Westinghouse

Hematite Former Fuel Cycle Facility Decommissioning

TITLE:	**Hematite Decommissioning Plan** **License SNM-33** **Docket No. 70-36**
USERS:	**Hematite Decommissioning**
REVISION:	**0**

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ABBREVIATIONS AND ACRONYMS

ABB	Asea Brown Boveri
ACM	asbestos-containing material
AEC	Atomic Energy Commission
ALARA	as low as reasonably achievable
Am-241	americium-241
CE	Combustion Engineering
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
cfs	cubic feet per second
CFR	Code of Federal Regulations
cpm	counts per minute
DCGL	derived concentration guideline level
DP	Decommissioning Plan
dpm/100 cm^2	disintegrations per minute per 100 square centimeters
DQO	data quality objective
DSCC	deeper, silty clay/clay
EPA	U.S. Environmental Protection Agency
EMC	elevated measurement comparison
FEMA	Federal Emergency Management Agency
FNMC	Fundamental Nuclear Material Control
gpm	gallons per minute
GWS	Gamma Walkover Survey
HEU	high-enriched uranium
HP	Health Physics
HQAPP	Hematite Quality Assurance Program Plan
HSA	Historical Site Assessment
LEU	low-enriched uranium
LLC	limited liability company
LLD	lower limit of detection
LLRW	low-level radioactive waste
MARSSIM	Multi-Agency Radiation Survey and Site Investigation Manual
µCi/ml	microCuries per milliliter
MDA	minimum detectable activity
MDC	minimum detectable concentration
MDNR	Missouri Department of Natural Resources
mrem/y	millirem per year
Np-237	neptunium-237
NRC	U.S. Nuclear Regulatory Commission
NSSSC	near-surface silt, silty clay
PCB	polychlorinated biphenyls
PCE	perchloroethylene

pCi/g	picoCuries per gram
pCi/L	picoCuries per liter
Pu-239	plutonium-239
QA	Quality Assurance
RCRA	Resource Conservation and Recovery Act
RESRAD	Residual Radioactive Material Guidelines computer code
RSO	Radiation Safety Officer
RWP	radiation work permit
SAA	site accumulation area
SNM	special nuclear material
Tc-99	technetium-99
TCE	trichloroethylene
TEDE	total effective dose equivalent
Th-232	thorium-232
TSCA	Toxic Substances Control Act
U-234	uranium-234
U-235	uranium-235
U-238	uranium-238
UF_4	uranium tetrafluoride
UF_6	uranium hexafluoride
UNC	United Nuclear Corporation
UO_2	uranium dioxide
VOC	volatile organic compound
WP	work plan

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PREFACE

This Decommissioning Plan was prepared using the guidance in NUREG-1757 as well as other applicable or relevant documents and guidance identified in the reference section of this Decommissioning Plan. This Decommissioning Plan also has been prepared so as to be in accord with the Remedial Investigation/Feasibility Study (RI/FS) Work Plan, the National Contingency Plan (NCP), 40 CFR Part 300, and related guidance. The RI/FS Work Plan, which has been reviewed and approved by the Missouri Department of Natural Resources (MDNR), serves as the overall template for site characterization.

It should be noted that although Westinghouse is following the NCP process in achieving site remediation objectives, the Hematite Site is not listed or proposed for listing on the National Priorities List, and the United States Environmental Protection Agency is not actively involved in overseeing activities at the Site. In addition to NRC involvement, MDNR is overseeing implementation of the RI/FS Work Plan.

Pursuant to the NRC regulations, the DP must designate whether the licensee intends to decommission the site for unrestricted use or whether some future restrictions will be included. Westinghouse’s intention and objective is to meet the criteria for unrestricted use, but it will continue to evaluate this objective as more information is gathered through implementation of the characterization and RI/FS Work Plan.

As part of this Decommissioning Plan, Westinghouse has established soil DCGLs in accordance with NRC protocol. The NCP process will also be followed to establish Preliminary Remediation Goals (PRGs) and Applicable or Relevant and Appropriate Requirements (ARARs), which will include the approved DCGLs.

The final status survey for the Hematite Site will be designed using the guidance contained in MARSSIM and will, to the greatest extent practicable, be conducted in a manner consistent with the objectives and process established in the NCP and underlying EPA regulations and guidance. See Appendix F of MARSSIM.

1.0 EXECUTIVE SUMMARY

Westinghouse Electric Company LLC (Westinghouse) is proposing to decommission the Hematite Former Fuel Cycle Facility (Hematite). This site-wide Decommissioning Plan (DP) and subsequent amendments will provide the decommissioning information necessary to allow license termination and unrestricted release in accordance with the requirements of the License Termination Rule at 10 CFR 20, Subpart E. This DP was prepared using guidance in NUREG-1757, *Consolidated NMSS Decommissioning Guidance*, Vol. 1–3 (Ref. 1). Westinghouse plans to perform this decommissioning in compliance with NRC regulations. Accordingly, this DP is being submitted to the NRC for review and approval.

Throughout its history, Hematite's primary function was to manufacture uranium metal and uranium compounds from natural and enriched uranium for use as nuclear fuel. The entire site covers an area of approximately 228 acres, but licensed activities were restricted to process buildings and grounds within an approximately 10-acre central site tract. The land areas outside the central site tract have no known history of licensed activities and no evidence of soil contamination.

The decommissioning project has been divided into phases as follows:

a. Outlying Land Areas
b. Subsurface Soil Areas
c. Surface Soil and Water
d. Non-contaminated Buildings
e. Groundwater

Following approval of this DP and associated submittals, work will begin on Phase a., Outlying Land Areas. An alternate schedule will be requested to complete the remaining phases (Phases b. – e.) of work under the DP. Plans and information necessary to obtain approval for the remaining phases will be submitted as amendment requests to the DP.

The overall scope of decommissioning work under this DP and its subsequent amendments will include remediation of impacted soil and water, and performance of a final status survey. Characterization and remediation of soil and other impacted material will be performed consistent with approved DCGLs and the remedial goals and objectives established through the NCP process.

1.1 Site and Licensee Information

The Hematite facility of Westinghouse Electric Company LLC is located on a site in Jefferson County, Missouri, approximately 3/4 mile northeast of the unincorporated town of Hematite, Missouri and 35 miles south of the city of St. Louis, Missouri.

The name and address of the site licensee are:

Westinghouse Electric Company LLC
P.O. Box 355
Pittsburgh, PA 15230

The address of the site is:

Westinghouse Electric Company LLC
Hematite Site
3300 State Road P
Festus, MO 63028

All correspondence pertaining to this license should be addressed to:

Mr. A. Joseph Nardi, License Administrator
Westinghouse Electric Company LLC
P.O. Box 355
Pittsburgh, PA 15230

Phone: (412) 374-4652
Email: nardiaj@westinghouse.com
Fax: (412) 374-3357

1.2 Summary of Licensed Activities

From its inception in 1956 through 1974, the Hematite facility was used primarily in support of government contracts that required production of high-enriched uranium (HEU) products. From 1974 through the plant closure in 2001, the focus changed from government contracts to commercial fuel production. Specifically, operations included the conversion of uranium hexafluoride (UF_6) gas of various uranium-235 enrichments to uranium oxide, uranium carbide, uranium dioxide pellets, and uranium metal. These products were manufactured for use by the federal government and government contractors and by commercial and research reactors approved by the Atomic Energy Commission (AEC) and its successor the U.S. Nuclear Regulatory Commission (NRC). Research and development was also conducted at the plant, as were uranium scrap recovery processes. Over the lifetime of the facility, there have been seven owners. Mallinckrodt Chemical Works, Mallinckrodt Nuclear Corporation, United Nuclear Corporation, Gulf United Nuclear Fuels Corporation and General Atomic Company owned the plant for the government-focused phase of operations. Combustion Engineering Inc. (ABB) and Westinghouse Electric Company LLC owned the plant during the commercial phase of operations.

1.3 Nature and Extent of Site Radiological Contamination

As a result of past activities, enriched uranium (principally) and technetium (minimally) have been released to the soils in the central site tract. Due to the unknowns associated with government activities on the site, other radionuclides that will be considered isotopes of concern until proven otherwise include americium-241 (Am-241), plutonium-239 (Pu-239), neptunium-237 (Np-237), and thorium-232 (Th-232) in equilibrium with its progeny, i.e., radium-228 (Ra-228), and thorium-228 (Th-228).

A *Historical Site Assessment* (HAS) (Ref. 2) completed in 2003 identified building, soil, and environmental locations where these radionuclides are known to be or potentially exist. The soil and environmental locations are being targeted during continuing characterization to better define remediation and work control requirements. Contaminated buildings have been vacated and equipment, machinery, and furniture are being removed under the site license so as to facilitate site characterization requirements.

Based on results from the HSA and site characterization performed to date, the land areas outside the central site tract show no documented evidence of activities that might have contaminated these areas. As such, these areas are not expected to be radiologically impacted. The groundwater in the overburden has historical contamination of technetium-99. The aquifers have shown no detectable levels of radiological contamination.

Trichloroethylene (TCE) was used in the U.S. Navy fuel processes. Perchloroethylene (PCE) was used at the facility in the high-enriched uranium scrap processing operations. Both of these volatile organic compounds (VOCs) have been found in the soil and groundwater and are being addressed by a manner that is in substantial compliance with the NCP.

1.4 Decommissioning Objective

It is the objective of Westinghouse to decommission the Hematite site in a manner that is consistent with its license requirements, NRC regulations and the goals and objectives established through the NCP process (see preface). Through implementation of the approved DP all areas of the site are expected to meet the criteria for unrestricted use as specified by 10 CFR 20.1402, which will allow for the termination of Nuclear Regulatory Commission (NRC) License No. SNM-33.

1.5 Site-Specific DCGLs

The soil DCGLs are presented in a report, “Derivation of Site-Specific DCGLs for Westinghouse Electric Co. Hematite Facility” (Ref. 3), which is provided as a submittal with this DP. Surface and volumetric soil DCGLs were derived for radionuclides of concern potentially present at the Hematite site, using a residential-farmer scenario. The

NRC's primary dose limit of 25 mrem in any year in excess of natural background radiation dose was used as the basis for each derivation.

The proposed site-specific soil DCGL values for the radionuclides of concern at the Hematite site are shown in Table 1-1 below. Each DCGL represents a concentration that would produce 25 mrem/y.

The DCGL values labeled "surface source" are applicable to situations where the residual concentrations, above background, of radionuclides are located in the near surface (within approximately 0-15 cm) of the final remediated surface. Since the calculations do not assume the presence of a cover material, which may actually exist, the final remediated surface will not necessarily correspond to the actual restored surface.

The "volumetric source" DCGL values are applicable to those situations where the thickness of the soil zone containing residual concentrations, above background, of radionuclides is greater than 15 cm. Such situations will occur, for example, if excavations are backfilled with soils that contain radionuclides above background but less than the volumetric source DCGL values.

These individual radionuclide DCGLs must be combined using the sum-of-fractions rule when there is a mixture of radionuclides present. In addition, these DCGLs are based on the full license termination criteria of 25 mrem/y. Implementation of these DCGLs will involve administrative controls to apportion the 25 mrem/y criteria between the anticipated final dose components of residual soil contamination, groundwater contamination, and remaining buildings, if any.

Table 1-1 Site-Specific Soil DCGLs

Radionuclide	Surface Source (pCi/g)	Volumetric Source (pCi/g)
Am-241	117	40
Np-237+D	1.4	0.11
Pu-239	129	43
Tc-99	140	23
Th-232+C	2.9	1.5
U-234	518	188
U-235+D	63	35
U-238+D	224	127

D = short-lived decay products; C = entire decay chain (Th-232 assumed to be in equilibrium with Ra-228+D and Th-228+D)

1.6 ALARA Analysis

Because the site objective is to remediate to unrestricted use criteria and to use site-specific dose modeling to relate concentrations to dose, the results of an ALARA analysis are known on a generic basis and an analysis is not necessary.

However, because Westinghouse actively promotes the ALARA philosophy, a simplified analysis will be developed. Because the pre-remediation ALARA analysis cannot be completed until the site characterization and the related NCP process is completed, a sample analysis is being provided in Section 7.0 of this DP to demonstrate the methodology that will be used for the final analysis. The sample analysis was completed in the context of NUREG-1757, Vol. 2, Appendix N. The analysis is based upon release criteria derived from site-specific dose modeling, that is, the DCGLs referenced in Section 5.0 of this DP.

1.7 Start and End Dates

Decommissioning activities addressed by this DP are scheduled to start in April 2005, following NRC approvals of this DP, soil DCGLs, and the Final Status Survey Plan. The initial phase of work, Phase a., consists of a final survey of surface soils in the outlying land areas of the site. Phase a. is scheduled to be completed in August 2005 with the completion of the Final Status Survey Report on the outlying land areas. An alternate schedule will be requested to complete the remaining phases (Phases b.– e.) of work under the DP. Projected submittal dates for DP amendment requests for the remaining phases are shown in Figure 8-1. Schedules for the remaining phases of work will be included in the DP amendment requests. Periodic schedule updates will be submitted as the work progresses.

1.8 Post-Remediation Activities

No post-remediation activities have been identified. If required, post-remediation activities will be identified in subsequent amendment requests for this DP.

1.9 Amendment to License to Incorporate DP

The licensee is requesting the NRC to amend License No. SNM-33 to incorporate this DP.

2.0 FACILITY OPERATING HISTORY

2.1 License Number, Status, and Authorized Activities

By application dated September 11, 2001, Westinghouse notified the NRC that all principal activities, specifically those related to the manufacture of nuclear reactor fuel utilizing low-enriched uranium (LEU), at the Hematite site had ceased. Westinghouse requested an amendment to License No. SNM-33 to change the scope of licensed activities to those associated with decommissioning activities. Amendment 42 to License No. SNM-33 was issued on April 11, 2002 to reduce the possession limits for source and special nuclear material and to change the scope of authorized activities to the performance of decommissioning activities. Amendment 43 to the license issued on October 17, 2003 further reduced the possession limits to the current levels shown in Table 2-1.

Table 2-1 Special, Source, and Byproduct Material Under License SNM-33

Item	Material	Chemical and/or Physical Form	Maximum Amount
A	Uranium enriched to a maximum of 5.0 weight percent in the U-235 isotope	Any (excluding metal powders)	1,250 kilograms U-235
B	Uranium, enriched to any enrichment in the U-235 isotope	Any (excluding metal powders)	350 grams U-235
C	Uranium (natural or depleted)	Any (excluding metal powders)	2,000 kilograms
D	Cobalt-60	Sealed sources	40 millicuries
E	Cesium-137	Sealed sources	500 millicuries
F	Byproduct material, including americium-241	Any	400 microcuries
G	Special, source, and byproduct material	Any (residual contamination)	Existing at the Hematite site on July 1, 2001
H	Californium-252	Sealed sources	23.77 micrograms

The above materials are being used as follows:

1. Item A, B and C – possession of this special nuclear material and source material is limited to those activities necessary to process and package the materials into forms suitable for transfer to other licensed operations. Receipt of any additional materials in these categories is limited to that necessary to complete the decommissioning of the site and facilities. Examples of such receipts would be calibration sources and residual contamination on shipping containers and packages.

2. Items D and H – for instrument calibration and testing.

3. Item E – for possession only pending transfer to other licensed operations.

4. Item F – for instrument calibration and testing and as residual contamination on shipping containers and packages.

5. Item G – possession of this residual contamination is limited to the activities associated with the decommissioning of the site.

Current locations of radionuclide use at the site are inside the central site tract shown in Figures 3-3 and 3-4.

Table 2-2 is a list of amendments to License No. SNM-33 since its renewal on July 28, 1994.

2.2 License History

Throughout its history, Hematite's primary function has been to manufacture uranium metal and uranium compounds from natural and enriched uranium for use as nuclear fuel. Specifically, Hematite was primarily used to convert government-owned and -leased UF_6 gas of various uranium-235 enrichments to uranium oxide, uranium carbide, uranium dioxide pellets, and uranium metal. These products were manufactured for use by the federal government and government contractors and by commercial and research reactors approved by the Atomic Energy Commission (AEC). Research and development was also conducted at the plant, as were uranium scrap recovery processes.

Table 2-2 List of Amendments to License No. SNM-33

Amend. No.	Subject	Issued
1	Schedule of the Standby Trust Agreement	12/8/94
2	Organization changes	3/14/95
3	Delay in starting 1995 physical inventory	3/29/95
4	Evaporation Ponds decommissioning	5/4/95
5	Increase in possession limit	5/11/95
6	Revised Fundamental Nuclear Material Control (FNMC) Plan	5/17/95
7	Delay in completion of biennial MC&A assessment	5/18/95
8	Temporary change of UF_6 sampling procedure	8/23/95
9	Request for delay in conducting emergency exercise	11/27/95
10	Branch Technical Positions	12/20/95
11	Request for R-3 oxide conversion reactor change	1/31/96
12	Temporary change to UF_6 receipt sampling procedure	4/15/96
13	Request for validation of criticality calculational method	6/21/96
14	Transitional Facility Attachment	7/18/96
15	Increase possession limit	11/18/96
16	Temporary change to UF_6 receipt sampling procedure	2/6/97
17	Organizational changes	8/13/97
18	Request to update decommissioning plan for Hematite Evaporation Ponds	1/26/98
19	Revisions of the FNMC Plan	2/12/98
20	Authorize release of hydrofluoric acid	2/26/98
21	Changes in Chapter 4, "Nuclear Criticality Safety," of the license application	7/23/98
22	Extension to certain commitments in the FNMC Plan	1/27/99
23	Revision to Hematite Emergency Plan	3/18/99
24	Change of mailing addresses for corporate offices and facility	4/9/99
25	Request to amend the FNMC Plan	5/99
26	Time extension to report the results of the April 1999 physical inventory	6/2/99
27	Transfer and amend materials licenses, QA program approval, and COCs	6/23/99
28	Licensee name change	8/19/99
29	Temporary change to UF_6 receipt sampling procedure	10/19/99
30	Physical Security Plan changes	12/2/99
31	Credit for neutron absorbers contained in fuel pellets	12/17/99
32	Temporary change to UF_6 receipt sampling procedure	2/3/00
33	Licensee name change	3/13/00
34	Licensee name change	7/13/00
35	Delete certain license and license application commitments	8/31/00
36	Request for extension to certain commitments in the FNMC Plan	1/5/01
37	Licensee name change	4/10/01
38	Request for time extension to conduct SNM physical inventory	5/7/01
39	Plan for completion of CSPU analyses and DP for Hematite Plant	5/30/01
40	Organizational changes, name changes	10/15/01
41	Authorize exemption to fissile materials classification and package standards in transport	4/15/02
42	Change possession limits and change authorized activities to decommissioning activities	4/11/02
43	Delete Emergency Plan and two license conditions, change possession limits and authorized activities, approve new Site Manager, and designate a RSO	10/22/02
44	Change of Site Manager	1/28/04
45	Update Hematite Site Physical Security Plan and incorporate commitments	4/14/04

In 1955, Mallinckrodt Chemical Works purchased the parcel of farmland on which the plant sits. The plant became operational in July of 1956, producing uranium products for use in the U.S. Navy nuclear fuel program. Mallinckrodt Chemical Works, or the affiliated Mallincrodt Nuclear Corporation, operated the facility until approximately May of 1961 at which time ownership was transferred to the United Nuclear Corporation (UNC). UNC provided uranium products to the federal government.

In 1970, UNC and Gulf Nuclear Corporation entered into a joint venture forming, Gulf United Nuclear Fuels Corporation (Gulf), which owned and operated the facility until the spring of 1973 when Gulf closed the plant and began decommissioning. In January 1974, Gulf transferred the property to General Atomic Company. Combustion Engineering Inc. (CE) purchased the property in May 1974. In 1989, Asea Brown Boveri (ABB) acquired the stock of CE, and CE began operating the facility. In April 2000, Westinghouse purchased the nuclear operations of ABB, which included the Hematite facility. In 2001, Westinghouse announced the shutdown of the facility.

During the period prior to CE's purchase of the facility in 1974, government projects dominated the operations at the site. During this time period, the government owned all the national uranium supply and leased it to facilities as needed. In order to obtain uranium, even for government projects, a facility had to submit a request for allocation to the AEC describing the amount and enrichment of uranium needed. A review of the requests for allocation from 1959 through 1966 (the only such documents located to date) indicates that approximately 7,576 kg of uranium were requested for government-related projects and 1,887 kg of uranium were requested for commercial projects.

Much of the work on behalf of the government at the site was classified, and therefore, specific details regarding the exact nature of the processes are not known. Generally, the government work began under Mallinckrodt's supervision and then dominated Hematite production during the ownership and operation by UNC and Gulf. Examples of government projects during this time include:

- Production of uranium metal for nuclear submarines and a D1G destroyer reactor
- Supply of specialized uranium oxides for the Army Package Power Reactor
- Supply of high-enriched oxides for a General Atomics' gas-cooled reactor in Fort St. Vrain, Colorado
- Production of high-enriched metal for materials test reactors utilized by the U.S. Navy
- Supply of uranium-beryllium pellets for use in the SL-1 reactor
- Production of high-enrichment uranium-zirconia pellets under contract to Bettis Laboratory
- Production of high-enriched oxides for General Atomics for use in the NERVA nuclear rocket projects

Hematite also contracted directly with the Oak Ridge AEC office and other government contractors for the recovery of uranium from scrap materials. Scrap recovery projects at Hematite included the recovery of uranium from scrap generated by a variety of U.S. Navy projects and CUNO filter scrap generated by the Aircraft Nuclear Propulsion program.

