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**COLORADO DEPARTMENT OF PUBLIC HEALTH
AND ENVIRONMENT
HAZARDOUS MATERIALS AND WASTE MANAGEMENT DIVISION**

FIVE-YEAR REVIEW

DENVER RADIUM SITE

DENVER, COLORADO



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List of Acronyms

ARAR	Applicable or Relevant and Appropriate Requirements
CCR	Code of Colorado Regulations
CERCLA	Comprehensive Environmental Response, Compensation Liability Act
CDPHE	Colorado Department of Public Health and Environment
CFR	Code of Federal Regulations
CSR	Central and Sierra Railroad
D&RGW	Denver and Rio Grande Western Railroad
DW	Drinking Water
EMI	Environmental Materials, Inc
EPA	Environmental Protection Agency
ESD	Explanation of Significant Differences
GIS	Geographic Information System
HASP	Health and Safety Plan
HSS	Hospital Shared Services
IC's	Institutional Control
ICRP	International Commission on Radiological Protection
IHOP	International House of Pancakes
MCL's	Maximum Contaminant Levels
Mrem/year	Milli-rem per year
mSv	Milli-Sievert
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NPL	Superfund National Priorities List
O&M	Operations and Maintenance
OSWER	Office of Solid Waste and Emergency Response
PRP	Potentially Responsible Party
RAL's	Risk Action Levels
RI/FS	Remedial Investigation/Feasibility Study
ROBCO	Robinson Brick Company
ROD	Record of Decision
ROW	Right of Way
SSC	State Superfund Contract
TBC	To Be Considered
OU	Operable Units

Executive Summary

The State of Colorado has conducted a second Five-Year review of the remedial actions performed at the Denver Radium Superfund Site located in Denver County, Colorado. The review was conducted from January through September 2003.

A Community Involvement Plan (CIP) Update (Appendix A) is included in this Five-Year Review and describes the community involvement and public participation program developed for the Denver Radium Superfund Site.

This review found that while Institutional Controls are in place at some Operable Units, others have no form of Institutional Controls in place. Therefore, the remedy is not protective of human health and the environment at these Operable Units. A meaningful system of Institutional Controls needs to be implemented in order for the remedy to be fully protective.

The City and County of Denver is currently negotiating a consent decree with the United States (Case Number 97-D-1611). If this is successfully completed, Denver will agree to implement management plans for radium contaminated soils remaining in place in Denver's rights-of-way and to continue to enforce Denver's zoning ordinance and its radium fee ordinance as institutional controls at private properties where radium contaminated soils remain in place where Supplemental Standards were applied. This implementation will resolve Deficiency Number 1.

A GIS database system is currently being prepared by EPA that will document all features of the Denver Radium Site. This should be completed by approximately summer of 2004 and include features discussed under the Risk Assessment heading below. Additionally, new figures will be generated as an addendum to this Five-Year Review.

The Risk Assessments for all the Denver Radium OU's where waste remains in place under supplemental standards do not meet the current requirements of CRR 1007 Parts 4.61.3.2 and 4.61.3.3 of the Colorado Rules and Regulations pertaining to Radiation Control. This also calls the protectiveness of the remedy into question.

EPA conducted a five-year review of the Shattuck Site in 1999 and found site-specific deficiencies in the solidified material cover design, the structural and chemical integrity, and the compliance program. Based on these findings, EPA could not be assured of the long-term protection of the original remedy. Ground water monitoring of the site plume is ongoing and needs to continue or be finalized.

A brief summary of the analytical data for OU3 has been included in this Five-Year Review. The analytical report needs to be completed and an additional round of ground water monitoring should be completed in December 2003 or January 2004 to check for seasonal fluctuations. CDPHE needs to complete the analytical report for OU 9B (ROBCO) Annual Ground water monitoring. Both of these reports will be submitted separately; not as Addendums to this Five-Year Review. The findings of these reports are not expected to change the conclusions in this Five-Year Review. CDPHE recommends, based on the trends shown in ground water data at OU9B, that the frequency be reduced from annual to bi-annual until the time of the next Five-Year Review when it will be reassessed.

Five Year Review Summary Form

SITE IDENTIFICATION		
Site name (from WasteLAN): Denver Radium Site		
EPA ID (from WasteLAN): COD980716955		
Region: 8	State: CO	City/County: Denver/Denver
SITE STATUS		
NPL Status: <input type="checkbox"/> Final, <input type="checkbox"/> Deleted, <input type="checkbox"/> Other (specify)		
Remediation Status (choose all that apply): <input type="checkbox"/> Under Construction, <input type="checkbox"/> Operating, <input type="checkbox"/> Complete		
Multiple OUs? <input type="checkbox"/> Yes, <input type="checkbox"/> No	Construction Complete date:	
Has site been put into reuse: Some properties of certain OUs have continued to be used and/or redeveloped. Please refer to text description for each OU.		
REVIEW STATUS		
Reviewing Agency: <input type="checkbox"/> EPA, <input type="checkbox"/> State, <input type="checkbox"/> Tribe, <input type="checkbox"/> Other		
Author Name: Mark Rudolph		
Author Title: Remedial Project Manager	Author Affiliation: CDPHE	
Review period: January 2003 to September 2003		
Date(s) of site inspection: 5/2003 through 9/2003		
Type of Review: <input type="checkbox"/> Statutory, <input type="checkbox"/> Policy (<input type="checkbox"/> Post-SARA, <input type="checkbox"/> Pre-SARA, <input type="checkbox"/> NPL-Removal Only) <input type="checkbox"/> Non-NPL Remedial Action Site, <input type="checkbox"/> NPL State Tribe Lead		
Review number: <input type="checkbox"/> 1 (first), <input type="checkbox"/> 2 (second), <input type="checkbox"/> 3 (third), <input type="checkbox"/> Other (specify)		
Triggering action: <input type="checkbox"/> Actual RA Onsite Construction at OU#, <input type="checkbox"/> Actual RA Start at OU#, <input type="checkbox"/> Construction Completion, <input type="checkbox"/> Previous Five-Year Review, <input type="checkbox"/> Other (specify)		
Triggering action date (from WasteLAN): 10/04/1995		
Due Date (five years after triggering action date): 10/04/1995		

Five-Year Review Summary Form

Deficiencies:

The following deficiencies were identified:

1. **Institutional Controls:** There are no ICs in place at the following properties and OU's: OU2 (1100 Umatilla Street; along the Burlington Northern Railroad ROW immediately east of 1100 Umatilla Street; alley between Yuma Street and Umatilla Street in the City and County of Denver Right-of-Way (ROW); OU3 (South Jason Street, around the Packaging Corporation of America building, and along South Platte River Drive); and OU6 (2301 East 15th Street).
2. **Risk Assessment:** The Risk Assessments for all the Denver Radium OU's where waste remains in place under supplemental standards do not meet the current requirements of CRR 1007 Parts 4.61.3.2 and 4.61.3.3 of the Colorado Rules and Regulations pertaining to Radiation Control.
3. **Ground Water:** Ground water monitoring at OU8 is ongoing and needs to continue or be finalized. A brief summary of OU3 ground water data has been included in this Five-Year Review. The analytical report needs to be completed and an additional round of ground water monitoring should be completed in December 2003 or January 2004 to check for seasonal fluctuations. Additionally, CDPHE needs to complete the analytical report for OU9B (ROBCO) Annual Ground water monitoring.
4. **Undocumented Removal at OU6 Supplemental Standards Location:** There has been no documentation as to the alleged removal or removals at 2301 15th Street. Until this area has been documented as clean, it will be presumed that the site remains as shown in the figures in this Five-Year Review. Current zoning of this site is now mixed residential commercial and no longer commercial/industrial.

Recommendations and Follow-up Actions:

With EPA and CDPHE oversight, the corresponding recommendations/follow-up actions are as follows:

Recommendations and Follow-Up Actions

Issue	Recommendation and Follow-up Action	Party Responsible	Milestone Date	Affects Protectiveness (Y/N)	
				Current	Future
Lack of ICs at various properties	<p>A meaningful system of IC's needs to be implemented. This includes the following properties and OU's: OU2 (1100 Umatilla Street; along the Burlington Northern Railroad ROW immediately east of 1100 Umatilla Street; alley between Yuma Street and Umatilla Street in the City and County of Denver Right-of-Way (ROW); OU3 (South Jason Street, around the Packaging Corporation of America building, and along South Platte River Drive; and OU6 (2301 East 15th Street).</p> <p>The City and County of Denver is currently negotiating a consent decree with the United States (Case Number 97-D-1611). If this is successfully completed, Denver will agree to implement management plans for radium contaminated soils remaining in place in Denver's rights-of-way and to continue to enforce Denver's zoning ordinance and its radium fee ordinance as institutional controls at private properties where radium contaminated soils remain in place where Supplemental Standards were applied. This implementation will resolve the deficiency associated with lack of IC's.</p>	EPA and CDPHE	12/2004	Y	Y
GIS database System for IC Overlay	<p>A GIS database system is currently being prepared by EPA that will document pertinent features of the Denver Radium Site. This GIS database will provide locations of waste left in place, remediation features and monitoring points. Further, this will also provide locations of monitoring points and buildings located within OU boundaries. This will aid in Operations and Maintenance (O&M) with respect to IC's at the Denver Radium Site. New figures will be generated from this GIS database system and will be provided as an addendum to this Five-Year Review.</p>	EPA	05/2005	N	N

Recommendations and Follow-Up Actions

Issue	Recommendation and Follow-up Action	Party Responsible	Milestone Date	Affects Protectiveness (Y/N)	
				Current	Future
Risk Assessment	The Risk Assessments for all the Denver Radium OU's where supplemental standards were applied do not meet the current ARAR requirements of CRR 1007 Parts 4.61.3.2 and 4.61.3.3 - Standards for Protection Against Radiation. A reassessment of the risks based on the current ARAR standard should be completed for implementation of future ICs. The existing source data may be reused, but the EPA, CDPHE, and City and County of Denver need to come to agreement during a planning meeting on other assumptions for these risk calculations. This affects the following OUs: OU2, OU3, OU4, OU6 and OU7.	EPA and CDPHE	12/2004	Y	Y
OU3 Ground Water Analytical Report	The analytical report needs to be completed and an additional round of ground water monitoring should be conducted in December 2003 or January 2004. This report will be submitted separately and not as Addendums to this Five-Year Review. This report is not expected to change the conclusions in this Five-Year Review.	CDPHE	03/2004	N	N
OU8 Ground Water Investigation	Ground water monitoring at OU8 is ongoing and needs to continue or be finalized.	EPA	12/2005	Y	Y
OU9 Ground Water Analytical Report	CDPHE needs to complete the analytical report for OU 9B (ROBCO) Annual Ground water monitoring. This report will be submitted separately and not as Addendums to this Five-Year Review. This report is not expected to change the conclusions in this Five-Year Review.	CDPHE	03/2004	N	N
OU9B Ground Water Monitoring Frequency	CDPHE recommends, based on the trends shown in ground water data at OU9B, that the frequency be reduced from annual to bi-annual until the time of the next Five-Year Review when it will be reassessed.	CDPHE and EPA	03/2004	N	N
Undocumented removal action at OU6 - 2301 15 th Street	There has been no documentation as to the alleged removal or removals at 2301 15 th Street. Until this area has been documented as clean, it will be presumed that the site remains as shown in the figures in this Five-Year Review. A complete file search and interviews of participants in this removal action (property owner, environmental consultant, City and County of Denver, CDPHE and EPA) should be conducted as part of this documentation. If no files are recovered, then based on interviews, a gamma survey should be conducted at this one location to re-document current site conditions.	CDPHE	05/2004	Y	Y

Protectiveness Statement(s):

The protectiveness of the remedies at the following OU's cannot be determined because the dose exposure limit used in the original Risk Assessment does not meet the current ARAR of CRR 1007 4.61.3.2 – 4.61.3.3 and because of a lack of IC's at the following OU's: OU2 (1100 Umatilla Street; along the Burlington Northern Railroad ROW immediately east of 1100 Umatilla Street; and the alley between Yuma Street and Umatilla Street in the City and County of Denver ROW); OU3 (South Jason Street, around the Packaging Corporation of America building, and along South Platte River Drive); and OU6 (2301 East 15th Street). IC's are currently being discussed between the CDPHE and the City and County of Denver. A reevaluation of the dose limit exposures along with site specific data needs to be determined to assess the protectiveness of this remedy.

Because remedial action is ongoing at OU8 (Shattuck), the protectiveness will be determined once the remedy is completed and operational.

The protectiveness of the remedies at the following OU's cannot be determined because the dose exposure limit used in the original Risk Assessment does not meet the current ARAR of CRR 1007 4.61.3.2 – 4.61.3.3. Even though there are enforceable IC's in place at these OU's, changes in the Risk Assessment methodologies and current dose exposure limit levels do not meet the current ARAR of CRR 1007 4.61.3.2 – 4.61.3.3: OU4 and OU7. A reevaluation of the dose limit exposures along with site specific data needs to be determined to assess the protectiveness of this remedy.

The remedy for the following OU's is protective of human health and the environment because immediate threats have been addressed and the remedy is in operation as required by the applicable ROD's and ESD's (where applicable): OU1, OU5, OU9A, OU9B, OU10, and OU11.

1.0 INTRODUCTION

This five-year review report summarizes the status of actions taken pursuant to the Superfund Records of Decision (RODs) for the Denver Radium Site located in Denver County, Colorado. This five-year review is a statutory review required of the Denver Radium site under the Comprehensive Environmental Response, Compensation Liability Act (CERCLA) and the National Contingency Plan for Oil and Hazardous Substances (NCP). The purpose of the review is to determine whether remedial response actions are protective of human health and the environment and to recommend ways to attain or maintain that protection. In accordance with the Comprehensive Five-Year Review Guidance, EPA 540-R-01-007, June 2001 (The Guidance) this five-year review does not reconsider decisions made during the remedy selection process but evaluates the implementation and performance of the selected remedies. The State of Colorado Department of Public Health and Environment (CDPHE) conducted this review.

This five-year review is a combination of Type 1 and Type 1a reviews. Type 1 reviews are performed for sites where the remedial actions have been completed, while the abbreviated Type 1a reviews are performed for sites where remedial actions are ongoing, as described by OSWER Directive 9355.7-03B-P. The Denver Radium site includes both ongoing and completed remedial actions.

This is the second Five-Year Review completed for the Denver Radium site. Additionally, there was a Five-Year Review completed specifically for OU8 Shattuck in 1999. In keeping with the requirements of CERCLA 121 (c) and the NCP, the subsequent five-year review triggers from the signature date of the previous five-year review. The first Denver Radium five-year review was completed in 1994. A second Five-Year review was submitted as draft on November 20, 1998, but it was never finalized due to unresolved comments between the EPA and the City and County of Denver.

The CDPHE Community Involvement Program is committed to promoting communication between citizens and CDPHE. The Community Involvement Plan (CIP) Update (Appendix A) describes the community involvement and public participation program developed for the Denver Radium Superfund Site (Denver Radium) in Denver, Colorado. This CIP Update was developed in coordination with the US Environmental Protection Agency (EPA) and updates the previous CIP, dated September 1989. Community involvement activities for Operable Unit 8 (Shattuck) are currently carried out by the EPA. Shattuck is not included in this CIP Update, however it was addressed separately in a CIP Update that was completed by the EPA in April 2002.

The results of this second five-year review indicate that the immediate and long-term health and environmental risks at some operable units are operating as expected and are protective while other operable units are not complete and the protectiveness of the remedies cannot be determined. Since hazardous substances, pollutants, or contaminants remain at the Site, another five-year review will be required in September 2008.

2.0 SITE BACKGROUND

The Denver Radium Superfund Site consists of over 65 properties throughout Denver, Colorado. These properties were contaminated by radioactive residues derived from the processing of radium in the early 1900s (Figure 1). The site was added to the Superfund National Priorities List (NPL) in September 1983. The properties were divided into eleven OUs, based on their location, to simplify the cleanup process.

Nine (9) RODS were written to document the remedial actions at the eleven Operable Units. These RODs are:

March 1986	Record of Decision	OU 7 ³
September 1986	Record of Decision	OU 4 ³ and 5 ³
June 1987	Record of Decision	OU 10
September 1987	Record of Decision	OU 1
September 1987	Record of Decision	OU 3 ³
September 1987	Record of Decision	OU 6 ³ , 9 ^{1, 3} & 11 ³
September 1987	Record of Decision	OU 2 ³ (11 th & Umatilla)
December 1991	Record of Decision	OU 9 ¹ (ROBCO Metals)
January 1992	Record of Decision	OU 8 ² (Shattuck)

Note¹: There are two Operable Units that were labeled 9. One is located on E. Colfax Avenue (OU9A) and is discussed as part of the "Open Space" properties (OU 6, 9, 11). The other is located on South Santa Fe Drive and includes the metals contamination discovered at the ROBCO site (OU 9B) along with OU 4 (ROBCO radioactive materials).

Note²: A ROD amendment was issued for in June 2000 for OU8 Shattuck.

Note³: An Explanation of Significant Difference (ESD) was issued at the following OU's that documented changes made to the selected remedy during the remedial implementation as defined in the ROD.

EPA and the State of Colorado entered into a State Superfund Contract (SSC) for remedial action at the Denver Radium NPL site on May 1, 1988.

3.0 REGULATORY COMPLIANCE

Consistent with Section 121(c) of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), as amended, and Section 300.430(f) of the National Contingency Plan (NCP), EPA is performing the Five-Year Review for the Denver Radium Site (EPA, 1991). EPA determined the level of review based on site-specific considerations including the nature of the response action, the status of the onsite response activities, proximity to populated areas and sensitive environments and the interval since the last review was conducted. In most cases, EPA performs a Level I analysis for the Five-Year Review. A Level I analysis was previously performed for the Denver Radium Site. The components of a Level I Five-Year Review, as suggested by EPA guidance (EPA, 1991; EPA, 1994a), include:

- Review of documented operation and maintenance of the site.
- Performance of a site visit;
- Limited analysis of site conditions;
- Review of the administrative record; and
- Review Federal and State environmental laws cited in the RODs to determine if they remain applicable or relevant and appropriate.

3.1 Statutory Review

A statutory five-year review is required at any site where unlimited use and unrestricted exposure, based on ROD cleanup levels, have not been attained (EPA, 1991). A Five-Year Review is required no less than every five years after initiation of the selected remedial action. EPA prepared a Five-Year Review for the Denver Radium Site in 1994 and completed draft review in 1998. EPA conducted a five-year review of OU8 Shattuck in 1999. Future Five-Year Review will be prepared by EPA or upon designation, by the CDPHE. EPA may prepare a five-year review addendum for Denver Radium OU8 depending on the results of the independent review board. Reviews entail a site visit to review the status of the implemented remedy and to determine its protectiveness of human health and the environment. This document presents the results of the 2003 review.

3.2 ARARS

As part of the Five-Year Review, ARAR's were reviewed. The primary purpose of this review was to determine if any newly promulgated or modified requirements of federal or state environmental laws have significantly changed the protectiveness of the remedies implemented at the site. The ARARs reviewed were those included in the Site's original decision documents.

Overall, the review indicates one substantive change to the regulations that would affect the remedy and its protectiveness. A change in the Colorado Rules and Regulations Pertaining to Radiation Control (CRR 1007 Part 4.61.3.2 through 4.61.3.3) for dose exposure limits are lower than when assessed during the original Risk Assessment was conducted. This is discussed at greater length in Section 5.0 "Assessment" on an OU by OU basis.

ARAR's pertaining to drinking water MCL's have been exceeded in the limited ground water monitoring conducted at OU3, OU4, and OU8. While MCL's have been exceeded in some ground water samples collected, future ground water characterization reports will be used during evaluation of future Five-Year Reviews.

EPA, CDPHE and the City and County of Denver will continue to monitor this site and any future changes or modifications in ARARs will be reported in the next Five-Year Review.

Existing RODs, ESD's, Supplemental Standards Reports, and Closure Reports for each Denver Radium Site Operable Unit were reviewed for this Level I Five-Year Review. Based on this review, each Denver Radium Site OU does not meet current ARARs.

4.0 REMEDIAL ACTIONS

4.1 Operable Unit 1

4.1.1 Location

OU1 is an 8-acre block bounded by Quivas Street to the east, Shoshone Street to the west, and West 12th Avenue to the north. Denver Radium OU1 includes the following properties in Denver, Colorado:

Table 1
 Operable Unit 1 Properties

Operable Unit	Property Name at Time of ROD	Address
OU1	B & C Metals	1623 – 1625 West 12 th Avenue
OU1	Erickson Monuments	1241 – 1245 Quivas Street
OU1	Materials Handling Inc.	1740 West 13 th Avenue
OU1	Rudd	1223 – 1229 Quivas Street
OU1	City and County of Denver Alley/Driveway	East of B & C, between 12 th Avenue and Erickson Monuments

4.1.2 History

Contamination at OU1 is resultant from a radium, vanadium, and uranium processing facility at 1201 Quivas Street owned by the Pittsburgh Radium Company (PRC) from 1925 until 1926. The Radium Ores Company, which was associated with PRC, operated the facility until approximately 1927. Approximately 120 tons of carnotite and 500 tons of vanadium were expected to have been processed monthly.

4.1.3 Remedial Objectives

In the ROD, dated September 1987, EPA selected excavation and offsite disposal as the remedy for OU1. The objectives of this remedy were to prevent: radiation

exposure due to inhalation of radon gas and its daughter products; radiation exposure due to inhalation and ingestion of long-lived radionuclides; and direct exposure to gamma radiation.

At the time the ROD was signed, there were no disposal facilities in the nation that accepted radium waste. For this reason, the ROD included temporary onsite storage of the contaminated material. However, onsite temporary storage was not required since a permanent disposal facility opened before excavation began. The excavated material was shipped by rail to Envirocare of Utah, Inc., a disposal facility in Tooele County, Utah.

4.1.4 Summary of Remedial Action

Remediation activities at OU1 were conducted in three phases (A, B, and C) to facilitate construction and to accommodate the various business activities in the unit. Construction began on October 2, 1989 and concluded on July 18, 1991. The quantity of material removed during remediation was 32,665 tons.

At OU1, Phase A remediation activities involved the areas to the south and west of the Materials Handling building. Phase B remediation activities involved the Materials Handling Building in the northwest portion of the unit. Following removal of contaminated soil, a new building was constructed

During Phases B and C, several areas on the unit required additional assessment or the use of area averaging calculations. Seven additional deposits of contamination at OU1 were left in place because levels of contamination met the standards when averaged over a 100² meter area.

Table 2
 Materials Left in Place as Averaged Areas – OU1

Site Location	Figure/ Area ID/Phase	Square Feet	Averaged Concentration	Comments
OU1 - Materials Handling	Figure 2, Area A/Phase B	60	6.8 pCi/g	Adjacent to and beneath foundation of Materials Handling Building
OU1 - Materials Handling	Figure 2, Area B/Phase B	27	5.6 pCi/g	Adjacent to and beneath foundation of Materials Handling Building
OU1 - Materials Handling	Figure 2, Area E/Phase B	150	7.7 pCi/g	Adjacent to and beneath foundation of Materials Handling Building
OU1 - Erickson Monuments	Figure 2, Area A/Phase C	193.5	12.0 pCi/g	Beneath restrooms and front office at Erickson Monuments
OU1 - Rudd Investments	Figure 2, Area B, Phase C	430.5	15.0 pCi/g	Under attached shed north of Rudd Investments Building

Table 2
Materials Left in Place as Averaged Areas – OU1

Site Location	Figure/ Area ID/Phase	Square Feet	Averaged Concentration	Comments
OU1 – B&C Metals	Figure 2, Area D1, Phase C	305	9.3 pCi/g	Underneath B&C Metals Building
OU1 – B&C Metals	Figure 2, Area D1, Phase C	370	8.0 pCi/g	Underneath B&C Metals Building

4.1.5 Site Visit

A site visit was performed in August 2003. All properties at OU1 remain under commercial or industrial use.

4.1.6 Recommendations

All ROD requirements were met and all contamination was removed from OU 1 and the remedy is protective of human health and the environment (Figure 2). The properties included at OU1 are available for unlimited use and unrestricted access. These properties are recommended for deletion from the Denver Radium Site and the NPL. The locations where materials were left in place where area averaging was applied are released for unrestricted use.

4.2 Operable Unit 2

4.2.1 Location

Denver Radium OU2 includes the following properties located near 11th Avenue and Umatilla Street in Denver, Colorado:

Table 3
Operable Unit 2 Properties

Operable Unit	Property Name at Time of ROD	Address
OU2	DuWald Steel	1100 Umatilla Street
OU2	Rocky Mountain Research Corporation	1020 and 1030 Yuma Street
OU2	G&K Services	999 Vallejo Street
OU2	Jenkins Property	2191 West 10 th Avenue
OU2	Staab Property	2121 West 10 th Avenue
OU2	Air Conditioning, Inc.	1001 South Tejon Street
OU2	Colorado Department of Transportation Jerome Maintenance Yard	2300 West 11 th Avenue
OU2	Burlington Northern Railroad	Between 10 th and 11 th Avenues

Table 3
 Operable Unit 2 Properties

Operable Unit	Property Name at Time of ROD	Address
OU2	Flame Spray, Inc	1900 West 12 th Avenue
OU2	Alpha Omega Electronics	1010 Yuma Street
OU2	Capital Management Realty	1050 Yuma Street
OU2	Denver Water Board	1600 West 12 th Avenue

4.2.2 History

The contamination at OU2 is the result of radium processing activities by the Schlesinger Radium Company which began operations in 1914 where the DuWald Steel Corporation is currently located (1100 Umatilla Street). In 1917, Schlesinger Radium Company became the Radium Company of Colorado (RCC), which reportedly processed between 1,000 and 1,200 tons of radium ore per year. RCC ceased operations at OU2 in 1924. Complex Ore Recovery Company occupied OU2 until 1928. It is not known whether that company also processed radium ore. Rocky Mountain Research Corporation received a license from the U.S. Atomic Energy Commission in 1955 to process uranium ore and occupied a building in OU2 until about 1991. Since 1914, a total of 38 companies have operated within the operable unit. OU2, as originally designated, included only the DuWald Steel Corporation and Rocky Mountain Research Corporation properties. The other properties listed in Table 3 were included as subsequent investigations revealed additional contamination (Figures 3, 4, 5, 6 and 7).

4.2.3 Remedial Objectives

In the ROD, dated September 1987, EPA selected excavation and offsite disposal as the remedy for OU2. The objectives of this remedy were to prevent: radiation exposure due to inhalation of radon gas and its daughter products; radiation exposure due to inhalation and ingestion of long-lived radionuclides; and direct exposure to gamma radiation.

At the time the ROD was signed, there were no disposal facilities in the nation that accepted radium waste. For this reason, the ROD included temporary onsite storage of the contaminated material. However, onsite temporary storage was not required since a permanent disposal facility opened before excavation began. The excavated material was shipped by rail to Envirocare of Utah, Inc., a disposal facility in Tooele County, Utah.

4.2.4 Summary of Remedial Action

Remedial actions at OU2 began in August 1990 and were completed in August 1993. A phased approach to the cleanup allowed onsite businesses to maintain operations throughout the excavation and shipment of 92,731 tons of contaminated soils from OU2. Activities included:

- Excavation of radium contaminated soils in open areas;
- Analysis of the contaminated materials for disposal to ensure compliance with transportation and disposal regulations;
- Shipment of contaminated materials to the permanent offsite disposal facility; and
- Confirmation sampling of excavated area.

A total of 1,359 tons of radiologically contaminated soil were excavated and disposed offsite during Phase A. In Phase B, a total of 3,622 tons of contamination was removed. For Phase C, both radiologic and heavy metal (lead) contamination were found on the 1100 Umatilla Street property. A total of 14,211 tons of radiologic and commingled material was excavated and shipped offsite. The commingled material was stabilized by solidification prior to offsite disposal. During Phase D, a total of 73,606 tons of radiologically contaminated soil was disposed offsite. In a separate removal action conducted in 1993, a total of 933 tons of lead-contaminated soils from the 1100 Umatilla Street property were treated and shipped to Weld County (Subtitle D) Landfill in Erie, Colorado.

EPA issued an ESD for OU2 in September 1993. The ESD presents the changes that were made to the remedy selected for OU2; briefly, the differences were:

- A greater volume of radium-contaminated soil was excavated and removed.
- Relatively small amounts of radium contamination were left on the 1100 Umatilla Street property.
- There was no temporary onsite storage.
- Soils containing commingled radium and lead were solidified in a cement matrix prior to shipment to a permanent, offsite disposal facility.

A Supplemental Standards Report was prepared in May 1994 to document that 11,060 cubic yards of radiological contaminated soil were left in place on the Burlington Northern Railroad property and the 1100 Umatilla Street property at OU2. The location of this contamination is shown on Figures 4 and 5. IC's at these properties are not in place and O&M Plans for OU2 have never been prepared. The current owner of the 1100 Umatilla Street property has prepared an O&M Plan for the property. The plan is currently in review for inclusion in an Environmental Covenant for this property. This covenant would provide an enforceable IC on the property.

Seven additional deposits of contamination at OU2 were left in place because levels of contamination met the standards when averaged over a 100² meter area.

Table 4
 Materials Left in Place as Averaged Areas – OU2

Site Location	Figure/Area ID	Square Feet	Averaged Concentration	Comments
CDOT	Figure 3, Area AA	120	9.6 pCi/g	Beneath a floor slab of CDOT Building
CDOT	Figure 3, Area AB	70	8.9 pCi/g	Around a telephone line at CDOT
CDOT	Figure 3, Area AD	75	16.3 pCi/g	Around a telephone line at CDOT
Jenkins Property	Figure 5, Area DT	210	14.2 pCi/g	10 feet deep/along a building foundation
Staab Property	Figure 5, Area ED	470	13.5 pCi/g	8 feet deep with difficult access
Air Conditioning, Inc.	Figure 5, Area EE	187	8.8 pCi/g	Difficult access
G&K Services	Figure 6, Area EF	408	12.5 pCi/g	8 feet deep with difficult access

4.2.5 Site Visit

A site visit was performed in August 2003. All properties at OU2 remain under commercial or industrial use.

4.2.6 Recommendations

Locations where contamination was removed are released for unrestricted use and have no requirements for Operation and Maintenance. The remedy is protective of human health and the environment at these locations. This includes the following properties or portions of the following properties: 1020-1030 Yuma Street (Rocky Mountain Research), 999 Vallejo Street (G&K Services), 2191 West 10th Avenue (Jenkins Property), 2121 West 10th Avenue (Staab Building), 1001 Tejon Street (Air Conditioning Inc.), 2300 West 11th Avenue (Jerome Maintenance Yard), 1900 West 12th Avenue (Flame Spray Inc.), 1010 Yuma Street (Alpha Omëga), and 1050 Yuma Street (CMR). These properties are recommended for deletion from the Denver Radium Site and the NPL.

The locations where materials were left in place where area averaging was applied are released for unrestricted use.

O&M at OU2 is, by statute, the responsibility of the State of Colorado and is required at the following properties: 1100 Umatilla Street; along the Burlington

Northern Railroad ROW immediately east of 1100 Umatilla Street; and alley between Yuma Street and Umatilla Street in the City and County of Denver ROW.

The dose exposure limits need to be reviewed for this OU as part of the Risk Assessment review that is recommended by this Five-Year Review.

During the site visit at the 1100 Umatilla Property, no evidence of recent sub-surface construction activities was observed. Contractors for the site owner were preparing the site for construction of a new concrete site pad and water lines for hydrants on site. While no construction activities were observed during the site visit in areas where supplemental standards have been applied, work was proposed in areas where contamination is present.

