DOE-EM/GJTAC1778

Environmental Management - Grand Junction Office

UMTRA Project

Moab UMTRA Project Baseline Gamma Radiation Exposure Rate Survey of a Portion of the Union Pacific Cane Creek Branch Line from Crescent Junction to the Moab Project Site

March 2009

U.S. Department of Energy

Office of Environmental Management

Prepared by the Technical Assistance Contractor under contract number DE-AC30-07CC60012 for the U.S. Department of Energy Office of Environmental Management, Grand Junction, Colorado.

DOE-EM/GJTAC1778

Moab UMTRA Project
Baseline Gamma Radiation Exposure Rate Survey of a Portion of the Cane Creek Branch Rail Line

March 2009

Prepared by the Technical Assistance Contractor under contract number DE–AC30–07CC60012
for the U.S. Department of Energy Office of Environmental Management, Grand Junction, Colorado.

Moab UMTRA Project
Baseline Gamma Radiation Exposure Rate Survey of a Portion of the Cane Creek Branch Rail Line

Revision 0

Review and Approval

for Thomas D. Bachtell 3/25/09

Robert B. Hopping
TAC Vicinity Property Manager

Date

for Thomas D. Bachtell 3/25/09

Joseph D. Ritchey
TAC Senior Program Manager

Date

Accepted by:

Donald R. Metzler 3/26/2009

Donald R. Metzler
DOE Federal Project Director

Date

Revision History

Revision No.	Date	Reason/Basis for Revision
0	March 2009	Initial issue.

Table of Contents

Figures

Photographs

Acronyms and Abbreviations

cps	counts per second
DOE	U.S. Department of Energy
EPA	Environmental Protection Agency
Fm	formation
GPS	global positioning system
GPS/GS	global positioning system/gamma scan
µR/h	microroentgens per hour
NaI	sodium iodide
NORM	naturally occurring radioactive material
pCi/g	picocuries per gram
RAC	Remedial Action Contractor
ROW	right-of-way
RRM	residual radioactive material
TAC	Technical Assistance Contractor
UMTRA	Uranium Mill Tailings Remedial Action
UP	Union Pacific Railroad Company

Executive Summary

A baseline gamma radiation exposure rate survey was performed on the Cane Creek branch line Green River District line junction near the Crescent Junction disposal site to the north portal of the Bootlegger Tunnel at the Moab Project site. The survey was performed extending approximately 9 feet laterally on either side of the center line of the track.

The purpose of the survey was to detect and map areas that displayed gamma radiation exposure rate readings 1.3 times the background value or greater. If anomalous gamma radiation exposure rate readings were observed, then additional observations were made to determine if residual radioactive material (RRM) was present on the Union Pacific Railroad company (UP) Cane Creek branch rail line or if the anomalous gamma readings were caused by the presence of naturally occurring radioactive materials (NORM).

Data were collected during October 2008 using Uranium Mill Tailings Remedial Action (UMTRA) procedures following protocols developed by the U.S. Department of Energy (DOE) Office of Remedial Action and Waste Technology's Technical Measurements Center. The data were evaluated to estimate the extent of contamination from RRM in excess of the U.S. Environmental Protection Agency (EPA) regulations.

The three-array sodium iodide (NaI) gamma probes and associated handheld global positioning system (GPS) units were fixed to a UP truck and suspended approximately 3 feet above the rail bed surface and spaced 6 feet apart using a fabricated "jig" that was made of square metal tubing and used to hold the NaI detectors and handheld GPS units. The UP truck was then operated at a rate of 2 to 3 miles per hour by a UP Track Supervisor. The survey took approximately 4 days to complete.

