



U.S. Department of Energy

2597 B³/₄ Road
Grand Junction, CO 81503

November 15, 2005

WM-110

Mr. Myron Fliegel
Office of Nuclear Material Safety & Safeguards
U.S. Nuclear Regulatory Commission
Mail Stop T8-F42
Washington, D.C. 20555-0001

Subject: Transmittal of Revisions to the Document Field Services Procedures for the Radiological Excavation Control and Radiological Verification of the Moab Project Site (DOE, May 2005)

Dear Mr. Fliegel:

During a teleconference held with you on October 18, 2005, the Department of Energy requested that the U.S. Nuclear Regulatory Commission suspend the review and comment of the above referenced document. The reason for the request was that DOE wanted to re-evaluate the proposed process for inclusion/exclusion of Moab vicinity properties.

Accordingly, enclosed for your review is a revised, simplified process flow chart for the inclusion/exclusion of vicinity properties and accompanying revised text section of the document.

If you have any questions, please call me at (970) 248-7612.

Sincerely,

Donald R. Metzler
Moab Federal Project Director

Enclosure

cc w/o enclosures:

J. Berwick, DOE (e)

J. Elmer, Stoller (e)

K. Karp, Stoller (e)

Project File MOA 2.12 (R. Burrows)

JDB\Moab\VicinityProp\NRC VP Incl Revised.doc

Attachment 1

Moab Inclusion/Exclusion Surveys

1. Purpose

An inclusion/exclusion survey evaluates radiological contamination at a vicinity property (VP) to determine if the material is tailings derived from the millsite, and if so does it exceed the applicable standards. If conditions on the property exceed the U.S. Environmental Protection Agency (EPA) standards (40 CFR 192), the Contractor will recommend to the U.S. Department of Energy (DOE) that the property be included in the Moab Project for remediation. If it does not exceed the standards, the property will be recommended for exclusion.

The procedures for inclusion/exclusion surveys are based on the "Indoor/Outdoor Radiological Surveys" procedure contained in the *Field Services Procedures Manual* (STO 203). This procedure defines the additional data required for making an inclusion/exclusion recommendation and the report format.

2. Background

The Moab site is the home of a former uranium-ore processing facility that was owned and operated by the Uranium Reduction Company and Atlas Minerals Corporation under a license issued by the U.S. Nuclear Regulatory Commission (NRC). The mill ceased operations in 1984. Decommissioning of the mill began in 1988, and an interim cover was placed on the tailings pile between 1989 and 1995. Atlas filed for bankruptcy in 1998 and a trust was created in 1999 to manage the site. The Floyd D. Spence Act for FY 2001 amended Title I of the Uranium Mill Tailings Radiation Control Act (UMTRCA) giving DOE responsibility for remediation of the Moab site, while terminating the NRC license for the site. The site was transferred to DOE from the trustee in October 2001.

UMTRCA Title I was established for the stabilization and remediation of inactive processing sites where their licenses had been terminated before 1978. Most of the Title I sites, where vicinity properties were cleaned up, were abandoned sites where no caretaker was responsible for maintenance and security. In addition, prior to 1978, there were no regulations requiring owners of uranium mill tailings sites to close or stabilize tailings piles.

As the Moab site was licensed by NRC and under the direct control of Atlas Minerals (the trustee and DOE), there has been control of the site since its operating days, unlike other Title I sites. Even after operations ceased in 1984, Atlas always had a physical presence on the site with workers performing maintenance, security, etc. In addition the NRC license held by Atlas required that the pile be stabilized. Atlas had a reclamation plan submitted to and approved by NRC to cap the tailings pile in-place.

Although most of the Title I tailings piles were established above ground using tailings dams, few of the sites operated as long or were as big as Moab. The Moab tailings dams have held saturated materials since they were built. Consequently, it does not make sense that Atlas or its predecessors would have allowed tailings to be removed from the dam embankments where the sandy tailings resided and were part of the dam structure. Since most of the interior was filled

with slimes and sandy slimes, it also doesn't make sense that people would want to use the finer grain material for fill or other construction purposes.

The wide spread use of tailings at other UMTRA Title I sites had a long documented history. At sites like Grand Junction, the site operators urged the community to utilize mill tailings and even had a loader parked for contractors to fill their trucks. Additionally, the soils in Grand Junction are primarily silty clays, high in salinity, structurally weak, and are not very good for lawns, gardens, and construction materials. The mill tailings provided a sandy soil ideal for augmenting the native clayey soils. In the City of Moab, where soils are primarily sands and sandstone, it also does not make sense that people would look to import more sand, even if available.

UMTRA Title I requires DOE to remediate processing sites, which includes by definition, "...any other real property or improvement thereon which is in the vicinity of such site, and is determined by the Secretary ... to be contaminated with radioactive materials derived from such site." DOE has already found contamination on properties adjacent to the former millsite, is planning to remediate contamination exceeding the standards set by EPA in 40 CFR 192, and is, therefore, meeting the legislative intent of UMTRCA.

These properties appear to be contaminated by windblown tailings or other activities inherent to the millsite operations. The City of Moab is separated from the millsite by the Matheson Wetlands Preserve, Colorado River, and for most of the years since Atlas operated, the limits of the city has been several miles from the site. There is not evidence due to prevailing winds, that windblown tailings would have deposited onto properties located in the city.

In 1971, the EPA surveyed 1,252 properties in the city and indicated 130 properties with gamma anomalies. In 2005, DOE performed gamma-screening surveys on 17 of these properties, the majority of which EPA had noted contained tailings. Most of the properties surveyed either did not have elevated gamma readings above background or had visible ore. The other properties had elevated gamma readings with some ore or elevated readings that could not be explained; however, there was no visual evidence or history that tailings from the Atlas millsite had been placed on the property.

In conclusion, for properties in the city, unless there was factual evidence that tailings left the Moab site and were used on a property, they will not be considered further for inclusion into the remedial action program. Properties adjacent to the millsite will be surveyed, if the owners agree, as there is sufficient evidence that tailings spilled over boundaries or were deposited by wind or erosion.

3. Field Procedures

A recommendation of inclusion or exclusion begins with collecting information about the property from historical EPA gamma surveys and from homeowner interviews before performing a field investigation. If there is strong evidence that tailings left the millsite and were deposited on the property, then additional field testing will be performed.

The field investigation requires making measurements of one or all of the following: gamma exposure rate, radium concentration in soil, isotopic concentrations in the materials, visual

characteristics, or radon decay product concentration (RDC) in air. The field investigation also requires completion of field forms to help assure that all necessary data are collected to defend the recommendation of inclusion or exclusion. Following the field investigation, a report is written to describe the survey results. Much of the report is a previously approved boilerplate that will produce reports, which are of consistent quality from investigation to investigation.

