

Phase II Final Status Survey Report Mallinckrodt Columbium-Tantalum Plant

St. Louis, Missouri

Chapter 1

Project No. 137131**Revision 0**

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ABBREVIATIONS AND ACRONYMS

ACE	U.S. Army Corps of Engineers
AEC	Atomic Energy Commission
C-T	columbium-tantalum
CFR	Code of Federal Regulations
DP	Decommissioning Plan
EPA	U.S. Environmental Protection Agency
FSS	final status survey
FSSR	Final Status Survey Report
FUSRAP	Formerly Utilized Sites Remedial Action Program
GSA	General Services Administration
m ²	square meters
Mallinckrodt	Mallinckrodt LLC
MCL	Maximum Contaminant Level
MED	Manhattan Engineering District
NRC	U.S. Nuclear Regulatory Commission

1.0 INTRODUCTION

This Phase II Final Status Survey Report (FSSR) provides a complete and concise record of the radiological status of the Mallinckrodt Columbium-Tantalum (C-T) Plant processing building slabs, wastewater neutralization basins, sewerage, and soil affected by C-T processing. Final status survey (FSS) data of sufficient type, quantity, and quality were collected to demonstrate that each survey unit of the C-T Plant satisfy the unrestricted release criterion of Title 10, Code of Federal Regulations (CFR), Part 20, Subpart E. This FSSR presents the information required as listed in Section 14.5 of the C-T Plant Phase II Decommissioning Plan (DP)¹, further discussed in Section 1.3. This chapter of the FSSR provides background information on the license, site, decommissioning strategy, operational history, radiological characterization, and FSSR organization.

1.1 LICENSE SUMMARY

Mallinckrodt LLC (Mallinckrodt) is a Delaware Corporation with its principal place of business located at 675 McDonnell Boulevard, St. Louis, MO, 63042. Mallinckrodt has held U.S. Nuclear Regulatory Commission (NRC) Radioactive Material License STB-401, Docket Number 40-6563, since 1961 for the extraction of columbium and tantalum from natural and synthetic ores and slags, which was originally issued by the Atomic Energy Commission (AEC). The license was required because processed raw materials and by-products contained sufficient quantities of natural uranium and thorium isotopes. It is currently a possession-only license.

1.2 SITE LOCATION AND DESCRIPTION

The licensed facility is the Columbium-Tantalum (C-T) Plant, which is located within the Mallinckrodt St. Louis Plant at 3600 North Second Street, St. Louis, Missouri, 63147 (see Figure 1-1). The Mallinckrodt Plant is a 43-acre (174,016 square meter [m²]) site located near the west bank of the Mississippi River in the northeastern section of the City of St. Louis. The site is located in an urban industrial area, zoned and developed for industrial use, in the northeastern section of the City of St. Louis. The C-T Plant boundaries are located within Plant 5 and Plant 7W of the St. Louis Plant. Within Plant 5, the C-T project remediation area boundaries have been defined as: areas south of the south edge of Destrehan Street, and areas north of a line drawn along the south sides of Building 200, and areas west of a line drawn on the east side of Buildings 222 and 223 (excluding the footprints of the buildings), and areas east of a line drawn along the west sides of Buildings 240 and 250. The sewerage from Plant 5 extending downstream to the wastewater handling facilities in Plant 7W is also included. Figure 1-2 shows the decommissioning site boundaries. Figure 1-3 provides an aerial view of the site. Figure 1-4 shows the locations of manhole samples (discussed in Section 1.5.2) and sewerage.

Mallinckrodt's St. Louis Plant currently contains more than 50 manufacturing and support buildings in an area of approximately twelve city blocks. Mallinckrodt currently produces a variety of products for the food, drug, pharmaceutical, and specialty chemical industries on a 24/7 operational schedule. It intends to continue industrial use of the site, including the areas in which C-T activities occurred requiring decommissioning.

¹ Including June 3, 2010 revisions.