The elevated readings were found to be from the imported clay materials used to construct the rail bed in combination with igneous (basalt and granite) rock that was used for the track ballast. The granite ballast contains NORM. An outcrop of the Morrison Formation (Fm) that the UP rail runs through was observed south of the Canyonlands Field Airport and displayed gamma radiation exposure rate readings from 17 to 35 microroentgens per hour (μR/h). Slightly elevated gamma readings were observed, as expected, where the railroad passes through the "Big Cut" walled by rocks of the Chinle Fm. Gamma radiation exposure rate readings ranging from 17 to more than 35 μR/h were observed along the track at the Moab Project site which were associated with post ore loading operations.

1.0 Introduction

This report presents the results of a gamma radiation exposure rate survey from the baseline survey performed on the Cane Creek branch line of the UP. The rail line extends south from the Green River District Junction rail line at mile marker 0.00 near the Crescent Junction disposal site to the north portal of the Bootlegger Tunnel at mile marker 28.54 at the Moab Project site. The gamma radiation exposure rate survey was performed on the described rail line and provided 100 percent coverage of the rail extending approximately 9 feet laterally on either side of the center line of the rail.

The purpose of the gamma radiation exposure rate survey was to provide a baseline survey and detect and map areas that displayed gamma radiation exposure rate readings 1.3 times the background value or greater. If anomalous gamma radiation exposure rate readings were detected, then a determination was made as to the cause and to determine if RRM was present on the UP Cane Creek branch rail line or if the anomalous gamma readings were caused by the presence of NORM.

The survey provided a radiologic evaluation of the UP Cane Creek branch rail line prior to the transport of RRM from the Moab Project site to the Crescent Junction disposal site.

Following methods described in the *Field Services Procedures Manual* (STO 203), gamma exposure rate data were collected on October 14 through 16 and completed on October 29, 2008. The data were evaluated to estimate the extent of contamination from RRM in excess of the EPA "Standards for the Control of Residual Radiocative Materials from Inactive Uranium Processing Sites" (40 Code of Federal Regulations 192.02 Subpart A). The measurement techniques, instrumentation, and procedures used in this gamma exposure rate survey are based primarily on protocols developed by the DOE Office of Remedial Action and Waste Technology's Technical Measurements Center and on field implementation experience gained from the characterization of millsites and vicinity properties for the UMTRA Program. Detailed procedures for collecting Global Positioning System/Gamma Scan (GPS/GS) gamma data measurements are presented in the *Field Services Procedures Manual.*

2.0 Background Gamma Exposure Rate and Radiologic Determinations

The background gamma radiation exposure rate and radium-226 concentration for the Moab UMTRA Project site was determined during the radiological characterization investigation conducted in November 2001 and completed in 2005 (*Radiological Assessment for Non-Pile Areas of the Moab Project Site* DOE-EM/GJ901-2005, June 2005). That investigation concluded that the average background gamma radiation exposure rate is 12 μR/h. The background radium-226 concentration is 1.0 picocuries per gram (pCi/g), total uranium is 1.2 pCi/g, and thorium-230 is 0.5 pCi/g.

3.0 Gamma Exposure Rate Survey

The GPS/GS scanning system was used to scan the rail line. The vehicle-based system utilized the Garmin LTD (Garmin Legend™) (wide area augmentation system-enabled [accuracy enhanced]) or equivalent handheld GPS units to report date, time, and location (latitude/longitude) data to a portable computer; at the same time exposure rate data from a series of Ludlum Measurements Inc. Model 2350 dataloggers/44-10-2-inch NaI gamma radiation detectors was recorded by the same computer. The data were jointly reported once per second for plotting using ESRI ArcInfo geographic information system tools and associated proprietary Gamma View™ software developed by MFG Inc., which is now owned by TetraTech, Inc.

The three-array NaI gamma probes and associated handheld GPS units were suspended approximately 3 feet above the rail bed surface and spaced 6 feet apart using a fabricated "jig" that was made of square metal tubing and used to hold the NaI detectors and handheld GPS units. The jig was attached via a modified receiver hitch attachment and nylon/ratchet tie-down straps to the rear of a UP-owned "Hy-Rail" equipped pickup. The Ludlum Model 44-10 NaI detectors and Garmin™ GPS units were cabled from the Ludlum Model 2350 data collectors and a multiple universal serial bus hub affixed to the rear of the truck and then to the pen-top computer that was carried inside the cab of the truck (Photo 2A). The UP truck was then operated at a rate of 2 to 3 miles per hour by a UP Track Supervisor. The survey took approximately 4 days to complete.