Conditions on the property will be compared to criteria for exterior deposits and interior deposits based on the EPA standards (40 CFR 192, page 2 of text) and the *UMTRA Vicinity Properties Management and Implementation Manual*, Appendix A, "Inclusion Criteria and Procedures."

The exterior parameters to be evaluated include gamma exposure-rates and radium-226 (Ra-226) concentration in soils, if it is attributed to tailings from the millsite.

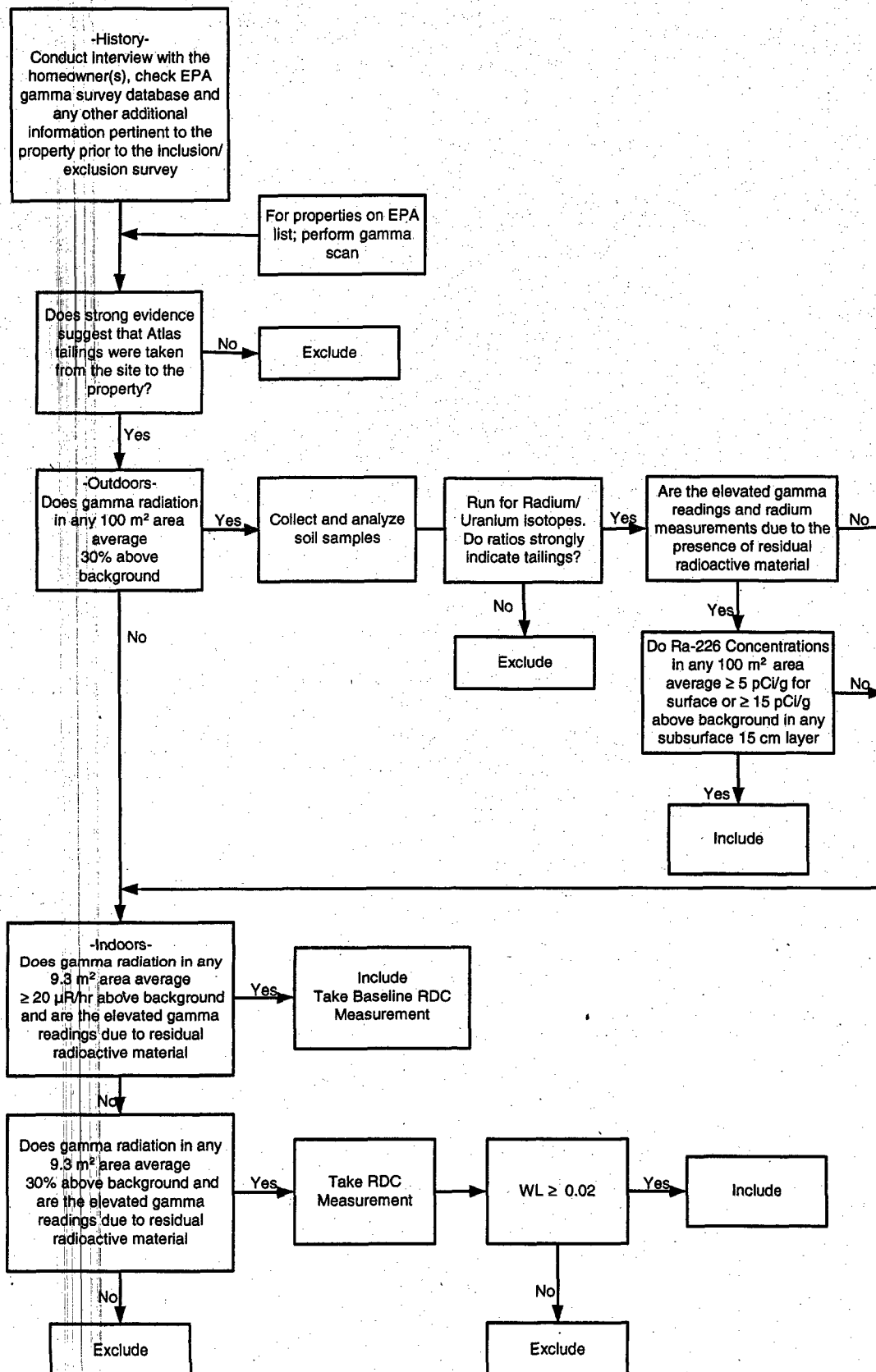
1. The net area-weighted average level of gamma radiation shall not exceed the background level by more than 30 percent in land averaged over any area of 100 square meters (m^2), it will be sampled.
2. The concentration of Ra-226 in land averaged over any area of 100 m^2 shall not exceed the background level by more than:
 - 5 picocuries per gram (pCi/g), averaged over the first 15 centimeters (cm) of soil below the surface; and
 - 15 pCi/g averaged over 15 cm thick layers of soil more than 15 cm below the surface.
3. Isotopic data will be analyzed to determine if uranium/radium isotopes are shown to be in equilibrium, indicating ore; or out-of-equilibrium, indicating tailings.

The interior parameters to be evaluated are gamma exposure-rates and RDC in air, if it is attributed to tailings from the millsite.

1. The net area-weighted average level of gamma radiation shall not exceed the background level by more than 20 microroentgens per hour ($\mu R/h$) averaged over any area of 9.3 m^2 .
2. An annual average (or equivalent) RDC (including background) not to exceed 0.02 working level (WL).

3.1 Decision Tree

The following page contains the decision tree to be used to determine the basis for recommending inclusion or exclusion. The decision tree will be applied to the data gathered for the exterior, if applicable, then to the data gathered for the interior. The decision tree is designed to provide a logical decision flow through the field data to determine if there are sufficient data to recommend inclusion or exclusion of the property.



Decision Tree for Interior and Exterior

3.2 Homeowner Consent, Interview, and Photograph

Before any radiological or land surveys are started, a consent for access must be obtained. When the location of the property, owner, and tenancy are confirmed, a Consent Form (Figure 1) must be signed by the owner(s).

The homeowner is interviewed to gather the owner data displayed in the top portion of the Survey Site Information Sheet (Figure 2); all structures are noted. A photograph of the property is taken that shows the improved portions. The photo is labeled with the property identification, date of photograph, name of photographer, and the direction the photographer was facing.

