Controlled Copy No. _____

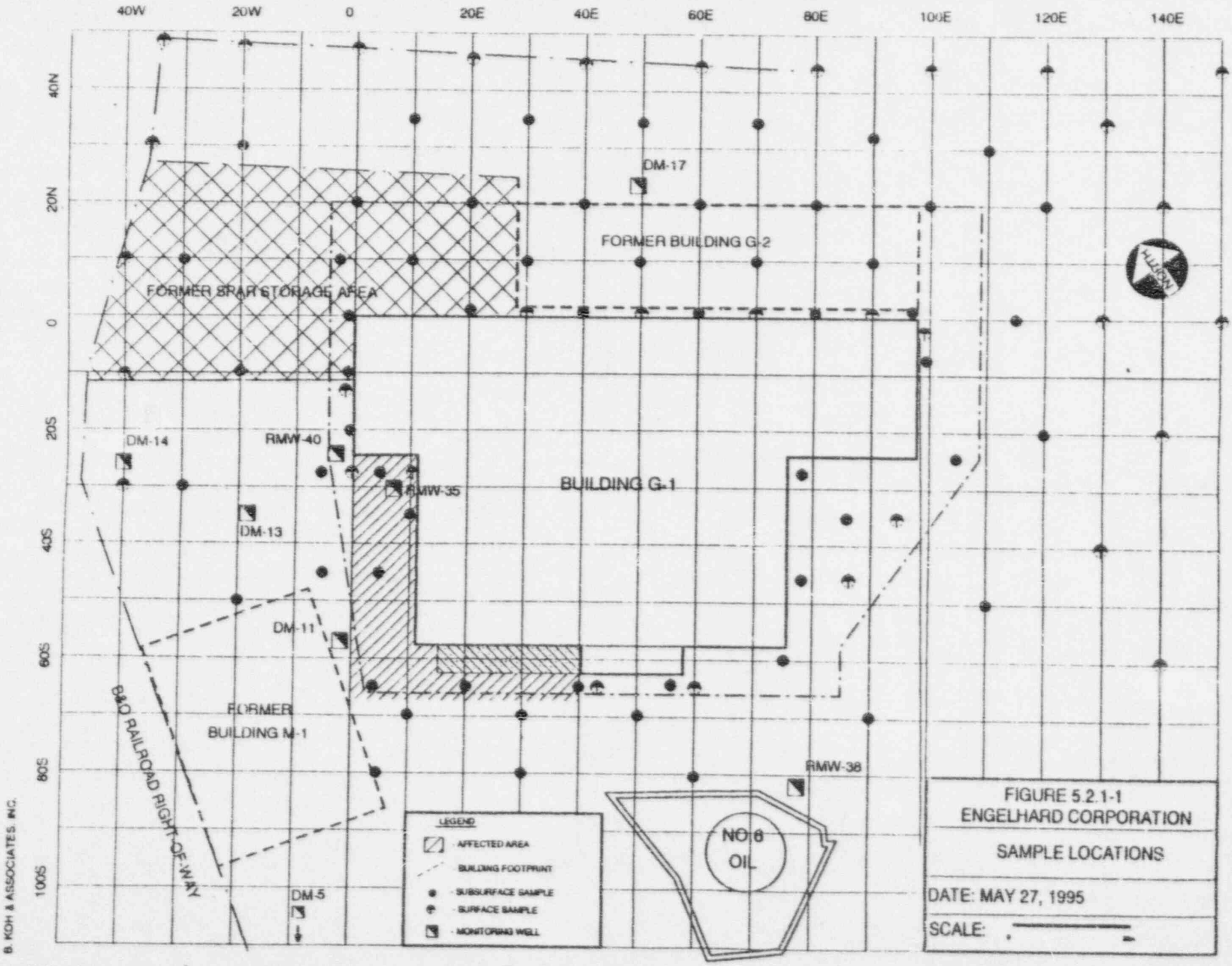
SITE CHARACTERIZATION PLAN
ENGELHARD CORPORATION
CLEVELAND, OHIO
MAY 1995

c/27

— B. KOH & ASSOCIATES, INC. —

11 West Main Street
Springville, NY 14141

10211A South Dolfield
Owings Mills, MD 21117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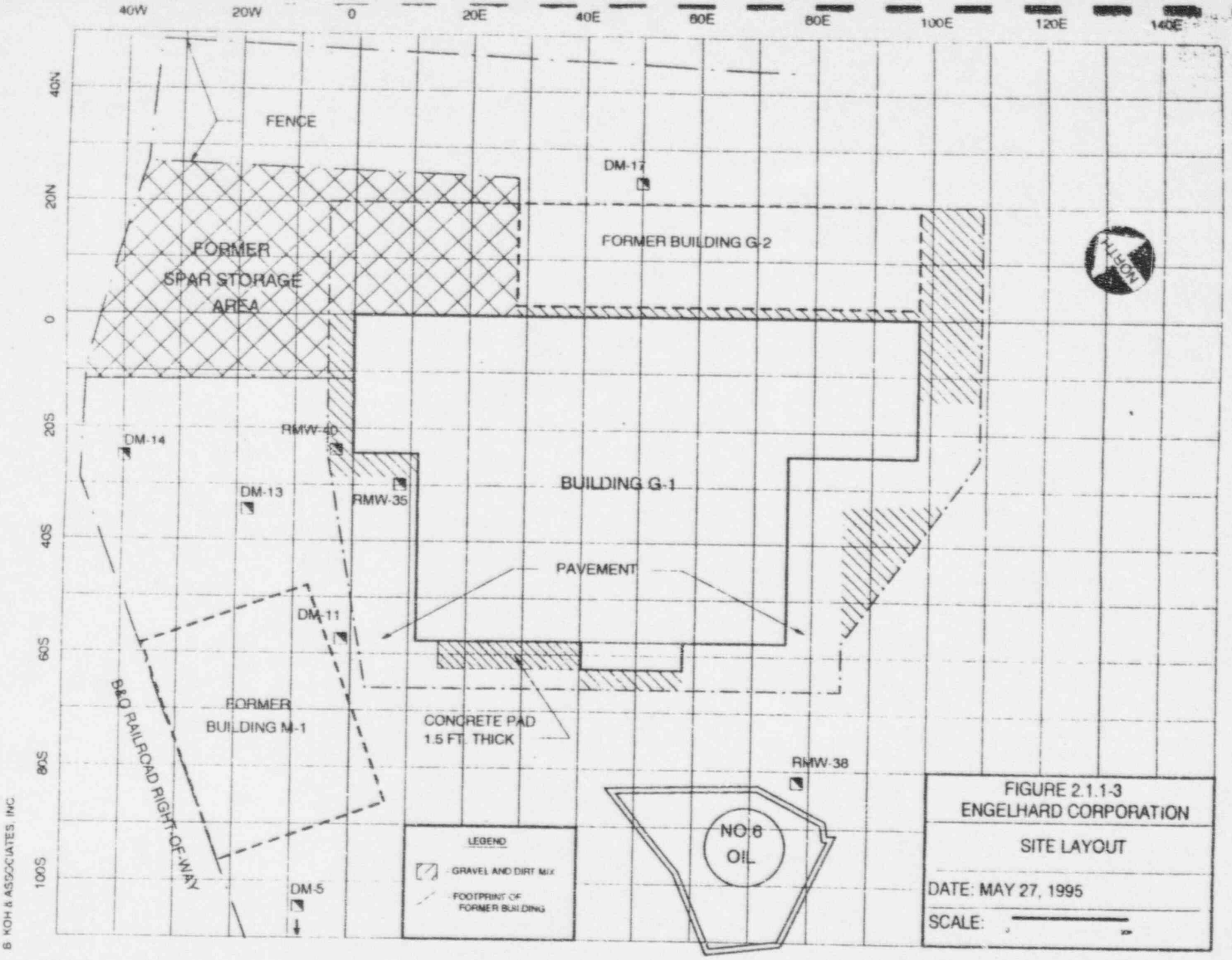
DM-17
FORMER BUILDING G-2
FORMER SRAP STORAGE AREA
DM-14
RMW-40
RMW-35
BUILDING G-1
DM-13
DM-11
B&O RAILROAD RIGHT-OF-WAY
FORMER
BUILDING M-1
DM-5
RMW-38
NO. 6
OIL
LEGEND
AFFECTED AREA
BUILDING FOOTPRINT
SUBSURFACE SAMPLE
SURFACE SAMPLE
MONITORING WELL
NORTH
FIGURE 5.2.1-1
ENGELHARD CORPORATION
SAMPLE LOCATIONS
DATE: MAY 27, 1995
SCALE:
B. KOH & ASSOCIATES, INC.
ENGEL 6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FORMER BUILDING G-2
FORMER SPAR STORAGE AREA
NORTH
DM-14
RMW-40
DM-13
RMW-35
BUILDING G-1
PAVEMENT
DM-11
B&O RAILROAD RIGHT-OF-WAY
FORMER BUILDING M-1
CONCRETE PAD 1.5 FT. THICK
RMW-38
NO. 6 OIL
DM-5
LEGEND
GRAVEL AND DIRT MIX
FOOTPRINT OF FORMER BUILDING
FIGURE 2.1.1-3
ENGELHARD CORPORATION
SITE LAYOUT
DATE: MAY 27, 1995
SCALE:
B. KOH & ASSOCIATES, INC.
ENGEL-5

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SITE CHARACTERIZATION PLAN
ENGELHARD CORPORATION
CLEVELAND, OHIO
MAY 1995

— B. KOH & ASSOCIATES, INC. —

11 West Main Street
Springville, NY 14141

10211A South Dolfield
Owings Mills, MD 21117

PROJECT NAME AND SITE LOCATION

Engelhard Corporation
1000 Harvard Avenue, Cleveland, Ohio

APPROVED

B. Koh & Associates, Inc.

PROJECT DIRECTOR

Theodore G. Adams
Name (Please Print Clearly or Type)

/ Theodore G. Adams / 5/31/95
Signature / Date

APPROVED

Engelhard Corporation

ENGELHARD TECHNICAL ADVISOR

L. Max Scott
Name (Please Print Clearly or Type)

L Max Scott / MAY 31, 1995
Signature / Date

ENGELHARD PROJECT MANAGER

Andy Kopas
Name (Please Print Clearly or Type)

Andrew Kopas / 31-MAY-95
Signature / Date

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1.0 INTRODUCTION

This document presents a Site Characterization Plan (SCP) for the Engelhard Corporation site located at 1000 Harvard Avenue in Cleveland, Ohio. Specifically, the characterization will include the pavement and soils surrounding Building G-1 (out to approximately 150 feet from the building) and the process/stormwater sewers. This site characterization effort and the subsequent remediation of the pavement process/stormwater sewers and soils, if necessary, will be carried out under the responsibility of the current owner of the site, Engelhard Corporation. The site characterization effort will be performed in a manner consistent with the sampling and analytical guidelines contained in this plan, as well as applicable Engelhard, federal, state and local requirements and/or regulations.

The purpose of this plan is to outline the characterization activities intended to determine the nature and extent of the onsite contamination and to provide sufficient information to develop a remedial action plan. This plan has been prepared in accordance with the guidance provided in the NRC Draft Branch Technical Position on Site Characterization for Decommissioning (NRC, November 1994). In addition, in accordance with the guidance and direction of Draft NUREG/CR-5849, Manual for Conducting Radiological Surveys in Support of License Termination (NRC, June 1991), this plan establishes the initial database to support the design of the final radiological termination survey of the Engelhard site (pavement and soils) surrounding Building G-1.

The information obtained from available records and site visits has been used in designing the site characterization activities outlined in this SCP. These include radiation surveys of Building G-1 and open lands, surface and subsurface contamination of soils, surface water and sediment and groundwater, as appropriate. Review of newly available records will be conducted as part of the site characterization effort. Specific details of the site characterization efforts are described in Section 5.0.

1.1 General Objectives

General objectives have been identified for the Engelhard site characterization. The general objectives are outlined as follows:

(1) Determine whether the concentrations and quantities of uranium (U-238, U-235 and U-234) present at the site exceed applicable regulatory limits (35 pCi/g total uranium).

(2) Determine the vertical and horizontal extent of the uranium present at the site.

(3) Quantify environmental parameters that may significantly affect potential human exposure from existing and potential future uranium contamination under unrestricted use conditions.

(4) Identify migration pathways and potential onsite and offsite receptors. Conduct pathway and risk analysis, if necessary.

(5) Evaluate the need for further investigations or data collection to assess exposure, endangerment and risk associated with the uranium contamination at the Engelhard site.

(6) Evaluate data and formulate any necessary remedial actions, including a preferred alternative, appropriate for the concentrations and quantities of uranium at the Engelhard site.

(7) Establishment of a database for use in supporting the design of the final radiological survey(s) of the site.

1.1.2 Comparison of Site Characterization Data

Collected data will meet specific characterization, quality assurance, and final termination survey objectives.