Although the physical design of the plant was modified over the years, certain areas of the plant were dedicated to particular production processes as well as certain types of work, i.e., low-enrichment processes versus high-enrichment processes. (The layout of the facility buildings is shown in Figure 3-4.) For example, Building 240 was historically dedicated to the chemical conversion of uranium into compounds, solutions, and metal. Building 240 was further divided into areas for high-enrichment and low-enrichment uranium processes—the "Red Room" (area 240-2) contained high-enrichment conversion processes, and the "Green Room" (area 240-3) contained low-enrichment conversion processes and high-enrichment scrap processing. The Red Room was specifically used for the reduction of UF_6 to uranium tetrafluoride (UF_4), the conversion of UF_4 to uranium metal, high-enrichment uranium scrap recovery, and other chemical conversion processes using highly or fully enriched uranium.

Building 255 of the plant is understood to have been used for the fabrication of uranium compounds into physical shapes. Again, this building was segregated into areas of high enrichment and low enrichment, with area 255-2 containing the low-enrichment pellet plant and area 255-3 containing the "Item Plant." The Item Plant work was classified, and products coming out of the plant were referred to only as "items," and thus, the area received its name as the Item Plant. The Item Plant was dedicated solely to classified government-related work and specifically, U.S. Navy fuel production work. The Item Plant was specifically designed to process uranium dioxide into a U.S. Navy fuel product. Other activities within the Item Plant included the blending of uranium dioxide (UO_2) with other chemical compounds.

Other areas of the Hematite facility were used for storage and again were separated primarily by degree of enriched material or product stored. High-enrichment storage areas included Buildings 235, 250, and 252. Also, high-enrichment scrap was held in an outdoor, fenced, 75-ft. x 120-ft. area to the south of the plant.

A review has been conducted of those license application and approval documents that are available on site for the period from the initial issuance of License No. SNM-33 (July 18, 1956) until 1974 when the license was transferred to Combustion Engineering and the facility converted to the fabrication of LEU fuel for nuclear power plants. In general the available records for the early years are incomplete. Because much work was done on classified projects, the available information is limited to generalized statements. In summary, the review identified that during this period, the facility was licensed to possess enriched uranium at all enrichments up to fully enriched. The description chemical and physical form of the material possessed is limited to general statements that include "metals, oxides, and other uranium compounds." Thus, this search did not produce any information that was not already included in the Historical Site Assessment.

The quantities of special, source, and byproduct material authorized under License No. SNM-33 (Amendment 15, approved November 18, 1996) prior to the termination of nuclear fuel manufacturing operations in 2002 are listed in Table 2-3. A complete history of special, source, and byproduct material authorized for use at the site is not available.

Table 2-3 Authorized Material Prior to Plant Shutdown in 2002

Material	Chemical and/or Physical Form	Maximum Amount
Uranium enriched to a maximum of 5.0 weight percent in the U-235 isotope	Any (excluding metal powders)	20,000 kilograms U-235
Uranium, enriched to any enrichment in the U-235 isotope	Any (excluding metal powders)	350 grams U-235 *
Source material (uranium and thorium)	Any (excluding metal powders)	50,000 kilograms
Cobalt-60	Sealed sources	40 millicuries
Cesium-137	Sealed sources	500 millicuries
Mixed activation and fission product calibration sources including Am-241	Solid sources	200 microcuries
Californium-252	Sealed sources	4 milligrams

* Higher quantities were authorized during earlier periods of nuclear fuel manufacturing operations.

2.3 Previous Decommissioning Activities

2.3.1 Former Evaporation Ponds

Formal decommissioning and decontamination efforts on the Evaporation Ponds were undertaken in 1984, as specified and ordered by the NRC in a March 8, 1984 letter (Ref. 4). In response, CE submitted a decommissioning plan to the NRC by letter dated May 31, 1984 (Ref. 5). The NRC approved the plan by letter dated October 3, 1984 (Ref. 6). As a result of the 1984 decontamination, approximately 2,800 ft^3 of sludge, rock, and dirt were removed from the primary pond in August 1985. Detailed sampling of the primary pond was performed during the period of August through October 1986. Additional sampling, following the remediation effort, determined the average uranium contamination of the soil in the ponds was below the 250-pCi/g decontamination limit set by the NRC. However, contamination levels in excess of the average limit remained. In a status report dated May 20, 1988 (Ref. 7) to NRC, CE provided further information concerning the remediation of the ponds. CE reported that core samples from the sides and bottom of the primary pond were taken and analyzed. The samples revealed an average contamination of approximately 60 pCi/g, with one sample as high as 674 pCi/g. Approximately 1,200 ft^3 of soil and rock was also removed from the secondary pond during 1987, and detailed surface soil samples were taken. The average contamination from these 150 samples was 173 pCi/g, and the highest reported level was 745 pCi/g.

During the period of 1991-1992, CE commissioned a contractor to plan and execute a soil and water study of residual contamination in the ponds. The results of this study were not consistent with the previous analyses. Rather, in this testing, the near surface soil samples from both ponds showed higher total uranium activity, and further characterization of this area was required.

A status update to the NRC on the ponds dated August 13, 1999 (Ref. 8) indicated that, since a decommissioning plan for the ponds was incorporated by amendment into the site license on May 4, 1995, approximately 6,000 ft^3 of additional soil had been removed and disposed. Surveys in 1999 of the pond area indicated an average concentration of 170 pCi/g. Uranium concentrations of approximately 100 pCi/g were detected at depths of 10 ft. below ground surface, greater than originally assumed. Remediation efforts in and around the Evaporation Ponds were suspended to investigate other remedial options.

Additional details on the Evaporation Ponds are provided in Section 4.4.2 of this DP.

2.3.2 Red Room, Item Plant, Related Areas

Because these areas were used for high-enrichment fuel production processes from at least the 1950's to the early 1970's, they are highly likely to contain nuclear contamination above currently applicable limits. In fact, these areas were identified as contaminated or "hot" areas during the transition of ownership of the plant from Gulf to CE in 1974. At that time, partial decontamination was undertaken. Specifically, equipment was removed, duct work and exhaust fans were removed, the floors were scarified and both rooms were vacuumed, steam cleaned, and painted. In the Red Room, three inches of concrete was added to the floor and the roof was removed and supposedly buried on-site. However, these decontamination efforts are probably not in compliance with current regulations for free release. Moreover, additional contamination has been identified in the areas under the Red Room floor and immediately outside the Red Room. These buildings are described in Section 4.1 of this DP.

2.3.3 Site Creek

In mid-1995, it was determined that the site sewage treatment plant was having a number of upsets during routine operations, which resulted in sewage sludge collecting in the Site Creek. The sewage effluent enters the Site Creek directly below the dam, which creates the Site Pond. The sludge settled out between the dam and the railroad that crosses the site property.

A decision was made to remove the settled material. A back-hoe was used to remove silt to a depth that varied from 0.5 to 3 ft. in the area between the site dam and the railroad tracks. The removed material was dried and placed into "super sacks," which were shipped to a licensed disposal facility.

The objective of the remediation was to remove the sewage sludge and contaminated soil so that the average contamination remaining would be less than 30 pCi/g, with no single sample above 90 pCi/g. This was not a free release survey, because licensed activities continued at the site.

2.3.4 Contaminated Buildings

Decontamination and removal of systems and components inside contaminated site buildings are being performed under the current site license and to facilitate further characterization of soils and structures (e.g., sewer lines) pursuant to the NCP process. In addition, removal of these systems, components and buildings will be protective of human health and the environment by addressing releases or threatened releases into the environment (i.e., by removing radioactive materials from the facilities).

2.4 Spills

Building 240 is described in Section 4.1.6 of this DP. Past operations in this building included the conversion of HEU using a wet conversion process and wet recovery of scrap. The effluent streams were piped to the retention ponds for settling and evaporation. The piping system is likely to contain HEU. Numerous spills and leaks likely occurred in these areas and parts of the slab were re-poured in 1974 over some existing contaminated flooring. Additionally, sub-slab contamination was found during the 1989 construction of Building 253.

Other spills associated with routine fuel fabrication operations have occurred in the process buildings. The buildings contain fixed and removable contamination above the release criteria established in the site license.

2.5 Prior On-site Burials

Beginning no later than 1965, and perhaps as early as 1958 or 1959, and continuing at least until November 1970, on-site burial was used as a means of disposal of contaminated materials and wastes at Hematite. From 1965 until 1971, up to 40 large, unlined pits were dug northeast of the plant buildings. Each pit is approximately 20 ft. by 40 ft. and 12 ft. deep. These pits were used to dispose of materials and waste generated by the plant processes. This on-site burial was a formally authorized activity, conducted pursuant to a former policy and memoranda describing the size and spacing of the pits, the thickness of the cover, and the quantity of radioactive material that could be buried in each pit.

UNC and Gulf maintained detailed logs of burials for the period of July 1965 through November 1970. The entries contain dates, descriptions of the waste buried, the weight of the uranium measured for that waste, and a cumulative total of the uranium buried in particular pits. Some entries also list percent enrichment for the uranium.

The logs show a wide variety of wastes being buried in the pits. Although the number of entries is too great to include, some examples of entries include:

- Tile (Red Room floor)
- Contam. 5 gal. Endshake oil
- B.D. Chlorotherm
- 97% Acid H_2
- R.S. oil
- UO_2 ThO_2 Paper Towels
- Unknown Oil
- R.S. Acid Insoluable
- Mixed Acid Residues
- MB Rafinate Sample bottles
- Bottle unknown organics
- Pickling Solution
- 1 Drum of TCE #930 unknown enr
- vac. Oil
- KOH Insoluables
- pentachloride from vaporizer
- Used Magnorite
- TCE u. metal wash
- chlorothene – can cleanup
- TCE Rags
- Oily rags from Item floor
- $NbCl_5$ vap. Cleanout
- Item 51 Poison equipt.
- TCE-Oil-Rags
- Perclene
- press oil

No records of burials exist prior to July 1965. However, an untitled memorandum has been located indicating that burial pits may have been used as early as 1958 or 1959 and that as many as three or four pits were used each year prior to 1965. Accordingly, it is estimated that an additional 20-25 pits may exist for which there are no records. There is no information to indicate the nature of the material buried in these other pits. These pits are being investigated during the characterization. Interviews from former plant employees indicate that these pits are located next to the process buildings between the process buildings and the known pit area.

On-site burial of radioactive material was terminated in November of 1970 as a result of an AEC citation issued for failure to adhere to AEC regulations concerning the quantity of material that could be buried on site. It appears, however, that Gulf did not cover the final pit until 1974, when it sold the property.

3.0 FACILITY DESCRIPTION

3.1 Site Location and Description

The Hematite facility of Westinghouse Electric Company LLC is located on a site of about 228 acres in Jefferson County, Missouri, approximately 3/4 mile northeast of the unincorporated town of Hematite, Missouri and 35 miles south of the city of St. Louis, Missouri.

Jefferson County is predominately rural and characterized by rolling hills with many sizable woodland tracts. The land area is classified as 51% forest, 33% agricultural with crops such as grain and hay, and approximately 16% urban, suburban, commercial, and unused or undeveloped. Although extensive development in the county has resulted from urban growth around St. Louis, agricultural land use is still predominant in the site's environs. Some areas, generally ½ to 5 miles from the plant site, have been developed as small- to moderate-sized subdivisions.

A map showing the general location of the site is presented in Figure 3-1. The area within a 5-mile radius of the site is presented in Figure 3-2. The current site boundaries and the central site tract are depicted in Figure 3-3, and a site map with building locations and other infrastructure features is included as Figure 3-4.

The site is situated between hills to the northwest and a terrace/floodplain of Joachim Creek, located along the southeast site boundary. Activities with special nuclear materials were conducted within an approximately 10-acre, central site tract adjacent to the site access road, State Road P. The central site tract is developed with buildings, infrastructure, and maintained landscaping. The remaining property is woods and farmland, with no documented evidence of historic operations by Westinghouse or pervious owners. An active railroad line runs across the site southeast of the central site tract. The highest elevation on the site is approximately 560 ft. above mean sea level. The site topography drops to approximately 420 ft. above mean sea level along the banks of Joachim Creek. Topographic contours around the site are shown in Figure 3-5.

Figure 3-3 illustrates several surface water features present on or in close proximity to the site. These features are described in Section 3.6 of this DP.

The area immediately surrounding the site is primarily woods, farmland, and suburban residential. Three private residences are located on the site property, and other residences are located within 1/4 mile of the site. Groundwater is widely used within five miles of the site as the primary source of household water. According to "Water Resources Report 30, 1974," (Ref. 9) domestic and industrial water wells in the vicinity produce water from the Powell–Gasconade aquifer group, which includes the Jefferson City Dolomite, the uppermost bedrock unit at the site. Wells in the area might penetrate the Jefferson City Dolomite if it is present but presumably do not derive significant quantities of water from it due to its poor storability. There are 763 wells within a 5-mile radius of the Hematite facility. There are 721 private drinking wells, 38 public wells, 4 industrial wells, and no irrigation wells. There are 29 wells within 0 to 1 mile of the site, 111 wells within 1 to 2 miles, 112 wells within 2 to 3 miles, 231wells within 3 to 4 miles, and 280 within 4 to 5 miles. The locations of private wells used by nearby residents down-gradient of the site and four proposed/contingent monitoring wells are shown in Figure 3-6. Not all wells in Missouri are registered with the state. There may be wells in existence near the facility that are not documented by the state.

According to an EPA field investigation report, “Preliminary Assessment, Hematite Radioactive Site, Hematite, Jefferson County, Missouri, 1990,” (Ref. 10) most of the residents in the community of Hematite and nearby Lake Virginia receive their drinking water from Public Water District No. 5. The report also states that surface water is not used for drinking water within a four-mile radius of the site. Public Water District No. 5 operates five public wells located in the Desoto and Festus quadrangles. Residents in Mapaville receive their public drinking water supply from Public Water District No. 7. Eight public wells service customers in Mapaville, Festus, Hillsboro, and Pevely (approximately 9 miles northeast of the site). The wells are located in the Festus and Desoto quadrangles. The nearest active public well (Well #3) to the Hematite site is located approximately 2 miles south/southeast of the plant site on Carron Road. There is a standby public well (Well #5) located approximately ¼ mile from the site in the Lake Virginia subdivision. This standby well is currently not in use.

There is a Head Start pre-school in the community of Hematite. A county school for handicapped children is located in Mapaville. There is a high school/middle school/elementary school complex in Festus.