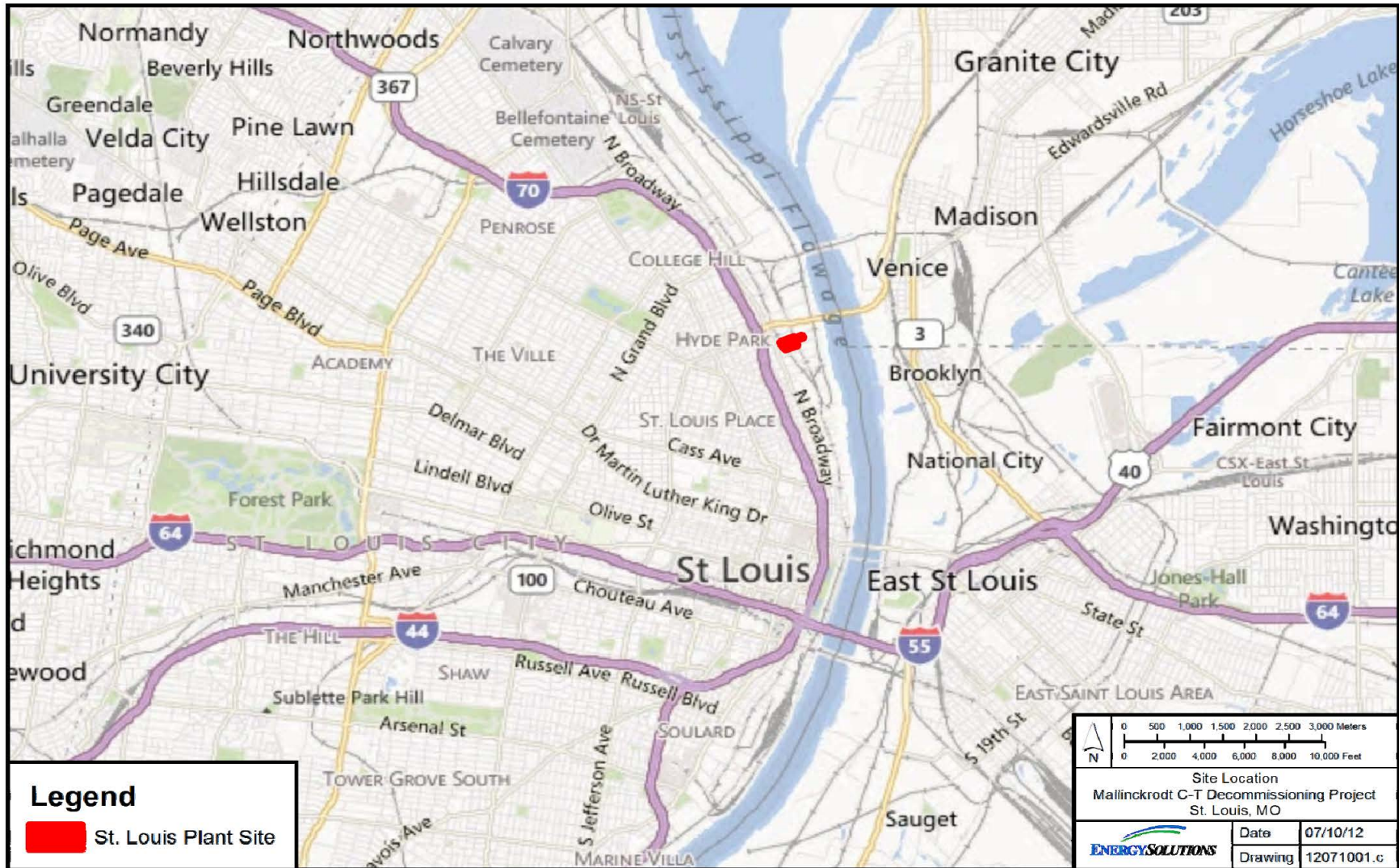


Figure 1-1 Mallinckrodt St. Louis Plant Site Location

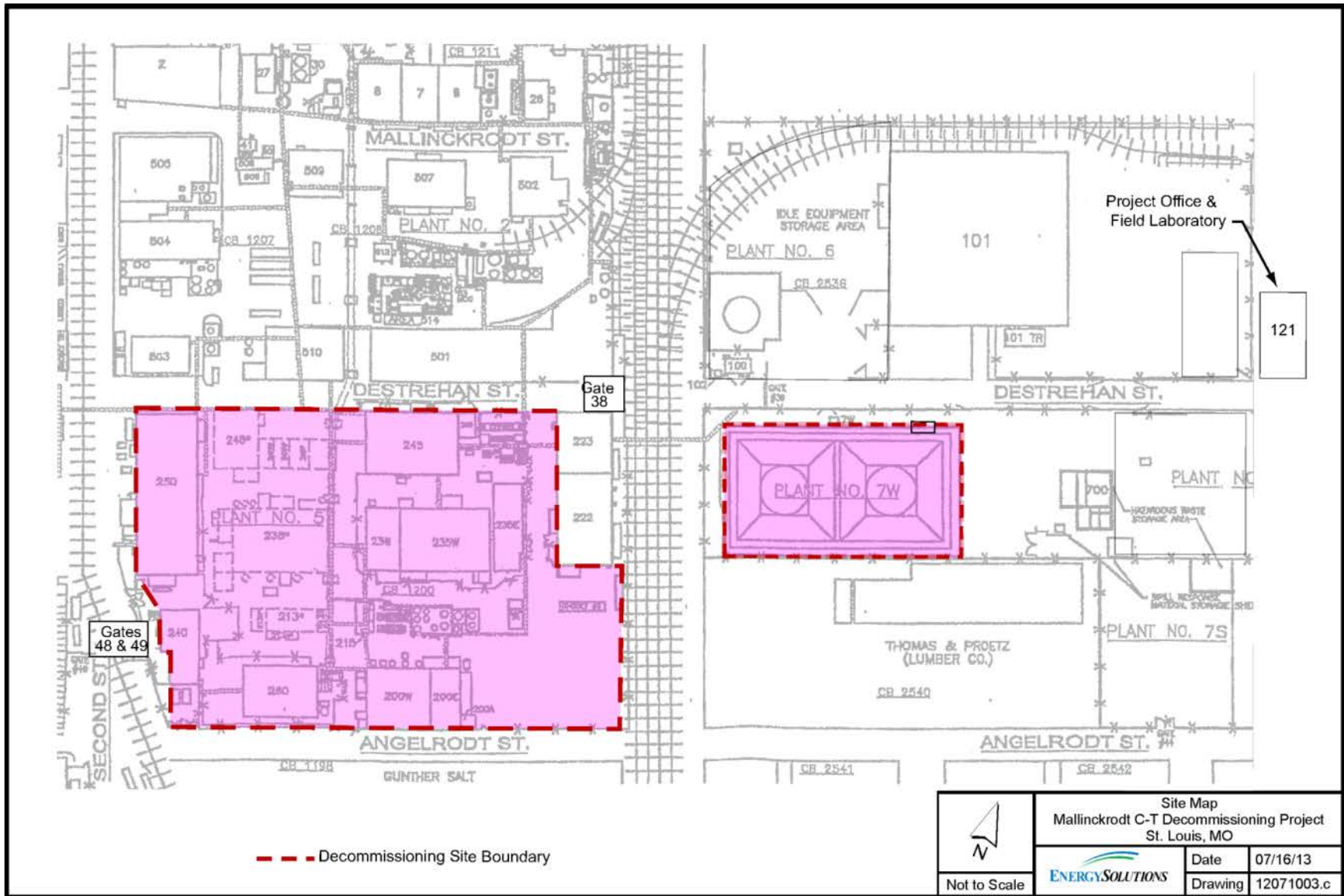


Figure 1-2 Decommissioning Site Boundary



Figure 1-3 Aerial Photograph of C-T Plant

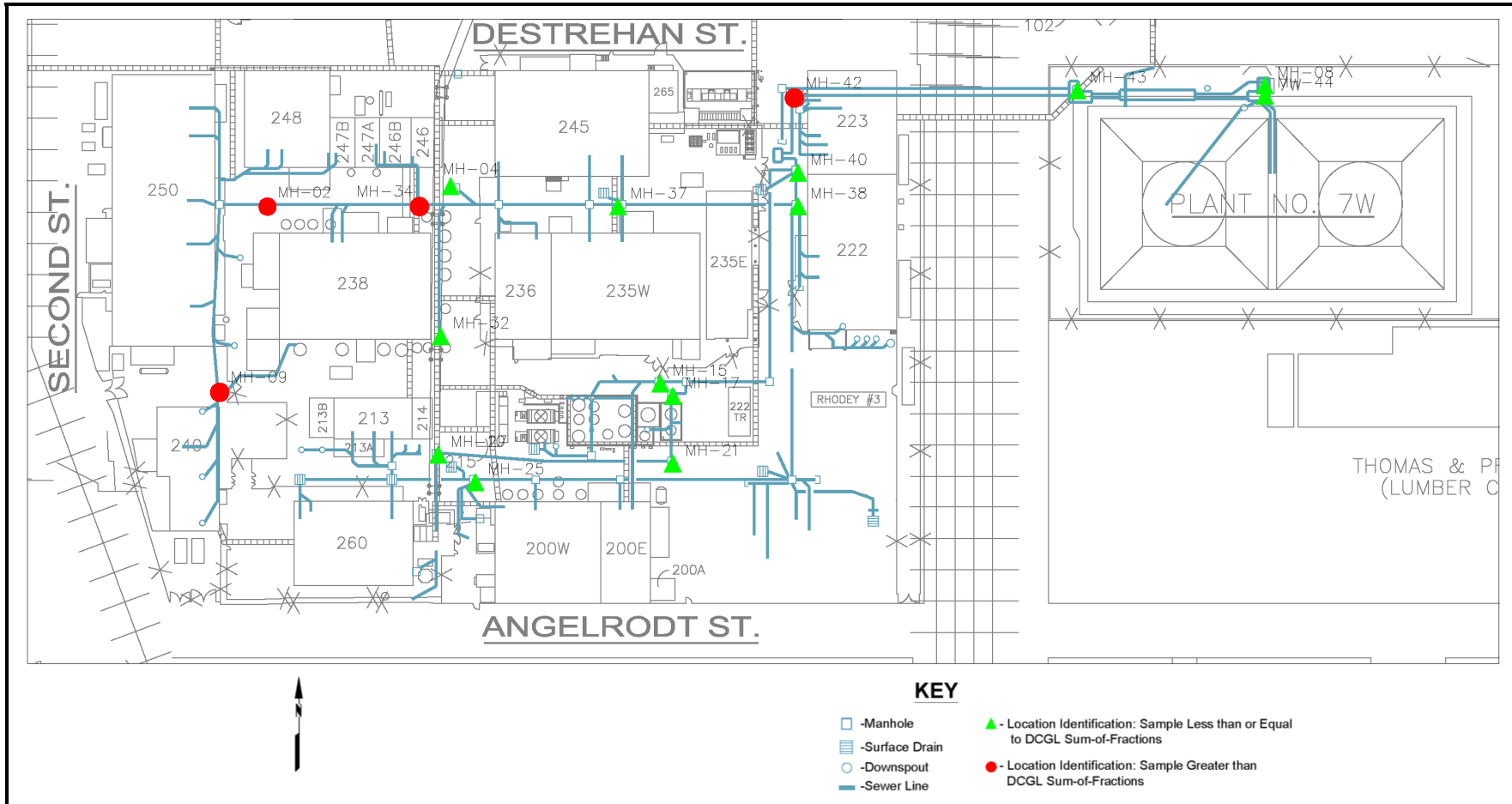


Figure 1-4 Manhole Samples and Sewerage (from C-T Phase II DP Figure 4-1)

1.3 DECOMMISSIONING STRATEGY

The goal of the C-T decommissioning is to remediate the radiological constituents associated with C-T production to the extent required to terminate license STB-401. The NRC approved a two-phase decommissioning process that provided Mallinckrodt the flexibility necessary to address the inherent complexities of an operating manufacturing site and take immediate steps to reduce the