 4 previously contained a shed-like structure housing two chemical reaction tanks. The structure and tanks were dismantled and removed as part of Alcatel's termination of printed circuit board manufacturing operations. As the tanks processed lead containing solutions, WEGS was contracted to perform lead sampling at Area 4 following dismantling activities. Their assessment is summarized in a report titled ***Field Sampling and Analytical Services - Area No. 4 Soil Sampling*** (provided in **Appendix D**).

Analytical results ranged from below quantitation limit (BQL) to 1.3 mg/L in TCLP extracts and from BQL to 21,100 mg/Kg as total lead in soil. WEGS indicated that "the lead contamination is limited in the soil to a depth of approximately one foot and in the overlying paving materials." A sampling location diagram and sampling results are included in the referenced report. No remedial action has occurred in Area 4 as of this writing.

4.2 Summary of Previous Actions - AOC #2

The NET report titled ***Phase I Soil and Groundwater Impact Assessment*** (**Appendix D**) was the first of three reports which addressed soil and ground water contamination in the area now referred to as AOC #2. Objectives of the report included assessment of ground

water quality and characterization of the hydrogeological conditions at the site. Pursuant to these objectives a passive soil gas survey was conducted, five monitoring wells were installed and falling head aquifer tests were performed.

Due to the soil gas survey being conducted beneath the floor slab of the main building, results were less than conclusive; however, results did indicate that potential ground water impacts may be relatively widespread. Subsequent installation of five shallow monitoring wells (MW-1s through MW-5s) confirmed this suspicion by the identification of certain VOCs in ground water samples recovered from the wells.

The aquifer characterization study revealed uniform weathering to the PWR/hard rock interface, a consistency in hydraulic conductivity between the three wells tested, and a consistent hydraulic gradient between the well locations. Hydraulic conductivities ranged from 3.02 to 5.72 ft./day with gradients ranging from 0.16 to 0.19 ft./ft. Further chemical and physical data regarding this study can be found in the referenced report.

Additional ground water quality work was accomplished during closure of Alcatel's on-site waste water treatment plant. This work was performed independently of the above mentioned assessment activities and resulted in the installation of four additional ground water monitoring wells. Monitoring wells MW-6s through MW-9s were installed up- and down-gradient of the treatment building. Sampling results from these wells indicated no impact to ground water occurred as a result of the operation of the treatment plant.

Further voluntary ground water investigative work was initiated in June 1993 and continued into October of the same year. This work is represented by two NET reports dated August 11, 1993 and October 22, 1993 and titled ***Results of Ground Water***

Investigation and ***Report of Ground Water Investigation***, respectively (see **Appendix D**). During these investigations, several borings were advanced inside the Alcatel main building for the purpose of water quality and soil assessment. Results indicated that little, if any, soil contamination was present; however, VOC impacted ground water encompassed an area of approximately four acres in the vicinity of the main building. The installation of monitoring wells MW-10s through MW-12s was accomplished during the studies.

4.3 S&ME Soil Sampling on Keebler Property

During environmental auditing activities associated with future development of the Keebler property, Soil & Materials Engineers (S&ME), under subcontract by others, sampled soils on the Keebler property to establish baseline conditions. Their assessment was conducted during the period February through April 1995.

During their study, S&ME collected soil samples from 11 points on the Keebler property. Four of these points were located on the northeast portion of the property, outside the present structures. Seven points were located inside the Keebler building, in the vicinity of monitoring wells MW-7sk and MW-7ik. Locations of the sampling points are depicted on the ***Soil Boring Locations*** drawing (see ***S&ME Soil Sampling***, **Appendix D**).

The soil borings were advanced with a stainless steel hand auger. All soil samples were screened for the presence of organic vapors using a Toxic Vapor Analyzer (TVA) and an OVA. Depths of the soil borings ranged from 4.3 feet to 7.3 feet below grade. Soils were described as clayey to silty sands and sandy silts to fine sands. Rock fragments and/or partially weather rock (PWR) were encountered in six of the borings. Soil samples for laboratory analysis were selected from grab samples obtained during boring

advancement. These samples were submitted to PAL in Wilmington, NC for laboratory analysis of Volatile Organics by EPA Method 601. No volatile compounds were detected during analysis of the soil samples. Complete laboratory analytical data for these samples are included in **Appendix D** (see ***S&ME Soil Sampling***).

4.4 RFI Soil Investigation

Soil sampling activities concentrated on areas beneath the main building which may be acting as a source for the ground water pathway. Investigative activities were concentrated in three areas: 1) Near the north (outside) wall of the main building; 2) Near the location of the east (rear) wall of the original 1958 building; and, 3) Near the former plating trenches. Soil samples collected from beneath the floor of the main building did not indicate impact by volatile constituents, however, several samples showed elevated concentrations of copper and/or lead. The majority of samples exhibiting elevated metals concentrations were collected near the north wall of the building bordering AOC #1. Soil sampling locations are shown on the drawing titled ***Soil Sampling Locations*** (see **Figures**). AOC #1 and AOC #2 are shown by drawings titled ***Location of Impacted Areas*** and ***Former Printed Circuit Board Manufacturing Area*** (see **Figures**), respectively.

As the identification of potential sources of contamination was an important objective of the soil investigation, soil samples collected from beneath the main building were analyzed for total metals. This analysis quantifies concentrations of metals in the soil, either free or bound within mineral or chemical structures, but gives no indication as to the mobility (i.e., leachability) of the constituent. Initial examination of analytical data for total copper suggested that a correlation exists between sample location and total copper concentration. Because of this, analytical data was statistically examined to

confirm such a correlation, and to identify samples having a concentration that may be naturally occurring.

In consideration of previous sampling results in Areas 1 through 4 and realizing the close proximity of AOC #1 to AOC #2, it was necessary to statistically compare AOC #1 and AOC #2 for the purpose of source identification. As many samples were acquired near the wall between AOC #1 and AOC #2, a frequency analysis was performed to determine if a correlation exists between sample location and total copper concentration. For the frequency analysis, a two by two matrix was established. The options for the matrix are shown below:

Near Outside Wall **Low Copper Concentration** **I**	**Near Outside Wall** **High Copper Concentration** **II**
Away from Outside Wall **Low Copper Concentration** **III**	**Away from Outside Wall** **High Copper Concentration** **IV**

where:

Near the Outside Wall is defined as a sampling location which is inside the main building at a distance less than or equal to 10 feet from the outside wall;

Away from the Outside Wall is defined as a sampling location which is inside the main building at a distance greater than 10 feet from the outside wall;

Low Copper Concentration is defined as samples having a total copper concentration of less than or equal to 10 mg/kg;

High Copper Concentration is defined as samples having a total copper concentration equal to or greater than 10 mg/kg.

Analytical results for 21 soil samples were used during the frequency analysis. Sixteen of the samples were obtained during this RFI (results in **Appendix A**) and five were obtained during NET's October 1993 investigation (see report titled ***Report of Ground Water Investigation***, October 22, 1993 in **Appendix D**). The frequency analysis resulted in the following distribution:

Near Outside Wall Low Copper Concentration (0)	**Near Outside Wall High Copper Concentration (9)**
Away from Outside Wall Low Copper Concentration (11)	**Away from Outside Wall High Copper Concentration (1)**

The correlation of *high* total copper concentrations in close proximity to the north outside wall (Quadrant II) implies that the source for copper detected in soil beneath the main building is located near the AOC #1/AOC #2 boundary or completely within AOC #1. With the exception of sample SBR-7 (near the former plating trench), it appears that releases within AOC #1 are the likely source for copper detected in AOC #2 soils. The highest copper concentration was detected in sample SBR-8B at 74 mg/kg. Conversely, concentrations detected away from the AOC #1/AOC #2 boundary (Quadrant III) may closer approximate naturally occurring concentrations. The geometric mean concentration of total copper for these 11 samples is 1.45 mg/kg.

Soil samples were also analyzed for total lead. Analysis of this data does not result in a similar correlation as compared with the data for total copper. Concentrations of total lead varied from BQL (below quantitation limit) to 10.7 mg/kg. As no correlation between location and concentration was noted during evaluation of the data, it is difficult to determine a likely background concentration or remaining source area, if any, for the constituent.

Copper and lead remaining in AOC #1 and AOC #2 soils are not accessible via air inhalation, water ingestion or soil ingestion pathways. All soils identified as having concentrations of copper or lead are contained beneath concrete structures. This arrangement virtually eliminates leaching to ground water and prohibits direct contact by humans, eliminating the soil ingestion pathway. Exposure via the air ingestion pathway is essentially non-existent as chemical complexing or volatilization processes would be required to liberate the constituents.

Although care should be exercised when using published risk-based concentrations for setting constituent no-action levels, it is important to note the difference between concentrations detected in site soils and published risk-based data. For example, the October, 1995 EPA Region III risk-based concentration table lists a copper concentration of 82,000 mg/kg for the industrial soil ingestion pathway, well over 1000 times the highest concentration discovered at the Alcatel facility. Risk-based lead data was not included in the EPA report.

4.5 Hydrogeological Investigation

A total of thirty-three ground water monitoring wells have been installed at the site for the purpose of determining ground water quality and water levels within the three

hydrolithologic units of the study area. Geologic logging during the installation of these wells has provided key information regarding the lateral and vertical hydrogeological relationships between these units. Although some water level variation exists between the saprolite and deeper fractured rock, the entire system is interconnected and functions as a single aquifer. Interpretation of rock core and drilling information place the bottom of the aquifer at a depth of approximately 100 feet below grade.

4.5.1 Profile of the Aquifer System

Boring logs and well construction data (**Appendix B**) were used to generate hydrogeologic cross-sections for the study area (see **Figures**). The orientation of each of the three sections is shown on the ***Cross-Section Location Map*** (see **Figures**). Although more detail is provided on the boring logs, variations within the subsurface are depicted as three distinct hydrolithologic units on the sections. These units are: the unconsolidated materials (saprolite), PWR, and hard rock (bedrock).

Observations during drilling and well installation activities indicate that the water bearing zone having the highest yield is the PWR and upper twenty feet of the fractured rock. This zone is composed of a mixture of unconsolidated materials, weathered rock and fractured bedrock and represents the transition from saprolite to hard rock. The thickness and degree of weathering of the high yield zone varies somewhat across the site. The lateral thickness change of the PWR, as depicted on the cross-sections, is a good indication of this variability.

Above the high yield zone is the saprolite, composed of unconsolidated sands, silts and clays. This material is derived from the chemical and physical weathering of

the bedrock. The degree of weathering of the saprolite is largely uniform throughout the site. Relic structures and remnant foliations were present at all locations where split-spoon samples were obtained.

Below the high yield zone is hard fractured rock composed of granite and gneiss. A rock core was obtained from the boring for MW-4d at Alcatel for the purpose of characterizing the fractured rock. Within the 37.5-foot core interval (from 30 to 67.5 feet below grade), seven sub-equally spaced fractures were noted. The width of these fractures varied from slightly less than one millimeter in the upper portion of the core to *"paper"* thickness with depth. Most fractures were within felsic and pegmatoidal felsic zones, and were relatively "clean" with little iron or magnesium precipitates present. The fractures within mafic zones appeared to be at least partially filled with a dark-colored, clay-like material, which can be attributed to the hydrous weathering of biotite. Recovery of the core was 100 percent.

Observations during drilling activities indicate that the fractures pinch out with depth. Aquaterra attempted to install a deep monitoring well at the MW-2k nest. This well is identified as MW-2dk on the boring logs (**Appendix B**). The log indicates that competent bedrock was encountered at 28.5 feet and continued through a depth of 150 feet below grade. Fractures dissipated with increasing depth and no water was encountered from 80 to 150 feet. The well was not completed due to dry conditions and the loss of drilling tools in the borehole.

4.5.2 Fracture Trace Study

Due to the general lack of outcrop at the study area, fracture trace information was obtained from researchers familiar with the area geology. Extensive geological mapping in the Raleigh West quadrangle (which begins less than 1/4 mile west of the Alcatel site) during the period 1992-1994 resulted in the identification of major lineations in the area. Dr. D.E. Blake, of UNC-W, identified a strong foliation trending roughly N 20 E throughout the mapped portion of Raleigh West quadrangle (northern half). Dips of the foliation are reported to be on the order of 60 to 80 degrees from vertical. Dr. Blake's ***Raleigh West N.C.*** map, showing the foliation, is included in the map pocket (see **Figures**). Note that the Alcatel site is positioned just off the eastern central portion of the Raleigh West map. The aforementioned ***Topographic Location Map*** can be used as a siting reference since a slight overlap exists between quadrangles.

The orientation of the foliation is critical as weathering creates planes of weakness in the rock along this foliation. As ground water flows along the weathered foliation planes, plume geometry can be greatly affected. Deeper ground water flow and plume geometry at the site appear to be affected by the foliation as both exhibit strong north-northeast/south-southwest preferences.

4.5.3 Ground Water Flow

Water level data obtained from the monitoring wells has been used to determine ground water flow directions and general ground water trends. These data have been utilized to generate graphical representations of the water table and hard rock potentiometric surface within the study area. The water table surface is graphically represented on the ***Water Table Surface Map*** (see **Figures**). The

bedrock potentiometric surface is graphically represented on the ***Bedrock Potentiometric Surface Map*** (see **Figures**). Both maps were generated from water level data collected on July 26, 1995.

Ground water flow at the water table surface trends towards the west-southwest, along a relatively uniform gradient. As compared to previous studies, the trends associated with flow direction and hydraulic gradient appear to remain constant regardless of season. Well hydrographs (**Appendix C**) further support this conclusion. Shallow ground water flow appears to be influenced by the small unnamed stream traversing the western portion of the property. Matching of stream elevations and ground water flow lines results in a plausible configuration, as shown on the ***Water Table Surface Map***. The remnant foliation in the saprolite does not appear to contribute to a preferred flow direction as the trend of the foliation and water table flow direction differ by at least 45 degrees. Homogenation during advanced weathering may be responsible for this observation.

A structural contour map of the bedrock surface was constructed to evaluate the effect of the hard rock surface on the water table orientation. Upon examination of the ***Bedrock Structural Contour Map*** and the ***Water Table Surface Map*** (see **Figures**), a similar orientation is noted for each surface. Thus, orientation of the hard rock surface appears to influence the gradient and flow direction of shallow ground water.

The pore water velocity in unconsolidated media (seepage velocity) is calculated by the formula shown below.

$$v = (K_h i)/n_{eff}$$

where: **v** is the seepage velocity
i is the hydraulic gradient
$\mathbf{K_h}$ is the horizontal hydraulic conductivity
$\mathbf{n_{eff}}$ is the effective porosity

For the unconsolidated materials of the PWR and saprolite units, $\mathbf{i_{avg}}$ across the study area was determined to be 0.02; $\mathbf{K_h}$ was estimated to be approximately 15.0 ft/day from pumping test and previous slug test data (see **Section 4.7**); and $\mathbf{n_{eff}}$ is generally accepted to be approximately 20%. From these values, a mean seepage velocity of 1.5 ft/day for the unconsolidated material is calculated. A lower seepage velocity, on the order of 0.3 ft/day, results from the sole use of slug test data obtained during previous studies.

As shown on the ***Bedrock Potentiometric Surface Map*** (see **Figures**), the ground water flow direction within the bedrock is generally southwest, with an apparent "trough" existing in the potentiometric surface beneath the Alcatel main building. As bedrock wells have not been monitored for an extended period of time, it is difficult to say if the "trough" is a seasonal phenomenon or a perennial feature. In the event the trough is a perennial feature, it is likely caused by localized differential weathering. This speculation is further supported by the greater relative thickness of the PWR in this portion of the site. Additionally, a higher transmissive zone would be expected to have a similar "fingerprint" on the potentiometric surface.

The velocity of laminar flow within the fractured rock can be approximated in a mathematical method similar to that for the unconsolidated material, in that the

variables $\mathbf{i_{avg}}$, $\mathbf{K_{hr}}$ (horizontal hydraulic conductivity of the bedrock), $\mathbf{n_f}$ (fracture porosity) are utilized. For the bedrock, $\mathbf{i_{avg}}$ across the study area was determined to be 0.01; $\mathbf{K_{hr}}$ was assumed to be 2.8 E^{-3} ft/day (Freeze and Cherry, 1979, p.409); and $\mathbf{n_f}$ was assumed to be 1.0 E^{-4} (Freeze and Cherry, 1979). Entering these values into the equation presented above yields a velocity of 0.3 ft/day for the bedrock. This value is consistent with the slow recovery of bedrock monitoring wells observed during well sampling activities. Additionally, this value may be typical of bedrock at a depth of 40-60 feet below grade, however, velocity at a depth of 80-100 feet would be expected to be significantly less.