The current owner of the 1100 Umatilla Street property has prepared an O&M Plan for the 1100 Umatilla Street Property and is currently in review for inclusion in an Environmental Covenant for this property. The remedy at 1100 Umatilla Street currently is not protective of human health and the environment, due to the lack of an enforceable Institutional Control. An enforceable IC could include either an Environmental Covenant or licensing of stored radioactive materials.

The City and County of Denver is currently negotiating a consent decree with the United States (Case Number 97-D-1611). If this is successfully completed, Denver will agree to implement management plans for radium contaminated soils remaining in place in Denver's rights-of-way and to continue to enforce Denver's zoning ordinance and its radium fee ordinance as institutional controls at private properties where radium contaminated soils remain in place where Supplemental Standards were applied. This would provide for an adequate IC at this OU if implemented.

4.3 Operable Unit 3

4.3.1 Location

OU3 covers approximately 15 acres and encompasses several properties in the area of West Louisiana Avenue, South Jason Street and South Platte River Drive (Figures 8 and 9). It consists of property owned by Creative Illumination, Inc.; the building owned by Packaging Corporation of America, the former Titan Labels Building (now Kwan Sang Noodle Co.) and several buildings east of South Jason Street. Two other properties owned by GT Car Shop and Aspen Design & Manufacturing were added to the operable unit and were included in the remediation process.

Table 5
 Operable Unit 3 Properties

Operable Unit	Property Name at Time of ROD	Address
OU3	Creative Illumination Inc.	1298 South Kalamath Street
OU3	Packaging Corp of America	1377 South Jason Street
OU3	Central and Sierra Railroad ROW	Between West Louisiana and West Florida Streets
OU3	GT Car Shop / Aspen Design and Manufacturing	1235 South Jason Street
OU3	Kwan Sang Noodle Company, formerly Titan Labels	1140 W Louisiana Ave
OU3	various offices	1300 South Jason Street

4.3.2 History

The OU3 properties were added to the NPL as part of the Denver Radium Site in September 1983. It is believed that the vacant lot, located at 1000 South Louisiana and owned by Packaging Corporation of America, may have been the site of a smelter that operated in the late 19th century. This smelter may have been turned into a radium-processing facility in the early 20th century. The Chemical Products Company, which occupied portions of OU3 between 1918 and 1921, separated radium and vanadium from uranium ores for the National Radium Institute. Most of the buildings associated with radium processing were demolished prior to 1970. The exception was a brick building located at 1298 South Kalamath Street, which was purchased by Creative Illumination, Inc. and used for light-fixture fabrication. The Creative Illumination, Inc. building was demolished during remediation activities.

4.3.3 Remedial Objectives

In the ROD, dated September 1987, EPA selected excavation and offsite disposal as the remedy for OU3. The objectives of this remedy were to prevent: radiation exposure due to inhalation of radon gas and its daughter products; radiation exposure due to inhalation and ingestion of long-lived radionuclides; and direct exposure to gamma radiation.

At the time the ROD was signed, there were no disposal facilities in the nation that accepted radium waste. For this reason, the ROD included temporary onsite storage of the contaminated material. However, onsite temporary storage was not required since a permanent disposal facility opened before excavation began. The excavated material was shipped by rail to Envirocare of Utah, Inc., a disposal facility in Tooele County, Utah.

4.3.4 Summary of Remedial Action

Remedial actions at OU3 began in August 1989 and were completed in September 1991. A phased approach to the cleanup allowed onsite businesses to maintain operations throughout the excavation and shipment of 63,672 tons of contaminated material from OU3. Activities included:

- Excavation of radium contaminated soils in open areas;
- Demolition of certain radium-contaminated buildings;
- Analysis of the contaminated materials to be disposed to ensure compliance with transportation and disposal regulations;
- Shipment of contaminated materials to the permanent offsite disposal facility;
and
- Confirmation sampling of excavated area.

During Phase A, the Creative Illumination building was demolished and 3,657 tons of radium-contaminated materials were excavated and removed from this location. A total of 32,389 tons of radium-contaminated soils were excavated and removed from the Packaging Corporation of America (PCA) property and a vacant lot owned by PCA located at 1000 West Louisiana during Phase B. Phase C activities included the excavation and offsite disposal of 27,626 tons of radiologically contaminated soil. Remediation of OU3 was completed during Phase D when 50 tons of radiologically contaminated soils were excavated from the GT Car Shop and Aspen Design and Manufacturing properties for offsite disposal.

The remedy, as implemented, differed in several respects from the remedy chosen in the 1987 ROD. An ESD for OU3 was issued in December 1993. The ESD presents the changes that were made to the remedy selected for OU3; briefly, the differences were:

- No temporary storage prior to removal and shipment of contaminated material to the permanent offsite disposal facility.
- Over 52,000 cubic yards of contaminated soil were excavated and the area of contamination was extended east of South Jason Street.
- As part of the remediation, the Creative Illumination building was demolished, contaminated material was removed, and the contaminated materials were shipped to the offsite repository.
- There was no excavation of contaminated soils below ground water, near water lines, or under South Jason Street, Platte River Drive and the Packaging Corporation of America building.

A Supplemental Standards Report was prepared in June 1995 to document the 5,868 cubic yards of radiological contaminated soil that remain onsite under South Jason Street, around the Packaging Corporation of America building, and along South Platte River Drive at OU3. The location of this contamination is shown on Figures 8 and 9.

During the summer of 1999, Metro Wastewater rehabilitated a sewer line under West Louisiana Street. This sewer line rehabilitation was completed under a CDPHE and City and County of Denver approved Soils Management Plan. The sewer was installed by digging two holes on opposite sides of the presumed contamination. Then a tunnel-boring device was used to bore underneath the location of presumed contamination, pulling the new sewer line as it progressed underneath West Louisiana Street. All soils were segregated, containerized and characterized and managed under the Soils Management Plan.

Previous sampling conducted in 2001 in the area of OU3 identified a monitoring well at Hospital Shared Services (HSS) with elevated levels of gross alpha and gross beta. This has sparked concern as to the source of this contamination. Theories exist that this contamination may originate from OU3, OU8, or a potential new source of contamination. In July 2003, SM Stoller, under contract from the EPA and CDPHE, installed and developed five new ground water monitoring wells surrounding the OU3 site. These wells along with the one existing well located at the Hospital Shared Services site were in-turn sampled by CDPHE On July 15-17, 2003. Analytical results revealed significantly lower concentrations of contaminants in this HSS well as compared to the December 2001 results. Preliminary review of the samples collected in July 2003 indicate that while MCL's for gross alpha and gross beta are exceeded in well OU3-GW5 (located within supplemental standards waste left in place) and the well immediately downgradient of that location (OU3-GW4), this contamination just exceeds drinking water MCL's. Sample results are shown in Table 7 and locations are shown on Figure 25.

Five additional areas of contamination at OU3 were left in place because levels of contamination met the standards when averaged over a 100² meter area.

Table 6
 Materials Left in Place as Averaged Areas – OU3

Site Location	Figure/ Area ID	Square Feet	Averaged Concentration	Comments
East of South Jason	Figure 8, Area A	25	5.0 pCi/g	At base of mature trees – Denver ROW
East of South Jason	Figure 8, Area B	24	5.0 pCi/g	At base of mature trees – Denver ROW
Kwan Sang	Figure 8, Area C	105	10.9 pCi/g	Along underground utility lines along West Louisiana Avenue
North of Harbert Castings building	Figure 9, Area D	506	13.8 pCi/g	Along foundation of building
Alley east of Creative Illumination, Inc.	Figure 8, Area E	509	10.3 pCi/g	Location of power pole in alley – Denver ROW

Table 7
Ground Water Analytical Results
All concentrations are in µg/L for Dissolved Metals and pCi/L for Radionuclides
Please refer to Figure 25 for Sample Locations

Date Collected		7/15/03	12/6/01	7/15/03	7/17/03	7/16/03	7/16/03	7/16/03	7/16/03
Location Analyte	DW MCL	HSS-GW1	HSS-MW4	HSS-MW4	OU3-GW2	OU3-GW3	OU3-GW4	OU3-GW5	OU3-GW6
Gross Alpha ¹	15	<4	297 ± 45	<4	7	<7	17	42	5
Gross Beta ¹	50	11	215 ± 32	20	11	<9	14	33	8
Uranium	30	1	22.6	1	17	<1	36	84	12
Arsenic	50.0	2.62	<10	1.8	1.77	0.549	0.882	1.37	1.49
Barium	1000	207	270	291	34.0	123	53.0	82.2	75.7
Cadmium	5.0	<0.2	<5.0	<0.2	<0.2	<0.2	<0.2	<0.2	0.206
Chromium	50	4.47	<10.0	4.34	4.33	5.26	4.57	4.67	3.22
Copper	1000	0.627	<10.0	0.695	1.96	0.501	1.76	2.76	7.8
Iron	300	3650	5300	4470	<50.0	7170	<50.0	<50.0	<50.0
Lead	50	0.133	<3.0	<0.1	0.146	<0.1	<0.1	<0.1	<0.1
Manganese	50	1330	2500	2060	1150	3210	12.6	777	785
Molybdenum ²	100	13.9	15.0	10.4	46.1	0.89	1.7	38.8	44.4
Selenium	50	1.4	<5.0	1.62	1.87	2.01	16.0	27.2	2.02
Zinc	5000	1.88	<20.0	2.13	12.5	1.31	1.5	5.14	3.97

1. Units are in pCi/l
2. Since there is no DW MCL molybdenum, this value is based on an existing ARAR at OU8



Shaded cell signifies an Exceedance of a State MCL or equivalent

4.3.5 Site Visit

A site visit was conducted in August 2003. New property owners currently own portions of the site. New construction (post 1993) has taken place at 1000 West Louisiana Street and 1298 South Kalamath Street.

One utility repair activity was conducted in the ROW in 2003 where supplemental standards have been applied. The City and County of Denver Department of Environmental Health managed all materials properly under the OU7 Soils Management Plan.

4.3.6 Recommendations

While a brief summary of this data has been included in this Five-Year Review, the analytical report needs to be completed and an additional round of ground water monitoring should be completed in December 2003 or January 2004 to check for seasonal fluctuations from the South Platte River. The potential exists that the South Platte River is a losing water body during high flows (July) thus potentially diluting the potential for contamination and a gaining water body during low flow (December) removing the potential for contaminant dilution. An additional round of ground water monitoring should be completed in December 2003 or January 2004 during low flow of the South Platte River.

Locations where contamination was removed are released for unrestricted use and have no requirements for Operation and Maintenance. At these locations, the remedy is protective of human health and the environment. This includes the following properties or portions of the following properties: 1298 South Kalamath Street (Creative Illumination Inc.); 1235 South Jason Street (GT Car Shop and Aspen Design and Manufacturing); 1140 West Louisiana Street (Kwan Sang Noodle Company); and 1300 South Jason Street (various offices). These properties are recommended for deletion from the Denver Radium Site and the NPL.

O&M at OU3 is, by statute, the responsibility of the State of Colorado and is required at the following properties: South Jason Street, around the Packaging Corporation of America building, and along South Platte River Drive. The remedy at these locations currently is not protective of human health and the environment, due to the lack of an enforceable Institutional Control. Additionally, the dose exposure limits need to be reviewed for this OU as part of the Risk Assessment review that is recommended by this Five-Year Review.

The City and County of Denver is currently negotiating a consent decree with the United States (Case Number 97-D-1611). If this is successfully completed, Denver will agree to implement management plans for radium contaminated soils remaining in place in Denver's rights-of-way and to continue to enforce Denver's zoning ordinance and its radium fee ordinance as institutional controls at private properties where radium contaminated soils remain in place where Supplemental Standards were applied. This would provide for an adequate IC at this OU if implemented.

The locations where materials were left in place where area averaging was applied are released for unrestricted use.

4.4 Operable Units 4 and 5

4.4.1 Location

OUs 4 and 5 is located at 500 South Santa Fe Drive in south-central Denver, Colorado (Figure 10) and includes the Robinson Brick Company property (ROBCO - OU4) and a railroad ROW owned by the Denver and Rio Grande Western Railroad (D&RGW – OU5). OUs 4 and 5 of the Denver Radium Superfund Site addresses radiologic contamination found on the ROBCO and D&RW properties. Metals contamination on the ROBCO property is addressed under Operable Unit 9B (ROBCO-Metals) of the Denver Radium Site.

Table 8
 Operable Units 4 and 5 Properties

Operable Unit	Property Name at Time of ROD	Address
OU4	Robinson Brick Company	500 South Santa Fe Drive
OU5	Denver and Rio Grande Western Railroad ROW	Immediately East of OU4

4.4.2 History

OU4 (ROBCO) was the site of a radium processing facility established by the National Radium Institute (NRI) in 1913. The NRI facility was created for the purpose of developing and demonstrating the commercial feasibility of radium extraction techniques. This facility operated on the site for approximately four years and then closed after producing 7.5 grams of radium and successfully demonstrating commercially feasible extraction processes. ROBCO acquired the property in the 1940s and used it as a brick and tile-manufacturing site until the 1980s. The radium contaminated area of OU5 (D&RGW ROW) covers 1.6 acres. This property is crossed by several rail lines and contains a network of electronic controls to operate railway lights and switches.

OUs 4 and 5 properties were added to the NPL as part of the Denver Radium Site in September 1983.

4.4.3 Remedial Objectives

EPA selected excavation and offsite disposal as the remedy for this OU in a ROD dated September 30, 1988. The objectives of this remedy were to prevent: radiation exposure due to inhalation of radon gas and its daughter products; radiation exposure due to inhalation and ingestion of long-lived radionuclides; and direct exposure to gamma radiation.

At the time the ROD was signed, there were no disposal facilities in the nation that accepted radium waste. For this reason, the ROD included temporary onsite storage of the contaminated material. The soils were stockpiled on the ROBCO property until a permanent disposal facility became available and a transportation and disposal contract was negotiated.

4.4.4 Summary of Remedial Action

Remedial action operations at OUs 4 and 5 included the following:

- Excavation of radium-contaminated soils;
- Demolition of certain radium-contaminated buildings;
- Analysis of the contaminated materials to ensure compliance with transportation and disposal regulations;
- Shipment of contaminated materials to the permanent offsite facility; and
- Confirmation sampling of excavated area.

Remedial action at OUs 4 and 5 was conducted in phases, beginning in April 1988 and completed in March 1991. A total of 57,586 tons of radiologically contaminated material was excavated during Phase A of the cleanup. This material was stockpiled onsite temporarily until it could be transported to the offsite disposal facility. Approximately 1,290 tons of soil contaminated with elevated levels of Thorium-230 were removed during a later phase of the project. The stockpiled material, as well as an additional 9,677 tons of contaminated material situated immediately below the stockpile, were shipped during Phase B of the cleanup. In Phase C, 29,721 tons of radiologically contaminated soils were excavated and transported by rail in covered gondola cars to a permanent offsite disposal facility operated by Envirocare of Utah, Inc., in Tooele County, Utah. Of this total, 2,100 tons were contaminated with metals as well as radioactive material.

The remedy, as implemented, differed in two respects from the remedy chosen in the 1986 ROD. Those differences were:

- The volume of contaminated soils increased; and
- Relatively small volumes of contaminated soils were left in place.

EPA issued an ESD for OUs 4 and 5 in December 1994. The ESD describes in more detail the changes that were made to the remedy selected for OUs 4 and 5.

A Supplemental Standards Report, prepared in March 1994, and documented radiological contamination that remains onsite at OU4. The location of this contamination is shown in Figure 10.

Four additional areas of contamination at OU5 were left in place because levels of contamination met the standards when averaged over a 100² meter area.

Table 9
 Materials Left in Place as Averaged Areas – OU5

Site Location	Figure/ Area ID	Square Feet	Averaged Concentration	Comments
DRGRR ROW	Figure 10, Area E	20	7.2 pCi/g	Adjacent to and beneath rail road tracks
DRGRR ROW	Figure 10, Area F	225	11.8 pCi/g	Adjacent to and beneath rail road tracks
DRGRR ROW	Figure 10, Area F1	9	11.8 pCi/g	Adjacent to and beneath rail road tracks
DRGRR ROW.	Figure 10, Area G	90	8.7 pCi/g	Adjacent to and beneath rail road tracks

4.4.5 Site Visit

A site visit was performed in August 2003. In addition to the Home Depot and adjacent parking lot, two commercial spaces were constructed immediately on the site to the north. These buildings are slab on grade, are not located over any materials where supplemental standards were applied, and did not impact any of the remedial action conducted at this site.

4.4.6 Recommendations

The remaining radiologically contaminated material at OU4 is addressed under Supplemental Standards and is discussed in the Management Plan for OU 9B ROBCO Metals. The remedy continues to be protective of human health and the environment. Ground water sampling is performed annually at this site in response to the ROD for OU 9B-ROBCO Metals. The most recent round of ground water sampling was conducted on July 10, 2003. Trends in groundwater show decreasing levels of contamination at individual locations over time as well as concentrations decreasing with distance, thus indicating attenuation is occurring. There have been no detrimental contaminant concentrations detected in the South Platte River to date. A ground water summary report will be submitted by CDPHE in the spring of 2004.

CDPHE recommends, based on the trends shown in ground water data at OU9B, that the frequency be reduced from annual to bi-annual until the time of the next Five-Year Review when it will be reassessed.

O&M at OU4 is, by statute, the responsibility of the State of Colorado and is required at the following properties: 500 South Santa Fe Drive (ROBCO); and the Burlington Northern Railroad ROW immediately east of ROBCO (OU4). OU4

currently has an enforceable IC in place under Home Depot. Home Depot has an amended O&M Plan as of August 18, 2003.

All ROD requirements were met and all contamination was removed from OU5 and the remedy is protective of human health and the environment (Figure 2). The property at OU5 is available for unlimited use and unrestricted access. This property is recommended for deletion from the Denver Radium Site and the NPL. The locations where materials were left in place where area averaging was applied are released for unrestricted use.

The dose exposure limits need to be reviewed for OU4 as part of the Risk Assessment review that is recommended by this Five-Year Review. Until the dose exposure limits are evaluated, the decision cannot be made as to the protectiveness of this remedy.

The City and County of Denver is currently negotiating a consent decree with the United States (Case Number 97-D-1611). If this is successfully completed, Denver will agree to implement management plans for radium contaminated soils remaining in place in Denver's rights-of-way and to continue to enforce Denver's zoning ordinance and its radium fee ordinance as institutional controls at private properties where radium contaminated soils remain in place where Supplemental Standards were applied. This would provide for an adequate IC at these OU's if implemented.

4.5 Operable Units 6, 9A and 11

4.5.1 Location

OU6, OU9A and OU11 of the Denver Radium Site encompass numerous contaminated properties, known as the "Open Space" properties, located throughout the Denver metropolitan area (OU6 - Figures 11, 12, 13, 14, and 15; OU9A - Figure 20; and OU 11 - Figure 24). These locations are summarized in Section 4.5.6.

Table 10
 Operable Units 6, 9A and 11 Properties

Operable Unit	Property Name at Time of ROD	Address
OU6	Alley in City and County of Denver ROW	Between Mariposa and Lipan Streets and between 5 th and 6 th Avenues
OU6	Allied (General Chemical)	1271 West Bayaud Avenue
OU6	Brannan Sand and Gravel	61 st Avenue and Clear Creek
OU6	Central and Sierra Railroad ROW / Centennial Tire	2301 15 th Street
OU6	Denver Water Department	1190 Yuma Street
OU6	Public Service Company	South Pecos Street and West Arizona Avenue

Table 10
 Operable Units 6, 9A and 11 Properties

Operable Unit	Property Name at Time of ROD	Address
OU6	Ruby Hill Park	Jewell Street and South Platte River Drive
OU9A	International House of Pancakes and Larry's Trading Post	2001, 2015, and 2017 East Colfax Avenue
OU11	Thomas	1285 – 1295 South Santa Fe Drive

4.5.2 History

Much of the radiological contamination present on the Open Space properties is believed to be either the direct result of radium and uranium processing on the property or the result of deposition of residual wastes from processing sites.

4.5.3 Remedial Objectives

EPA selected excavation and offsite disposal as the remedy for OU6, OU9A, and OU11 in a ROD dated September 29, 1987. The objectives of this remedy were to prevent: radiation exposure due to inhalation of radon gas and its daughter products; radiation exposure due to inhalation and ingestion of long-lived radionuclides; and direct exposure to gamma radiation.

At the time this ROD was issued, a permanent offsite disposal facility was not available. Plans for temporary onsite containment and storage were considered. These plans for temporary storage were abandoned when a commercial disposal facility in Tooele County, Utah was licensed to accept radioactive waste materials. Consequently, remedial design at these operable units focused on excavation and direct offsite disposal of radiologic waste materials.

4.5.4 Summary of Remedial Action

Remedial action operations at OU6, OU9A, and OU11 included the following:

- Excavation of radium-contaminated soils;
- The analysis of the contaminated materials to ensure compliance with transportation and disposal regulations;
- Shipment of contaminated materials to the permanent offsite disposal facility; and
- Confirmation sampling of excavated area.

Remediation was conducted in phases to facilitate the cleanup and to accommodate the various business activities within these operable units. Remediation began in March 1989 and was completed in December 1993. During the remedial action for

OU's 6, 9A, and 11, 8,336 tons of contaminated soil were excavated and disposed offsite.

During Phase A, 118 tons of contaminated soil was excavated from a property at South Pecos Street and West Arizona Avenue and disposed offsite. The excavated area was backfilled with clean soil and re-vegetated. Various properties within OUs 6, 9A and 11 were remediated during Phase B and a total of 5,365 tons of material were excavated for offsite disposal. A total of 2,403 tons of contaminated soil were excavated from the Environmental Materials, Inc. (EMI) and Regional Transportation District properties. These soils were transported by rail to the permanent disposal facility in Utah during Phase C. In 1993 during the final phase, 450 tons of contaminated soil were excavated from the EMI property and transported by rail to the permanent disposal facility in Utah.

EPA issued an ESD in January 1995 for OUs 6, 9A and 11. The ESD describes the changes that were made to the remedy selected for OUs 6, 9A, and 11. Briefly, these differences include:

- A small amount of radium-contaminated soils was not removed at OU6 (2301 15th Street).
- Additional properties were found to be contaminated and a greater volume of radium-contaminated soil was excavated and placed in a permanent offsite repository.
- Soils commingled with metals contamination were shipped to the permanent offsite disposal facility.

A Supplemental Standards report was prepared in April 1994 to document radiological contamination remaining on the 15th Street property of OU6. The location of this contamination is shown on Figure 13. Allegedly in 1995 a total of approximately 150 cubic yards of radiologically contaminated material were removed as a result of utility improvement activities. This material was apparently placed in sealed metal boxes and temporarily stored at 818 Water Street. These metal boxes were allegedly transported by flatbed trailers to Envirocare in July of 1996. To date, no documentation of these removal actions have been found in site files. Until this area has been documented as clean, it will be presumed that the site remains as shown in the figures in this Five-Year Review.

Additionally to the areas addressed under supplemental standards, ten additional areas of contamination at OU6 were left in place because levels of contamination met the standards when averaged over a 100² meter area.

Table 11
Materials Left in Place as Averaged Areas – OU6

Site Location	Figure/ Area ID	Square Feet	Averaged Concentration	Comments
15 th Street near CSRR	Figure 13, Area A	170	9.5 pCi/g	Considering of volume and concentration
Beneath Confluence Park Jogging trail – near CSRR tracks	Figure 13, Area B	360	14.4 pCi/g	Considering of volume and concentration and difficult access
North side of Environmental Materials building	Figure 11, Area D	595	14.1 pCi/g	Would restrict building access during removal
North side of Environmental Materials building	Figure 11, Area E	192	10.3 pCi/g	On a 1:1 slope that would of caused structural damage to building
West side of storage yard at Environmental Materials	Figure 11, Area F	369	10.8	Deposit discovered after remedial action complete and transportation contract expired
West side of storage yard at Environmental Materials	Figure 11, Area G	10	7.3	Structural damage to retaining wall
West side of Environmental Materials building	Figure 11, Area H	5	8.5	On a 1:1 slope that would of caused structural damage to building
Beneath railroad tracks west of Environmental Materials building	Figure 11, Area I	346	12.4	Considering of volume and concentration
West side of Environmental Materials building	Figure 11, Area J	17	6.8	On a 1:1 slope that would of caused structural damage to building
South side of Environmental Materials building	Figure 11, Area K	10	7.8	On a 1:1 slope that would of caused structural damage to building

4.5.5 Site Visit

A site visit was performed in August 2003.

At OU6, demolition of the Centennial Tire building (2301 15th Street) has taken place and the construction of luxury apartments has been completed. Communication with the City and County of Denver indicates that the builder at 2301 15th Street was in communication with the City and County of Denver and had taken precautions during excavation to identify potential contamination.

Also at OU6, The Brannan Sand and Gravel Operation remains a sand and gravel operation. The Denver Water Department building was remediated by Denver Water by a separate contractor aside from any EPA remedial action. The site currently has a slab on grade commercial building and is operating as a commercial wholesaler for Wine. The Public Service property remains under the same land use category now owned and operated by Excel Energy. Ruby Hill Park remains as public open space owned by the City and County of Denver. The Allied Chemical building (1271 West Bayaud) was converted to General Chemical and currently is vacant.

At OU9A, the International House of Pancakes and Larry's Trading Post are now occupied by Mamma's Café and three retail stores, respectively.

At OU11, a Starbucks Express coffee stand has been constructed on the northern portion of the property and what appears to be a vacant office building occupied the southern portion of the property.

4.5.6 Recommendations

Contamination was removed from all properties at OU6 (except 2301 15th Street), OU9A, and OU11. The remedy at these locations is protective of human health and the environment. These properties are released for unlimited use and unrestricted access. These properties are recommended for deletion from the Denver Radium Site and the NPL.

Supplemental Standards were written on two deposits of contamination located at 2301 15th Street. These locations are next to a concrete box water line that runs between the Colorado and Southern Railroad ROW and the South Platte River. Adjacent to this location was the Centennial Tire building (2301 15th Street) that was demolished and luxury apartments were constructed. Review of the administrative record has failed to provide the proper documentation for remedial action at 2301 15th Street. Until this area has been documented as clean, it will be presumed that the site remains as shown in the figures in this Five-Year Review. A complete file search and interviews of participants in this removal action (property owner, environmental consultant, City and County of Denver, CDPHE and EPA) should be conducted as part of this documentation. If no files are recovered, then based on interviews, a gamma survey should be conducted at this one location to re-document

current site conditions. Based on existing site knowledge, the remedy at 2301 15th Street is not protective of human health and the environment, due to the lack of an enforceable Institutional Control. The dose exposure limits need to be reviewed for this location in OU6 as part of the Risk Assessment review that is recommended by this Five-Year Review.

The City and County of Denver is currently negotiating a consent decree with the United States (Case Number 97-D-1611). If this is successfully completed, Denver will agree to implement management plans for radium contaminated soils remaining in place in Denver's rights-of-way and to continue to enforce Denver's zoning ordinance and its radium fee ordinance as institutional controls at private properties where radium contaminated soils remain in place where Supplemental Standards were applied. This would provide for an adequate IC at this OU if implemented.

O&M at these OU's is, by statute, the responsibility of the State of Colorado and is required at OU6 - 2301 East 15th Street.

The locations where materials were left in place where area averaging was applied are released for unrestricted use.

4.6 Operable Unit 7

4.6.1 Location

OU7 of the Denver Radium Site includes several Denver street segments that contain contaminated asphalt. These street segments contain a 4- to 6-inch layer of radium-contaminated asphalt underlain by compacted gravel road base. Usually, these street segments are overlain by 4- to 12-inches of uncontaminated asphalt pavement. There is an estimated 38,700 cubic yards of radium- contaminated material at OU7. The street segments are owned by the City and County of Denver and extend largely through residential areas (Figures 16 and 17).

4.6.2 History

Radium production from about 1914 to the mid-1920s generated large quantities of radioactive residues in the Denver area. Radium contaminated tailing and other wastes were discarded or left onsite when the facilities were closed. Due to changes in ownership and use of the properties, the residues were used as cover, fill, foundation material, and as aggregate in concrete and asphalt mixtures.

4.6.3 Remedial Objectives

EPA issued a ROD for OU7 on March 24, 1986 that combined features of the Excavation and Offsite Disposal alternative with a No Action alternative. The ROD called for leaving the contaminated material in-place and monitoring all maintenance, repair, or construction activities in the affected streets. Any contaminated material excavated during these activities would be shipped offsite for disposal.

The objectives of this remedy were to prevent: radiation exposure due to inhalation of radon gas and its daughter products; radiation exposure due to inhalation and ingestion of long-lived radionuclides; and direct exposure to gamma radiation.

4.6.4 Summary of Selected Remedy

The EPA selected remedy combines features of excavation and disposal with the modified no action alternative. This remedy entails:

- Leaving the contaminated material in place,
- Improving institutional controls so that all routine maintenance, repair and construction activities in the affected streets by government agencies, utility companies, contracting companies, and private individuals will be monitored, and
- Removing any contaminated material excavated during routine maintenance, repair, or construction activities in the affected streets to a facility approved for storage or disposal of contaminated material.

Due to the location, nature, and volume of radioactive contamination at OU7, the modified no action alternative was implemented at this operable unit. The potential routes of human exposure to the radioactivity are limited since the contaminated material is bound in the asphalt and is not free to move in any direction. None of the streets are near surface water or groundwater resources and the material has little potential for erosion or leaching because the contaminated aggregate is bound in the asphalt matrix within the pavement cap. Thus, the contamination in the asphalt matrix does not pose a threat to human health or the environment if left undisturbed.

The selected remedy was modified by the EPA in an ESD dated September 1992, amending the existing ROD to allow for reburial of excavated materials. The significant difference from the original remedy allows onsite retention and reburial of radium contaminated material excavated during all maintenance, repair or other construction activities. Should maintenance, repair or other construction activities be required, excavated radium-contaminated materials will be retained and reburied onsite if feasible, provided that the area to be excavated is not greater than 20% of the total area of the roadway in one city block. Special variance to the 20% limit may be granted by the CDPHE should an unusual circumstance require such a variance. Reburied materials will be covered with a new, hard surface, such as asphalt or concrete having a minimum depth of 6 inches to ensure no direct exposure. If retention and reburial are not feasible, the materials will be disposed at a licensed, offsite disposal facility, consistent with the ROD.

The Management Plan for OU7 was developed and adopted in 1993 by the City and County of Denver to govern all maintenance, repair, or other construction activities at OU7. This plan was updated in 2000 and in 2002. Quarterly reports of street activities in OU7 are submitted by Denver to CDPHE. Based on City and County of Denver records from August 1993 through August 2003, 2003, a total of 129 known street cuts have been made for gas, sewer and water line repairs. Information from

the City and County of Denver indicates that approximately 10% of these street cuts were performed outside the constraints of the management plan.

In February 1998, Denver requested a radioactive materials license from CDPHE for the temporary storage of radioactive soil and asphalt wastes that may be generated as a result of utility and street maintenance activities at various locations throughout OU7. The request identified a temporary, secured storage location at Denver International Airport and final disposal within two years at a permanent disposal facility. This license is currently active until December of 2003. The City and County of Denver is currently preparing an application for a new radioactive materials license.

In August 2002, the City and County of Denver conducted a Curbstone Preservation and Decontamination Study on 11th Avenue between Gaylord Street and Race Street to determine the economic and environmental viability of preserving historic curbstones during future reconstruction and remediation of 11th Avenue. All radium-contaminated materials were properly disposed of at a licensed disposal facility. Additionally, this study tested the ability of street remediation without having to remove the curb and gutters, thus reducing the cost of street remediation significantly. The work included removing asphalt and road materials for approximately nine feet from the curb and cleaning the curbstone to remove any radium-contaminated materials. The study determined the existing curbstone or curb and gutter could be preserved during future remediation of other radium streets.