Surface water and groundwater data will be compared to Drinking Water Standards, established background levels, downgradient levels, and NRC regulations, as appropriate. Surface and subsurface soil and sediment and air sampling data will be compared to the Nuclear Regulatory Commission (NRC) and the Environmental Protection Agency's (EPA) recommended guidelines for evaluating cleanup and decontamination requirements.

After validation, analytical data will be examined to determine if the uranium contamination present on the site poses any significant impacts to the environment and potential receptors.

1.1.3 Data Quality Objectives

Data collected from site characterization sampling and monitoring activities will be used to achieve the general objectives identified in Section 1.1. The most significant objectives are the determination of the magnitude and extent of contamination, the identification of the preferred remedial approach, and the design of the final radiological survey.

To ensure achievement of these objectives, the following Data Quality Objectives (DQOs) have been developed for the processed uranium that has not undergone isotopic separation *(Scott, 1995)* at the Engelhard site:

Media	Lower Limit of Detection (LLD)
Liquid (surface water, groundwater)	0.5 pCi/l
Solids (soils, sediments, vegetation)	2 pCi/g
Air	3 E-14 μCi/ml
Thermoluminescent Dosimeters (TLDs)	10 mRem

Sample results will be reported with an uncertainty at the 95% confidence level (2σ) for that value.

1.2 Program Overview

The Site Characterization Plan is comprised of five major activities:

(1) Historical site review and literature search.

(2) Site investigation and sampling activities.

(3) Data management and analysis.

(4) Pathway and risk analysis, if necessary.

(5) Reports and deliverables.

1.3 Organization

The organizational chart of the management structure responsible for providing oversight to the development and implementation of the SCP is presented in Figure 1.3-1.

1.4 Applicable Regulations and Guidance

Radiological contamination assessment associated with uranium is considered and addressed by this plan. The survey and sampling methodologies presented herein are consistent with the regulations and guidelines set forth in the foliowing documents to the extent they are applicable to this type of activity.

Federal Regulations

- Code of Federal Regulations, Title 10, Part 20.

Nuclear Regulatory Commission (NRC) Guidance

- NRC Draft Branch Technical Position on Site Characterization for Decommissioning (NRC, November 1994).

- Draft NUREG/CR-5849, Manual for Conducting Radiological Surveys in Support of License Termination (ORISE, June 1992).

- NRC Guidelines for Decontamination of Facilities and Equipment Prior to Release for Unrestricted Use or Termination of Licenses for By-Product, Source or Special Nuclear Material (NRC, August 1987).

- NRC Branch Technical Position for the Disposal or Onsite Storage of uranium or uranium Wastes from Past Operations (NRC, October 1981).

- NUREG/CR-5569, Health Physics Positions Data Base *(ORNL, February 1994).*

Environmental Protection Agency

- EPA Interim Primary Drinking Water Regulations, 40 CFR Part 141 (41 FR 38404: July 9, 1976).

- EPA Test Methods for Evaluating Solid Wastes, Third Edition, November 1986 (SW-846).

Ohio Environmental Protection Agency

- Ohio EPA/DERR, Final "How Clean is Clean Policy."

1.5 Revisions to This Plan

In the event that conditions other than those anticipated in developing this plan are encountered, the plan and/or affected field procedure(s) will be revised and submitted to the Project Director (PD) for approval. Plan revisions or field changes are categorized into two types: major and minor.

In general, major field changes are changes which:

(1) Cause a potential safety or environmental impact.

(2) Adversely affect the quality of the data.

(3) Cause significant change in the cost of the field effort.

(4) Create a major change in the scope of the field effort.

(5) Cause significant delays in the schedule.

The PD, Project Manager (PM) and Site Supervisor approve major field changes.

Minor field changes are changes which do not affect the quality of the data, the rationale for the field procedures, plans or sampling locations. Examples of minor field changes include:

(1) Relocation of a planned sampling location within five feet of the original location to avoid obstruction.

(2) Modifying soil sampling intervals to avoid subsurface obstruction.

Minor field changes are approved by the Site Supervisor and PM.

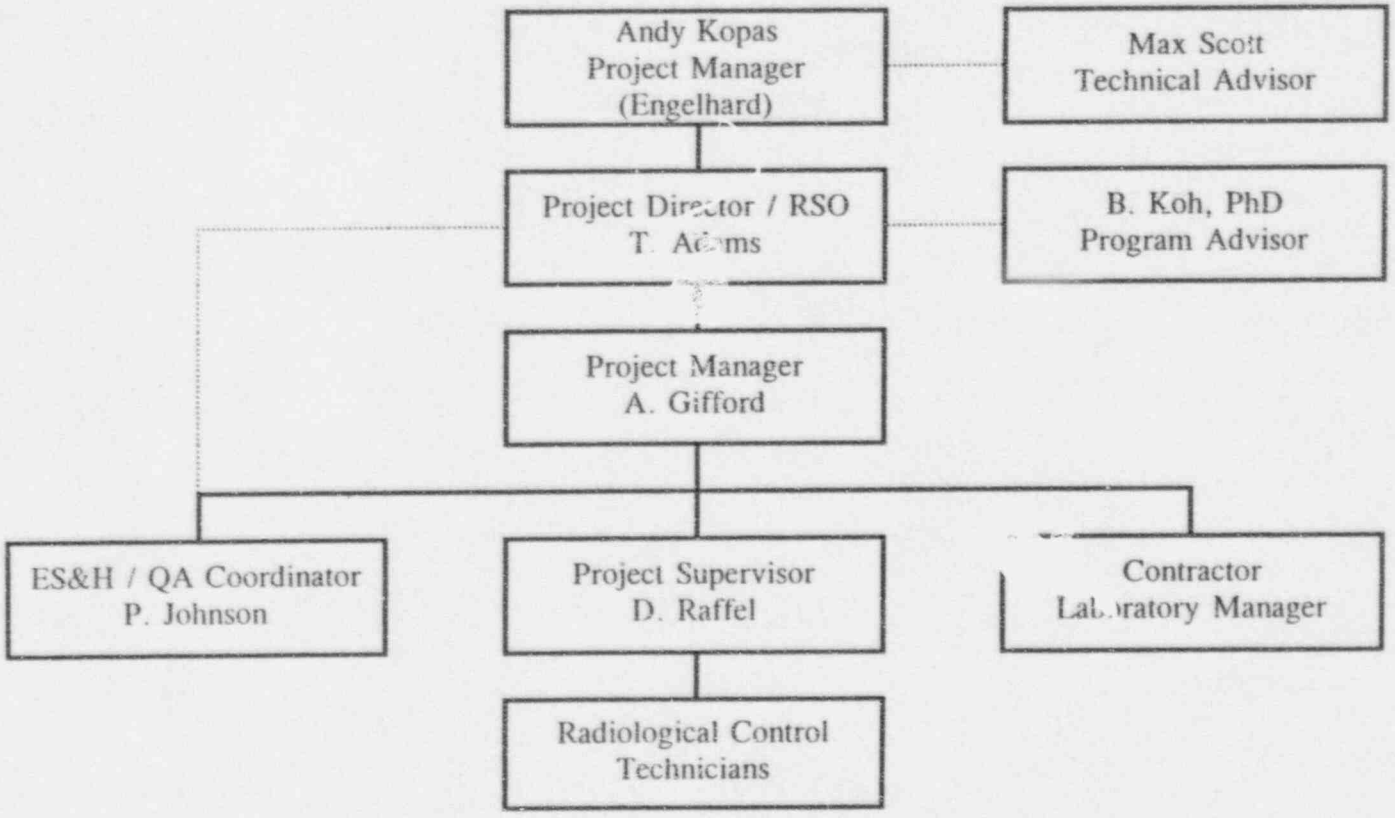
All plan revisions or field changes will be reviewed by the PM or designee as to the change and whether the change is major or minor.

Major plan revisions will be prepared and submitted to the PD for approval. Field changes are to be submitted within one day of the change and the review must be completed within two working days of the date of the change. Plan revisions will be reviewed and approved in the same manner as this original SCP. It is the responsibility of the PM or his designee to obtain the necessary approvals, to advise the appropriate parties of work which is affected by the revisions, and to ensure the correct plan revision is being used at the work site.

Changes should be highlighted in the revision draft by marking a change bar in the right-hand margin with the revision number. Review of this revision draft should be limited to the revisions and their affect on program objectives. The revision number and date will appear at the top of each page of an approved and revised plan. Copies of the SCP and any related changes/modifications will be maintained as part of the Engelhard Project Files.

FIGURE 1.3-1

ORGANIZATION CHART FOR ENGELHARD REMEDIATION PROJECT ACTIVITES



2.0 GENERAL INFORMATION

The following sections provide background information regarding the locations, history and operations and the related uranium contamination of the G-1 building and the surrounding land areas. In addition, these sections summarize previous site activities including site surveys and remedial efforts.

2.1 Site Background

2.1.1 Site Location and Description

The Engelhard site is located at 1000 Harvard Avenue, Cuyahoga County, which is approximately 5 miles southwest of downtown Cleveland, Ohio (Figure 2.1.1-1 and Figure 2.1.1-2). The area to be characterized is the pavement and soil area surrounding Building G-1 and G-2 (Figure 2.1.1-3).

2.1.2 Site History

2.1.2.1 Past Operations and Onsite Activities

Chemical operations have existed at the Engelhard facility since the 1900s *(Remcor, 1990)*. The plant has historically produced specialty chemicals and metal salts. The facilities within or adjacent to the area of concern consist of a series of building complexes that are grouped according to past or current use:

- Nickel Chloride Complex (N-Complex)
- Nickel Sulfate Complex (M-Complex)
- Uranium Processing (G-Complex)
- Catalyst, Acetates, and Nitrate Complex (C-Complex).

During the Manhattan Engineering District (MED)/Atomic Energy Commission (AEC) era, Harshaw Chemical Company, the owner of the site at that time, processed large quantities of processed uranium.

The principle building involved with the uranium processing activities was the refinery building, identified as Plant C (Building G-1, Figure 2.1.1-3). Essentially all of the equipment used in Building G-1 operations was government owned. Building G-1 was used primarily for the refining of yellowcake into uranium orange oxide, although the plant was capable of reducing orange oxide (UO_3) to brown oxide (UO_2), fluorination of brown oxide to green salt (UF_4), and fluorination of green salt to hexafluoride (UF_6). This work was done under contract to MED and its successor, AEC. Liquid sulfate solution was handled in the southwest area of the first floor of Building G-1. Tin fluoroborate was handled on the second floor. The G-Complex was decontaminated by Harshaw (site operator) under AEC guidance and released from AEC control in 1960.

2.1.2.2 Past Characterization

Three radiological assessments on Building G-1 and surrounding land areas have been performed. Argonne National Laboratory completed an assessment in 1979, Remcor, Inc. performed an assessment in 1989, and Chemical Waste Management, Inc. completed an assessment in 1992.

2.1.2.2.1 Argonne National Laboratory Radiological Assessment

The DOE document entitled "Formerly Utilized MED/AEC Sites Remedial Action Program Radiological Survey of the Harshaw Chemical Company, Cleveland, Ohio" (DOE/EV-0005/48) is a report of a radiological assessment of what was then the Harshaw Chemical Company Facility. This assessment was performed by Argonne National Laboratory (ANL) in several different campaigns from 1976 through 1979.

Records indicate that in 1960 the AEC contract was terminated, the facility was decontaminated by Harshaw and released for unrestricted use by the AEC. Later, the Nuclear Regulatory Commission reviewed the AEC records and concluded that documentation was insufficient to determine whether the decontamination was adequate by the then-current guidelines. Hence, an ANL radiological assessment of the site was initiated in 1976.

Alpha and beta/gamma survey results on pavement and soil areas surrounding Building G-1 ranged up to 1,000 dpm/100 cm^2 and 400,000 dpm/100 cm^2 respectively. Several soil samples were taken from the site some of which revealed concentrations above the current uranium release criterion.

Based on review of the ANL assessment, Engelhard determined that levels of contamination at the site are above current guidelines for release of the site for unrestricted use.

2.1.2.2.2 REMCOR Radiological Assessment

2.1.2.2.2.1 Subsurface Soil Sampling

Remcor, Inc. performed an underground investigation of the Engelhard site in 1989 in order to identify and define potential subsurface environmental issues (REMCOR, 1990).

Under the supervision of Remcor, Lake Drilling, Inc. of Cleveland, Ohio implemented a two-phase drilling, soil sampling, and well installation program at the Engelhard site. The Phase I subsurface exploration program was conducted June 26 through 29, 1989. Phase II subsurface exploration program was conducted October 16 through 19, 1989.

The highest levels of gross alpha and beta radioactivity were found in the near-surface sample from Boring RMW-35 (Figure 2.1.1-3). This boring location is adjacent to Building G-1 in which uranium processing was conducted. The samples taken between 1 and 3 feet and 5 and 7 feet had gross alpha radioactivity of 110 to 47 pCi/g, respectively.