Vertical ground water flow information was obtained through comparison of water level elevations at twelve well nests throughout the site. To graphically depict vertical flow relationships across the site, a ***Water Level Elevation Difference Map*** (see **Figures**) was constructed from water table and bedrock water level elevation data. Contours on the referenced map indicate the relative difference in water level between the upper and lower portions of the aquifer. Elevation, or total head, differences that are *positive* indicate an *upward* hydraulic gradient (upward ground water flow) while *negative* head differences indicate a *downward* gradient.

Note that vertical flow on the western portion of the site is upward, in response to the unnamed stream which traverses this area. Towards the center of the site and eastward ground water flow is generally downward. As will be discussed in the following section, this vertical relationship assists in understanding the distribution of ground water constituents throughout the aquifer.

Most of the shallow (water table) wells on the Alcatel property have been in place for several years, which has allowed for the collection of time-series data regarding water levels at the site. Water level data have been plotted as hydrographs (see **Appendix C**). Examination of these graphs indicate the water levels in the wells demonstrate only minor seasonal fluctuations. With the exception of wells MW-3s and MW-12s, which are located near the stream, a slight declining water level trend is noted in several wells over time. This is due largely to recent years of reduced recharge by precipitation. Lowering water levels cannot be attributed to the nearby pumping of ground water, as the local area is provided water via a public water system.

4.5.4 Ground Water Quality

Thirty-one monitoring wells and recovery wells RW-1 and RW-2 were sampled on November 30 - December 1, 1994 (December 1994) to establish ground water quality conditions at the site. While many of the monitoring wells were sampled multiple times prior to this date, the December 1994 sampling represents the most recent data for the entire site. Ground water samples were analyzed for 1,1-Dichloroethane (DCA), 1,2-Dichloroethane (2-DCA), 1,1-Dichloroethene (DCE), 1,1,1-Trichloroethane (TCA), 1,1,2-Trichloroethane (2-TCA), Trichloroethene (TCE), Tetrachloroethene (PCE), copper and lead as specified in the RFI Workplan. ***Table 5*** (see **Tables**) summarizes the December 1994 sampling event and contains previous sampling event data.

Analytical results from the December 1994 sampling event were used to generate two ground water quality VOC isopleth maps, one for the water table (saprolite hydrolithologic unit) and one for the bedrock hydrolithologic unit. Total VOC

isopleths were derived by summing VOC constituent concentrations reported for each well (see ***Laboratory Analytical Results*, Appendix A**). Water table and shallow well ground water quality data were used to generate the ***Water Table VOC Isopleth Map***. Deep well data were used to generate the ***Bedrock VOC Isopleth Map*** (see **Figures**). On each respective map, wells *not* used for generation of the isopleths have the designation **(NI)** for *Not Included.* Due to the low concentrations of copper and lead as compared to EPA risk-based concentration data, isopleth maps for copper and lead constituents were not generated.

The total VOC plume at the water table appears as a roughly symmetrical, elliptical feature (see ***Water Table VOC Isopleth Map***) having a longitudinal axis oriented northeast-southwest. The plume encompasses approximately 9.75 acres in lateral extent. In the bedrock, the lower extent of the plume also appears as a sub-symmetrical, ellipsoidal feature (see ***Bedrock VOC Isopleth Map***) with a longitudinal axis oriented north-south. The lateral extent of the bedrock plume encompasses approximately 10.5 acres.

It is evident that plume geometry is controlled primarily by ground water flow, as the longitudinal axis of each plume is roughly parallel to the principle flow direction. This relationship is constant upon examination of previously reported data for the site. Furthermore, the longitudinal axis of the bedrock plume is roughly parallel to the foliation trend of the area. The lateral axis of each plume is approximately two times the longitudinal axis. One difference between the plume geometries is the steep concentration gradient along the western boundary of the bedrock plume. This feature is likely an artifact of the positive head

difference (discharge area) between the lower and upper portions of the aquifer in this area.

The likely origin for the VOC plume is in the vicinity of MW-13 and Area 3 of AOC #1. Minor spills of TCA were known to have occurred in the vicinity of Area 3 in the early to mid-1980s and it is suspected that PCE releases occurred near the juncture of the original 1958 and the 1963 and 1973 building additions (see ***Building Additions Diagram***, in **Figures**). As Alcatel personnel report no known use of PCE at the facility, this constituent was likely introduced to the subsurface through improper waste handling practices during the early operational history of the plant. Decay products of both TCA and PCE are seen in the analytical data.

The U.S. EPA's Risk Reduction Environmental Laboratory's (RREL) Treatability Database (ver. 5.0) was examined for specific gravity and solubility data. As constituent concentrations near the solubility limit indicate saturation, and thus, the potential of free-phase product, the difference between actual constituent concentrations and reported solubilities is important. Data indicates that the target compounds have solubilities ranging from 150 mg/L to 8690 mg/L (***Table 9***, see **Figures**). Comparison of site laboratory analytical data with the RREL solubility limit indicates none of the VOC concentrations are near the solubility limit. This suggests that the free-phase product does not exist at the site.

Knowledge of the approximate date of TCA releases (assumed to be 1984) allows a comparison of apparent constituent velocity with calculated ground water flow velocity. From the isopleth maps and the laboratory analytical data, TCA is

known to exist at a distance of approximately 960 feet down-gradient of the source area. With elapsed time set at 10 years (1994-1984), 0.26 ft/day is calculated for the velocity of TCA. The linear velocity as determined from pump testing is 0.3 ft/day, or about 115% of the apparent velocity. The difference between the two is attributed to many factors including but not limited to aquifer anisotropy, retardation and dispersion. A similar comparison was not attempted for PCE as the release date was unknown.

4.6 Stream Sampling

The stream transecting the western portion of the study area is a perennial stream which receives baseflow from ground water and overland flow from precipitation events. The stream crosses the study area with a length of approximately 1,250 feet. Much of the stream now flows underground via galvanized steel culverts. As it crosses the Alcatel property, a 370-foot length of the stream is exposed and accessible for sampling. The stream is characterized by an essentially straight channel which has been artificially modified. The bedload of the stream consists of sand-sized sediment and rip-rap blocks which have fallen into the stream from the engineered banks. Native crystalline rock is present in the stream bed in the northern portion of the study area.

Water depths at baseflow conditions varied from approximately one to six inches, with the apparent average depth being three inches. The average width of the channel at baseflow conditions is approximately four feet. Accounting for channel geometry, a cross-sectional flow area of 0.5 ft^2 was calculated. The set of stream flow measurements described in **Section 3.4** were obtained for estimation of stream flow velocity during baseflow conditions; the geometric mean of these measurements is 31.9 ft/min. Using the preceding data, baseflow discharge was calculated from the relationship shown below.

$$Q_{BF} = (WDS)V$$

where: Q_{BF} is baseflow discharge
W is the width of the channel
D is the water depth
S is the channel shape factor (0.5)
V is the stream flow velocity

The resulting baseflow discharge is 15.9 ft^3/minute or about 120 gallons/minute.

Two water samples were collected from the stream to assess water quality in the stream. Sample CS-1 was collected approximately ten feet south of the point where the stream enters the Alcatel property (upstream of Outfall A). Sample CS-2 was collected at a culvert (Outfall B) where the stream leaves the southwest portion of the Alcatel property. Refer to the ***Water Table Surface Map*** for these locations (**see Figures**). Downstream of Outfall B, the stream is contained entirely within the culvert.

Carbon disulfide, copper, and lead were detected in both creek samples. Carbon disulfide was detected by Method 8240 analysis at concentrations of 11.0 ug/L and 14.0 ug/L in samples CS-1 and CS-2, respectively. No other VOC compounds were detected. Copper was detected at 2.5 ug/L and 3.5 ug/L in samples CS-1 and CS-2, respectively; while lead was detected at 1.7 ug/L and 1.1 ug/L in samples CS-1 and CS-2, respectively. From these results, it may be concluded that the stream is not impacted by regulated constituents form AOC #1/AOC #2, or any other portion of the Alcatel property. Complete analytical results for the stream sampling are included in **Appendix A**.

4.7 Aquifer Testing

Data collected during the 72-hour aquifer test for pumping well RW-1 and observation wells RW-2, MW-2sk, MW-2ik, and MW-4d were reduced using GWAP (Graphical Well

Analysis Package). **Appendix C** contains raw time and drawdown input data used for the analysis. The resulting time-drawdown plot for each data set was graphically matched against non-equilibrium reverse type curves for either phreatic or leaky-confined conditions, depending on well screen position. A summary page showing the field data, the matching non-equilibrium reverse type curve, match point values, well information and the solution is provided for each of the five sets of data. Aquifer parameters calculated from the five data sets are shown by the ***Aquifer Test Results*** table below. Values for horizontal hydraulic conductivity (K_h) and transmissivity (T) have been converted to daily units for clarity, storativity (S) is dimensionless.

Aquifer Test Results

Well Number	K_h (ft/day)	T (ft^2/day)	S
RW-1	19.89	596.45	0.1561
RW-2	17.97	359.42	0.0302
MW-2sk	12.60	226.80	0.0393
MW-2ik	40.59	1,217.81	0.0014
MW-4d	15.02	750.82	0.0130

The geometric mean hydraulic conductivity (K_h) from above is 19.40 ft/day. As the pump test was designed to determine aquifer characteristics within the highest yielding zone of the aquifer system, the resulting mean hydraulic conductivity value is representative of this interval. Earlier slug testing results in the saprolite hydrolithologic unit provide a mean hydraulic conductivity of 3.99 ft/day. In consideration of the thickness of the saprolite unit, the thickness of the PWR and the upper fractured portion of the hard rock

unit, an empirical hydraulic conductivity value on the order of 15.0 ft/day can be derived for the site.

5.0 CONCLUSIONS AND RECOMMENDATIONS

Through voluntary assessment actions previously conducted at the site and by implementation of the October 1994 RFI Workplan, soil and ground water impacts at Alcatel's Raleigh, NC facility have been assessed. This RFI focused mainly on AOC #2 as data deficiencies existed in previous assessment efforts. Several assessment and remedial activities had occurred in AOC #1 prior to this investigation.

Results of the collective investigation identified minor VOC soil contamination remaining in the vicinity of AOC #1 Area 3. Concentrations of copper identified in AOC #2 soils are below reported risk based levels. Previous remedial efforts within AOC #1 have effectively removed areas impacted by copper, lead and VOCs.

This investigation determined the lateral and vertical extent of the ground water VOC plume identified during previous voluntary assessment actions. The approximate width, length and depth of the plume is 500, 1000 and 100 feet, respectively. Impacted ground water spans three distinct hydrolithologic units. These units are the saprolite, PWR and hard rock. The linear flow velocity of impacted ground water is on the order of 0.3 ft/day. This velocity agrees with the apparent plume velocity for a known TCA release which occurred during the mid-1980s. Total VOC concentrations within the center of the plume are on the order of 7000 ug/L. Concentrations attenuate sharply near the plume boundary.

Pathways for human consumption of regulated constituents are limited. The soil ingestion pathway is practically non existent as remaining soil impact areas are covered by concrete or the floor of the main building. Receptors in the ground water pathway are also limited. No ground water production wells are located within two miles of the study area. Furthermore, Alcatel and the local area receive water from the municipal water distribution system. This system is fed by

a reservoir located 16 miles away. The only receptors in the local vicinity are the unnamed creek which traverses the western portion of the Alcatel property and Crabtree Creek located about 4/10-mile to the south. Water quality sampling of the unnamed creek *does not confirm* impact by regulated constituents from the Alcatel facility. Results of the passive soil gas survey indicate little exposure to regulated constituents via the air pathway.

Demolition and redevelopment of the neighboring Keebler property is planned. In response to this action and in consideration of the plume existing on the Keebler property, interim corrective measures (ICM) are recommended to mitigate further downgradient migration of the VOC plume. ICM will likely be implemented on a voluntary basis so as not to interfere with development of the neighboring property. ICM is expected to utilize two arrays of ground water recovery wells, one situated in the high concentration portion of the plume and the other acting as a containment barrier on the southern extent of the plume. Ground water injection will be required to balance the water budget for the site. During planned redevelopment activities on the Keebler property, several existing monitoring wells will be affected. Wells will be salvaged where possible. It is anticipated that well nest 8k will be relocated further toward the southeast.

6.0 REFERENCES

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2. Final Report: RCRA Facility Assessment Report; Raleigh, Wake County, North Carolina," CDM Federal Programs Corporation, September 1992.

3. "Local Climatological Data; Raleigh, North Carolina," NOAA, 1992.

4. Hazardous Waste Management Permit for Alcatel Network Systems, Inc.; Number NCD 003 185 238-R1," North Carolina Department of Environment, Health, and Natural Resources, Division of Environmental Management, Division of Solid Waste Management, May 1994.

5. Freeze, R. Allan, Groundwater. Prentice-Hall Publishers, Englewood Cliffs, New Jersey. 1979. pp. 154-162, 297, 409.

6. Report: "Keebler Company Site Assessment; 2900 Wake Forest Road; Raleigh, North Carolina." S&ME, Inc.; Raleigh, NC; April 1995.

7. Risk-Based Concentration Table; USEPA Region III, Philadelphia, PA.; July-December 1995.

8. Blake, Dr. David E., Geologic Map of the Northern Half of the Raleigh West 1:24,000 Quadrangle, Wake County, North Carolina: 1992-1994 Field Research. 1994 STATEMAP Project Final Report.

9. Graphical Well Analysis Package ver 2.0; Groundwater Graphics, Oceanside, CA; 1987.

PLEASE SEE OTHER MATERIALS

MAPS IN THE BOOK

N

RALEIGH EAST QUADRANGLE
(7.5 Minute Series - Topographic)
Contour Interval 10'

1 1/2
Scale 1:24000

CLIENT/TITLE

ALCATEL NETWORK SYSTEMS
Raleigh, North Carolina

Figure 1
Topographic Location Map

DRAWN	JB
CHECKED	
DATE	6/94

NATIONAL ENVIRONMENTAL TECHNOLOGIES, INC.
Wilmington, NC

AVERY PV119E

60 0 30 60 120

(IN FEET)

1 INCH = 60 FT.

ENVIRONMENTAL TECHNOLOGIES, INC.

on, NC

REVISION	DATE	DESCRIPTION	BY	APP
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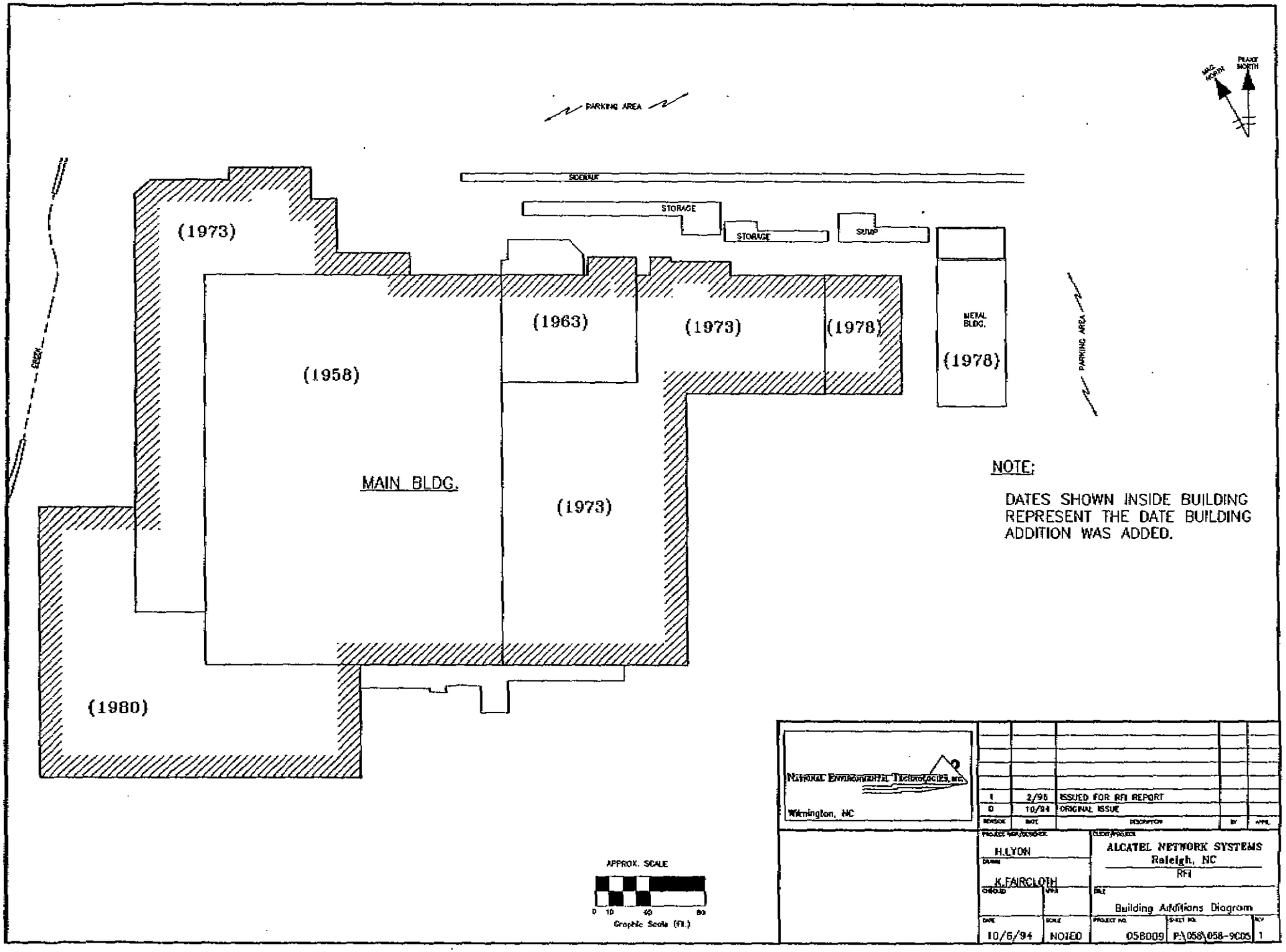
1	8/95	ADDED WELLS 10sK, 10DK, 3dK & 13S		
0	4/95	ORIGINAL ISSUE		