The homeowner will be asked what knowledge they have of the history of the property to try to determine whether tailings might be present on the property. In addition, the EPA gamma scan database will be checked to see what anomalies were cited. Additionally, such items as proximity to known ore-buying stations will be noted.

3.3 Exterior Gamma Scan

A land survey crew will produce a drawing of the property showing all of the major improvements and property lines on the property. The radiologic survey crew will then use this drawing as a field map. The improved portions of the property will be completely gamma scanned and elevated gamma readings greater than 30-percent above background as well as background ranges for the remainder of the property will be recorded on the field map. The areas exceeding the 30-percent above background readings will then be screened and possibly investigated to determine if any of the areas exceed EPA exterior soil criteria. If no elevated gamma exposure rates are found on the property, the property will be excluded for exterior contamination. Areas that are elevated shall be investigated further to determine if the material is tailings related. Factors to consider include history of the property, visual data (discernable color, chunks of rock), and isotopic data.

Occasional point sources may be encountered. These point sources may consist of ore, dinosaur bones, radium dial watches, or personal collectible items. These items will be evaluated for high gamma exposure rates and in-situ Ra-226 concentrations. The results of the measurements and a complete description of the items will be shown in the report; however, point sources will not affect the inclusion/exclusion decision.

3.4 Exterior Soil Samples

To determine if the EPA standard for Ra-226 in soil is exceeded, a surface (0–15 cm) and subsurface (15–30 cm) soil sample is gathered at the location of the Highest Outdoor Gamma (HOG) provided the HOG exceeds $\geq 25 \mu\text{R/h}$ above background averaged over 100 m^2 . Additional soil samples are also gathered at the next highest area of exterior gamma of the same deposit at least 1 meter away from the first sample. These samples will be analyzed and the results averaged to determine the net estimated area-weighted average concentration (See Section 3.2). Samples are recorded on the Delta/Soil Sample Data Form (Figure 3) as well as the field map (Figure 4). If the 0–15 cm or the 15–30 cm soil samples exceed the EPA standard for Ra-226, no further soil samples will be collected and the property will be recommended for inclusion based on exterior criteria. If the soil samples do not exceed the EPA standard, the property will be excluded based on exterior criteria.

3.5 Interior Gamma Scan and RDC

Interior surveys are performed by scanning with gamma scintillometers at a distance of approximately 2 inches from floors and walls. The interior background value for a structure shall be the midpoint of the gamma-exposure rate range measured in an uncontaminated area of the structure. Gamma-scan data is used to identify interior areas associated with the following exposure rate ranges:

- Background to 30 percent above background,
- 30 percent above background to 20 $\mu\text{R/h}$ above background, and
- Greater than 20 $\mu\text{R/h}$ above background.

The boundaries of these areas are recorded on the field map of the structure with a range showing the highest and lowest gamma exposure rate measured within each area (Figure 5).

If the gamma exposure rates are elevated above background levels, but do not exceed interior gamma inclusion criteria, the property will be excluded.

If there are no gamma exposure rates that exceed 30 percent above background levels, the property will be excluded based on interior criteria.

3.6 Spillover Material

While performing inclusion/exclusion surveys, all spillover type deposits onto adjacent properties should be evaluated (with permission of the owner) to determine if the spillover material is sufficient to recommend inclusion to DOE. This evaluation may be accomplished through gamma scans and/or soil samples.

3.7 Inclusion Boundaries

Moab VP inclusion boundaries define the area where the survey is conducted. The property boundary shall be the primary basis for the inclusion boundary. The legal property boundary, if known, may be modified in the following situations:

- If a common usage boundary has been established between properties, such as a fence that is different from legal property boundary, the common usage boundary shall be used.
- If the property boundary is adjacent to an unpaved road or unpaved alley, the inclusion boundary shall be extended to the edge of the road or center of an unpaved alley.

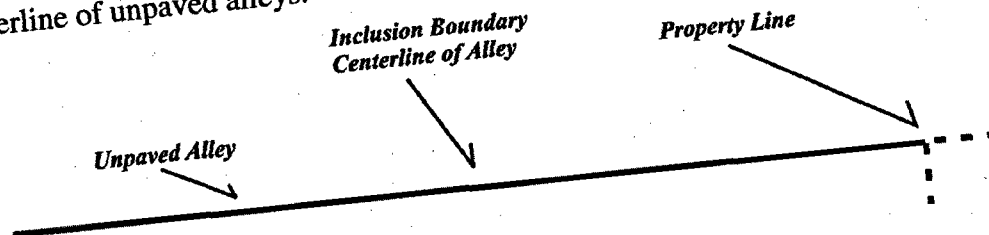
If the property boundary is contiguous to a paved road or paved alley, the inclusion boundary shall:

- Be extended to the asphalt if there is a monolithic sidewalk, curb, and gutter structure;
- Be extended to sidewalks detached from the paved road, curb, or gutter if the City has requested that newly installed sidewalks not be disturbed;
- Be extended to the curb if there is a sidewalk that is attached, but poured separately from the curb and gutter, and removal of the sidewalk has been approved by the City; or

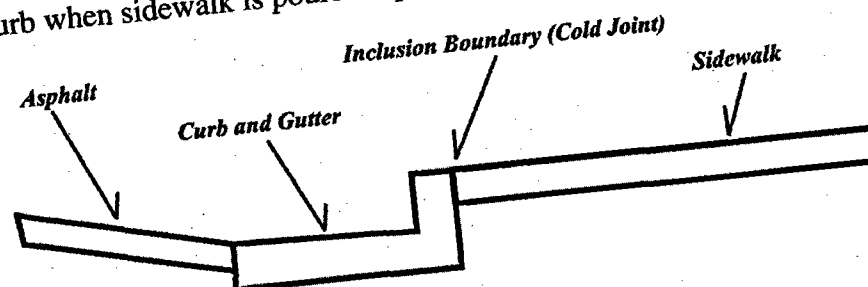
- Be extended to the pavement if there is no curb or gutter and removal of any existing sidewalk has been approved by the City.

Examples of inclusion boundaries are as follows:

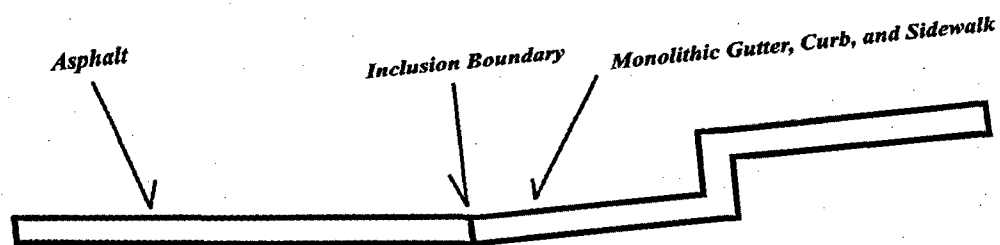
- Centerline of unpaved alleys.