2.1.2.2.2.2 Sanitary Sewer Sampling

During the subsurface investigations performed by Remcor, liquid samples were collected from the sanitary sewer June 23 through 27, 1989, July 29, 1989 and October 19 and 20, 1989. Relatively low levels of radioactivity, 0 to 22 pCi/l of alpha activity and 5 to 45 pCi/l beta activity, were measured in samples collected from the sewer. The highest levels, 120 pCi/l of beta, were measured in the June samples of stagnant perched water in Manholes 2 and 3 located adjacent to Building G-1.

2.1.2.2.2.3 Groundwater Sampling

During the subsurface investigations performed by Remcor, 27 groundwater samples were collected on July 20, 1989 from existing and new monitoring wells on site. Groundwater samples from most of the monitoring wells indicated low levels of alpha and beta radioactivity. Samples from wells DM-5 and DM-14 (Figure 2.1.1-3) had gross beta levels of 760 and 220 pCi/l, respectively. The location of these wells does not appear to demonstrate a localized source of the radiation, because samples from intermediate wells have relatively low levels of activity. The activity in the sample from DM-5 is probably related to potassium storage in that area.

2.1.2.2.3 Chemical Waste Management, Inc. Radiological Assessment

"Chevron Chemical Company Plant C, Cleveland, Ohio, Radiological Assessment Report" *(Chemical Waste Management, Inc., June 1992)* details a radiological assessment of Plant C (Building G-1 and surrounding land areas) that was performed by Chemical Waste Management, Inc. (CWM) in April of 1992. This radiological assessment was equivalent to a scoping survey as described in NUREG/CR 5849, "Manual for Conducting Radiological Surveys in Support of License

Termination" *(NRC, 1992)*. The following conclusions were determined from the CWM assessment:

- No external radiation dose hazard exists from the contamination contained in Plant C;
- The only radioactive contaminant discovered in Plant C was processed natural uranium and the associated progeny. The source of contamination is the natural uranium processing conducted in the building during the 1940s and 1950s.
- Several locations on the surface of the first floor contain removable contamination above NRC release guidelines. Most of the removable contamination that exceeds release guidelines is from beta/gamma emissions. Only one location with alpha contamination above the unrestricted release limits for natural uranium was detected.
- Fixed contamination exists inside Plant C.
- Areas adjacent to drain lines and ground floor penetrations were discovered to contain uranium concentrations above NRC release guidelines.

2.1.2.3 Current Operations and Onsite Activities

No production or plant operations are currently taking place in Building G-1. Building G-1 is scheduled to be demolished in 1995 by the Chevron Chemical company.

2.1.2.3.1 Current Characterization and Remedial Actions

No characterization or remedial activities are currently being performed at the Engelhard site.

2.1.2.4 Historical Site Review

A site's history contains important information for determining the contamination boundaries in both the vertical and horizontal directions. In many cases, where soil contamination is due to spillage or natural migration mechanisms, it is easier to estimate the extent of horizontal and vertical contamination.

To support the site characterization activities and to address any unknown subsurface site conditions, a historical review of the Engelhard site will be conducted. The review will include, but will not be limited to, researching past operations at the site, and interviewing individuals who have knowledge of past disposal or operational procedures at the site.

2.2 General Physical Setting

A summary of the general physical setting of the Engelhard site, including general physical characteristics of the site and its proximity to individuals that potentially could be affected by the existing uranium contamination or required remediation activities will be provided.

2.2.1 Physical Site Characteristics

A summary of the physical characteristics regarding the Engelhard site will be provided. These characteristics include, as appropriate:

- Climate (e.g., temperature, precipitation)
- Geologic Setting (e.g., unconsolidated deposits and bedrock strata).
- Vegetation (e.g., unvegetated, forested, grassy).

- Soil (e.g., composition, thickness, chemistry).
- Groundwater (e.g., depth, quality, uses, and direction and rate of flow).
- Location and description of surface water (e.g., type, flow rates, quality and uses).

2.2.2 General Information on Exposed Individuals

A summary description of the general characteristics of the potentially exposed populations, both onsite and offsite, will be provided. The summary will include:

- General distribution and number of people on and near the site.
- Current land use(s) adjacent to the site.
- Anticipated future land use(s) on and adjacent to the site.
- Location and characteristics of any subgroup of special concern.

2.3 Preliminary Evaluation of Uranium Contamination

Based on review of available historic operational data, records of past and current surveys and direct observation via site visits, the following is a preliminary evaluation of the uranium contamination.

Uranium contamination identified in the open land areas surrounding Building G-1 does not appear to be widespread. The major known areas of contamination are located adjacent to Building G-1

in the southwest corner and to the south. Uranium concentrations in soil range from 1,190 pCi/g to 1,820 pCi/g.

In addition, a review of past *(ANL, 1984)* and current *(Scott, 1995)* records has confirmed that the principal radionuclide of concern is processed natural uranium that has not undergone isotopic separation. The NRC and their contractor, Oak Ridge Institute of Science and Education (ORISE) have reviewed the information providing the justification for determining the material is processed uranium and concur with the determination *(ORNL, February 1994)*.

Thus, the applicable cleanup criteria are as follows:

Soil	35 pCi/g (Total Uranium U-238, U-235 and U-234), as specified in the NRC Branch Technical Position "Disposal or Onsite Storage of Uranium or Uranium Wastes from Past Operations" (NRC, 1981)
Surface Water	30 pCi/l Total Uranium as specified in 40 CFR 141 "Interim Primary Drinking Water Regulations"
Groundwater	30 pCi/l Total Uranium as specified in 40 CFR 141 "Interim Primary Drinking Water Regulations"
Surface Contamination	1,000 dpm/100 cm^2 α,β-γ removable activity 5,000 dpm/100 cm^2 α,β-γ average over 1 m^2 15,000 dpm/100 cm^2 α,β-γ maximum over 100 cm^2 "Guidelines for Decontamination of Facilities and Equipment Prior to Release for Unrestricted Use or Termination of License for Byproduct, Source, or Special Nuclear Materials" (NRC, August 1987).

Exposure Rates

Structures - ≤ 5 μR/hr above background (measured at 1 m above surface)

Open Land - ≤ 10 μR/hr (average) above background (measured at 1 m above the ground surface), average over 100 m^2 grid areas

- ≤ 20 μR/hr (maximum) above background (measured at 1 m above the ground surface), over discrete area of < 100 m^2