Figure 3-1 General Location of the Hematite Site

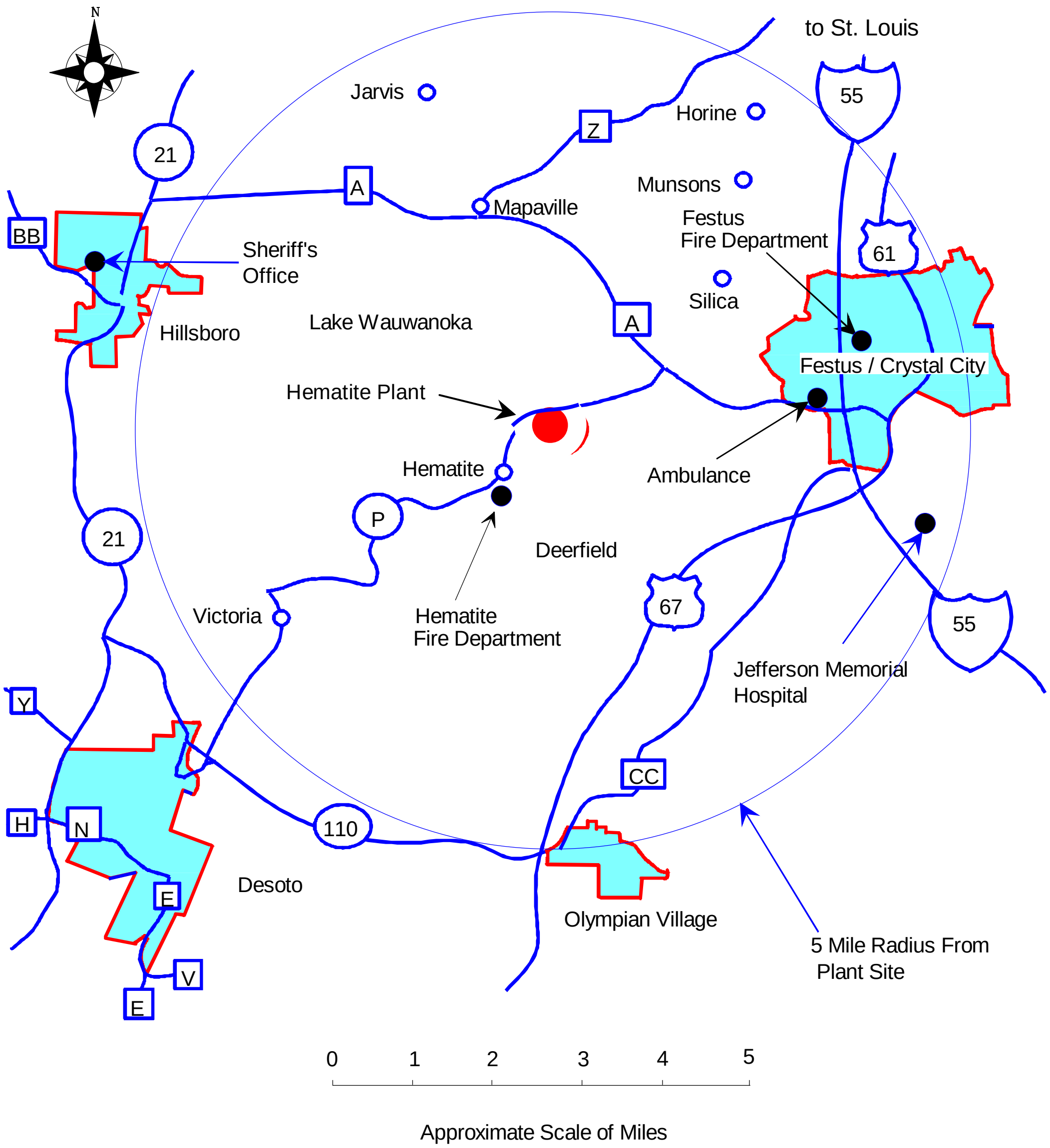


Figure 3-2 Area Within 5-Mile Radius of the Hematite Site

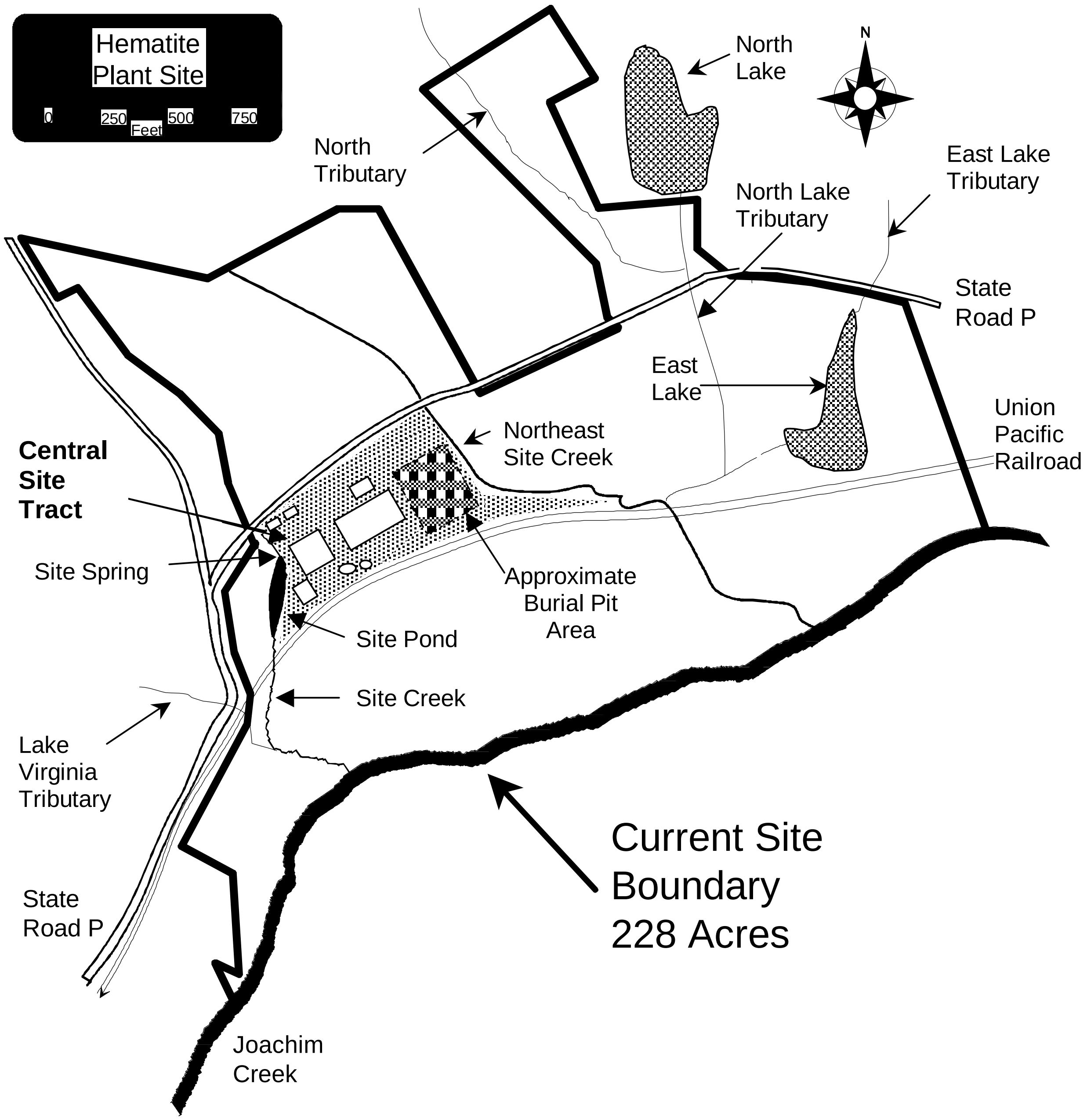


Figure 3-3 Hematite Site Boundaries

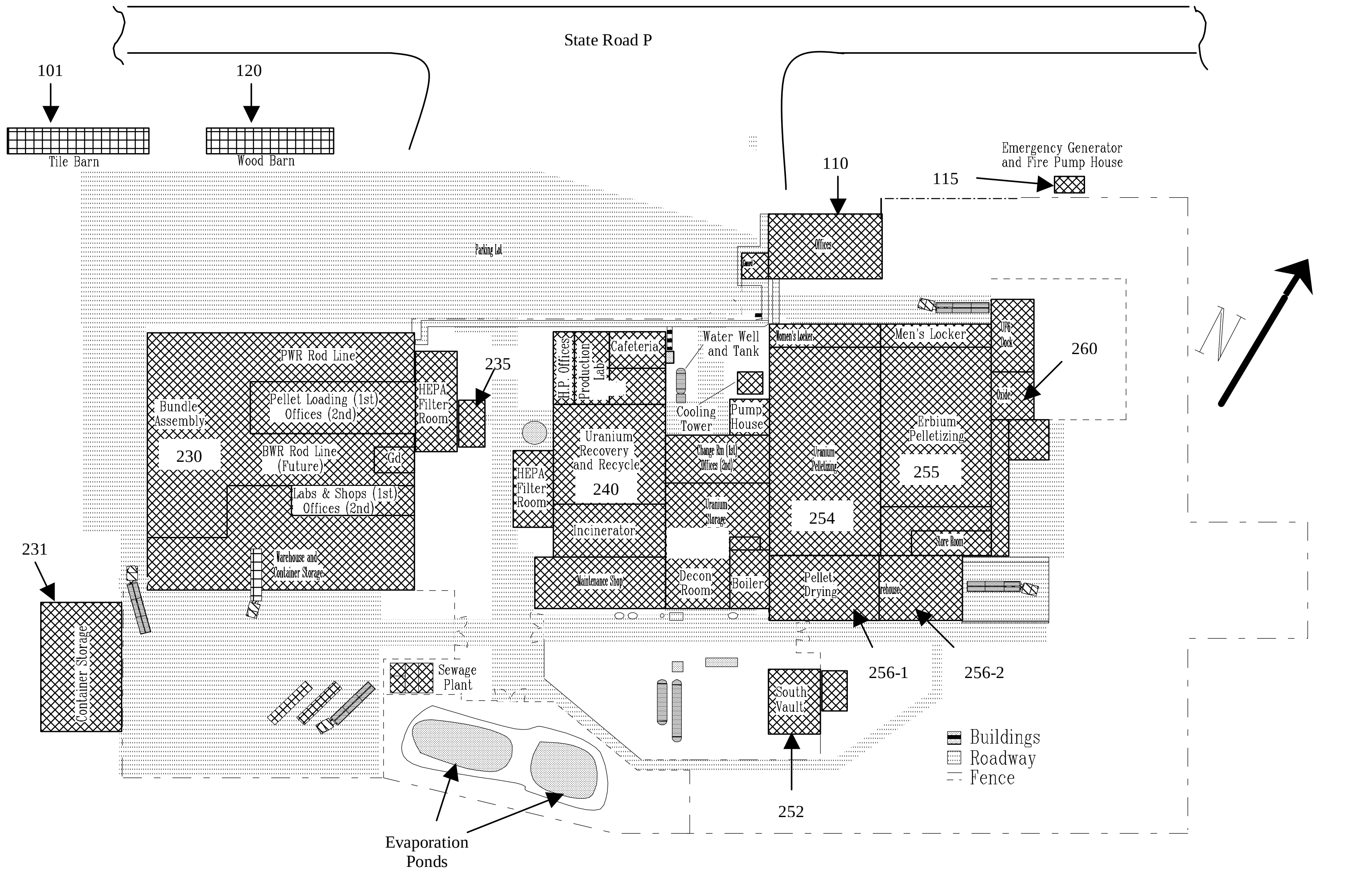


Figure 3-4 Hematite Plant Buildings

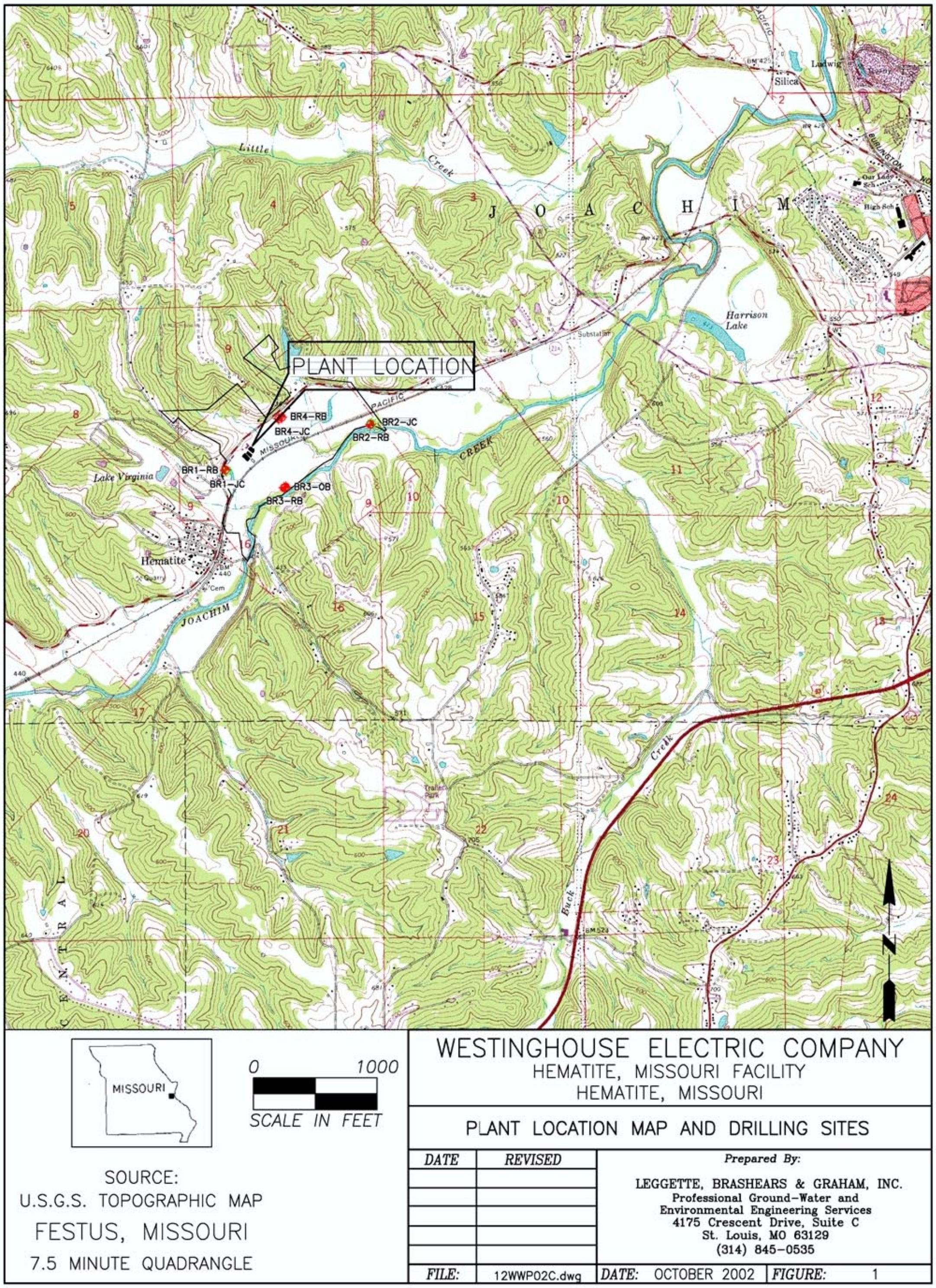


Figure 3-5 Topographic Contours Around the Hematite Site

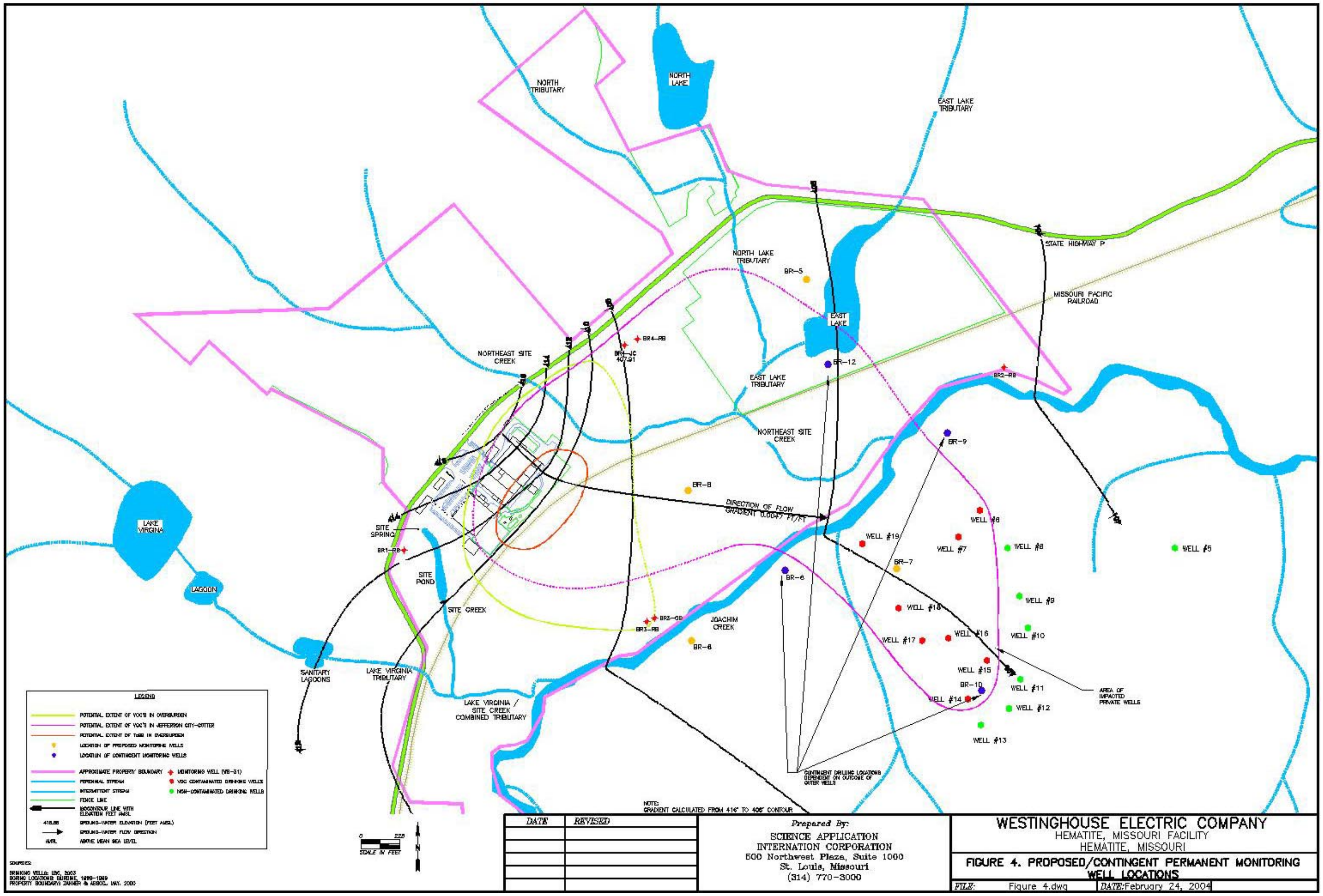


Figure 3-6 Nearby Drinking Water Wells

3.2 Population Distribution

Several towns and unincorporated settlements are wholly or partly within a 5-mile radius of the Hematite plant. Hematite is the closest settlement, and is a bedroom community having about 125 people. Festus and Crystal City, located 3.5 miles east of the site and having a combined population of about 13,900 people, are the nearest towns of significant size. They are the county's second largest incorporated community, and include a substantial amount of commercial and retail businesses. The locations of nearby communities are shown in Figure 3-2, and information on these communities is provided in Table 3-1.

Table 3-1 Communities Within 5 Miles of the Hematite Site

Town or Settlement	Direction from Plant	Distance from Plant (miles)	1990 Census	2000 Census
Crystal City	E	4.5	4,088	4,247
DeSoto	SW	5	5,993	6,375
Festus	E	3.5	8,105	9,660
Hematite	SW	0.5	125	
Hillsboro	NW	5	1,625	1,675
Horine	NE	5	1,043	923
Mapaville	N	3.5	100	
Olympian Village	S	5	669	669
Victoria	SW	3	100	

The county's average population density is 301 people per square mile based on the total estimated 2000 census population of 198,099 persons and an area of 657 square miles. Most of the population is White (193,102), followed by Black or African American (1,354), Asian (708), American Indian or Alaska Native (577), and other races. The median annual income is approximately $45,000. Owner-occupied housing units outnumber renter-occupied units by a ratio of approximately 6 to 1. The average size of an owner-occupied household is 2.81 people; the average size of a renter-occupied household is 2.42 people.

Estimates provided by the Missouri Census Data Center indicate the population of Jefferson County is projected to increase by approximately 31% between 2000 and 2025.

3.3 Current and Future Land Use

The current land use in the surrounding area is a mixture of farming, light industry, and suburban residential. Current land use within the site boundaries consists of characterization and decommissioning activities, primarily in the central site tract. Part of the site property outside the process plant area is leased to residents and to farmers.

It is anticipated that future uses of the land in and around the site will remain roughly consistent with its current use—residential, agricultural, and light industrial.

3.4 Meteorology and Climatology

The *Missouri Water Atlas*, 1986 (Ref. 11) was referenced to determine local precipitation. The area receives an average of 38 inches of precipitation per year, with 12 inches of average annual runoff. The maximum 10-day event expected precipitation is 9 inches in a given 25-year event. Snowfall has averaged less than 20 inches per winter season since 1930. The three winter months are the driest, the spring months are normally the wettest, and it is not unusual to have extended periods (1 to 2 weeks or more) without appreciable rainfall from the middle of the summer into the fall. Thunderstorms occur on the average between 40 to 50 days per year. The U.S Department of Commerce reports a mean annual frequency of about 8 tornadoes per year for a 30-year period. The probability of a tornado striking the site location is computed as 7.51×10^{-4}, and the recurrence interval is 1,331 years.

General climatological characteristics of the site area can be approximated by those of St. Louis, the location of the nearest U.S. Weather Bureau recording station. The region experiences a modified continental climate without prolonged periods of extreme cold, extreme heat, or high humidity. To the south, the warm, moist air comes off the Gulf of Mexico, and to the north, Canada is a source of cold air masses. The alternate invasion of the region by air masses from these sources produces a variety of weather conditions, none of which is likely to persist for any length of time. Winters are brisk but seldom severe. Minimum temperatures remain as cold as 32˚F or lower fewer than 20 to 25 days in most years. Summers are warm with a maximum temperature of 90˚F or higher an average of 35 to 40 days per year.

3.5 Geology and Seismology

The Hematite site is on the north, northeast flank of the Precambrian age St. Francis Mountains uplift, which created the Ozark Dome. Cambrian, Ordovician, Silurian, Devonian, and Mississippian age sedimentary formations of various depositional environments are draped on the flanks of the Ozark Dome. The site is situated over these sedimentary formations. Based upon the "Missouri Geologic Map," 1979 (Ref. 12) and the "Bedrock Geologic Map of the Festus 7.5 Minute Quadrangle, Jefferson County, Missouri" (Ref. 13) the uppermost bedrock beneath the site is the lower Ordovician Canadian series, Jefferson City Dolomite.

The Jefferson City Dolomite is described in Martin et al (Ref. 14) as mostly light-brown to medium-brown, medium to finely crystalline dolomite and argillaceous dolomite. Chert, which is not abundant, is typically oolitic, banded, mottled, or sandy. Lithologic succession within the formation is complex and varies among locations. The Jefferson City Dolomite, typically is 125 to 325 ft. thick, is bounded by the overlying Cotter Formation also mostly a dolomite, and beneath by the Roubidoux Formation that is dominantly a sandy dolomite with lesser beds of dolomitic sandstone and dolomite. The indurated sedimentary rocks in this area dip gently and uniformly to the north, northeast.

Several test borings have been made in connection with past construction activities at the site. The borings were drilled to depths of approximately 35 ft. The soil profile thus obtained shows upper alluvial soils of stiff, very silty clays containing some sand, underlain by silty clays of firm to stiff consistency to depths of 10 to 13.5 ft. Very stiff, highly plastic clay with limestone fragments were next encountered to depths of approximately 22 ft. Firm to stiff, sandy, silty clay was then found until auger refusal was obtained on boulders or limestone bedrock at an approximated depth of 36 ft.

The southeastern area of Missouri is quite active seismically and also contains a portion of the New Madrid Fault that caused the "great earthquakes" of 1811 and 1812. There were three quakes of Epicentral Intensity XII Modified Mercalli scale (M.M.) that took place on December 6, 1811 and January 23 and February 7, 1812 near New Madrid. In 1962, a quake measuring V (M.M) was recorded in the New Madrid area. A quake with a magnitude of 4-1/2 was recorded in the New Madrid area in 1963. A quake reported as "the strongest in years" occurred near Caruthersville, Missouri, 150 miles southeast of Hematite, on December 3, 1980. Figure 3-7 shows the location of mapped faults and folds in the Hematite, Missouri area. Figure 3-8 illustrates measured earthquakes in and near southeast Missouri from roughly 1900 to present. The closest earthquake to the Hematite facility of 3.0 magnitude or greater was centered roughly 10 miles south-southeast of the facility.

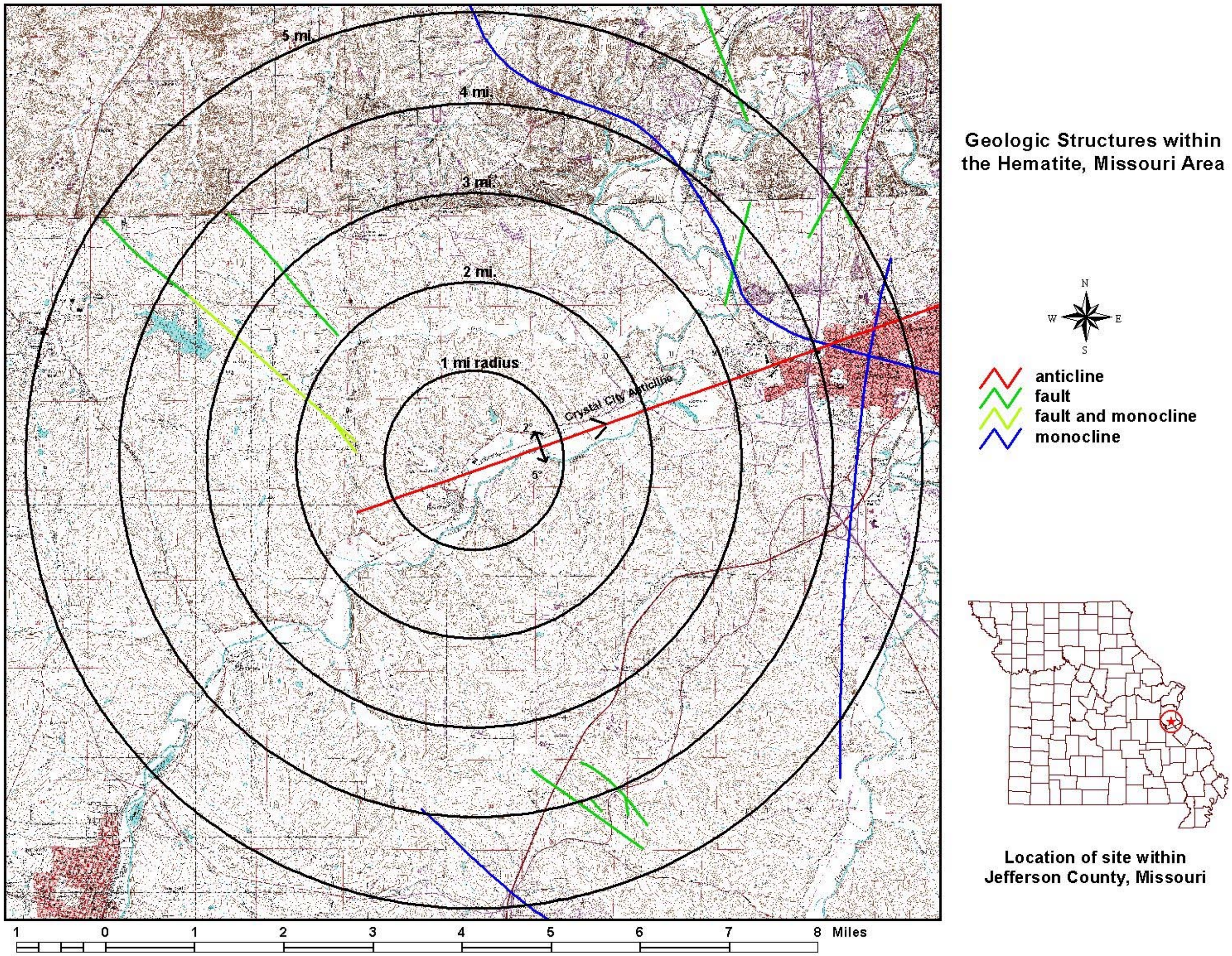
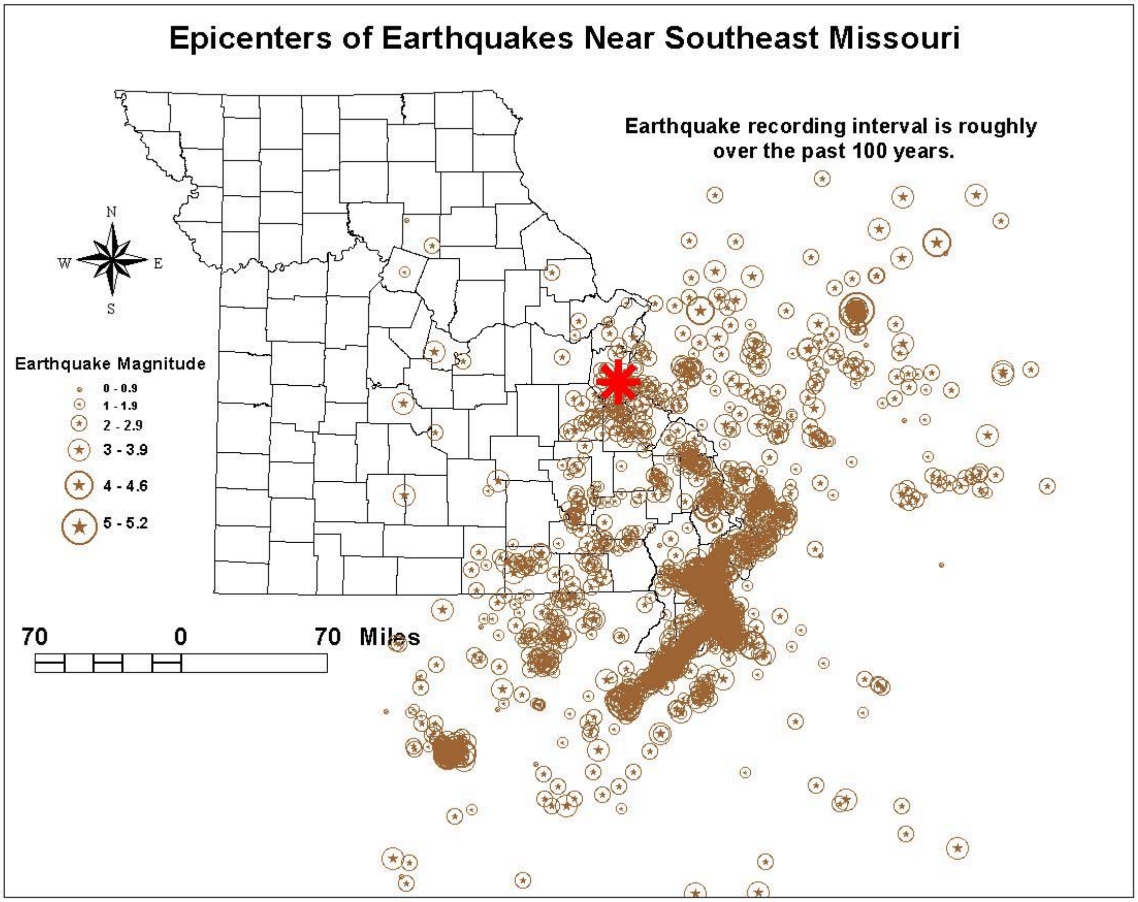