When gamma radiation exposure rates exceeded 1.3 times the background value, further investigation of the anomalous readings was performed using handheld Mount Sopris Instrument Co. (Model SC-132) crutch-type gamma scintillometers. These data, in combination with the exposure rate data from the Ludlum 2350/44-10 instruments, were then evaluated to assess the source of the elevated gamma radiation readings. Additional visits were made by the Technical Assistance Contractor (TAC) project staff to specific portions of the survey area (rail) to further evaluate elevated exposure rate readings that were recorded. The Mount Sopris instruments measure gross gamma radiation in counts per second (cps) and are cross-correlated with a pressurized ionization chamber to determine the correction factors used to convert the raw data to true gamma radiation exposure rates, i.e., µR/h. The Ludlum 2350/44-10 instrumentation collects and displays all survey data in exposure rates, ie., µR/h, and are calibrated to read as such from the manufacturer.

4.0 Survey Results

Gamma radiation exposure rate readings ranged from background values (12 to 13 µR/h) to approximately 30 percent above background (16 to 17 µR/h) which were observed and recorded for the first part of the UP rail survey south of mile marker 0.00 to approximately mile marker 6.00 (see Figure 1A). Slightly elevated gamma readings for a small portion (approximately 0.5 mile) of the rail depicted in Figure 1A were noted and were due to imported granite fill used for track ballast and riprap to fill and stabilize a small portion of the track that had been affected by a previous wash-out due to flooding conditions (Photo 2B). The granitic ballast/riprap material contains NORM (typically uranium) and is not associated with RRM originating from the Moab site.

Gamma radiation exposure rate readings ranging from 17 to 25 μR/h were observed north of the Canyonlands Field Airport (Figure 1B). A revisit to this portion of the rail bed following the original rail survey was performed with a sample of the clay material used to construct the rail bed. The material was analyzed using the Opposed Crystal System counting system and contained a Radium-226 concentration of 3.2 pCi/g. The elevated readings were found to be from the imported clay materials used to construct the rail bed in combination with igneous (basalt and granite) rock that was used for the track ballast (Photo 2C). The elevated exposure rate readings observed, from the use of the described track bed and ballast materials, extended for approximately 2.25 miles in this general track area.

The material appears to be NORM-related and not RRM originating from the Moab site. An outcrop of the Morrison Fm that the UP rail runs through was observed south of the Canyonlands Field Airport and displayed gamma radiation exposure rate readings from 17 to 35 μR/h (see Figure 1B). At the time of the survey, this area was further investigated using hand held crutch-type scintillometer instruments and found to contain NORM-related material to 800 cps (65 μR/h). The Morrison Fm typically contains volcanic ash and as a result may have elevated levels of uranium present (Photos 2D and 2E). These elevated uranium levels are due to NORM-related materials and not a result of RRM-related materials originating from the Moab site.

To the south of the crest of the topographic rise near Seven-mile Hill (intersection of State Highway 191 and State Route SR 313) (Photo 2F), the UP rail transects the Chinle Fm as it approaches the Moab site. The Big Cut (see Figure 1C) exposure rate readings that were observed while performing the rail survey ranged from 17 to 25 μR/h. In places, the actual vertical cut for the rail bed through the Chinle approached 100 feet in depth (Photo 2G). Due to the slightly elevated gamma readings associated with the Chinle Fm combined with the "scatter effect" as a result of the geometry and limits in the measurement of the gamma radiation associated with the deep, solid, rock cut through the Chinle Fm, the observed exposure rate readings were normal, and to be expected.