PROJECT MGR/DESIGNER: H. LYON		CLIENT/PROJECT: ALCATEL NETWORK SYSTEMS Raleigh, NC		
DRAWN: K. FAIRCLOTH		RFI		
CHECKED	APPR.	TITLE: ALCATEL & KEEBLER SITE MAP		
DATE: 10/19/94	SCALE: NOTED	PROJECT NO.: 058010	SHEET NO.: P:\058\058010C1	REV: 2

AVERY PV119E



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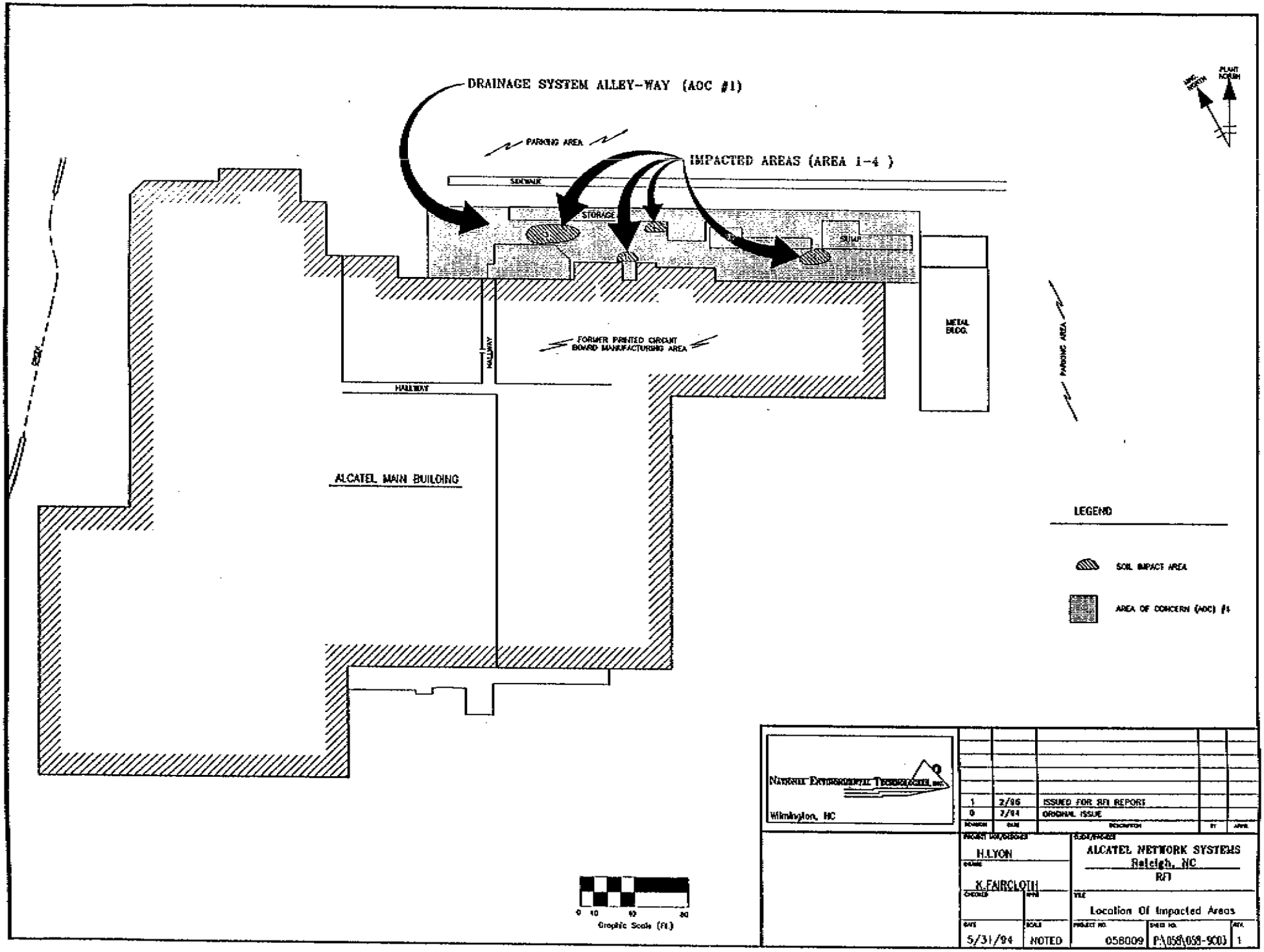

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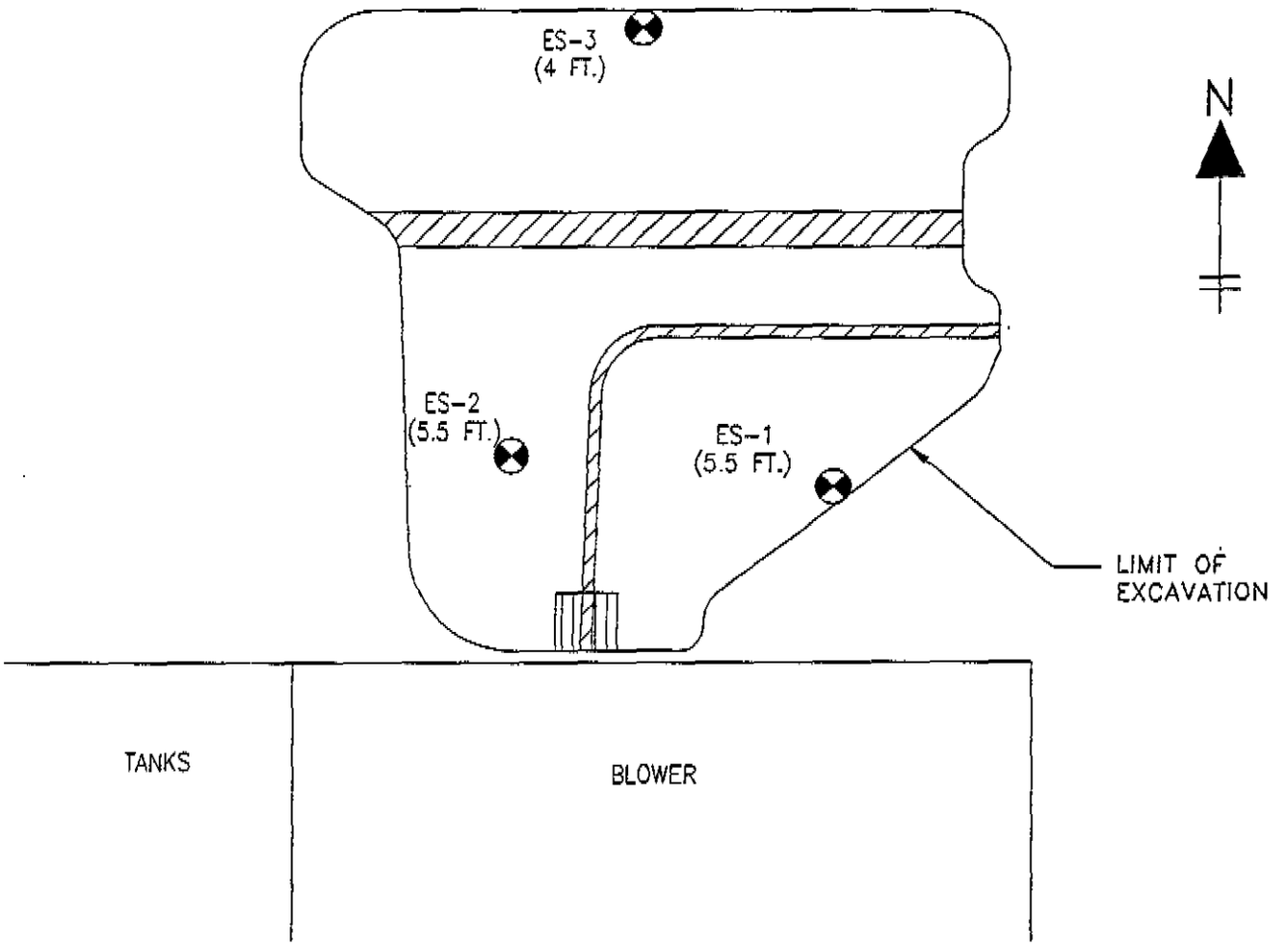
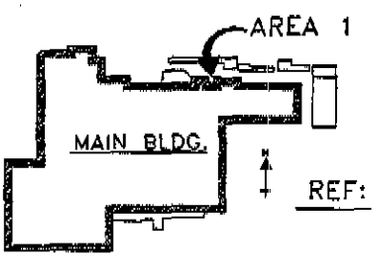
1	2/96	ISSUED FOR RFI REPORT



LEGEND

PIPES

SOIL SAMPLING LOCATION



KEY PLAN

REF: DWG. #058001R02
NET REPORT: 058001 (FEB. 1991)
MODIFICATION OF WESTINGHOUSE FIG. 2
FOR MAY REPORT (MAY 1990)
EXCAVATION FILLED FOLLOWING SAMPLING.

APPROX. GRAPHIC SCALE (FT.)

0 1 2 3 4

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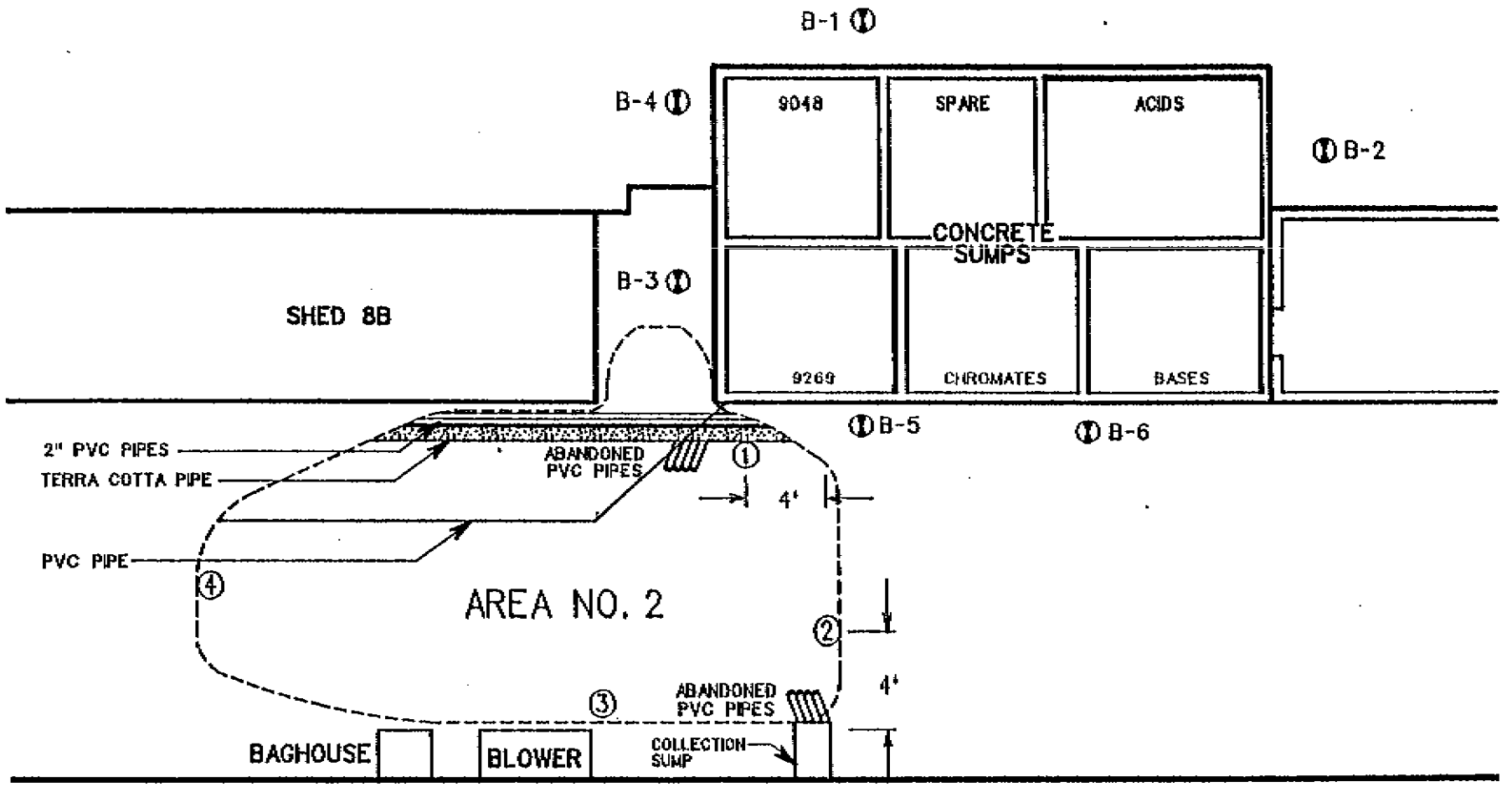
PROJECT MGR.	H.LYON
DRAWN	K.FAIRCLOTH
CHECKED	
DATE	6/2/94
SCALE	NOTED

CLIENT/TITLE
ALCATEL NETWORK SYSTEMS
Raleigh, NC

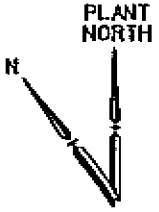
RFI
Area 1

PROJECT NO.	SHT. No.	REV.
058009	P:\058\058-9R02	1

AVERY™ PV119E M



MAIN BUILDING



NOTE: NORTH IN THE TEXT REFERS TO THE TOP OF THE FIGURE TO FACILITATE DESCRIPTIONS

KEY

1. SAMPLE NO. 1 - DEPTH 5'-0"
2. SAMPLE NO. 2 - DEPTH 5'-0"
3. SAMPLE NO. 3 - CORNER OF BLOWER DEPTH 8'-0"
4. SAMPLE NO. 4 - DEAD CENTER, DEPTH 6'-0"