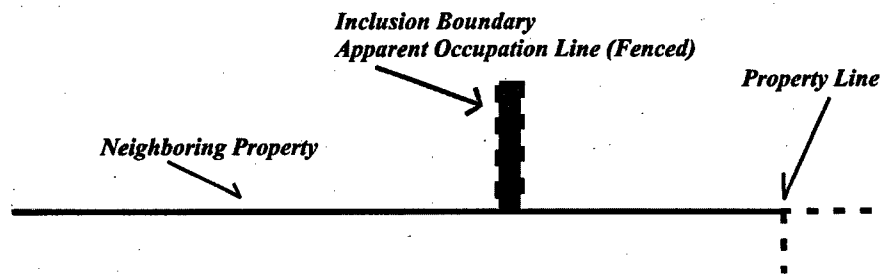
- Back of curb when sidewalk is poured separately from the curb and gutter.



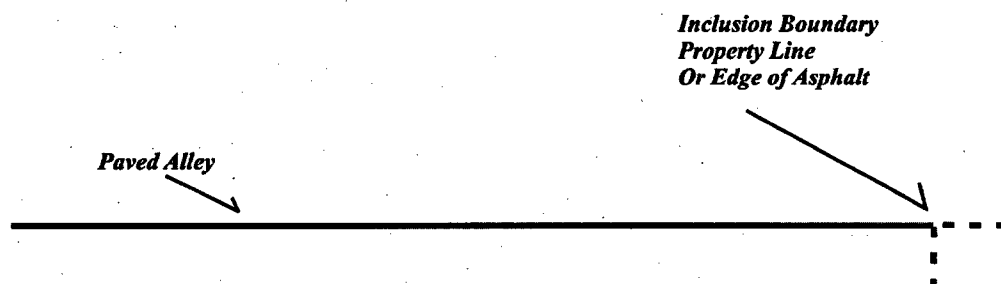
- Lip of gutter when the sidewalk, curb, and gutter are poured monolithically.



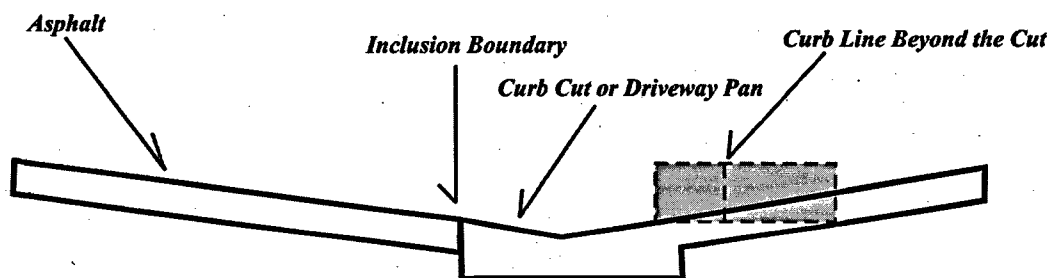
- Apparent line of land usage on property sides.



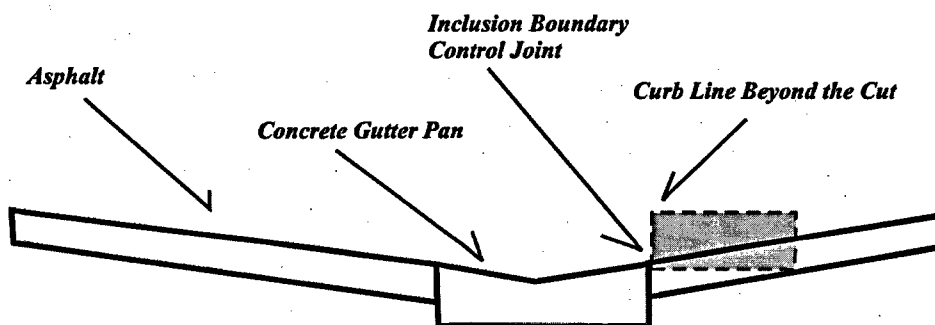
- Edge of asphalt of paved alleys.



- Gutter pan is monolithic with curb cut or driveway pan.



- Gutter pan is separate from curb cut or driveway pan.



4. Formulas Used

4.1 Gamma Exposure Rates

The formula used to calculate the net area-weighted average gamma exposure rate is:

$$G_{AW} = \sum_{i=1}^n \frac{G_i \times A_i}{X}$$

G_{AW} = the net area-weighted average gamma exposure rate ($\mu\text{R/h}$)

G_i = a series of average gamma exposure rates less background ($\mu\text{R/h}$)

A_i = a series of areas within regions of contamination (m^2)

X = threshold area (100 m^2 for exterior and 9.3 m^2 for interior)

Example

An interior has two areas within a 9.3 m^2 area. One area is 1.1 m^2 and has an average gamma exposure-rate of $35 \mu\text{R/h}$. Another area is 1.9 m^2 and has an average gamma exposure-rate of $42 \mu\text{R/h}$. The background gamma exposure-rate for the room is $15 \mu\text{R/h}$. What is the net area-weighted average gamma exposure-rate and does the interior exceed 30-percent above background?

First find the net gamma exposure rates for the two areas by subtracting the background from both:

$$\text{first area } (35 \mu\text{R/h} - 15 \mu\text{R/h}) = 20 \mu\text{R/h}$$

$$\text{second area } (42 \mu\text{R/h} - 15 \mu\text{R/h}) = 27 \mu\text{R/h}$$

Insert the numbers into the formula:

$$G_{AW} = \frac{(20 \mu\text{R/h} \times 1.1 \text{ m}^2) + (27 \mu\text{R/h} \times 1.9 \text{ m}^2)}{9.3 \text{ m}^2}$$

$$G_{AW} = 8 \mu\text{R/h} \text{ (Net area-weighted average gamma exposure-rate)}$$

This value is less than $20 \mu\text{R/h}$ above background averaged over 9.3 m^2 ; however, it is greater than 30-percent above background averaged over 9.3 m^2 or $(0.3 \times 15 \mu\text{R/h}) = 4.5 \mu\text{R/h}$. Annual average RDC measurements shall be taken to determine if the property will be recommended for inclusion or exclusion.