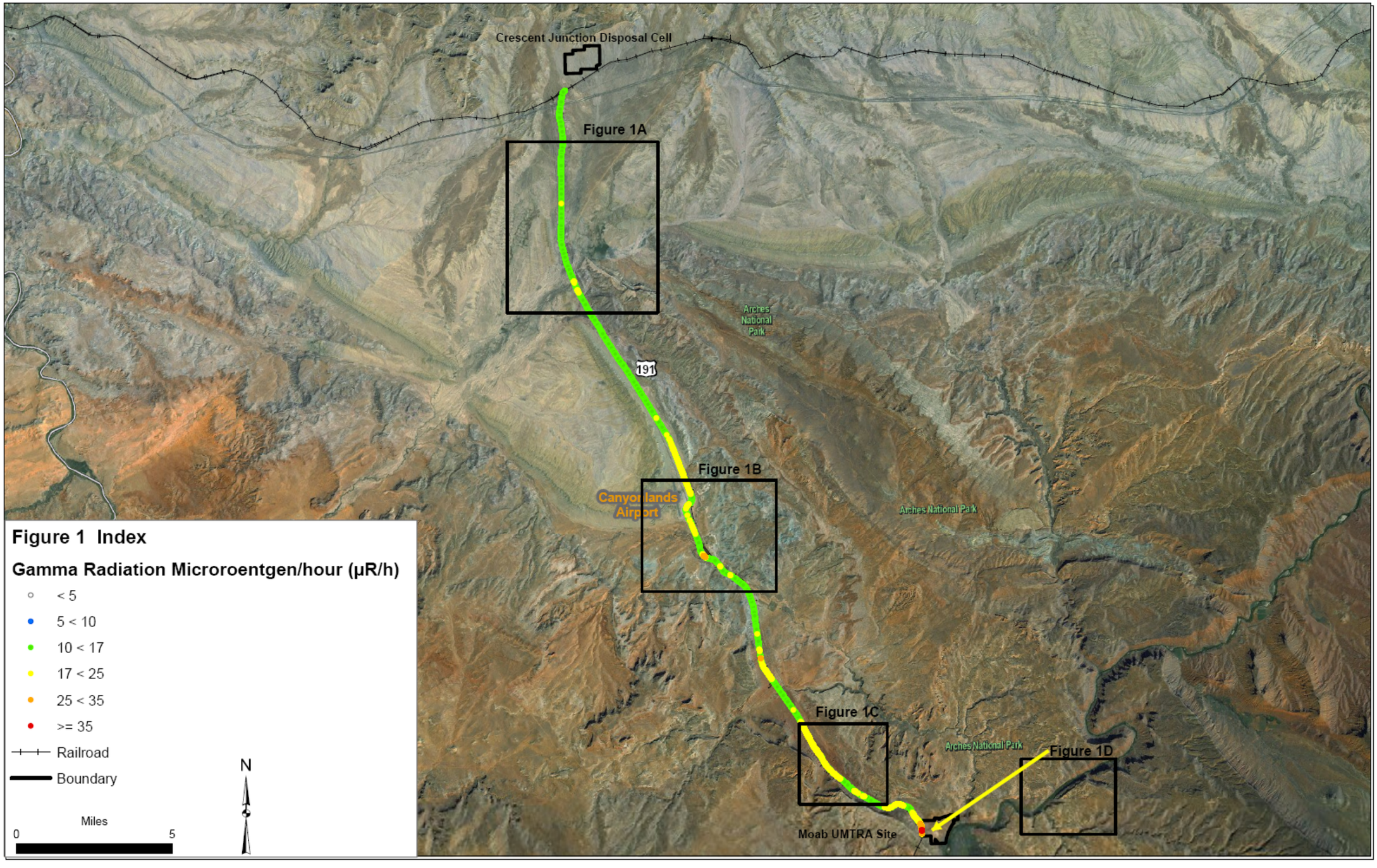
Gamma radiation exposure rate readings ranging from 17 to more than 35 μR/h were observed along the UP branch line during the last part of the rail survey west/northwest of the Moab site (see Figure 1D). This portion of the UP main rail, the rail spur that was recently removed by the Remedial Action Contractor (RAC), and the adjacent areas along the UP-owned right-of-way (ROW) had a formal radiological assessment performed, which was documented in the final *Radiological Assessment for Non-Pile Areas of the Moab Project Site*. Windblown tailings material ranging in depth from 6 to18 inches and abundant uranium ore was identified in this portion of the UP rail and ROW. Subsequent partial remedial action in this general area by the RAC has reduced the amount of uranium ore and higher level soil contamination, especially with the removal of the rail spur, the site of a gantry crane, and the adjacent soil areas (Photo 2H). Primarily lower level soil contamination and uranium ore in the UP branch line were detected during the rail survey activities. The gamma radiation exposure rate survey ended at mile marker 28.54, which is the north portal entrance of the Bootlegger Tunnel, located along the west boundary of the Moab site.