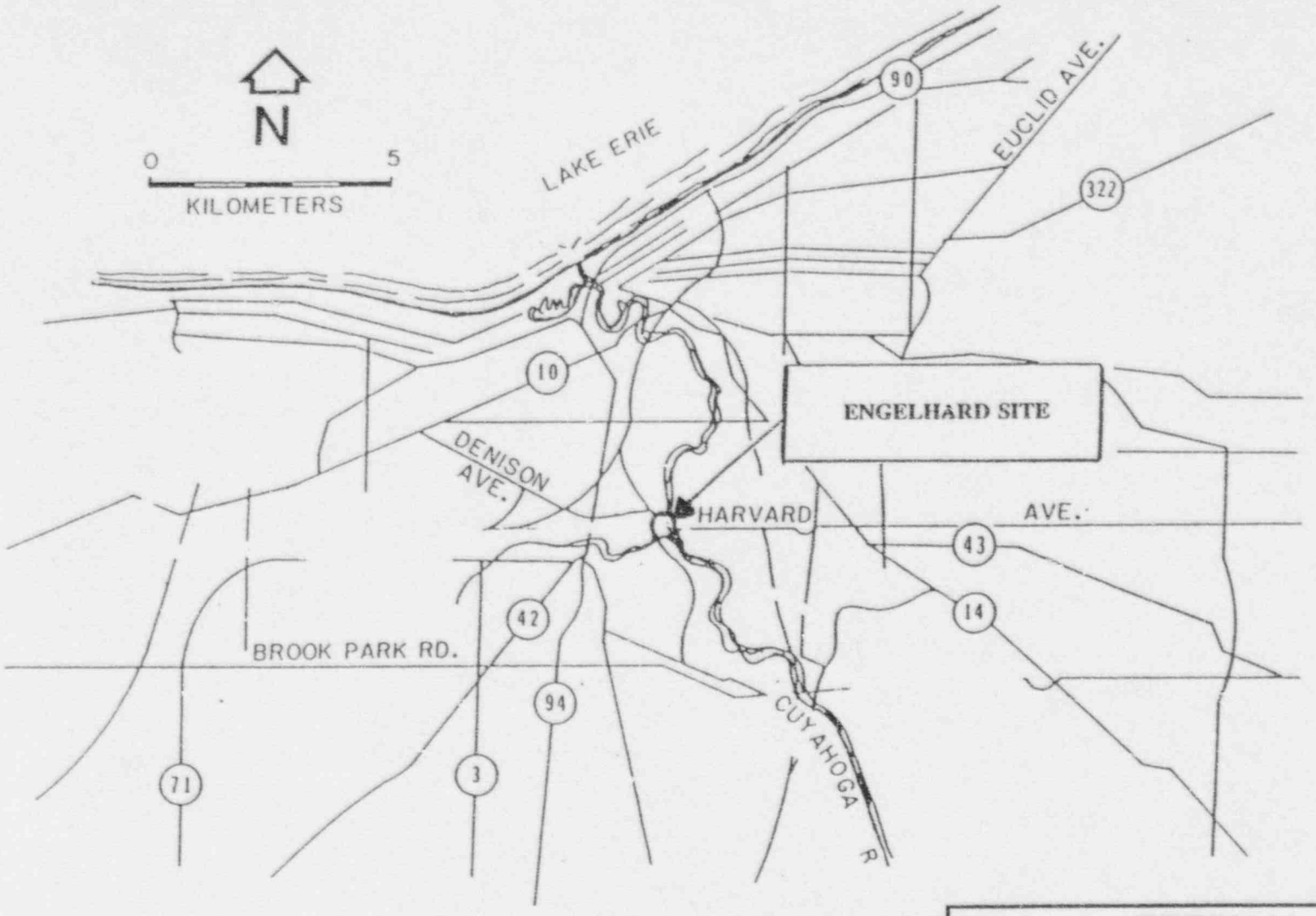


FIGURE 2.1.1-1

ENGELHARD CORPORATION
SITE LOCATION

B. KOH & ASSOCIATES, INC.

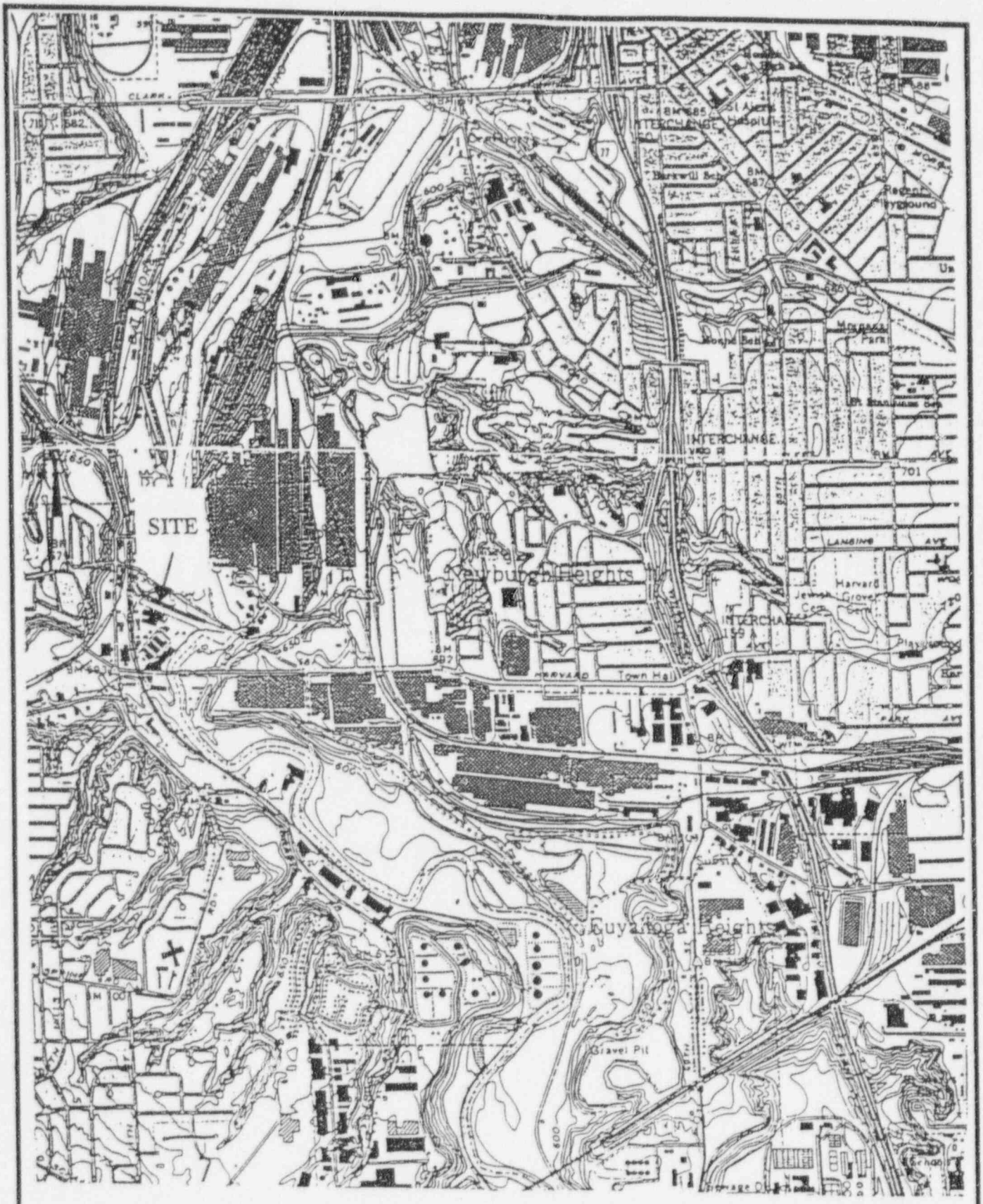
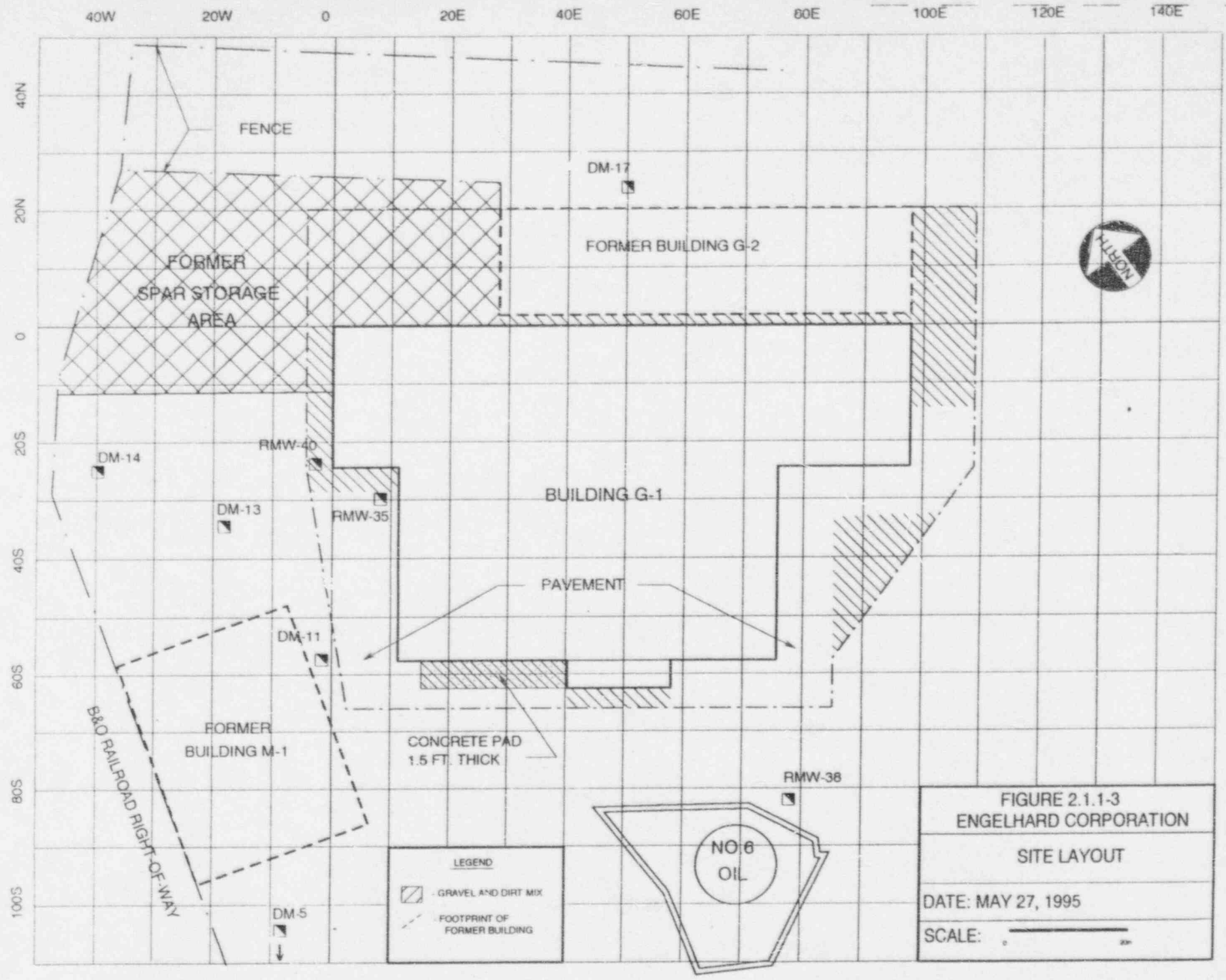


FIGURE 2.1.1-2

ENGELHARD CORPORATION
TOPOGRAPHIC MAP

B. KOH & ASSOCIATES

Source: USGS, Cleveland South, 7.5 Minute Quadrangle,
Topographic Map, Photorevised 1984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FORMER BUILDING G-2
FORMER SPAR STORAGE AREA
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DM-13
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BUILDING G-1
PAVEMENT
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B&O RAILROAD RIGHT-OF-WAY
FORMER BUILDING M-1
CONCRETE PAD 1.5 FT. THICK
RMW-38
NO.6 OIL
DM-5
LEGEND
GRAVEL AND DIRT MIX
FOOTPRINT OF FORMER BUILDING
FIGURE 2.1.1-3
ENGELHARD CORPORATION
SITE LAYOUT
DATE: MAY 27, 1995
SCALE:
B. KOH & ASSOCIATES, INC.
ENGEL-5

3.0 DOSE ASSESSMENT

As stated in the NRC Draft Branch Technical Position (BTP) on Site Characterization for Decommissioning, November 1994, dose assessments may not be necessary at sites that will be decommissioned in accordance with the interim cleanup criteria for release of the site for unrestricted use and license termination. The interim cleanup criteria are identified in the NRC Site Decommissioning Management Plan Action Plan *(NRC, 1992a)*. Related cleanup criteria established for the Engelhard site are presented in Section 2.3 of this SCP.

Since the preferred decommissioning alternative is to remediate the Engelhard site to the limits specified in the interim cleanup criteria for unrestricted use, a dose assessment may not be required *(NRC, 1994)*. However, depending on the level and extent of uranium contamination found at the Engelhard site, preliminary dose assessments may be performed. If required, the initial dose assessments will be performed using hand calculations and appropriate dose conversion factors (e.g., Federal Guidance Report No. 11, EPA-520/1-8820; September 1988).

If the preliminary dose assessments result in exposures of ≥ 10% of the NRC allowable limit (5000 mrem/yr Total Effective Dose Equivalent [TEDE] for the worker and 100 mrem/yr TEDE to the public, thus 500 and 10 mRem/yr, respectively) a more sophisticated dose assessment will be performed using computer codes such as RESRAD *(DOE, 1989)* or NRC D&D Screen *(NRC, 1992b)*. Since default parameters and assumptions may be unjustified and inapplicable to the Engelhard site, Engelhard will contact the NRC staff in advance of the modeling to discuss plans for the assessment and the appropriate use of assumptions and assessment techniques, if utilized.

4.0 PHYSICAL CHARACTERISTICS OF THE SITE

4.1 Surface Features

4.1.1 Regional Topography

Topographic information regarding the Engelhard site was obtained from the US Geological Survey, Cleveland South, 7.5 minute, topographic map, photorevised 1984 (Figure 2.1.1-2). The Engelhard site is located in Cuyahoga County. Elevations of this area are approximately 600 feet near the site. Surface water bodies near the site include the Cuyahoga River and Big Creek which are located approximately 500 feet to the east and 1,100 feet to the south, respectively.

4.1.1.1 Site Specific Topography

As presented above, the Engelhard site is located approximately 500 feet from the west bank of the Cuyahoga River immediately north (1,100 feet downstream) of the confluence of Big Creek. The site is relatively flat-lying at an elevation approximately 20 feet above the river (594 feet above mean sea level).

4.2 Meteorology and Climatology

Meteorology and climatological data for the greater Cleveland area averaged over the past 30 years is presented below:

- The average annual temperatures 49.7 °F.
- The average annual rainfall is 35.4 inches.
- The average annual snowfall is 53.6 inches.

The wind rose for the greater Cleveland area is presented in Figure 4.2-1. The predominant wind direction is from the south.

4.3 Surface Water Hydrology

No site specific surface water hydrology information was obtained during development of this SCP. As part of the site characterization activities, site specific surface water hydrology data will be obtained and documented in the Site Characterization Report.

4.4 Geology

4.4.1 Regional Geology

The Engelhard site is located within Cuyahoga County, which is situated within two major physiographic provinces *(B. Koh & Associates, Inc., 1995)*: the Appalachian Plateau Physiographic Province and the Eastern Lake Section of the Central Lowland Physiographic Provence in Ohio, which are joined by the Portage Escarpment. Deep valleys intersect the Portage Escarpment, which drain Cuyahoga County. These valleys contain till and associated Lacustrine and fluvial terraces through which the present rivers cut their respective channels. In its lower reaches, the Cuyahoga River has partially cut through a prism of sediment (alluvial fan) that was deposited in a deeper, wider bedrock valley.

The unconsolidated deposits of late glacial and post glacial age consist of madeland (fill), undifferentiated sand and gravel deposits with interbedded silt and clay and undifferentiated silt and clay lacustrine deposits. The tills are identified and correlated based on lithographic characteristics and stratigraphic relations. The oldest till exposed is correlated with the pre-Woodfordian Substage Mogadore Till. Successively younger tills include Kent, Lavery, and Hiram tills of Woodfordian Substage. The surficial bedrock in Cuyahoga County consists predominately

of thick Paleozoic shales and sandstones. that range from late Devonian Period (345-355 million years [M.Y.] ago) to early Pennsylvania Age (265-280 M.Y. ago).

4.4.2 Site Specific Geology

Fill and alluvial material make up the surface material at the site. The alluvial material is a loose mixture of sand, silt, clay and very angular gravel. These materials have been deposited by the Cuyahoga River (REMCOR, 1990). The thickness of these deposits range from 6 to 30 feet. A basal sand and gravel zone is reported as the main water-bearing formation of these materials. Groundwater flow at the site within the alluvial materials is generally in an eastward direction towards the Cuyahoga River. The saturated thickness of the alluvial materials at the site ranges from 5 to 15 feet. Previous investigations (Dames and Moore, 1987) report permeabilities within the alluvial material of 10^{-5} to 10^{-4} centimeters per second.

The bedrock underlying the site is identified as Chagrin member of the Ohio Shale. In the vicinity of the site, this unit is reportedly hundreds of feet thick (Cushing, 1931). The surface of this bedrock is undulatory and forms a bedrock ridge that runs across the site. All test borings in this unit report it as dry and the unit is thought to be fairly impermeable, poor source of water.

4.5 Hydrogeology

4.5.1 Regional Hydrogeology

Prima / hydrogeologic units in the region are the Undifferentiated Unit and the Lacustrine Unit. The Undifferentiated Unit forms a water table aquifer which is confined below the Lacustrine Unit. The Lacustrine Unit overlies a confined bedrock aquifer which is occasionally used for industrial water supply. The confined aquifer is isolated from the water table aquifer by approximately 600 feet of clay; therefore, the bedrock aquifer is considered a separate hydrogeologic system.

Lake Erie is the public water supply for the general Cleveland area. Water is pumped from the lake, stored in reservoirs, treated and then distributed.

4.5.2 Site Specific Hydrogeology

Limited site specific hydrogeological information was obtained during development of this SCP. The general groundwater flow in the area near Building G-1 is toward the Cuyahoga River (REMCOR, 1990). As part of the site characterization activities, site specific hydrogeology data will be obtained and documented in the Site Characterization Report.