amount of residual radioactive material at the St. Louis Plant. Phase I included the decontamination and removal of above-grade buildings, surfaces, and equipment and was performed in accordance with the Phase I DP. Any items that remain on site as part of the C-T Phase I decommissioning are not included in this FSSR. The Phase I FSSRs were reviewed and approved by NRC. Phase II included C-T processing building slabs, sewerage, wastewater neutralization basins, and soil affected by C-T processing. This FSSR documents the radiological condition of the remaining surfaces and soils to support the termination of the aforementioned license (STB-401).

1.4 OPERATIONAL HISTORY

Between 1942 and 1958, Mallinckrodt refined uranium ore and concentrate to produce uranium compounds and metal in support of early Federal Government programs to develop atomic weapons under the Manhattan Engineering District (MED) and later the AEC. Areas of the St. Louis Plant and vicinity properties affected by MED-AEC material are currently being remediated under the U.S. Government Formerly Utilized Sites Remedial Action Program (FUSRAP) by the U.S. Army Corps of Engineers (ACE).

From 1956 to 1960, Mallinckrodt extracted columbium, tantalum, uranium, thorium, and rare earth elements from euxenite mineral ore for delivery to the AEC and the General Services Administration (GSA) as part of the Defense Materials Procurement Program. The Euxenite operation was performed under AEC source material license R-226 which expired in 1960.