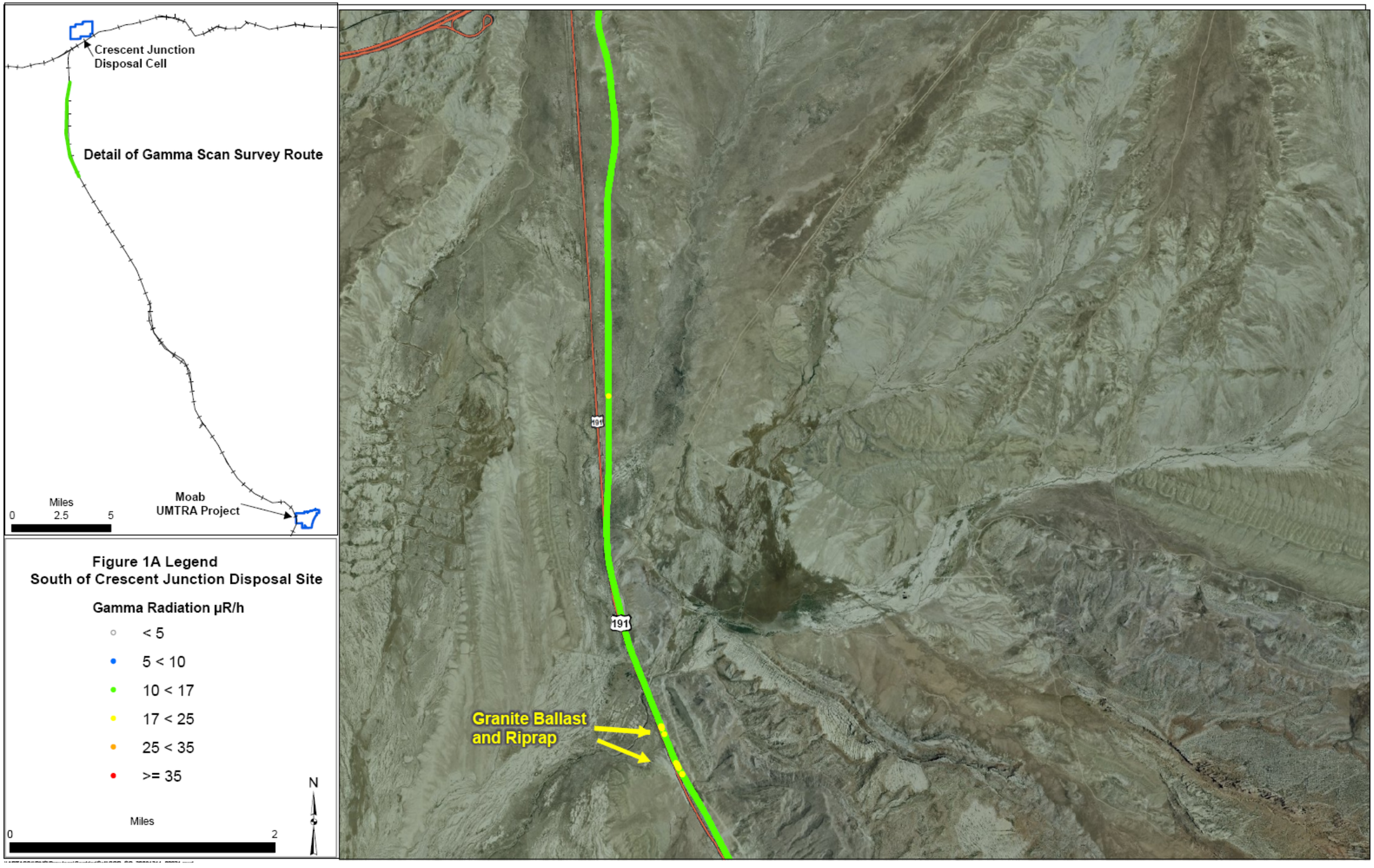
5.0 References

40 CFR 192.02 Subpart A, *Code of Federal Regulations*, "Standards for the Control of Residual Radiocative Materials from Inactive Uranium Processing Sites."

DOE (U.S. Department of Energy) 2005. *Moab UMTRA Project Radiological Assessment for Non-Pile Areas of the Moab Project Site* (DOE-EM/GJ901-2005), Grand Junction, Colorado, June.

DOE (U.S. Department of Energy) 2007. *Moab UMTRA Project Field Services Procedures Manual* (STO 203), Grand Junction, Colorado, July.


Crescent Junction Disposal Cell
Figure 1A
191
Arches National Park
Figure 1B
Canyonlands Airport
Arches National Park
Figure 1C
Arches National Park
Figure 1D
Moab UMTRA Site
Figure 1 Index
Gamma Radiation Microroentgen/hour (µR/h)
< 5
5 < 10
10 < 17
17 < 25
25 < 35
>= 35
Railroad
Boundary
N
Miles
0
5


Crescent Junction
Disposal Cell
Detail of Gamma Scan Survey Route
Miles
0
2.5
5
Moab
UMTRA Project
Figure 1A Legend
South of Crescent Junction Disposal Site
Gamma Radiation µR/h
< 5
5 < 10
10 < 17
17 < 25
25 < 35
>= 35
Miles
0
2
N
191
191
Granite Ballast
and Riprap