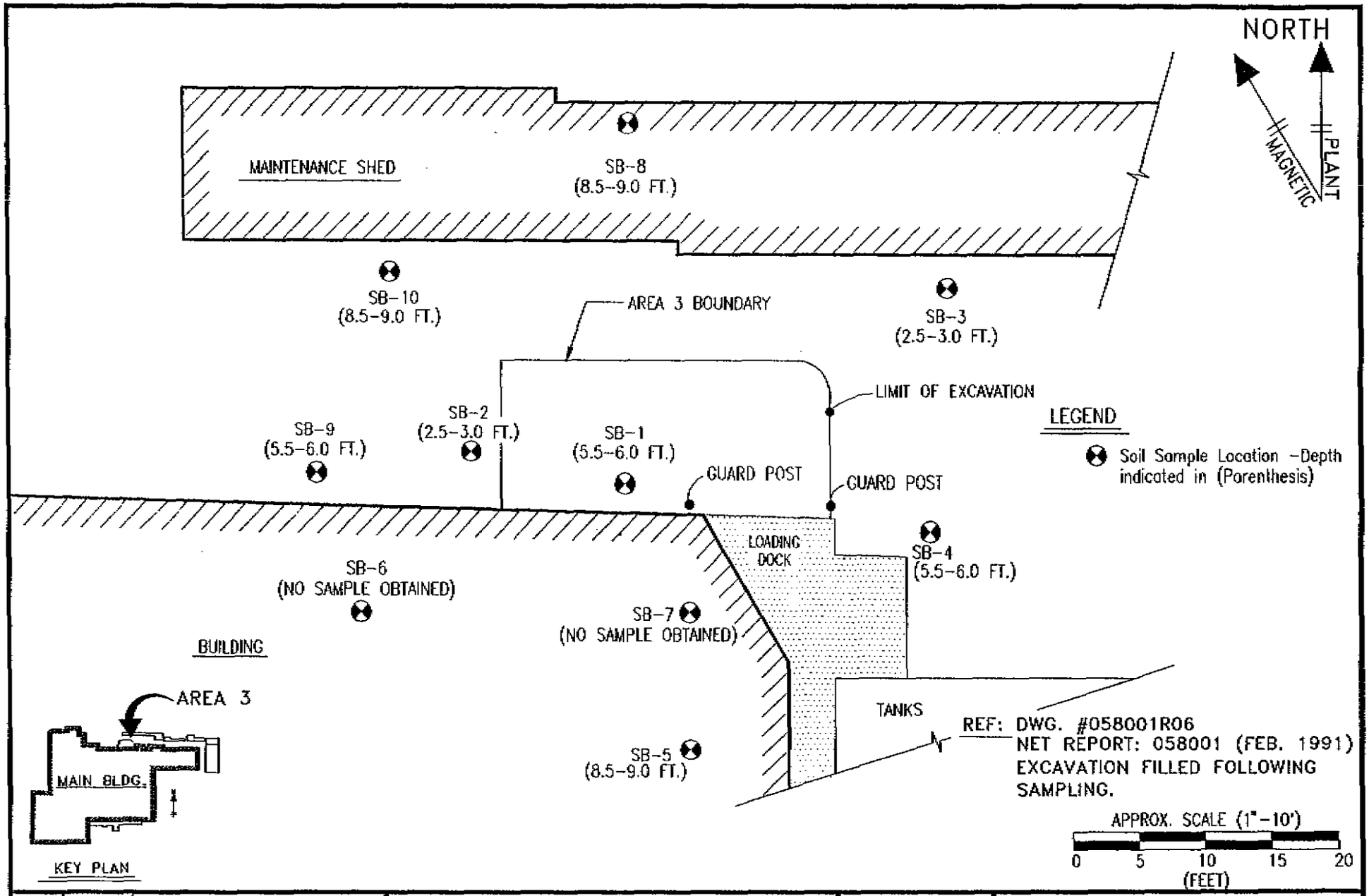
B SOIL BORING LOCATIONS

Westinghouse Environmental And Geotechnical Services, Inc.

AREA NO. 2
ALCATEL NETWORK SYSTEMS
RALEIGH, N.C.

PROJECT NO.: 4115-90-502	2
CHECKED BY: PBT	SCALE: 1" = 10'
DRAWN BY: DCW	DATE: 7-20-90

AVERY™ PV119E M



REV.	DATE	DESCRIPTION
1	2/96	ISSUED FOR RFI REPORT
0	7/94	ORIGINAL ISSUE

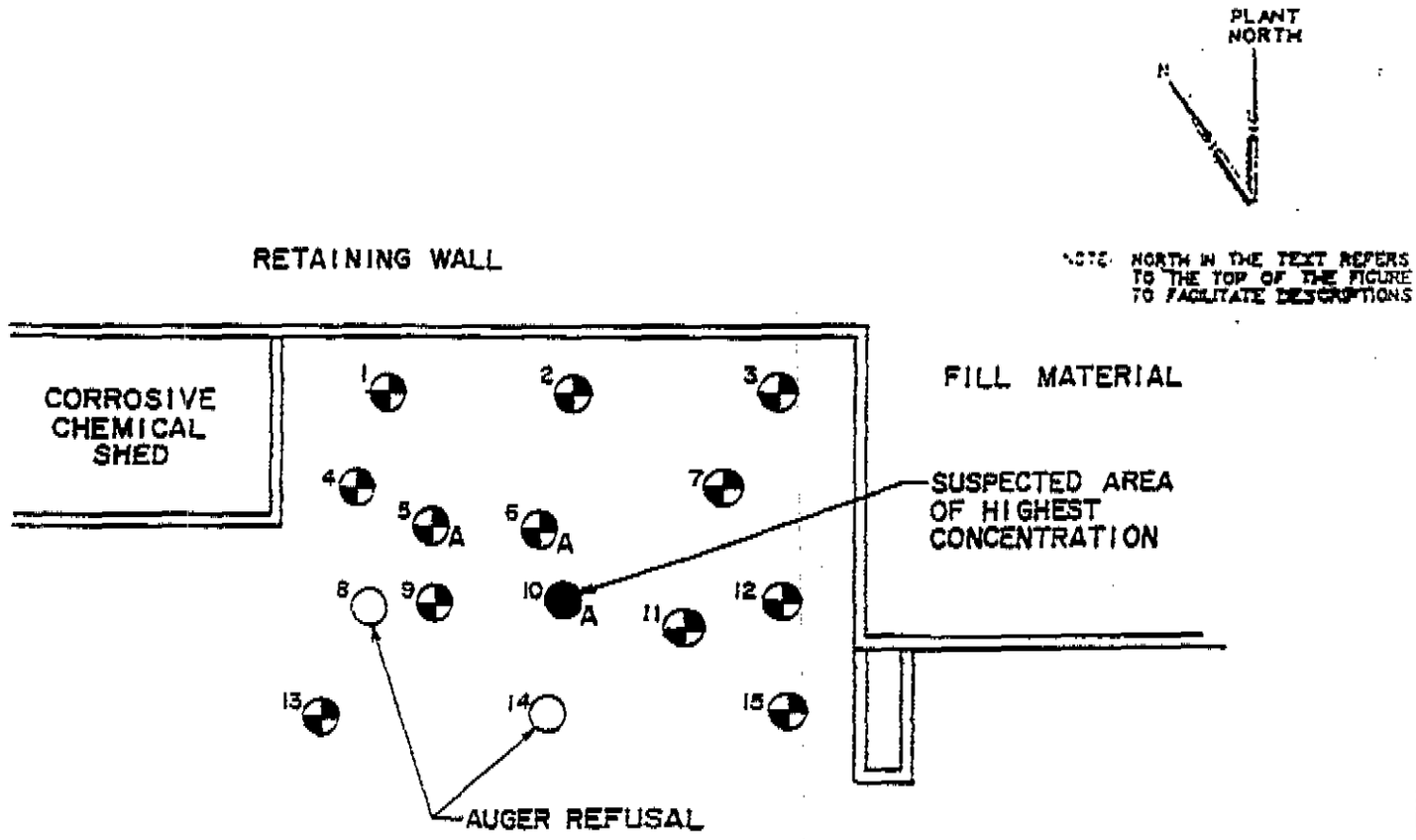
NATIONAL ENVIRONMENTAL TECHNOLOGIES, INC.

Wilmington, NC

PROJECT MGR. H.LYON
DRAWN K.FAIRCLOTH
CHECKED
DATE 6/2/94
SCALE NOTED

CLIENT/TITLE
ALCATEL NETWORK SYSTEMS
Raleigh, NC
RFI
Area 3

PROJECT NO. 058009
SHEET NO. P:\058\058-9R04
REV. 1



KEY:

- HAND AUGER BORING LOCATIONS SAMPLE AT 0" 6" AND 18" 24"
- HAND AUGER BORING LOCATION SAMPLE AT 2' 4' 6'
- AUGER REFUSAL
- A ASPHALT SAMPLE

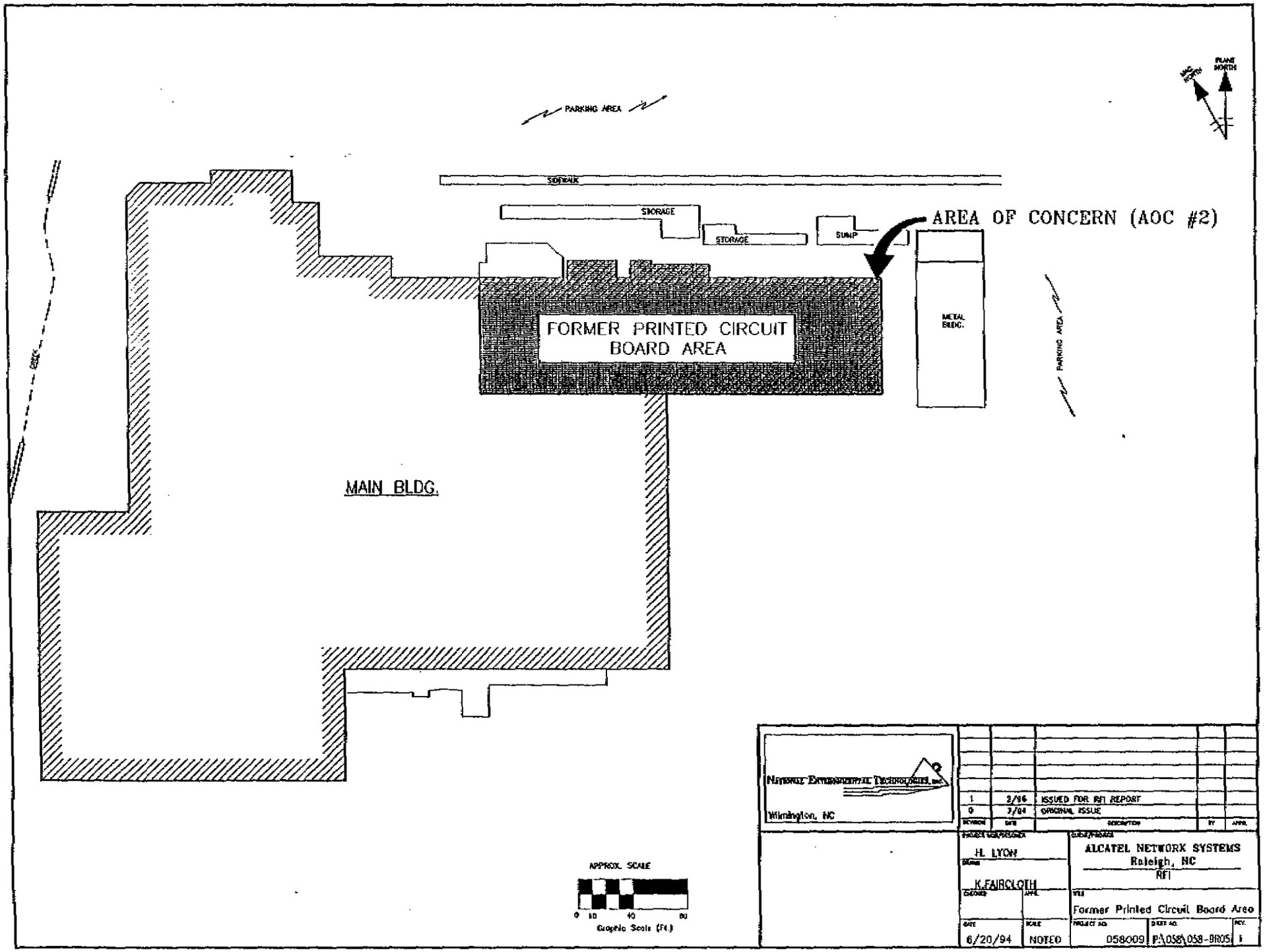
NOTE:

-AT SAMPLE POINTS 5, 6 AND 10 ASPHALT SAMPLES WERE ALSO TAKEN.

AREA NO. 4

PROJECT ALCATEL NETWORK SYSTEMS RALEIGH, N. C.	Westinghouse	SCALE: 1" = 10' JOB NO: REW-A-425 FIG. NO: 1

AVERY™ PV119E M



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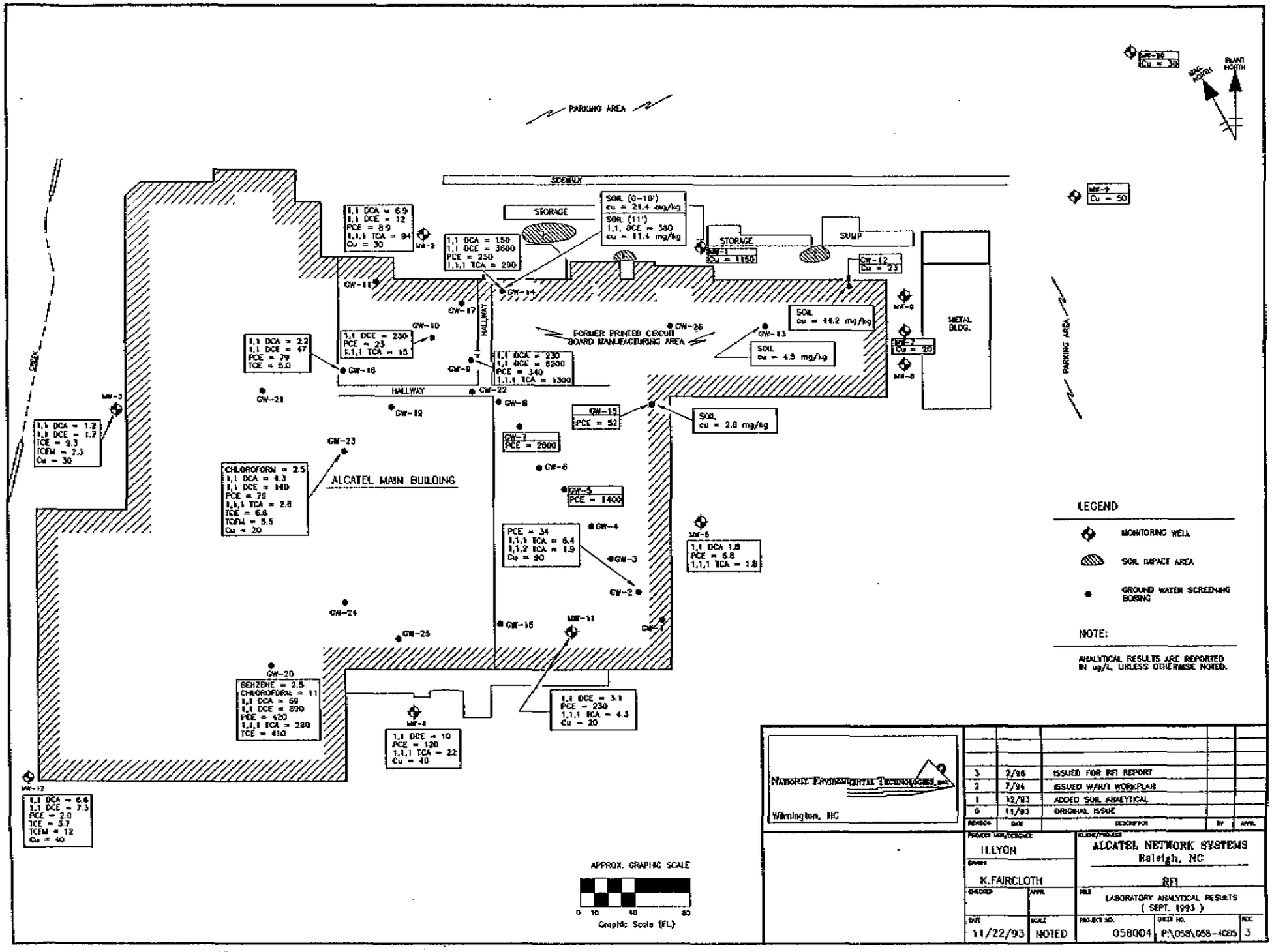