4.6.5 Site Inspection

A site visit was performed at OU7 August 2003. Denver's Department of Environmental Health is currently (2003) removing contamination from 11th Avenue, from Race to Josephine, and Marion Street, from 6th Avenue to 10th Avenue. These streets were selected based on the need for maintenance and reconstruction.

4.6.6 Recommendations

While O&M of OU7 is, by statute, the responsibility of the State of Colorado and the City and County of Denver, Denver has adopted the Management Plan for OU7 as part of their rules and regulations. The City and County of Denver will progressively be remediating the streets as part of their O&M, continuing until approximately 2009. Partial deletions of street segments should occur on an annual basis to reduce annual O&M costs incurred by the City and County of Denver.

The dose exposure limits need to be reviewed for this OU as part of the Risk Assessment review that is recommended by this Five-Year Review. Until the dose exposure limits are evaluated, the decision cannot be made as to the protectiveness of this remedy.

The City and County of Denver is currently negotiating a consent decree with the United States (Case Number 97-D-1611). If this is successfully completed, Denver

will agree to implement management plans for radium contaminated soils remaining in place in Denver's rights-of-way and to continue to enforce Denver's zoning ordinance and its radium fee ordinance as institutional controls at private properties where radium contaminated soils remain in place where Supplemental Standards were applied. This would provide for an adequate IC at this OU if implemented.

4.7 Operable Unit 8 – Shattuck Chemical Company and Vicinity Properties

4.7.1 Location

OU8 of the Denver Radium site is located in south-central Denver, Colorado and consists of the Shattuck Chemical Company, Inc. (Shattuck) property located at 1805 South Bannock Street, the adjacent railroad ROW property, a portion of South Bannock Street, and a few properties (vicinity Properties) east of Shattuck where radium contaminated soils were found (Figures 18 and 19).

4.7.2 History

The Shattuck property has been the location of several mineral-processing operations since the early 1900s. The operations included the extraction of molybdenum and vanadium from ores, processing of "radium slimes" for the production of radium salts and uranium compounds, recovery of rhenium as a by-product of molybdenum production, and for a short period of time processing of depleted uranium. The primary site contaminants are radium, thorium, uranium, molybdenum, arsenic, selenium, and several volatile and semi-volatile organics. Shattuck's operations ceased in 1984.

The original ROD was signed in January 1992. In it, EPA selected on-site stabilization and solidification as the remedy for soils and natural attenuation with monitoring for groundwater.

EPA conducted a five-year review of the Shattuck Site in 1999 and found site-specific deficiencies in the solidified material cover design, the structural and chemical integrity, and the compliance program. Based on these findings, EPA could not be assured of the long-term protection of the original remedy.

On June 16, 2000, EPA selected off-site removal in a ROD Amendment because it best met Superfund's nine evaluation criteria. Additionally, the Amended ROD stated that ground water monitoring will continue to address the deficiencies identified in the 1999 Five-Year Review.

EPA began to remove the contaminated soil and monolith in March 2003 to U.S. Ecology, a permitted facility in Grandview, Idaho

Waste shipments began on March 9, 2003. The site currently loads five rail cars per day, each rail car carrying up to 108 tons of waste material. The railroad pulls out 20 rail cars a week from the Shattuck spur. It is anticipated that the last waste load will be removed by the end of 2005.

4.7.3 Remedial Objectives

The original ROD for Shattuck was signed in 1992. EPA selected onsite stabilization and solidification for soils, and to prevent further degradation of ground water and allow for natural attenuation with monitoring for ground water. At the time, this met the statutory preference for a remedy although it increased the mass of materials and created a monolith. EPA conducted a five-year-review of the Shattuck site and found deficiencies in the monolith cover design, the integrity of the monolith, and the monolith's compliance program. Based on these findings, EPA could not be assured of the long-term protection of the original remedy. In addition to the technical concerns raised by the 1999 Five-Year Review, the State, Denver, elected officials, and the local community requested that EPA consider other alternatives to the onsite remedy to allow for unrestricted use of the Site.

In June 2000 after developing a proposed plan and receiving public input, EPA selected off-site removal in a ROD Amendment. Off-site disposal offers benefits including:

- Long-term protection of human health and the environment;
- Removal of potential source material for future ground-water contamination;
- Disposal of material in a permitted facility; and
- Unrestricted future land use.

4.7.4 Summary of Remedial Action

The Remedial Action at OU8 was substantially completed in September 1998. Remedial action operations at OU8 include the following:

- Demolition of radium-contaminated buildings;
- Excavation of radium-contaminated soil from vicinity properties, Bannock Street, the storm sewer located east of Santa Fe Drive, and the Shattuck Chemical property;
- Onsite stabilization/solidification of the radium-contaminated soil into a disposal cell;
- Capping of the stabilized material; and
- Installation of monitoring wells to evaluate the effectiveness of the remedy.

The remedial action at OU8 was conducted in two phases, beginning September 1992, and was substantially complete in September 1998. During Phase I approximately 67,345 tons of building debris were disposed offsite and 8,700 cubic yards of soil were excavated from the vicinity properties. During this phase, approximately 200 cubic yards of asbestos containing material were removed and disposed under appropriate regulations. Approximately 400 cubic yards of radiologically contaminated material were excavated from beneath Bannock Street. Stabilization/solidification of the radiologically contaminated material began in July 1996 and was completed in November 1997.

Approximately 65,000 loose cubic yards of radiologically contaminated soil excavated from Shattuck Chemical and the vicinity properties were stabilized/solidified onsite in a disposal cell. Capping of the stabilized material was completed in June 1998. The Draft Construction Completion Report was submitted on September 29, 1998.

During the excavation of radiologically contaminated soils, oil-impacted soils also were found onsite. The materials were below the action levels established in the ROD. Approximately 2,000 cubic yards of oil-impacted soil were excavated from the Shattuck Chemical Property located at 1805 South Bannock Street during Phase 2 activities. This material was covered and transported by truck to Conservation Services Inc. in Thornton, Colorado. Bioremediation was used for oil-impacted soils that extended beneath the completed portion of the monolith. A plan addressing the remaining oil-contaminated soils at OU8 was submitted in August 1998. The bio-venting system was approved by EPA and was installed in September 1998.

In 1997, the storm sewer along Santa Fe Boulevard west of the site was remediated. During the remediation, an In-Situ Form Liner was installed into the original pipe to isolate storm water discharges to the South Platte River from the influx of contaminated ground water. This liner system, while in place, has not remedied the problem to date. In 1998, the sewer remediation was investigated by EPA and the City of Denver and determined to be incomplete. At this time, EPA, CDPHE and City and County of Denver personnel are reviewing the remedy in preparation to propose further remediation in the sewer line west of OU8. Ground water characterization is ongoing for characterization and remedial evaluation. Please refer to the December 2001 U.S. Department of Energy Letter Report for the Shattuck Chemical Ground Water Project for more specific data pertaining to OU8 ground water.

A Management Plan for OU8 Bannock Street was developed and adopted in March 1999 by the City and County of Denver to govern all maintenance, repair, or other construction activities at OU8 Bannock Street.

4.7.5 Site Visit

A site visit was performed in August 2003. Removal of the contaminated soil and the monolith as directed by the June 2000 ROD Amendment has begun. The temporary structure has been constructed and the stabilized material has begun to be excavated and shipped off site.

4.7.6 Recommendations

The Vicinity Properties are available for unlimited use and unrestricted access. The remedy here is protective of human health and the environment. These properties are recommended for deletion from the Denver Radium Site and the NPL.

Ground water monitoring at OU8 is ongoing and needs to continue or be finalized. Future ground water characterization reports will be used during evaluation of future Five-Year Reviews.

The remedial action for OU8 Shattuck will be complete at the time of the next five-year review. Verification that the remedial action undertaken at OU8 remains intact and is protective of human health and the environment will be assessed. The O&M Plan is under development and Shattuck has initiated sampling under the Plume Monitoring Plan and Monolith Monitoring Plan. Because the remedy is not yet complete, protectiveness cannot be determined. O&M at OU8 is, by statute, the responsibility of the State of Colorado.

The City and County of Denver is currently negotiating a consent decree with the United States (Case Number 97-D-1611). If this is successfully completed, Denver will agree to implement management plans for radium contaminated soils remaining in place in Denver's rights-of-way and to continue to enforce Denver's zoning ordinance and its radium fee ordinance as institutional controls at private properties where radium contaminated soils remain in place where Supplemental Standards were applied. It is currently not known whether Supplemental Standards will be applied at OU8. If they were applied here, this would provide for an adequate IC at this OU if implemented.

4.8 Operable Unit 9

4.8.1 Operable Unit 9A – 2001, 2015 and 2017 East Colfax Avenue

OU9A is discussed in full in Section 4.5 of this text.

4.8.2 Operable Unit 9B – Robinson Brick Company 500 South Santa Fe Drive

4.8.2.1 Location

OU9B- ROBCO Metals is located in south-central Denver near the intersection of Interstate 25 and East Alameda Avenue, at 500 South Santa Fe Drive (Figures 21 and 22). Radiological contamination at the property location was addressed in conjunction with OUs 4 and 5.

4.8.2.2 History

OU 9B-ROBCO Metals was placed on the NPL as part of the Denver Radium Site in September 1983. In May 1988, excavation of the radiologically contaminated soils began. In September 1988, during the course of the radium cleanup, metals contamination was discovered on the ROBCO property. An investigation to characterize the nature and extent of metals contamination was conducted in 1989 and 1990.

4.8.2.3 Remedial Objectives

At this OU, EPA selected a remedy leaving the metals contaminated soils onsite with a protective soil cover with implementation of IC's. The objectives of the remedy were to:

- Prevent direct contact with or ingestion of metals contaminated soils that exceed the health-based action levels and monitor migration of the contaminants of concern in ground water that could result in degradation of water quality in the South Platte River.
- The selected remedy includes capping the metals-contaminated soils, conducting environmental monitoring to ensure the effectiveness of the remedial action, and implementing IC's to limit use of groundwater at the site and maintain the integrity of the cap.

4.8.2.4 Summary of Remedial Action

EPA and the State of Colorado entered into a State Superfund Contract (SSC) for remedial implementation for this portion of the Denver Radium NPL Site on July 24, 1992.

The Remedial Action at OU9B (ROBCO Metals) was completed in three phases, beginning in October 1995 and completed in April 1996. During Phase 1 activities, the ROBCO Site was prepared for the excavation, movement and consolidation of heavy metal contaminated soils. During Phase 2 activities, the existing ROBCO Building/Plant foundation were crumbled and the area of contamination outside the Area of Consolidation was excavated. Approximately 62,062 cubic yards of material were excavated and/or moved during Phase 2 of the remedial action (Figure 22). During Phase 3 activities, the Area of Consolidation cap was constructed, the identification barrier was installed, and structural fill was placed and compacted to final design grade and contour (Figure 21).

In accordance with the Agreement and Covenant Not to Sue (July, 1995; also called the Prospective Purchaser Agreement (PPA)), Home Depot USA (Home Depot), USEPA, and CDPHE performed closure of the Robinson Brick Company in a defined "shared" and "phased" manner. Home Depot submitted a Draft O&M Plan on May 30, 1997. CDPHE and EPA approved the O&M Plan on March 17, 1998. Based on the O&M Plan, EPA and CDPHE will perform biannual, offsite ground water monitoring and Home Depot will perform biannual inspections of store facilities and site utilities.

The first ground water monitoring event occurred in April 1998. Since then, four ground water monitoring events have occurred. The most

recent ground water monitoring occurred in July 2003. The results indicate that ground water contamination has decreased over time and is migrating and decreasing over time in a northwest direction. The South Platte River is not impacted.

The Prospective Purchaser Agreement (PPA) required that any breaches of the soil cap system over the Post-Consolidation Area of Contamination will be reported to EPA and CDPHE with the requirement that new construction, remodeling and site repair generally will not be conducted in this area.

4.8.2.5 Site Visit

A site visit was conducted in August 2003. In addition to the construction of the Home Depot and its parking lot, two commercial buildings were built to the north of Home Depot. An automotive repair facility (Star Tech Mercedes) and an unoccupied building share a sewer line that was placed through the northern end of the contingency zone for ROBCO Metals wastes. The sewer line was installed properly under the Home Depot O&M Plan.

4.8.2.6 Recommendations

O&M at OU9B is, by statute, the responsibility of the State of Colorado. Home Depot signed a Covenant Not to Sue with the EPA that binds them to providing O&M at OU9B. Home Depot has an amended O&M Plan as of August 18, 2003.

CDPHE recommends, based on the trends shown in ground water data at OU9B, that the frequency be reduced from annual to bi-annual until the time of the next Five-Year Review when it will be reassessed. EPA and CDPHE recommend that Home Depot continue to report annually the status of the OU9B monitoring program.

4.9 Operable Unit 10

4.9.1 Location

OU10, also known as the Card Corporation during the issuance of the ROD, was built by the Overland Cotton Mill in 1890. This location is currently 1314 West Evans Avenue.

Denver Radium OU10 includes the following property in Denver, Colorado:

Table 12
 Operable Unit 10 Properties

Operable Unit	Property Name at Time of ROD	Address
OU10	Card Corporation	1314 West Evans Avenue

4.9.2 History

Contamination at OU10 is resultant from PRC processing of vanadium between 1920 and 1924. During 1924, PRC is believed to have processed as much as 10 tons of vanadium daily.

4.9.3 Remedial Objectives

In the ROD, dated September 1987, EPA selected excavation and offsite disposal as the remedy for OU10. The objectives of this remedy were to prevent: radiation exposure due to inhalation of radon gas and its daughter products; radiation exposure due to inhalation and ingestion of long-lived radionuclides; and direct exposure to gamma radiation.

At the time the ROD was signed, there were no disposal facilities in the nation that accepted radium waste. For this reason, the ROD included temporary onsite storage of the contaminated material. However, onsite temporary storage was not required since a permanent disposal facility opened before excavation began. The excavated material was shipped by rail to Envirocare of Utah, Inc., a disposal facility in Tooele County, Utah.

4.9.4 Summary of Remedial Action

Remediation activities at OU10 began in September 1988 and ended September 22, 1989. A total of 15,021 tons of materials with depths ranging from 0 to 80 inches were removed and was disposed offsite at Envirocare of Utah.

No extensive changes were made to the major structures on the property, although several small structures were removed and not replaced at the request of the owner. Some un-assessed contamination required removal, but the volumes were not large.

Two additional deposits of contamination at OU10 were left in place because levels of contamination met the standards when averaged over a 100² meter area.

Table 13
 Materials Left in Place as Averaged Areas – OU10

Site Location	Figure/ Area ID/Phase	Square Feet	Averaged Concentration	Comments
OU10 – Card Corp	Figure 23, Area A	50	4.7 pCi/g	Beneath a large air compressor on the Card property
OU10 – Card Corp	Figure 23, Area B	445	13.6 pCi/g	Beneath a punch press on the Card property

4.9.5 Site Visit

A site visit was performed in August 2003. All properties at OU10 remain under commercial or industrial use.

4.9.6 Recommendations

All ROD requirements were met and all contamination was removed from OU10 (Figure 23). The remedy at OU10 is protective of human health and the environment. The properties included at OU10 are available for unlimited use and unrestricted access. These properties are recommended for deletion from the Denver Radium Site and the NPL. The locations where materials were left in place where area averaging was applied are released for unrestricted use.

5.0 Assessment

The following conclusions have been determination for the remedies at the Denver Radium Superfund Site:

OU1

Question A: *Is the remedy functioning as intended by the decision documents?*

Yes, all ROD requirements were met, all contamination was removed from OU 1 and the remedy is protective of human health and the environment.

Question B: *Are the Assumptions made at the time of the remedy selection still valid?*

Yes, all assumptions used at the time of the remedy selection remain valid.

Question C: *Has any other information come to light that could call into question the protectiveness of the remedy?* No, no additional information has been identified that would call into question the protectiveness of the remedy.

OU2

Question A: *Is the remedy functioning as intended by the decision documents?*

No, there are no IC's in place at the following properties at OU2: 1100 Umatilla Street; along the Burlington Northern Railroad ROW immediately east of 1100 Umatilla Street; and the alley between Yuma Street and Umatilla Street in the City and County of Denver Right-of-Way (ROW). All ROD requirements were met at all other properties at OU2.

Question B: *Are the Assumptions made at the time of the remedy selection still valid?*

No, all assumptions used at the time of the remedy selection are not valid.

Changes in Risk Assessment Methodologies: Regulations pertaining to restricted release of a radiological site in Colorado are found in CRR 1007 Parts 4.61.3.2 through 4.61.3.3 of the Colorado *Rules and Regulations Pertaining to Radiation Control*. The significant sections, 4.61.3.2 and 4.61.3.3 requires that the licensee has made provisions for durable, legally enforceable institutional controls which provide reasonable assurance that the total effective dose equivalent (TEDE) from residual radioactivity distinguishable from background to the average member of the critical group will not exceed 0.25 milli-Sievert (mSv) per year (25 milli-rem per year (mrem/y)); and residual radioactivity at the site has been reduced so that if the institutional controls were no longer in effect, there is reasonable assurance that the TEDE from residual radioactivity distinguishable from background to the average member of the critical group is ALARA (As Low As Reasonably Achievable) and would not exceed either: 1 mSv per year (100 mrem/y); or 5 mSv per year (500 mrem/y), provided the licensee

demonstrates that further reductions in residual radioactivity necessary to comply with the 1 mSv per year (100 mrem/y) value of this paragraph are not technically achievable, would be prohibitively expensive, or would result in net public or environmental harm.

The near-surface residual radioactivity representing the highest gamma flux used to calculate the dose to the worker is covered by concrete. The current estimate is that the business worker (the modeled average member of the critical group) would receive 73 mrem/y, which exceeds the current requirement of 25 mrem/y. Furthermore, it is not shown what the dose to the receptor would be if the concrete were removed (i.e., institutional control failed). If the concrete were removed from an area where supplemental standards were applied, the assumption that there would be no inhalation or ingestion would be invalidated, and could increase the dose to the receptor higher than what is projected. Since the current estimate is 73 mrem/y, it is reasonable to assume that the dose to the receptor would exceed the public dose limit if the concrete were removed. Therefore, the projected doses in the Denver Radium Superfund Site Supplemental Standards Report Operable Unit 2, DuWald Steel Property, Appendix C Health Risk Assessment Operable Unit 2, DuWald Steel Property, do not meet the current requirements of CRR 1007 Part 4.61.3.2 and 4.61.3.3 of the Colorado *Rules and Regulations Pertaining to Radiation Control*. A reassessment of the risks based on current standards should be completed.

Question C: *Has any other information come to light that could call into question the protectiveness of the remedy?* No, no additional information has been identified that would call into question the protectiveness of the remedy.

OU3

Question A: *Is the remedy functioning as intended by the decision documents?* No, there are no IC's in place at the following properties at OU3: South Jason Street, around the Packaging Corporation of America building, and along South Platte River Drive. All ROD requirements were met at all other properties at OU3.

Question B: *Are the Assumptions made at the time of the remedy selection still valid?*

No, all assumptions used at the time of the remedy selection are not valid.

OU3 ground water has not been adequately defined. New information may come to light after the characterization is completed.

Changes in Risk Assessment Methodologies: Regulations pertaining to restricted release of a radiological site in Colorado are found in CRR 1007 Parts 4.61.3.2 through 4.61.3.3 of the Colorado *Rules and Regulations Pertaining to Radiation Control*. The significant sections, 4.61.3.2 and 4.61.3.3 requires that the licensee has made provisions for durable, legally

enforceable institutional controls which provide reasonable assurance that the total effective dose equivalent (TEDE) from residual radioactivity distinguishable from background to the average member of the critical group will not exceed 0.25 milli-Sievert (mSv) per year (25 milli-rem per year (mrem/y)); and residual radioactivity at the site has been reduced so that if the institutional controls were no longer in effect, there is reasonable assurance that the TEDE from residual radioactivity distinguishable from background to the average member of the critical group is ALARA (As Low As Reasonably Achievable) and would not exceed either: 1 mSv per year (100 mrem/y); or 5 mSv per year (500 mrem/y), provided the licensee demonstrates that further reductions in residual radioactivity necessary to comply with the 1 mSv per year (100 mrem/y) value of this paragraph are not technically achievable, would be prohibitively expensive, or would result in net public or environmental harm.

Question C: *Has any other information come to light that could call into question the protectiveness of the remedy?* No, no additional information has been identified that would call into question the protectiveness of the remedy.

OU4

Question A: *Is the remedy functioning as intended by the decision documents?*
Yes, all ROD requirements were met at OU4. Enforceable IC's are in place at this OU.

Question B: *Are the Assumptions made at the time of the remedy selection still valid?*

No, all assumptions used at the time of the remedy selection are not valid.

New information may come to light pertaining to OU4 ground water after the characterization is completed this year and future years.

Changes in Risk Assessment Methodologies: Regulations pertaining to restricted release of a radiological site in Colorado are found in CRR 1007 Parts 4.61.3.2 through 4.61.3.3 of the Colorado *Rules and Regulations Pertaining to Radiation Control*. The significant sections, 4.61.3.2 and 4.61.3.3 requires that the licensee has made provisions for durable, legally enforceable institutional controls which provide reasonable assurance that the total effective dose equivalent (TEDE) from residual radioactivity distinguishable from background to the average member of the critical group will not exceed 0.25 milli-Sievert (mSv) per year (25 milli-rem per year (mrem/y)); and residual radioactivity at the site has been reduced so that if the institutional controls were no longer in effect, there is reasonable assurance that the TEDE from residual radioactivity distinguishable from background to the average member of the critical group is ALARA (As Low As Reasonably Achievable) and would not exceed either: 1 mSv per year (100 mrem/y); or 5 mSv per year (500 mrem/y), provided the licensee demonstrates that further reductions in residual radioactivity necessary to

comply with the 1 mSv per year (100 mrem/y) value of this paragraph are not technically achievable, would be prohibitively expensive, or would result in net public or environmental harm.

Question C: *Has any other information come to light that could call into question the protectiveness of the remedy?* No, no additional information has been identified that would call into question the protectiveness of the remedy.

OU5

Question A: *Is the remedy functioning as intended by the decision documents?*
Yes, all ROD requirements were met, all contamination was removed from OU5 and the remedy is protective of human health and the environment.

Question B: *Are the Assumptions made at the time of the remedy selection still valid?*

Yes, all assumptions used at the time of the remedy selection remain valid.

Question C: *Has any other information come to light that could call into question the protectiveness of the remedy?* No, no additional information has been identified that would call into question the protectiveness of the remedy.

OU6

Question A: *Is the remedy functioning as intended by the decision documents?*
No, there are no IC's in place at OU6 - 2301 East 15th Street where locations were addressed under supplemental standards. All ROD requirements were met at all other properties at OU6.

Question B: *Are the Assumptions made at the time of the remedy selection still valid?*

No, all assumptions used at the time of the remedy selection are not valid.

The site is currently zoned under a mixed residential commercial use. The ROD specified cleanup levels under a commercial/industrial land usage.

Changes in Risk Assessment Methodologies: Regulations pertaining to restricted release of a radiological site in Colorado are found in CRR 1007 Parts 4.61.3.2 through 4.61.3.3 of the Colorado *Rules and Regulations Pertaining to Radiation Control*. The significant sections, 4.61.3.2 and 4.61.3.3 requires that the licensee has made provisions for durable, legally enforceable institutional controls which provide reasonable assurance that the total effective dose equivalent (TEDE) from residual radioactivity distinguishable from background to the average member of the critical group will not exceed 0.25 milli-Sievert (mSv) per year (25 milli-rem per year (mrem/y)); and residual radioactivity at the site has been reduced so that if the institutional controls were no longer in effect, there is reasonable assurance that the TEDE from residual radioactivity distinguishable from background

to the average member of the critical group is ALARA (As Low As Reasonably Achievable) and would not exceed either: 1 mSv per year (100 mrem/y); or 5 mSv per year (500 mrem/y), provided the licensee demonstrates that further reductions in residual radioactivity necessary to comply with the 1 mSv per year (100 mrem/y) value of this paragraph are not technically achievable, would be prohibitively expensive, or would result in net public or environmental harm.

Question C: *Has any other information come to light that could call into question the protectiveness of the remedy?* No, no additional information has been identified that would call into question the protectiveness of the remedy.

OU7

Question A: *Is the remedy functioning as intended by the decision documents?*

Yes, all ROD requirements were met at OU7. Enforceable IC's are in place at this OU and are being implemented by the City and county of Denver. Operations and Maintenance is being conducted at OU7 currently in the form of complete removal of street contamination for road resurfacing and utility upgrading.

Question B: *Are the Assumptions made at the time of the remedy selection still valid?*

No, all assumptions used at the time of the remedy selection are not valid.

Changes in Risk Assessment Methodologies: Regulations pertaining to restricted release of a radiological site in Colorado are found in CRR 1007 Parts 4.61.3.2 through 4.61.3.3 of the Colorado *Rules and Regulations Pertaining to Radiation Control*. The significant sections, 4.61.3.2 and 4.61.3.3 requires that the licensee has made provisions for durable, legally enforceable institutional controls which provide reasonable assurance that the total effective dose equivalent (TEDE) from residual radioactivity distinguishable from background to the average member of the critical group will not exceed 0.25 milli-Sievert (mSv) per year (25 milli-rem per year (mrem/y)); and residual radioactivity at the site has been reduced so that if the institutional controls were no longer in effect, there is reasonable assurance that the TEDE from residual radioactivity distinguishable from background to the average member of the critical group is ALARA (As Low As Reasonably Achievable) and would not exceed either: 1 mSv per year (100 mrem/y); or 5 mSv per year (500 mrem/y), provided the licensee demonstrates that further reductions in residual radioactivity necessary to comply with the 1 mSv per year (100 mrem/y) value of this paragraph are not technically achievable, would be prohibitively expensive, or would result in net public or environmental harm.

Question C: *Has any other information come to light that could call into question the protectiveness of the remedy?* No, no additional information has been identified that would call into question the protectiveness of the remedy.

OU8

Question A: *Is the remedy functioning as intended by the decision documents?*

Yes, the remedy at OU8 is currently underway as proposed.

Question B: *Are the Assumptions made at the time of the remedy selection still valid?*

OU8 ground water has not been adequately defined. New information may come to light after the characterization is completed.

Question C: *Has any other information come to light that could call into question the protectiveness of the remedy?* No, no additional information has been identified that would call into question the protectiveness of the ongoing remedy.

OU9A

Question A: *Is the remedy functioning as intended by the decision documents?*

Yes, all ROD requirements were met, all contamination was removed from OU9A and the remedy is protective of human health and the environment.

Question B: *Are the Assumptions made at the time of the remedy selection still valid?*

Yes, all assumptions used at the time of the remedy selection remain valid.

Question C: *Has any other information come to light that could call into question the protectiveness of the remedy?* No, no additional information has been identified that would call into question the protectiveness of the remedy.

OU9B

Question A: *Is the remedy functioning as intended by the decision documents?*

Yes, all ROD requirements were met at OU9B. Enforceable IC's are in place at this OU.

Question B: *Are the Assumptions made at the time of the remedy selection still valid?*

Yes, all assumptions used at the time of the remedy selection remain valid.

Question C: *Has any other information come to light that could call into question the protectiveness of the remedy?* No, no additional information has been identified that would call into question the protectiveness of the remedy.

OU10

Question A: *Is the remedy functioning as intended by the decision documents?*

Yes, all ROD requirements were met, all contamination was removed from OU10 and the remedy is protective of human health and the environment.

Question B: *Are the Assumptions made at the time of the remedy selection still valid?*

Yes, all assumptions used at the time of the remedy selection remain valid.

Question C: *Has any other information come to light that could call into question the protectiveness of the remedy?* No, no additional information has been identified that would call into question the protectiveness of the remedy.

OU11

Question A: *Is the remedy functioning as intended by the decision documents?*

Yes, all ROD requirements were met, all contamination was removed from OU11 and the remedy is protective of human health and the environment.

Question B: *Are the Assumptions made at the time of the remedy selection still valid?*

Yes, all assumptions used at the time of the remedy selection remain valid.

Question C: *Has any other information come to light that could call into question the protectiveness of the remedy?* No, no additional information has been identified that would call into question the protectiveness of the remedy.

6.0 Deficiencies

Deficiencies were discovered during the 5-Year Review. The following are the discovered deficiencies:

1. **Institutional Controls:** There are no ICs in place at the following properties and OU's: OU2 (1100 Umatilla Street; along the Burlington Northern Railroad ROW immediately east of 1100 Umatilla Street; alley between Yuma Street and Umatilla Street in the City and County of Denver Right-of-Way (ROW); OU3 (South Jason Street, around the Packaging Corporation of America building, and along South Platte River Drive); and OU6 (2301 East 15th Street).
2. **Risk Assessment:** The Risk Assessments for all the Denver Radium OU's where waste remains in place under supplemental standards do not meet the current requirements of CRR 1007 Parts 4.61.3.2 and 4.61.3.3 of the Colorado Rules and Regulations pertaining to Radiation Control.
3. **Ground Water:** Ground water monitoring at OU8 is ongoing and needs to continue or be finalized. A brief summary of OU3 ground water data has been included in this Five-Year Review. The analytical report needs to be completed and an additional round of ground water monitoring should be completed in December 2003 or January 2004 to check for seasonal fluctuations. Additionally, CDPHE needs to complete the analytical report for OU9B (ROBCO) Annual Ground water monitoring.
4. **Undocumented Removal at OU6 Supplemental Standards Location:** There has been no documentation as to the alleged removal or removals at 2301 15th Street. Until this area has been documented as clean, it will be presumed that the site remains as shown in the figures in this Five-Year Review. Current zoning of this site is now mixed residential commercial and no longer commercial/industrial.