4.2 Exterior Net Estimated Area-Weighted Average Ra-226 Concentration

The formula used to calculate the net estimated area-weighted average Ra-226 concentration in a 0.15-meter (6-inch) soil layer is:

$$C_{AW} = \sum_{i=1}^n \frac{C_i \times A_i \times D_i}{100}$$

C_{AW}	=	the area-weighted average Ra-226 concentration (pCi/g)
C_i	=	a series of average Ra-226 concentrations less background (pCi/g)
A_i	=	a series of areas within regions of contamination (m^2)
D_i	=	a series of depths of samples (m)
100	=	the area used in average (m^2)

Example

Three exterior deposits were found within the trailer-house rule of 100 m^2 area. The deposits were 5 m^2 , 10 m^2 , and 43 m^2 . The two surface soil samples were gathered from the HOG and the next highest HOG in each of the three deposits and the contamination does not appear to extend deeper than 15 cm. The average gross Ra-226 concentrations of the deposits were 44.0 pCi/g, 12.0 pCi/g, and 6.0 pCi/g, respectively. Does this 100 m^2 -area exceed the net estimated area-weighted average Ra-226 concentration?

The first part of the problem will be solved using the net estimated area-weighted average Ra-226 concentration in soil formula. Background will not be subtracted through the use of the OCS system. Background will be subtracted from the Ra-226 concentrations of the deposits if the analytical laboratory is used in place of the OCS system.

$$C_{AW} = \frac{(44.0 \text{ pCi/g} \times 5 \text{ m}^2) + (12.0 \text{ pCi/g} \times 10 \text{ m}^2) + 6.0 \text{ pCi/g} \times 43 \text{ m}^2}{100}$$

$$C_{AW} = 6.0 \text{ pCi/g}$$

This value is greater than EPA standard of 5.0 pCi/g Ra-226 when averaged over 100 m^2 and the property would be recommended for inclusion.

5. Inclusion/Exclusion Report

After the field measurements are gathered, a report is written to make and support the recommendation of inclusion or exclusion. The Inclusion/Exclusion Report consists of a Summary of Evaluation/Findings (Figures 6 through 8) and a Report of Inclusion/Exclusion (Figures 9 through 14).

5.1 Table of Evaluation/Findings

The Table of Evaluation/Findings includes a summary of findings for the property, the evaluation scope, and the specific standards or guidelines that were exceeded. It consists of:

- Vicinity Property Summary Evaluation and Findings (Figure 6)
- Contractor Findings (Figure 7)
- U.S. Department of Energy Evaluation (Figure 8)

5.2 Report of Inclusion/Exclusion

The Report of Inclusion/Exclusion (Figures 9 through 14) contains Stoller's recommendation for inclusion or exclusion and discusses the basis for that recommendation. The report includes:

- Report of Radiological Survey (Figures 9 through 11)
- Property/Owner Information (Figure 12)
- Table of Radiological Screening Survey Results (Figure 13)
- Table of Extended Survey Results (Figure 14)

6. Records

Records that may be generated by this procedure include:

- Site Survey Information Sheet
- Field Measurement Data forms
- Field Maps (Procedure 2.0)
- Summary of Evaluations and Findings
- Report of Inclusion/Exclusion
- Owner Consent Form
- Property Photographs
- Table of Radiological Screening Survey Results
- Table of Exterior Radiological Survey Results and Data

All records will be placed in the property folio or forwarded to Records Management for inclusion in the property folio.

7. References

The following references contain information used in the development of this procedure.

Vicinity Properties Management and Implementation Manual, Revision B, April 29, 1985

Basic Radiation Protection Technology, 3rd Edition, Daniel A. Gollnick

Environmental Implementation Guide for Radiological Survey Procedures, Draft, November 1992, U.S. Department of Energy

8. Definitions

Contamination—The presence of unwanted radioactive material.

EPA Standards—Standards for cleanup of land and buildings contaminated with residual radioactive materials from inactive uranium processing sites (40 CFR 192, page 2 of text).

Extended Measurements—Soil samples, concrete sampling, indoor RDCs, or media sampling that requires an extended time period for analysis or data collection.

HIG—Area displaying the highest inside gamma exposure-rate measurement.

HOG—Area displaying the highest outside gamma exposure-rate measurement.

Point Source—An area that displays sharp increases in the gamma exposure-rate measurements and can be attributed to rocks (ore), dinosaur bones, radium-watch dials, or other like items.

RDC—Radon decay-product concentration expressed as a working level (WL). The formal definition of WL is any combination of short-lived radon decay-products in 1 liter of air that will result in the emission of 1.3×10^5 MeV of potential alpha energy. (It is usually easier to measure the Ra-222 and not the decay-product concentrations. The conversion is 100 picocuries per liter (pCi/L) = 1 WL for equilibrium. In Moab, an equilibrium factor of 50-percent is assumed, thus a 4.0 pCi/L Ra-222 concentration converts to 0.02 WL.)

Spillover—Contamination that is identified on the parent property and is contiguous with a deposit on one or more adjacent properties.

Trailer-House Rule—The minimum dimensions that should be used in combining deposits to evaluate a 100 m²-area. The trailer-house rule uses an area of 15 by 70 feet, or the approximate area occupied by a residential mobile home.

**CONSENT FOR ACCESS TO CONDUCT SURVEYS
AND ENGINEERING STUDIES**

***VICINITY PROPERTY NO.:**

***PROPERTY ADDRESS:**

***PROPERTY PARCEL NUMBER OR DESCRIPTION:**

I (We) acknowledge that I (we) own the property described above and grant permission to employees, contractor, and subcontractor personnel and other representatives of the U.S. Department of Energy (DOE) to enter upon the property at a reasonable time during the next 26 months to conduct radiation surveys to determine the nature and extent of any radioactive material that may be present. In addition, permission is given to perform engineering assessments, if necessary, to evaluate the measures that might be taken, as well as to evaluate the extent of the work required and the cost.

I (We) understand that DOE's responsibility for any damage or disturbance to my (our) property caused by the survey and engineering activities shall be any backfilling, seeding, sodding, landscaping, rebuilding, or repair of the property required to restore it to a condition comparable to its apparent physical condition immediately prior to entry upon the property.

I (We) understand that the DOE is not obligated to perform remedial action upon the property. I (We) understand that no remedial action shall be performed until the DOE and the property owner have entered into a separate written agreement setting forth the terms, conditions, and plans for remedial action.

I (We) understand that the DOE has the right to disclose to the public, in the form of technical data and reports, the results of its data gathering on the above-described property.

- ☐ I grant access for the conduct of surveys and engineering studies as provided in the consent for access.
- ☐ I have decided not to participate in the project.