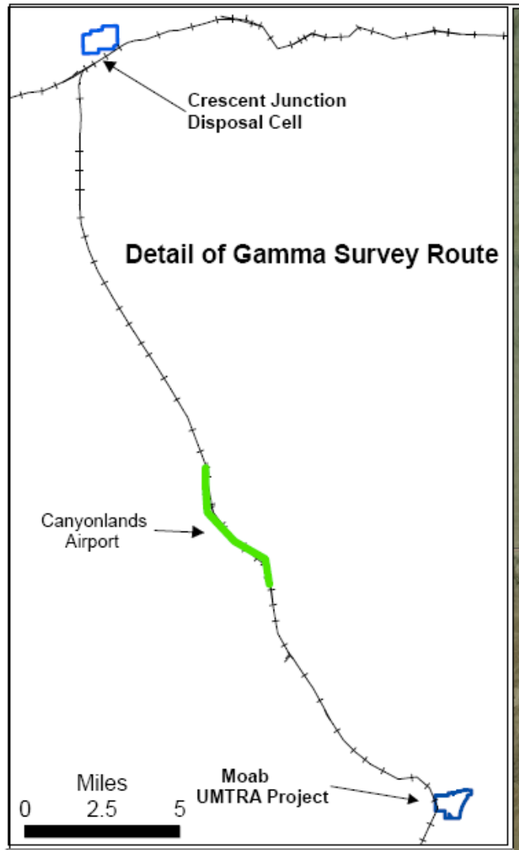