7.0 Recommendations and Follow-Up Actions

With EPA and CDPHE oversight, the corresponding recommendations and follow-up actions are as follows:

Table 14
Recommendations and Follow-Up Actions

Issue	Recommendation and Follow-up Action	Party Responsible	Milestone Date	Affects Protectiveness (Y/N)	
				Current	Future
Lack of ICs at various properties	<p>A meaningful system of IC's needs to be implemented. This includes the following properties and OU's: OU2 (1100 Umatilla Street; along the Burlington Northern Railroad ROW immediately east of 1100 Umatilla Street; alley between Yuma Street and Umatilla Street in the City and County of Denver Right-of-Way (ROW); OU3 (South Jason Street, around the Packaging Corporation of America building, and along South Platte River Drive; and OU6 (2301 East 15th Street).</p> <p>The City and County of Denver is currently negotiating a consent decree with the United States (Case Number 97-D-1611). If this is successfully completed, Denver will agree to implement management plans for radium contaminated soils remaining in place in Denver's rights-of-way and to continue to enforce Denver's zoning ordinance and its radium fee ordinance as institutional controls at private properties where radium contaminated soils remain in place where Supplemental Standards were applied. This implementation will resolve the deficiency associated with lack of IC's.</p>	EPA and CDPHE	12/2004	Y	Y
GIS database System for IC Overlay	<p>A GIS database system is currently being prepared by EPA that will document pertinent features of the Denver Radium Site. This GIS database will provide locations of waste left in place, remediation features and monitoring points. Further, this will also provide locations of monitoring points and buildings located within OU boundaries. This will aid in Operations and Maintenance (O&M) with respect to IC's at the Denver Radium Site. New figures will be generated from this GIS database system and will be provided as an addendum to this Five-Year Review.</p>	EPA	05/2005	N	N

Table 14
Recommendations and Follow-Up Actions

Issue	Recommendation and Follow-up Action	Party Responsible	Milestone Date	Affects Protectiveness (Y/N)	
				Current	Future
Risk Assessment	The Risk Assessments for all the Denver Radium OU's where supplemental standards were applied do not meet the current ARAR requirements of CRR 1007 Parts 4.61.3.2 and 4.61.3.3 - Standards for Protection Against Radiation. A reassessment of the risks based on the current ARAR standard should be completed for implementation of future ICs. The existing source data may be reused, but the EPA, CDPHE, and City and County of Denver need to come to agreement during a planning meeting on other assumptions for these risk calculations. This affects the following OUs: OU2, OU3, OU4, OU6 and OU7.	EPA and CDPHE	12/2004	Y	Y
OU3 Ground Water Analytical Report	The analytical report needs to be completed and an additional round of ground water monitoring should be conducted in December 2003 or January 2004. This report will be submitted separately and not as Addendums to this Five-Year Review. This report is not expected to change the conclusions in this Five-Year Review.	CDPHE	03/2004	N	N
OU8 Ground Water Investigation	Ground water monitoring at OU8 is ongoing and needs to continue or be finalized.	EPA	12/2005	Y	Y
OU9 Ground Water Analytical Report	CDPHE needs to complete the analytical report for OU 9B (ROBCO) Annual Ground water monitoring. This report will be submitted separately and not as Addendums to this Five-Year Review. This report is not expected to change the conclusions in this Five-Year Review.	CDPHE	03/2004	N	N
OU9B Ground Water Monitoring Frequency	CDPHE recommends, based on the trends shown in ground water data at OU9B, that the frequency be reduced from annual to bi-annual until the time of the next Five-Year Review when it will be reassessed.	CDPHE and EPA	03/2004	N	N
Undocumented removal action at OU6 - 2301 15 th Street	There has been no documentation as to the alleged removal or removals at 2301 15 th Street. Until this area has been documented as clean, it will be presumed that the site remains as shown in the figures in this Five-Year Review. A complete file search and interviews of participants in this removal action (property owner, environmental consultant, City and County of Denver, CDPHE and EPA) should be conducted as part of this documentation. If no files are recovered, then based on interviews, a gamma survey should be conducted at this one location to re-document current site conditions.	CDPHE	05/2004	Y	Y

8.0 Protectiveness Statement

The protectiveness of the remedies at the following OU's cannot be determined because the dose exposure limit used in the original Risk Assessment does not meet the current ARAR of CRR 1007 4.61.3.2 – 4.61.3.3 and because of a lack of IC's at the following OU's: OU2 (1100 Umatilla Street; along the Burlington Northern Railroad ROW immediately east of 1100 Umatilla Street; and the alley between Yuma Street and Umatilla Street in the City and County of Denver ROW); OU3 (South Jason Street, around the Packaging Corporation of America building, and along South Platte River Drive); and OU6 (2301 East 15th Street). IC's are currently being discussed between the CDPHE and the City and County of Denver. A reevaluation of the dose limit exposures along with site specific data needs to be determined to assess the protectiveness of this remedy.

Because remedial action is ongoing at OU8 (Shattuck), the protectiveness will be determined once the remedy is completed and operational.

The protectiveness of the remedies at the following OU's cannot be determined because the dose exposure limit used in the original Risk Assessment does not meet the current ARAR of CRR 1007 4.61.3.2 – 4.61.3.3. Even though there are enforceable IC's in place at these OU's, changes in the Risk Assessment methodologies and current dose exposure limit levels do not meet the current ARAR of CRR 1007 4.61.3.2 – 4.61.3.3: OU4 and OU7. A reevaluation of the dose limit exposures along with site specific data needs to be determined to assess the protectiveness of this remedy.

The remedy for the following OU's is protective of human health and the environment because immediate threats have been addressed and the remedy is in operation as required by the applicable ROD's and ESD's (where applicable): OU1, OU5, OU9A, OU9B, OU10, and OU11.

9.0 Next Review

The Denver Radium Superfund Site is a Statutory Site that requires ongoing 5-Year Reviews. The next 5-Year Review will be conducted within 5 years of the completion of this 5-Year Review report. The completion date is the date of the signature shown on the signature cover page attached to the front of this report. The next Five-Year Review for OU8 Shattuck will be conducted within 5 years from its signing date in 1999. All Denver Radium OU's and properties not deleted from the NPL will be included in future Five-Year Reviews and will be included until deleted from the NPL.

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Community Involvement Plan Update

Denver Radium Superfund Site
Denver, Colorado
August 2003



Colorado Department of Public Health and Environment

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Section 1.0 Introduction

The Colorado Department of Public Health and Environment (CDPHE) Community Involvement Program is committed to promoting communication between citizens and CDPHE. This Community Involvement Plan (CIP) Update describes the community involvement and public participation program developed for the Denver Radium Superfund Site (Denver Radium) in Denver, Colorado. This CIP Update was developed in coordination with the US Environmental Protection Agency (EPA) and updates the previous CIP, dated September 1989. Community involvement activities for Operable Unit 8 (Shattuck) are currently carried out by the EPA. Shattuck is not included in this CIP Update, however it was addressed separately in a CIP Update that was completed by the EPA in April 2002.

1.1 Purpose

The purpose of the CIP Update is to provide appropriate opportunities for the community to learn about Denver Radium, to ensure the public appropriate opportunities for involvement in Denver Radium remedial decisions and to determine, based on community interviews and other relevant information, appropriate community involvement activities. This CIP identifies and documents community concerns and identifies community involvement activities used to encourage public involvement and two-way communication between CDPHE and interested community members regarding Denver Radium environmental remediation efforts. The public participation program will be implemented in cooperation with the EPA and the City and County of Denver (Denver).

1.2 Objectives of the CIP

The overall objectives of CDPHE's CIP Update are to:

- Ensure two-way communication between the community and CDPHE. Develop and maintain open communication between CDPHE, the EPA, and Denver, in addition to community leaders, environmental public interest groups, and any other interested or affected groups.
- Provide appropriate opportunities for the community to learn about Denver Radium and inform them about the environmental remediation actions at the various locations within the site. Encourage community involvement by conducting interactive activities and providing accurate, timely information about the clean-up activities and other important technical and administrative matters.
- Insure appropriate opportunities for public involvement and receive feedback from the community.
- Identify and monitor community concerns and information needs.

1.3 Relationship to Five-Year-Review

Mark Rudolph, Environmental Protection Specialist II, CDPHE, is the Project Manager for Denver Radium. He is currently conducting a five-year review according to procedures in OSWER Directive 93 5 5.7-02, Structure and Components of Five-Year Reviews (CDPHE, 1991); and OSWER Directive 9355.7-02A, Supplemental Five-Year Review Guidance (CDPHE, 1994a). This is consistent with the provisions of the Superfund Amendments and Reauthorization Act of 1986 (SARA); the Comprehensive Environmental Response Compensation and Liability Act (CERCLA) (42 USC 9601, et seq.); and the National Contingency Plan (NCP).

The five-year review will determine if the remedy is protective of human health and the environment. If any deficiencies are found during the review, the report will recommend corrections. In addition, Denver, with support from the EPA, is developing plans to remove contamination from beneath all of the city's streets, curbs, gutters, sidewalks, alleys and other rights-of-way (streets). CDPHE is updating this CIP to continue the communication process as the five-year review is conducted.

Many changes have taken place in the community since the last CIP was written. Denver Radium has undergone major clean-up activities; the demographics of the community have changed; ownership of properties within several of the Denver Radium locations has changed hands; and new businesses and residences have come to the area. This CIP Update will provide communication strategies to continue to inform and involve the community impacted by Denver Radium. The CDPHE Community Involvement Specialist serves as a public participation and communications advisor, ensuring effective communications with the community. Part of the community involvement process is to review and revise the existing CIP as necessary.

Section 2.0

Capsule Site Description

2.1 General Site History

In the early 1900s, several companies began mineral operations in Denver that included the processing of radium, uranium and vanadium. The industry died out in the 1920s and the locations of the processing sites and debris were forgotten.

In 1979, the EPA discovered the situation during review of old documents. CDPHE, with the help of numerous agencies, conducted several studies to locate the Denver area properties, including contaminated fill material under several Denver streets. Following the study, more than 65 contaminated properties throughout Denver were added to the Superfund National Priorities List (NPL) in September 1983 as the Denver Radium Superfund Site.

To facilitate the clean-up activities, Denver Radium was divided into 11 Operable Units (OUs). An Operable Unit is made up of contaminated sites with similar geographic

locations, industrial processes, and/or waste characteristics. A map of the City of Denver, visually indicating where each OU is located along with a chart of the site addresses by OU number can be found at Appendix A.

2.2 Environmental Concerns

Contaminants at Denver Radium include radium, thorium, uranium, arsenic, lead, cadmium, zinc and radon gas. Contaminant-impacted media includes soil, and where soil is in contact with groundwater, groundwater as well.

Because radium generates gamma and alpha radiation as well as radon gas, it is of greatest concern. Radon is only a risk if the gas is concentrated in buildings where people can be exposed for long periods of time. Long-term exposure to radon and radon-decay products in air increases chances of getting lung cancer. When exposures are high, noncancer diseases of the lungs may occur, such as thickening of certain lung tissues. Although radon is radioactive, it gives off little gamma radiation. Therefore, harmful health effects from external exposure when the chemical comes into direct contact with your body (dermal exposure) are not likely to occur. In addition, it is not known if radon causes health effects other than to the lung.

Although radium was the only contaminate addressed in the Record of Decision (ROD) and the Explanation of Significant Differences (ESD) for OU 7, the remedial activities taken for radium appropriately address the other contaminates as well. A listing of the ROD dates by OU number can be found at Appendix B.

2.3 Remedial Activities to Date

Remedial activities of all the contaminated locations is now complete, with the exception of Shattuck. Remedial activities usually included the removal of contaminated soil and debris to a permanent disposal site. At facilities and streets where waste was left in place, installation of ventilation systems to vent radon gas, and/or stabilization and capping in place prevented the contamination from finding an exposure pathway. Additionally, institutional controls (IC) set in place will protect future generations. Please refer to the five-year review for the exact locations where waste has been left in place.

To protect public health and the environment, Denver has taken responsibility to develop, implement and enforce a plan (i.e. Denver Radium Streets Management Plan) to ensure that all maintenance, repair or other construction activities conducted in OU 7 by local governmental agencies, utility companies, contracting companies and private individuals would be monitored and controlled. Through experience, Denver has learned that developing a plan for dealing with waste comprehensively over ten years is more protective of public health and more cost effective, than to try to manage it piecemeal over the next 100 years. This is especially true given that maintenance has been deferred on the streets and underground utilities for the past 20 years. Denver is currently taking measures to remove waste from the streets so that contaminated material is properly handled and disposed.

2.4 Brownfields

Two adjacent properties, the Robinson Brick Company* and the Denver & Rio Grande Railroad*, were redeveloped under the EPA's "Brownfields" program. This program seeks to clean up contaminated properties and make them economically viable. The properties are now a Home Depot store, bringing in tax dollars for the city as well as replacing an area eyesore.

Section 3.0 Community Background

3.1 Denver History and Economics

A party of prospectors established Denver on November 22, 1858, after a gold discovery at the confluence of Cherry Creek and the South Platte River. The town was named for James W. Denver, Governor of Kansas Territory, of which eastern Colorado was then a part. Other gold discoveries sparked a mass migration of some 100,000 in 1859-1860, leading the federal government to establish the Colorado Territory in 1861.

Denver built a network of railroads that made the town the banking, supply and processing center not only for Colorado, but for neighboring states. Between 1870 when the first railroads arrived and 1890, Denver grew from 4,759 to 106,713, becoming the second most populous city in the West, second only to San Francisco. Although founded as the main supply town for Rocky Mountain mining camps, Denver also emerged as a hub for high plains agriculture. Denver's breweries, bakeries, meat packing and other food-processing plants made it the regional agricultural center, as well as a manufacturing hub for farm and ranch equipment, barbed wire, windmills, seed, feed and harnesses.

The depression of 1893 ended Denver's first boom. Civic leaders began promoting economic diversity—growing wheat and sugar beets, manufacturing, tourism and service industries. Denver began growing again after 1900, but at a slower rate.

Regional or national headquarters of many oil and gas firms fueled much of Denver's post-World War II growth. By the 1970s, Denver's energy boom spurred a proliferation of suburban subdivisions, shopping malls, 40- and 50-story high-rise buildings, and a second office core in the suburban Denver Tech Center.

When the price of crude oil dropped from \$39 to \$9 a barrel in the 1980s, Denver sank into a depression, losing population and experiencing the highest office vacancy rate in the nation.

** Descriptions used in this document reflect the previous Denver Radium Site designation and does not necessarily indicate the current name or ownership of a property.*

Denver's economic base now includes skiing and tourism, electronics, computers, aviation and the nation's largest telecommunications center. Additionally, Denver has more federal employees than any city besides Washington, D. C.

3.2 Location and Climate

Located on high plains at the eastern base of the Rocky Mountains, Denver has a sunny, cool, dry climate, averaging 13 inches of precipitation a year. The sun shines 300 days a year, and warm Chinook winds break up the winters between snowstorms.

3.3 Cultural Facilities

Notable institutions include the Denver Museum of Nature and Science, the Denver Public Library, the Colorado History Museum, the Denver Art Museum and the Denver Center for the Performing Arts, as well as the U. S. Mint and major league baseball, basketball, football, hockey and soccer teams.

3.4 Population and Ethnicity

In 2000, the metro area reached a population of 2.1 million, three-fourths of who live in the suburban counties—Adams, Arapahoe, Boulder, Denver, Douglas and Jefferson. Core Denver also gained population in the 1990s for the first time since the 1970s, climbing once again beyond the 500,000 mark. Roughly 20 percent of the core city population is Spanish-surnamed, 13 percent African-American, two percent Asian and one percent Native American. Denver has elected Hispanic (Federico Peña), and African-American (Wellington Webb) mayors in recent years and has enjoyed relatively smooth race relations.

3.5 Technology

The high tech industry has seen dramatic growth over the last ten years in Colorado. As the birthplace of cable television and now as an expanding telecommunications center, Denver is known as a location of choice for high tech companies. There are 5,500 high technology businesses in Colorado. High technology exports comprise 61% of all exports from Colorado, the 4th highest concentration nationally.

3.6 Education

One of the Colorado's greatest resources is its highly educated workforce. The following citations show how Colorado and Denver rank nationally:

- Colorado has the largest share of graduates from four-year and advanced degree programs;
- Denver has the highest percentage of high school graduates for cities its size in the nation;
- Colorado ranks third for science and engineering graduate students nationally;

- Colorado has the 2nd highest concentration of research scientists and engineers in the U.S.; and
- Colorado has the largest share of workers with bachelor's degrees.

The Denver metro area contains rich and varied resources in higher education, including world class research institutions, graduate and professional schools, and a broad range of undergraduate programs.

3.7 Income

The median household effective buying income (income after taxes) in the Denver metro area of \$45,207 is 15.5 percent higher than the national average. Historically, the Denver metro area has had higher income than the nation, reflecting the high concentration of two income households in the area.

3.8 Community Concerns

The top community concerns cited by voters included: education 29 percent, growth 19 percent, traffic 12 percent and sprawl 8 percent.

Additionally, a recent growth poll conducted by The Denver Channel revealed the following:

- 61 percent want the federal government to lower immigration levels to reduce the environmental impact and development pressure on communities nationwide.
- 78 percent believe that current growth rates are overcrowding schools and threatening the quality of education.
- 82 percent believe that current growth rates are a serious threat to natural resources, national and state parks, rivers and open space.

Gun violence and crime, as well as air quality (smog), are among the other principal concerns for Denverites.

Section 4.0

Denver Radium Superfund Site

4.1 History of Community Involvement

The initial discovery of the Denver Radium properties in 1979 generated considerable media coverage and a correspondingly high level of public interest. CDPHE and the EPA received numerous inquiries about the locations of the contaminated properties and, in one case, received information from the public, which led to the identification of another location.

From 1980 through 1983, CDPHE entered an agreement with the EPA to carry out the technical investigations as well as the community involvement activities. According to CDPHE quarterly status reports, much of the community involvement efforts during the

early 1980s consisted of contact with the Denver Radium property owners to arrange access, help in coordinating private-party clean-up efforts, or inform owners of CDPHE activities and findings. A public meeting was held at the conclusion of the CDPHE investigation to report the findings and to explain the transition of the study effort from CDPHE to the EPA.

For the most part, public interest in Denver Radium has remained low, apart from involvement with the property owners. Occasional media attention and sporadic inquiry from interested parties characterize the level of public interest. An exception was the EPA's proposal to have a waste consolidation and storage facility at Operable Unit 10.

Community Involvement efforts have included the following:

- The EPA met with neighborhood associations and elected officials to keep them informed of site progress and when a Record of Decision for each OU was issued;
- A groundbreaking ceremony took place on May 2, 1988, when remediation began at the first Denver Radium locations (OU 4 and 5);
- In October 1988, the EPA held a media briefing following the detection of possible heavy-metal contamination at OUs 4 and 5;
- When the contract for the transportation and disposal of the waste was awarded to Chem-Nuclear Systems, Inc., a press release was issued. Prior to the beginning of the waste transportation, more than 60 elected city and county emergency responders were contacted to discuss the transportation issue. The EPA provided a transportation and disposal fact sheet;
- In March 1989, a Denver Radium Site Information Update was produced;
- When residents of Globeville, Swansea, and Elyria neighborhoods expressed alarm at the proposed Denver Radium staging area at 51st and York, Chem-Nuclear and the EPA met with elected officials and neighborhood representatives, and, responding to their concerns, decided against it;
- Copies of the Remedial Investigation/Feasibility Study (RI/FS) reports, Records of Decision, supplemental data, and fact sheets were placed in information repositories;
- News releases and display ads announcing public comment periods were placed in the *Denver Post* and the *Rocky Mountain News*; and
- Copies of news releases were distributed to those on Denver Radium mailing list.

4.2 Community Interviews

Four sets of community interviews were conducted – two sets concerning OU 3, and two sets concerning the entire Denver Radium Superfund Site, excluding Shattuck.

The first two sets of interviews covered OU 3. OU 3 consists of approximately 15 acres and encompasses several properties in the area of West Louisiana Avenue, South Jason Street and South Platte River. It is believed that a vacant lot, located at 1000 South Louisiana, may have been the site of a smelter that operated in the late 19th century. This smelter may have been turned into a radium-processing facility in the early 20th century.

The second two sets of interviews covered the entire Denver Radium Superfund Site, excluding Shattuck. John Student, Remedial Program Manager, and Ali Sogue, Environmental Scientist, both from Denver, were invited to participate in interview sets III and IV, however, they were unable to take part.

The four interview sets are as follows:

Set I

Area: OU 3

Interview Dates: March, April and May 2001

Profile of Interviewees: Denver, utility companies, and one business owner, who required a Mandarin Chinese translator.

Interviewers: One or more of the following individuals

- Erna Waterman, Environmental Engineer, EPA;
- Dr. Milton Lammering, Supervisory Environmental Scientist, EPA, now retired;
- Eleanor Dwight, Public Affairs Specialist, EPA, now retired;
- Mary Wu, Environmental Engineer, EPA;
- Bill Benerman, Environmental Scientist Supervisor, Denver; and
- Mark Rudolph, Environmental Protection Specialist II, CDPHE.

Set II

Area: OU III

Interview Dates: March, April and May 2001

Profile of Interviewees: Business owners whose properties are a part of Denver Radium.

Interviewers: One or more of the following individuals

- Erna Waterman, Environmental Engineer, EPA;
- Dr. Milton Lammering, Supervisory Environmental Scientist, EPA, now retired;
- Eleanor Dwight, Public Affairs Specialist, EPA, now retired;
- Bill Benerman, Environmental Scientist Supervisor, Denver; and
- Mark Rudolph, Environmental Protection Specialist II, CDPHE.

Set III

Area: All of the other Denver Radium Superfund Site area, excluding Shattuck.

Interview Dates: March 2003

Profile of Interviewees: A representative from the Sierra Club, an elected city official, and 11 randomly chosen individuals from residences and businesses in the Denver area.

Interviewers: One or more of the following individuals

- Rob Henneke, Public Affairs Specialist, EPA; and
- Beth Williams, Community Involvement Specialist, CDPHE

Set IV

Area: All of Denver Radium Superfund Site area, excluding Shattuck.

Interview Dates: March 2003

Profile of Interviewees: Business owners whose properties are a part of Denver Radium.

NOTE: In order to reach as many business owners as possible, two meetings were held to which all Denver Radium property owners were invited to attend. A site clean-up summary update was presented to each property owner who attended, and each attendee was interviewed. For those site property owners who did not attend, the clean-up summary update information and the interview questions were mailed to them, with a stamped, self-addressed envelope and the CDPHE's toll-free number. Property owners were invited to respond to the interview questions and/or ask additional questions. Ten property owners responded and were interviewed, either in person at one of the two meetings, through the mail or through the toll-free number.

Interviewers: One or more of the following individuals

- Rob Henneke, Public Affairs Specialist, EPA;
- Mark Rudolph, Environmental Protection Specialist II, CDPHE;
- Dan Scheppers, Superfund/VCRA Unit Leader, CDPHE; and
- Beth Williams, Community Involvement Specialist, CDPHE .

4.2.1 Key Community Concerns Set I

Questions were addressed to the municipality, the utility companies, and one business owner. A copy of the interview questions and answers can be found at Appendix C.

The municipality and the utility companies were all very knowledgeable about the site and the clean-up activities, however none of them were satisfied with the clean up. Their concerns included public and worker health and safety, as well as possible liability and the expense involved whenever work is performed in the contaminated streets. One individual expressed concern about the contamination spreading to the rights-of-way; and another stated he fears the contamination is more extensive than currently thought – thinking that it extends farther west on West Louisiana Avenue. Most of them advocated that the waste be removed. When asked about land use changes or disturbances to the buried waste, one person expressed concern that Capitol Hill and other areas have water mains that are more than 100 years old. Another said telecommunications boring sometimes enters a radium street. It was learned that they are all diligent in their safety practices, but “bootleg” contractors, or plumbers, who dug up the streets years ago, may not have been protected.

Nearly everyone desired information on the five-year review process, and everyone knows how to contact the EPA and/or CDPHE with questions or concerns. When asked if they desired follow-up meetings with other property owners, most were amenable to the idea, believing that the community should have the opportunity to attend informational meetings. One person stated that those who live on the OU 7 streets do not know about the contamination.

Most believed Jason Street and/or West Louisiana Avenue either needed to be cleaned up, or “down-graded”, so construction costs would not be so high. One person expressed concern about possible groundwater and soil contamination. It was suggested Denver and the EPA look at long-term issues.

The business owner, whose answers were translated, did not have an initial understanding of the site or the clean-up activities. He was unaware that his business property was a part of or very near Denver Radium, or that the cleanup left radioactive materials on site. He did not realize waste is still located under South Jason Street. During the interview process, he was provided site information, after which he said that he need not test for radon gas or review information about preventing radon exposure at his business location. He did not think the center of Jason Street and/or West Louisiana Avenue needed to have the waste removed. However, he requested more information about the clean-up remedy and where waste was left behind.

4.2.2 Key Community Concerns Set II

Questions were addressed to business owners whose properties are a part of Denver Radium. A copy of the interview questions and answers can be found at Appendix D.

All the site business property owners interviewed were satisfied with the cleanup and only one person had concerns that waste was left in place on Jason Street. None of them had undergone any land use changes, although two businesses expressed a desire for future building expansion.

Overall, the site business property owners knew whom to contact at the federal, state and city levels with questions or concerns, and only one person expressed a desire for information on the five-year review process. One person requested a copy of the report when it is finished, and no one felt the need for a follow-up meeting or a meeting with other property owners, although one person stated that if there were one, he would probably attend.

None of the site business property owners felt the center of Jason Street and/or West Louisiana should be cleaned up although one person asked if street contamination could affect the drinking water. When asked for additional comments, nearly half of the site business property owners interviewed expressed a desire to have the site deleted from the NPL.

4.2.3 Key Community Concerns Set III

Questions were addressed to a representative from the Sierra Club, an elected city official, and 11 randomly chosen individuals from residences and businesses in the Denver area. A copy of the interview questions and answers can be found at Appendix E.

Most of the interviewees had a limited knowledge of Denver Radium, with the lion's share of their knowledge stemming from the media attention given to Shattuck. A couple of people were very knowledgeable, and a couple had no knowledge at all. One person believed that citizen involvement was the driving force for governmental agencies getting involved in clean-up efforts.

About half the people interviewed had no concerns with the remedial efforts, but half expressed concerns about leaving waste in place, groundwater, and the clean-up efforts in general. One individual expressed distrust about the competence and the ethics of the state and federal governments.

All the interviewees said the community wants to know that their families, their property and their groundwater/drinking water is safe. They want to know where the contamination is located, how it has been cleaned up, and how their property values have been impacted. They also said the information should be translated into Spanish. Other languages mentioned were: Mandarin Chinese; Vietnamese; Ethiopian; and Russian. One individual brought up the fact that our elderly population is growing and suggested reading materials in large type.

Newspapers were cited as the most frequent source of information when they want to know about important community issues. Other sources included television, radio, the Internet, homeowners' associations, and newsletters. The majority of individuals knew whom to contact, or how to find out whom to contact at CDPHE or the EPA. Almost no one knew where an information repository is located.

The list of other people or groups they thought we should be talking to included the following: labor unions of workers digging in the contaminated areas (utility workers, street crews, etc.); schools; neighbor and homeowner associations; elected city and state officials; environmental groups; citizen groups; economic development groups; the Colfax Improvement Board; and the Stadium Area Task Force.

4.2.4 Key Community Concerns Set IV

Questions were addressed to business owners whose properties are a part of Denver Radium. A copy of the interview questions and answers can be found at Appendix F.

Denver Radium property owners who either attended one of the two informational meetings or responded to our interviews through the mail or telephone had a higher rate of knowledge of Denver Radium and its history. However, 20 percent did not have knowledge of the site or its background. Most of the property owners had no concerns about the remediation efforts on the site. Those who did express concern wished to know where the contamination is located, what the clean-up efforts have been to date, if they should be concerned about the radiation levels; and if street contamination cleanup would result in a disruption of their business. Two people expressed a desire for site closure (removal from the NPL).

One property owner had added a driveway to his property and one stated soil disturbances, including digging, foundations, and street and utility construction had taken place on his property. Only two individuals test for radon gas, and three requested information on radon exposure.

Seventy percent of the property owners interviewed believed they had a good understanding of the five-year review process. Approximately half of them knew whom to contact at CDPHE or the EPA, and 20 percent knew the location of an information repository.

4.3 Response to Community Concerns

4.3.1 Response to Community Concerns Set I

The municipality and the utility companies employ individuals who are at the most risk. These are the people rolling up their sleeves, cutting into contaminated streets and working there. The training is expensive. The personal protective equipment is expensive. The extra precautions, notifications and paperwork are expensive. All this is time consuming as well.

Although the EPA and CDPHE has determined that the street capping remedy is protective of public health and the environment, Denver has taken measures to remove waste from streets in OU 7 as street cuts and repairs have occurred. Additionally, Denver is currently proposing to completely remove contamination from streets at OUs 2, 3, 4, 7, and 8.

Denver has been managing the Denver Radium Streets (OU 7) informally since 1983 and more formally since 1990 under a management plan. Based on it's experience Denver has learned four major lessons that have prompted Denver to develop plans for the removal of waste from the public rights-of-way.

1. Long-term management of wastes that are widely scattered and not easily identifiable as hazardous is unlikely at best.
2. The prohibition or management of all street cuts is impossible, even in the short term.
3. Managing and disposing of waste on a piecemeal basis is expensive.
4. Streets cannot be maintained properly as long as radium waste exists within them. (e.g. rotomilling street surfaces, which is a standard practice used in the maintenance of streets, cannot be implemented because dust generated from the process could be dangerous to the health of the public and workers.)

The first two problems can directly affect public health; the third affects the amount of public money spent to address the remaining radium contamination; and the forth problem affects public health and quality of life.

CDPHE will work with Denver to disseminate timely and accurate information to the community prior to the contamination removal process. Additionally, community

meetings in the vicinities of street cleanup are recommended. CDPHE is willing to assist Denver in coordinating meetings as initial plans for clean up unfold.

4.3.2 Response to Community Concerns Set II

Site business owners in OU 3 are eager to see their locations deleted from the NPL. Knowledgeable about Denver Radium as a whole, and satisfied with the clean-up efforts, they are looking forward to the site closure, and closure on their property locations in particularly.

Denver will be requesting deleting of some streets from the NPL as they are cleaned up. Streets in the vicinity of 11th Avenue and Marion Street are scheduled for cleanup during 2003. A public notice of intent will be published in the two major Denver newspapers as well as in the Federal Register when various, cleaned locations are proposed for deletion from the NPL. Information supporting the proposed deletions will also be placed in the information repositories. A 30-day public comment period will be provided followed by CDPHE's response to the comments received. Affected property owners will receive written notification of the action proposals and final decisions.

4.3.3 Response to Community Concerns Set III

Responses from an environmental group, an elected city official and 11 randomly chosen individuals from residences and businesses in the Denver area proved very enlightening. Media attention concerning Denver Radium has been directed towards Shattuck for more than a decade. As a result, the community has limited knowledge of Denver Radium as a whole and what knowledge they do have is colored by the publicity at Shattuck.

A current Fact Sheet containing historic information on clean-up efforts could be a useful tool in boosting community confidence and eliminating negative perceptions. The Fact Sheet should also list Denver's website at www.denvergov.org/radium, which provides current updates as streets are cleaned up.

4.3.4 Response to Community Concerns Set IV

Most business owners whose properties are a part of Denver Radium had no concerns regarding the cleanup. Those who did express concerns desired to know where contamination is located, details on the clean-up efforts, and what, if any, health risks exists.