4.6 Demography and Land Use

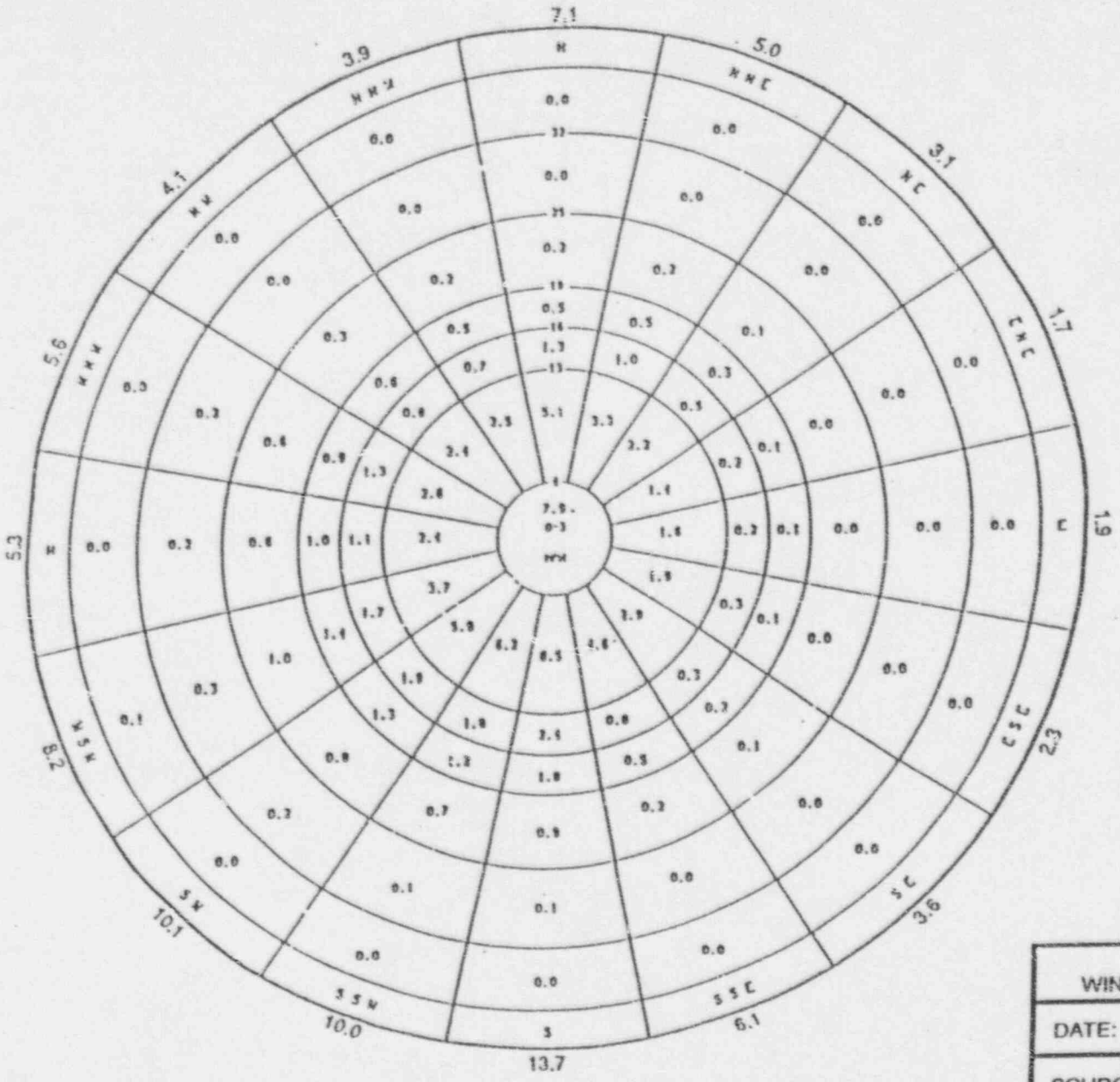
4.6.1 Demography

Population data on the site and its surrounding areas will be collected to assess the potential health and safety and socio-economic impacts of the uranium contamination at the Engelhard site.

The demographic data will include the residence inventory which will identify the locations and number of residents within a 2-km (1.2 miles) radius from the site boundary. Any sensitive population (e.g., medical institutions, nursing homes, etc.) will be identified within the designated radius.

4.6.2 Land Use

Land use information regarding the site and the surrounding vicinity will be collected and reviewed to assess potential impacts on the public health and safety from radiological releases from the contaminated areas of the site and the potential onsite exposure due to remediation.



CLASS 7
CEILING-VISIBILITY

LEGEND:

4.1 Percent of time wind blows from a given direction

FIGURE 4.2-1
WIND ROSE FOR CLEVELAND, OHIO

DATE: JANUARY 20, 1995

SOURCE: "Final Site Characterization Report", 6/15/92, Dames & Moore

B. Kon & Associates, Inc.

5.0 EXTENT AND CONCENTRATION OF CONTAMINATION

5.1 Analysis and Review of Source and Contamination Characterization

The complexity and depth of detail of contamination characterization depends primarily on the extent and concentration of the contamination. Therefore, the first phase of the SCP in determining the extent of uranium contamination within the open land areas surrounding Building G-1 at the Engelhard site is to analyze the type of facility and nature of the process(es) that may have caused the radiological contamination.

Specifically, this SCP will assess the former process(es) to determine their effect on site uranium contamination in terms of the following information:

- Physical and chemical properties of the uranium.
- Specific raw uranium material composition used.
- Location of effluent discharges and releases.
- Waste management practices.
- Other plant and operational records.
- Reports, accidents and incidents (e.g., fires, spills, unintentional releases and leakages).

In order to gather information necessary to address the above items, the following sources of information will be reviewed:

- Analyses of historical records on environmental monitoring.

- AEC applications, amendments and renewal.

- Operational permits.

- Interviews with long-time employees (e.g., past, retired, present).

Since surveys have been conducted (Section 2.1.2) which have confirmed uranium contamination at the Engelhard site, the proposed characterization of the extent of the contamination, as outlined in this SCP, will include an assessment of the distribution of the uranium in soils, surface water and sediments, and vegetation at the site. Uranium contamination of the groundwater will also be assessed.

The site characterization activities, as outlined in this section of the SCP, will include sufficient information on the uranium radiological and physio-chemical analytical data to ensure their reliability and representativeness including sampling analysis methodology (Sections 5.0, 6.0 and 7.0) and quality assurance and quality control requirements (Section 8.0).

It should be noted that the sampling locations, depths, type, and amounts presented in this document are based upon the best available information at the time of preparation of this SCP, and may be revised based on actual field conditions and interim findings as site characterization progresses.

5.2 Design of Survey and Sampling of Contamination

The extent of the uranium contamination at the Engelhard site will be determined using an appropriate combination of field survey, sampling techniques and laboratory analysis for each medium (e.g., water, soil).

The site characterization activities will be performed by qualified individuals using calibrated survey and sampling instrumentation/equipment. The activities will be conducted in accordance with approved plans and/or procedures. Furthermore, the site characterization activities including the design and conduct of the radiological surveys, as described in the subsequent section, have been developed consistent with the guidance contained in the NRC Draft Branch Technical Position on Site Characterization for Decommissioning (NRC, November 1994) and in Draft NUREG/CR-5849, Guidance Manual for Conducting Radiological Surveys in Support of License Termination (NRC, June 1992).

5.2.1 Survey and Sampling Design

Based upon review of the available information regarding the past operations and the resultant uranium contamination, it is apparent that all areas of the site (openland areas surrounding Building G-1) do not have the same potential for residual contamination. Consequently, these areas do not require the same level of survey/sampling coverage as the areas likely to be contaminated to achieve an acceptable level of confidence that the site satisfies the established release criteria for uranium.

Therefore, the survey and sampling efforts outlined in this SCP have been designed such that the open land areas surrounding Building G-1 with higher potential for uranium contamination will receive a higher degree of survey and sampling effort. This approach provides for a survey and sampling process which is both cost effective and efficient.

Consistent with Draft NUREG/CR-5849, the Engelhard site was subdivided into survey units and strata based on the potential for and the type of contamination. These subdivisions will be used as references for purposes of conducting site characterization activities and establishing the sampling and measurement frequency and pattern. Specifically the open land areas surrounding Building G-1 was segregated into two classification areas; these are termed affected and unaffected areas. These classifications are defined as follows:

- Affected Areas

Areas that have potential uranium contamination (based on plant operating history) or known uranium contamination (based on preliminary radiological surveillance). This would normally include areas where uranium materials were used and stored, where records indicate spills or other unusual occurrences that could have resulted in spread of uranium contamination and where uranium materials were buried. Areas immediately surrounding or adjacent to locations where uranium materials were used and stored, spilled or buried are included in this classification because of the potential for inadvertent spread of uranium contamination.

- Unaffected Areas

All areas not classified as affected. These areas are not expected to contain uranium residual radioactivity, based on a knowledge of site history and previous survey information.

It is recognized that as site characterization and sampling efforts progress, an area's classification may require changing, based on collected survey and sampling data. Identification of soil activity levels in excess of 25% of the guideline, either by scans or measurements, will require further investigation to determine whether reclassification of an area to the "affected category" is necessary. Identification of soil activity levels in unaffected areas in excess of 75% of the guideline will require that the area be classified as "affected."

To facilitate survey design and assure that the number of survey data points from an area is sufficient to enable statistical evaluation, the areas have been divided into survey units which have a common history or other characteristics naturally distinguishable from other portions of the site. Table 5.2.1-1 presents the classifications of the affected and unaffected areas of the Engelhard site. Figure 5.2.1-1 shows the location of the identified affected areas.

5.2.1.1 Grid System

In accordance with the guidance presented in Draft NUREG/CR-5849, a grid system will be established to provide a traceable reference for survey measurements/sampling locations, to provide a convenient method for determining the average uranium contamination levels, and for providing a reference for future relocation of survey and sampling points. The grid intervals will be based on the potential for residual uranium contamination on the pavement buildings and open land areas.

A 2 meter x 2 meter (6 feet x 6 feet approximately) grid will be established for affected area pavement identified in Section 5.2.1.2.2. A 10 meter x 10 meter (30 feet x 30 feet approximately) grid will be established for affected and unaffected open land areas identified in Section 5.2.1.2 and 5.2.1.3.

5.2.1.2 Affected Areas

5.2.1.2.1 Open Land

The affected areas specific to the open land areas onsite are located to the south and west, adjacent to Building G-1 (Figure 5.2.1-1).

5.2.1.2.2 Pavement

The paved area adjacent to the south and west of Building G-1 will be considered an affected area (Figure 2.1.1-3).

5.2.1.3 Unaffected Areas

5.2.1.3.1 Open Land

The unaffected open land areas include all remaining openland areas surrounding Building G-1 extending outward to 150 feet, where accessible.

5.2.1.3.2 Pavement

All paved areas excluding those identified in Section 5.2.1.2.2 will be considered unaffected.

5.2.2 Sampling Methodology and Frequencies

The determination of the distribution and extent of the residual uranium contamination in the selected affected open land areas surrounding Building G-1 and G-2 will be accomplished through the use of surface scans, surface activity measurements (direct and removable), exposure rate measurements and surface and subsurface soil sampling. In addition, surface water, groundwater, vegetation and air sampling will be performed.

5.2.2.1 Surface Scans

Scanning of surfaces to identify locations of residual surface and near-surface uranium activity will be performed according to the following protocol:

- 100% scan of the openland area surrounding Building G-1 and G-2 (up to a distance of 150 feet, where accessible).

- 100% scan of accessible process/storm sewers.

Open land surfaces and pavement will be scanned for beta/gamma radiations only at 1 cm from ground surface using a calibrated Geiger Mueller (GM) pancake probe coupled with ratemeter, or equivalent instrumentation. The paved areas will be scanned using a large area (425 cm^2) gas proportional detector mounted on wheels.

Instrumentation for scanning is listed in Table 5.2.2.1-1. The instruments having the lowest detection sensitivity will be used for the scans, wherever physical surface conditions and measurement locations permit.

Scanning speeds will be no greater than one detector width per second for beta gamma detection instruments and 1.5 feet per second for gamma instruments. Audible indicators will be used to identify locations, having elevated (2 to 3 times ambient) levels of direct radiation. All scanning results will be noted on standard field record forms.

Areas of elevated direct radiation (above the guideline limit) identified during scan surveys of soil surfaces and pavement will be identified and documented. The results of the scan will satisfy the guideline limit at the 95% confidence level. Locations of elevated radiation will be identified for later investigation, biased soil sampling and remediation, if necessary.

5.2.2.2 Surface Activity Measurements

5.2.2.2.1 Direct Measurements

Direct measurements of beta-gamma surface activity will be performed at selected locations using instrumentation described in Table 5.2.2.1-1. Direct measurements of alpha surface activity will be performed on 10% of the beta-gamma direct measurements. Unless precluded by surface conditions or physical parameters, the most sensitive of the instruments listed for surface

measurements will be used. Measurements will be conducted by integrating counts over a one minute period.

Because the scanning techniques using the gas proportional flow counter with a large probe area (100 cm^2) is capable of detecting residual uranium activity at < 25% of the guideline level, direct surface activity measurements will be systematically performed at 2 m intervals on paved surfaces of affected areas.

5.2.2.2.2 Removable Contamination Measurements

A smear for removable alpha and beta/gamma contamination will be collected on paved surfaces and process/storm sewers at each direct surface activity measurement location if direct surface activity readings are above the removable (fixed) surface activity contamination limits.