From 1961 to 1989 Mallinckrodt extracted columbium and tantalum compounds under NRC License STB-401 from ores in the C-T processing buildings formerly located within the city block identified as Plant 5 (see Figure 1-2). The C-T feed materials included ore and tin slag; process products included tantalum oxide, potassium fluotantalate, and columbium oxide. The same processing facilities used under the AEC source material license R-226 were also subsequently used for C-T processing.

Information regarding other historical radiological activities performed at the site is provided in Chapter 2 of the C-T Phase II DP.

1.5 CHARACTERIZATION SUMMARY

The radiological status of the C-T Decommissioning Project is interpreted on historical characterization programs. The characterizations were designed to quantify the physical and chemical characteristics of the C-T process and process support areas, and perform an initial assessment of the areal and vertical extent of radioactive contamination. Affected and potentially affected surface and subsurface materials were characterized.

1.5.1 Contaminated Structures

Contaminated structures, defined as a building or other structure above ground, was the scope of the C-T Phase I DP and are not described in this FSSR.

1.5.2 Contaminated Systems and Equipment

Systems and equipment that are above-grade was the scope of the C-T Phase I DP and are not described in this FSSR. Below-grade systems and equipment are within the scope of the C-T Phase II DP. A total of 18 samples of sediment from sewer pipes at manholes were collected during characterization. Interpretation of the manhole samples revealed contamination in the sewer lines to be confined to segments immediately southwest, west, and north of Building 238 (see Figure 1-4).

1.5.3 Surface Contamination

Surfaces are paved with concrete or asphalt, or covered by structures. Two separate characterization campaigns were conducted and are described in detail in Chapter 4 of the C-T Phase II DP. Measurement techniques for pavement included gamma scanning while walking over the areas, and beta-gamma activity measurements on a gridded surface using hand-held, direct reading instruments. A total of 24 scabble samples were also collected—only one sample exceeded the exempt concentration limit for release of source material of 0.05% weight, described in 10 CFR 40.13(a).

Figure 1-5 shows the scabble results presented in the C-T Phase II DP. The direct survey results and the scabble samples from the characterization studies indicate that almost all of the pavement of Plant 5 could be released for unrestricted use. Only 3 of the 1670 measurement results exceeded the release limit. Figure 1-6 and Figure 1-7 show the surface contamination measurements for Plant 5 and Plant 7W, respectively, presented in the C-T Phase II DP.

1.5.4 Soil Contamination

Characterization of subsurface materials was achieved by soil core sampling. Samples of soil were collected from cores and analyzed by alpha or gamma spectrometry. Sampling was conducted during 11 separate characterization studies and is described in detail in Chapter 4 of the C-T Phase II DP.

Based on the analytical information obtained from the characterization studies, some soils in the Plant 5 area contained radionuclide concentrations exceeding the release limits. The locations of samples exceeding the release limits were shown in C-T Phase II DP Figures 4-7 through 4-16. Figure 1-8 depicts the extent of the contaminated soils in Plant 5 based upon this characterization data as estimated in the C-T Phase II DP.