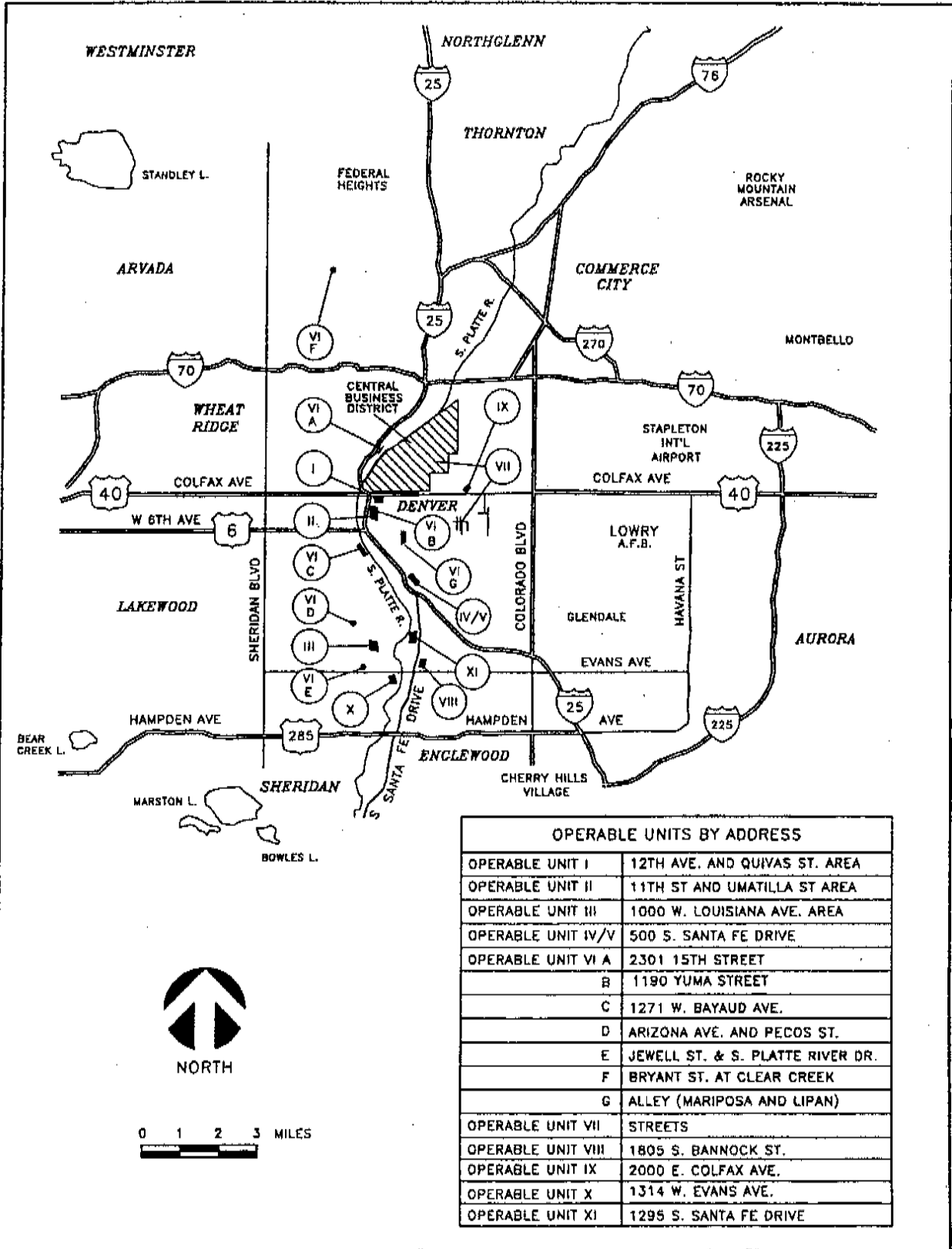
A major consideration for these business owners had to do with Denver's proposed contamination removal from the streets. They want to know how such efforts may affect their businesses. CDPHE recommends that Denver develop a question and answer sheet addressing such things as: clean-up process, timelines, traffic, dust, noise, publicity, etc. for the residences and businesses along the streets they will be cleaning up. Additionally, CDPHE will work closely with the municipality in coordinating any community meetings

they may desire to address these individuals, as they solicit their questions, comments, and concerns.

4.4 General Communication Needs

Each set of interviews reflected a unique set of needs and concerns. The following approaches address the community as a whole:

- **Provide the community with accurate and timely information.**
To keep the community apprised of current actions, CDPHE will disseminate timely and accurate information to those listed on the community mailing list and continue to maintain and update the information repositories. CDPHE will also send news articles to local newspapers as appropriate and will keep both printed and electronic media updated. Information may include findings from the five-year review, such as sampling and/or study results; information on any potential impacts to human health or the environment; and procedures on site closeout.
- **Enhance and maintain open communication between CDPHE, the EPA, Denver, and the community.**
Communication allows the community to stay informed as the environmental activities conclude. Public outreach and feedback also allow CDPHE, the EPA, and Denver to understand the community's perspective on issues and to become more aware of the community's concerns and needs.
- **Identify and respond to community concerns and needs.**
During the five-year review process, CDPHE has performed community interviews that have identified and documented community concerns and targeted community involvement activities to encourage public involvement and two-way communication with interested community members. The CIP Update will be implemented in cooperation with the EPA and the City and County of Denver.
- **Provide for effective management of the CIP.**
The CIP Update is a "living document" and is implemented upon coordination and approval by regulatory agencies. It assures that the program continues through site closeout. This document will be revised according to CERCLA guidance when there has been a significant change in Denver Radium.



OPERABLE UNITS BY ADDRESS	
OPERABLE UNIT I	12TH AVE. AND QUIVAS ST. AREA
OPERABLE UNIT II	11TH ST AND UMATILLA ST AREA
OPERABLE UNIT III	1000 W. LOUISIANA AVE. AREA
OPERABLE UNIT IV/V	500 S. SANTA FE DRIVE
OPERABLE UNIT VI A	2301 15TH STREET
B	1190 YUMA STREET
C	1271 W. BAYAUD AVE.
D	ARIZONA AVE. AND PECOS ST.
E	JEWELL ST. & S. PLATTE RIVER DR.
F	BRYANT ST. AT CLEAR CREEK
G	ALLEY (MARIPOSA AND LIPAN)
OPERABLE UNIT VII	STREETS
OPERABLE UNIT VIII	1805 S. BANNOCK ST.
OPERABLE UNIT IX	2000 E. COLFAX AVE.
OPERABLE UNIT X	1314 W. EVANS AVE.
OPERABLE UNIT XI	1295 S. SANTA FE DRIVE

APPENDIX - A DENVER RADIUM SITE

Appendix B

Records of Decision (RODS)

March 1986	Record of Decision	OU 7
September 1986	Record of Decision	OUs 4 and 5
June 1987	Record of Decision	OU 10
September 1987	Record of Decision	OU 1
September 1987	Record of Decision	OU 3
September 1987	Record of Decision	OU 4, 9 & 11
September 1987	Record of Decision	OU 2 (11 th & Umatilla)
December 1991	Record of Decision	OU 9 (ROBCO-metals)
January 1992	Record of Decision	OU 8

The EPA and the State of Colorado entered into a State Superfund Contract (SSC) for remedial implementation at Denver Radium on May 1, 1988.

Appendix C – Set I

Date of Questions: March, April, and May 2001.

Focus of Questions: Operable Unit 3

Make-up of Interviewees: Interviewees included representatives from Excel Energy, Metro Wastewater Reclamation District, Denver, Denver Water, and one individual who owns business property in or near the OU 3 area.

Make-up of Interviewers: The March, April, May 2001 interviews were conducted by one or more of the following persons: Erna Waterman, Environmental Engineer, EPA; Dr. Milton Lammering, Supervisory Environmental Scientist, EPA; Eleanor Dwight, Public Affairs Specialist, EPA; Mary Wu, Environmental Engineer, EPA; Bill Benerman, Environmental Scientist Supervisor, Denver; and Mark Rudolph, Environmental Protection Specialist II, CDPHE.

Q. Are you aware that this property was part of or is very near to part of Denver Radium?

1. Yes, in particular South Jason Street because of the work that Metro Wastewater has done in that area.
2. Yes.
3. Yes, at least the utilities at three Operable Units.
4. Yes.
5. Yes, I know there are many Denver Radium sites. We were educated on OU 3 South Jason Street/West Louisiana Avenue with the hoops we had to jump through on the sewer replacement last year.
6. No, and no one told me.

Q. Are you aware that the cleanup left radioactive materials onsite and that waste is still located under South Jason Street?

1. Yes, Bob knows more specifically, where the waste is located.
2. Yes.
3. Absolutely. We have the location of waste left in place on GIS maps, which we use for our work. Work crews pull service area maps to show where there is material left in place.
4. Yes.
5. Yes. We couldn't do the work without making adjustments.
6. No, not aware of that.

Q. What else do you know about Denver Radium?

1. We know the city treats the streets differently than the EPA or the state. We pay additional money for permits and we are required to haul off all materials under city ordinance requirements.
2. Very familiar with the site and knows the history.

3. We have pertinent documentation but we may not have the most current documentation.
4. Very familiar with the site both in current role working with environmental compliance, and in this job position.
5. We hired HDR consultants to help us get the work done for a 600+ -foot sewer pipe replacement on West Louisiana Avenue so we learned a lot by that effort. We had a soils management plan on what to do before and during the work in the street. We redesigned our plan to make it a tunnel rather than a trench, to go deeper than the possible contamination. We tunneled about 10-12 feet below the surface. In addition to these costs, we had to pay to store the soil excavated offsite at CSI for about 30K more, due to public concern over the material. All 1100 yards were essentially clean except one small bucket, but we paid the price to have it all taken at CSI.
6. Yes, I know some about the Denver Radium Site and the Superfund program.

Q. Are you satisfied with the cleanup that was completed several years ago?

1. No, we are not satisfied as it directly impacts our operations. It would be better if it were removed from the areas where the utilities are located.
2. No, we are not satisfied. The current status of cleanup makes extra work for the staff. In addition, contractor costs are nearly triple when working in radium-contaminated streets. This department prioritizes the work they do. Generally, emergency work comes first. However, because of the radium in the streets we may have work there first, even though it is not as great as an emergency as say a cave-in. It requires additional staff to stay at the site the entire time work is being done on these streets, which sometimes can be 12 hours. This is a big imposition on our staff's time. Whereas, when working in other street work, oversight staff just check in and then can leave. City streets and utilities are in a continual state of degradation so they are opened up often. They have a few people, particularly in residential areas, who do road cuts without proper permits. Public works staff is hazardous materials (OSHA) trained. They use protective clothing when working on radium streets. In addition, we perform gamma radiation monitoring to be protective. We have found some low levels of radiation (in these streets) when dosimeter readings are being monitored.
3. No, it is burdensome to manage work crews working in these areas. It requires additional training, a longer amount of time to do the work, and it has caused problems. It would be better if the material wasn't there and it was clean.
4. No, not satisfied. I have some concerns for the public health, for citizens and city workers, and also as the site relates to liability for the city which are:
 - Public health concerns;
 - The management of OU 7 is meant to monitor street cuts, to protect city employees and residences - but there is no comparable plan in place for other OUs;
 - Street cuts are done illegally;
 - Training for workers is costly, there are enforcement costs, costs for disposing contaminated material workers remove from those streets which do have institutional controls in place;

- At the OUs without institutional controls in place, there is a daily potential to get into the rights-of-way;
 - Individuals and workers are put at risk;
 - The city is incurring the liability and the costs for disposal and training.
5. It didn't help us any. It was a very expensive project.
 6. From what I have been told I think the problem has been taken care of.

Q. Have you had any concerns about the cleanup since it was completed?

1. We are not sure of the full extent of the OU 3 contamination and fear it extends more on West Louisiana Avenue as well. We can't absorb the additional costs of working in these areas. The costs are passed on to our customers.
2. Referred to previous answer, which was: No, we are not satisfied. The current status of cleanup makes extra work for the staff. In addition, contractor costs are nearly triple when working in radium-contaminated streets. This department prioritizes the work they do. Generally, emergency work comes first. However, because of the radium in the streets we may have work there first, even though it is not as great as an emergency as say a cave-in. It requires additional staff to stay at the site the entire time that work is being done on these streets, which sometimes can be 12 hours. This is a big imposition on our staff's time. Whereas, when working in other street work, oversight staff just check in and then can leave. City streets and utilities are in a continual state of degradation so they are opened up often. They have a few people, particularly in residential areas, who do road cuts without proper permits. Public works staff is hazardous materials (OSHA) trained. They use protective clothing when working on radium streets. In addition, we perform gamma radiation monitoring to be protective. We have found some low levels of radiation (in these streets) when dosimeter readings are being monitored.
3. Yes. We paid a lot of money to dispose of this material. We paid between \$120,000 – \$130,000 to ship this material to the Envirocare facility in Utah, which was not a planned expenditure.
4. Refer to past answer, which was: No, not satisfied. I have some concerns for the public health, for citizens, and city workers and also as the site relates to liability for the City which are:
 - Public health concerns;
 - The management of OU 7 is meant to monitor street cuts, to protect city employees and residences - but there is no comparable plan in place for other OUs;
 - Street cuts are done illegally;
 - Training for workers is costly, there are enforcement costs, costs for disposing contaminated material workers remove from those streets which do have institutional controls in place;
 - At the OUs without ICs in place, there is a daily potential to get into the right-of-way;
 - Individuals and workers are put at risk;
 - The city is incurring the liability and the costs for disposal and training.
5. No.

6. I do not want any kind of threat to my company.

Q. Do you have any information about land-use changes that we may need to know?

1. No.
2. Work on the Botanic Gardens – 11th Avenue. Work coming up on the OU 7. The telecommunications growth has brought a great increase in directional boring. However, sometimes the drilling has been misdirected and the boring has entered a radium street.
3. Nothing we are initiating. We will work with the city on the Bannock Street plan and we have talked to the city about 11th and Marion Street. The Capitol Hill area mains are generally over 100 years old and should be replaced. We are concerned about these and other areas as well.
4. None in particular. A lot of development is going on, which causes constant monitoring.
5. No.
6. No.

Q. Do you have any information about disturbances of the buried waste, such as construction crews working in the street, or workers digging to repair utilities that we need to know?

1. Don't think so, no.
2. Licensed contractors are aware of the Denver Radium site but there were a few "bootlegs". Most work is done under permit.
3. I certainly hope not, but I have heard stories about plumbers digging up parts of the street, but that was before I started. I have been here for 7 ½ years now and haven't heard of this type of problem since I started.
4. On South Jason Street where lots of work has taken place, Metro Wastewater has borne the burden of work there. Were there groundwater issues? The street has already created problems in this short period of time. I wonder what it will be like over the much longer term.
5. No. It would not surprise me if there were activity with others who may not be as diligent as we were in this work.
6. Only that Metro Wastewater had plans for a sewer replacement.

Q. Do you test for radon on your property?

1. No
2. Yes.
3. No, it has not been a concern to us.
4. Yes, there is a test they use.
5. No.
6. No, since the waste was removed I am confident it is okay.

Q. Would you like information about preventing radon exposure?

1. No.
2. No.
3. No
4. No. (They have good information on this.)
5. No.
6. I do not think the department of health needs to inspect my property to see that it's safe.

Q. Do you need any information about the remedy or the five-year review process?

1. I didn't know anything about the five-year review process. Yes, I would like information about it.
2. Yes.
3. Yes. We would like a copy of the report.
4. No, I'm familiar with it.
5. Would like a copy of the final report.
6. Yes, I would like information about the clean-up remedy and where the waste was left behind.

Q. Do you know how to contact the EPA, state or city regarding any questions on this process?

1. We do now, yes.
2. Yes.
3. Now I do, yes.
4. Yes.
5. Yes.
6. I have . . . phone numbers now.

Q. Would you like a follow-up meeting with property owners that are a part of this local (Operable Unit 3) remedy?

1. If there were one, we would like to know about it.
2. Homeowners need more information. Those who live on OU 7 are not aware of the contamination in the streets.
3. If there were one, we would participate. We don't need one just for us.
4. I always like to give people the opportunity and then they can decide to come if they want.
5. No.
6. No.

Q. Do you think the center of Jason Street and/or West Louisiana Avenue needs to be cleaned up?

1. Yes. If the City of Denver persists with requiring that all the material be hauled off. If not, like what the state and EPA accept, then it puts matters back where it is more reasonable to deal with – cost wise.
2. Yes. There is a potential for groundwater contamination and a possible growing plume. There is a concern about the radioactivity of the soils.
3. Absolutely. And in other areas as well.
4. No, institutional controls are in place. There would be a problem of who pays, etc.
5. Yes, but it would be better if it were “downgraded” so that it was not so expensive to go through what we went through. It may be that the best use of taxpayer’s money is to go after it, but it is not working well. Somebody needs to make guidelines for the utilities to know the process and how to better deal with the problem, as it is painful to figure it out on your own. We need to put a 42-inch sewer in South Jason Street in the next 20 years, and we really don’t want to go through those hoops again.
6. If there is no public health risk, then leave it in place.

Q. Do you have any other comments?

1. The waste was not ours. The current permitting process is too much. Why can’t we use road base and compact as usual? The current city requirements cost three times as much money to do the same job.
2. The EPA needs to look at long-term issues. The city bears responsibility, too.
3. The addition to the building at the Denver Botanical Gardens required installing additional fire hydrants, which delayed the opening of the building. In addition, the cost to install the hydrants was more due to the problem of waste in the streets. This was complex to resolve. The hydrants are now in place but this area still needs to be cleaned up.
4. No.
5. The consultants were a big help. Having guidelines for the process would be a help.
6. No.

Appendix D – Set II

Date of Questions: March, April, and May 2001.

Focus of Questions: Operable Unit 3

Make-up of Interviewees: Interviewees included several individuals who own business property in or near the OU 3 area.

Make-up of Interviewers: The March, April, May 2001 interviews were conducted by one or more of the following persons: Erna Waterman, Environmental Engineer, EPA; Dr. Milton Lammering, Supervisory Environmental Scientist, EPA; Eleanor Dwight, Public Affairs Specialist, EPA; Bill Benerman, Environmental Scientist Supervisor, Denver; and Mark Rudolph, Environmental Protection Specialist II, CDPHE.

Q. Are you satisfied with the cleanup that was completed several years ago?

1. Yes. They tested my property and didn't find anything.
2. Yes. I don't have a way to know otherwise, so I assume it was done properly.
3. Yes. I remember when EPA drilled holes under my buildings to see if there was contamination and there wasn't. They tested indoor radon and didn't find a problem. They did find contamination in the parking lot in front, adjacent to Jason Street. It was cleaned up and reconstructed as needed.
4. Yes.
5. Yes.
6. Yes. If there were any questions about the work done, it was taken care of.
7. It was okay. They did some averaging and left some contamination in place at the south end of the property.

Q. Have you had any concerns about the cleanup since it was completed?

1. No.
2. Jason Street. It did not make sense that the street wasn't cleaned up at the same time the other properties were.
3. No.
4. No.
5. We are unaware of any concerns and safety is the number one concern of our manufacturing work.
6. Not really.
7. No.

Q. Do you have any information about land use changes that we may need to know?

1. No.
2. No.
3. No.
4. No.
5. We may be replacing the boiler in the future. We are talking about expanding the building to the south. There is a cut in the concrete in the production area to test for support for a stronger foundation for a piece of equipment we are installing. (Dr. Richard Graham, EPA, looked over the situation and concluded that the EPA does not need to test the open area. He explained how the boiler could be replaced without disturbing the concrete floor. Additionally, it was determined that the foundation of the building to the south would be above where there was contamination left in place below the water table.)
6. We would like to expand and build another building later.
7. There are new buildings in the neighborhood.

Q. Do you need any information about the remedy or the five-year review process?

1. No.
2. No.
3. No. Not unless there is something new.
4. No.
5. Why is it needed? (This was explained during the interview.)
6. We would like a copy of the report.
7. No.

Q. Do you know how to contact the EPA, state or city regarding any questions on this process?

1. Yes.
2. Yes, knows whom now.
3. Yes. (Then he told us the contact names and numbers.)
4. Yes.
5. Yes. I do now.
6. Yes. I do now.
7. Yes.

Q. Would you like a follow-up meeting with property owners that are a part of this local (Operable Unit 3) remedy?

1. No, I'm usually busy.
2. Not really.
3. No.
4. I can't see a reason for that.
5. No. If there were one, we would attend.
6. If there were one, we would probably attend.
7. Probably not.

Q. Do you think the center of Jason Street and/or West Louisiana Avenue needs to be cleaned up?

1. I don't think it is necessary.
2. I don't think you could justify it. Is it bad now? The traffic on Jason Street is heavy and there is no parking – less parking now that the big building went in across the street.
3. No.
4. The biggest risk on that street is car accidents. I don't think it needs to be cleaned up. Why waste the taxpayer's money on it?
5. Cleanup of the street would be a disruption to our business and we are very busy right now. We are in the consolidation process, absorbing the Salt Lake City plant's work. Contamination is not a problem in the street. Jason Street is heavily used.
6. Is there any way the contamination from the street would get into the water supply we drink?
7. As long as it is capped with asphalt, it is okay. I know the state has naturally high radiation. If there is no public health risk, then leave it in place.

Q. Do you have any other comments?

1. No.
2. The property on this side of Jason Street was residential when radium work was being done. There is a lot of history in this area.
3. If possible, I would like my property not to have future five-year reviews unless they are needed. I would like my property deleted from the NPL, as it is clean.
4. I am surprised that you (EPA) need to do this. I don't really see a purpose of this review. What purpose is there to keep this property on the NPL? It should be taken off, as it was cleaned up.
5. No.
6. No.
7. I'd like to see the property deleted from the NPL now.

Appendix E – Set III

Date of Questions: March 2003

Focus of Questions: All of Denver Radium, except Shattuck.

Make-up of Interviewees: The interviewees included a representative from the Sierra Club, an elected city official, and 11 randomly chosen individuals from residences and businesses in the Denver area.

Make-up of Interviewers: Rob Henneke, Public Affairs Specialist, EPA; and Beth Williams, Community Involvement Specialist, CDPHE conducted the March 2003 interviews.

Q. What is your understanding of the history and cleanup concerning Denver Radium?

1. I did not know before our meeting. I only had some information about Shattuck.
2. I had limited knowledge, except for the Shattuck site.
3. Shattuck was the only site I was aware of. I didn't know Denver Radium consisted of anything more than Shattuck.
4. I was aware there are several sites and that they are being cleaned up.
5. Shattuck was the only site I was aware of. I didn't know, until our meeting here today, the vastness of the area involved. I have been aware of the Shattuck site clean-up efforts, but no other sites or clean-up efforts.
6. I am very knowledgeable. Processing in the 1920s produced tailings that were used in the city and in residential areas. They are radioactive soils. When it was discovered, clean-up efforts began.
7. I know there are a number of locations. Shattuck and Denver streets will remove the waste. Other sites are monitored and reviewed every five years.
8. I don't know much detail. I know the contaminated sites were identified and there has been clean-up activities at the sites.
9. I didn't know much about Denver Radium until your visit.
10. I know that because of citizen involvement, the government is paying more attention to the site. The EPA Ombudsman was important and essential to the Shattuck site.
11. I know nothing about any of this.
12. I remember when you first found "hot" streets in Denver. I was involved in the development of the Home Depot and I know the extent they went to control it.
13. Zero knowledge.

Q. What, if any, are your concerns or issues with the remedial efforts that have been conducted to date?

1. I have no concerns.
2. We need to do more in communicating to the community about the sites and the ramifications.
3. I have no issues because I only work in Denver. I don't live in Denver.
4. My only issue is that waste has been left in place. If businesses "screwed up" the environment, we need to clean it up.
5. I'm pleased there is a five-year review. I would have concerns, but I assume EPA and CDPHE and Denver City are addressing the issues and receiving public input – not using a "band-aide" approach. I'm happy cleanup is being done properly.
6. I'm concerned about how good of a job was done. Was the clean up appropriate? Like Shattuck, will we discover the remedy was not appropriate?
7. I'm mostly concerned that the sites are along the Platte River.
8. I have no concerns.
9. I have no concerns.
10. Ground water issues are not being addressed. Paving or capping is not a good remedy. What about our drinking water? Ground water issues are not being addressed. I do not feel the EPA or CDPHE know what they're doing. I feel uncomfortable and unsafe. The state has indicated they will not do the right thing without pressure.
11. No concerns.
12. None.
13. Who is paying for this cleanup?

Q. What do you think the community wants to know?

1. Are there any immediate health risks and how can we avoid them? Who is at risk?
2. What are the ramifications to people's gardens, yards, drinking water, etc?
3. Are people safe if they live or work in Denver?
4. Where are the sites? What are you doing to monitor the sites? What are the risks involved?
5. People want to know their health and their property are safe. They want to know their property values are all right.
6. Where are the locations? Is it (the waste) being handled properly? Are environmental groups also provided with the information? The environmental groups can let the community know if there are issues.
7. The community has a very limited knowledge. They only have the information that they read in the newspapers. They need good information. No information is better than misinformation.
8. Where are the sites? Are we affected by these sites? New neighbors need history and information.
9. I will bring this summary to my community and I will let you know if they ask for more information.

10. The community wants the truth. All of the truth. What is the groundwater contamination and what are you doing about it? Have you checked the river? The riverbed? Have boreholes been dug? Have you checked for radioactive plumes contaminating the groundwater that feeds to the river? All of this can contaminate the river, which supplies Denver Water, which is our drinking water.
11. If the media brought the site to the public, there would be some initial concern, but it would all die down.
12. The community wants to clearly understand that there are no health issues. It appears poor neighborhoods are not told in a timely manner if there are health risks. If there are health risks, the community needs to know how to deal with them.
13. Is the community currently exposed to health risks? If so, how much of a hazard is it and how much exposure does it take to cause a health problem?

Q. Do you think there is a need for a translation of information in a language other than English?

1. Spanish and Mandarin Chinese.
2. Vietnamese, Ethiopian, and Russian.
3. Spanish, Mandarin Chinese, and large print for the growing senior population.
4. Find out who speaks what languages and translate it. Everyone has the right to know.
5. Spanish.
6. Spanish. Environmental justice issues show that environmental problems occur more frequently in low-income, minority neighborhoods.
7. Spanish.
8. There is no need for translations.
9. No. People who live in the United States need to learn to speak, read and write in English.
10. Spanish.
11. Spanish.
12. Spanish and Vietnamese.
13. No, do not translate the information.

Q. Where do you go for information about important community issues?

1. Radio and the Internet.
2. TV and newspapers.
3. The Internet and neighborhood associations.
4. Newspapers, radio, TV and the Internet.
5. Newspapers first - both the Post and the Rocky Mountain News. Neighborhood associations are best for a question and answer format.
6. Newspapers and National Public Radio.
7. The Internet (the Mayor's web site) and neighborhood association quarterly meetings.
8. Local newspapers like the Washington Park Profile or the Cherry Creek News.
9. Newspapers and the radio.
10. Both newspapers, TV and the Internet.

11. Newspapers, TV and the Internet.
12. The Denver Post newspaper and Radio.
13. Newspapers and the Internet.

Q. Whom at the Colorado Department of Public Health and Environment and the US Environmental Protection Agency would you contact if you had any questions?

1. I'd call you.
2. First I'd call the city, then the state health department.
3. I don't know. I would go to the Internet.
4. I didn't know until I met you.
5. I would look up EPA in the phonebook.
6. I would check the phonebook for the EPA's number.
7. I would look up state and EPA web sites.
8. I would start with Denver City and County – then I might call the state.
9. You.
10. I would call the technical people at EPA and the state. And, I would call the old Ombudsman for the Shattuck site.
11. I have no idea whom to contact.
12. I would call the EPA main number and ask for the project manager.
13. I would look up CDPHE in the phone book.

Q. Is there any one else we should be talking to?

1. Utility work unions and schools.
2. Denver neighborhood inspection services in solid waste.
3. Some of my neighbors.
4. As many people as you possibly can from all over the city.
5. Elected city officials.
6. Elected city officials and environmental groups - especially the Sierra Club.
7. Sloan Lake Citizen Group.
8. Talk to no one. This is not a topic of conversation.
9. Community groups and the Colfax Improvement District Board.
10. Elected state and city officials, the city planner, sports teams, homeowner associations, and the director of the parks.
11. If people are not in harm's way, they don't care.
12. Neighborhood groups, economic development groups, elementary school principals, Denver City Council Taskforce.
13. No one.

Q. Where is Denver Radium information Repository located?

1. I don't know.
2. I'm not aware of one.
3. I don't know.
4. I don't know.
5. Unknown.
6. Denver Library.
7. I don't know.

8. CDPHE
9. Unknown.
10. Not aware.
11. I have no idea.
12. I don't know.
13. I have no idea.

Appendix F –Set IV

Date of Questions: March 2003

Focus of Questions: All of Denver Radium, except Shattuck.

Make-up of Interviewees: Two meetings were held in which all Denver Radium property owners were invited to attend. A site clean-up summary update was presented to each property owner who attended, and each attendee was interviewed. For those site property owners who did not attend, the clean-up summary update information and the interview questions were mailed to them, with a stamped, self-addressed envelope and CDPHE's toll-free number. Property owners were invited to respond to the interview questions and/or ask additional questions. Ten property owners responded and were interviewed, either in person at one of the two meetings, or through the mail or the toll-free number.

Make-up of Interviewers: Rob Henneke, Public Affairs Specialist, EPA; and Beth Williams, Community Involvement Specialist, CDPHE conducted the March 2003 interviews. Additionally, Dan Scheppers, Program Manager, CDPHE attended the two special meetings.

Q. Are you aware that your property was a part of or very near to Denver Radium? And, if so, what is your understanding of the history and remedial efforts concerning Denver Radium?

1. Yes, I am aware. We were the first group CDPHE worked with. Our site was one of the first remediated.
2. I inherited the property and I was not aware it was a part of Denver Radium.
3. The effort was made to cleanup several sites and help land owners to rebuild the business they affected.
4. Yes, I was aware of the cleanup but I didn't realize the extent of the cleanup until after reading your document this month.
5. I was not aware of this until I was just notified by mail!
6. Yes, my site was cleaned up a number of years ago.
7. Yes, I have a complete understanding.
8. Yes. The full update was received in the meeting on the site about the potential cleanup in the next seven years.
9. Yes. My site was remediated in the 1990s.
10. Yes, and it was remediated in the '90s.

Q. What, if any, are your concerns or issues with the remedial efforts that have been conducted to date?

1. I am very happy. I am 100 percent satisfied with the remediation.
2. None. My business site seems to be just fine.
3. No concerns.
4. I would like to have a current clearance letter about the status of the property.
5. Primarily the progress being made; the central location of the efforts; health inspections; and the levels I should be concerned about.
6. None.
7. Removal of fill under streets.
8. When clean-up disruption (potential) of businesses will occur and for how long.
9. Yes, streets need to be cleaned up.
10. I want closure by removal of the property from the Superfund list.

Q. What is your understanding of Denver Radium five-year review process?

1. I was told at the time there would be a review of the remedies every five years.
2. The five-year review is a check-up to make sure everything is still all right.
3. It is to keep tabs on the areas involved and send any updates to owners of the properties.
4. I'm not clear what the review includes.
5. It is your effort to remove and control radium contaminated soil at specific sites.
6. I have no idea.
7. I have spoken to CDPHE and the EPA and I understand the five-year review.
8. It is re-evaluation of any further movement and/or penetration or issues affecting the properties.
9. It is a review after the cleanup has ended.
10. It is a part of the federal procedure.

Have there been any land use changes we may need to know?

1. No.
2. No.
3. Not on my site.
4. None.
5. No, none that I am aware of.
6. No.
7. No.
8. N/A
9. Yes. We built a drive-thru coffee shop.
10. No

What soil disturbances (digging, foundations, street or utility construction crews, etc.) have occurred on the property?

1. None
2. None.
3. None
4. None
5. None in the past 11 years.
6. All of the above, plus floors.
7. I'm not concerned about individual properties. I'm concerned about utilities in the street.
8. Not in the past 15 years. The only change was the internet/business system lines.
9. After the property was remediated we improved the property.
10. Only after remediation.

Do you test for radon gas on your property? Would you like information about preventing radon exposure?

1. Yes. Tests indicate I don't have a problem, but I would like information on radon anyway.
2. No, I don't test. Yes, I want information.
3. We do not test and we don't need information.
4. No and No.
5. Yes to both questions.
6. No and No.
7. No and No.
8. We do not test and we already have information from EPA.
9. No and No.
10. No. We have no basements or crawlspaces.

Whom at the Colorado Department of Public Health and Environment and the US Environmental Protection Agency would you contact if you had any questions?

1. I would go find out whom to talk to on the web.
2. I would call CDPHE from the phone number on the letterhead.
3. Unknown.
4. I would look in the phone book.
5. Beth Williams from the interview team.
6. I have no idea.
7. Mark Rudolph at the health department.
8. Mark Rudolph.
9. Beth Williams in the hazardous waste division.
10. Beth Williams or an equivalent authority.

Is there anyone else you think we should be talking to?

1. No.
2. No. You are the experts. Just stay balanced in your approach.
3. Not at this time.
4. None that I know of.
5. All property owners should be updated on your progress.
6. No one.
7. No.
8. Not at this time.
9. No one.
10. No one. It's not necessary.