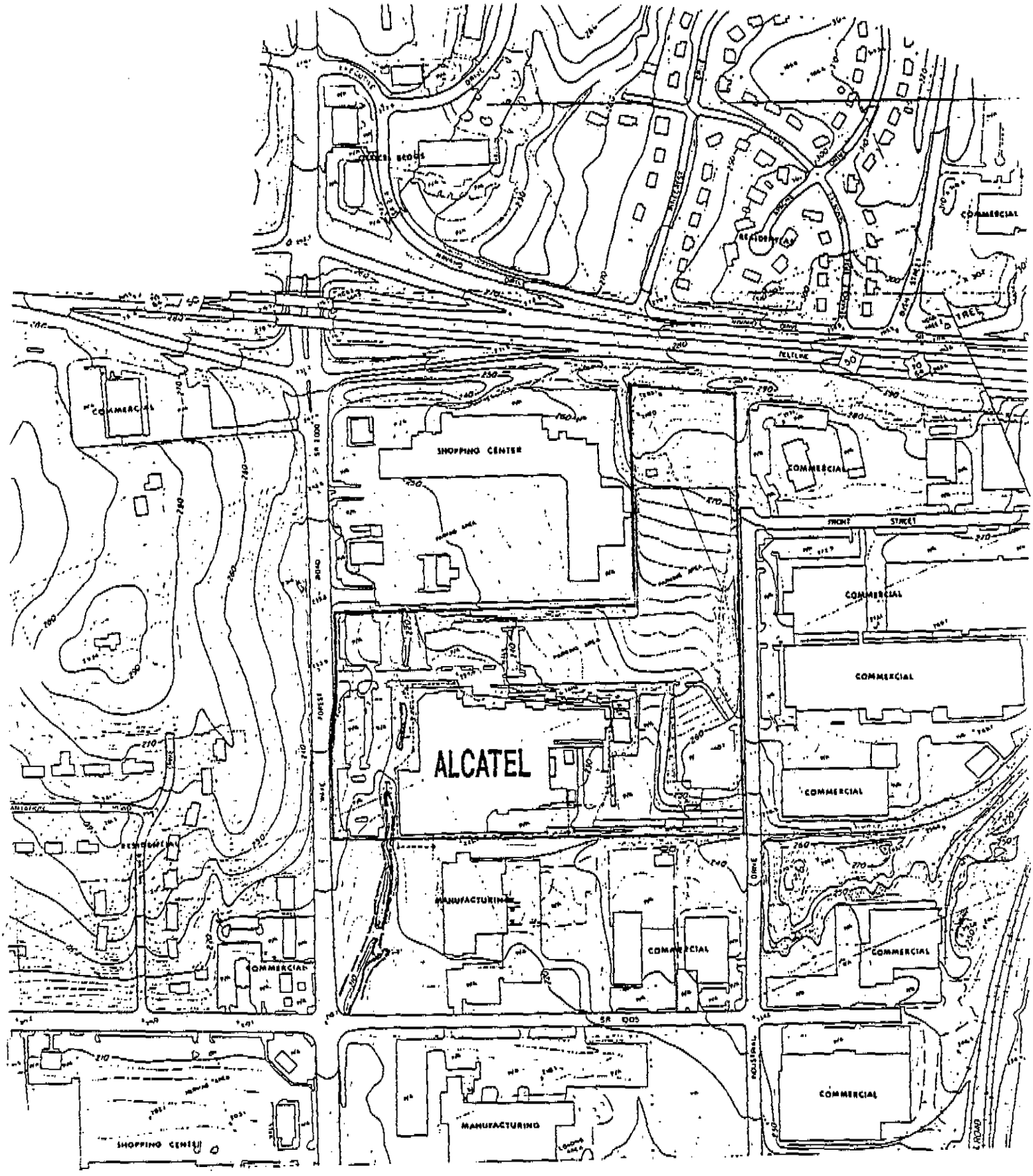

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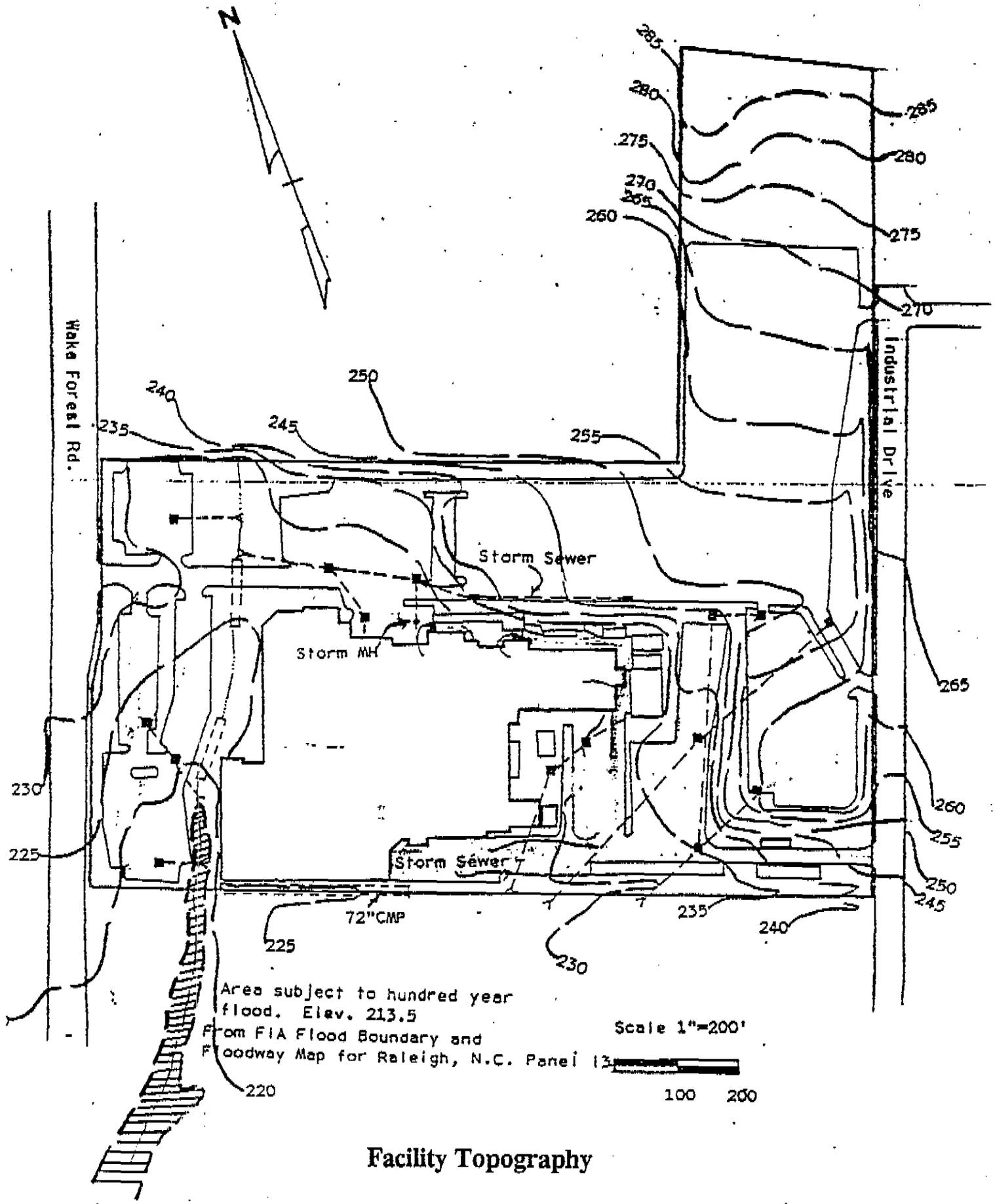
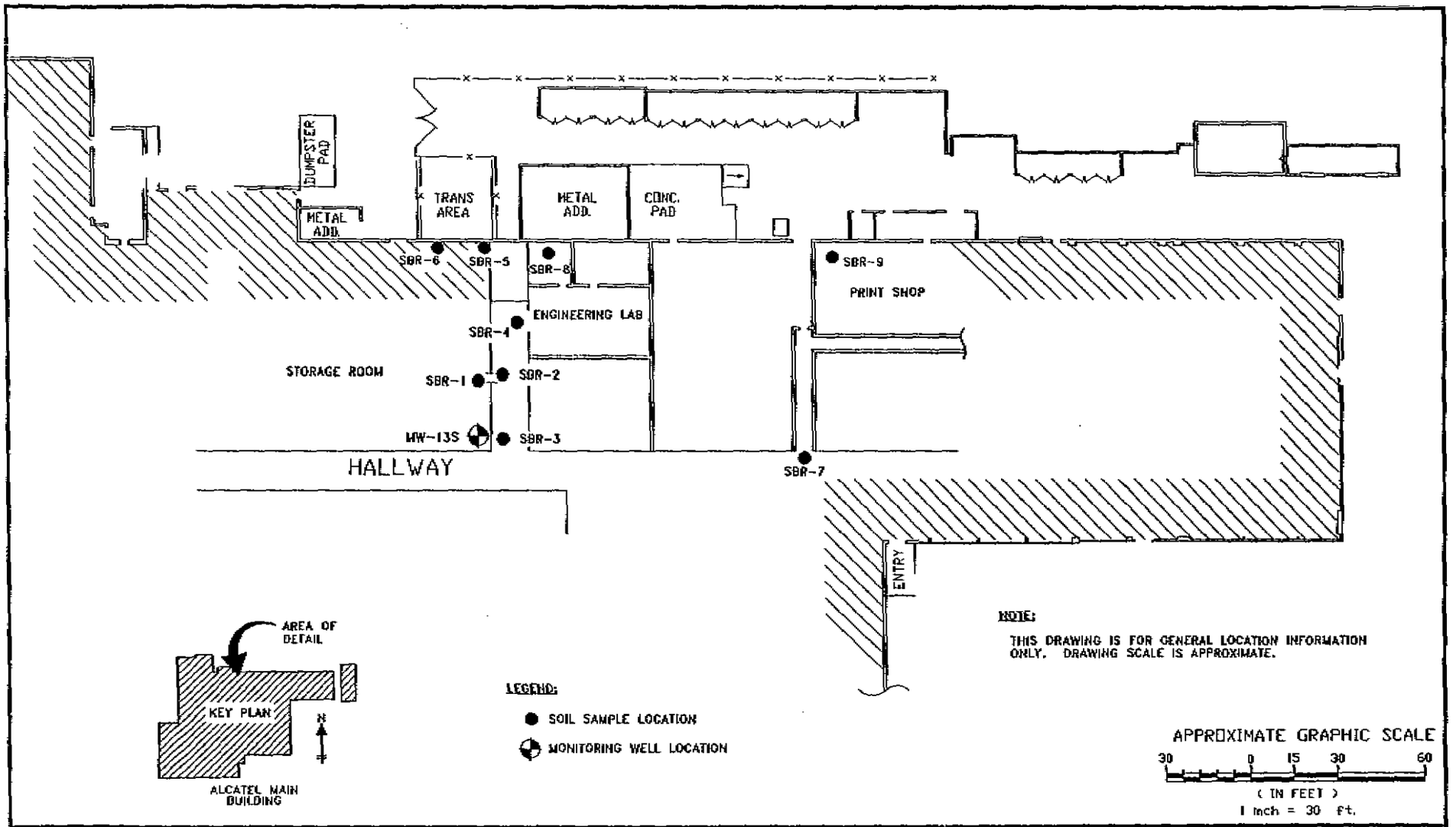


Facility Topography

Prepared by Bass, Nixon & Kennedy, Engrs.
October 11, 1982

AVERY™ PV119E M



REV.	DATE	DESCRIPTION	BY	APPR
0	2/96	ISSUED FOR RFI REPORT		
A	6/95	PRELIMINARY		

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DATE: 6/9/95
CHECKED BY:
SCALE: NOTED
DESIGNED: J. BEAMAN
PROJ. MGR. H. LYON
APPROVED:

CLIENT/TITLE
ALCATEL NETWORK SYSTEMS
Raleigh, North Carolina
RFI
Soil Sampling Locations

PROJECT NO. 058010
SHEET NO. p:\058\05801008
REV. 0

GRAPHIC SCALE

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(IN FEET)

1 INCH = 60 FT.

ENVIRONMENTAL TECHNOLOGIES, INC.

1, NC

REVISION	DATE	DESCRIPTION	BY	APPR.
1	2/96	ISSUED FOR RFI REPORT		
0	4/95	ORIGINAL ISSUE		

PROJECT MGR/DESIGNER: H. LYON

DRAWN: K. FAIRCLOTH

CHECKED:

APPR.:

CLIENT/PROJECT: ALCATEL NETWORK SYSTEMS
Raleigh, NC

RFI

TITLE: CROSS-SECTION LOCATION MAP
(A-A', B-B', C-C')

DATE	SCALE	PROJECT NO.	SHEET NO.	REV.
2/2/95	NOTED	058010	P:\058\058010C2	1

BETWEEN THESE POINTS IS INFERRED.

REFER TO CROSS SECTIONS B–B' AND C–C' FOR GROUND WATER QUALITY DATA.

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n, NC

REVISION	DATE	DESCRIPTION	BY	APPR.
1	2/96	REVISED RW–1, ISSUED FOR RFI REPORT		
0	4/95	ORIGINAL ISSUE		

PROJECT MGR/DESIGNER: H. LYON		CLIENT/PROJECT: ALCATEL NETWORK SYSTEMS Raleigh, NC		
DRAWN: K.FAIRCLOTH		RFI		
CHECKED	APPR.	TITLE: CROSS–SECTION A–A'		
DATE: 1/24/95	SCALE: NOTED	PROJECT NO.: 058010	SHEET NO.: P:\058\058010G1	REV.: 1

ISOCONCENTRATION LINES ON THIS MAP WERE GENERATED FROM LABORATORY ANALYTICAL DATA OF SAMPLES COLLECTED IN DEC. 1994. ONLY AT THE WELL POINTS SHOULD THESE LINES BE CONSIDERED ACCURATE. THE LINES BETWEEN THESE POINTS ARE INFERRED.

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on, NC

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0	4/95	ORIGINAL ISSUE		

PROJECT MGR/DESIGNER: H. LYON		CLIENT/PROJECT: ALCATEL NETWORK SYSTEMS Raleigh, NC		
DRAWN: K.FAIRCLOTH		RFI		
CHECKED	APPR.	TITLE: CROSS-SECTION B-B'		
DATE: 1/26/95	SCALE: NOTED	PROJECT NO.: 058010	SHEET NO.: P:\058\058010C2	REV.: 1

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on, NC

REVISION	DATE	DESCRIPTION	BY	APPR.
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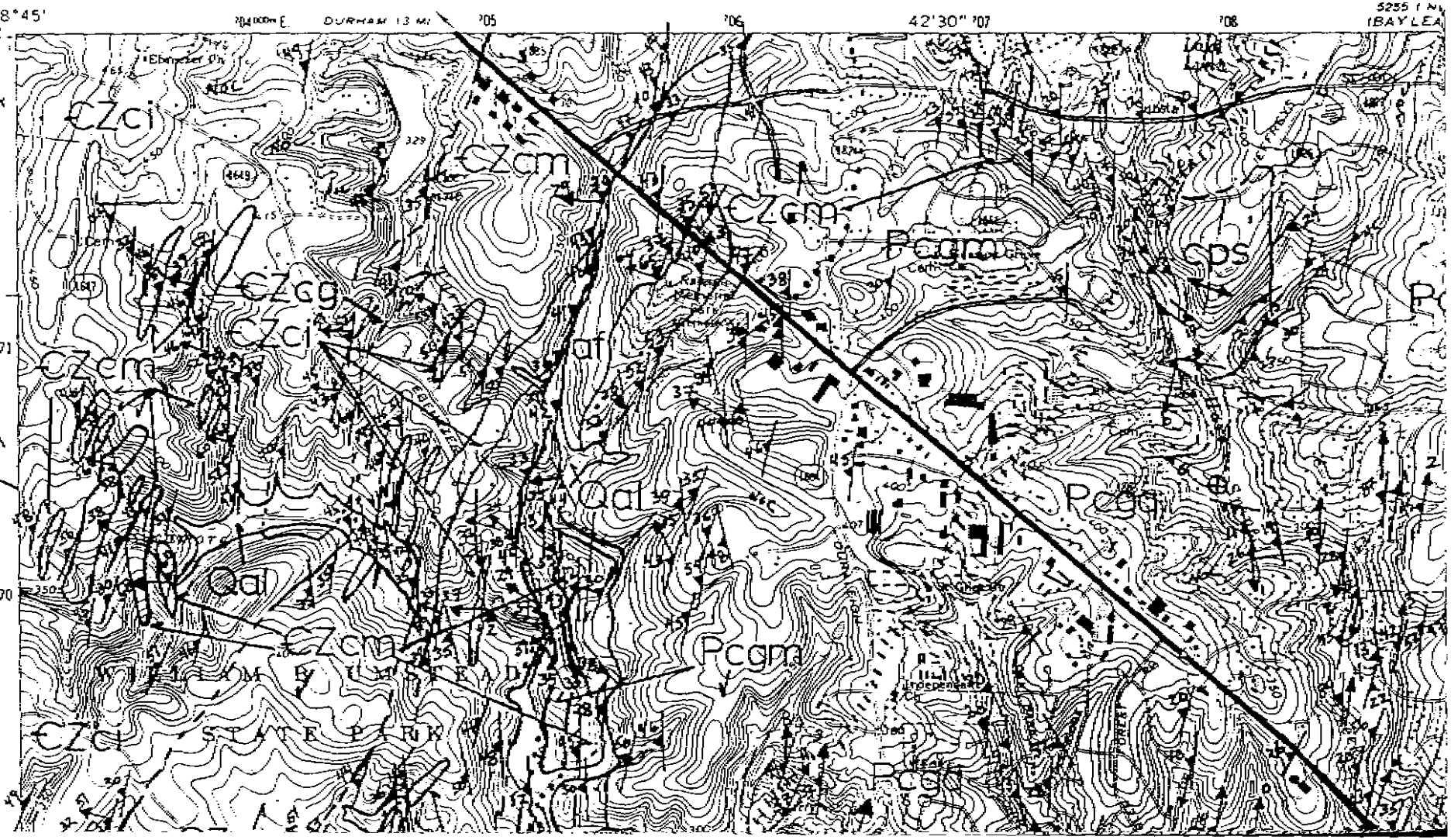
0	4/95	ORIGINAL ISSUE		

PROJECT MGR/DESIGNER: H. LYON		CLIENT/PROJECT: ALCATEL NETWORK SYSTEMS Raleigh, NC		
DRAWN: K.FAIRCLOTH		RFI		
CHECKED	APPR.	TITLE: CROSS-SECTION C-C'		
DATE: 1/27/95	SCALE: NOTED	PROJECT NO.: 058010	SHEET NO.: P:\058\058010G3	REV.: 1

GEOLOGIC MAP OF THE W
NORTH-CENTRAL NO

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY



GRAPHIC SCALE

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(IN FEET)

1 INCH = 60 FT.

ENVIRONMENTAL TECHNOLOGIES, INC.