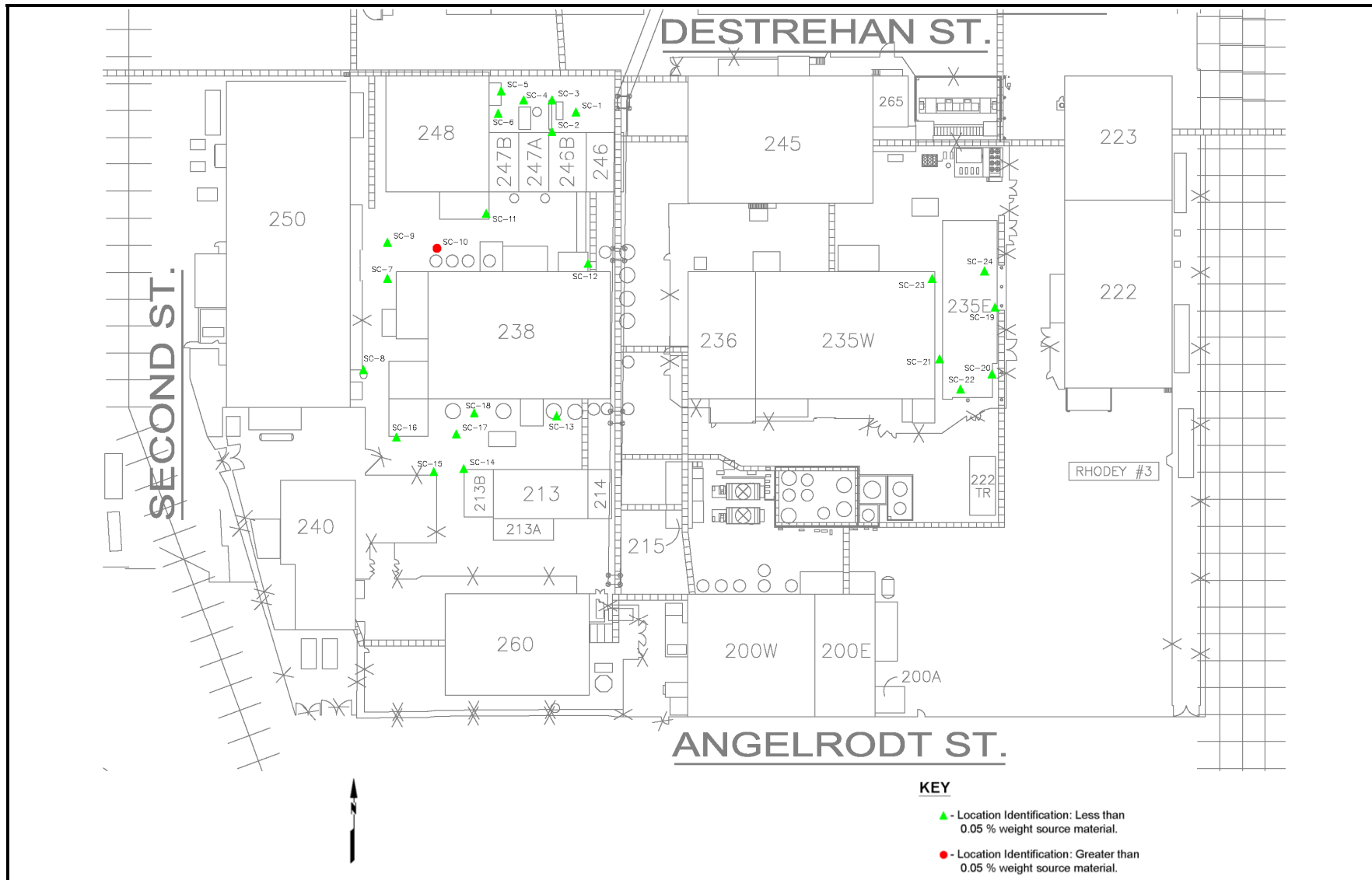


Figure 1-5 Scable Sample Results (from C-T Phase II DP Figure 4-2)