Where is Denver Radium information repository is located?

1. At Uravan
2. In all the libraries.
3. I don't know.
4. Unknown.
5. I don't know.
6. CDPHE
7. I'm not sure.
8. CDPHE, EPA, and the City
9. Somewhere on the Western Slope.
10. I don't know.

Appendix G

State and Federal Government Contacts

Colorado Department of Public Health and Environment Contacts

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Denver, CO 80246-1530
Phone: 303-692-3308
Toll Free: 1-888-569-1831 ext: 3308
Fax: 303-759-5355
bethann.williams@state.co.us

U.S. Environment Protection Agency Contacts

Rebecca Thomas, Environmental Engineer
US EPA Region 8
999 18th Street, Suite 300
MC: 8EPR-SR
Denver, CO 80202-2466
Phone: 303-312-6552
Fax: 303-312-6897
thomas.rebecca@epa.gov

Rob Henneke, Public Affairs Specialist
US EPA Region 8
999 18th Street, Suite 300
MC: 8OC
Denver, CO 80202-2466
Phone: 303-312-6734
Fax: 303-312-6961
henneke.rob@epa.gov

Appendix H

Denver City and County Contacts

John D. Student, Remedial Program Manager
201 West Colfax Avenue
Department 1009
Denver, CO 80202
Phone: 720-865-5432
Fax: 720-865-5534
e-mail: john.student@ci.denver.co.us
www.denvergov.org

Mayor
John W. Hinkenlooper
1437 Bannock Street
Suite 350
Denver, Colorado 80202
Phone: (720) 865-9000
Fax: (720) 865-8791
mayorden@ci.denver.co.us

Council Members having an Operable Unit of the Denver Radium Superfund Site

District 3

Rosemary E. Rodriguez
69 Knox Court
Denver, Colorado 80219
Phone: (303) 922-7755
Fax: (303) 937-4651
rosemary.rodriguez@ci.denver.co.us

District 7

Kathleen MacKenzie
1437 Bannock Street, Suite 432
Denver, Colorado 80202
Phone: (720) 865-8900
Fax: (720) 865-8903
kathleen.mackenzie@ci.denver.co.us

District 8

Elbra Wedgeworth
3280 Downing St., Unit C
Denver, Colorado 80205
Phone: (303) 298.7641
Fax: (303) 298.9716
elbra.wedgeworth@ci.denver.co.us

District 9

Judy H. Montero

2828 Speer Blvd., Suite 111

Denver, Colorado 80211

Phone: (303) 458-8960

Fax: (303) 458-4789

judy.montero@ci.denver.co.us

District 10

Jeanne Robb

1232 East Colfax Avenue

Denver, Colorado 80218

Phone: (303) 377-1807

Fax: (303) 377-1902

jeanne.robb@ci.denver.co.us

Appendix I

Environmental Citizen Groups

The Aspen Center for Environmental Studies
100 Puppy Smith Road
Aspen, CO 81611
Phone: 970-925-5756

The Center for Resource Management
1410 Grant Street, Suite C-307
Denver, CO 80203
Phone: 303-832-6855

Clean Water Action
899 Logan, Suite 101
Denver, CO 80203
Phone: 303-839-9866

Coloradoans for Clean Air
1985 Grape Street
Denver, CO 80220
Phone: 303-388-4858

Concurrent Technologies Corporation
999 18th Street, Suite 2750
Denver, CO 80202
Phone: 303-297-0180

Colorado Environmental Coalition
1536 Wynkoop, Suite 5-C
Denver, CO 80202
Phone: 303-534-7066

Colorado Mountain Club
710 10th Street
Golden, CO 80401
Phone: 303-279-3080

Colorado Open Lands
274 Union Blvd
Lakewood, CO 80228
Phone: 303-988-2373

Colorado Parks and Recreation Association
Post Office Box 1037
Wheatridge, CO 80034
Phone: 303-231-0943

Colorado Pesticide Network
Post Office Box 6108
Denver, CO 80202
Phone: Unavailable

Colorado Public Interest Research Group
1530 Blake Street
Denver, CO 80202
Phone: 303-573-7474

Colorado Trout Unlimited
7200 Dry Creek Drive, Suite G-201
Englewood, CO 80228
Phone: Unavailable

Colorado Wildlife Federation
445 Union Blvd, Suite 302
Lakewood, CO 80228
Phone: 303-987-0400

Council of Energy Resource Tribes
1999 Broadway, Suite 2600
Denver, CO 80202
Phone: Unavailable

Environmental Defense Fund
2334 North Broadway
Boulder, CO 80304
Phone: 303-440-4901

Environmental Policy and Management Program
University of Denver
2211 South Josephine
Denver, CO 80208
Phone: Unavailable

Greenpeace
702 "H" Street, Northwest
Washington, DC 20001
Phone: 800-326-0959

League of Women Voters
1410 Grand, Suite B-204
Denver, CO 80203
Phone: 303-415-0130

National Audubon Society
3109 28th Street
Boulder, CO 80201
Phone: 303-415-0130

National Wildlife Federation
2260 Baseline Road, Suite 100
Boulder, CO 80302
Phone: 303-786-8001

The Nature Conservancy
1881 9th Street, Suite 200
Boulder, CO 80302
Phone: 303-444-2950

Rocky Mountain Institute
1739 Snowmass Creed Road
Snowmass, CO 81654
Phone: 970-927-3851

Sierra Club, Rocky Mountain Chapter
1410 Grant Street
Denver, CO 80203
Phone 303-861-8819

The Telluride Institute
Post Office Box 1770
Telluride, CO 81435
Phone: 970-728-4402

Thome Ecological Institute
5398 Manhattan Circle, Suite 120
Boulder, CO 80303
303-499-3647

United Sportsmen's Council of Colorado
7336 Beech Court
Arvada, Colorado 80005
Phone: Unavailable

Volunteers for Outdoor Colorado
600 South Marion Parkway
Denver, CO 80209
Phone: 303-715-1010

Western Colorado Congress
Post Office Box 472
Montrose, CO 81402
Phone: 970-249-1978

Appendix J

Media Contacts

Daily Newspapers

The Daily Journal
2000 South Colorado Blvd, Suite 2000
Denver, CO 80222
Phone: 303-756-9995
Fax: 303-756-4465

The Denver Post
1560 Broadway, 3rd Floor
PO Box 1709 (80201)
Denver, CO 80202
Phone: 303-820-1010
Fax: 303-820-1497

The Rocky Mountain News
100 Gene Amole Way
PO Box 719 (80201)
Denver, CO 80204
Phone: 303-892-5201
Fax: 303-892-2568

Major Denver Television Stations

KCEC-TV Channel 50 (Spanish/Univision)
777 Grant Street, #500
Denver, CO 80203
Phone: 303-832-0050

KCNC-TV Channel 4 (CBS)
1044 Lincoln
Denver, CO 80203
Phone: 303-861-4444

KDVR-TV Channel 31 (Fox)
100 E. Speer
Denver, CO 80203
Phone: 303-595-3131

KMGH-TV Channel 7 (ABC)
123 Speer Blvd.
Denver, CO 80203
Phone: 303-832-7777

KUSA-TV Channel 9 (NBC)
500 Speer Blvd.
Denver, CO 80203
Phone: 303-871-9999

KWGN-TV Channel 2 (WB)
6160 South Wabash Way
Englewood, CO 80111
Phone: 303-740-2222

Appendix K

Repository Locations

Central / Downtown Denver Public Library
10 W. Fourteenth Ave. Pkwy.
Denver, CO 80204-2731
(720) 865-1111
TTY (720) 865-1472

Colorado Department of Public Health and Environment
Records Center
4300 Cherry Creek Drive South
Denver, CO 80246-1530
Phone: 303-692-3331
Toll Free: 1-888-569-1831 ext: 3331
Fax: 303-759-5355

The Environmental Protection Agency
Records Center
999 18th Street, Suite 300
Denver, CO 80202
Phone: 303-312-6473

Appendix B
Site Photographs

OU1



1623 – 1625 West 12th Avenue – B&C Metals



Driveway between 1623 – 1625 West 12th Avenue and Erickson Memorial

OU1 (continued)



1241 – 1245 Quivas Street – Erickson Monuments



1740 West 13th Avenue – Materials Handling Inc.

OU1 (continued)



1223 – 1229 Quivas Street – Rudd Property

OU2



1001 South Tejon Street - Air Conditioning, Inc. with 1100 Umatilla in background.
OU2 (continued)



1001 South Tejon Street - Air Conditioning, Inc. with 1100 Umatilla in background right.

OU2 (continued)



Between 10th and 11th Avenues - Burlington Northern Railroad ROW

OU2 (continued)



1010 Yuma Street - Alpha Omega Electronics



1050 Yuma Street - Capital Management Realty

OU2 (continued)



999 Vallejo Street - G&K Services



2191 West 10th Avenue - Jenkins Property

OU2 (continued)



2300 West 11th Avenue - Colorado Department of Transportation Jerome Maintenance Yard with 1100 Umatilla in background.



1020 and 1030 Yuma Street - Rocky Mountain Research Corporation

OU2 (continued)



2121 West 10th Avenue - Staab Property



2121 West 10th Avenue - Staab Property

OU2 (continued)



1900 West 12th Avenue - Flame Spray, Inc



1900 West 12th Avenue (Flame Spray, Inc.) on right and 1100 Umatilla Street (formerly DuWald Steel) on left.

OU2 (continued)



1100 Umatilla Street - formerly DuWald Steel now Atlas Metals



1100 Umatilla Street - formerly DuWald Steel now Atlas Metals

OU2 (continued)



1100 Umatilla Street - formerly DuWald Steel now Atlas Metals



1100 Umatilla Street - formerly DuWald Steel now Atlas Metals. Workers doing site prep work for new pad at Atlas Metals.

OU3



1298 South Kalamath Street - Creative Illumination Inc.



1235 South Jason Street - GT Car Shop / Aspen Design and Manufacturing

OU3 (continued)



1140 W Louisiana Ave - Kwan Sang Noodle Company, formerly Titan Labels



Between West Louisiana and West Florida Streets - Central and Sierra Railroad ROW

OU3 (continued)



South Jason Street (on left) and Louisiana Street (on right)



South Jason Street ROW

OU3 (continued)



1377 South Jason Street - Packaging Corp of America

OU4 and OU5



500 South Santa Fe Drive – Robinson Brick Company



500 South Santa Fe Drive – Robinson Brick Company

OU4 and OU5 (continued)



500 South Santa Fe Drive – Robinson Brick Company – Location of Star Tech in background.

OU6



2301 15th Street – Central and Sierra Railroad ROW / Centennial Tire



2301 15th Street – Central and Sierra Railroad ROW / Centennial Tire

OU6 (continued)



1190 Yuma Street - Denver Water Department



1271 West Bayaud Avenue - Allied (General Chemical)

OU6 (continued)



1271 West Bayaud Avenue - Allied (General Chemical)



South Pecos Street and West Arizona Avenue - Public Service Company

OU6 (continued)



South Pecos Street and West Arizona Avenue - Public Service Company



Jewell Street and South Platte River Drive - Ruby Hill Park

OU6 (continued)



Jewell Street and South Platte River Drive - Ruby Hill Park



Jewell Street and South Platte River Drive - Ruby Hill Park

OU7



Cleanup on OU7 Marion Street



Cleanup on OU7 Marion Street

OU7 (continued)



Cleanup on OU7 Marion Street

OU8



1805 South Bannock Street - Shattuck Chemical Site



1805 South Bannock Street - Shattuck Chemical Site – Newly excavated monolith location along left edge of photo.

OU9



2001 East Colfax Avenue – Formerly International House of Pancakes



2001 East Colfax Avenue – Formerly International House of Pancakes

OU9 (continued)



2015 and 2017 East Colfax Avenue – Formerly Larry's Trading Post

OU10



1314 West Evans Avenue - Card Corporation

OU11



1285 – 1295 South Santa Fe Drive – Thomas



1285 – 1295 South Santa Fe Drive - Thomas

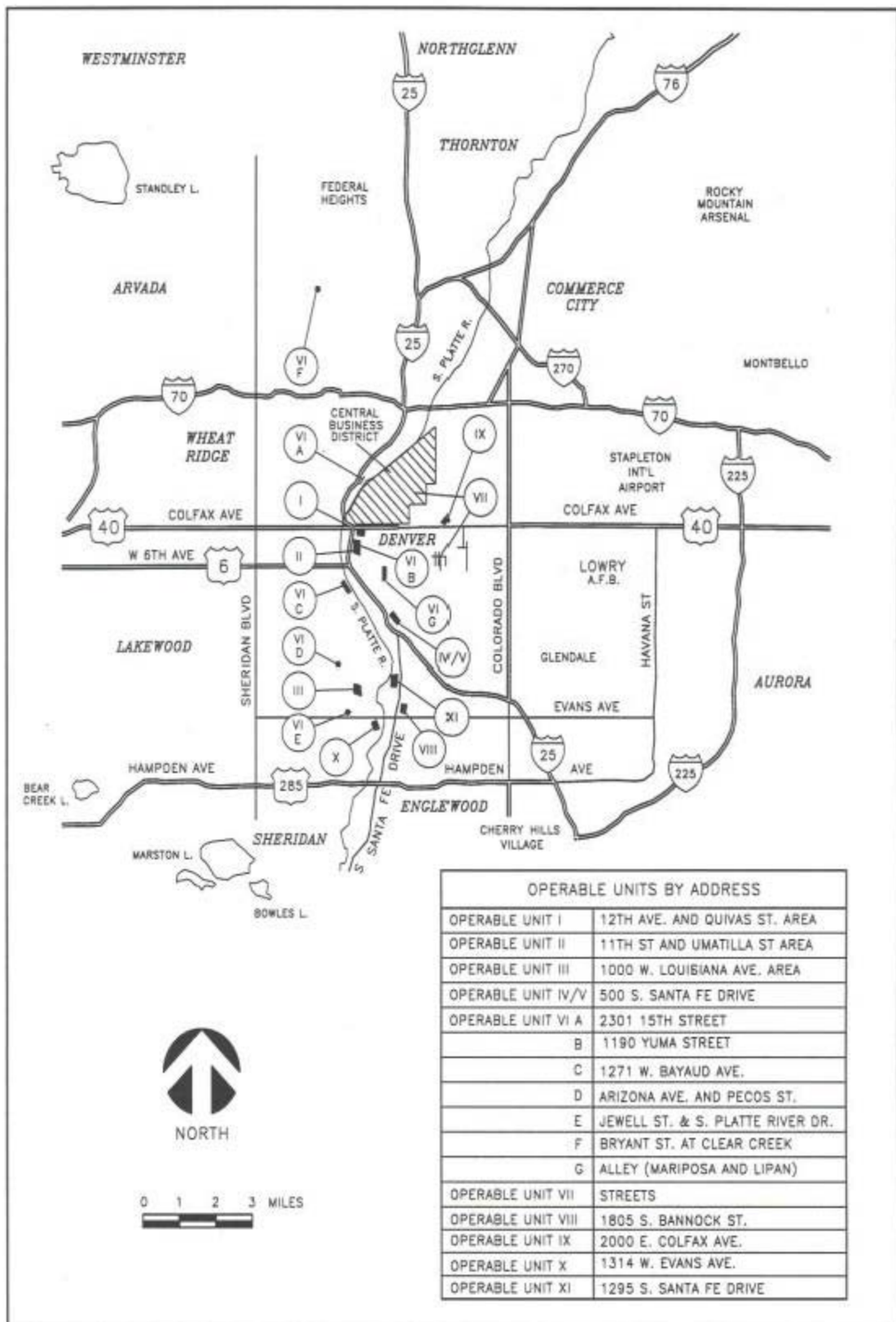


Figure 1. Denver Radium Site

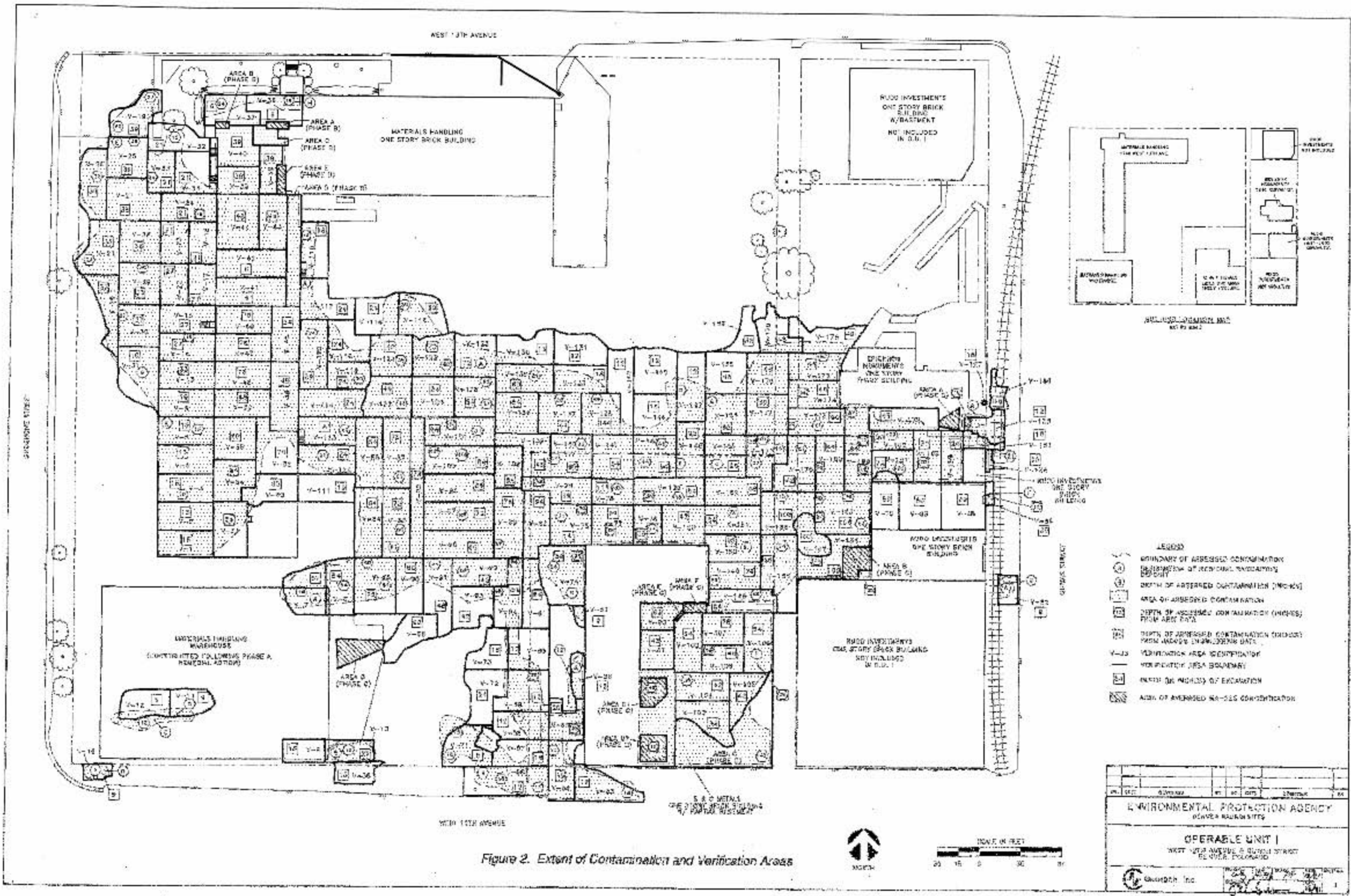


Figure 2. Extent of Contamination and Verification Areas

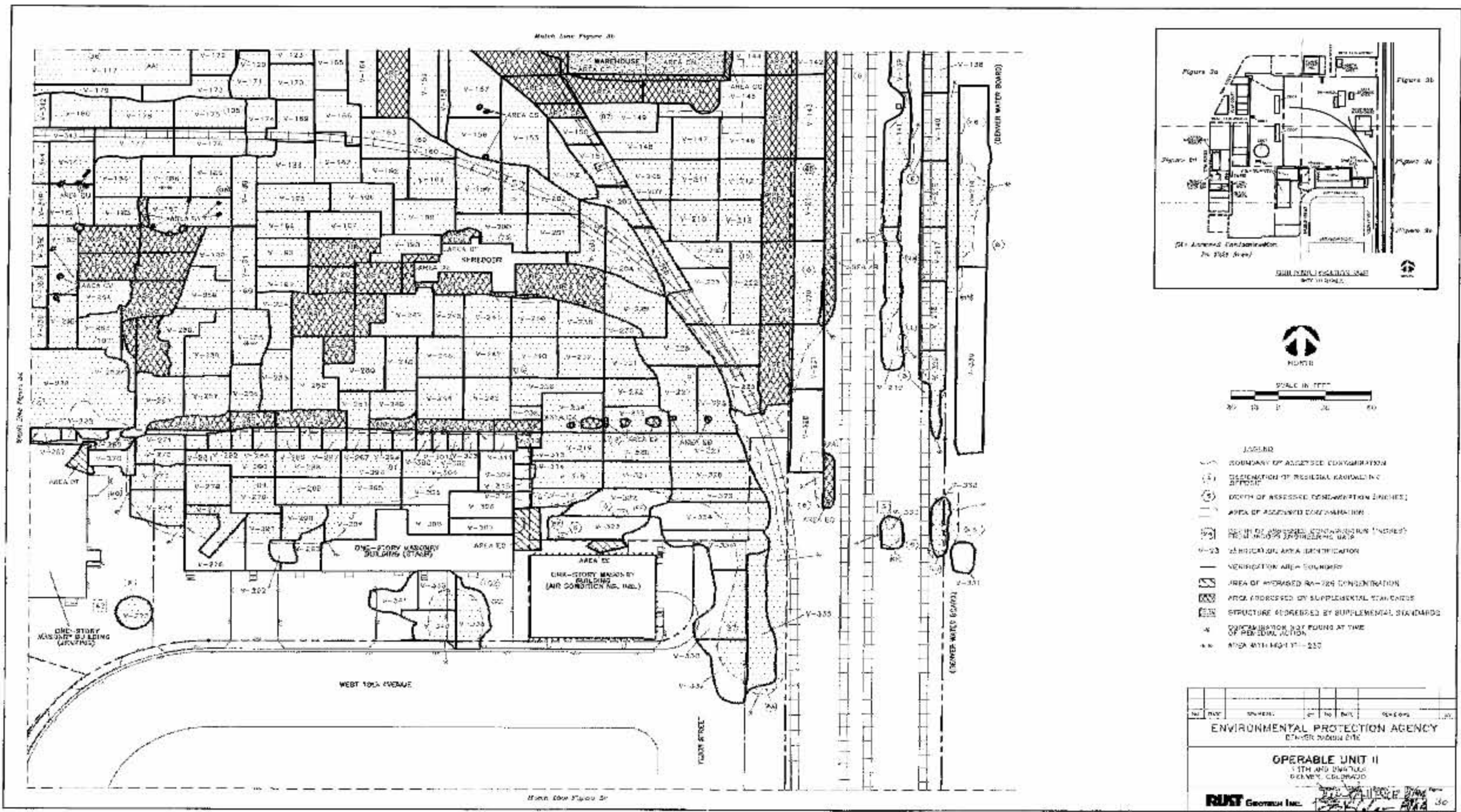
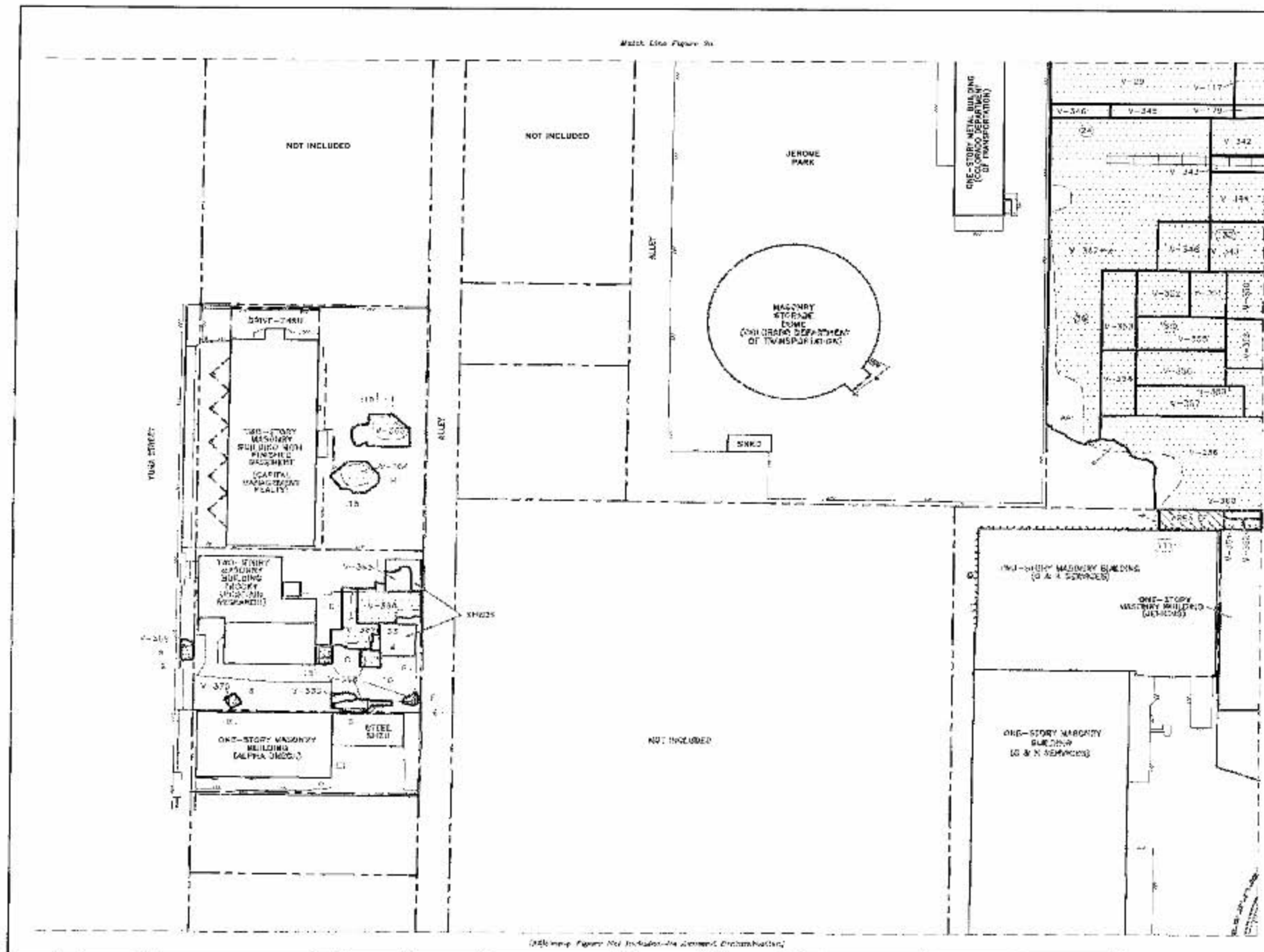
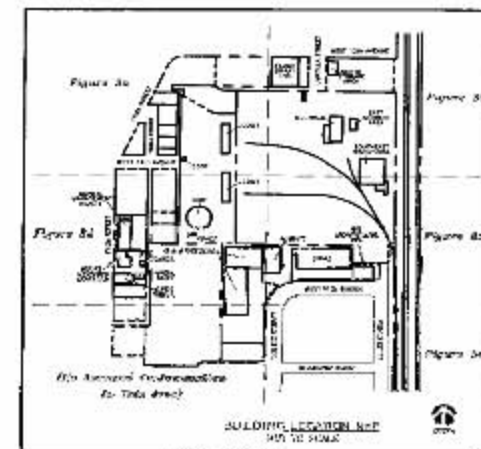


Figure 3c. Extent of Contamination and Verification Areas

Match Line Figure 3a



(Reference Figure 3a to include the General Contamination)



SCALE IN FEET
0 10 20 30 40

- LEGEND**
- BOUNDARY OF ASSESSED CONTAMINATION
 - BOUNDARY OF RESIDUAL NEGATIVE RESULT
 - DATA OF ASSESSED CONTAMINATION (POINT)
 - AREA OF ASSESSED CONTAMINATION
 - DEPTH OF ASSESSED CONTAMINATION (FROM FRESH SURFACE CORRELATING DATA)
 - ▨ AREA OF AERATED SOIL-USE CONCENTRATION
 - V-23 VERIFICATION AREA IDENTIFICATION
 - VERIFICATION AREA BOUNDARY
 - ONE MASTERY UNIT FOUND AT TIME OF REMEDIAL ACTION
 - DATA NOT HIGH (M-200)