<div style="border-bottom: 1px solid black; margin-bottom: 5px;">Signature of Owner(s)</div> <div style="display: flex; justify-content: space-between;"><div style="width: 45%;"><p>NAME: <input style="width: 90%;" type="text"/></p><p>STREET: <input style="width: 90%;" type="text"/></p><p>CITY, STATE: <input style="width: 90%;" type="text"/></p><p>HOME PHONE: <input style="width: 90%;" type="text"/></p><p>BUSINESS PHONE: <input style="width: 90%;" type="text"/></p></div><div style="width: 45%;"><p>NAME: <input style="width: 90%;" type="text"/></p><p>HOME PHONE: <input style="width: 90%;" type="text"/></p><p>BUSINESS PHONE: <input style="width: 90%;" type="text"/></p><p>COMMENTS: <input style="width: 90%;" type="text"/></p></div></div>	<div style="border-bottom: 1px solid black; margin-bottom: 5px;">Date</div> <div style="border-bottom: 1px solid black; margin-bottom: 5px;"></div> <div style="border-bottom: 1px solid black; margin-bottom: 5px;"></div> <div style="border-bottom: 1px solid black; margin-bottom: 5px;"></div> <div style="border-bottom: 1px solid black; margin-bottom: 5px;"></div>
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***To be completed by project participants.**

Figure 1. Owner Consent Form

SURVEY SITE INFORMATION

Survey Date: _____

Site Number: _____

Owner Data

Name: _____

Location: _____

Address: _____

Phone: _____

Land Use

Residential ?

Single Family ?
Multi Family ?

Commercial ?

Retail Store ?
Office ?
Manufacture ?
Hotel/Motel ?

Public Building ?

School ?
Church ?

Vacant Lot ?
Open Land ?

Other _____

Description _____

Number of Structures: _____

Type of Construction (Number of levels, frame/masonry, basement/crawl space/slab on grade, etc.):

Building 1: _____

Building 2: _____

Building 3: _____

Building 4: _____

Photograph(s)

Film Roll Number: _____

Frame No.	Compass Direction Looking:	At	Description
Frame No. _____	Looking: _____	At _____	_____
Frame No. _____	Looking: _____	At _____	_____
Frame No. _____	Looking: _____	At _____	_____
Frame No. _____	Looking: _____	At _____	_____

Spillover to Adjacent Property: ☐ Yes ☐ No

Spillover Property Address: _____

Figure 2. Survey Site Information Sheet

DELTA/SOIL SAMPLE DATA FORM

Survey Date: _____

Site Number: _____

Interior ? Exterior ?

Sample Location: _____ Area Represented: _____ m²

Visible Ore: Yes ? No ?

Background Sample: Yes ? No ?

Visible Tailings	Sample Number	Depth (m)	Delta pCi/g	Gamma cps	Gamma μ R/h	Ra-226 pCi/g
		Surface				
		0.15				

Sample Location: _____ Area Represented: _____ m²

Visible Ore: Yes ? No ?

Background Sample: Yes ? No ?

Visible Tailings	Sample Number	Depth (m)	Delta pCi/g	Gamma cps	Gamma μ R/h	Ra-226 pCi/g
		Surface				
		0.15				

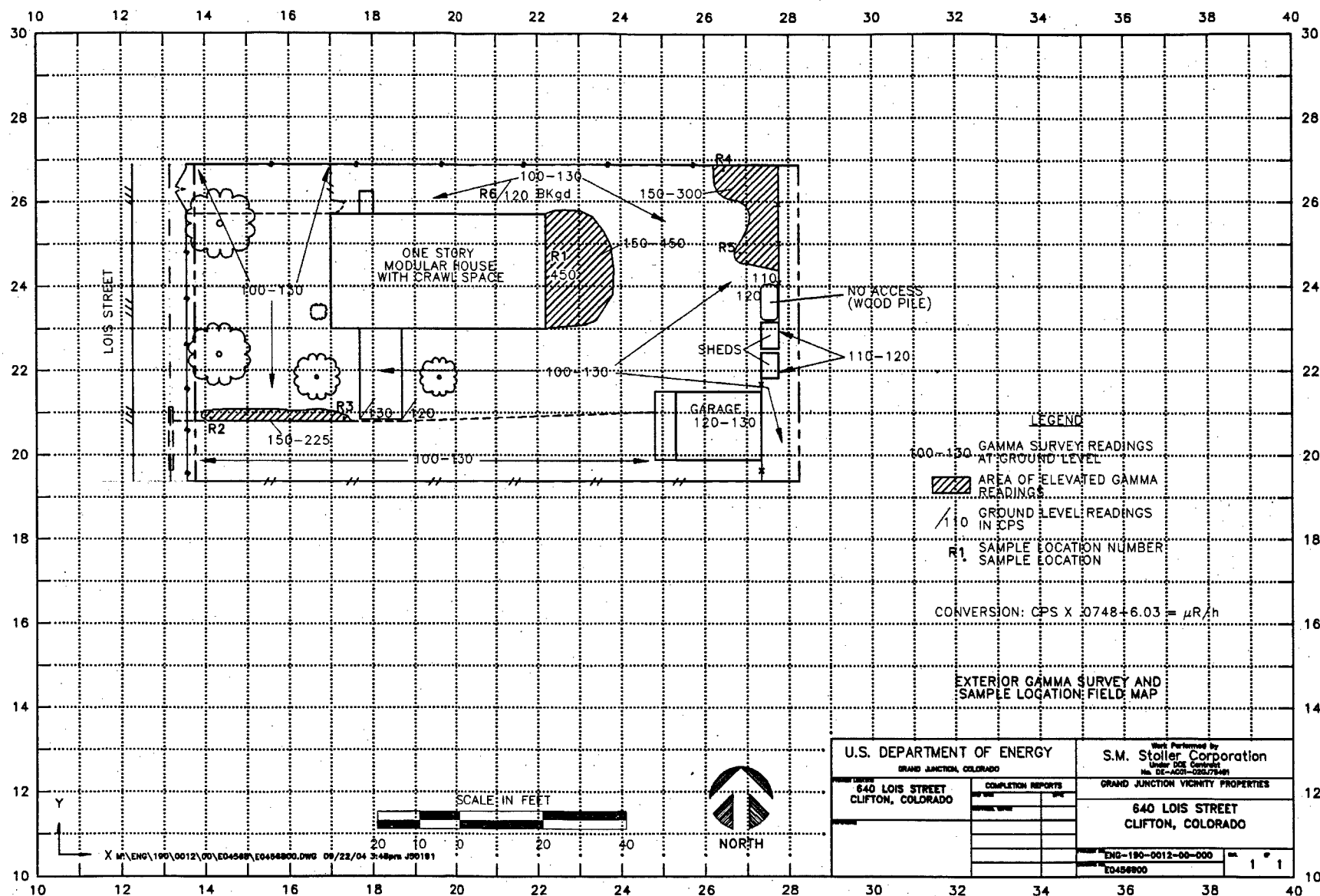
Sample Location: _____ Area Represented: _____ m²

Visible Ore: Yes ? No ?