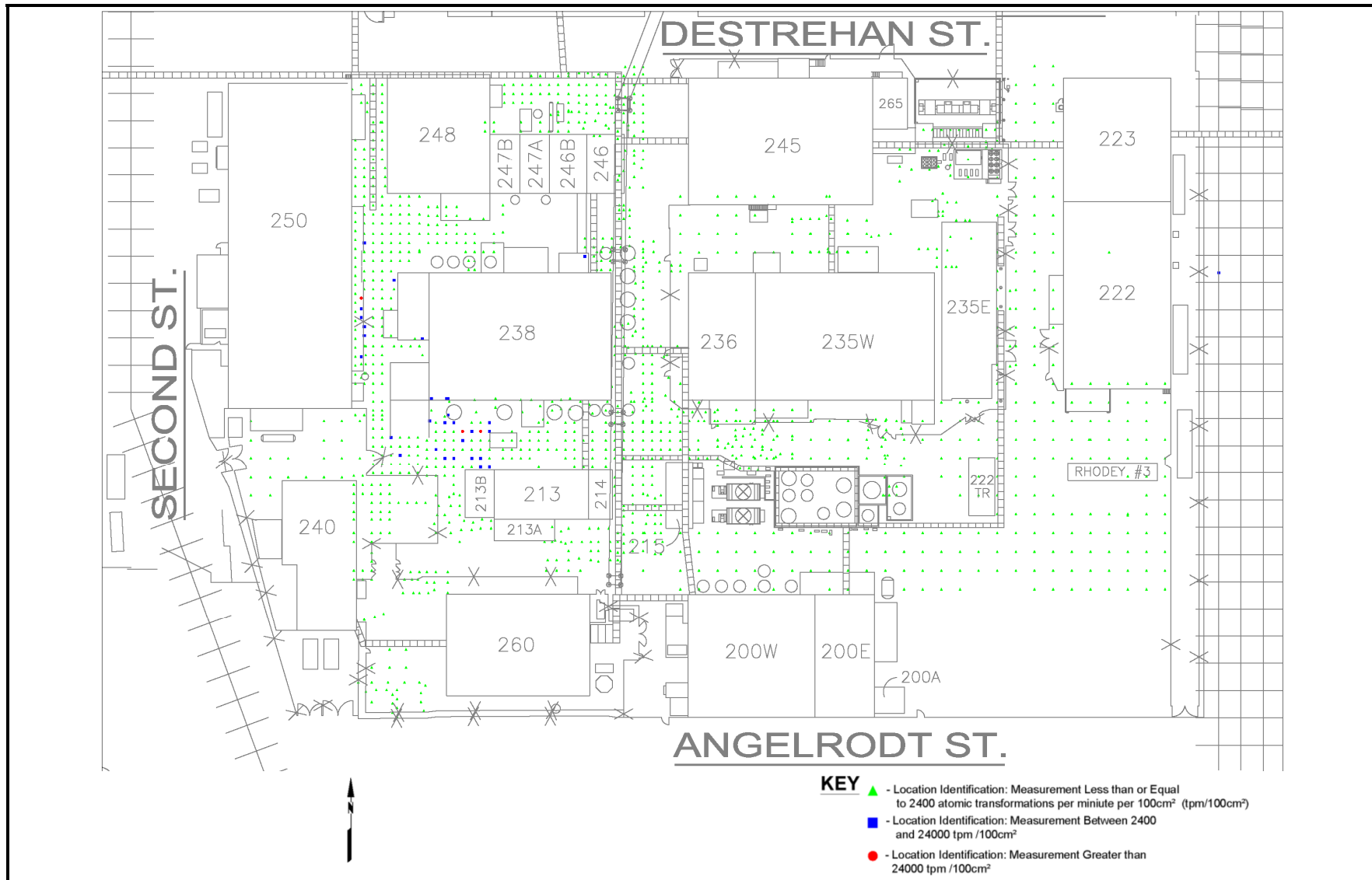


Figure 1-6 Plant 5 Surface Activity (from C-T Phase II DP Figure 4-3)