DATE	SCALE	BY	CHKD	REV	DATE

ENVIRONMENTAL PROTECTION AGENCY
DENVER REGIONAL OFFICE

OPERABLE UNIT II
11TH AND CORNELIA
DENVER, COLORADO

RUST Geotech Inc. *[Signature]* 5d

Figure 3d. Extent of Contamination and Verification Areas

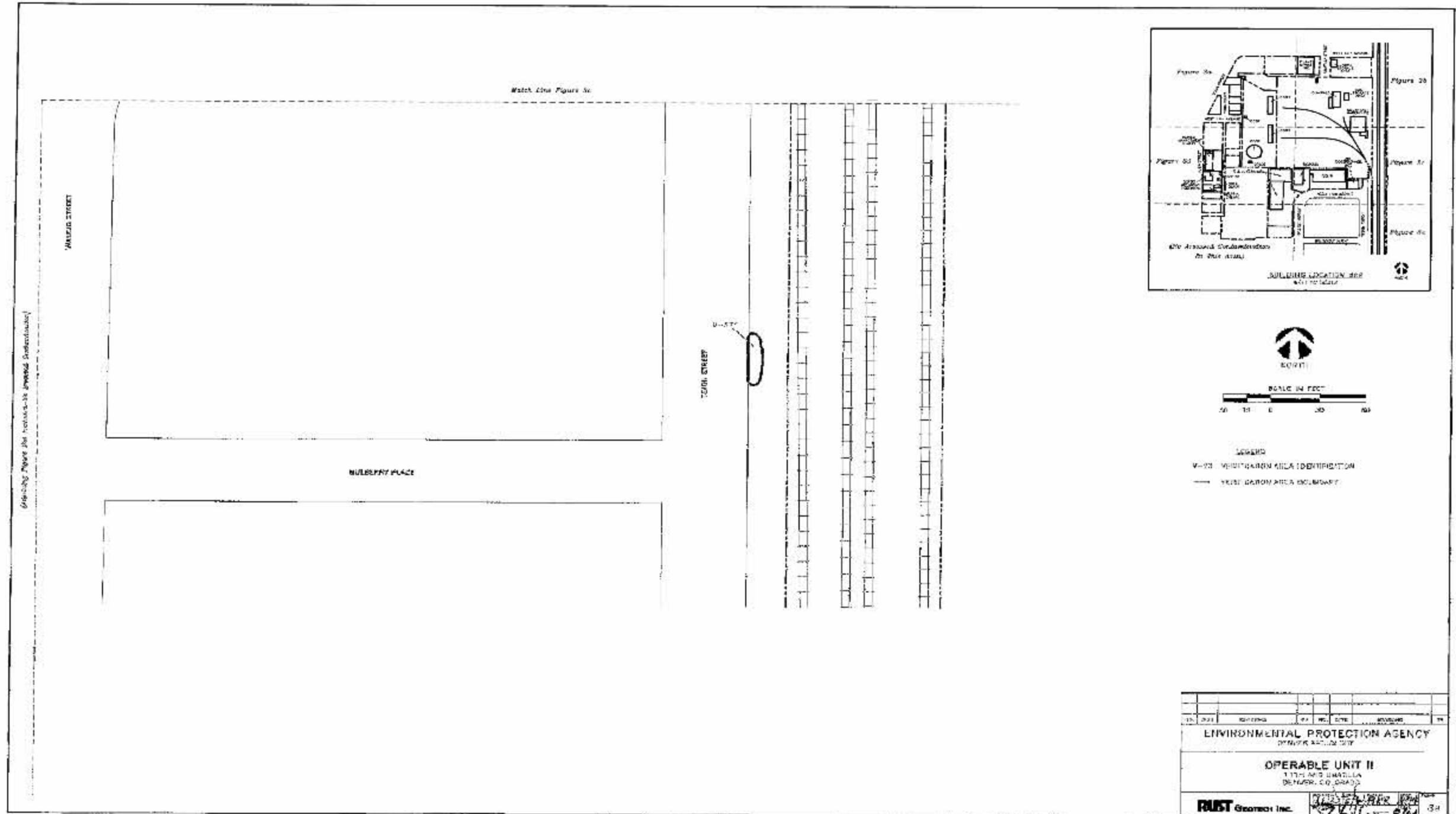


Figure 3c. Extent of Contamination and Verification Areas

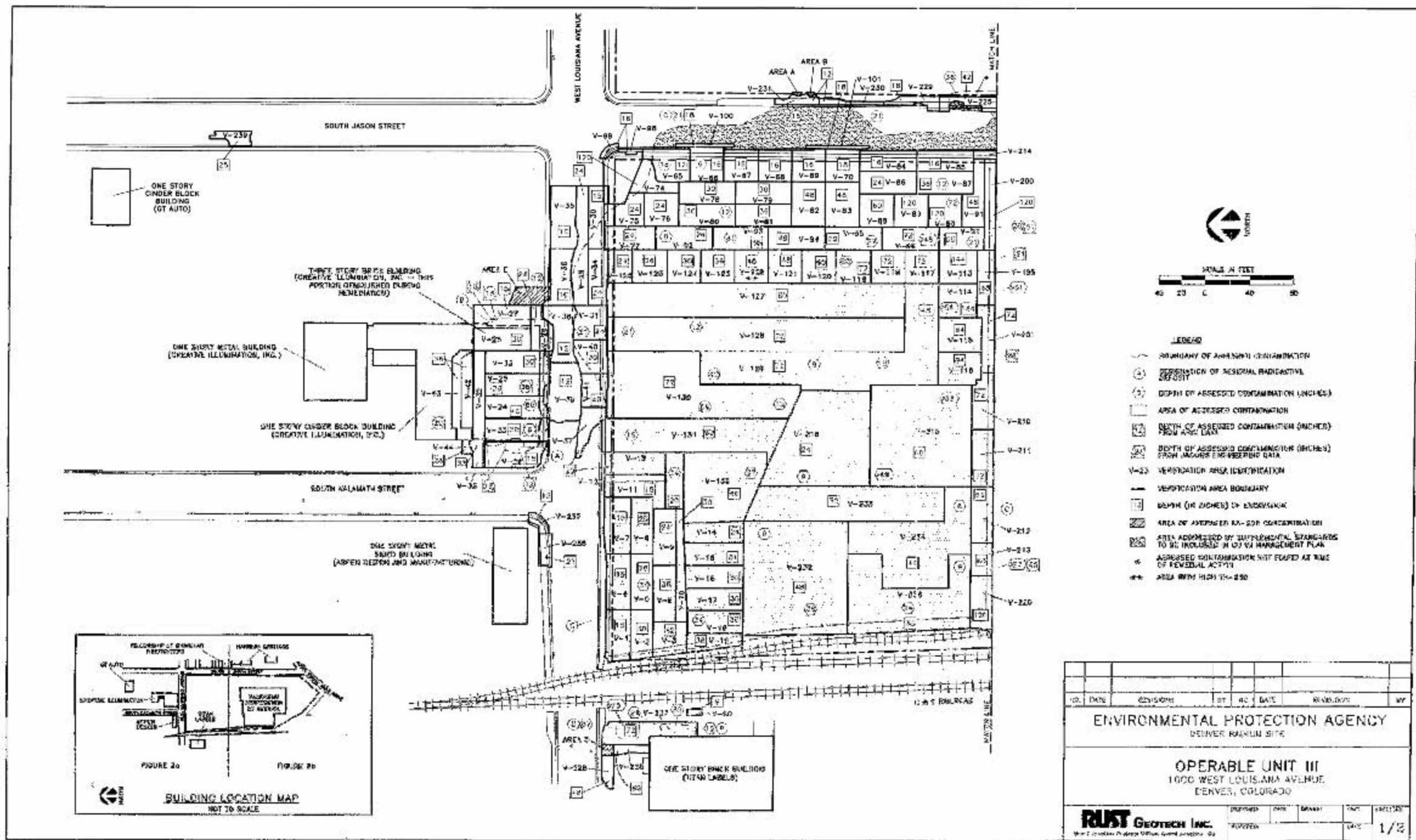


Figure 2a. Extent of Contamination and Verification Areas

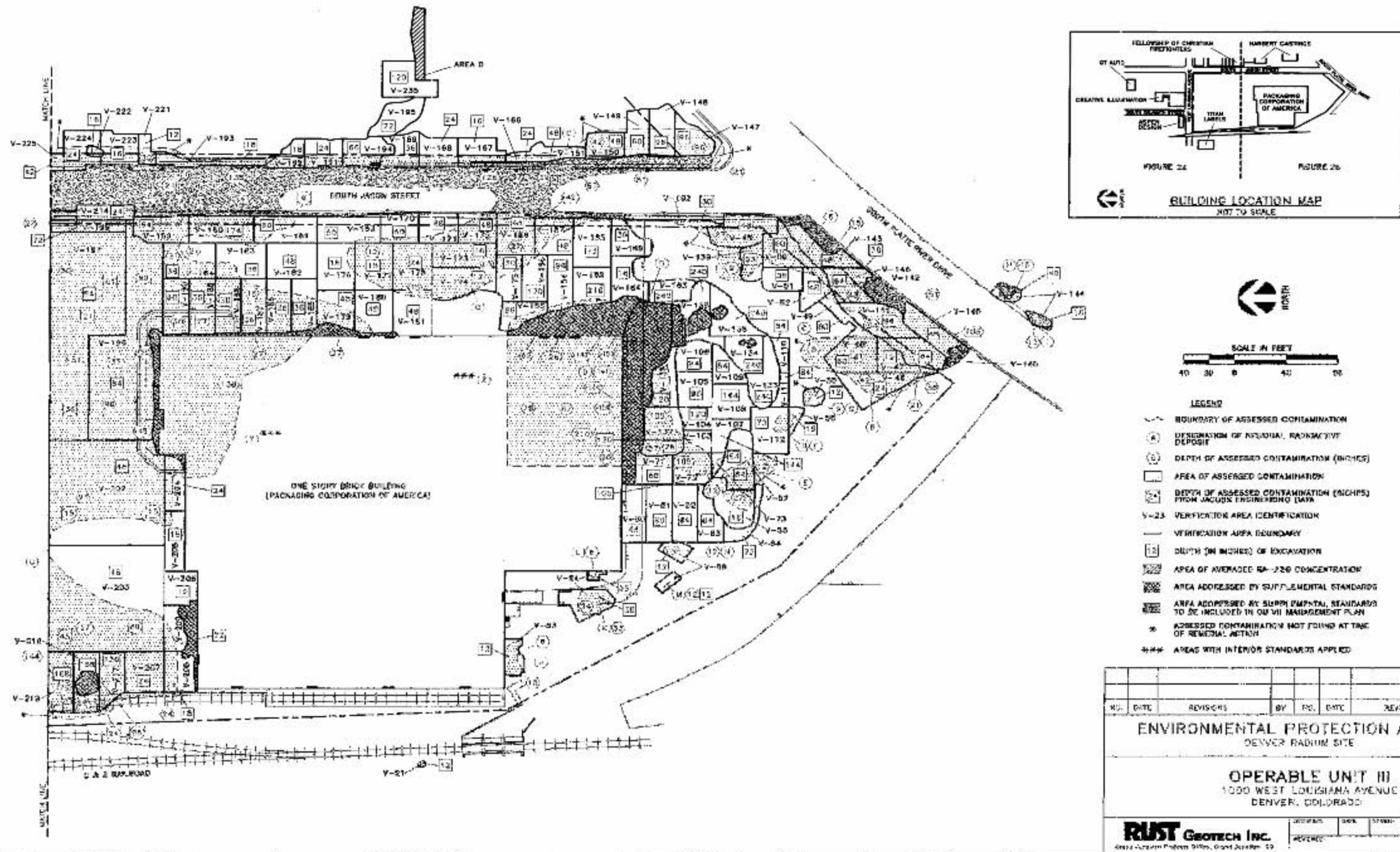


Figure 2b. Extent of Contamination and Verification Areas

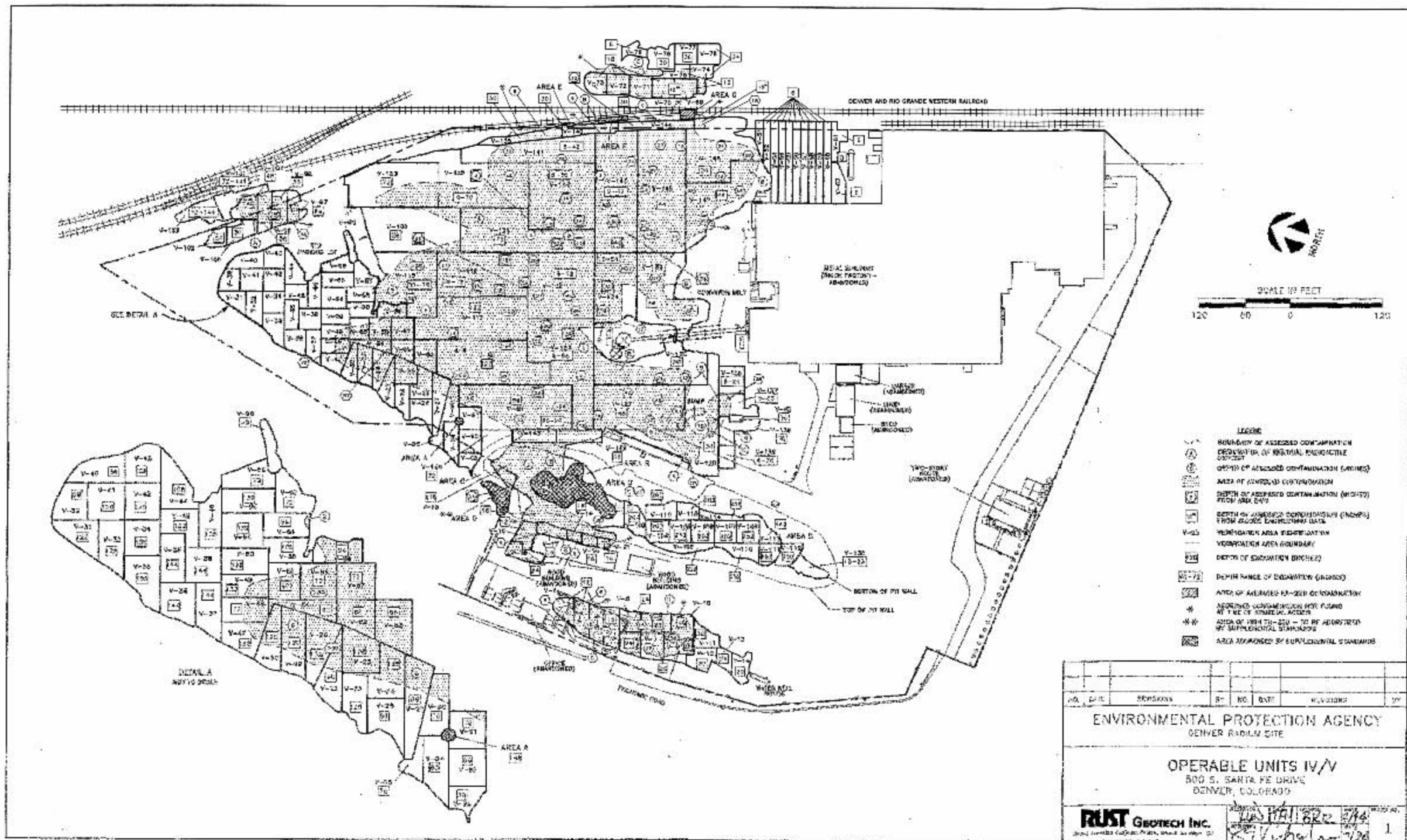


Figure 3. Extent of Contamination and Verification Areas

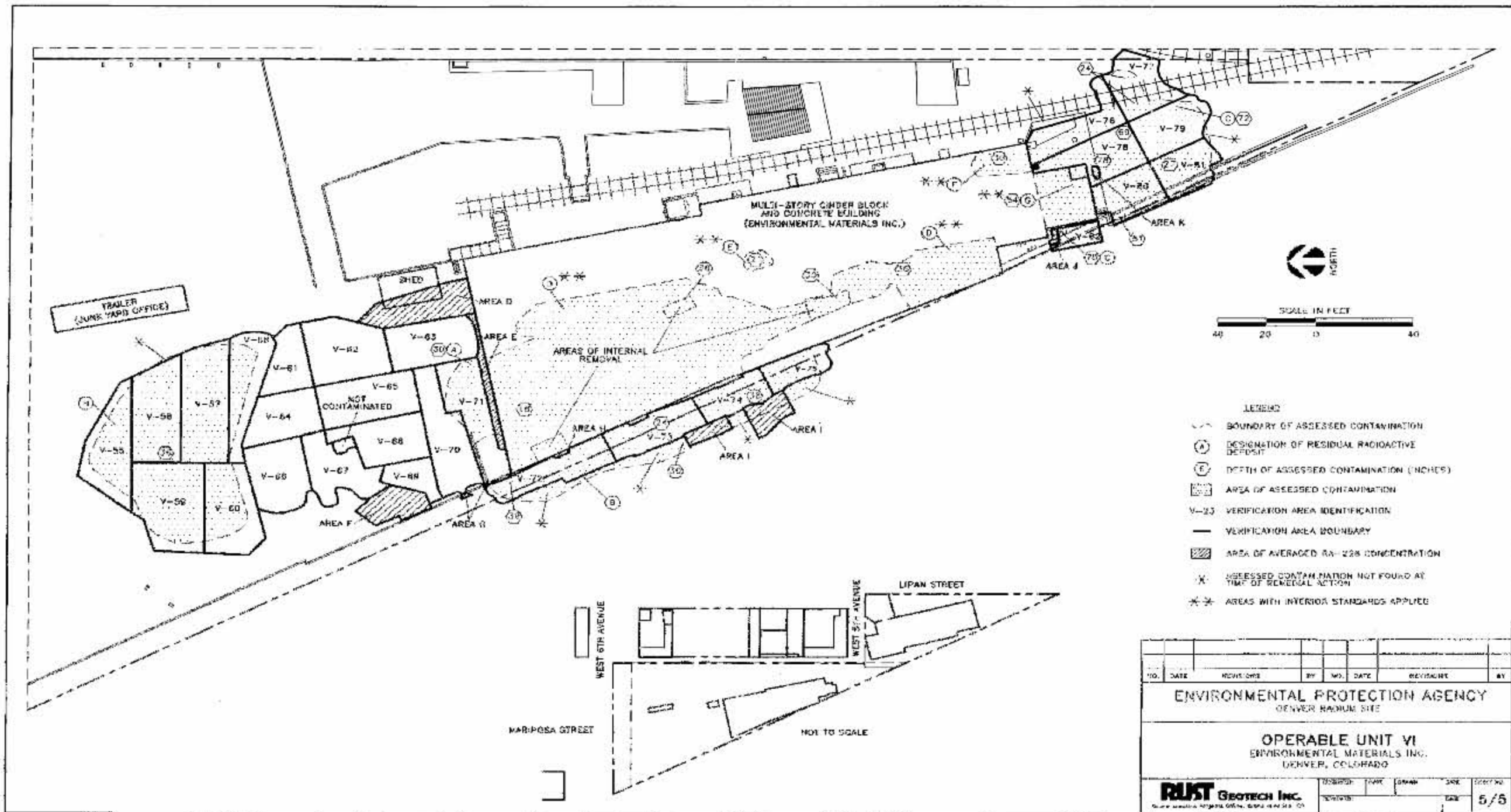


Figure 2a. Extent of Contamination and Verification Areas

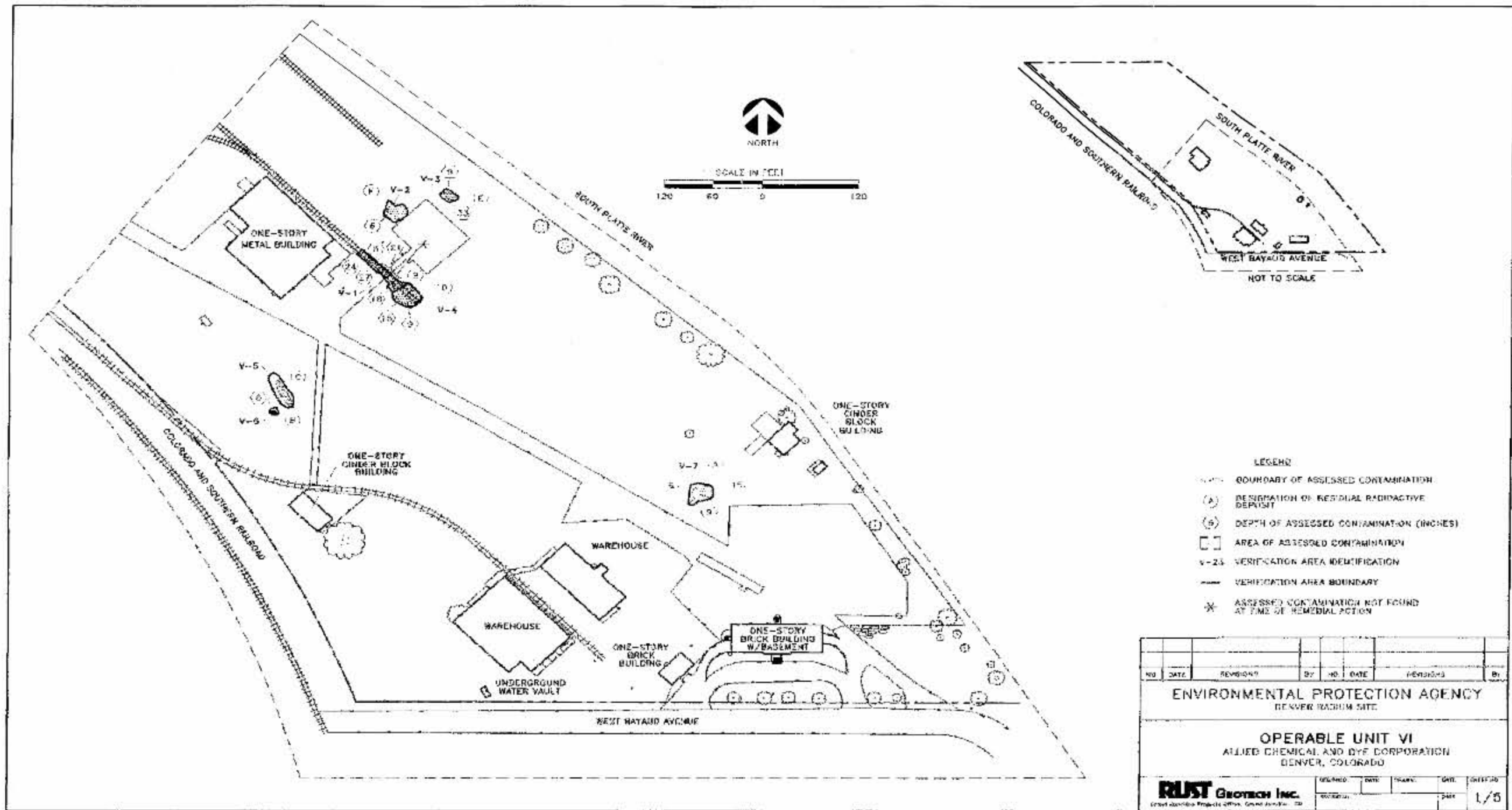


Figure 2a. Extent of Contamination and Verification Areas

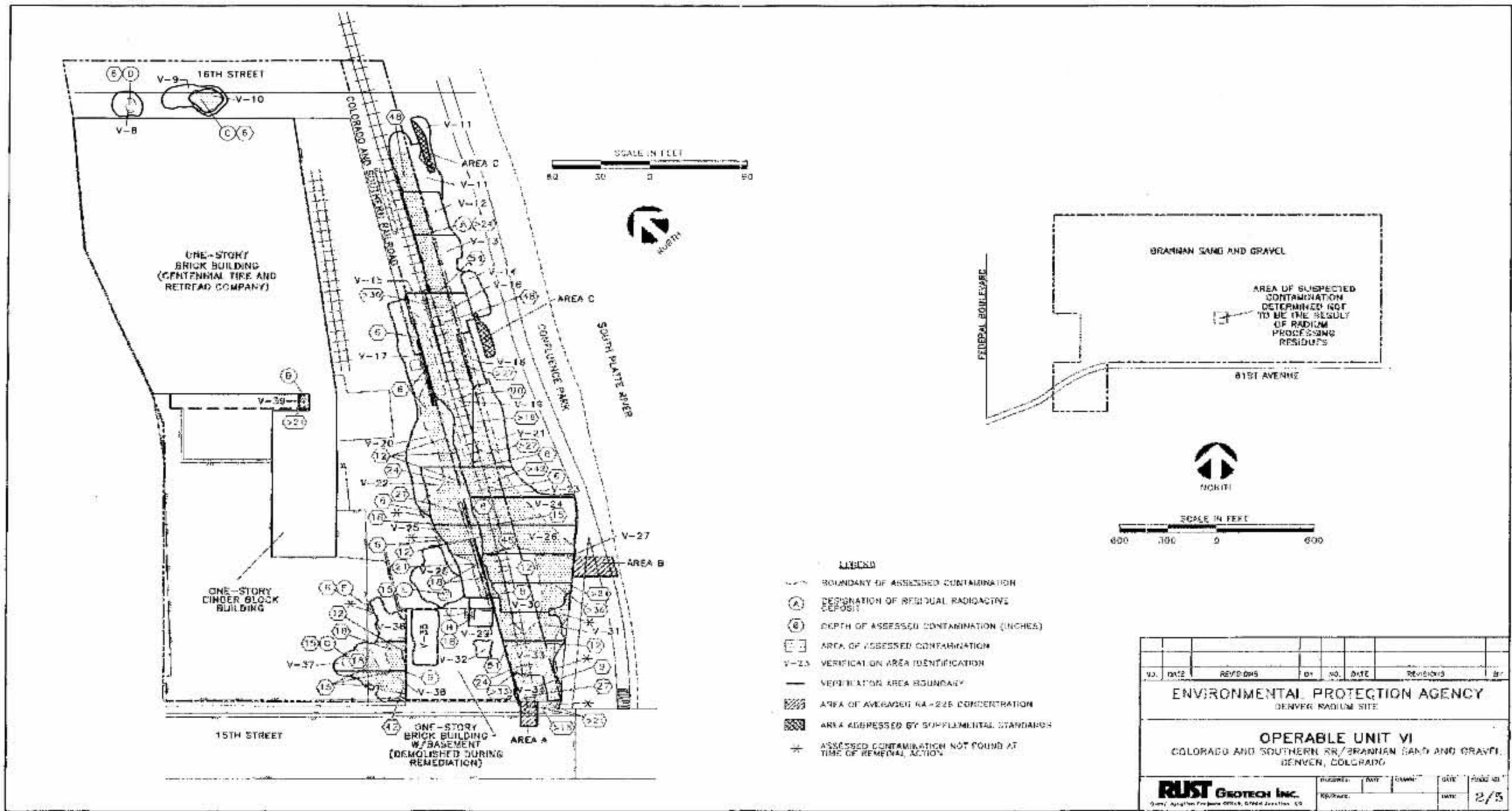


Figure 2b. Extent of Contamination and Verification Areas

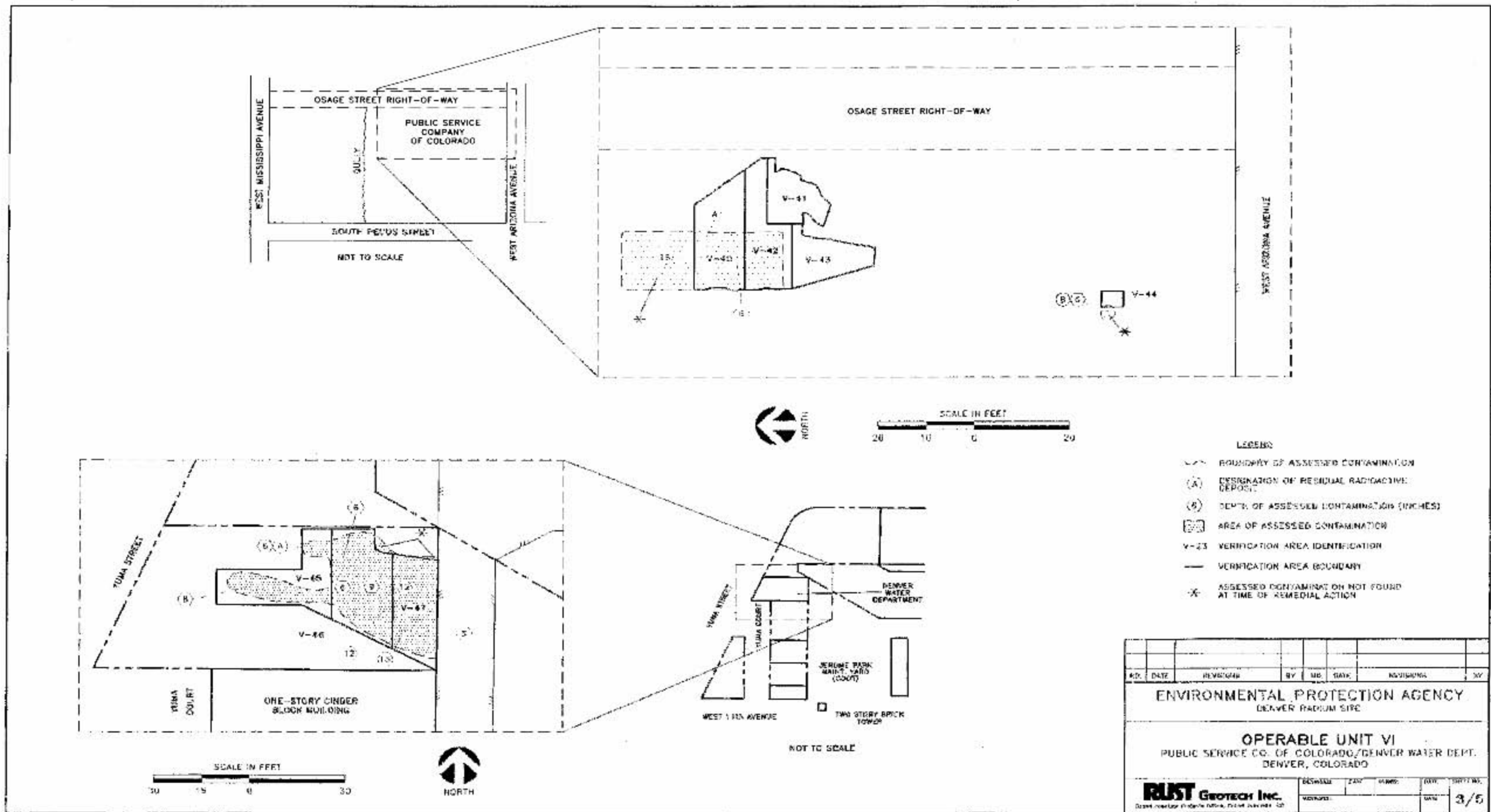


Figure 2c. Extent of Contamination and Verification Areas

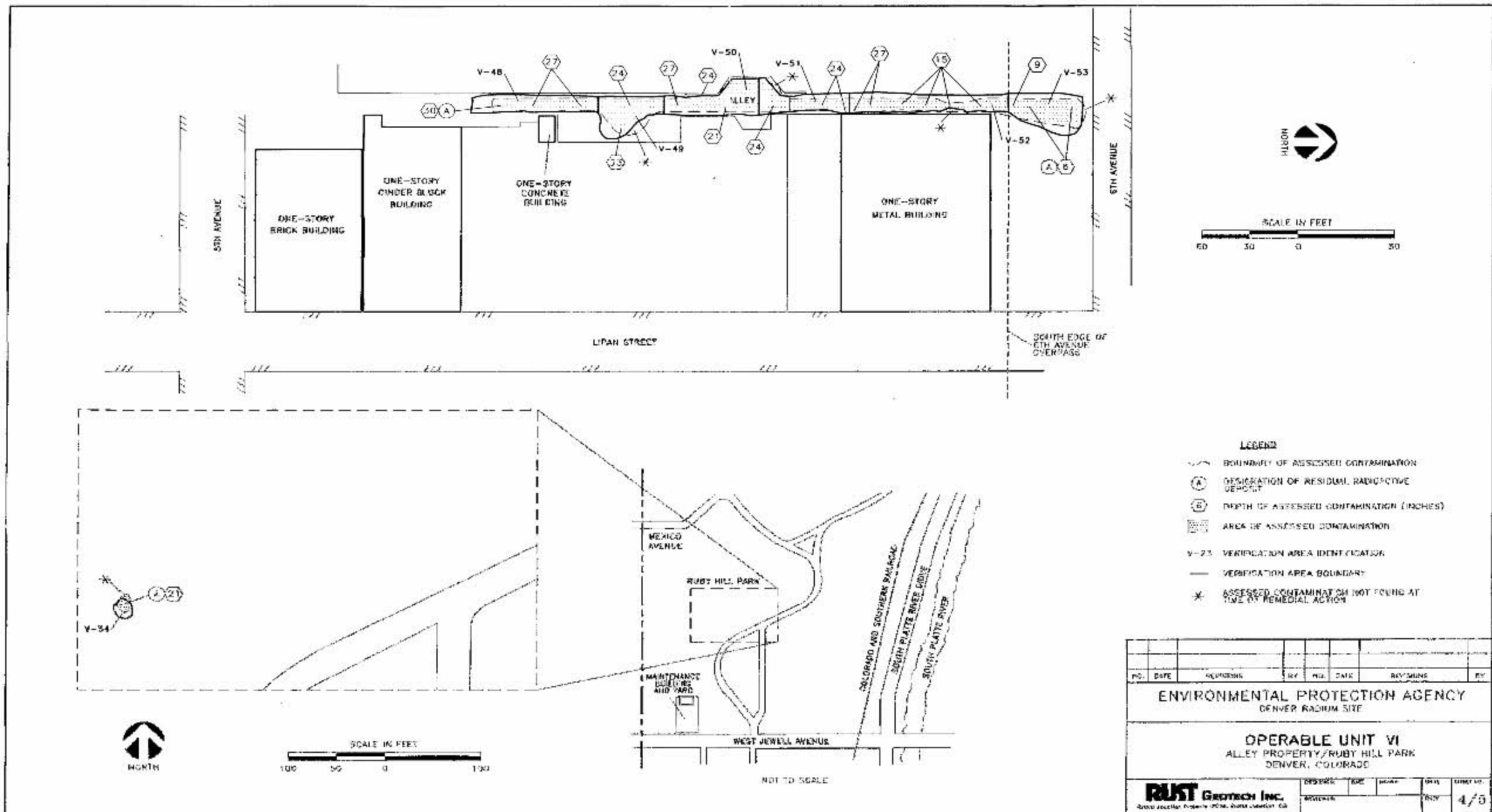
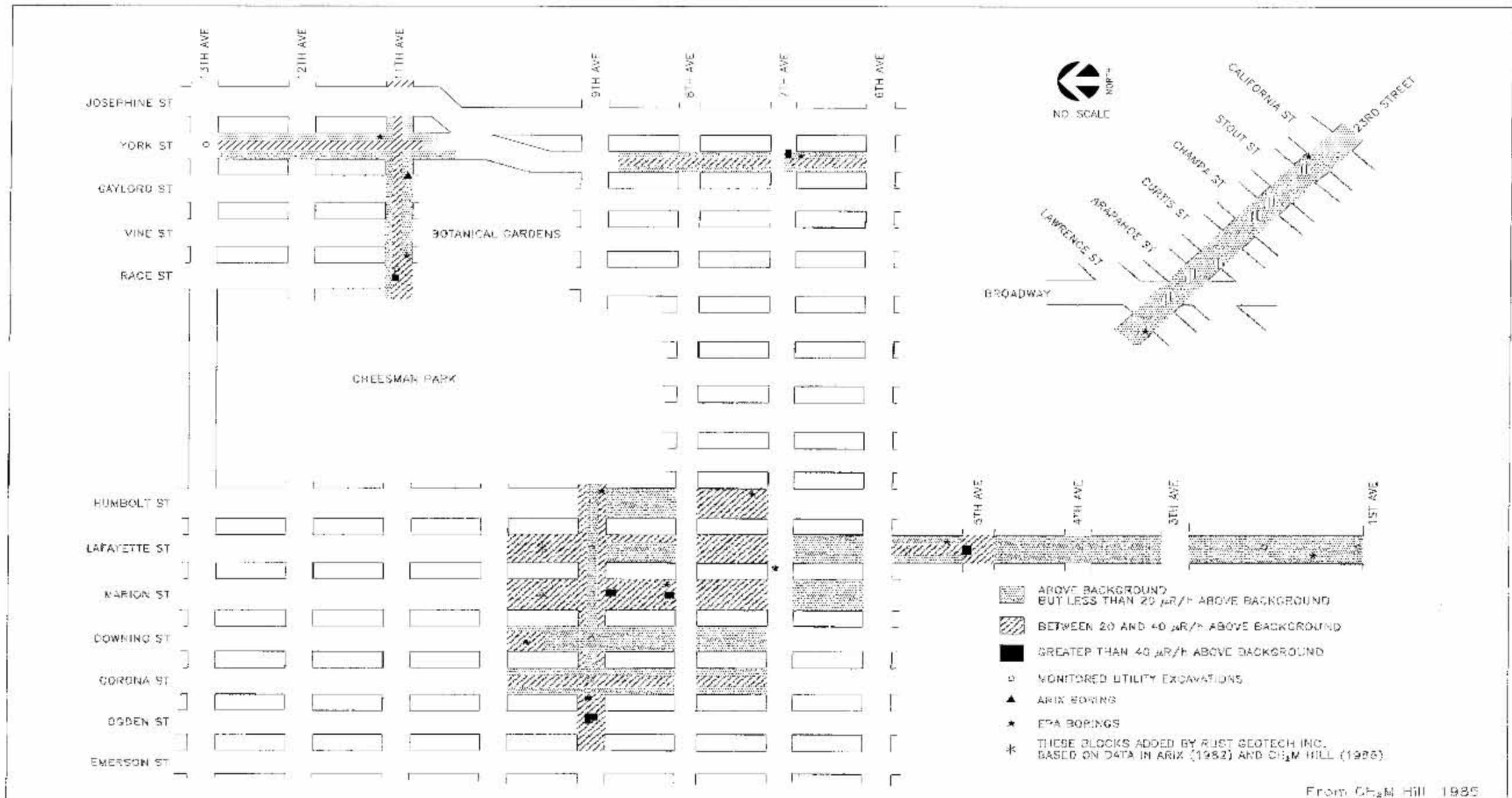