Figure 3-7 Hematite Area Faults



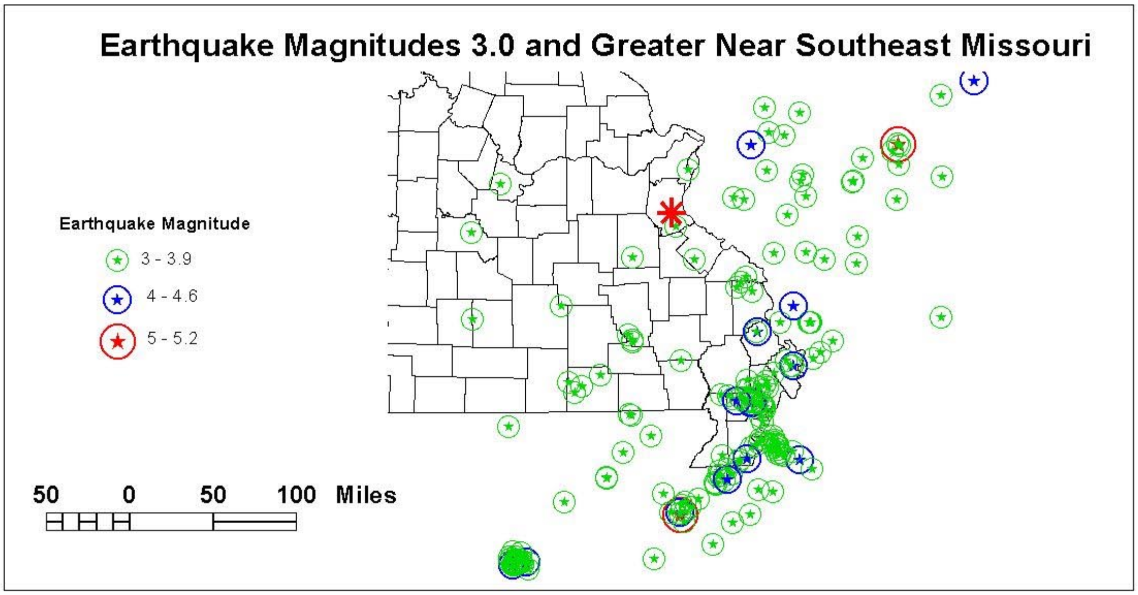


Figure 3-8 Earthquakes Near Southeast Missouri

3.6 Surface Water Hydrology

The “Missouri Water Atlas, 1986” (Ref. 15) was referenced to determine local stream characteristics. The atlas shows that Joachim Creek, located along the southeast site boundary, is a permanent flowing stream. There are several other surface water features present on or near the site, including a spring, intermittent perennial and ephemeral streams, a lake and ponds. These features are listed as follows:

- Site Spring flows an estimated 1 to 10 gpm most of the year. The spring is likely a result of fracture flow in the Jefferson City-Cotter Formation, which receives its source water in the hills northwest of the site.
- Site Pond is a small concrete dam impoundment southwest of the plant. It receives flow from the Site Spring and storm water runoff from the plant area.
- Site Creek is the effluent from below the dam of the Site Pond that receives discharge from the sanitary and storm water system. It flows through a culvert beneath the railroad track and joins the effluent from the Lake Virginia drainage basin.
- Lake Virginia/Site Creek Combined Tributary flows east to Joachim Creek.
- Northeast Site Creek flows southeast to the east of the Burial Pits and then east to its confluence with the effluent of East Lake tributary, then to the Joachim Creek.
- East Lake east of the site is an earth impoundment lake used as a water supply for cattle. It is reported to never have been used in conjunction with plant operations.
- North Lake is located just outside the northeast site boundary. It is an earth impoundment lake used as a water supply for cattle.
- North Lake Tributary is the effluent drainage from North Lake and North Tributary. This tributary crosses the terrace, west of East Lake.
- North Tributary is an intermittent stream west of North Lake.

Quantitative data regarding flow quantity, duration, peak discharge, etc. is not available for all of these features. However, some observations can be made.

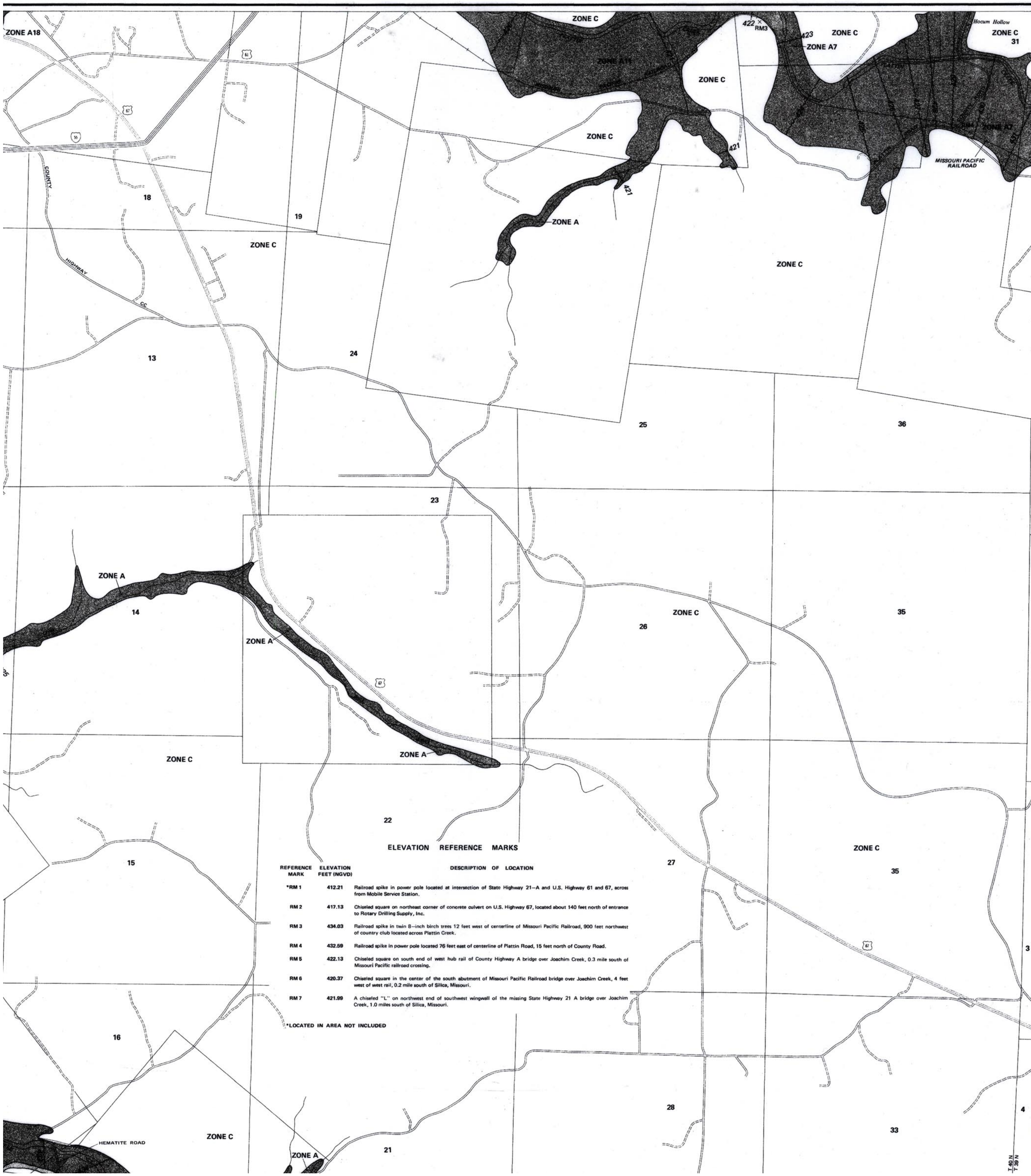
- The Site Spring flows continually.
- The ponds and lake on the site hold water year round. (Flow is measured at the Site Pond dam and reported quarterly to the Missouri Department of Natural Resources (MDNR) Water Pollution Control Program.)
- The streams flow intermittently.
- Joachim Creek is perennial. Based on flow gauge information from the U.S. Geological Survey, the annual mean flow is approximately 132 cubic feet per second (cfs). The seasonal mean flows are: spring-330 cfs, summer-12 cfs, fall-16 cfs, and winter-169 cfs. Joachim Creek flows into the Mississippi River near Herculaneum, Missouri. MDNR reports that there are no registered major water users that take water from Joachim Creek, and there are no public water systems listed in the “Census of Missouri Public Water Systems 2004” that take water from the creek.

There are two water control structures on the site—the Site Pond dam and the East Lake dam. The Site Pond dam is made of concrete and is approximately 32 ft. long, 16 in. wide, and 40 in. from the footing to the top of the dam. The East Lake has a earthen dam, which is approximately 175 ft. long.

There are two lakes within a one mile radius of the site that have water control structures. North Lake is located northeast of the site and has an earthen dam of approximately 200 ft. in length. Lake Virginia is located southwest of the site and has an earthen dam structure. With the exception of Lake Virginia (actually a small pond), there are no known water obstructing barriers within 5 miles upstream of the Hematite facility.

The drainage channels for all of the above structures cross through the site boundaries and empty into Joachim Creek.

Floods that might occur at the site will produce different flood levels depending upon the flow rate of Joachim Creek. While historical records (maximum observed level of 431 ft. above mean sea level) and analysis by the Federal Emergency Management Agency (FEMA) show that a site flood is not likely, it is still considered remotely possible. If a flood of larger magnitude (greater than 432 ft. above mean sea level) were to occur, water at the plant site would rise, but there is not expected to be any significant water velocity associated with the flooding. The reason for the minimal water velocity is that the railroad track, which is located between Joachim Creek and the plant, would serve to isolate the plant area from the main stream flow. Figure 3-9 shows the 100- and 500-year flood boundaries for Joachim Creek.



ELEVATION REFERENCE MARKS

REFERENCE MARK	ELEVATION FEET (NGVD)	DESCRIPTION OF LOCATION
*RM 1	412.21	Railroad spike in power pole located at intersection of State Highway 21–A and U.S. Highway 61 and 67, across from Mobile Service Station.
RM 2	417.13	Chiseled square on northeast corner of concrete culvert on U.S. Highway 67, located about 140 feet north of entrance to Rotary Drilling Supply, Inc.
RM 3	434.03	Railroad spike in twin 8–inch birch trees 12 feet west of centerline of Missouri Pacific Railroad, 900 feet northwest of country club located across Plattin Creek.
RM 4	432.59	Railroad spike in power pole located 76 feet east of centerline of Plattin Road, 15 feet north of County Road.
RM 5	422.13	Chiseled square on south end of west hub rail of County Highway A bridge over Joachim Creek, 0.3 mile south of Missouri Pacific railroad crossing.
RM 6	420.37	Chiseled square in the center of the south abutment of Missouri Pacific Railroad bridge over Joachim Creek, 4 feet west of west rail, 0.2 mile south of Silica, Missouri.
RM 7	421.99	A chiseled "L" on northwest end of southwest wingwall of the missing State Highway 21 A bridge over Joachim Creek, 1.0 miles south of Silica, Missouri.

*LOCATED IN AREA NOT INCLUDED

KEY TO MAP

500-Year Flood Boundary	ZONE B
100-Year Flood Boundary	
Zone Designations*	
100-Year Flood Boundary	
500-Year Flood Boundary	ZONE B
Base Flood Elevation Line With Elevation In Feet**	513
Base Flood Elevation in Feet Where Uniform Within Zone**	(EL 987)
Elevation Reference Mark	RM7×
Zone D Boundary	
River Mile	•M1.5

**Referenced to the National Geodetic Vertical Datum of 1929

*EXPLANATION OF ZONE DESIGNATIONS

ZONE	EXPLANATION
A	Areas of 100-year flood; base flood elevations and flood hazard factors not determined.
A0	Areas of 100-year shallow flooding where depths are between one (1) and three (3) feet; average depths of inundation are shown, but no flood hazard factors are determined.
AH	Areas of 100-year shallow flooding where depths are between one (1) and three (3) feet; base flood elevations are shown, but no flood hazard factors are determined.
A1-A30	Areas of 100-year flood; base flood elevations and flood hazard factors determined.
A99	Areas of 100-year flood to be protected by flood protection system under construction; base flood elevations and flood hazard factors not determined.
B	Areas between limits of the 100-year flood and 500-year flood; or certain areas subject to 100-year flooding with average depths less than one (1) foot or where the contributing drainage area is less than one square mile; or areas protected by levees from the base flood. (Medium shading)
C	Areas of minimal flooding. (No shading)
D	Areas of undetermined, but possible, flood hazards.
V	Areas of 100-year coastal flood with velocity (wave action); base flood elevations and flood hazard factors not determined.
V1-V30	Areas of 100-year coastal flood with velocity (wave action); base flood elevations and flood hazard factors determined.

NOTES TO USER

Certain areas not in the special flood hazard areas (zones A and V) may be protected by flood control structures.

This map is for flood insurance purposes only; it does not necessarily show all areas subject to flooding in the community or all planimetric features outside special flood hazard areas.

For adjoining map panels, see separately printed Index To Map Panels.

INITIAL IDENTIFICATION:
JULY 29, 1980

FLOOD HAZARD BOUNDARY MAP REVISIONS:

FLOOD INSURANCE RATE MAP EFFECTIVE:
MAY 16, 1983

FLOOD INSURANCE RATE MAP REVISIONS:

Refer to the FLOOD INSURANCE RATE MAP EFFECTIVE date shown on this map to determine when actuarial rates apply to structures in the zones where elevations or depths have been established.

To determine if flood insurance is available in this community, contact your insurance agent, or call the National Flood Insurance Program, at (800) 638-6620.

N

APPROXIMATE SCALE
1000 0 1000 FEET

NATIONAL FLOOD INSURANCE PROGRAM

FIRM
FLOOD INSURANCE RATE MAP

COUNTY OF
JEFFERSON,
MISSOURI
(UNINCORPORATED AREAS)

PANEL 110 OF 275

COMMUNITY-PANEL NUMBER
290808 0110 B

EFFECTIVE DATE:
MAY 16, 1983

3.7 Groundwater Hydrology

The near-surface hydrostratigraphic units at the site were characterized in *Hydrogeological Investigation and Groundwater, Soil and Stream Characterization*, 1999 (Ref. 16). In that investigation, groundwater monitoring wells were installed to serve the purposes of discrete geologic unit mapping and sampling and to provide vertical hydraulic gradient information.

As part of the hydrogeologic studies, single-well hydraulic conductivity tests were performed to characterize the horizontal hydraulic conductivity of distinct geologic horizons. From these tests, the average hydraulic conductivities of the unconsolidated materials above bedrock were found to be 3×10^{-5} cm/sec and 8×10^{-4} cm/sec for the near-surface silt, silty clay (NSSSC) and deeper, silty clay/clay (DSCC) units, respectively. Single-well testing of the Jefferson City Dolomite showed a hydraulic conductivity of 8×10^{-4} cm/sec. Fracturing and other features causing secondary porosity and permeability in the rock affect the hydrogeologic characteristics of the Jefferson City Dolomite and other bedrock formations. The primary permeability of the bedrock (i.e., through the solid rock matrix) is measured to be low, thus slow groundwater velocity would be predicted. However, groundwater flowing discretely through fractures, partings, or other secondary permeability features may do so at a much higher velocity. The size, density, and orientation of these fractures and partings determine the effective hydraulic conductivity of the bedrock.

Potentiometric surface (groundwater elevation) maps were constructed for the NSSSC, DSCC, and Jefferson City units to determine groundwater flow direction and hydraulic gradient. In the NSSSC unit, groundwater flows to the northeast and southeast. In the DSCC and Jefferson City units, groundwater flows to the southeast. Recent work shows the Roubidoux Formation's pieziometric surface as also indicating southeast flow direction. The orientation of the fractures and other secondary permeability features influence groundwater flow directions and gradients in the Jefferson City and other bedrock formations. Figure 3-10 shows groundwater flow direction and gradient in the vicinity of the site buildings.

In 1996, a site investigation by MDNR revealed the presence of volatile organic compounds (VOCs) in several monitoring wells located on site. Four private domestic wells located east of the site were sampled at that time, and no contaminants were found. In December 2001, the Missouri Department of Health and Senior Services conducted annual monitoring of the four private wells near the site. Results of that sampling revealed that one of the private wells (located on the site property) had VOCs—primarily perchloroethylene (PCE), trichloroethylene (TCE), and their degradation by-products—significantly above drinking water standards. In 2002, the need for more hydrogeologic data was prompted by the discovery of the VOCs in private domestic wells. Additional drilling and characterization were accomplished, adding to the hydrogeologic body of knowledge. In response to the information gathered, the affected private wells have been taken out of service, and the residents have been switched to a public water supply. This information is summarized in *Engineering Evaluation and Cost Analysis for Response Action for Off-Site Groundwater*, January 2003 (Ref. 17).

Hydrogeologic evaluations and private domestic well sampling data indicate that groundwater flow is to the east/southeast and that the most distant private wells with VOC contamination are approximately 0.6 miles from the plant site. Except for one private well located northeast of the plant at a residence on the site property, all affected wells (a total of eight) are at residences located southeast of the site.

Public water supply wells are not located in an area that is expected to be impacted by VOCs. Public or industrial water supply wells are typically constructed to withdraw water from a deeper part of the aquifer than private wells. For example, the closest active public well on Carron Road is approximately 1,000 ft. deep and the Hematite plant well is approximately 600 ft. deep, while residential wells in the affected area are typically only 250 to 350 ft. deep. Data from the Hematite plant well confirms that the identified contamination has not extended to that depth (600 ft. below ground surface), thus the public water supply wells are expected to remain free of VOC contamination.

There are thirty-four existing monitoring wells and piezometers installed to monitor the unconsolidated and bedrock aquifers at the site. The shallow wells/piezometers range from approximately 14 to 60 ft. in depth below ground surface. The deeper wells range from 105 to 335 ft. in depth below ground surface. Selected wells are sampled periodically as part of the site's environmental monitoring program. Some wells/piezometers have not been developed/sampled in several years and may require development (i.e., removal of excessive silt/sand accumulation) for the additional characterization. The locations of monitoring wells in the vicinity of the site buildings are shown in Figure 3-10.

Additional information on groundwater will be developed and summarized in the site characterization.