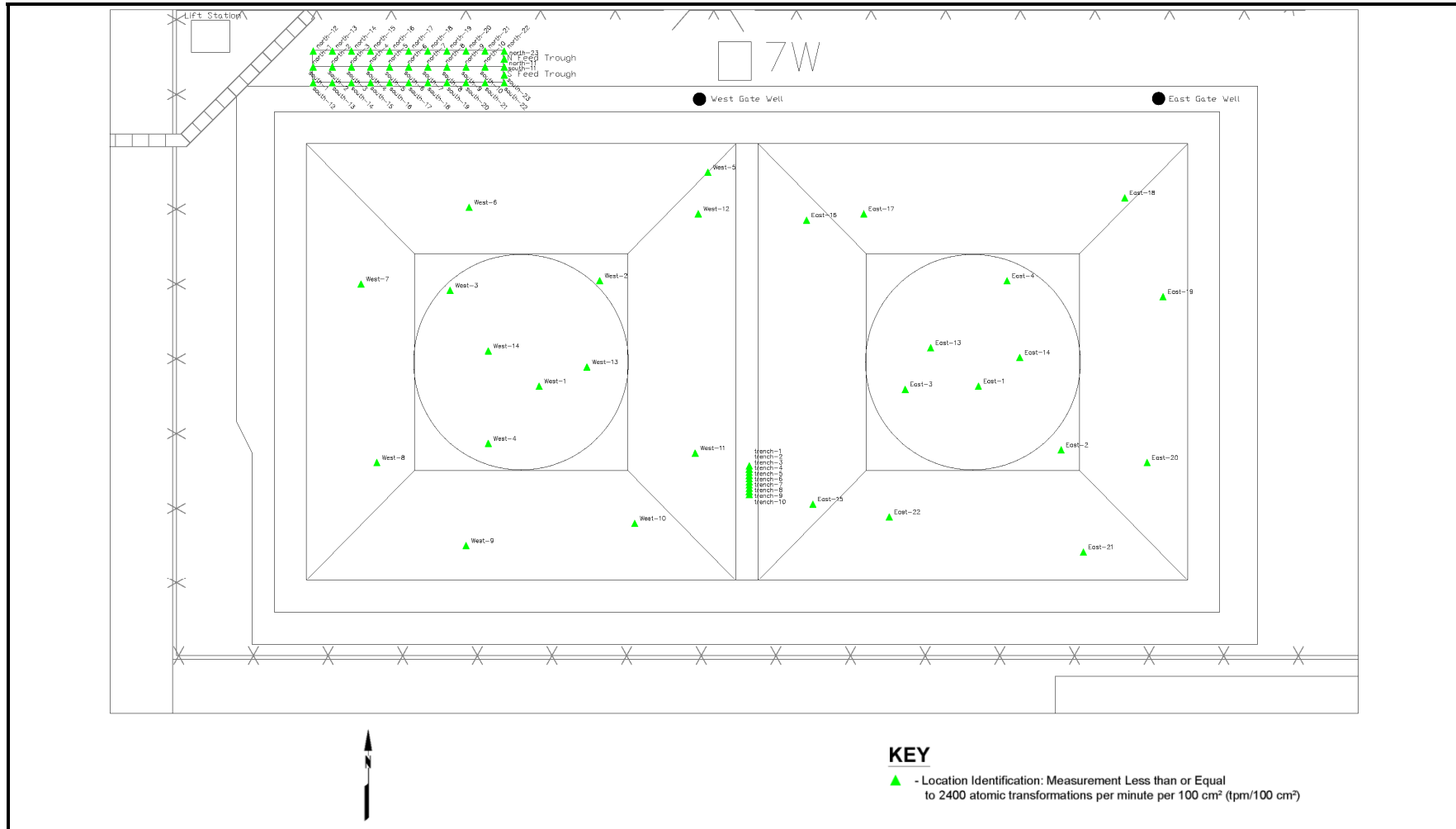


Figure 1-7 Plant 7W Surface Activity (from C-T Phase II DP Figure 4-5)



Figure 1-8 Estimated Contaminated Soil Extent (from C-T Phase II DP Figure 4-17)

1.5.5 Surface Water

The only surface water in the area is the Mississippi River, adjacent the east side of the plant site. There are no other rivers and no lakes or ponds on or adjacent the facility. Due to the large flow volume of the Mississippi River and the environmental controls established for the site, there would be no detectable impact to surface water from decommissioning activities.

1.5.6 Groundwater

Radionuclides were detected in samples collected from eight monitoring wells located on the Mallinckrodt St. Louis Plant property during four quarterly sampling events between July 1988 and April 1989. These detections do not present a groundwater ingestion hazard because the samples were collected from the perched groundwater in the upper zone and this water is not considered a drinking water source. No radionuclides were detected above U.S. Environmental Protection Agency (EPA) Maximum Contaminant Level (MCL) in filtered groundwater samples from the lower zone. These findings suggest that the low-permeability silt and clay layers between the upper and lower zones retard contaminant migration between the two zones.

1.6 FSSR ORGANIZATION

This Phase II FSSR is divided into the following chapters:

- Chapter 1 – Introduction
- Chapter 2 – Organization and Responsibilities
- Chapter 3 – Site Release Criteria
- Chapter 4 – Final Status Survey Design
- Chapter 5 – Data Quality Assessment
- Chapter 6 – Plant 5 Pavement FSS Results Summary
- Chapters 7 through 28 – Plant 5 Subsurface Survey Unit FSS Results Summaries (SU01 through SU22)
- Chapter 29 – C-T Plant Sewerage FSS Results Summary
- Chapters 30 through 33 – Plant 7W Pavement Survey Unit FSS Results Summaries (SU01 through SU04)

1.7 REFERENCES

Mallinckrodt, *Mallinckrodt Columbium-Tantalum Phase II Decommissioning Plan*, Revision 2, August 2008.

Mallinckrodt, Letter from Ms. Karen Burke (Mallinckrodt) to Mr. John Buckley (NRC), dated June 3, 2010, Subject: *Revisions to Phase 2 Decommissioning Plan*.

U.S. Army Corps of Engineers, *Groundwater Characterization Report of 1997/1998 Baseline Data for the St. Louis Downtown Site*, St. Louis, MO, July 1998.

U.S. Nuclear Regulatory Commission, 10CFR20, Title 10 Code of Federal Regulation Part 20, *Standards for the Protection Against Radiation*.