Background Sample: Yes ? No ?

Visible Tailings	Sample Number	Depth (m)	Delta pCi/g	Gamma cps	Gamma μ R/h	Ra-226 pCi/g
		Surface				
		0.15				

Figure 3. Delta/Soil Sample Data Sheet



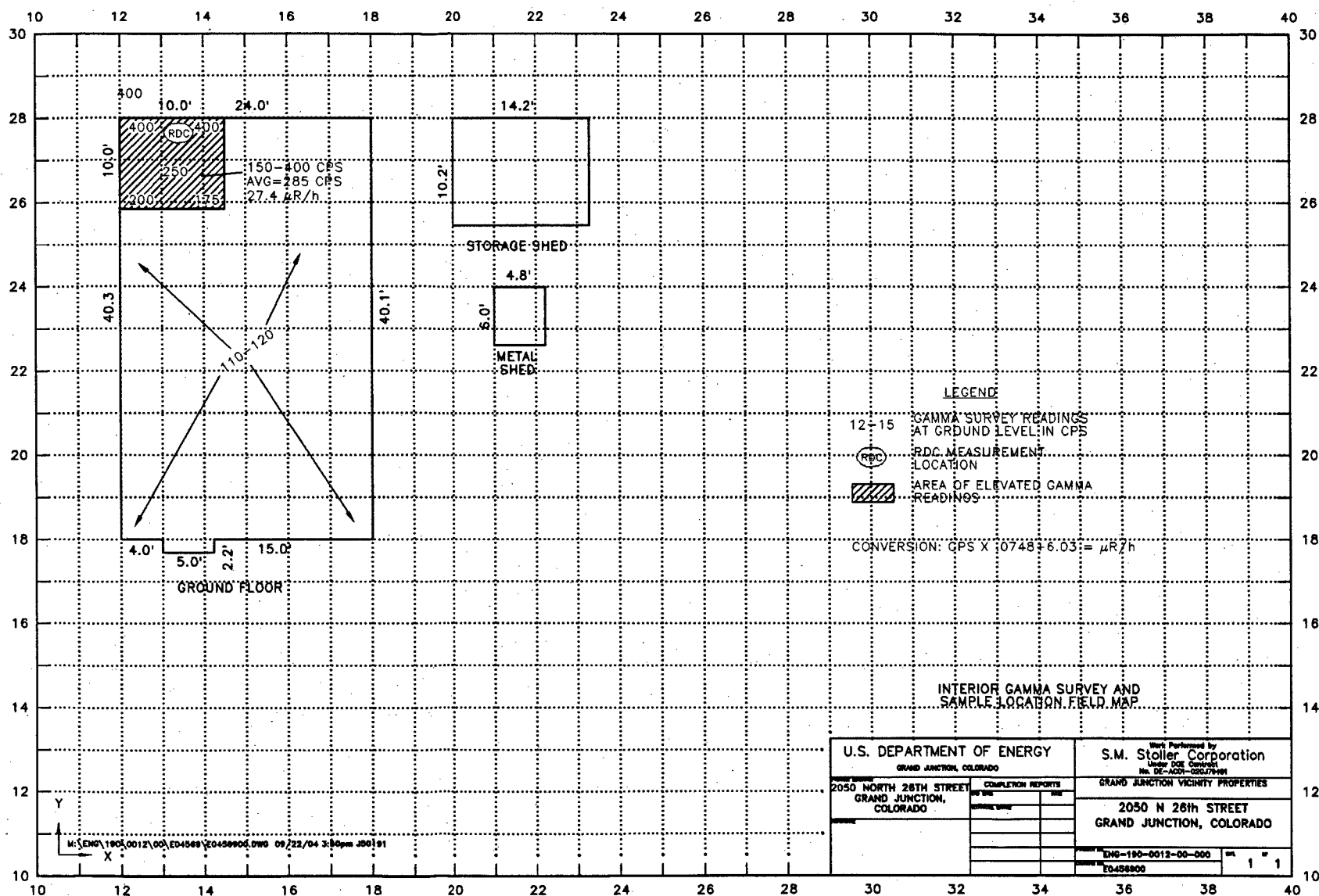


Figure 5. Interior Gamma Survey and Sample Location Field Map

DOE ID No. _____

Address: _____

VICINITY PROPERTY SUMMARY EVALUATION AND FINDINGS

1.0 Summary Evaluation

	Inclusion Survey Contractor			U.S. Department of Energy (DOE)		
	Yes	No	Not Taken*	Yes	No	Not Taken*
1.1 Exterior Measurements						
Gamma is > 25 μ R/h above background averaged over 100 m ²						
Gamma is less than 30% above background averaged over 100 m ²						
Radium-226 is > 5 pCi/g above background in top 15 cm layer averaged over 100 m ²						
Radium-226 is > 15 pCi/g above background in any subsurface 15 cm layer averaged over 100 m ²						
1.2 Interior Measurements						
Gamma is > 20 μ R/h above background averaged in any room (9.3 m ²)						
Gamma is less than 30% above background in all rooms						
Annual average radon decay-product concentration is < 0.02 working level						

Other: _____

*Data was not taken because:

☐ Data were not required to derive the findings.

☐ Property owner did not authorize access for interior sampling.

Figure 6. Vicinity Property Summary Evaluation and Findings

DOE ID No. _____

Address: _____

2.0 Contractor Findings

The following table shows the property that was investigated by S.M. Stoller Corp. to determine whether the radiation levels exceed the guidelines specified by EPA for residual radioactive material at UMTRA vicinity properties. The table also shows S.M. Stoller Corp. evaluation and DOE's evaluation for this property.

Summary Table of Evaluation

DOE ID Number	S.M. Stoller Corp. Evaluation Exceeds Guidelines		DOE's Evaluation		
	Yes	No	Exceeds Guidelines Yes	No	Additional Data Required
	[]	[]	[]	[]	[]

Based on S.M. Stoller Corporations evaluation:

- ☐ This property is recommended for inclusion.
- ☐ This property is recommended for exclusion.