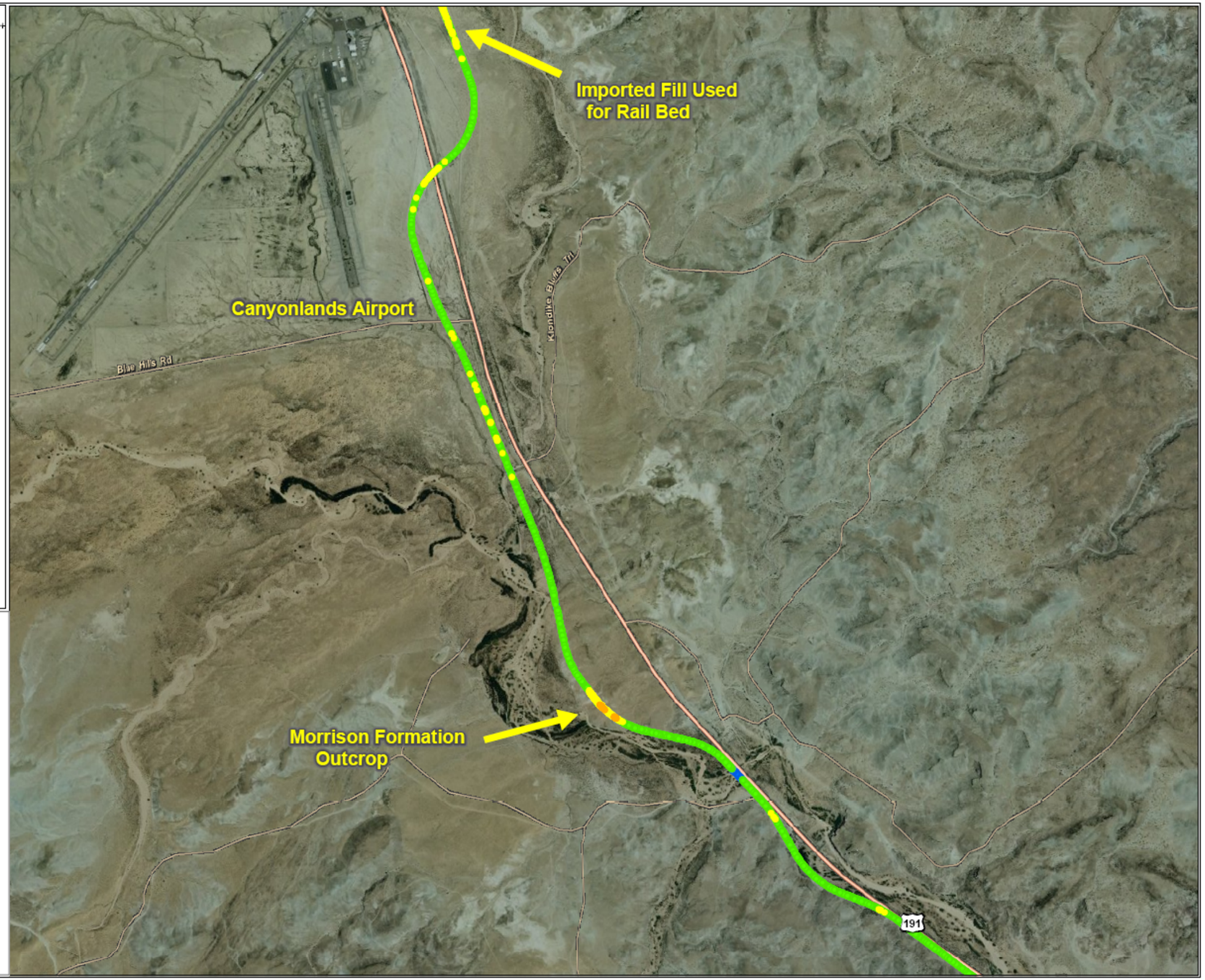