5.2.2.3 Exposure Rate Measurements

Gamma exposure rates will be measured at one meter above ground using a pressurized ionization chamber (PIC), a NaI (Tl), μR-meter, a μRem-meter, or equivalent gamma scintillation instrument, that has been calibrated against a PIC at the site. Measurements will be uniformly spaced according to the following pattern:

Open Land Areas

Affected Areas: 5 measurements per 100 m^2 grid block and any other locations where the radiation level measured during the 100% walkover scan exceeded twice background.

Unaffected Areas: 90 measurements at the borehole and surface sample locations and any other locations where the radiation level measured during the 100% walkover scan exceeded twice background.

5.2.2.4 Soil Sampling

5.2.2.4.1 Surface

5.2.2.4.1.1 Affected Areas

Eight surface (0-6 in) soil samples (approximately 1 pound each) will be collected from surface and subsurface sample locations from each specified 10 meter x 10 meter grid block located within the affected area as shown on Figure 5.2.1-1.

The surface soil samples will be analyzed for uranium via gamma spectroscopy. Alpha spectroscopy will be performed on three soil samples to confirm the gamma spectroscopy results.

5.2.2.4.1.2 Unaffected Areas

Eighty-two surface (0-6 in) soil samples (approximately one pound each) will be obtained from surface and subsurface locations within unaffected openland areas surrounding Building G-1 and G-2 as shown on Figure 5.2.1-1. At each surface sampling location, contact beta-gamma levels will be obtained prior to sampling to determine whether subsurface uranium contamination may be present. The soil samples will be analyzed for uranium via gamma spectroscopy.

5.2.2.4.2 Subsurface

Subsurface investigation will be performed at 57 locations (Figure 5.2.1-1) surrounding Building G-1 and G-2. The borings will be advanced through the soil and pavement using a truck mounted drill rig and a split spoon sampler. The borings will extend to a depth of four feet. Samples will be recovered from the surface (0-6 in) and from each two foot increment (0-2 ft and 2-4 ft). Field screening of the concrete/asphalt and soil samples will be conducted to determine the presence of contamination. The two foot sample will be separated into 6-inch increments, depending on the results of the field screening of each 2-foot sample. The samples will than be analyzed for their uranium concentration by gamma spectroscopy. The specific number of subsurface soil samples that will be collected from the affected and unaffected areas are described in the subsequent sections.

5.2.2.4.2.1 Affected Areas

Subsurface samples will be collected from six locations in the affected area (Figure 5.2.1-1).

5.2.2.4.2.2 Unaffected Areas

Subsurface samples will be collected from fifty-one locations in the unaffected areas (Figure 5.2.1-1).

5.2.2.5 Water

5.2.2.5.1 Surface

Six surface water samples will be collected from the Cuyahoga River at various locations (three upstream and three downstream of the process/stormwater discharge) to determine the impact of the uranium contamination on local surface water regime. Samples will also be taken from any standing water located onsite. These samples will be analyzed for gross alpha and gross beta activity. If the gross alpha and/or gross beta analysis results exceed the proposed EPA limit of 30 pCi/l and 50 pCi/l, respectively, or if the reported lower limit of detection for these analyses exceed the proposed EPA limits, then the samples will be analyzed for uranium via gamma spectroscopy.

5.2.2.5.2 Groundwater

Eight groundwater samples will be collected from existing (DM-5, DM-11, DM-13, DM-14, DM-17, RMW-35, RMW-38, RMW-40) wells onsite (Figure 5.2.1-1) to determine the impact of uranium contamination on the local groundwater regime. These samples will be analyzed for gross alpha and gross beta activity. If the gross alpha and/or gross beta analysis results exceed the proposed EPA limit of 30 pCi/l and 50 pCi/l, respectively, or if the reported lower limit of detection for these analyses exceed the proposed EPA limits, then the samples will be analyzed for uranium via gamma spectroscopy.

5.2.2.6 Sediments

Six sediment samples will be collected from the sewer (if available). Samples of sediments found in other stormwater drain lines will also be collected, if available. The actual number of sediment samples to be taken is not known at this time since the availability of the sediment in the lines is unknown. Sediment samples collected will be analyzed for uranium via gamma spectroscopy.

5.2.2.7 Vegetation

Six samples of vegetation will be collected at various locations to determine uranium uptake, if any, in indigenous plant species. The vegetation samples will be analyzed for uranium via gamma spectroscopy.

5.2.2.8 Air Sampling

Air samplers will be set up at the north, south, east and west site perimeter fence lines to confirm the absence of airborne uranium. At the end of each day or week (or sooner if dust loading of the filter paper dictates) the filter pad will be exchanged and analyzed for gross alpha and beta activity. All filters will be analyzed for gross alpha and gross beta activity. A select number (3) of the filter pads will be analyzed for uranium activity to establish a correlation between gross alpha and gross beta and uranium.

5.2.2.9 Environmental Exposure Rate Measurements

A thermoluminescent dosimeter (TLD) will be installed on the north, south, east and west fence lines (total of 4 TLDs) to measure the exposure rates to the public from onsite residual uranium contamination. In addition, these TLDs will provide a baseline during site characterization activities and subsequent remediation activities. The TLDs will be exchanged on either a monthly or quarterly frequency.

5.2.2.10 Background Level Determinations

A total of three surface soil samples will be collected from various locations within 0.5 to 10 km of the Engelhard site to establish background levels of uranium in soil. These samples will be

collected from locations which are geologically similar to the site and are unlikely to be affected by the contamination from the presence of any licensed material from any user. The background soil samples will be analyzed for uranium contamination via gamma spectroscopy. In addition to soil samples, exposure rate levels will be measured at one meter above the ground surface at the same location that the background soil samples will be collected to establish background exposure rates.

Three of the six surface water samples collected from the Cuyahoga River, upstream of the site discharge will be used to establish background levels of uranium in water.

A total of three vegetation samples will be collected from nearby areas to establish background levels of uranium in indigenous plants.

5.3 Laboratory Analytical Work

Proposed analytical work for uranium is gross alpha and gross beta activity and gamma and/or alpha spectroscopy. All laboratory analysis will be done by a qualified contractor laboratory and will follow analysis methodology outlined in EPA 900.0 for gross alpha and gross beta activity, ESML-LV-0530 (or equivalent) for gamma spectroscopy, and ESML-LV-0539-17 (or equivalent) for alpha spectroscopy. Laboratory quality assurance and quality control procedures are to be provided by the laboratory and specific quality assurance procedures for contracted laboratory work will be provided in the contract laboratory Quality Assurance Program. Quality assurance/quality control requirements for site characterization activities are described in detail in Sections 7.0 and 8.0.

5.4 Data Management and Analysis

The preparation of the Site Characterization Plan (SCP) for the site included a preliminary review of radiological surveys and final reports prepared during previously conducted monitoring, remedi-

al/decontamination efforts, and confirmatory surveys at the site. A complete review of available information and the correlation of this data with collected data will be conducted as part of the site characterization activities and during the preparation of remedial and decontamination options for affected areas.

Data collected and managed under the plan can be divided into field and technical data. Field data will consist of real-time measurements. Technical data will include field and laboratory analytical data, plus the results of field and laboratory quality control samples. Elements of field and laboratory documentation will include: recording of field data in notebook entries, data forms, and electronic media; recording or laboratory data; validation of data entry and data display, and analysis methods.

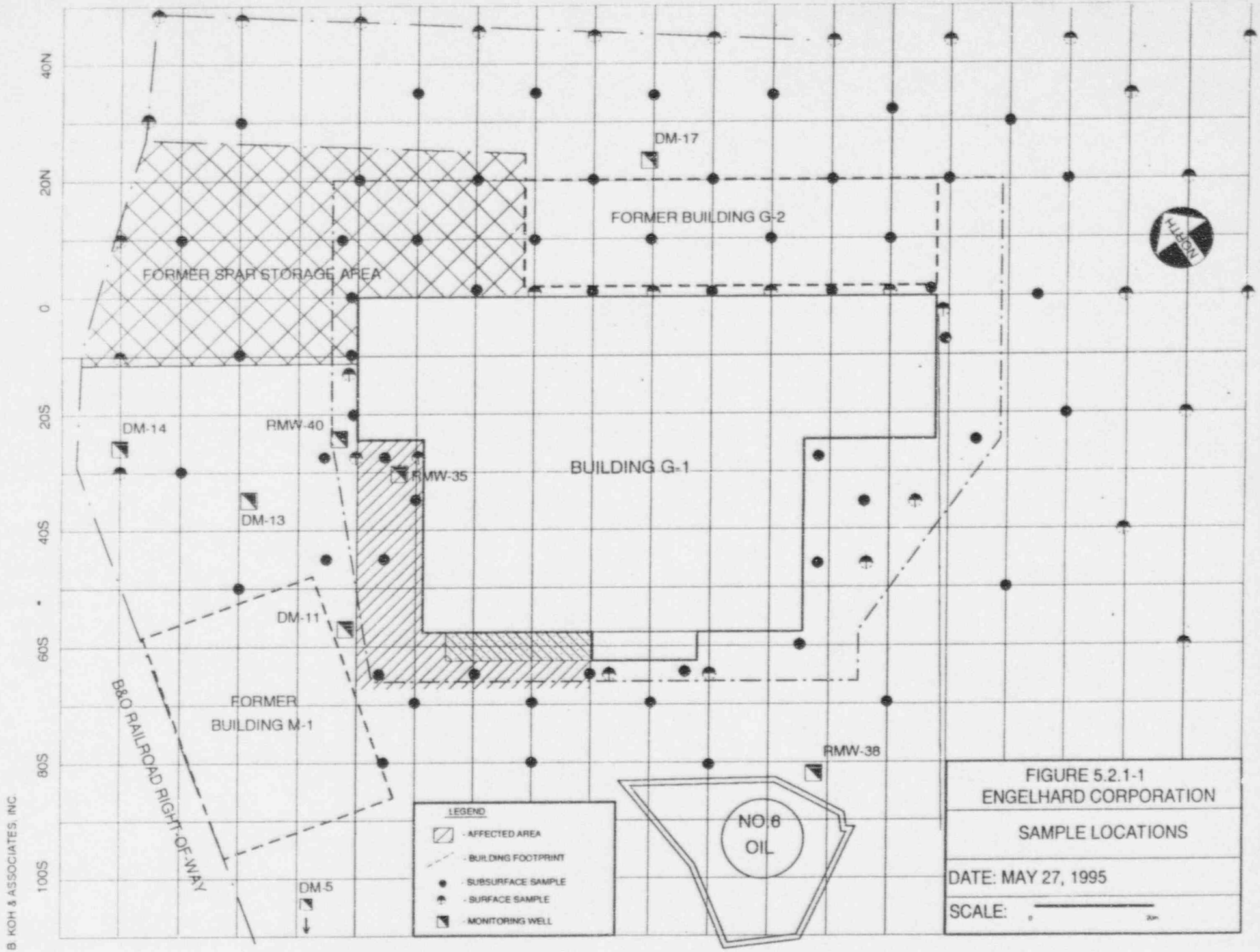
Data recording, reduction, validation, reporting and other recordkeeping/documentation associated with processing samples and data collected during the site characterization activities will be maintained by the Project Manager or designee.