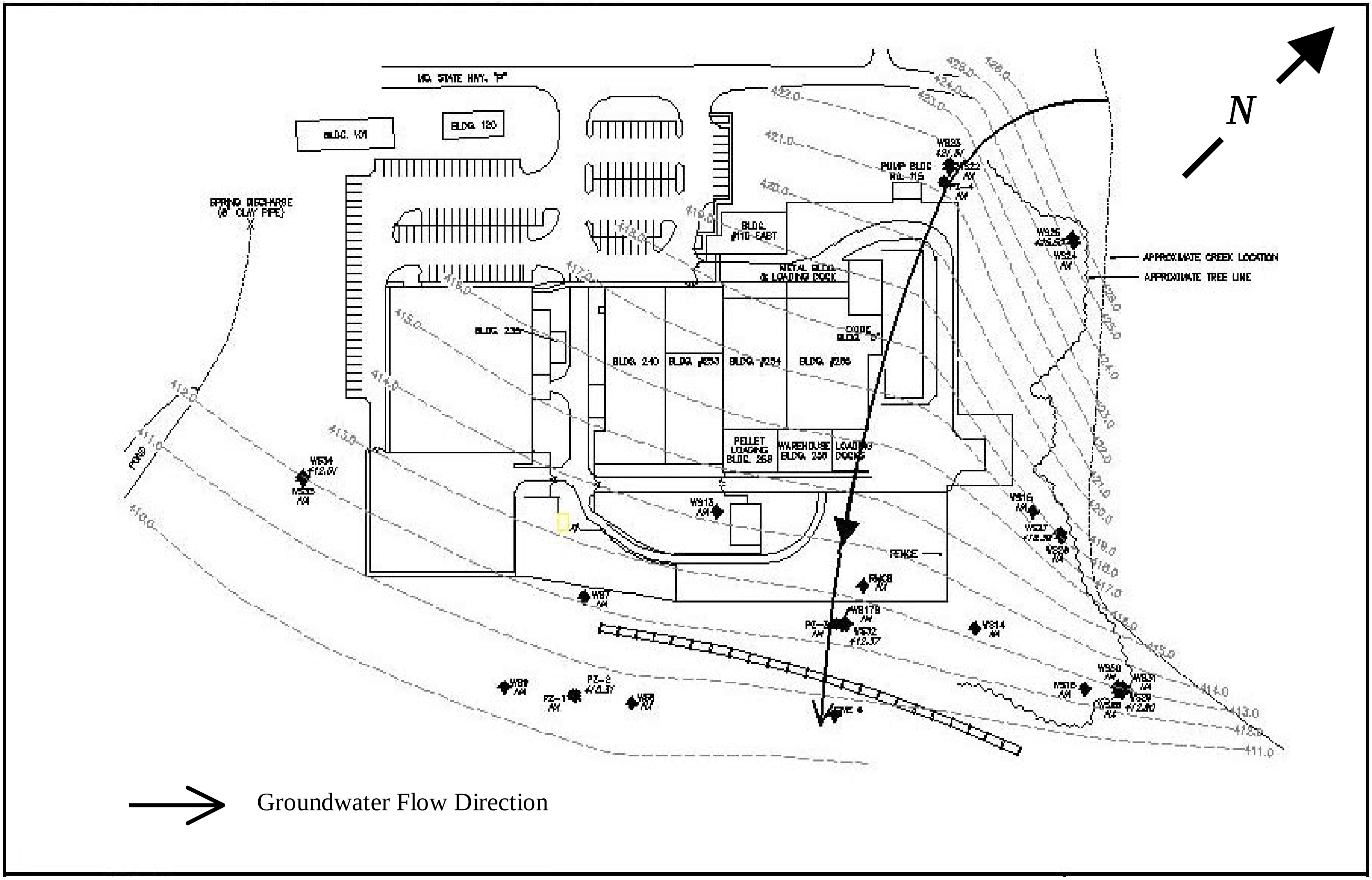


Figure 3-10 Groundwater Flow Direction and Gradient

3.8 Natural Resources

The primary natural resources occurring at or near the site are agricultural lands, surface water ponds and streams, and groundwater. There are some wooded areas on and surrounding the site, but the low quality of the timber makes any major harvesting unlikely.

The surface water features on and near the site are described in Section 3.6 of this DP. These surface water features are not used for drinking water, but some are used for watering livestock. Groundwater is widely used as the primary source of household water.

There are 33 surface mines within 5 miles of the Hematite site. The closest are two limestone quarries, less than two acres in size, that are approximately 1 mile southwest of the site. The other mines consist of 1 copper, 11 lead, 2 other limestone, and 17 sandstone quarries. Most of these lie outside of a 2-mile radius from the site.

4.0 RADIOLOGICAL STATUS OF FACILITY

The descriptions in this section are summarized from the same or equivalent information presented in the Historical Site Assessment (HSA), the Gamma Walkover Survey (GWS) described in the "Gamma Survey Data Evaluation Report" (Ref. 18), and other characterization efforts, i.e., soil sampling for soil distribution coefficient (K_d) determination, "Deul's Mountain" characterization, and characterization of soil under site buildings. The "Gamma Survey Data Evaluation Report" is provided as which is provided as a submittal with this DP.

The HSA assessed the potential radiological impacts of historic operations at the site and provides a history of site activities that might have resulted in the release of licensed material. The HSA was prepared in accordance with NUREG-1575, *Multi-Agency Radiation Survey and Site Investigation Manual* (MARSSIM) (Ref. 19) to address the following:

- Identify the potential, likely, and known sources of radioactive material and radioactive contamination based on existing or derived information
- Differentiate impacted from non-impacted areas
- Identify whether or not areas pose a threat to human health and the environment
- Provide an assessment for the likelihood of contaminant migration
- Provide input to scoping and characterization surveys

The GWS was performed in 2003 at the Hematite site to identify the presence of natural uranium, LEU, HEU, technicium-99, and thorium contamination in surface or near-surface soils to aid in area classification and future characterization planning at the site. The GWS was designed to follow the guidance for scoping surveys presented Section 5.2 of MARSSIM.

Soil characterization was performed in selected locations inside the central site tract in 2003 to facilitate K_d determination. The results of this characterization are described in Section 14.2.2.

Soil samples from Deul's Mountain were collected and analyzed in 2002 to characterize the stockpiled soil resulting from building construction. The results are described in Section 4.3.1.

Soil samples from underneath site buildings have also been collected and analyzed as described in Section 4.3.1.

4.1 Contaminated Structures

Structures that have been or might be radiologically impacted by historic licensed activities at the Hematite site are described in this section.

4.1.1 Building 101 – Tile Barn

The Tile Barn formerly functioned as the emergency operations center. The building has been used to store both clean and radiologically contaminated equipment.

4.1.2 Building 115 – Generator/Fire Pump Building

A diesel-powered emergency generator was located in this building. No work with radioactive materials was reportedly performed in this building. A diesel fire water pump currently remains in the building.

4.1.3 Building 120 – Wood Barn

The wood barn has been used to store both clean and contaminated equipment. The floor is dirt and might have residual contamination in low concentrations.

4.1.4 Building 231 – Warehouse

Building 231 was used to store shipping containers. Some shipping container refurbishment was performed in this area. A small potential for UO_2 contamination exists.

4.1.5 Building 235 – West Vault

The West Vault was most recently used to store depleted and natural uranium. It was historically used to store HEU. The interior of the building was painted in 1994, and contamination may be present under the paint.

4.1.6 Building 240 – Recycle Recovery (Red Room, Green Room, Blue Room)

This building contains laboratory and maintenance areas, a recycle recovery area, a waste incinerator area and the former health physics laboratory. Support operations were conducted for conversion, pelletizing, and fuel assembly, including material recycle, scrap recovery, cylinder heel recovery, quality control, analytical laboratory, maintenance, waste consolidation, and disposal preparation. This building was integral to the historic operations of the facility. Past operations included the conversion of HEU using a wet conversion process and wet recovery of scrap. The effluent streams were piped to the retention ponds for settling and evaporation. The pipe system is likely to contain HEU. Numerous spills and leaks likely occurred in these areas and parts of the slab were re-poured in 1974 over some existing contaminated flooring.

Additionally, sub-slab contamination was found during the 1989 construction of Building 253.

Building 240-1 currently houses the health physics and production laboratories, lunchroom, and laundry for radiologically contaminated personal protective equipment. It historically housed the lunchroom, offices, locker rooms, and laundry.

Building 240-2 (Red Room) was used for recycle and recovery operations. It historically included high-enrichment powder and metal operations, including recycle and recovery.

Building 240-3 (Green Room) is currently used for the incinerator and associated support operations. It historically included low-enrichment powder operations, including ammonium diurinate and oxidation/reduction furnaces.

Building 240-4 (Blue Room) currently houses the maintenance shop. It also housed the production laboratory until 1993 when it was moved to 240-1. It formerly housed low-enriched powder operations.

4.1.7 Bldg 245 Well House

The Well House is the block building attached to the potable water tank by the double doors into the laundry room. Currently, chlorinating of potable water occurs in the building using sodium hypochlotite (bleach), and the tank marked "potable water" is used to ensure appropriate contact time. This building and the attached tank are connected to the 200,000-gallon gravity tank on the hill across State Road P, whose elevation creates a 50-psig static head throughout the system. A pressure switch in the Well House automatically activates the well pump when static pressure drops below 50-psig.

Formerly, the existing chlorine contact tank was used as a pressure tank to create the static head by adding nitrogen as necessary. That operation ended when the gravity tank was built in 1991. The Well House formerly contained a mop water boil-down tank immediately east of the chlorinating tank with a storm drain under the tank for overflow. The boil-down tank was eliminated around 1993 and the storm drain was capped with concrete.

4.1.8 Building 252 – South Vault

The South Vault was used for storage of low- and high-enrichment nuclear material. It was most recently used for storage of chemicals and low-level radioactive wastes.

4.1.9 Building 253 – Office

This building contains offices, various site utilities, storage of uranium, processing areas, and decontamination facilities. Within Building 253 is an inner Building 250 that was formerly a stand-alone structure used for storage and housed the boiler, cooling tower pumps, and recycle hopper makeup.

4.1.10 Building 254 – Pellet Plant

In the pelletizing buildings, granules of UO_2 or uranium oxide (U_3O_8) were fed into a mill (micronizer) that produced fine powder for pressing. A starch and die lubricant were added and blended into a batch and subsequently pressed into pellets. The "Green" fuel pellets were processed through a de-waxing furnace to remove the additives and then passed through a sintering furnace where they were made into a ceramic. These furnaces were electrically heated and used disassociated ammonia to provide a reducing atmosphere.

4.1.11 Building 255 – Erbia Plant

The most recent use of this building was for the special product line making erbium pellets. It was the main pellet plant from 1974 through the opening of Building 254 in 1989. This process area included agglomeration, which used cranko and freon, instead of the slugging presses, to increase particle size between the micronization/blending and pellet pressing. Additionally, Building 255-3, the most recent erbium recycling area, was historically called the Item Plant in which high-enrichment shot to be used as reactor fuel was sized and coated.

4.1.12 Building 256

Building 256-1 was used for pellet drying. Pellet trays were loaded into pans, dried in an electric oven using disassociated ammonia as a cover gas, and either stored or transferred to Building 230. This structure was originally used as warehouse space.

Building 256-2 was the main site warehouse for shipping and receiving pellets and powder and for receiving site supplies.

4.1.13 Building 260 – Oxide and Oxide Loading Dock

The Oxide Building was built in approximately 1968 and is a four-story Butler-type building. This building was used for the conversion of uranium compounds into uranium oxide granules.

4.2 Contaminated Systems and Equipment

All contaminated systems and equipment are being removed from contaminated building. The buildings are being stripped to bare walls and floors. This work is being performed under the current site license and will facilitate the additional characterization of soils and potential structures under the buildings. These steps will also be protective of human health and the environment by removing radioactive impacts from the facility. Demolition of the buildings is being evaluated under a license amendment and will support the required characterization of soils underlying these structures.

4.3 Surface Soil Contamination

Based on historical operations and supporting data from the GWS, the surface soils in the central site tract (around and under the plant buildings) are considered to be Class 1 or Class 2 impacted areas. The exact classification of the areas inside the central site tract and the precise extent of these impacted areas will be defined during characterization efforts and during decommissioning. A perimeter area around three sides of the central site tract has been categorized as a Class 2 impacted area. The outlying land areas of the site have been categorized as a Class 3 impacted area. Figure 4-1 shows the locations of central site tract, the Class 2 impacted perimeter area, and the Class 3 impacted outlying land areas.

4.3.1 Central Site Tract

The GWS in the central site tract was designed to provide 100% coverage of all accessible areas that were not beneath buildings or covered with asphalt or concrete. Contaminated areas of special interest inside the central site tract are described as follows:

<u>Former Leach Field</u>
The former Leach Field and septic system were used until 1977 when a water treatment plant was built and placed into service. Located west of the water treatment plant and Evaporation Ponds, the leach field and septic system might have been used for sanitary waste and liquid waste from the operation and maintenance of the facility.

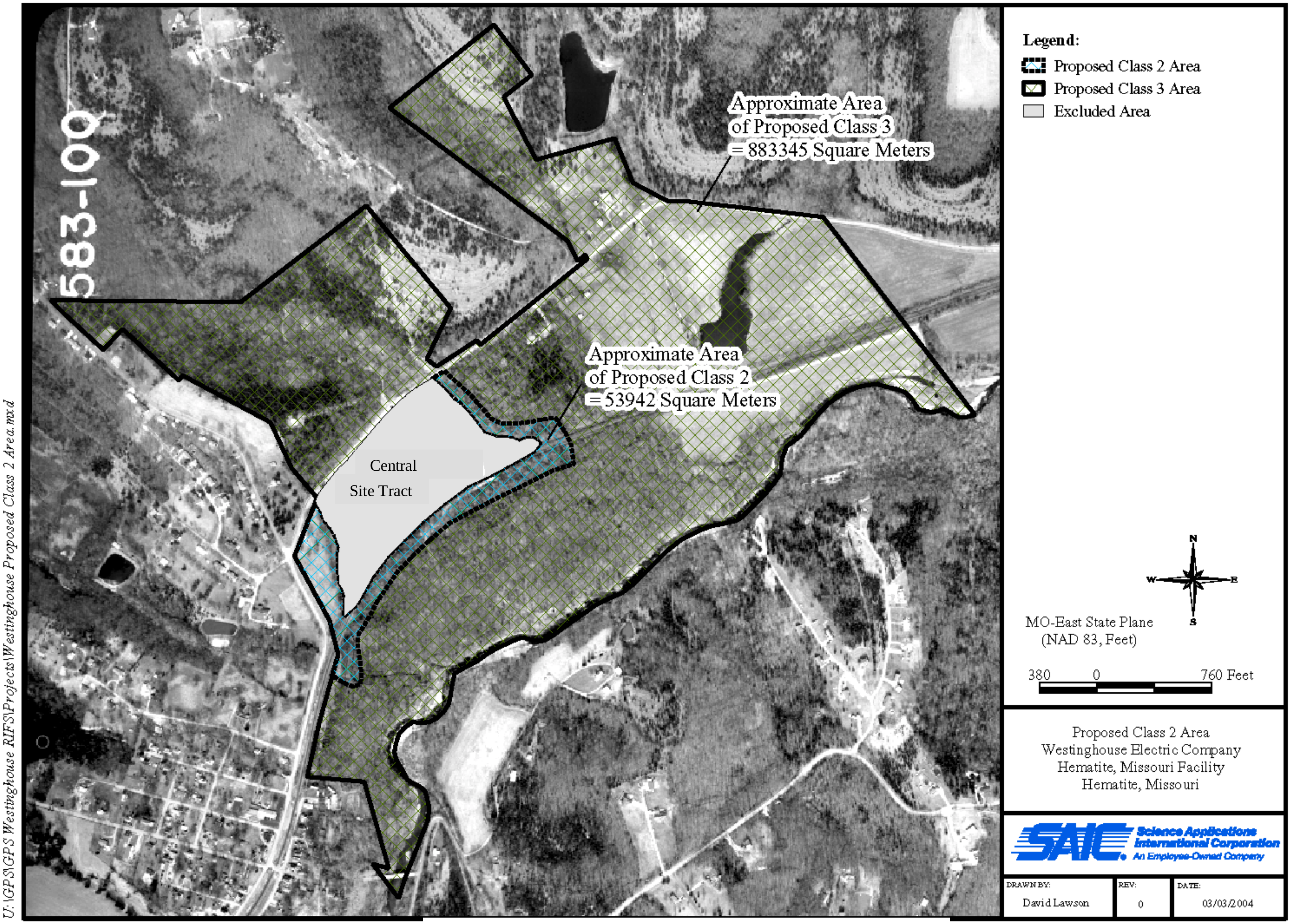


Figure 4-1 Map of Site Soil Areas

Spent Limestone Pile

The Hematite plant used crushed limestone rock chips in dry scrubbers to facilitate the removal of hydrogen fluoride from off-gas streams associated with the UF_6 to UO_2 conversion process. The limestone chips are partially converted to calcium fluoride in the scrubbers and the waste limestone chips are referred to as "spent limestone." After removal from the scrubbers, the spent limestone was tested to determine the level of radiological activity.

Prior to 1979, all spent limestone with radiological activity above 100 dpm/100 cm^2 was quarantined in a pile located in the southeast corner of the current fenced area of the plant. Since 1979, all spent limestone with radiological activity below 100 dpm/100 cm^2 has been used, with NRC approval, as onsite landfill, while spent limestone with activity greater than 100 dpm/100 cm^2 has been quarantined in piles in the southeast corner. All spent limestone with greater than 1,000 dpm/100 cm^2 activity has been sent to a licensed burial facility. Sampling and testing of the material has been performed periodically, revealing uranium contamination concentrations in the piles and the soils adjacent to and/or beneath the piles.

During the GWS, no indication of elevated gamma radiation was identified due to the existence of the spent limestone pile within the fenced area or in two fill locations outside the fence—one near the Site Spring and the other in the northeast section of the Burial Pits. The GWS was not specifically performed on the spent limestone pile within the fence, but only along the edges of the pile.

Deul's Mountain

During the construction of the Building 256 warehouse, a large area of potentially contaminated soil was removed and stored along the southeast corner of the fence line. This pile has become known as "Deul's Mountain." The volume of the pile is estimated at 1,250 cubic yards. The GWS found no elevated gamma radiation levels during the walkover of this stockpiled soil; however, a significant area of elevated activity was identified at the foot of the pile where a piece of sheet plastic was found protruding from the soil.

In 2002, a characterization of the soil pile was performed, as described in a report entitled "Characterization Report for Deul's Mountain" (Ref. 20), and samples revealed the presence of U-238, U-235, and U-234. No other isotopes were detected above natural background. The characterization was performed by drilling 12 bore holes into the pile for the purpose of collecting radiological data at various depths and to collect soil samples. The bore holes were drilled to a depth of three feet, and three discrete samples, containing one foot of soil each (~454 g), were taken from each bore hole. The soil concentration background levels for the three uranium isotopes were derived from a sample collected within two miles of the Hematite facility and are as follows:

- 7.70E-01 pCi/g for U-238
- <2.95E-02 pCi/g for U-235
- 5.92E-01 pCi/g for U-234

Through laboratory analysis, it was found that collected samples contained uranium concentrations higher than the above stated backgrounds.

Soil Beneath Site Buildings

Soil samples were collected from eight (8) locations beneath building foundations during a site characterization effort in 2003. Bore hole and sampling locations were selected based on input from previous employees and historical knowledge of site operations to provide biased sampling locations most likely to be impacted by radioactive materials. The radiological results of the samples collected are presented in Table 4-1. Sampling and analysis for chemical constituents of potential concern were also conducted as part of the project.

The following issues must be considered when evaluating Table 4-1:

- Samples from the concrete foundations themselves were removed from the data set. They do not represent the soils under the foundation.
- Data for the hard-to-detect radionuclides (Am-241, Np-237, and Pu-239) were not available or not of sufficient quality to allow evaluation.
- There is limited data on Tc-99. Tc-99 can be highly mobile in soils and groundwater.
- There is limited data on U-234.

Table 4-1 Soil Samples Underneath Site Buildings

Sample ID	Units	Tc-99	U-234	U-235	U-238
BLD240-01-01	pCi/g	NA	NA	0.12	1.1
BLD240-01-09	pCi/g	NA	NA	0.23	0.9
BLD240-01-Fill	pCi/g	NA	NA	5.9	17
BLD240-03-04	pCi/g	NA	NA	0.44	1.32
BLD240-03-19	pCi/g	NA	NA	0.36	0.7
BLD240-03-Fill	pCi/g	NA	NA	17.9	71
BLD240-04-02	pCi/g	NA	NA	0.02	1.7
BLD240-04-04	pCi/g	NA	NA	0.3	0.9
BLD240-04-Fill	pCi/g	NA	NA	0.7	2.59
BLD240-05-01	pCi/g	NA	NA	-0.08	1.37
BLD240-05-02	pCi/g	NA	NA	-0.4	1.6
BLD253-02-01	pCi/g	NA	NA	0.9	3.7
BLD253-02-04	pCi/g	7.5	172	9.5	11.7
BLD253-02-Fill	pCi/g	NA	NA	1.2	2.6
BLD255-05-Fill	pCi/g	NA	NA	0.17	1.7
BLD255-07-02	pCi/g	NA	NA	0.06	1.7
BLD255-07-15	pCi/g	NA	NA	0.37	1.1
BLD255-07-Fill	pCi/g	NA	NA	0.17	0.8
BLD255-08-01	pCi/g	30.2	604	23.1	13.8
BLD255-08-08	pCi/g	NA	NA	0.34	0.85
BLD260-06-01	pCi/g	NA	17.8	0.87	5.04
BLD260-06-03	pCi/g	NA	NA	0.12	0.6
BLD260-06-FILL	pCi/g	NA	NA	3.34	16.4

NA – not analyzed

Based upon the sampling information gathered through this effort, it is apparent that no clear pattern of soil impacts under the buildings has been formed, and that additional characterization of these soils and potential underground structures will be needed. As noted elsewhere in this DP, contaminated equipment and structures and the contaminated buildings themselves will need to be removed in order to properly complete site characterization work and to address releases or threatened releases of radioactive impacts into the environment.

<u>Tile Barn</u>

Several areas (soils within the original fence line and soil adjacent to the barns) are known to have surface or near surface uranium contamination. Adjacent to the Tile Barn is an area that was used to store excess contaminated equipment. The GWS detected several areas of elevated gamma radiation around the Tile Barn, adjacent to the original fence line, and in nearby drainage ditches.

Red Room Roof

The old roof of the Red Room (Building 240) was buried in an area south of the Tile Barn. The GWS identified elevated areas of contamination south-southwest of the Tile Barn; however, it could not be confirmed that this was due to the presence of the Red Room roof burial. Additional characterization will be performed in this area.

Cistern Burn Pit

The Cistern Burn Pit near the Tile Barn was used historically to burn contaminated wood and pallets. In early 1993 the cistern was cleaned to less than 30 pCi/g uranium. Additional characterization will be needed to assess the effectiveness of the prior remediation efforts.