, NC

REVISION	DATE	DESCRIPTION	BY	APPR.
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PROJECT MGR/DESIGNER: H. LYON		CLIENT/PROJECT: ALCATEL NETWORK SYSTEMS Raleigh, NC		
DRAWN: K. FAIRCLOTH		RFI		
CHECKED	APPR.	TITLE: WATER TABLE SURFACE MAP		
DATE: 8/2/95	SCALE: NOTED	PROJECT NO.: 058010	SHEET NO.: P:\058\058010G9	REV.: 1

OFF SITE.

GRAPHIC SCALE

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(IN FEET)

1 INCH = 60 FT.

VIRONMENTAL TECHNOLOGIES, INC.

NC

REVISION	DATE	DESCRIPTION	BY	APPR.
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0	8/95	ISSUED W/REPORT		

PROJECT MGR/DESIGNER: H. LYON		CLIENT/PROJECT: ALCATEL NETWORK SYSTEMS Raleigh, NC		
DRAWN: K. FAIRCLOTH		RFI		
CHECKED	APPR.	TITLE: BEDROCK POTENTIOMETRIC SURFACE MAP		
DATE: 8/10/95	SCALE: NOTED	PROJECT NO.: 058010	SHEET NO.: P:\058\05801G10	REV.: 1

GRAPHIC SCALE

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(IN FEET)

1 INCH = 60 FT.

ENVIRONMENTAL TECHNOLOGIES, INC.

NC

REVISION	DATE	DESCRIPTION	BY	APPR.
1	2/96	ISSUED FOR RFI REPORT		
0	8/95	ISSUED W/REPORT		

PROJECT MGR/DESIGNER: H. LYON		CLIENT/PROJECT: ALCATEL NETWORK SYSTEMS Raleigh, NC		
DRAWN: K. FAIRCLOTH		RFI		
CHECKED	APPR.	TITLE: BEDROCK STRUCTURAL CONTOUR MAP		
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GRAPHIC SCALE

60 0 30 60 120

(IN FEET)

1 INCH = 60 FT.

ENVIRONMENTAL TECHNOLOGIES, INC.

, NC

REVISION	DATE	DESCRIPTION	BY	APPR.
1	2/96	ISSUED FOR RFI REPORT		
0	8/95	ISSUED W/REPORT		

PROJECT MGR/DESIGNER: H. LYON

DRAWN: K. FAIRCLOTH

CHECKED:

APPR.:

CLIENT/PROJECT: ALCATEL NETWORK SYSTEMS
Raleigh, NC

RFI

TITLE: WATER LEVEL ELEVATION DIFFERENCE MAP

DATE	SCALE	PROJECT NO.	SHEET NO.	REV.
8/30/95	NOTED	058010	P:\058\05801G12	1

GRAPHIC SCALE

60 0 30 60 120

(IN FEET)

1 INCH = 60 FT.

ENVIRONMENTAL TECHNOLOGIES, INC.

, NC

REVISION	DATE	DESCRIPTION	BY	APPR.
1	2/96	ISSUED FOR RFI REPORT		
0	4/95	ORIGINAL ISSUE		

PROJECT MGR/DESIGNER: H. LYON		CLIENT/PROJECT: ALCATEL NETWORK SYSTEMS Raleigh, NC		
DRAWN: K. FAIRCLOTH		RFI		
CHECKED	APPR.	TITLE: WATER TABLE VOC ISOPLETH MAP		
DATE: 3/10/95	SCALE: NOTED	PROJECT NO.: 058010	SHEET NO.: P:\058\058010G6	REV.: 1

GRAPHIC SCALE

60 0 30 60 120

(IN FEET)

1 INCH = 60 FT.

ENVIRONMENTAL TECHNOLOGIES, INC.

on, NC

REVISION	DATE	DESCRIPTION	BY	APPR.
1	2/96	ISSUED FOR RFI REPORT		
0	4/95	ORIGINAL ISSUE		

PROJECT MGR/DESIGNER: H. LYON		CLIENT/PROJECT: ALCATEL NETWORK SYSTEMS Raleigh, NC		
DRAWN: K. FAIRCLOTH		RFI		
CHECKED	APPR.	TITLE: BEDROCK VOC ISOPLETH MAP		
DATE: 3/9/95	SCALE: NOTED	PROJECT NO.: 058010	SHEET NO.: P:\058\058010G5	REV.: 1

Table 1

Alcatel Network Systems
Raleigh, North Carolina
NCD 003 185 238

Summary of Field Analytical Data
Soil Analysis

Sample Number	Depth (ft.)	Date of Collection	Time of Collection	OVA (ppm)	pH	corpH*	Description
MW - 13sA	4-5	5-26-95	1900	2.0	7.50	8.05	Tan silty clay.
MW - 13sB	9-10	5-26-95	1930	2.0	6.67	7.22	Orange sandy clay.
SBR - 1A	1-2	5-26-95	2045	<2.0	6.41	6.96	Orange silty clay.
SBR - 1B	5-6	5-26-95	2055	<2.0	6.62	7.17	Orange sandy silt.
SBR - 1 C	10-11	5-26-95	2120	<2.0	6.30	6.85	Grey silty sand.
SBR - 2A	1-2	5-26-95	2215	<2.0	6.20	6.75	Orange gravelly silty clay.
SBR - 3A	1-2	5-26-95	2220	<2.0	6.42	6.97	Orange silty clay.
SBR - 3B	5-6	5-26-95	2300	2.0	6.37	6.92	Tan to black clay.
SBR - 3C	10-11	5-26-95	0010	2.0	5.95	6.50	Orange silty clayey sand.
SBR - 4A	1-2	5-27-95	1140	2.0	6.35	7.05	Orange silty sandy clay.
SBR - 4B	5-6	5-27-95	1210	4.0	7.23	7.93	Orange sandy silt.
SBR - 4C	9-10	5-27-95	1240	>2.0	7.05	7.75	Tan silty sand.
SBR - 5A	1-2	6-27-95	2010	0	9.25	8.22	Orange silty sand.
SBR - 5B	4-5	6-27-95	2020	>2.0	10.30	9.27	Green, silty fine sand.
SBR - 6A	1-2	6-27-95	2050	>2.0	9.50	8.47	Orange silty sand.
SBR - 6B	4-5	6-27-95	2130	>2.0	7.90	6.87	Gray gravelly sand.
SBR - 7A	1-2	6-27-95	2215	>2.0	8.44	7.41	Orange silty sand.
SBR - 7B	4-5	6-27-95	2240	>2.0	7.73	6.70	Gray gravelly sand.
SBR - 8A	1-2	6-27-95	2310	>2.0	8.70	7.67	Orange clayey sand.
SBR - 8B	4-5	6-27-95	2330	>2.0	7.85	6.82	Orange sandy silt.
SBR - 8C	9-10	6-27-95	2350	>2.0	7.68	6.65	Orange sandy silt.
SBR - 9A	1-2	6-28-95	0130	>2.0	6.79	5.76	Orange silty clay.
SBR - 9B	4-5	6-28-95	0200	>2.0	6.55	5.52	Orange sandy clay.
SBR - 9C	9-10	6-28-95	0230	>2.0	6.40	5.37	Gray silty sand.
DI Water	n/a	5-26-95	n/a	n/a	6.45	n/a	n/a
DI Water	n/a	5-27-95	n/a	n/a	6.30	n/a	n/a
DI Water	n/a	6-27-95	n/a	n/a	8.03	n/a	n/a

Notes: "*" corpH is corrected pH. pH normalized for pH of DI Water not equal to 7.0.
"n/a" denotes Not Applicable.

Table 2

Alcatel Network Systems
Raleigh, North Carolina
NCD 003 185 238

Summary of Laboratory Analytical Results
Soil Samples

Sample Number	Collection Date	Collection Depth (ft.)	Volatile Compounds	Copper		Lead	
				Det. Limit	Concentration	Det. Limit	Concentration
MW - 13sA	5-26-95	4-5	All BQL	0.11	1.5	5.1	BQL
MW - 13sB	5-26-95	9-10	All BQL	0.11	0.49	5.1	BQL
SBR - 1A	5-26-95	1-2	All BQL	0.11	2.7	5.1	BQL
SBR - 1C	5-26-95	10-11	All BQL	0.11	0.72	5.1	BQL
SBR - 2A	5-26-95	1-2	All BQL	0.11	1.7	5.1	BQL
SBR - 3A	5-26-95	1-2	All BQL	0.11	1.6	5.1	BQL
SBR - 3C	5-27-95	10-11	All BQL	0.11	1.3	5.1	BQL
SBR - 4A	5-27-95	1-2	All BQL	0.11	0.61	5.1	BQL
SBR - 4C	5-27-95	9-10	All BQL	0.11	1.6	5.1	BQL
SBR - 5	6-27-95	comp 1-5	All BQL	0.11	16	5.1	BQL
SBR - 6	6-27-95	comp 1-5	All BQL	0.11	16	5.1	BQL
SBR - 7	6-27-95	comp 1-5	All BQL	0.11	13	5.1	BQL
SBR - 8A	6-27-95	1-2	All BQL	0.11	50	5.1	BQL
SBR - 8B	6-27-95	4-5	All BQL	0.11	74	5.1	9.5
SBR - 9A	6-28-95	1-2	All BQL	0.11	16	5.1	BQL
SBR - 9C	6-28-95	9-10	All BQL	0.11	BQL	5.1	BQL

Notes: "BQL" denotes Below Quantitation Limit.
"comp" denotes composite sample.
All metals concentrations are reported in mg/kg.

Table 3

ALCATEL NETWORK SYSTEMS
Raleigh, North Carolina
NCD 003 185 238

Summary of Well Completion Data

Well Number	Top of Casing Elevation	Ground Surface Elevation	Total Well Depth	Depth to Top of Screen	Screen Length	Screened Interval Top	Screened Interval Bottom	Well Information Well Type	Well Information Well Casing Diam.	Well Information Surf. Casing Diam.
MW - 1S	228.40	229.25	18.0	8.0	10.0	221.25	211.25	Monitoring	2-inch Sch. 40 PVC	n/a
MW - 2S	225.59	225.99	18.0	8.0	10.0	217.99	207.99	Monitoring	2-inch Sch. 40 PVC	n/a
MW - 2D	225.81	226.14	65.0	55.0	10.0	171.14	161.14	Monitoring	2-inch Sch. 40 PVC	6-inch Sch. 40 PVC
MW - 3S	228.55	228.74	20.5	10.5	10.0	218.24	208.24	Monitoring	2-inch Sch. 40 PVC	n/a
MW - 3D	225.48	228.64	70.0	55.0	15.0	173.64	158.64	Monitoring	2-inch Sch. 40 PVC	6-inch Sch. 40 PVC
MW - 4S	226.71	227.31	15.0	10.0	5.0	217.31	212.31	Monitoring	2-inch Sch. 40 PVC	n/a
MW - 4D	227.20	227.42	67.0	37.0	30.0	190.42	160.42	Monitoring	2-inch Sch. 40 PVC	6-inch Sch. 40 PVC
MW -5S	228.40	229.25	20.0	10.0	10.0	219.25	209.25	Monitoring	2-inch Sch. 40 PVC	n/a
MW - 6S	229.16	229.58	20.3	10.3	10.0	219.28	209.28	Monitoring	2-inch Sch. 40 PVC	n/a
MW - 7S	229.27	229.56	9.0	9.0	10.0	220.56	220.56	Monitoring	2-inch Sch. 40 PVC	n/a
MW - 7D	229.35	229.53	70.0	50.0	20.0	179.53	159.53	Monitoring	2-inch Sch. 40 PVC	6-inch Sch. 40 PVC
MW - 8S	229.34	229.46	20.0	10.0	10.0	219.46	209.46	Monitoring	2-inch Sch. 40 PVC	n/a
MS - 9S	243.17	243.42	18.0	8.0	10.0	235.42	225.42	Monitoring	2-inch Sch. 40 PVC	n/a
MW - 10S	252.71	253.09	24.0	14.0	10.0	239.09	229.09	Monitoring	2-inch Sch. 40 PVC	n/a
MW - 11S	229.63	229.81	14.0	4.0	10.0	225.81	215.81	Monitoring	2-inch Sch. 40 PVC	n/a
MW - 12S	227.05	227.32	20.0	10.0	10.0	217.32	207.32	Monitoring	2-inch Sch. 40 PVC	n/a
MW - 12DK	221.59	221.84	65.0	55.0	10.0	166.84	156.84	Monitoring	2-inch Sch. 40 PVC	6-inch Carbon Steel
MW - 13S	229.71	229.80	15.0	5.0	10.0	224.71	214.71	Monitoring	2-inch Sch. 40 PVC	n/a
RW - 1	226.59	227.12	24.0	9.0	15.0	218.12	203.12	Recovery	6-inch Sch. 40 PVC	n/a
RW - 2	224.85	225.27	40.0	15.0	25.0	210.27	185.27	Recovery	6-inch Sch. 40 PVC	n/a
MW - 1SK	222.06	222.41	20.0	10.0	10.0	212.41	202.41	Monitoring	2-inch Sch. 40 PVC	n/a
MW - 1IK	222.18	222.25	42.5	37.5	5.0	184.75	179.75	Monitoring	2-inch Sch. 40 PVC	6-inch Sch. 40 PVC
MW - 2SK	226.16	226.39	20.0	10.0	10.0	216.39	206.39	Monitoring	2-inch Sch. 40 PVC	n/a
MW - 2IK	225.38	226.20	42.0	32.0	10.0	194.20	184.20	Monitoring	2-inch Sch. 40 PVC	6-inch Sch. 40 PVC
MW - 3SK	225.74	225.92	17.0	7.0	10.0	218.92	208.92	Monitoring	2-inch Sch. 40 PVC	n/a
MW - 4SK	226.89	227.10	19.0	9.0	10.0	218.10	208.10	Monitoring	2-inch Sch. 40 PVC	n/a
MW - 5SK	220.91	220.95	24.0	14.0	10.0	206.95	196.95	Monitoring	2-inch Sch. 40 PVC	n/a
MW - 6SK	226.69	226.93	23.0	13.0	10.0	213.93	203.93	Monitoring	2-inch Sch. 40 PVC	n/a
MS - 6IK	226.69	226.94	58.0	53.0	5.0	173.94	168.94	Monitoring	2-inch Sch. 40 PVC	6-inch Sch. 40 PVC
MW - 7SK	226.77	226.99	23.0	13.0	10.0	213.99	203.99	Monitoring	2-inch Sch. 40 PVC	n/a
MW - 7IK	226.01	227.01	73.0	58.0	15.0	169.01	154.01	Monitoring	2-inch Sch. 40 PVC	6-inch Sch. 40 PVC
MW - 8SK	225.11	225.37	20.0	10.0	10.0	215.37	205.37	Monitoring	2-inch Sch. 40 PVC	n/a
MW - 8DK	225.31	225.75	80.0	50.0	30.0	175.75	145.75	Monitoring	2-inch Sch. 40 PVC	6-inch Sch. 40 PVC
MW - 9SK	216.00	216.34	46.0	6.0	40.0	210.34	170.34	Monitoring	2-inch Sch. 40 PVC	n/a
MW - 9DK	215.94	216.42	70.0	55.0	10.0	161.42	146.42	Monitoring	2-inch Sch. 40 PVC	6-inch Sch. 40 PVC