TABLE 5.2.1-1

CLASSIFICATION OF OPENLAND AREA SURROUNDING BUILDING G-1
ACCORDING TO CONTAMINATION POTENTIAL

Location	Survey Unit	Classification of Contamination Potential	Remarks
Openland Area adjacent to West Side of Building G-1	Five 10 m x 10 m Grids	Affected	Known contamination from ANL Report (1,820 pCi/g Uranium) and Remcor Report (110 pCi/g gross alpha)
Openland Area adjacent to South Side of Building G-1	Three 10 m x 10 m Grids	Affected	Known contamination from ANL Report (1,190 pCi/g uranium)
Process/Storm Sewer	Accessible manhole locations	Unaffected	No known history of contamination
All other openland areas surrounding Building G-1 and G-2 extending outward to 50m	Openland area excluding affected area	Unaffected	No known history of contamination

Type of Measurement	Meter			Detector						
	Make	Model	Description	Make	Model	Description	BKG	EFF	Detector Sensitivity	Mode of Operation
Exposure rate measurements	Bicron	Micro Rem	Exposure rate analog display in units of μRem/hr	Bicron	N/A	Internally mounted tissue equivalent scintillator	7 μR	N/A	2 μR/hr	Analog display of exposure rate
Exposure rate measurements	Ludlum	19	Exposure rate analog display in units of μR/hr	Ludlum	N/A	Internal 1" x 1" NaI scintillation	7 μR	N/A	2 μR/hr	Analog display of exposure rate
Low level gamma scans, correlation with exposure rates or activity concentration	Ludlum	2221	LCD digital scaler/ratemeter with analog scaler	Ludlum	44-10	2" x 2" NaI scintillation	2000 cpm	About 500 cpm per μR/hr	2 μR/hr	Digital and analog display of count rate
Low level gamma scans, correlation with exposure rates or activity concentration	Ludlum	2241	LCD digital scaler/ratemeter	Ludlum	44-10	2" x 2" NaI scintillation	2000 cpm	About 500 cpm per μR/hr	2 μR/hr	Digital display of count rate
Exposure rate instrument	Ludlum	2241	Exposure rate digital display in units of μR/hr	Ludlum	44-10	2" x 2" NaI scintillation		N/A		Digital display of exposure rate
Exposure rate instrument	Ludlum	2241	Exposure rate digital display in units of mR/hr	Ludlum	44-9	15 cm^2 GM tube		N/A		Digital display of exposure rate
Direct measurements for beta emitters	Ludlum	2221	LCD digital scaler/ratemeter with analog scaler	Ludlum	44-9	15 cm^2 GM tube	50 cpm	26%	77 cpm	Digital and analog display of count rate
Direct measurements for beta emitters	Ludlum	2241	LCD digital scaler/ratemeter with analog scaler	Ludlum	43-68	Gas flow proportional detector (100 cm^2 active area with thin aluminized mylar window 0.8 mg/cm^2)	300 cpm	37%	361 cpm	Digital display of count rate
Direct measurements for beta emitters	Ludlum	2221	LCD digital scaler/ratemeter with analog scaler	Ludlum	43-68	Gas flow proportional detector (100 cm^2 active area with thin aluminized mylar window 0.8 mg/cm^2)		36%		
Direct measurements for alpha emitters	Ludlum	2241	LCD digital scaler/ratemeter with analog scaler	Ludlum	43-68	Gas flow proportional detector (100 cm^2 active area with thin aluminized mylar window 0.8 mg/cm^2)		60%		Digital display of count rate
Direct measurements for alpha emitters	Ludlum	2241	LCD digital scaler/ratemeter with analog scaler	Ludlum	43-5	Zinc sulfide probe, 50 cm^2 active area with .8 mg/cm^2 aluminized mylar		11%		Digital display of count rate
Direct measurements for alpha emitters	Ludlum	2221	LCD digital scaler/ratemeter with analog scaler	Ludlum	43-5	Zinc sulfide probe, 50 cm^2 active area with .8 mg/cm^2 aluminized mylar	.5 cpm	11%	5.6 cpm	Digital and analog display of count rate
Portable contamination monitor	Ludlum	3	Count rate analog display	Ludlum	44-9	15 cm^2 GM tube	50 cpm	approx 23%	N/A	Analog display of count rate
Portable floor contamination monitor	Eberline	ESP-1	LCD digital scaler/ratemeter	Ludlum	43-37	Gas flow proportional detector (425 cm^2 active area with thin aluminized mylar window 0.8 mg/cm^2)	1,500 cpm	35% α 50% β		Digitial display of countrate
Air samplers	Radeco	H-809V1	Variable flow rate sampler	N/A	N/A	N/A	N/A	N/A	N/A	Timed sample of no more than 15 min
Air samplers	Eberline	RAS-1	Flow rate sampler	N/A	N/A	N/A	N/A	N/A	N/A	Continuous
Air samplers	SKC	PCXR3	Variable flow rate sampler	N/A	N/A	N/A	N/A	N/A	N/A	Continuous
Air sample and smear counter scaler	Ludlum	2929	LCD digital alpha/beta scaler	Ludlum	43-10-1		60 cpm beta 0.07 cpm alpha	27% 30%	89 cpm 3.7 cpm	Digital display of count rate


40N
20N
0
20S
40S
60S
80S
100S
DM-17
FORMER BUILDING G-2
FORMER SRAP STORAGE AREA
NORTH
DM-14
RMW-40
RMW-35
BUILDING G-1
DM-13
DM-11
FORMER
BUILDING M-1
B&O RAILROAD RIGHT-OF-WAY
RMW-38
NO.6
OIL
DM-5
LEGEND
- AFFECTED AREA
- BUILDING FOOTPRINT
- SUBSURFACE SAMPLE
- SURFACE SAMPLE
- MONITORING WELL
FIGURE 5.2.1-1
ENGELHARD CORPORATION
SAMPLE LOCATIONS
DATE: MAY 27, 1995
SCALE:
B. KOH & ASSOCIATES, INC.
ENGEL-6

6.0 TECHNICAL APPROACH

6.1 Sampling and Surveying Protocols

Several sampling and survey protocols are considered for collection of data required to characterize the open land areas surrounding Building G-1 and G-2. Each of the potentially impacted media will be included in the evaluation, including soils, surface water and sediments, groundwater, and air quality, vegetation, and direct exposure. Collection of all samples will be conducted in accordance with accepted NRC or EPA guidelines, as outlined in referenced literature.

6.1.1 Soils

6.1.1.1 Surface

Surface samples will be collected using trowels, spoons, or shallow cores (0-6 in). No other special equipment or provisions are required.

6.1.1.2 Subsurface

Subsurface soil samples will be collected by hand augering surface soil sampler or by drilling and sampling using a split spoon soil sampler. Subsurface soil samples will be collected down to a 4 foot depth and will be continuously collected at 2 foot intervals along the length of the borehole.

6.1.2 Surface Water and Sediments

Surface water samples will be collected using either direct fill methods (i.e., the sample will be collected directly into the sample container) or other acceptable procedures as outlined in

EPA/SW-846. As an alternative, the sample jar may be fastened to an extension handle if required due to inaccessibility of sample location.

Sediment samples will be collected using a stainless steel spoon for shallow (0-6 in) sediment samples or a sediment core for deeper (6-24 in) samples.

6.1.3 Groundwater

Previous groundwater monitoring of the site was conducted by Remcor *(Remcor, 1991)* (see Section 2.1.2.2.2.3). Groundwater samples from most of the existing and newly installed monitoring wells indicated low levels (background) of gross alpha and gross beta activity. Samples obtained from wells DM-5 and DM-14 contained gross beta levels of 760 and 220 pCi/l, respectively. These levels were attributed to the presence of K-40 which is related to potassium storage in that area(s). No gamma spectroscopy or other analyses were performed to identify the specific nuclides. Therefore, additional samples of selected onsite wells will be performed to determine the specific contaminant via alpha and gamma spectroscopy.

If site characterization data indicates that a potential for impact to local groundwater exists, then additional groundwater monitoring wells will be proposed. The additional groundwater monitoring program will include the number of wells, their location and depth, and the frequency of sampling.

All wells will be installed such that the top portion of the upper aquifer is screened. Actual well placement depths will be based on site hydrology and will be determined by the field hydrogeologist/geotechnical consultant. Groundwater will be sampled and analyzed for gross alpha and gross beta activity in a manner similar to Section 5.2.2.5.2.

6.1.4 Air Quality

Air quality will be monitored for dust concentrations using particulate samplers. High volume samplers and/or low volume continuous samplers will be used to collect particulates on filters and the filters subsequently analyzed for gross alpha and gross beta activity to determine the potential uranium airborne contamination.

6.1.5 Vegetation

Samples will be taken of vegetation from onsite to determine possible uptake of uranium. Grab samples of similar species of vegetation will be collected from various locations onsite and offsite. Sample locations and plant species will be documented.

6.1.6 Walkover Scans

Walkover scans of the open land areas of the site will be performed using a calibrated 2" x 2" NaI(Tl) probe (e.g., Ludlum Model 44-10) coupled with a ratemeter (e.g., Ludlum Model 2221 or 2241), a Geiger Mueller (GM) pancake probe (e.g., Ludlum Model 44-9) coupled with a ratemeter (e.g., Ludlum Model 2221) or equivalent.

Walkover scans of the pavement of the site will be performed using a cart mounted calibrated gas proportional survey probe (Ludlum 43-37) coupled with a ratemeter (Eberline Model ESP-1).

6.1.7 Contamination Survey Measurements

Contamination survey measurements will be performed on paved surfaces to determine the level of surface contamination (fixed and removable). Contamination surveys will consist of direct and smear measurements.

The direct measurements will be performed using a calibrated GM pancake probe (e.g., Ludlum Model 44-9 for β-γ and Model 43-5 for α) coupled with a survey ratemeter (e.g., Ludlum Model 2221 or 2241) or equivalent. Direct surveys will be performed for both α and β-γ contamination.

Smear measurements will be performed using an adhesive backed filter pad and applying moderate pressure. Smearing 100 cm^2 area. The smear will be counted for α and β/γ activities in a calibrated proportional counter (e.g., Ludlum Model 2929) or equivalent.

Table 5.2.2.1-1 presents the typical radiation survey instrumentation and equipment that will be used during characterization of the Engelhard site.

6.1.8 Radiation Exposure Measurements

Radiation level measurements (gamma radiation) will be obtained at approximately 70 locations (measured at 1 meter form the soil surface) throughout the paved and open land soil areas. The radiation levels will be measured using a calibrated μR/hr or μRem (e.g., Ludlum Model 19 or Bicron) survey ratemeter or equivalent.

6.1.9 Environmental Exposure Monitoring

Thermoluminescent dosimeters (TLDs) may be used to measure the exposure rates to the general public at the site boundaries, if deemed appropriate. The TLDs will be obtained from a qualified vendor who participates in the National Voluntary Laboratory Accreditation Program (NAVLAP).

7.0 ANALYTICAL PROGRAM AND PROCEDURES

The analytical program for the field activities at the Engelhard site are described below. Laboratory analysis will consist of radiological analysis by alpha or gamma spectroscopy for uranium and chemical analysis for metals.

Radiological and chemical analysis will be conducted by an offsite laboratory under contract to B. Koh & Associates, Inc. The required analyses will be performed by qualified individuals using approved and documented laboratory procedures. The data quality objectives for uranium analysis of various media (water, soil, sediment and vegetation) are presented in Section 1.1.3. Laboratories will conduct internal quality assurance audits in accordance with their respective quality control program.

A summary of the types and number of samples to be analyzed is shown in Table 7-1. A summary of the types and number of samples to be analyzed for quality control purposes is shown in Table 7-2. Samples will be collected in accordance with protocols described in Section 5.0.

Methods to be utilized for the analysis of water samples will be consistent within EPA methods and guidelines and are presented below.

Parameter	Container	Preservative	Holding Time	Analysis Method
Water				
Gross α/β	1 liter (P or G)	Nitric Acid	6 Months	EPA 900.0
Uranium				EPA 901.1
Soil/Sediment				
Gross α/β	100g-500g (P)	None	N/A	EPA 900.0
Uranium				EPA 901.1
TCLP Metals				EPA 6010
Total Nickel				EPA 6010
Vegetation				
Uranium	100g-500g (P)	None	N/A	EPA 901.1

P = Plastic, G = Glass

7.1 Surface Water Samples

7.1.1 Sampling and Analysis Plan

Six surface water samples (three upstream and three downstream) will be collected from the Cuyahoga River. In addition, surface water samples will be collected from the stormwater sewers and/or manholes running northwest to southeast (to the south of Building G-1) onsite, when stormwater is available. Water samples will be analyzed for gross alpha and gross beta activities. If the gross alpha and/or gross beta analysis results exceed the proposed EPA limit of 30 pCi/l and 50 pCi/l, respectively, or if the reported lower limit of detection for these analyses exceed the proposed EPA limits, then the samples will be analyzed for uranium via gamma spectroscopy.

7.1.2 Quality Control Samples

Two field duplicates and an appropriate number of trip blanks will be submitted to the laboratories along with the surface water samples. In addition, Section 8.0 outlines the quality assurance/quality control requirements to be implemented for the site characterization activities.

7.2 Soil/Sediment Samples

7.2.1 Sampling and Analysis Plan

Sediment, surface, and subsurface soil samples are to be collected from within the Engelhard site. Based on existing data, approximately 318 soil and six sediment samples will be collected for analysis from within the site, as described in Section 5.0.

Radiological testing for uranium via alpha or gamma spectroscopy will be completed on all surface/sediment and subsurface soil samples collected during site characterization.

7.2.2 Quality Control Samples

Quality control samples to be collected during soil/sediment sampling activities consist of the original samples collected and analyzed. Section 8.0 outlines the quality assurance/quality control protocols to be implemented for the site characterization activities.

As part of the quality assurance procedures, five to ten percent of the samples analyzed for uranium will be sent to an independent laboratory or to the NRC Oak Ridge Institute for Science and Education for verification analysis.

7.3 Groundwater Samples

7.3.1 Sampling and Analysis Plan

One groundwater sample will be collected from each of the following monitoring wells (DM-5, DM-11, DM-13, DM-14, DM-17, RMW-35, RMW-38, RMW-40). Groundwater samples will be analyzed for gross alpha and gross beta activities. If the gross alpha and/or gross beta analysis results exceed the proposed EPA limit of 30 pCi/l and 50 pCi/l, respectively, or if the reported lower limit of detection for these analyses exceed the proposed EPA limits, then the samples will be analyzed for uranium via gamma spectroscopy.