4.3.2 Outlying Land Areas

The outlying land areas comprise all the site land outside the central site tract and its Class 2 perimeter area. The GWS was designed to cover approximately 10% of the outlying land areas. The GWS concluded that surface soil contamination appears to be confined to the central site tract. Surface contamination does not appear to have migrated a great distance from the building facility area in any of the normal topographical transport modes. With the exception of a few anomalies, the GWS data indicate that there is no obvious surface soil contamination in the outlying land areas.

The railroad easement that cuts through the site is not considered a potential Area of Concern; however, a portion of the ballast used to construct the railroad is Rhyolite. The Rhyolite deposit is known to have naturally occurring radioactivity. The GWS confirmed increased gamma radiation levels associated with the Rhyolite. The railroad easement that cuts through the site exhibited elevated count rates in the range of 14,000–16,000 cpm. In addition, the railroad adjacent to the United States National Guard Armory exhibited similar count rates. The Rhyolite on the site does exhibit elevated levels of gamma radiation consistent with Rhyolite on the non-impacted railroad adjacent to the armory.

4.4 Subsurface Soil Contamination

In addition to soils and buildings, as discussed above, two subsurface soil areas within the central site tract are known to be radiologically impacted—the Burial Pits and the Evaporation Ponds. A third area, the natural gas pipeline, is a potential conduit for subsurface soil contamination. A description of these areas is provided as follows:

4.4.1 Burial Pits

Additional information on the Burial Pits is provided in Section 2.5 of this DP.

The Burial Pits remain in substantially the same condition as when Gulf ended on-site burial activity in November 1970. There has been no substantial investigation or analysis of the extent of the contamination of the Burial Pits and the surrounding area. In the GWS, individual elevated count rates were identified and confirmed in the general vicinity of the area where the Burial Pits are expected to be located.

4.4.2 Former Evaporation Ponds

As discussed in Section 2.3.1 above, the two former filtrate disposal Evaporation Ponds were used for on-site disposal of low-level contaminants and both high-enrichment and low-enrichment uranium materials. The two ponds consisted of a primary pond and a larger secondary/overflow pond. When constructed, the ponds were excavated to a depth of 3 ft., 4 in. and the soil removed was used to construct a 1 ½ ft. high berm around each pond. The ponds were then lined with a 6-in. bed of 3-in. diameter rock, followed by a 4-in. bed of ½ in. diameter rock. The original size of the primary pond was 30 ft. by 40 ft. and the secondary pond was 30 ft. by 85 ft. Twelve feet separated the two ponds.

The Evaporation Ponds were primarily used for the disposal of low level liquid wastes containing insoluble uranium bearing precipitates and other solids. The precipitates and solids were allowed to settle and the water evaporated naturally. As additional liquids were added to the primary pond, the overflow flowed through a pipe into the secondary pond. The ponds were originally built to receive filtrates from the low-enrichment ammonium diurinate conversion facility but were later used for the disposal of both high- and low-enrichment recovery waste liquid. The logs from the burial pits also contain a number of entries reflecting disposal of various materials in the ponds. Examples of such entries include:

- Filtered Perclene
- Liquid from Sump
- TCE from Metal Wash
- Filtered Reactor Cleanout
- Filtered KOH Solution
- Acid Water Cleanup
- HCl Solution
- TCE Cleanup
- Oil from Vac. Pump
- Mop Water
- TCE and Oil
- TCE (u. Metal Wash)
- Acetic Acid & H_2O
- H_2O and Perclene
- Filtrate
- Nitric Acid Wash Water
- Pickling Hood Cleanup

Immediately after CE purchased the plant in 1974, use of the ponds was curtailed so as to allow only disposal of spent potassium hydroxide scrubber solution from the uranium dry recycle process and liquids from startup testing of the wet recovery process. Use of the ponds was discontinued altogether in September 1978. Following the discontinued use of the ponds, 700 ft3 of sludge was pumped out of the primary pond on October 1979. The sludge was dried and shipped to licensed burial during 1982, 1983, and early 1984.

4.4.3 Gas Pipeline

Missouri Natural Gas (MNG), a subsidiary of Laclede Gas in St. Louis, Missouri owns and operates a high-pressure natural gas transmission line located on a right-of-way that parallels the railroad track. Because this line runs beneath or adjacent to the Evaporation Ponds, Burial Pits, and former Leach Field, it might be acting as a conduit for contaminant transport in the subsurface.

4.5 Surface Water

The surface water features on the site are described in Section 3.6 of this DP. Five intermittent tributaries (North Lake Tributary, East Lake Tributary, Northeast Site Creek, Site Creek, and Lake Virginia/Site Creek Tributary) and one perennial stream (Joachim Creek) flow across or run adjacent to the site. Two ponds/lakes, including East Lake and Site Pond are also on the property. These water resources are under the jurisdiction of the federal government and the State of Missouri.

The potential for radioactive contamination in Site Creek on the west side of the plant is discussed in Section 2.3.3 of this DP. Northeast Site Creek also has a high potential for radioactive contamination due to the visible surface runoff and the proximity of the tributary to the Burial Pits. The extent of surface water contamination on the site will be further characterized.

4.6 Groundwater

The groundwater in the overburden has historical contamination of technetium-99. A field investigation to determine the source of the technetium-99 contamination was performed in 1996. The results of this investigation are presented in "Investigation to Determine the Source of Technetium-99 in Groundwater Monitoring Wells 17 and 17B," September 27, 1996 (Ref. 21). This investigation revealed that technetium-99 entered the groundwater system in the area behind building 256 and traveled down gradient. Based upon site specific groundwater flow information and groundwater quality data, the investigation concluded that it is doubtful that elevated gross beta concentrations from technetium-99 would reach Joachim Creek before diluting to background concentration.

Table 4-2 shows gross alpha and gross beta averages during 2003 for groundwater from six of the site monitoring wells. These monitoring wells are sampled quarterly. Tc-99 has been identified in wells WS-17 and WS-17B. The limit for uranium in 10CFR20, Appendix B, Table 2 is 3.00E+02 pCi/L.

Table 4-2 Sample Results From Groundwater Monitoring Wells

Monitoring Well	Gross Alpha (pCi/L)	Gross Beta (pCi/L)
WS-7 (North)	3.76E+01	3.40E+02
WS-8 (Southeast)	5.60E+00	2.42E+00
WS-9 (Southwest)	7.94E+00	2.67E+01
WS-15 (Burial Pits)	5.63E-01	1.12E+01
WS-16 (Burial Pits)	3.96E+00	8.08E+00
WS-17B (Burial Pits)	1.06E+02	3.00E+03

Additional characterization of groundwater contamination will be performed. The aquifers have shown no detectable levels of radioactive contamination.

As discussed in Section 3.7 of this DP, VOCs were discovered in private domestic wells on and near the site. The affected wells have been taken out of service, and the residents have been switched to a public water supply (Ref. 17).

5.0 DOSE MODELING

5.1 Unrestricted Release Using Site-Specific Information

5.1.1 Building Surface Evaluation Criteria

As discussed above, the aboveground structures of contaminated site buildings will be removed under the site license to facilitate further characterization of soils under the buildings. For any non-impacted buildings that are left in place, evaluation criteria will be developed to demonstrate that the buildings meet the criteria for unrestricted use.

5.1.2 Soil Evaluation Criteria

Surface and volumetric soil DCGLs have been determined for radionuclides of concern potentially present in soil (including sediment) at the Hematite site. A detailed description of the methodology and resulting DCGL's is presented in a report entitled, "Derivation of Site-Specific DCGLs for Westinghouse Electric Co. Hematite Facility," which is provided as a submittal with this DP. The DCGLs were determined to meet requirements set forth by the NRC. The NCP process will also be followed to establish Preliminary Remediation Goals (PRGs) which will be considered in concert with the approved DCGLs. The NRC has promulgated a primary limit of 25 mrem total effective dose equivalent (TEDE) in any one year, in excess of natural background, for releasing a radiologically contaminated site.

Radionuclides of concern for the site have been identified as U-234, U-235, U-238, Tc-99, Th-232 and progeny, Am-241, Np-237, and Pu-239. The site has both surface soil and groundwater contamination. The soil DCGLs were derived using groundwater as an indirect (modeled) pathway without the use of actual groundwater data. When adequate groundwater data is available, the dose contribution from groundwater as a direct pathway will be reevaluated. DCGLs were derived using dose modeling and the RESRAD code Version 6.21. The modeling, in most cases, used site-specific values and values presented in NRC's NUREG guidance documents for a residential-farmer scenario.

Sensitivity analyses were performed by examining the model input parameters related to intake assumptions for the receptor. Fruits, vegetables, and grain consumption is the most sensitive parameter for most of the radionuclides of concern at the site.

6.0 ENVIRONMENTAL INFORMATION

The characterization to be implemented in 2004 outlines plans to investigate and evaluate the effects decommissioning and remediation of the Hematite facility might have on wetlands and surface water, threatened and endangered species, and cultural resources.

6.1 Wetlands and Surface Water

Jurisdictional wetlands and surface water issues will be considered in operations and actions related to decommissioning and remediating the Hematite facility.

6.1.1 Wetlands

Wetlands are believed to be present on the Hematite site and the surrounding properties. This natural resource is under the jurisdiction of the federal government, jointly administered by the U.S. Army Corps of Engineers and the EPA. At the state level, jurisdiction is administered by participating state agencies including the MDNR and the Missouri Department of Conservation Wetlands Management Program. The characterization will address the effects decommissioning and remediation might have on this natural resource.

6.1.2 Surface Water

Five intermittent tributaries (North Lake Tributary, East Lake Tributary, Northeast Site Creek, Site Creek, and Lake Virginia/Site Creek Tributary) and one perennial stream (Joachim Creek) flow across or run adjacent to the site. Two ponds/lakes, including East Lake, and Site Creek Pond are also on the property. These water resources, just as wetlands, are under the jurisdiction of the federal government and the State of Missouri. The characterization will address the effects decommissioning and remediation might have on these tributaries and ponds/lakes.

6.2 Threatened and Endangered Species

The characterization will evaluate the potential effects the site's decommissioning and remediation might have on threatened and endangered species. Threatened and endangered species are protected under federal and state statutes and are often key indicators to the overall health of an ecosystem.

An evaluation of the potential presence of threatened and endangered species within the project area and assessment of potential impacts to these species and/or their habitats will utilize a multi-phased approach. First, listed species potentially occurring within the project area will be identified through consultation with the Missouri Department of Conservation and from the list of threatened, endangered, and proposed species provided by the U.S. Fish and Wildlife Service. Second, existing site-specific and regional information will be collected and reviewed to assess the potential of the project area to provide the habitat requirements of threatened or endangered species. This information, in addition to existing data regarding the range and habitat preferences of potential threatened and endangered species, will be used to determine the potential for occurrence of these species in the project area and to determine the need and focus of field surveys. Once a review of existing information is completed, a field reconnaissance of the project area will be conducted to verify project area habitats, assess current habitat conditions, and identify any unique habitat features. The final step in the evaluation process will be a determination of effects for those species that might occur within the project area or be affected by offsite or indirect impacts such as changes in downstream water quality. If a potential listed species is not expected to be present or affected by the proposed project, evidence or rationale for supporting this conclusion will be presented. A final impact assessment report will be prepared addressing all state and federal listed threatened and endangered species potentially affected by proposed decommissioning activities.

6.3 Cultural Resources Management

The Antiquities Act of 1906 and Historic Sites Act of 1935 seek to preserve historic sites, buildings, and objects of national significance for the inspiration and benefit of the people of the United States. As part of the characterization, Cultural Resource Management activities will be carried out in three phases. Phase I consists of a records and literature review along with a pedestrian survey. Phase II includes archaeological test excavations at selected sites that may be significant, and Phase III investigations are full scale data recovery efforts at identified significant sites. A vast number of archaeological sites and historic resources that are initially located are deemed non-significant, that is, further investigations of the site would not contribute new or significant information about the past. These would be recommended as requiring no further evaluation at the Phase I level. A few archaeological sites may require further evaluation through Phase II excavations to make a recommendation of significance or non-significance, and finally if a site is determined to be historically significant, Phase III data recovery would occur if the site cannot be avoided by construction or remediation.

7.0 ALARA ANALYSIS

7.1 Introduction

A pre-remediation ALARA analysis will be conducted to demonstrate that the dose criteria in Subpart E of 10 CFR 20 have been met and whether it is feasible to further reduce the levels of residual radioactivity to levels below those necessary to meet the dose criteria (i.e., to levels that are ALARA). The analysis will encompass the approximately 228 acres of land located at the Hematite Site. Because the pre-remediation ALARA analysis cannot be completed until the characterization and related NCP process are completed, a sample analysis is being provided to demonstrate the methodology that will be used for the final analysis.

As noted above, it is the intention of the licensee to remediate soil such that the site meets the unrestricted use criteria presented in 10 CFR 20.1402, that is, the TEDE to an average member of the critical group does not exceed 25 mrem/y.

Because the site objective is to remediate to unrestricted use criteria and to use appropriate dose modeling to relate concentrations to dose, the licensee can apply Section N.1.5, Appendix N of NUREG-1757, Vol. 2, which states "In certain circumstances, the results of an ALARA analysis are known on a generic basis and an analysis is not necessary. For residual radioactivity in soil at sites that may have unrestricted release, generic analyses show that shipping soil to a low-level waste disposal facility is unlikely to be cost effective for unrestricted release, largely because of the high costs of waste disposal. Therefore, shipping soil to a low level waste disposal facility generally does not have to be evaluated for unrestricted release."

With this in mind, the results of an ALARA analysis are "known on a generic basis and an analysis is not necessary." However, because Westinghouse actively promotes the ALARA philosophy, a simplified analysis (possible benefits and costs relating to decommissioning, a determination of residual radioactivity levels that are ALARA, and cost vs. soil activity levels) will be performed. NUREG-1757, Vol. 2, Appendix N provides information outlining a simplified method to estimate when a proposed remediation guideline is cost effective. Possible benefits, as well as possible costs, are derived and compared. If the desired beneficial effects (benefit) from the remediation action are greater than the undesirable effects (cost) of the action, the remediation action being evaluated is cost-effective and should be performed. Conversely, if the benefits are less than the cost, the level of residual radioactivity is already ALARA without taking additional remediation action. A list of possible benefits and costs to be considered in the analysis is shown in Table 7–1.

Table 7-1 Possible Benefits and Costs Related to Decommissioning

Possible Benefits	**Possible Costs**
• Collective Dose Averted • Regulatory Costs Avoided • Changes in Land Values • Aesthetics • Reduction in Public Opposition	• Remediation Costs • Additional Occupational/Public Dose • Occupational Non-radiological Risks • Transportation Direct Costs and Implied Risks • Environmental Impacts • Loss of Economic Use of Site/Facility

During the analysis, results from an appropriate dose modeling method will be used to relate concentration to dose. Information used for the analysis, regarding concentration to dose values, will be obtained from the “Derivation of Site-Specific DCGLs for Westinghouse Electric Co. Hematite Facility,” report. The following is a sample analysis that demonstrates the methodology that will be used in the final analysis. The values used in this sample analysis are not representative of the values that will be determined for the final ALARA analysis. As noted above, cleanup goals will also be developed and evaluated through implementation of the NCP process.

7.2 Determination of Benefits

7.2.1 Collective Dose Averted Benefit

Remediation of site soils to levels that meet the unrestricted use criteria in 10 CFR 20.1402, using appropriate dose modeling to relate concentrations to dose, is known on a generic basis to demonstrate that these levels are ALARA. Therefore, calculation of the collective dose averted is not required in this analysis. However, collective dose costs are determined and evaluated in Section 7.3 of this DP.

7.2.2 Regulatory Cost Avoided Benefit

Based on the site objective to remediate the site to unrestricted use criteria, costs associated with a decision to remediate the site to a restricted release level (additional licensing fees, financial assurance related to both the decommissioning fund and the site restriction, cost associated with public meetings or the community review committee, and future liability to release the site) are avoided and not taken into account in this analysis.

7.2.3 Changes in Land Value Benefit

Land released for unrestricted use from this site would be primarily suited for agricultural, residential, and light-industrial uses due to its current status, geographical location, and proximity to other similar use areas. Remediation to unrestricted use criteria levels (established DCGLs) will allow for any and all land use scenarios, including the most restrictive, Suburban Residential scenario (Child). In light of this, changes in land value can occur without adverse effect on the remediation activities planned for the site, thus no additional land value benefit is gained with additional remediation activities.

7.2.4 Esthetics Benefit

If contaminated soil is removed to meet the established DCGL soil activity values, the excavation will be refilled and contoured to the surroundings and vegetation will be restored for erosion control. However, if a decision was made to remediate below the established DCGL value, an increasing quantity of previously undisturbed land might be disrupted and removed. This additional remedial action would increase the overall environmental disturbance of the land and prove to be a negative esthetics benefit overall.

7.3 Determination of Costs

The determination of costs includes all possible costs (excluding Environmental Impacts and Loss of Economic Use of Site/Facility costs, which need not be considered due to the site objective of remediating to unrestricted use criteria presented in 10 CFR 20.1402). This level of remediation ensures that the site will be available for any future proposed activity, hence eliminating the loss of economic use. In addition, land contours and vegetation will be restored in site remediation areas for the purpose of erosion control. These costs are unavoidable regardless of the remediation method and, therefore, are excluded.

7.3.1 Determination of Total Costs

The total cost of a decommissioning alternative is determined in accordance with Equation N-3 of NUREG-1757, Vol. 2, Appendix N, which states:

$$Cost_T = Cost_R + Cost_{WD} + Cost_{Acc} + Cost_{TF} + Cost_{WDose} + Cost_{PDose} + Cost_{Other}$$

Where:

$Cost_T$ = Total cost

$Cost_R$ = Monetary cost of the remediation action

$Cost_{WD}$	=	Monetary cost for transport and disposal of the waste generated by the action
$Cost_{ACC}$	=	Monetary cost of worker accidents during the remediation action
$Cost_{TF}$	=	Monetary cost of traffic fatalities during transport of the waste
$Cost_{WDose}$	=	Monetary cost of dose received by workers performing the remediation action and transporting waste to the disposal facility
$Cost_{PDose}$	=	Monetary cost of the dose to the public from excavation, transport, and disposal of the waste
$Cost_{Other}$	=	Other costs as appropriate for the particular situation

The cost of the remedial action (removal of contaminated soil to a DCGL value of 25 mrem/y) does not include land restoration costs. The cost of remediation action ($Cost_R$) and the cost for transport and disposal of the waste generated by the action ($Cost_{WD}$) are combined into one value for this assessment. The $Cost_T$ is calculated as follows:

$Cost_{R+WD}$	=	$Cost_R + Cost_{WD}$
	=	(Volume of waste produced) x (cost of remediation, disposal, and transportation per unit volume)
	=	[10,000] m^3 x [$800]/$m^3$
	=	[$8,000,000]
$Cost_{ACC}$	=	(Monetary value of a fatality equivalent to $2000/person-rem) x (workplace fatality rate in fatalities/hour worked) x (worker time required for remediation in units of worker-hours)
	=	($3,000,000/fatality) x ($4.2 \times 10^{-8}$ fatalities/person-h) x ([10,000] m^3 x 1.62 person-h/m^3)
	=	[$2,041]
$Cost_{TF}$	=	(Monetary value of a fatality equivalent to $2000/person-rem) x (volume of waste produced/volume of a shipment) x (fatality rate per kilometer traveled) x (distance traveled)
	=	($3,000,000/fatality) x ([10,000] m^3 / 13.6 m^3/shipment) x (3.8×10^{-8} fatalities/km) x ([2500] km)

	=	[$209,559]
$Cost_{WDose}$	–	This cost is not applicable. Based on dose modeling performed, dose to an average construction worker is estimated to be 8 mrem/y at a soil concentration of 1500 pCi/g Total U. At $2000 per person-rem x 0.008 rem/y = $16/y/construction worker. This dollar value is insignificant and will not add significant cost to the total cost of remediation and need not be evaluated for the different alternatives
$Cost_{PDose}$	–	This cost is not applicable. Dose to the public from excavation, transport, and disposal of the waste is negligible; hence, monetary cost of the dose to the public from excavation, transport, and disposal of the waste is negligible and will not add a significant cost to the total cost of remediation.
$Cost_{Other}$	–	This cost is not applicable. Land restoration costs are not included in this analysis.
$Cost_T$	=	[$8,211,600]

Note: [ ] – Highlighted values are for demonstration purposes only. These values are not representative of actual values.

7.4 Determination of Residual Radioactivity Levels That Are ALARA

The purpose of this section is to determine whether the DCGLs selected for remediation action are ALARA. Because the intent of the calculation is to determine whether additional soil should be remediated in order to lower the radiological dose, only the cost associated with the additional remediation is used as input for this section.

Soil concentrations that are ALARA are determined in accordance with Equation N-8 of NUREG-1757, Vol. 2, Appendix N, where:

$$\frac{Conc}{DCGL_W} = \frac{Cost_T}{\$2000 \times P_D \times 0.025 \times F \times A} \times \frac{r+\lambda}{1-e^{-(r+\lambda)N}}$$

Where:

Conc	=	Average concentration of residual radioactivity in the area being evaluated
$DCGL_W$	=	Derived concentration guideline equivalent to the average concentration of residual radioactivity per unit volume
$Cost_T$	=	[$8,211,600] (See calculation in Section 7.3.1 of this DP)
r	=	Monetary discount rate (0.03/y for soil)
λ	=	Radiological decay constant for the radionuclide
P_D	=	Population density (0.0004 person/m^2 for land)
F	=	Fraction of the residual radioactivity removed by the remediation action ([0.8]—assuming [80%] of the source term removed during remediation activities)
A	=	Area being evaluated ([90,000] m^2)
N	=	Number of years over which the collective dose will be evaluated (1000 y for soil)

This calculation allows the licensee to estimate a concentration at which a remediation action will be cost-effective prior to starting remediation. Results less than one (1) indicate the remediation action is warranted to meet the ALARA requirement. Results greater than one (1) indicate the remediation action is not warranted to meet the ALARA requirement.

$$\frac{Conc}{DCGL_W} = \frac{\$8{,}211{,}600}{\$2{,}000 \times \left(4 \times 10^{-4}\right) \times 0.025 \times 0.8 \times 90{,}000} \times \frac{0.03 + 0}{1 - e^{-(0.03+0)1000}}$$

$$\frac{Conc}{DCGL_W} = 171$$

Because this value is greater than one (1), it is determined that the remedial action DCGL is ALARA, and no additional remediation action is warranted.