Toby Wright
Moab Project Manager

Date

U.S. Department of Energy Evaluator

Date

Figure 7. Contractor Findings

DOE ID No. _____

Address: _____

3.0 U.S. Department of Energy Evaluation

3.1 Additional Data Required:

3.2 S.M. Stoller Corp. Response to Request for Additional Data:

3.3 DOE Approval or Response:

Based on DOE's review of this evaluation, including the further information provided by S.M. Stoller in Section 3.2 above, the recommendation for the above property is listed below:

U.S. Department of Energy Evaluator

Date

Figure 8. U.S. Department of Energy Evaluation

FIELD ASSESSMENTS SECTION

REPORT OF INCLUSION/EXCLUSION

FOR

GJ-00410

GRAND JUNCTION, COLORADO

Submitted: June 16, 1995

**Prepared for
U.S. Department of Energy**

**Prepared by
S.M. Stoller
Grand Junction, Colorado**

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Radiological Screening Survey Results - Interior Screening

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Figure 9. Example of Report of Inclusion/Exclusion

Report of Radiological Survey

1.0 Introduction

A radiological screening survey of DOE ID number GJ-00410 was conducted by S.M. Stoller. This survey was conducted using methods, as defined in the *Vicinity Properties Management and Implementation Manual*, UMTRA-DOE/AL-050601 (March 1988) and the S.M. Stoller *Field Assessments Procedures Manual*.

The radiological survey of this property included gamma scans of the entire ground surface (interior and exterior), samples of exterior soil, and evaluation of historical data when present. An assessment also was performed on this property to determine the aeral and vertical extent of contamination. The results of the radiological assessment are shown in the Appendix A.

2.0 Summary of Recommendation

DOE ID number GJ-00410, located at 164 South Street, is recommended for inclusion based on the following:

- Radium-226 concentration is greater than 5.0 pCi/g above background in the surface 15-cm soil layer averaged over 100 m².

3.0 Results and Conclusions

This property was previously excluded by the DOE based on Oak Ridge National Laboratory's recommendations; however, during the assessment investigation of GJ-00222-RS, located at 252 South Street, contamination was found to spill over on to this property in sufficient concentration to recommend inclusion.

The exterior background gamma exposure rate is 13 μ R/h; the interior background gamma exposure rates for the two story rock and frame house is 13 μ R/h. Seven regions of exterior elevated gamma exposure rates were found and labeled Regions E1 through Regions E7 (Appendix A, Figure 1). For brevity, Region E1 was the only region used for evaluation to determine the inclusion/exclusion recommendation. This region has the greatest potential for exceeding the U.S. Environmental Protection Agency (EPA) guidelines.

Figure 10. Example of Report of Radiological Survey

Two soil samples collected from Region E1 (Location Numbers R1 and R13, Figure 1, Appendix A) yielded a net area-weighted average radium-226 concentration of 138.1 pCi/g. This value is greater than the EPA guideline of 5.0 pCi/g above background for surface soil averaged over 100 m². The gross radium-226 concentration results for the soil samples are shown in Table 1, Appendix A.

The soil samples and in-situ measurement results of the remaining regions and the background area are shown in Table 1 of the Appendix A.

Contamination spills over from the south (DOE ID number GJ-00222-RS), located at 252 South Street.

/ljg

Figure 11. Example of Report of Radiological Survey

PROPERTY/OWNER INFORMATION

Page 1 of 1

DOE ID Number: GJ-00410

Property Location: 164 South Street, Grand Junction, Colorado 81501
Property Owner:
Owner Address:
Telephone Number:
Occupant/Tenant:
Telephone Number:
Property Classification: Residence
Total Area of Property: 3,897 m²
Structures on Property: Two story rock and frame house and a metal shed



Looking west

Figure 12. Example of Property/Owner Information

Radiological Screening Survey Results Exterior Screening		
Mean Background Exposure Rate ($\mu\text{R/h}$):	13	
Background Plus30 Percent ($\mu\text{R/h}$):	17	
Exposure-Rate Range in Contaminated Regions ($\mu\text{R/h}$):	Region E1	17-157
Region of Highest Exterior Gamma Exposure Rate ($\mu\text{R/h}$):	Region E1	157
Point Sources (Discussed in Section 3.0):	None	
Estimated Area of Exterior Contamination by Region (m^2):	Region E1	16.4
Net Estimated Area-Weighted Average Gamma Exposure Rate by Region ($\mu\text{R/h}$):	Region E1	12

Radiological Screening Survey Results Interior Screening		
Structure Description or Number:	Two story rock and frame house with basement	
Mean Background Exposure Rate ($\mu\text{R/h}$):	12	
Background Plus30 Percent ($\mu\text{R/h}$):	16	
Region of Highest Exterior Gamma Exposure Rate ($\mu\text{R/h}$):	General	13
Point Sources (Discussed in Section 3.0) :	None	
Net Estimated Area-Weighted Average ($\mu\text{R/h}$):	N/A	

Formula used to calculate the net estimated area-weighted average gamma exposure rate for interior and exterior screening:

$$G_{AW} = \sum_{i=1}^n \frac{G_i \times A_i}{X}$$

- G_{AW} = the net area-weighted average gamma exposure rate ($\mu\text{R/h}$)
 G_i = a series of average gamma exposure rates less background ($\mu\text{R/h}$)
 A_i = a series of areas within regions of contamination (m^2)
 X = threshold area (100 m^2 for exterior and 9.3 m^2 for interior)

Figure 13. Example of Table of Radiological Screening Survey Results

Extended Survey Results Exterior Extended Data			
Sample Location Number:	R1	R13	R9
Region Sampled:	E1		Bkgd
Sample Depth (cm):	15		
Radium-226 Concentration (pCi/g):	1,668.2	19.8	1.0
Representative (Biased) Sampling Area (m ²):	16.4		0
Net Estimated Area-Weighted Average (pCi/g):	138.1		N/A

Formula used to calculate the net estimated area-weighted average radium-226 concentration in soil:

$$C_{AW} = \sum_{i=1}^n \frac{C_i \times A_i \times D_i}{100 \times 0.15}$$

- C_{AW} = the net area-weighted average radium-226 concentration (pCi/g)
- C_i = a series of average radium-226 concentrations less background (pCi/g)
- A_i = a series of areas within regions of contamination (m²)
- D_i = a series of depths of samples (m)
- 100 = the area used in averaging (m²)
- 0.15 = the depth of sample used in averaging (m)

Figure 14. Example of Table of Exterior Radiological Survey Results and Data