Table 4

Alcatel Network Systems
Raleigh, North Carolina
NCD 003 185 238

Summary of Field Analytical Data
Ground Water Samples

Well Number	Date of Collection	pH	SC (uS/cm)	Temp. (deg. C)
MW - 1s	11-30-94	5.79	167.6	14.0
MW - 2s	11-30-94	6.14	478	15.0
MW - 2d	11-30-94	6.19	1283	16.3
MW - 3s	11-30-94	5.89	98	14.1
MW - 3d	11-30-94	6.05	122.2	15.1
MW - 4s	11-30-94	5.74	490	17.6
MW - 4d	11-30-94	6.85	737	19.7
MW - 5s	11-30-94	6.01	308	16.6
MW - 7s	11-30-94	6.12	304	13.4
MW - 7d	11-30-94	6.65	359	12.4
MW - 9s	11-30-94	5.85	158.3	18.1
MW - 10s	11-30-94	6.43	161.7	23.0
MW - 11s	11-30-94	6.01	386	17.1
MW - 12s	11-30-94	5.65	154.2	16.4
MW - 13s	5-28-95	6.17	1347	19.5
MW - 1sk	12-01-94	5.92	199	19.0
MW - 1ik	12-01-94	6.30	141	18.0
MW - 2sk	12-01-94	6.00	466	19.9
MW - 2ik	12-01-94	6.33	509	19.2
MW - 3sk	12-01-94	5.72	690	18.0
MW - 4sk	12-01-94	6.34	190	16.8
MW - 5sk	12-01-94	6.08	407	16.2
MW - 6sk	12-01-94	6.03	221	19.7
MW - 6ik	12-01-94	6.36	127.7	19.5
MW - 7sk	12-01-94	6.58	527	19.6
MW - 7ik	12-01-94	7.10	905	20.1
MW - 8sk	12-01-94	6.10	271	22.2
MW - 8dk	12-01-94	6.64	380	20.1
MW - 9sk	12-01-94	5.91	295	16.9
MW - 9dk	12-01-94	6.27	233	19.2
MW - 12dk	12-01-94	6.60	160	19.7

Table 5

Summary of Ground Water Analytical Results

ALCATEL NETWORK SYSTEMS
Raleigh, NC
NCD 003 185 238

MW-1s
VOC and Metals Analytical History

Date Sampled	1,2-Dichloroethane (ug/l)	Tetrachloroethene (ug/l)	1,1-Dichloroethene (ug/l)	1,1-Dichloroethane (ug/l)	1,1,1-Trichloroethane (ug/l)	Trichloroethene (ug/l)	1,1,2-Trichloroethane (ug/l)	Copper (ug/l)	Lead (ug/l)
08/21/90	BQL	2	BQL	BQL	11	BQL	BQL	1200	BQL
02/08/93	BQL	BQL	BQL	BQL	BQL	BQL	BQL	667	14
09/19/93	BQL	BQL	BQL	BQL	BQL	BQL	BQL	1150	3
06/30/94	BQL	BQL	BQL	BQL	BQL	N/A	BQL	877	BQL
11/30/94	BQL	BQL	BQL	BQL	BQL	BQL	BQL	85	6

N/A = Data Not Available
BQL = Below Quantitation Limits
ug/l = Micrograms Per Liter

ALCATEL NETWORK SYSTEMS
Raleigh, NC
NCD 003 185 238

MW-2s
VOC and Metals Analytical History

Date Sampled	1,2-Dichloroethane (ug/l)	Tetrachloroethene (ug/l)	1,1-Dichloroethene (ug/l)	1,1-Dichloroethane (ug/l)	1,1,1-Trichloroethane (ug/l)	Trichloroethene (ug/l)	1,1,2-Trichloroethane (ug/l)	Copper (ug/l)	Lead (ug/l)
08/21/90	BQL	9	16	7	120	BQL	BQL	BQL	BQL
02/08/93	BQL	9	19	9	130	BQL	BQL	10.3	6.6
09/19/93	BQL	8.9	BQL	6.9	94	BQL	BQL	30	5
08/30/94	BQL	18	20	BQL	140	BQL	BQL	BQL	BQL
11/30/94	BQL	6.4	16	BQL	43	BQL	BQL	BQL	BQL

N/A = Data Not Available
BQL = Below Quantitation Limits
ug/l = Micrograms Per Liter

ALCATEL NETWORK SYSTEMS
Raleigh, NC
NCD 003 185 238

MW-2d
VOC and Metals Analytical History

Date Sampled	1,2-Dichloroethane (ug/l)	Tetrachloroethene (ug/l)	1,1-Dichloroethene (ug/l)	1,1-Dichloroethane (ug/l)	1,1,1-Trichloroethane (ug/l)	Trichloroethene (ug/l)	1,1,2-Trichloroethane (ug/l)	Copper (ug/l)	Lead (ug/l)
11/29/94	BQL	540	1600	BQL	2800	BQL	BQL	BQL	BQL

N/A = Data Not Available
BQL = Below Quantitation Limits
ug/l = Micrograms Per Liter

ALCATEL NETWORK SYSTEMS
Raleigh, NC
NCD 003 185 238

MW-3s
VOC and Metals Analytical History

Date Sampled	1,2-Dichloroethane (ug/l)	Tetrachloroethene (ug/l)	1,1-Dichloroethene (ug/l)	1,1-Dichloroethane (ug/l)	1,1,1-Trichloroethane (ug/l)	Trichloroethene (ug/l)	1,1,2-Trichloroethane (ug/l)	Copper (ug/l)	Lead (ug/l)
08/21/90	BQL	BQL	2	2	1	5	BQL	BQL	BQL
02/08/93	BQL	BQL	BQL	BQL	BQL	BQL	BQL	BQL	30
09/19/93	BQL	BQL	1.7	1.2	BQL	9.3	BQL	BQL	30
08/30/94	BQL	BQL	BQL	BQL	BQL	BQL	BQL	BQL	20
11/30/94	BQL	BQL	BQL	BQL	BQL	2.7	BQL	BQL	BQL

N/A = Data Not Available
BQL = Below Quantitation Limits
ug/l = Micrograms Per Liter

ALCATEL NETWORK SYSTEMS
Raleigh, NC
NCD 003 185 238

MW-3d
VOC and Metals Analytical History

Date Sampled	1,2-Dichloroethane (ug/l)	Tetrachloroethene (ug/l)	1,1-Dichloroethene (ug/l)	1,1-Dichloroethane (ug/l)	1,1,1-Trichloroethane (ug/l)	Trichloroethene (ug/l)	1,1,2-Trichloroethane (ug/l)	Copper (ug/l)	Lead (ug/l)
11/30/94	BQL	BQL	BQL	BQL	BQL	BQL	BQL	BQL	BQL

N/A = Data Not Available
BQL = Below Quantitation Limits
ug/l = Micrograms Per Liter

ALCATEL NETWORK SYSTEMS
Raleigh, NC
NCD 003 185 238

MW-4s
VOC and Metals Analytical History

Date Sampled	1,2-Dichloroethane (ug/l)	Tetrachloroethene (ug/l)	1,1-Dichloroethene (ug/l)	1,1-Dichloroethane (ug/l)	1,1,1-Trichloroethane (ug/l)	Trichloroethene (ug/l)	1,1,2-Trichloroethane (ug/l)	Copper (ug/l)	Lead (ug/l)
08/21/90	BQL	210	23	BQL	140	BQL	BQL	BQL	BQL
02/08/93	BQL	170	17	BQL	36	BQL	BQL	26.6	15.4
09/19/93	BQL	120	10	BQL	22	BQL	BQL	40	4
06/30/94	BQL	39	BQL	BQL	BQL	BQL	BQL	BQL	BQL
11/30/94	BQL	54	BQL	BQL	8.3	BQL	BQL	BQL	9

N/A = Data Not Available
BQL = Below Quantitation Limits
ug/l = Micrograms per Liter

ALCATEL NETWORK SYSTEMS
Raleigh, NC
NCD 003 185 238

MW-4d
VOC and Metals Analytical History

Date Sampled	1,2-Dichloroethane (ug/l)	Tetrachloroethene (ug/l)	1,1-Dichloroethene (ug/l)	1,1-Dichloroethane (ug/l)	1,1,1-Trichloroethane (ug/l)	Trichloroethene (ug/l)	1,1,2-Trichloroethane (ug/l)	Copper (ug/l)	Lead (ug/l)
11/30/94	BQL	240	230	BQL	130	BQL	BQL	BQL	BQL

N/A = Data Not Available
BQL = Below Quantitation Limits
ug/l = Micrograms Per Liter

ALCATEL NETWORK SYSTEMS
Raleigh, NC
NCD 003 185 238

MW-5s
VOC and Metals Analytical History

Date Sampled	1,2-Dichloroethane (ug/l)	Tetrachloroethene (ug/l)	1,1-Dichloroethene (ug/l)	1,1-Dichloroethane (ug/l)	1,1,1-Trichloroethane (ug/l)	Trichloroethene (ug/l)	1,1,2-Trichloroethane (ug/l)	Copper (ug/l)	Lead (ug/l)
08/21/90	BQL	BQL	BQL	BQL	1	BQL	BQL	BQL	BQL
02/08/93	BQL	7	BQL	BQL	BQL	BQL	BQL	66.6	28.4
09/19/93	BQL	6.8	BQL	1.8	1.6	BQL	BQL	BQL	4
08/30/94	BQL	BQL	BQL	BQL	BQL	BQL	BQL	BQL	BQL
11/30/94	BQL	BQL	BQL	3	BQL	BQL	BQL	BQL	BQL

N/A = Data Not Available
BQL = Below Quantitation Limits
ug/l = Micrograms Per Liter

ALCATEL NETWORK SYSTEMS
Raleigh, NC
NCD 003 185 238

MW-6s
VOC and Metals Analytical History

Date Sampled	1,2-Dichloroethane (ug/l)	Tetrachloroethene (ug/l)	1,1-Dichloroethene (ug/l)	1,1-Dichloroethane (ug/l)	1,1,1-Trichloroethane (ug/l)	Trichloroethene (ug/l)	1,1,2-Trichloroethane (ug/l)	Copper (ug/l)	Lead (ug/l)
10/17/90	BQL	BQL	BQL	BQL	BQL	BQL	BQL	30	BQL
02/08/93	BQL	BQL	BQL	BQL	BQL	BQL	BQL	28.3	9

N/A = Data Not Available
BQL = Below Quantitation Limits
ug/l = Micrograms Per Liter

ALCATEL NETWORK SYSTEMS
Raleigh, NC
NCD 003 185 238

MW-7s
VOC and Metals Analytical History

Date Sampled	1,2-Dichloroethane (ug/l)	Tetrachloroethene (ug/l)	1,1-Dichloroethene (ug/l)	1,1-Dichloroethane (ug/l)	1,1,1-Trichloroethane (ug/l)	Trichloroethene (ug/l)	1,1,2-Trichloroethane (ug/l)	Copper (ug/l)	Lead (ug/l)
10/17/90	BQL	BQL	BQL	BQL	BQL	BQL	BQL	BQL	5
02/08/93	BQL	BQL	BQL	BQL	BQL	BQL	BQL	221	25.1
09/19/93	BQL	BQL	BQL	BQL	BQL	BQL	BQL	20	3
08/30/94	BQL	BQL	BQL	BQL	BQL	BQL	BQL	BQL	BQL
11/30/94	BQL	BQL	BQL	BQL	BQL	BQL	BQL	BQL	BQL

N/A = Data Not Available
BQL = Below Quantitation Limits
ug/l = Micrograms Per Liter

ALCATEL NETWORK SYSTEMS
Raleigh, NC
NCD 003 185 238

MW-7d
VOC and Metals Analytical History

Date Sampled	1,2-Dichloroethane (ug/l)	Tetrachloroethene (ug/l)	1,1-Dichloroethene (ug/l)	1,1-Dichloroethane (ug/l)	1,1,1-Trichloroethane (ug/l)	Trichloroethene (ug/l)	1,1,2-Trichloroethane (ug/l)	Copper (ug/l)	Lead (ug/l)
11/30/94	BQL	BQL	BQL	BQL	BQL	BQL	BQL	BQL	BQL

N/A = Data Not Available
BQL = Below Quantitation Limits
ug/l = Micrograms Per Liter

ALCATEL NETWORK SYSTEMS
Raleigh, NC
NCD 003 185 238

MW-8s
VOC and Metals Analytical History

Date Sampled	1,2-Dichloroethane (ug/l)	Tetrachloroethene (ug/l)	1,1-Dichloroethene (ug/l)	1,1-Dichloroethane (ug/l)	1,1,1-Trichloroethane (ug/l)	Trichloroethene (ug/l)	1,1,2-Trichloroethane (ug/l)	Copper (ug/l)	Lead (ug/l)
10/17/90	BQL	BQL	BQL	BQL	BQL	BQL	BQL	30	BQL
02/08/93	BQL	BQL	BQL	11	BQL	3	BQL	17.4	6.5

N/A = Data Not Available
BQL = Below Quantitation Limits
ug/l = Micrograms Per Liter

ALCATEL NETWORK SYSTEMS
Raleigh, NC
NCD 003 185 236

MW-9s
VOC and Metals Analytical History

Date Sampled	1,2-Dichloroethane (ug/l)	Tetrachloroethene (ug/l)	1,1-Dichloroethene (ug/l)	1,1-Dichloroethane (ug/l)	1,1,1-Trichloroethane (ug/l)	Trichloroethene (ug/l)	1,1,2-Trichloroethane (ug/l)	Copper (ug/l)	Lead (ug/l)
10/18/90	BQL	BQL	BQL	BQL	BQL	BQL	BQL	40	10
02/08/93	BQL	BQL	BQL	BQL	BQL	BQL	BQL	56.5	15.3
09/20/93	BQL	BQL	BQL	BQL	BQL	BQL	BQL	50	15
08/30/94	BQL	BQL	BQL	BQL	BQL	BQL	BQL	BQL	BQL
11/30/94	BQL	BQL	BQL	BQL	BQL	BQL	BQL	157	53

N/A = Data Not Available
BQL = Below Quantitation Limits
ug/l = Micrograms Per Liter

ALCATEL NETWORK SYSTEMS
Raleigh, NC
NCD 003 185 238

MW-10s
VOC and Metals Analytical History

Date Sampled	1,2-Dichloroethane (ug/l)	Tetrachloroethene (ug/l)	1,1-Dichloroethene (ug/l)	1,1-Dichloroethane (ug/l)	1,1,1-Trichloroethane (ug/l)	Trichloroethene (ug/l)	1,1,2-Trichloroethane (ug/l)	Copper (ug/l)	Lead (ug/l)
06/27/93	BQL	BQL	BQL	BQL	1.9	BQL	BQL	BQL	BQL
09/19/93	BQL	BQL	BQL	BQL	BQL	BQL	BQL	30	2
06/30/94	BQL	BQL	BQL	BQL	BQL	BQL	BQL	BQL	15
11/30/94	BQL	BQL	BQL	BQL	BQL	BQL	BQL	BQL	BQL

N/A = Data Not Available
BQL = Below Quantitation Limits
ug/l = Micrograms Per Liter

ALCATEL NETWORK SYSTEMS
Raleigh, NC
NCD 003 185 238

MW-11s
VOC and Metals Analytical History

Date Sampled	1,2-Dichloroethane (ug/l)	Tetrachloroethene (ug/l)	1,1-Dichloroethene (ug/l)	1,1-Dichloroethane (ug/l)	1,1,1-Trichloroethane (ug/l)	Trichloroethene (ug/l)	1,1,2-Trichloroethane (ug/l)	Copper (ug/l)	Lead (ug/l)
06/27/93	BQL	270	BQL	BQL	BQL	BQL	BQL	BQL	BQL
09/19/93	BQL	230	BQL	3.1	4.3	BQL	BQL	20	2
08/30/94	BQL	130	BQL	BQL	BQL	BQL	BQL	BQL	38
11/30/94	BQL	120	BQL	BQL	BQL	BQL	BQL	BQL	12

N/A = Data Not Available
BQL = Below Quantitation Limits
ug/l = Micrograms Per Liter

ALCATEL NETWORK SYSTEMS
Raleigh, NC
NCD 003 185 238

MW-12s
VOC and Metals Analytical History

Date Sampled	1,2-Dichloroethane (ug/l)	Tetrachloroethene (ug/l)	1,1-Dichloroethene (ug/l)	1,1-Dichloroethane (ug/l)	1,1,1-Trichloroethane (ug/l)	Trichloroethene (ug/l)	1,1,2-Trichloroethane (ug/l)	Copper (ug/l)	Lead (ug/l)
09/19/93	BQL	2	7.3	6.6	BQL	3.7	BQL	40	2.1
08/30/94	BQL	BQL	BQL	BQL	BQL	BQL	BQL	BQL	BQL
11/30/94	BQL	2.8	11	11	BQL	3.1	BQL	BQL	18