Note: [ ] – Highlighted values are for demonstration purposes only. These values are not representative of actual values.

7.5 Conclusion

This pre-remediation ALARA analysis demonstrates that the dose criteria in Subpart E of 10 CFR 20 will be met using the remedial action DCGL, concludes whether it is feasible to further reduce the levels of residual radioactivity to levels below those necessary to meet the dose criteria, and demonstrates that the remedial action DCGL is ALARA.

As presented in Section 7.2 of this DP, because the site objective is to remediate to unrestricted use values, all possible benefits are realized with no comparison against cost for the benefit.

As presented in Section 7.3 of this DP, costs were determined for the remedial action.

As presented in Section 7.4 of this DP, an ALARA analysis for the remedial action was performed. The ratio of conc to $DCGL_W$ was calculated to be [171]. Because this value is greater than one, it is determined that the $DCGL_W$ for the remedial action for unrestricted release of the area is ALARA and no additional remediation for the area is justified.

Note: [ ] – Highlighted values are for demonstration purposes only. These values are not representative of actual values.

8.0 PLANNED DECOMMISSIONING ACTIVITIES

Decommissioning activities will be performed in phases as follows:

a. Outlying Land Areas
b. Subsurface Soil Areas
c. Surface Soil and Water
d. Non-contaminated Buildings
e. Groundwater

Phase a. will be done under this DP. An alternate schedule will be requested to complete the remaining phases (Phases b.– e) of work under the DP. Plans and information necessary to obtain approval for the remaining phases will be submitted as amendment requests to the DP, pending completion of the site characterization and related NCP process.

The overall scope of decommissioning includes the following:

- Removal of pavement, concrete slabs, foundations, and below-grade utilities left from the demolition of contaminated buildings (Phase c.)
- Removal of contaminated soil (consistent with DCGLs and the NCP process)
- Remediation of surface water and groundwater, as determined by the characterization results and the NCP process
- Transportation of waste
- Site restoration
- Final status surveys and sampling

During the operations phase of the plant, a number of Integrated Safety Analyses (ISAs) were conducted. These ISAs covered various portions of the fuel fabrication process. All fuel fabrication and associated operations have ceased, and the equipment and systems have been cleaned of SNM to the extent possible. In addition, the bulk chemicals (i.e., ammonia and liquid nitrogen) associated with the processing operations have been removed from the site. The considerations covered by the ISAs are therefore not applicable to the work that will be done under the DP beyond the general issues of external events such as severe weather.

8.1 Contaminated Structures

Decontamination and demolition of contaminated, above-grade structures will be conducted under the site license. This work will be performed so as to facilitate additional site characterization activities and to remove or reduce radioactive contamination from the facilities consistent with the NCP objectives and license termination efforts.

The plan for non-contaminated structures, Phase d., will be submitted in a separate amendment request for this DP if the buildings are to remain in place. Building 110 is an office building, and no work with radioactive or chemical compounds was reportedly undertaken in this building. Building 230 is the Rod Loading building. Finished pellets (standard, erbium, and gadolinium) were loaded into fuel rods and assemblies for shipment offsite from Building 230. The plans for these two buildings are being evaluated. These buildings do not contain any contamination above the license's limits for free release. The final status of these buildings will be determined based on the results of the characterization of the soils beneath the buildings. If it is determined that the buildings can remain, DCGLs for the buildings will be submitted with the Phase d. amendment request for this DP.

8.2 Contaminated Systems and Equipment

To accomplish the objectives set forth above, contaminated systems and equipment are being removed from contaminated buildings under the current site license.

8.3 Soil

8.3.1 Outlying Land Areas (Phase a.)

Phase a. addresses the remediation of surface soils in outlying land areas, i.e., outside the central site tract and perimeter area. The outlying land areas have no documented evidence of contamination. As such, these areas are conservatively classified as Class 3 impacted.

<u>Removal/Remediation Tasks</u>

Activities in Phase a. for the outlying land areas will be limited to performing a final status survey of the Class 3 impacted area in accordance with MARSSIM methodology. A final status survey plan, as described in Section 14.4 of this DP, will be developed to demonstrate, within acceptable limits of uncertainty, that residual radioactivity in the soil does not exceed the established DCGLs or PRGs as determined by the NCP process.

<u>Techniques Employed to Remove or Remediate Surface Soil</u>

No soil removal will be performed during Phase a. If any soil removal is indicated in these outlying land areas based on the approved DCGLs, the affected areas will be marked for remediation during Phase c. following development of soil remediation alternatives under the NCP evaluation process. Techniques that will be used for soil removal will be described in an amendment to this DP for Phase c.

Radiation Protection Methods

Radiation protection methods that will be used for decommissioning activities, including Phase a. surveys, are addressed in Section 10.0 of this DP.

Procedures Authorized Under the Existing License

NRC License No. SNM-33 does not authorize remediation of contaminated soils without NRC approval via a specific license amendment or a Decommissioning Plan.

Use of Procedures

All decommissioning activities involving licensed material will be conducted in accordance with approved, written procedures as described in License No. SNM-33.

8.3.2 Subsurface Soil Areas (Phase b.)

The plan for remediation of subsurface soil areas will be submitted in a separate amendment of DP after additional characterization information is gathered. The potential to find HEU in the Burial Pits represents a unique remediation issue that will be addressed in the amendment.

8.3.3 Surface Soils Inside the Central Site Tract (Phase c.)

The plan for remediation of surface soils inside the central site tract will be submitted in a separate amendment request for this DP.

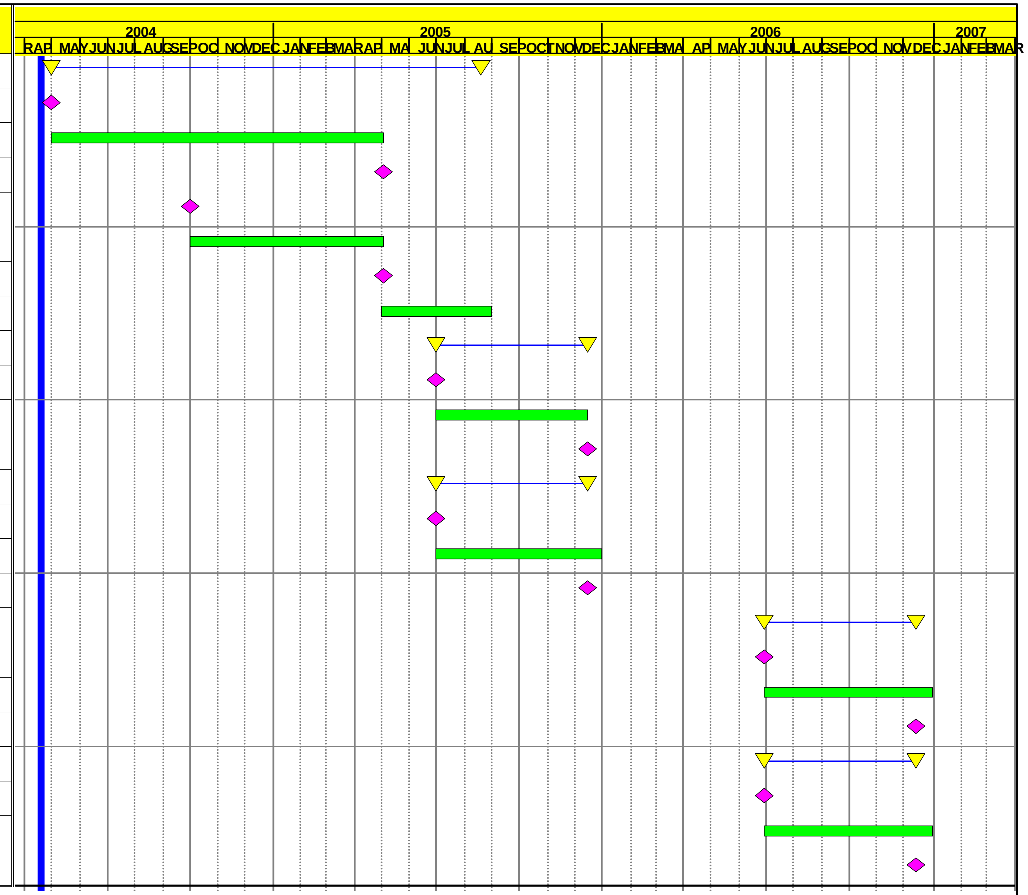
8.4 Surface and Groundwater

The plans for remediation of surface water and groundwater will be submitted in separate amendment requests for this DP. Surface water remediation will be performed in Phase c. in conjunction with surface soil remediation. Groundwater remediation will be performed in Phase e in accordance with the amended DP and the NCP process.

8.5 Schedules

The projected schedule for decommissioning, Figure 8-1, identifies decommissioning milestones and tasks. The milestones and tasks are organized according to the planned work sequence. The dates are contingent on NRC approval of this DP and approvals of other submittals to the NRC (e.g., DCGLs and Final Status Survey Plan). Circumstances can change during decommissioning, and, if the licensee determines that the decommissioning cannot be completed as outlined in the schedule, the licensee will provide an updated schedule to NRC. If the decommissioning is not expected to be completed within the timeframes outlined in NRC regulations, a request for an alternative schedule for completing the decommissioning will be submitted. Periodic updates to the schedule also will be submitted to the NRC. Schedules for subsequent decommissioning phases will be provided with the respective amendment requests for this DP.

Activity ID	Activity Description	m Early Start
000060	Phase II.a Outlying Land Areas	30APR04
000070	Submit Decomissioning Plan (DP) to NRC	30APR04*
000080	NRC Review of DP	30APR04
000090	DP Approved	
000100	Submit Final Status Survey Plan (FSSP)	
000105	NRC Review FSSP	01OCT04
000110	FSSP Approved	
000115	Final survey of Outlying Land Areas	02MAY05*
000120	Phase II.b Subsurface Soil Areas	30JUN05
000130	Submit DP to NRC	30JUN05*
000140	NRC Review of DP	30JUN05
000150	DP Approved	
000160	Phase II.c Surface Soil and Water	30JUN05
000170	Submit DP to NRC	30JUN05*
000180	NRC Review of DP	30JUN05
000190	DP Approved	
000200	Phase II.d Noncontaminated Buildings	30JUN06
000210	Submit DP to NRC	30JUN06*
000220	NRC Review of DP	30JUN06
000230	DP Approved	
000240	Phase II.e Groundwater	30JUN06
000250	Submit DP to NRC	30JUN06*
000260	NRC Review of DP	30JUN06
000270	DP Approved	



Finish Date 14DEC06

Projected Decommissioning
Plan Schedule

Figure 8-1 Projected Decommissioning Plan Schedule

9.0 PROJECT MANAGEMENT AND ORGANIZATION

9.1 Decommissioning Management Organization

The functional organization for the completion of decontamination and decommissioning and remediation activities, along with descriptions of management positions and qualifications, is described in the Hematite *Project Management Plan* (Ref. 22) and in License No. SNM-33. The *Project Management Plan* is being submitted with this DP. Additional details on the RSO position are provided in Hematite's *Radiation Protection Plan* (Ref. 23), which is provided as a submittal with this DP.

The Project Oversight Committee enables the self-regulation of the project. The goal of the Project Oversight Committee is to promote and continuously improve work place safety on the Hematite D&D and remediation project. The Committee's purpose is to evaluate the effectiveness of and recommend improvements to the Project safety rules, policies, and procedures for accident and illness prevention programs in the workplace and, ensure that written updates and changes to policies and procedures of the safety programs are completed.

The Committee provides management oversight and review of operations associated with the Westinghouse FFCF D&D. The Committee monitors D&D operations to ensure they are being performed safely and according to regulatory requirements. The Committee ensures that appropriate measures are taken to maintain radiation exposures ALARA through administrative and procedural controls, in addition to the design and control of radiological facilities and equipment.

The Project Oversight Committee performs an annual review of each of the following:

- Industrial safety trends
- Radiation safety trends
- Environmental protection trends
- Criticality safety practices
- Adequacy of emergency planning and drills
- Effectiveness of ALARA Program
- Effectiveness of Waste Minimization Program
- Abnormal occurrences and accidents

The Committee shall have a minimum of five members chosen to provide administrative and technical competence. The Committee consists of the Radiation Safety Officer (RSO), the Chairperson, a Committee Secretary and other management and qualified individuals as appointed by the Project Director.

The Committee meets at least quarterly, or more frequently at the discretion of the Committee Chairperson or designated alternate. The Committee maintains a written record of the minutes of each meeting.

A Project Oversight Committee Charter is maintained that establishes the duties and responsibilities of the Project Oversight Committee. Changes to the charter that do not degrade the intent of the charter are made by the Chairman.

9.2 Decommissioning Task Management

The methods employed to ensure that decommissioning activities are conducted in accordance with written, approved procedures, including a description of the methodology used to manage the development, review, and maintenance of the procedures, are described in the Hematite *Project Management Plan*. Details on the generation, proper use, and termination of RWPs are provided in Hematite's *Radiation Work Permit* procedure (Ref. 24), which is included as a submittal with this DP.

9.3 Training

The *Project Management Plan* defines Hematite's training program and establishes administrative controls for the program. Hematite's *Training Plan* (Ref. 25), which is provided as a submittal with this DP, defines the site-specific training required to safely perform decommissioning work at the Hematite facility. A description of training scope and requirements for decommissioning personnel is provided in the *Training Plan*. The training program shall be conducted under the requirements of the *Hematite Quality Assurance Program Plan* (HQAPP) (Ref. 26), which is provided as a submittal with this DP. Site employees and contractors shall comply with this training program.

Radiological protection components of the training program will be approved by the Radiation Safety Officer.

9.4 Contractor Support

The Hematite *Project Management Plan* addresses the requirements for contractor support. This includes:

- A summary of decommissioning tasks that may be performed by contractors
- A description of the management interfaces
- A description of Hematite oversight responsibilities
- A description of training

In addition, it is required by Hematite that contractors comply with the site license and site policies.

10.0 HEALTH AND SAFETY PROGRAM DURING DECOMMISSIONING

Occupational dose will be kept as low as is reasonably achievable. To this end, Hematite's *Radiation Protection Plan* has been established commensurate with the scope and extent of licensed activities at the site. This plan and associated procedures are the primary means used to administratively establish safe radiation work practices and ensure compliance with the requirements of the NRC. Radiation safety controls and monitoring for workers will be conducted in accordance with the *Radiation Protection Plan*.

Supplemental information relevant to radiation safety controls is provided as follows:

- Minimum Detectable Activities (MDA) for Air Samples—In the event that a specific radionuclide activity is required for air samples, an off-site commercial analytical laboratory will be used. The commercial laboratory selected from the approved vendors list will state the MDA/lower limit of detection (LLD) on the analytical report.

- Leak Testing of Sealed Sources—Hematite's *Contamination Control* procedure requires that each sealed source containing licensed material shall be leak tested at least every six months while in use. Sealed sources not in use, but in storage, do not have to be tested. Prior to transferring a source from storage to use or to another person, it will be tested for leakage if a leakage test has not been performed within the last six months.

  The source shall be removed from its container, and the container shall be checked for loose contamination. If leak test results show that there is contamination of 0.005 microcuries (6,600 dpm) or greater on the source container, the following actions will be taken:

  – Immediately remove the sealed source from use and notify the RSO
  – Forward completed leak test surveys to the RSO

- Instrumentation Facilities - Instruments used for decommissioning activities will be calibrated in accordance with approved procedures or by calibration facilities operating with an approved Quality Assurance Program. Instruments that are in need of calibration or repair will be appropriately identified as such and removed from the work area to prevent inadvertent use. Calibrated instruments available for use will be segregated from damaged or out-of-calibration instruments and maintained in an area accessed by authorized personnel only.

- Minimum Detectable Concentration (MDC) or MDA (at the 95 % confidence level)—Soil samples will be analyzed by a contract laboratory operating with an approved QA program and approved procedures. The results of the soil analyses will include calculated MDA/MDC and/or LLD values. The analysis results will also include associated uncertainty bounds and limits, as appropriate.

11.0 ENVIRONMENTAL MONITORING AND CONTROL PROGRAM

Decommissioning activities will be conducted in a manner that protects the environment and the health and safety of the public and employees. This includes development of programs and procedures that provide for monitoring, detection, and control of releases of radioactive material into the environment as a result of decommissioning activities. Protection of human health and the environment will also be considered through implementation of the NCP process.

Hematite's radiological environmental monitoring program will be conducted in accordance with License No. SNM-33 and Section 7.17 of Hematite's *Radiation Protection Plan*. Activities related to environmental monitoring and control shall comply with the HQAPP.

The environmental monitoring and control program will be reviewed and revised as necessary during the decommissioning process. The license commitment for environmental monitoring and control serves as a minimum commitment. As remediation activities begin, the monitoring program will be revised as necessary to ensure adequate environmental monitoring and controls are in place. These revisions shall be discussed in the subsequent amendments to this DP applicable to the scopes of work described in the DP amendments.

Supplemental information relevant to environmental monitoring and control is provided as follows:

- ALARA Goals for Effluent Control—In accordance with Hematite policy, every effort will be made to ensure that operations are conducted in accordance with ALARA principles. Effluent radiological constituent levels are historically extremely low. Even so, all effluent sampling events occur according to approved procedures and with the use of proper PPE and/or engineering controls to minimize exposure to contaminants by workers.

- Background and Baseline Concentrations of Radionuclides in Environmental Media—Background and baseline concentrations will be determined during planned site characterization. A significant amount of environmental monitoring data has been accumulated during the history of the site license. The environmental monitoring data was prepared and generally reported without subtracting natural background. Subsequently, the historical environmental monitoring data may be used to supplement the results obtained during the planned characterization efforts.

- Known or Expected Concentrations of Radionuclides in Effluents—Gross alpha and gross beta analyses are performed on liquid effluent samples. Gross alpha analysis is performed on air effluent (stack) samples. The average concentrations for 2003 are as provided in Table 11-1:

Table 11-1: 2003 Average Effluents

Effluent	Gross Alpha	Gross Beta	10CFR20 App. B Limit
Liquid	1.52E-8 μCi/ml	2.07E-8 μCi/ml	3.00E-7 μCi/ml
Air (stacks)	2.27E-15 μCi/ml	N/A	6.00E-14 μCi/ml

- Analyses of Physical and Chemical Characteristics of Radionuclides in Effluents—have not been performed. Air samples are analyzed for particulates. Water samples will be analyzed for filtered and unfiltered fractions.

- Effluent Sample Collection and Analysis—Effluent samples are collected in accordance with site procedures, e.g., "Environmental Sampling of Water, Soil, Vegetation, and Air" (PR-HP-011). Analyses of effluent samples are performed by a contract laboratory selected from the Approved Vendors List.

- Doses to the Public—Environmental air emissions were monitored for 19 stacks during operations of the facility. The 2002 radiological results for the air emissions were loaded into COMPLY Code–V1.6 and executed at Level 1, the most conservative level. The results of the COMPLY run indicated that the Hematite facility was in compliance with 40 CFR 61, National Emissions Standards for Hazardous Air Pollutants and 10 CFR 20.1101. During decommissioning activities, air emissions will not approach the release levels observed during plant operations. Execution of the COMPLY Code may be implemented if deemed appropriate.

12.0 RADIOACTIVE WASTE MANAGEMENT PROGRAM

12.1 Program Description

Radioactive waste management will be performed in accordance with Hematite's *Waste Management and Transportation Plan* (Ref. 27), which is provided in as a submittal with this DP, and License No. SNM-33.

The waste streams generated as a result of the decommissioning effort will be characterized by sampling and analysis to establish profile, packaging, and disposal criteria. Characterization may encompass a combination of process knowledge, radiological survey, volumetric sampling and direct sampling. Direct sampling may be performed utilizing direct radiological and hazardous constituent reading instruments to survey the material before and after removal. Characterization data will provide information to support health and safety operations, as well as waste packaging and transportation requirements. The sampling protocol will be adequate to meet the waste acceptance criteria of the approved disposal facility. Each waste stream is unique and will require specific handling, containerization, labeling, transportation, and disposal requirements. Based on characterization data, the waste will be segregated and analyzed as required by the disposal facility's waste acceptance criteria. If the analytical results determine an out of compliance result, an alternate disposal facility will be used.

12.2 Solid Radioactive Waste

12.2.1 Low-Level Radioactive Waste (LLRW) Solids

LLRW solids might include soil, brick, concrete, masonry, paper, wood, glass, metal, plastics, sheetrock, mineral material, equipment, tables, wire, pipe, ductwork, chairs, desks, roofing, filing cabinets, laboratory fume hoods, and any other debris or material normally found in the facilities being demolished. LLRW will be characterized, containerized, transported, and disposed at a permitted disposal facility as described in the waste profile. LLRW will be stored/staged in the appropriate container depending on the volume of waste. Metal boxes may be utilized for small volumes while intermodal or gondola containers may be utilized for large volumes depending on method of transportation.

If contaminated soil or other loose, solid radioactive waste is excavated, a storm water control plan will be implemented to control erosion and mitigate the entry of any contaminants from the work area into the storm drain system or onto other offsite areas. Best management practices will be used to control re-distribution of contamination, including silt fencing and straw bales, work sequencing, and re-seeding of exposed soil areas. Spill containment and cleanup materials will be kept for ready use in the work area. Silt controls will remain in place until disturbed soil is covered with gravel or stabilized with seeding.