Figure 2d. Extent of Contamination and Verification Areas



From CH₂M Hill 1985

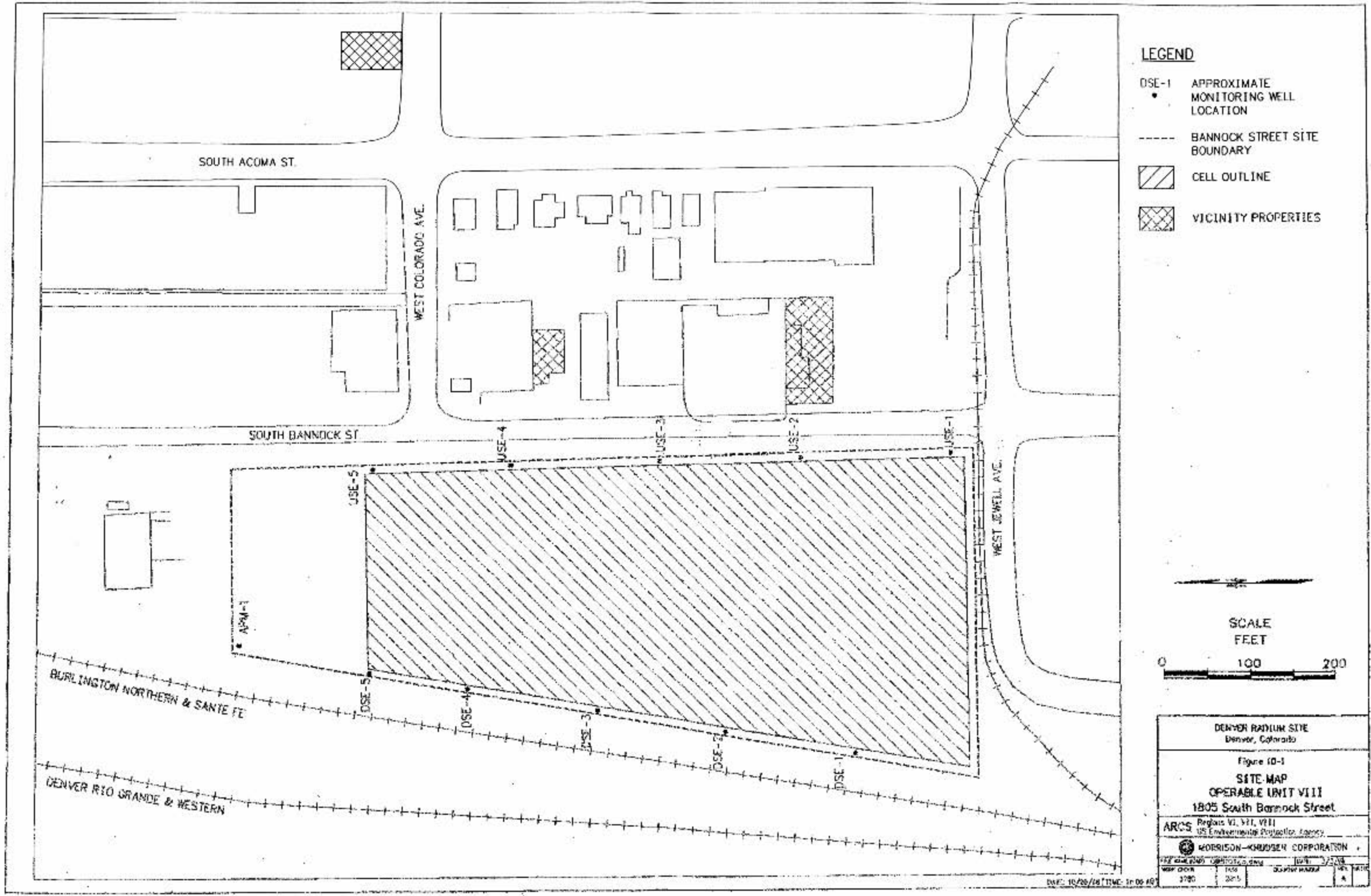
Figure 2a. Extent of Contamination



- LEGEND**
- BOUNDARY OF ASSIGNED CONTAMINATION
 - BOUND. OF ASSIGNED CONTAMINATION (INCL. IS)
 - AREA OF ASSIGNED CONTAMINATION

NO.	DATE	DESCRIPTION	BY	NO.	NO. OF	REVISIONS	BY
ENVIRONMENTAL PROTECTION AGENCY DENVER STATION SITE							
OPERABLE UNIT VII 1540 15201 LOUISIANA AVENUE DENVER, COLORADO							
RLST Geosynth Inc. <small>Small Business Technology Transfer (STTR) Agreement</small>		[Handwritten signatures and dates]					

Figure 2b. Extent of Contamination



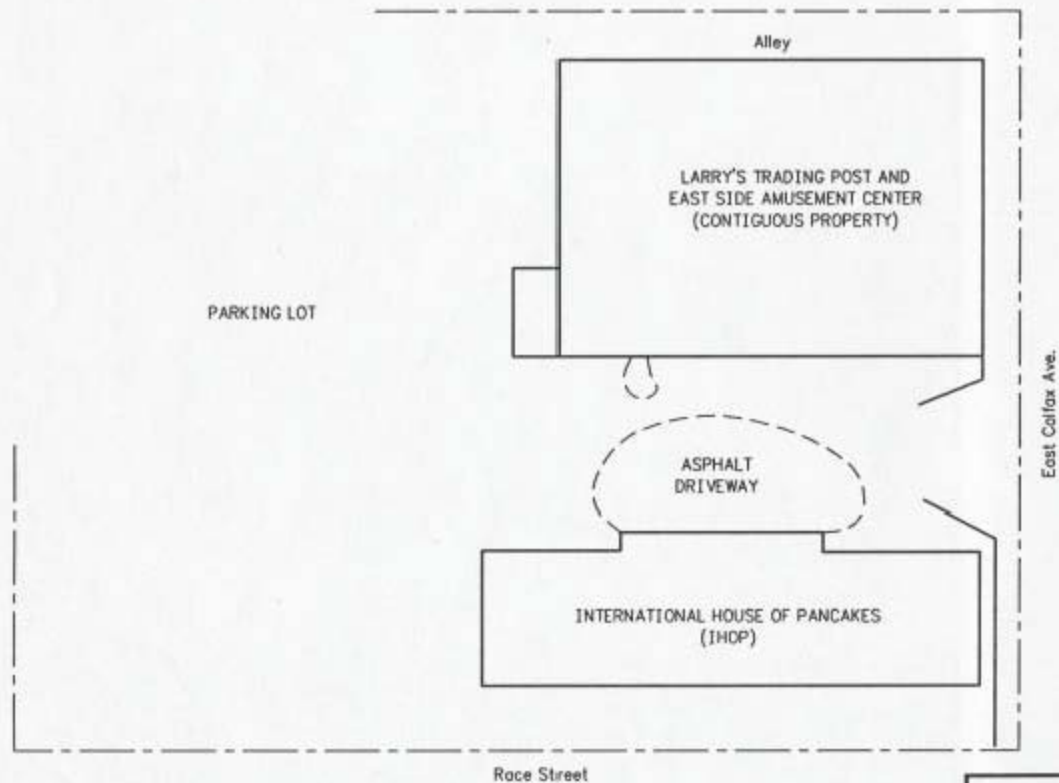
LEGEND

- DSE-1 APPROXIMATE MONITORING WELL LOCATION
- BANNOCK STREET SITE BOUNDARY
- ▨ CELL OUTLINE
- ▩ VICINITY PROPERTIES



DENVER RADIUM SITE Denver, Colorado			
Figure 10-1			
SITE MAP OPERABLE UNIT VIII 1805 South Bannock Street			
ARCS Region VI, VII, VIII US Environmental Protection Agency			
MORRISON-KNOXER CORPORATION			
REV	DATE	DESCRIPTION	BY
001	1/85	ISSUE	WMA
002	2/85	REVISED	WMA

DATE: 10/20/84 TIME: 11:05 AM



Source: U.S. Environmental Protection Agency

DENVER RADIUM SITE
Denver, Colorado

Figure 8-2
SITE MAP
OPERABLE UNIT IX
East Colfax Avenue

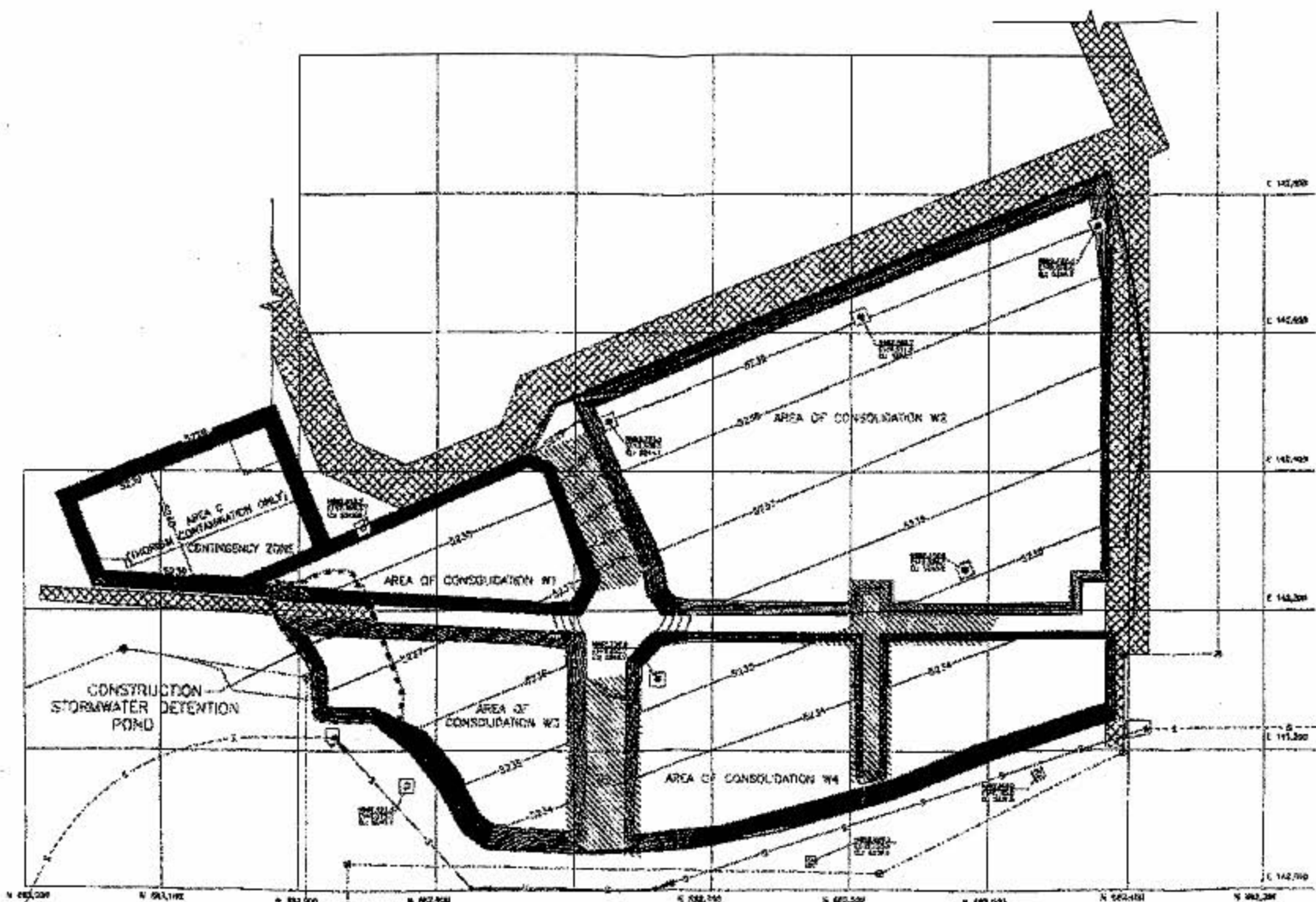
ARCS Regions VI, VII, VIII
US Environmental Protection Agency

MORRISON-KNUDSEN CORPORATION

FILE NAME (TAB)	DATE	DESCRIPTION	DATE	REV	BY
WORK ORDER	3780	2815		A	



KEY MAP



LEGEND

- UTILITY TRENCH BY OTHERS
- TOP OF DIRT EXCEEDING ONE SPECIFIC GRAVITY WHEN CUT IS PREPARED
- EXISTING 48" TERRETTA SANITARY SEWER (30' RC DUCTILE/COULDED IN PLACE)
- NEW 36" RCP SANITARY SEWER
- TOP OF PROPOSED UTILITY TRENCH
- BOTTOM OF PROPOSED UTILITY TRENCH
- PROPERTY LINE
- 52.35 TOP OF SOL. CAP (END OF PHASE I)
- LIGHT POLE BASE (TO BE INSTALLED PRIOR TO PLACEMENT OF STRUCTURAL FILL)
- LIGHT POLE BASE (TO BE INSTALLED AFTER PLACEMENT OF STRUCTURAL FILL)
- LOCATION OF CENTER OF LIGHT POLE BASE. ELEVATION AT TOP OF CONCRETE HEEL

NOTES

- 1) CONSOLIDATION CONTINGENCY ZONE TO BE CONSTRUCTED AT END OF PHASE I, SEPARATE OF PHASE II. PHASE II CONTRACTOR (IF CONTINGENCY CAPACITY IS REQUIRED).
- 2) TOTAL SURFACE AREA OF CAP FOR AREA OF CONSOLIDATION IS 20,000 SQUARE YARDS (INCLUDING CONTINGENCY ZONE)

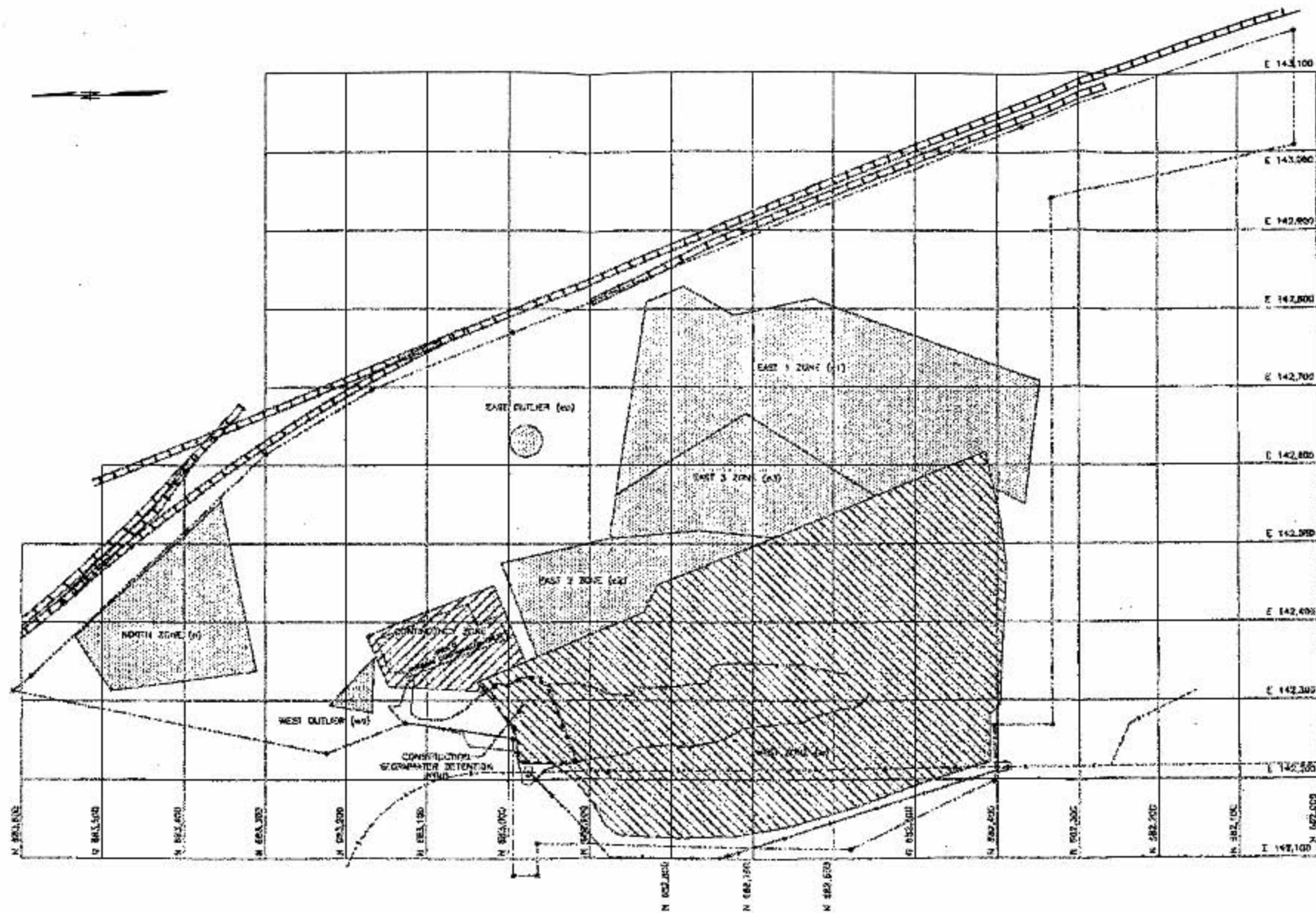
DENVER RADIUS SITE
Denver, Colorado

Figure 11-2
**AREAS OF CONSOLIDATION
OPERABLE UNIT IX**
500 South Santa Fe Drive

ARCS
Phase VI, VII, VIII
US Environmental Protection Agency

MORRISON-KNUDSEN CORPORATION

DATE: 05/09/88	SCALE: 1"=40'
PROJECT NO: 2780	DATE: 2/81
DESIGNER: [blank]	CHECKED: [blank]
DRAWN: [blank]	DATE: [blank]



- LEGEND**
- PLAN VIEW OF AREA OF CONTAMINATION (A.O.C.) TO BE EXCAVATED AND MOVED TO AREA OF CONSOLIDATION
 - PLAN VIEW OF AREA OF CONSOLIDATION
 - PLAN VIEW OF AREA OF CONSOLIDATION CONTINGENCY ZONE, TO BE CONSTRUCTED AT END OF PHASE I/BEGINNING OF PHASE II, BY PHASE II CONTRACTOR (IF CONTINGENCY CAPACITY IS SECURED)
 - EXISTING 48" TEMPOREX SANITARY SEWER (TO BE DEMOLISHED/CLOSED IN PLACE)
 - NEW 36" RCP SANITARY SEWER

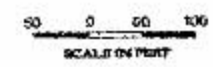
NOTES

ESTIMATED VOLUMES OF SOIL EXCEEDING 5% SCREENING CAPACITY IN:

NORTH ZONE	-	5,265	YD ³
EAST OUTLIER	-	43	YD ³
WEST OUTLIER	-	62	YD ³
EAST 1 ZONE	-	8,302	YD ³
EAST 2 ZONE	-	1,583	YD ³
EAST 3 ZONE	-	788	YD ³
WEST ZONE	-	28,627	YD ³

OVERHEAD CAPACITY OF AREA OF CONSOLIDATION FOR A.O.C. TO BE EXCAVATED AND MOVED:

WEST ZONE	-	30,755	YD ³
CONTINGENCY ZONE	-	4,270	YD ³



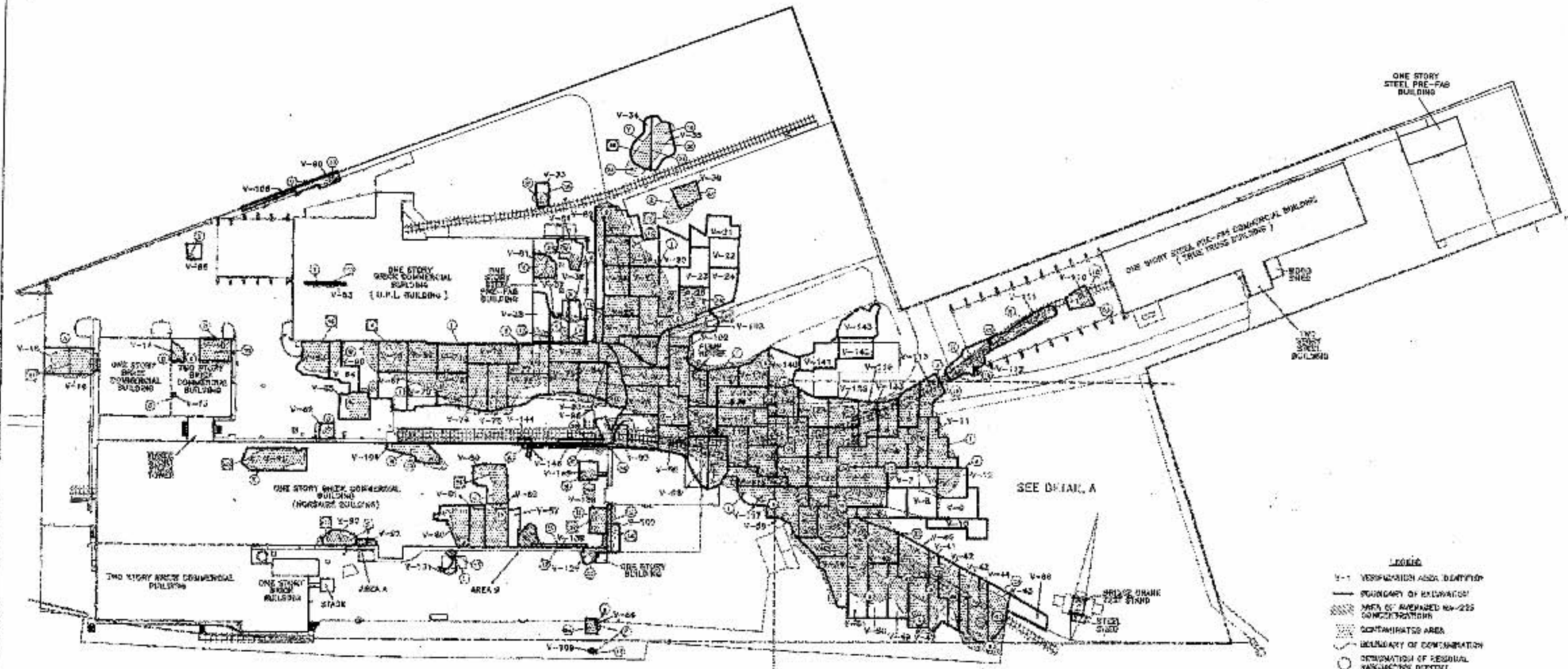
DENVER RADIUM SITE
Denver, Colorado

Figure 11-1
SITE MAP
OPERABLE UNIT IX
500 S. Santa Fe Drive

Regions V, VII, VIII
US Environmental Protection Agency

ARCIS
MORRISON-KNUDSEN CORPORATION

FILE NAME (PLOT)	OPERABLE UNIT IX	DATE	3/2/99
WORK NUMBER	3702	TRK	285
DRAWING NUMBER		REV	A

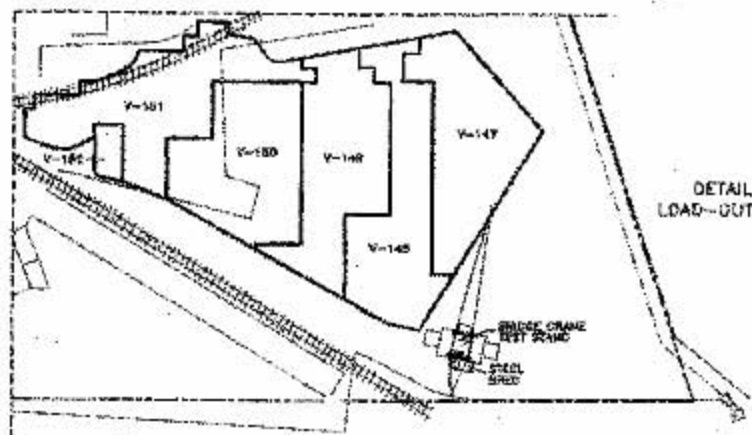


SEE DETAIL A

- LEGEND**
- V-1 VERIFICATION AREA IDENTIFIED
 - BOUNDARY OF EXCAVATION
 - ▨ AREA OF AVERAGE RA-225 CONCENTRATION
 - ▤ CONTAMINATED AREA
 - - - BOUNDARY OF CONTAMINATION
 - IDENTIFICATION OF PERSONAL RADIOMETER DEPOSIT
 - DEPTH OF CONTAMINATION (INCHES) BY RESISTOR
 - ⊖ APPROXIMATE DEPTH OF CONTAMINATION IN INCHES BY SPECIAL ENGINEERING GROUP



SCALE IN FEET
 0 20 40 60 80 100



DETAIL A
LOAD-OUT AREA

Figure 2. Extent of Contamination and Verification Areas

NO. 002		REV. 001		DATE 05/80		BY [Signature]	
ENVIRONMENTAL PROTECTION AGENCY OFFICE OF RADIATION PHYSICS							
OPERABLE UNIT X 5314 WEST COMBIE AVENUE DENVEN, CO 80249							
[Logo]		[Signature]		[Signature]		[Signature]	

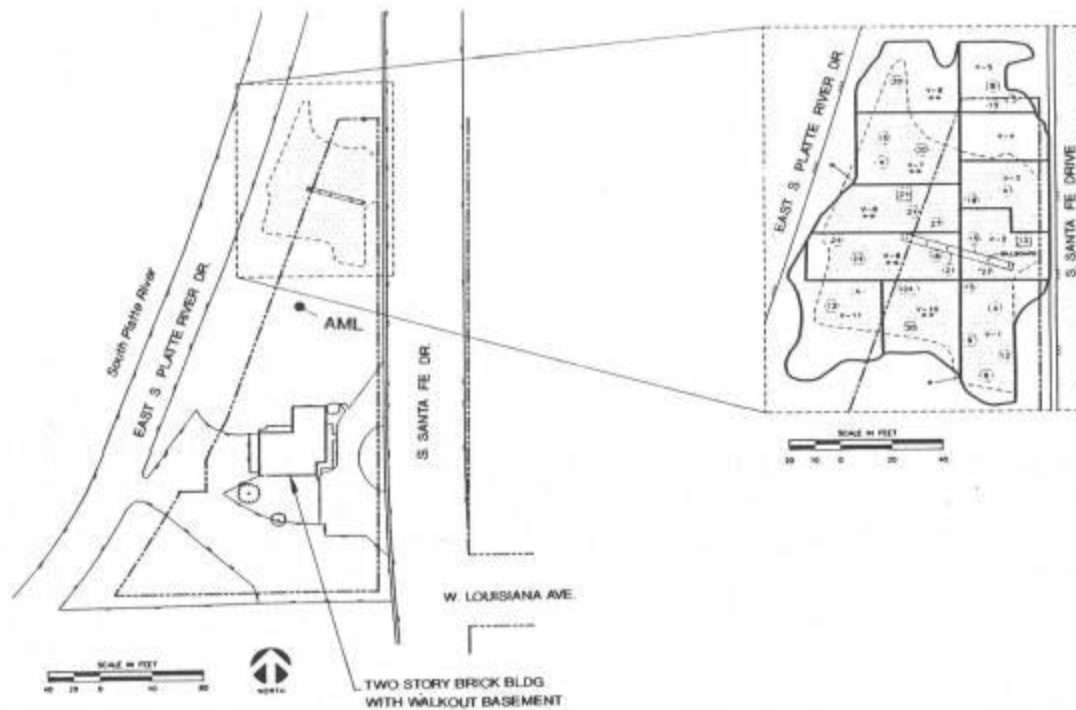


Figure 25
Ground Water Sample Locations
Denver Radium Site OU3 and Hospital Shared Services



0 145 290 580 870 1,160 Feet

Legend

- OU3 Monitoring Wells
- Site Boundaries