7.3.2 Quality Control Samples

Two field duplicates and an appropriate number of trip blanks will be submitted to the laboratories along with the groundwater samples.

7.4 Vegetation Samples

7.4.1 Sampling and Analysis Plan

Six vegetation samples will be taken by grab sampling from the grassy area to the North of Building G-1. Also, three vegetation samples will be taken by grab sampling from outside the site. Analytical methods to be utilized for the analysis of vegetation during characterization activities will be consistent with EPA Method 900.1 (EMSL-LV-0534-17, 0539-17) and guidelines.

7.4.2 Quality Control Samples

One vegetation sample will be collected and split for quality control purposes.

7.5 Air Samples

Four air samples will be collected during the characterization activities in accordance with the protocol, as described in Section 5.2.2.8.

7.5.1 Sampling and Analysis Plan

The four air samples will be collected in accordance with the protocol, as described in Section 5.2.2.8.

7.5.2 Quality Control Samples

Two of the air particulate samples collected will be analyzed for gross alpha and gross beta activity and then sent to an independent laboratory for gross alpha and gross beta activities for quality control purposes. Uranium analysis will be performed if the gross alpha and/or gross beta limits are exceeded. The air samplers will be calibrated in accordance with the manufacturer's specification.

7.6 Radiation Level Measurements

Gamma exposure rate measurements and TLD placement and removal performed during site characterization activities will be conducted in accordance with the protocol described in Sections 5.2.2.3 and 5.2.2.9. TLDs will be analyzed by a NAVLAP vendor.

7.6.1 Sampling and Analysis Plan

Approximately 130 gamma exposure rate measurements will be taken at the site. In addition, readings from the TLDs placed around the perimeter of the site will be obtained monthly or quarterly.

7.6.2 Quality Control Samples

Gamma exposure measurements will be taken with a portable ratemeter with a gamma scintillation detector. The ratemeter will be calibrated with a suitable and traceable source standard cross-calibrated with a Reuter-Stokes pressurized ionization chamber.

In addition, daily source checks will be conducted to ensure proper instrument operation.

TABLE 7-1

RADIOLOGICAL AND CHEMICAL ANALYSIS SUMMARY
ENGELHARD SITE

	Uranium	Gross Alpha	Gross Beta
Surface Water	6*	6	6
Sediment	6	-	-
Soil	318	-	-
Groundwater	8*	8	8
Vegetation	6	-	-
Air	4**	6	6
TOTAL	348	20	20

*Uranium analysis will be performed if gross alpha and gross beta activities exceed proposed EPA limits of 30 pCi/l and 50 pCi/l, respectively, or if lower lin of detection for gross alpha and gross beta activities are greater than the proposed EPA limits.

**Uranium analysis will be performed if the gross alpha and gross beta activities exceed the 10 CFR 20 limits for public exposure.

TABLE 7-2

QUALITY CONTROL RADIOLOGICAL SAMPLE SUMMARY
ENGELHARD SITE

	Uranium	Gross Alpha	Gross Beta
Surface Water	2*	2	2
Sediment	1	-	-
Soil	15	-	-
Groundwater	2*	2	2
Vegetation	1	-	-
Air	2**	2	2
TOTAL	23	6	6

*Uranium analysis will be performed if gross alpha and gross beta activities exceed proposed EPA limits of 30 pCi/l and 50 pCi/l, respectively, or if lower lim of detection for gross alpha and gross beta activities are greater than the proposed EPA limits.

**Uranium analysis will be performed if the gross alpha and gross beta activities exceed the 10 CFR 20 limits for public exposure.

8.0 QUALITY ASSURANCE

Site characterization activities at the site will be conducted under a system of management and quality assurance (QA) controls to ensure the validity of data. The purpose of these controls is to ensure that technical data generated are accurate, representative, and will ultimately withstand regulatory agency scrutiny.

Quality Control (QC) consists of a system of checks on field sampling and laboratory analysis (through the use of field blanks, duplicates, documentation of sample movement, chain-of-custody records, etc.) to provide supporting information on the quality of the methods employed and on the data. QA consists of independent overview checking to certify that the QC procedures have been properly implemented to produce accurate data.

The management and QA controls established for site characterization activities will incorporate the following activities:

- Sample collection, control, chain-of-custody, and analysis;
- Document control;
- Laboratory instrumentation, analysis, and control; and
- Review of project reports.

Analytical samples will be collected in the field utilizing approved field procedures consistent with EPA SW-846 and NUREG/CR-5849 and will be sent to the designated laboratory for analysis. Duplicates, replicates, and blank samples will be used, as appropriate, to develop estimates of the quality of the analytical data. Cross checks with NRC, ORISE or other outside independent laboratories will be used. Field surveillances will be conducted to document that proper sampling techniques and chain-of-custody procedures are followed. Field data compilation, tabulation, and analysis will be checked for accuracy. Calculations and other post-field tasks will be reviewed by the Project Manager or designee. Equipment used to take field measurements will be maintained and calibrated in accordance with established procedures. Records of calibration and maintenance

will be kept by assigned personnel. Field testing and data acquisition will be performed following guidelines presented in Sections 5.0, 6.0 and 7.0.

9.0 HEALTH AND SAFETY PLANS

A Health and Safety Plan which includes a Radiological Control Plan will be developed which meets the objectives of the site characterization activities. Each contractor will have a designated Health and Safety Officer for the project who will be responsible for implementation of and compliance with the Site Health and Safety Plan. It is anticipated that characterization work will be performed in Modified Level D protection with shoe covers, disposable gloves and coveralls/Tyveks. TLDs will also be worn, other protective equipment include eye protection, hearing protection, hard hats and steel-toed safety shoes, as appropriate. Materials coming into contact with samples will be monitored for contamination and/or decontaminated prior to coming into contact with another sample. Air purifying respirators will be provided by each contractor if air monitoring indicates the need to do so.

On the basis of field monitoring, the level of protection may be downgraded or upgraded at the discretion of the contractor's Health and Safety Officer and concurrence of the Project Manager. Crew members will conduct onsite activities in pairs utilizing the "buddy system." Team members will stand upwind during the collection of samples, when possible.

Each contractor will remain an independent contractor with respect to all services performed and is responsible for complying with all federal, state, and local regulations regarding worker health and safety.

10.0 PROGRAM SCHEDULE

The characterization schedule presented in Table 10-1 outlines the proposed listing of activities for conducting the characterization of the former site.

TABLE 10-1

PROPOSED PROGRAM SCHEDULE
ENGELHARD SITE

ACTIVITY	COMPLETION TIME
Grid Layout	2 Days
Surveying Affected and Unaffected Areas	5 Days
Surface Water, Groundwater and Vegetation Sampling	1 Day
Survey/Sampling of Process/Stormwater Sewer	2 Days
Surface and Subsurface Soil Sampling	3 Days
Review of Records and Interviews	2 Days
Lab Analyses	30 Days
Review Data and Prepare Report	10 Days

11.0 REPORTS AND DELIVERABLES

All field work will be carried out in accordance with this Site Characterization Plan, the Health and Safety Plan, and the management and QA controls.

11.1 Final Report

The Final Site Characterization Report (FSCR) will include sections addressing all of the subjects discussed in this Site Characterization Plan (SCP), including recommendations for specific tasks in the next phase of the site investigation, if required. Specifically, the FSCR will be developed consistent with the NRC "Branch Technical Position on Site Characterization for Decommissioning" (NRC, November 1994) and will address results of the investigations of the site history, topography, geology, hydrology, geochemistry, climate, routes of migration, environmental fate modeling, and human health and environmental impacts as determined through dose and risk assessments, if appropriate.

Analytical data will be presented in summary tables within the text. Full data reports and analytical results will be presented in Appendices to the Final Site Characterization Report.

12.0 REFERENCES

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A D A CONSULTANTS
1348 Chippenham Drive
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504-388-4400

May 5, 1995

Mr. Andy Kopas
Engelhard Corporation
120 Pine Street
Elyria, OH 44035

Mr. William Potter
Chevron Chemical Company
6601 Bollinger Canyon Road
Sam Ramon, CA 94583

Subject: Building G1, Engelhard Corporation Harvard-Denison Plant

Dear Messrs. Kopas and Potter:

Attached are the results of the analyses of samples collected to determine if the uranium in and around the subject building was processed uranium that had not been enriched or depleted in ^{235}U.

The samples were collected by Ameriwaste Environmental and shipped to me. The samples remain under my control.

The results of these analyses confirm my contention that the uranium in Building G-1 at the Engelhard Corporation Harvard-Denison Plant is in fact processed uranium that had not been enriched or depleted in ^{235}U. As you know, the sample identified as "spar drying, third floor" was also analyzed by the Oak Ridge Institute for Science and Education (ORISE). I have not received a written copy of those results; however, I have been informed by Mr. Bill Snell (USNRC Region 3) and Mr. Eric Abelquist (ORISE) that those results confirm that the uranium was processed uranium that had not been enriched or depleted in ^{235}U.

If you have any questions, please contact me.

Sincerely,

L. Max Scott, PhD
Certified Health Physicist

Enclosures

CL28

Building G1, Harvard-Denison Plant
Engelhard Corporation

DETERMINATION OF URANIUM ISOTOPIC ABUNDANCE BY ALPHA SPEC

A sub-sample of the Engelhard "H-D Spar Drying, Third Floor" sample of 03/07/95 was selected, and ground to a fine mesh using a mortar and pestle. One gram of the ground material was weighed out and placed into a 250-ml Teflon beaker. Concentrated nitric acid (30 ml) and concentrated hydrochloric acid (20 ml) were added to the beaker, and the mixture allowed to pre-digest overnight. The next day, 2 ml of concentrated hydrofluoric acid (47%) was added to the beaker, and the mixture was brought to boiling. All particulate appeared to dissolve during the digestion, which was carried out until 10 ml of mixture remained. The beaker was allowed to cool, and then the contents were decanted into a 600 ml Pyrex beaker containing 300 ml of distilled deionized water. This solution was subsequently filtered through a 0.45 micron membrane filter and the filter discarded. The solution was then decanted into a clean 600 ml glass beaker. The beaker was rigged for electroplating with a 2.5 cm diameter, 99.999% pure polished silver disk (attached to the negative pole of a D.C. power supply). An aluminum strip was attached to the positive pole and placed in the beaker opposite the silver disk. A 0.5 mA current at 12 volts was sustained for ten minutes, which allowed positively-charged cations to plate out on the silver disk. The silver disk was removed from solution, rinsed with distilled water, and allowed to air dry.

ALPHA COUNT OF SAMPLE

The silver disk was placed into the chamber of a Tennelec TC-257 Alpha Spectrometer interfaced with a Canberra Series 35 Multichannel Analyzer. The chamber was evacuated, and an 800,000-second count was carried out.

Sample Result — Spar Drying, Third Floor:

atom ratio $^{235}U/^{238}U$ 0.0070, atom percent 0.70, and mass percent 0.69.

L. Max Scott

L. Max Scott, PhD, CHP
4/20/95

Building G1, Harvard-Denison Plant
Engelhard Corporation

GAMMA ANALYSIS

Samples were placed in 100x15-mm plastic petri dishes and analyzed using an EG&G Ortec Multichannel Analyzer connected to a Canberra High Purity Intrinsic Germanium Detector. Samples were counted for 6000 seconds. Data reduction was achieved using EG&G Gammavision. The system was calibrated in accordance with Gammavision procedures using a mixed gamma standard traceable to the National Accreditation Service (Great Britain).

L. Max Scott, PhD, CHP
4/17/95

GAMMA SPECTROSCOPY SAMPLES
BUILDING G-1, HARVARD DENISON PLANT
ENGELHARD CORPORATION

LOCATION	^{238}U [a] (pCi/g)	^{235}U (pCi/g)	$^{238}U/^{230}Th$ Activity Ratio	$^{238}U/^{226}Ra$ [b] Activity Ratio
Spar Drying, Third Floor	$6.6x10^4 \pm 2.3x10^4$	$2.1x10^3 \pm 8.4x10^1$	7.2	660
West Wall, TSD	$1.2x10^3 \pm 4.2x10^2$	$3.7x10^1 \pm 1.6x10^0$	N/A $^{230}Th < 6.5x10^1$ [c]	N/A $^{226}Ra < 1.1x10^1$ [c]
Doorway, SW Corner	$1.9x10^3 \pm 6.7x10^2$	$6.6x10^1 \pm 2.8x10^0$	N/A $^{230}Th < 8.1x10^1$ [c]	N/A $^{226}Ra < 1.6x10^1$ [c]
Soil, West of G-1 Building	$7.0x10^2 \pm 2.5x10^2$	$2.3x10^1 \pm 9.2x10^0$	N/A $^{230}Th < 5.4x10^1$ [c]	N/A $^{226}Ra < 9.4x10^0$ [c]

[a] Based on ^{234m}Pa
[b] Based on ^{214}Pb
[c] pCi/g

L. Max Scott, PhD, CHP
4/20/95