Projected volumes of solid radioactive waste and the names and locations of potential disposal facilities being considered for solid radioactive waste will be provided, as appropriate, in the plans for the subsequent phases of decommissioning work to be submitted as amendment requests for this DP. Class B, C, or greater-than-C solid radioactive waste will not be generated at the site.

12.2.2 LLRW Asbestos-Containing Material (ACM)

LLRW ACM will be handled as radioactive waste. The LLRW ACM will be double wrapped, labeled both "asbestos" and "radioactive", containerized, transported, and disposed at a permitted facility. LLRW ACM that is bagged will be stored/staged in the appropriate container depending on the volume of waste. Metal boxes, and drums may be utilized for small volumes, while roll-offs or intermodal containers may be utilized for large volumes. LLRW ACM, such as transite, will be double wrapped, placed on pallets, or packaged and staged for transport.

The projected volume of LLRW ACM and the names and locations of potential disposal facilities being considered for LLRW ACM will be provided, as appropriate, in the plans for the subsequent phases of decommissioning work to be submitted as amendment requests for this DP.

12.3 Liquid Radioactive Waste

LLRW liquids such as sludge, oil, and wastewater will be sampled, characterized, containerized, labeled, transported, and disposed at a permitted disposal or process facility. LLRW liquids will be stored/staged in the appropriate container, depending on the volume and type of waste. Filled and partially filled containers will be staged on spill pallets or in a bermed area. The containers will be filled so that the weight does not exceed the maximum weight specified by the manufacturer.

LLRW liquids will be stored in an area that provides secondary containment of such size so as to contain 10 percent of the volume of all containers or the volume of the largest container (whichever is greater). LLRW liquids will be segregated from uncontaminated wastes to minimize the amount of contaminated liquid generated. LLRW liquids may be absorbed to meet the disposal facility's waste acceptance criteria.

The projected volume of LLRW liquids and the names and locations of potential disposal facilities being considered for LLRW liquids will be provided, as appropriate, in the plans for the subsequent phases of decommissioning work to be submitted as amendment requests for this DP. Class B, C, or greater-than-C liquid radioactive waste will not be generated at the site.

12.4 Mixed Waste

Mixed waste that meets the EPA definition of a hazardous waste that is also radiologically contaminated will be disposed of at a permitted disposal facility. If mixed waste is found during decommissioning, it will be identified via characterization and volumetric sampling. Analytical data will delineate the specific hazardous material, the levels of contamination and the radioactive isotopes. In the event the material exceeds the Land Disposal Restrictions set forth by the EPA, the material will be treated at a permitted facility prior to disposal.

Mixed waste will be stored/staged in the appropriate container depending on the volume and type of waste. One-gallon containers, 55-gallon drums or metal boxes may be utilized for smaller volumes of hazardous waste while intermodal containers may be utilized for larger volumes.

Suspect/unknown material will be sampled and sent to a laboratory for analysis for hazardous materials outlined in Table 1 of 40 CFR 261.24. Upon receipt of the analytical data and in the event the suspect/unknown material meets the definition of a hazardous waste or a mixed waste, the material will be managed in a Site Accumulation Area (SAA) near the point of generation until a quantity of 55 gallons is generated. While being stored in the SAA, the container will be labeled, and the label will identify the container's contents, contaminants, and the contaminant waste code(s). Within 3 days of generating 55 gallons of waste, the waste shall be moved to a less than 90-day storage area or transported for treatment and/or disposal.

Mixed wastes (LLRW/RCRA or LLRW/TSCA) will be managed in an area that meets the requirements of a LLRW staging area and SAA or LLRW staging area/PCB storage area according to waste characterization. PCB waste will be treated within one year of generation unless covered by a regulatory agreement allowing longer storage. The Westinghouse EPA identification number is MOR000012724. The State of Missouri ID number is 032741.

The estimated volume of mixed wastes and the names and locations of potential disposal facilities being considered for mixed wastes will be provided, as appropriate, in the plans for the subsequent phases of decommissioning work to be submitted as amendment requests for this DP. There is potential for mixed waste in the Burial Pits based on information found in the burial logs. No Class B, C, or greater-than-C mixed waste will be generated at the site.

12.5 Waste Segregation

Demolition debris and the various waste streams will be segregated, size reduced if necessary, packaged in accordance with the appropriate waste acceptance criteria and staged in the immediate vicinity of the structure being decontaminated or demolished.

Demolition, radiological, and hazardous materials may not be containerized immediately but may be staged for sampling and characterization prior to being placed in the appropriate shipping container. Radioactive wastes will be staged to the greatest extent possible in remaining structures. In the event that a structure is not available, radioactive wastes will be containerized in intermodal containers, metal boxes, or roll-off boxes to minimize runoff. Erosion controls will be established, as required, around waste material that is stored outside.

Co-mingling will be strictly prohibited and controlled through containerization and segregation. Co-mingling will be prevented to the extent possible through the use of tarps, discrete barriers, and containerization. Staging areas will be established to control waste packages that are ready for transportation and disposal. Staging areas will be identified and posted in accordance with approved procedures.

13.0 QUALITY ASSURANCE PROGRAM

The HQAPP (Ref. 26) establishes the project constraints necessary to comply with corporate and regulatory quality assurance (QA) requirements. The HQAPP includes a description of the management system that shall be implemented to ensure continued compliance with applicable requirements. Key elements of the HQAPP include:

- Quality System
- Document Control
- Records Management
- Surveillance and Audits
- Control of Inspection, Measuring, and Test Equipment
- Control of Non-Conforming Items
- Corrective Action

Hematite's Quality Assurance Program will be conducted in accordance with the HQAPP. This policy is provided as a submittal with this DP.

14.0 FACILITY RADIATION SURVEYS

Radiological characterization survey results will be collected to provide sufficient information to allow planning for the Hematite site decommissioning and remediation. The results will be used to ensure that remediation workers will not be endangered, to demonstrate that it is unlikely that significant quantities of residual radioactivity are undetected, and to provide information that will be used to design the final status survey.

14.1 Release Criteria

The radiological criteria for release of materials for unrestricted use are addressed in License No. SNM-33 and Section 7.8.8 of Hematite's *Radiation Protection Plan*. The unrestricted release criteria for soils and sediments that remain on site will be in accordance with the DCGLs described in Section 5.0 of this DP.

Surface contamination surveys will be conducted for both removable and fixed contamination before contaminated equipment or facilities are released for unrestricted use. Release limits for equipment shall be in accordance with the NRC "Guidelines for Decontamination of Facilities and Equipment Prior to Release for Unrestricted Use or Termination of Licenses for Byproduct, Source, or Special Nuclear Material," dated April 1993. The survey methodology used will be sufficient to detect the release limits specified. Equipment and facilities shall be decontaminated to levels that are ALARA prior to release.

Release surveys will be performed and documented in accordance with written procedures.

14.2 Characterization Surveys

14.2.1 Gamma Walkover Survey

The Gamma Walkover Survey (GWS) was performed at the Hematite site to identify the presence of natural uranium, LEU, HEU, technicium-99, and thorium contamination in surface or near-surface soils to aid in area classification and future characterization planning at the site. The GWS also attempted to locate buried trenches and other Areas of Concern known or suspected to be on site. The GWS was designed to cover 100% of the central site track and approximately 10% of the outlying land areas.

The GWS was also conducted with the intent of maximizing the use of all data collected in future site evaluations. Although the GWS was conducted to aid in classification of site areas as impacted or non-impacted and therefore should not be considered a scoping survey, the GWS was designed to follow the guidance for scoping surveys presented in Section 5.2 of MARSSIM.

The GWS data will assist in verifying the conclusions of the Historical Site Assessment (HSA) and provide input for the design of the characterization.

14.2.2 Soil Characterization for K_d Determination

Because higher-than-background levels of uranium isotopes (U-234, U-235, and U-238) and technetium (as Tc-99) have been measured during previous characterization events, site-specific K_d factors for these radionuclides were measured in the laboratory using soil samples collected from the Hematite site. This work is described in a report entitled “Determination of Distribution Coefficients for Radionuclides of Concern at the Westinghouse Hematite Facility” (Ref. 28), which is provided as which is provided as a submittal with this DP. Six bore holes were drilled to refusal or bedrock (~30 to 35 ft), and 18 soil samples (3 depth intervals per bore hole) were collected for K_d testing, radionuclide analysis, and general soil characterization procedures. The bore holes were located based on site history, previous subsurface characterization, and the GWS. Bore hole locations are described as follows:

- Deul’s Mountain—refers to a pile of excavated and potentially contaminated soil stored along the southeast corner of the fence line.
- Burial Pits—approximately 40 burial pits are known to exist
- Tile Barn Cistern Burn Pit—the roof of the Red Room (referring to Building 240, formerly used highly enriched uranium conversion processes) was reportedly buried in an area south of the Tile Barn.
- Fenced Area No. 1—this bore hole is located where elevated gamma radiation was detected during the GWS.
- Fenced Area No. 2— this bore hole is located where elevated gamma radiation was detected during the GWS.
- Evaporation Ponds—past waste management practices have included the disposal of waste water in these ponds.

Uranium activities were detected at significant levels in samples from the fenced areas, and in the shallowest sample from the Tile Barn/Cistern Burn Pit area. A summary of activities in the soil samples is provided in Table 14-1:

Table 4-1 Activities in Soil Samples for K_d Determination

Location	Upper Limit of Sample Interval (ft)	Lower Limit of Sample Interval (ft)	U-234 (pCi/g)	U-235 (pCi/g)	U-238 (pCi/g)	T_c-99 (pCi/g)
Deul's Mountain	4	8.6	6.14	0.26	1.48	6.6
	23	28	1.79	N.D.	1.04	6.23
	28	33	0.92	N.D.	0.73	2.84
Burial Pits	4	10	4.97	0.18	1.22	N.D.
	13	17	0.85	N.D.	0.93	N.D.
	23	34	0.72	N.D.	0.78	N.D.
Tile Barn/Cistern Burn Pit	8	13	21.5	1.31	12	N.D.
	16	20	1.48	0.15	0.93	N.D.
	23	27	1.63	0.24	1.01	N.D.
Fenced Area #1	2	14	3	N.D.	0.99	2.8
	14	21	20.2	0.66	3.32	13.8
	24	30	1.38	N.D.	0.94	0.82
Fenced Area #2	1	12	218	9.8	33.6	2.52
	19	24	90	4.12	14.5	1.18
	27	31	75.8	2.67	6.57	0.91
Evaporation Ponds	1	8	11.6	0.45	2.06	2.55
	11	16	1	N.D.	0.91	2
	26	30	1.14	N.D.	0.66	5.86

ND – none detected

14.2.3 Characterization of Soil Under Site Buildings

The results of soil characterization under site buildings are described in Section 4.3.1.

14.2.4 Deul's Mountain Characterization

The characterization results on Deul's Mountain are described in Section 4.3.1.

14.2.5 Site Characterization

Site characterization to be implemented in 2004 includes a Field Sampling Plan designed to characterize specific Areas of Concern, provide data for future potential remedy selection, understand risks, and fill data gaps from previous efforts. Media of concern include groundwater, surface water, stream and pond sediments, and surface and subsurface soils.

14.3 In-Process Surveys

14.3.1 General

Radiation surveys will be conducted to 1) support remediation activities, 2) determine when a survey unit is ready for the final status survey, and 3) provide updated estimates of parameters used for planning the final status survey. These surveys may include routine operational surveys conducted to support remediation activities. These surveys may be performed on building and equipment surfaces and bulk materials. Areas or items that are expected to satisfy the DCGLs on the basis of in-process surveys will be identified as ready for final status survey.

14.3.2 Survey Design

Random and biased surveys will be performed. Biased sampling will be based on results of historical surveys, walk-downs, historical use of the item or area, and professional judgment.

14.3.3 Conducting Surveys

In-process surveys will include one or more of the following:

- Surface scans
- Direct static measurements
- In situ gamma measurements
- Material sampling
- Removable sampling

Surface scans and direct static measurements will be performed with portable radiation detection instrumentation (e.g., gas proportional detector, alpha/beta scintillation detector, gamma detectors). Samples of material will be collected to identify and quantify radionuclide concentrations. Measurements of removable radioactivity will be performed on surfaces using standard smear techniques.

14.3.4 Evaluating Survey Results

Survey data (e.g., surface activity levels and radionuclide concentrations in media) will be converted to standard units and compared to the DCGLs. If results of these surveys indicate that remediation has been successful in meeting the DCGLs, decontamination efforts will cease. Otherwise, additional remediation will be performed.

14.4 Final Status Survey Design

14.4.1 Overview

NRC regulation, 10 CFR 30.36(g)(4)(iv) requires a description of the final radiation survey. The final status survey plan for soils will be submitted prior to beginning final status surveys in the outlying land areas (Phase a.). The final status survey report will be submitted after the final radiological survey has been completed. For license termination, the final design will encompass consideration for the entire site. The final status survey for the Hematite site will be designed using the guidance contained in MARSSIM. The surveys will demonstrate that the residual radioactivity in each survey unit satisfies the applicable criteria for unrestricted release, as described in Section 5.0 of this DP. The surveys will provide data to demonstrate that radiological parameters do not exceed the established DCGLs.

Survey Design

The survey designs will begin with the development of data quality objectives (DQOs). The DQOs will be developed using guidance provided in the DQO process in Appendix D of MARSSIM. On the basis of these objectives and the known or anticipated radiological conditions at the site, the numbers and locations of measurement and sampling points used to demonstrate compliance with the release criterion will be determined. Finally, survey techniques appropriate for development of adequate data will be selected and implemented.

Radionuclides of Concern

Enriched uranium (principally) and technetium (minimally) have been identified in the soils in the central site tract. Due to the unknowns associated with government activities on the site, other radionuclides that will be considered isotopes of concern until proven otherwise include americium-241 (Am-241), plutonium-239 (Pu-239), neptunium-237 (Np-237), and thorium-232 (Th-232) in equilibrium with its progeny, i.e., radium-228 (Ra-228), and thorium-228 (Th-228).

Derived Concentration Guideline Levels (DCGL)

Section 5.0 of this DP provides the DCGLs used to design the surveys. For the purpose of the final status surveys, the DCGLs of Section 5.0 represent contamination conditions that are approximately uniform across the survey unit and will be specifically referred to as $DCGL_W$. A separate DCGL will be derived for small areas of elevated activity and will be specifically referred to as $DCGL_{EMC}$ (elevated measurement comparison). The method for determining the values for the $DCGL_{EMC}$ will be to modify the $DCGL_W$ by a correction factor that accounts for the difference in area and the resulting change in dose. The area factor is the magnitude by which the concentration within a small area of elevated activity can exceed the $DCGL_W$ while maintaining compliance with the release criterion. (If the $DCGL_W$ is multiplied by the area factor, the resulting concentration distributed over the specified smaller area delivers the same calculated dose.)

Classification of Areas based on Contamination

All areas of the site do not have the same potential for contamination and, accordingly, do not need the same level of survey coverage to demonstrate that residual radioactivity in the area satisfies the applicable criteria. The surveys will be designed so that areas with higher potential for contamination receive a higher degree of survey effort. The survey designs fall into one of two categories, non-impacted and impacted. In the interest of conservatism, all soil areas on the Hematite site are being treated as impacted areas, i.e., have some potential for containing residual contamination. Impacted areas are subdivided into three classes according to known or suspected levels of contamination with regard to the classification guidance of MARSSIM. Specific and thorough consideration will be given to site operating history and/ or known contamination based on site characterization efforts:

- Class 1 areas have, or had prior to remediation, a potential for radioactive contamination (based on site operating history) or known contamination (based on radiological surveys). Areas that are suspected of containing contamination in excess of the DCGLs shall be classified as Class 1.
- Class 2 areas have, or had prior to remediation, a potential for radioactive contamination or known contamination, but are not expected to exceed the DCGLs.
- Class 3 areas are potentially impacted but are not expected to contain any residual radioactivity or are expected to contain levels of residual radioactivity at a small fraction of the DCGL, based on site operating history and previous radiological surveys. These are areas with very low potential for residual contamination but insufficient information to justify a non-impacted classification.

Class 1 areas have the greatest potential for contamination and, therefore, receive the highest degree of survey effort, followed by Class 2, and then Class 3 areas. Areas may be further subdivided into units in accordance with the guidance in MARSSIM to better facilitate assessment of the area.

14.4.2 Investigation Levels

Radionuclide-specific investigation levels will be used to indicate when additional investigations may be necessary. The investigation levels will also serve as a quality control check for the measurement process. The investigation levels to be used at the site are provided in Table 14-2.

Table 14-2 Final Status Survey Investigation Levels

Survey Unit Classification	Investigate When Sample Result:	Investigate When Scanning Measurement:
Class 1	>$DCGL_{EMC}$	>$DCGL_{EMC}$
Class 2	>DCGL	>DCGL
Class 3	>fraction of DCGL	>Minimum Detectable Concentration

14.4.3 Instruments and Methods

The instruments and calibration and operational checks to be used during the final status survey are described in Section 7.9 of Hematite's *Radiation Protection Plan*.

Measurement techniques used to generate data during the surveys can be classified into three categories commonly known as scanning surveys, direct measurements, and sampling. These techniques will be combined in an integrated survey design. Descriptions of these techniques are as follows:

- Scanning surveys will be performed to identify areas of elevated activity that may not be detected by other measurement methods. Scanning will be performed of structure surfaces and land areas. Structure surfaces will be scanned for both alpha and beta/gamma radiations. Land areas will be scanned for gross-gamma radiation.
- Direct and removable measurements will be made to determine average activity in a survey area or unit. These measurements will only be made on structural surfaces and will be limited to alpha and beta/gamma measurements.
- Sampling will be limited to land areas. Samples of soil will be collected and analyzed for the radionuclides of concern, as applicable.

14.4.4 Reference Areas

The reference areas used for the conduct of the final status surveys for land areas will be as described in the final status survey plan. The reference for structural surfaces will be determined at the time of the survey as part of instrument calibration.

14.4.5 Reference Coordinate System

Reference coordinate systems will be used to facilitate selection of measurement and sampling locations and to provide a mechanism for relocating a survey point. Land area scanning surveys and soil sample locations will be referenced to State Plane.

14.4.6 Summary of Statistical Tests

Measurements from a survey unit will be compared to equivalent measurements from the reference areas. In general, the comparison will be whether the survey unit exceeds the reference area by more than the DCGL. The MARSSIM Sign Statistical Test will be used to evaluate the data from the final status surveys.

In addition, an elevated measurement comparison (EMC) will be performed against each measurement in a Class 1 unit to ensure that the measurement result does not exceed the specified investigation level—the $DCGL_{EMC}$. If any measurement exceeds the $DCGL_{EMC}$, then additional investigation will be completed regardless of the outcome of the Sign Test.

14.4.7 Control and Handling of Samples for Laboratory Analysis

Sample collection will be conducted in accordance with a written procedure. Laboratory analyses will be conducted in accordance with a written procedure. A written chain-of-custody procedure will be used to ensure integrity of samples and data from sample collection through data reporting.

14.5 Final Status Survey Report

A report will be prepared to document the final conditions of the site. The report will include information concerning:

- An overview of the results of the final status survey
- A discussion of any changes that were made in the survey from what was proposed in the DP
- A description of the method by which the number samples was determined for each survey unit
- A summary of values used to determine the number of samples and justification for these values
- The survey results for each survey unit including:
    - Number of samples taken for the survey unit
    - A map or drawing of the survey unit showing the reference system and random start systematic sample locations
    - Measured sample concentrations

  - Statistical evaluation of measured concentrations
  - Judgmental and miscellaneous sample data sets reported separately from those samples collected for performing the statistical evaluation
  - A discussion of anomalous data including any areas of elevated direct radiation detected during scanning that exceeded the investigation level or measurement locations in excess of the $DCGL_W$
  - A statement that a given survey unit satisfied the $DCGL_W$ and the elevated measure comparison if any sample points exceeded the $DCGL_W$
  - A description of any changes in initial survey unit assumptions relative to the extent of residual radioactivity

- Results of investigations, including causes and impacts, of any failed survey units

- A summary of conclusion

15.0 FINANCIAL ASSURANCE

The Westinghouse Electric Company has established and submitted to the NRC a Decommissioning Funding Plan for the Hematite site. Currently, this funding plan is based on a decommissioning cost estimate of $9,926,184. A financial assurance mechanism in the form of a Letter of Credit and the associated Standby Trust have been established and provided to the NRC in accordance with regulatory requirements. An updated decommissioning cost estimate has been prepared based on available information. This estimate is summarized in Table 15-1. The cost estimate provides for a realistic estimate of the costs associated with the radiological issues for decommissioning the site. As further characterization information is obtained and evaluated in conjunction with submission of amendments to the Decommissioning Plan, the decommissioning cost estimate will be re-evaluated and adjusted as appropriate. Based on the current total of $40,500,000 of forward costs, the appropriate revisions will be made to the current financial assurance mechanisms to increase the total financial assurance to the new estimate. This revision will be submitted by June 15, 2004. Included with the submittal will be the updated Continuing Certification of Financial Assurance.

Table 15-1: Decommissioning Cost Estimate

Cost Element	**Costs Spent as of 4/04 ($1,000)**	**Forward Total ($1,000)**
Project Management	$ 7,000	$ 5,500
Remedial Investigation	$ 1,000	
Mobilization	$ 2,000	
Facility Cleanout	$ 10,000	
Building Preparation	$ 3,000	
Contractor Costs		
Equipment Removal and Disposal		$ 8,500
Building Demolition and Disposal		$ 12,000
Burial Pit Excavation and Disposal		$ 10,000
Surface Soil Excavation and Disposal		$ 3,000
Final Status Survey and Documentation		$ 1,500
Prior Costs	$ 23,000	
Projected Additional Costs		$ 40,500
Existing Financial Assurance		$ 9,926
Additional Financial Assurance		$ 30,574