N/A = Data Not Available
BQL = Below Quantitation Limits
ug/l = Micrograms Per Liter

ALCATEL NETWORK SYSTEMS
Raleigh, NC
NCD 003 185 238

MW-12dk
VOC and Metals Analytical History

Date Sampled	1,2-Dichloroethane (ug/l)	Tetrachloroethene (ug/l)	1,1-Dichloroethene (ug/l)	1,1-Dichloroethane (ug/l)	1,1,1-Trichloroethane (ug/l)	Trichloroethene (ug/l)	1,1,2-Trichloroethane (ug/l)	Copper (ug/l)	Lead (ug/l)
12/01/94	BQL	BQL	BQL	BQL	BQL	BQL	BQL	BDL	BDL

N/A = Data Not Available
BQL = Below Quantitation Limits
ug/l = Micrograms Per Liter

ALCATEL NETWORK SYSTEMS
Raleigh, NC
NCD 003 185 238

MW-13s
VOC and Metals Analytical History

Date Sampled	1,2-Dichloroethane (ug/l)	Tetrachloroethene (ug/l)	1,1-Dichloroethene (ug/l)	1,1-Dichloroethane (ug/l)	1,1,1-Trichloroethane (ug/l)	Trichloroethene (ug/l)	1,1,2-Trichloroethane (ug/l)	Copper (ug/l)	Lead (ug/l)
05/28/95	BQL	BQL	2000	BQL	390	BQL	BQL	BQL	6.6

N/A = Data Not Available
BQL = Below Quantitation Limits
ug/l = Micrograms Per Liter

ALCATEL NETWORK SYSTEMS
Raleigh, NC
NCD 003 185 238

MW-1sk
VOC and Metals Analytical History

Date Sampled	1,2-Dichloroethane (ug/l)	Tetrachloroethene (ug/l)	1,1-Dichloroethene (ug/l)	1,1-Dichloroethane (ug/l)	1,1,1-Trichloroethane (ug/l)	Trichloroethene (ug/l)	1,1,2-Trichloroethane (ug/l)	Copper (ug/l)	Lead (ug/l)
12/01/94	BQL	BQL	BQL	BQL	BQL	BQL	BQL	BQL	8

N/A = Data Not Available
BQL = Below Quantititation Limits
ug/l = Micrograms Per Liter

ALCATEL NETWORK SYSTEMS
Raleigh, NC
NCD 003 185 238

MW-2sk
VOC and Metals Analytical History

Date Sampled	1,2-Dichloroethane (ug/l)	Tetrachloroethene (ug/l)	1,1-Dichloroethene (ug/l)	1,1-Dichloroethane (ug/l)	1,1,1-Trichloroethane (ug/l)	Trichloroethene (ug/l)	1,1,2-Trichloroethane (ug/l)	Copper (ug/l)	Lead (ug/l)
09/21/94	BQL	270	1000	47	260	8	BQL	14	24
12/01/94	BQL	240	940	BQL	BQL	BQL	BQL	BQL	BQL

N/A = Data Not Available
BQL = Below Quantitation Limits
ug/l = Micrograms Per Liter

ALCATEL NETWORK SYSTEMS
Raleigh, NC
NCD 003 185 238

MW-2ik
VOC and Metals Analytical History

Date Sampled	1,2-Dichloroethane (ug/l)	Tetrachloroethene (ug/l)	1,1-Dichloroethene (ug/l)	1,1-Dichloroethane (ug/l)	1,1,1-Trichloroethane (ug/l)	Trichloroethene (ug/l)	1,1,2-Trichloroethane (ug/l)	Copper (ug/l)	Lead (ug/l)
09/21/94	BQL	340	1800	63	300	41	BQL	BQL	26
12/01/94	BQL	260	1500	BQL	220	BQL	BQL	BQL	BQL

N/A = Data Not Available
BQL = Below Quantitation Limits
ug/l = Micrograms Per Liter

ALCATEL NETWORK SYSTEMS
Raleigh, NC
NCD 003 185 238

MW-3sk
VOC and Metals Analytical History

Date Sampled	1,2-Dichloroethane (ug/l)	Tetrachloroethene (ug/l)	1,1-Dichloroethene (ug/l)	1,1-Dichloroethane (ug/l)	1,1,1-Trichloroethane (ug/l)	Trichloroethene (ug/l)	1,1,2-Trichloroethane (ug/l)	Copper (ug/l)	Lead (ug/l)
09/21/94	BQL	360	28	BQL	58	BQL	BQL	1	8
12/01/94	BQL	300	38	BQL	65	BQL	20	55	57

N/A = Data Not Available
BQL = Below Quantitation Limits
ug/l = Micrograms Per Liter

ALCATEL NETWORK SYSTEMS
Raleigh, NC
NCD 003 185 238

MW-4sk
VOC and Metals Analytical History

Date Sampled	1,2-Dichloroethane (ug/l)	Tetrachloroethene (ug/l)	1,1-Dichloroethene (ug/l)	1,1-Dichloroethane (ug/l)	1,1,1-Trichloroethane (ug/l)	Trichloroethene (ug/l)	1,1,2-Trichloroethane (ug/l)	Copper (ug/l)	Lead (ug/l)
09/21/94	BQL	BQL	BQL	BQL	BQL	BQL	BQL	32	BQL
12/01/94	BQL	BQL	BQL	BQL	BQL	BQL	BQL	BQL	BQL

N/A = Data Not Available
BQL = Below Quantitation Limits
ug/l = Micrograms Per Liter

ALCATEL NETWORK SYSTEMS
Raleigh, NC
NCD 003 185 238

MW-5sk
VOC and Metals Analytical History

Date Sampled	1,2-Dichloroethane (ug/l)	Tetrachloroethene (ug/l)	1,1-Dichloroethene (ug/l)	1,1-Dichloroethane (ug/l)	1,1,1-Trichloroethane (ug/l)	Trichloroethene (ug/l)	1,1,2-Trichloroethane (ug/l)	Copper (ug/l)	Lead (ug/l)
12/01/94	BQL	BQL	2.5	2.5	BQL	3.1	BQL	BQL	11

N/A = Data Not Available
BQL = Below Quantitation Limits
ug/l = Micrograms Per Liter

ALCATEL NETWORK SYSTEMS
Raleigh, NC
NCD 003 185 238

MW-6sk
VOC and Metals Analytical History

Date Sampled	1,2-Dichloroethane (ug/l)	Tetrachloroethene (ug/l)	1,1-Dichloroethene (ug/l)	1,1-Dichloroethane (ug/l)	1,1,1-Trichloroethane (ug/l)	Trichloroethene (ug/l)	1,1,2-Trichloroethane (ug/l)	Copper (ug/l)	Lead (ug/l)
12/01/94	BQL	19	58	6.8	5.4	34	BQL	BQL	BQL

N/A = Data Not Available
BQL = Below Quantitation Limits
ug/l = Micrograms Per Liter

ALCATEL NETWORK SYSTEMS
Raleigh, NC
NCD 003 185 238

MW-6ik
VOC and Metals Analytical History

Date Sampled	1,2-Dichloroethane (ug/l)	Tetrachloroethene (ug/l)	1,1-Dichloroethene (ug/l)	1,1-Dichloroethane (ug/l)	1,1,1-Trichloroethane (ug/l)	Trichloroethene (ug/l)	1,1,2-Trichloroethane (ug/l)	Copper (ug/l)	Lead (ug/l)
12/01/94	BQL	5.8	15	BQL	2	4.6	BQL	BQL	BQL

N/A = Data Not Available
BQL = Below Quantitation Limits
ug/l = Micrograms Per Liter

ALCATEL NETWORK SYSTEMS
Raleigh, NC
NCD 003 185 238

MW-7sk
VOC and Metals Analytical History

Date Sampled	1,2-Dichloroethane (ug/l)	Tetrachloroethene (ug/l)	1,1-Dichloroethene (ug/l)	1,1-Dichloroethane (ug/l)	1,1,1-Trichloroethane (ug/l)	Trichloroethene (ug/l)	1,1,2-Trichloroethane (ug/l)	Copper (ug/l)	Lead (ug/l)
12/01/94	BQL	110	79	BQL	28	BQL	7.1	BQL	8

N/A = Data Not Available
BQL = Below Quantitation Limits
ug/l = Micrograms Per Liter

ALCATEL NETWORK SYSTEMS
Raleigh, NC
NCD 003 185 238

MW-7ik
VOC and Metals Analytical History

Date Sampled	1,2-Dichloroethane (ug/l)	Tetrachloroethene (ug/l)	1,1-Dichloroethene (ug/l)	1,1-Dichloroethane (ug/l)	1,1,1-Trichloroethane (ug/l)	Trichloroethene (ug/l)	1,1,2-Trichloroethane (ug/l)	Copper (ug/l)	Lead (ug/l)
12/01/94	BQL	3200	400	BQL	230	BQL	BQL	BDL	BDL

N/A = Data Not Available
BQL = Below Quantitation Limits
ug/l = Micrograms Per Liter

ALCATEL NETWORK SYSTEMS
Raleigh, NC
NCD 003 185 238

MW-8sk
VOC and Metals Analytical History

Date Sampled	1,2-Dichloroethane (ug/l)	Tetrachloroethene (ug/l)	1,1-Dichloroethene (ug/l)	1,1-Dichloroethane (ug/l)	1,1,1-Trichloroethane (ug/l)	Trichloroethene (ug/l)	1,1,2-Trichloroethane (ug/l)	Copper (ug/l)	Lead (ug/l)
12/01/94	BQL	BQL	BQL	BQL	BQL	BQL	BQL	BDL	BDL

N/A = Data Not Available
BQL = Below Quantitation Limits
ug/l = Micrograms Per Liter

ALCATEL NETWORK SYSTEMS
Raleigh, NC
NCD 003 185 238

MW-8dk
VOC and Metals Analytical History

Date Sampled	1,2-Dichloroethane (ug/l)	Tetrachloroethene (ug/l)	1,1-Dichloroethene (ug/l)	1,1-Dichloroethane (ug/l)	1,1,1-Trichloroethane (ug/l)	Trichloroethene (ug/l)	1,1,2-Trichloroethane (ug/l)	Copper (ug/l)	Lead (ug/l)
12/01/94	BQL	76	32	BQL	13	BQL	BQL	BDL	BDL

N/A = Data Not Available
BQL = Below Quantitation Limits
ug/l = Micrograms Per Liter

ALCATEL NETWORK SYSTEMS
Raleigh, NC
NCD 003 185 238

MW-9sk
VOC and Metals Analytical History

Date Sampled	1,2-Dichloroethane (ug/l)	Tetrachloroethene (ug/l)	1,1-Dichloroethene (ug/l)	1,1-Dichloroethane (ug/l)	1,1,1-Trichloroethane (ug/l)	Trichloroethene (ug/l)	1,1,2-Trichloroethane (ug/l)	Copper (ug/l)	Lead (ug/l)
12/01/94	BQL	BQL	BQL	BQL	BQL	BQL	BQL	BDL	BDL

N/A = Data Not Available
BQL = Below Quantitation Limits
ug/l = Micrograms Per Liter

ALCATEL NETWORK SYSTEMS
Raleigh, NC
NCD 003 185 238

MW-9dk
VOC and Metals Analytical History

Date Sampled	1,2-Dichloroethane (ug/l)	Tetrachloroethene (ug/l)	1,1-Dichloroethene (ug/l)	1,1-Dichloroethane (ug/l)	1,1,1-Trichloroethane (ug/l)	Trichloroethene (ug/l)	1,1,2-Trichloroethane (ug/l)	Copper (ug/l)	Lead (ug/l)
12/01/94	BQL	41	180	BQL	27	BQL	BQL	BDL	BDL

N/A = Data Not Available
BQL = Below Quantitation Limits
ug/l = Micrograms Per Liter

ALCATEL NETWORK SYSTEMS
Raleigh, NC
NCD 003 185 238

RW-1
VOC and Metals Analytical History

Date Sampled	1,2-Dichloroethane (ug/l)	Tetrachloroethene (ug/l)	1,1-Dichloroethene (ug/l)	1,1-Dichloroethane (ug/l)	1,1,1-Trichloroethane (ug/l)	Trichloroethene (ug/l)	1,1,2-Trichloroethane (ug/l)	Copper (ug/l)	Lead (ug/l)
12/01/94	BQL	160	12	BQL	30	BQL	10	BDL	BDL

N/A = Data Not Available
BQL = Below Quantitation Limits
ug/l = Micrograms Per Liter

ALCATEL NETWORK SYSTEMS
Raleigh, NC
NCD 003 185 238

RW-2
VOC and Metals Analytical History

Date Sampled	1,2-Dichloroethane (ug/l)	Tetrachloroethene (ug/l)	1,1-Dichloroethene (ug/l)	1,1-Dichloroethane (ug/l)	1,1,1-Trichloroethane (ug/l)	Trichloroethene (ug/l)	1,1,2-Trichloroethane (ug/l)	Copper (ug/l)	Lead (ug/l)
11/30/94	BQL	220	500	BQL	200	BQL	BQL	BDL	BDL

N/A = Data Not Available
BQL = Below Quantitation Limits
ug/l = Micrograms Per Liter

Table 6

Alcatel Network Systems
Raleigh, North Carolina
NCD 003 185 238

Summary of Field Analytical Data
Creek Samples

Sample Number	Date of Collection	pH	SC (uS/cm)	Temp. (deg. C)
CS - 1	06-27-95	8.34	126.3	22.6
CS - 2	06-27-95	6.46	120.7	22.2

Table 7

Alcatel Network Systems
Raleigh, North Carolina
NCD 003 185 238

Summary of Laboratory Analytical Results
Creek Samples

Sample Number	Date of Collection	Compound Name	Detection Limit	Concentration (ug/L)
CS - 1	6-28-95	Carbon disulfide	1.0 ug/L	11.0
		Copper	1.1 ug/L	2.5
		Lead	0.76 ug/L	1.7
CS - 2	6-28-95	Carbon disulfide	1.0 ug/L	14.0
		Copper	1.1 ug/L	3.5
		Lead	0.76 ug/L	1.1

Notes: "ug/L" denotes micrograms/Litre.

Table 8

Alcatel Network Systems
Raleigh, North Carolina
NCD 003 185 238

Summary of Pump–Test Analytical Results

Date of Sampling	Time of Sampling	Type of Sample	1,1 DCE (ppb)	1,1,1 TCE (ppb)	PCE (ppb)	Comments
1–09–95	19:29	Effluent	n/d	n/d	n/d	Four hour step–drawdown test.
1–10–95	12:08	Effluent	n/d	n/d	n/d	One hour following beginning of 72–hour test.
	12:22	Influent	237.3	73.7	56.7	
	20:38	Influent	180.2	30.2	63.5	
	20:48	Effluent	2.0	n/d	n/d	
	21:00	Effluent	2.7	n/d	n/d	
1–11–95	01:02	Influent	109.7	18.4	n/d	
	01:12	Effluent	n/d	n/d	n/d	
	08:33	Effluent	n/d	n/d	n/d	
	14:05	Effluent	n/d	n/d	n/d	
	15:40	*Effluent*	*n/d*	*n/d*	*n/d*	*Certified laboratory sample.*
	21:24	Influent	261.1	125.2	55.7	
	21:39	Effluent	n/d	n/d	n/d	
1–12–95	00:30	Influent	210.4	96.0	26.7	
	00:44	Effluent	n/d	n/d	n/d	
	07:37	Effluent	n/d	n/d	n/d	
	15:59	Effluent	n/d	n/d	n/d	
1–13–95	08:26	Effluent	n/d	n/d	n/d	Dirty particulate filters.
	08:50	Effluent	5.4	n/d	n/d	Post particulate filter change.
	11:48	Effluent	2.9	n/d	n/d	Conclusion of 72–hour test.

Notes: "n/d" denotes Not Detected.
"ppb" denotes Parts Per Million.

Table 9

Alcatel Network Systems
Raleigh, North Carolina
NCD 003 185 238

Constituent Characteristics

Compound	CAS Number	Solubility (mg/L @ 25C)	Specific Gravity
1,1–Dichloroethane	75–34–3	5500	1.18
1,1–Dichloroethene	75–35–4	210	not reported
Tetrachloroethene	127–18–4	150	1.62
1,1,1–Trichloroethane	71–55–6	4400	1.34
1,1,2–Trichloroethane	79–00–5	4500	1.44
Trichloroethene	79–01–6	1100	1.46
1,2–Dichloroethane	107–06–2	8690 @ 20	1.24

Reference: U.S. EPA RREL Treatability Database Ver 5.0
NIOSH Chemical Hazards Guide (June 1990)