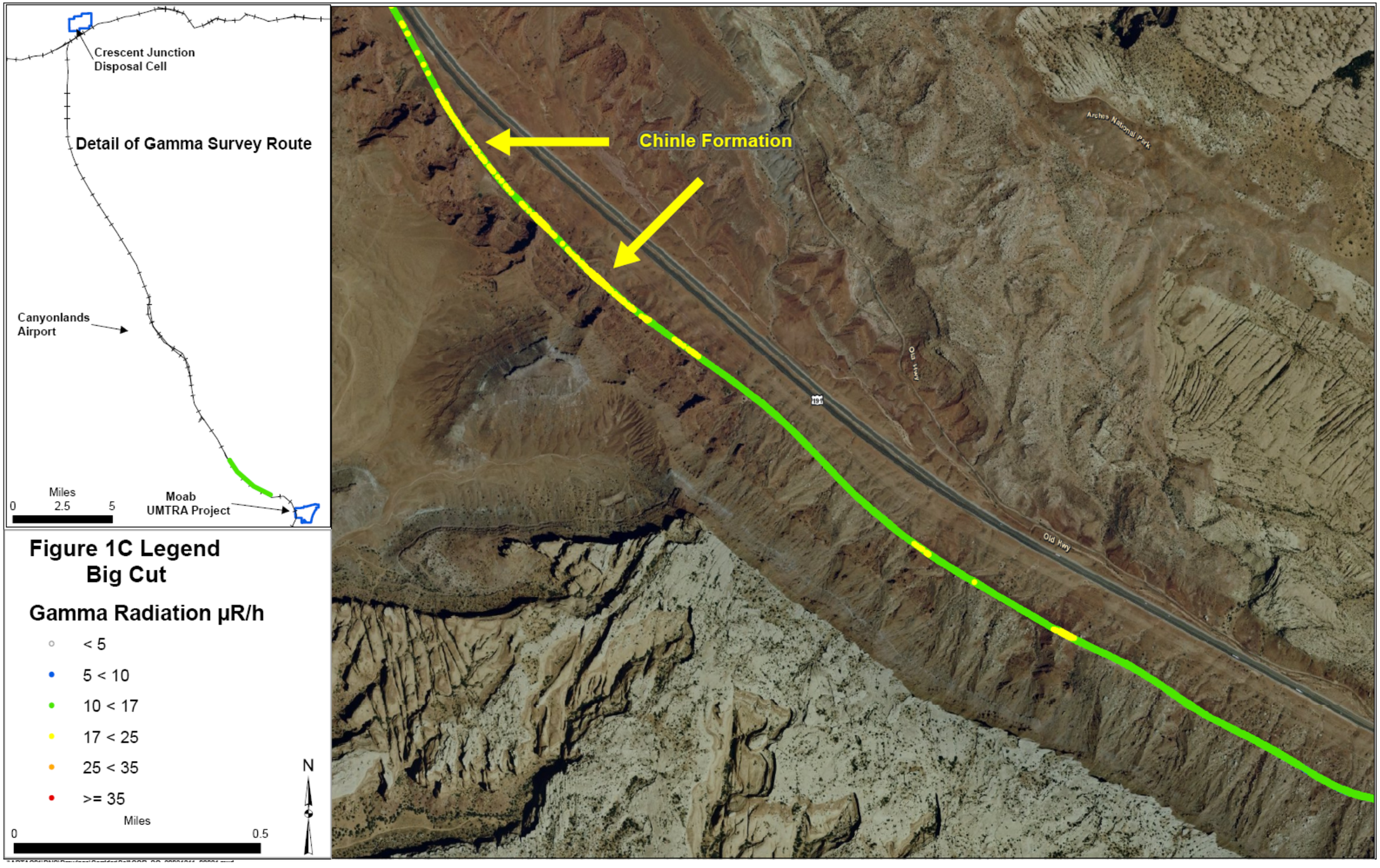
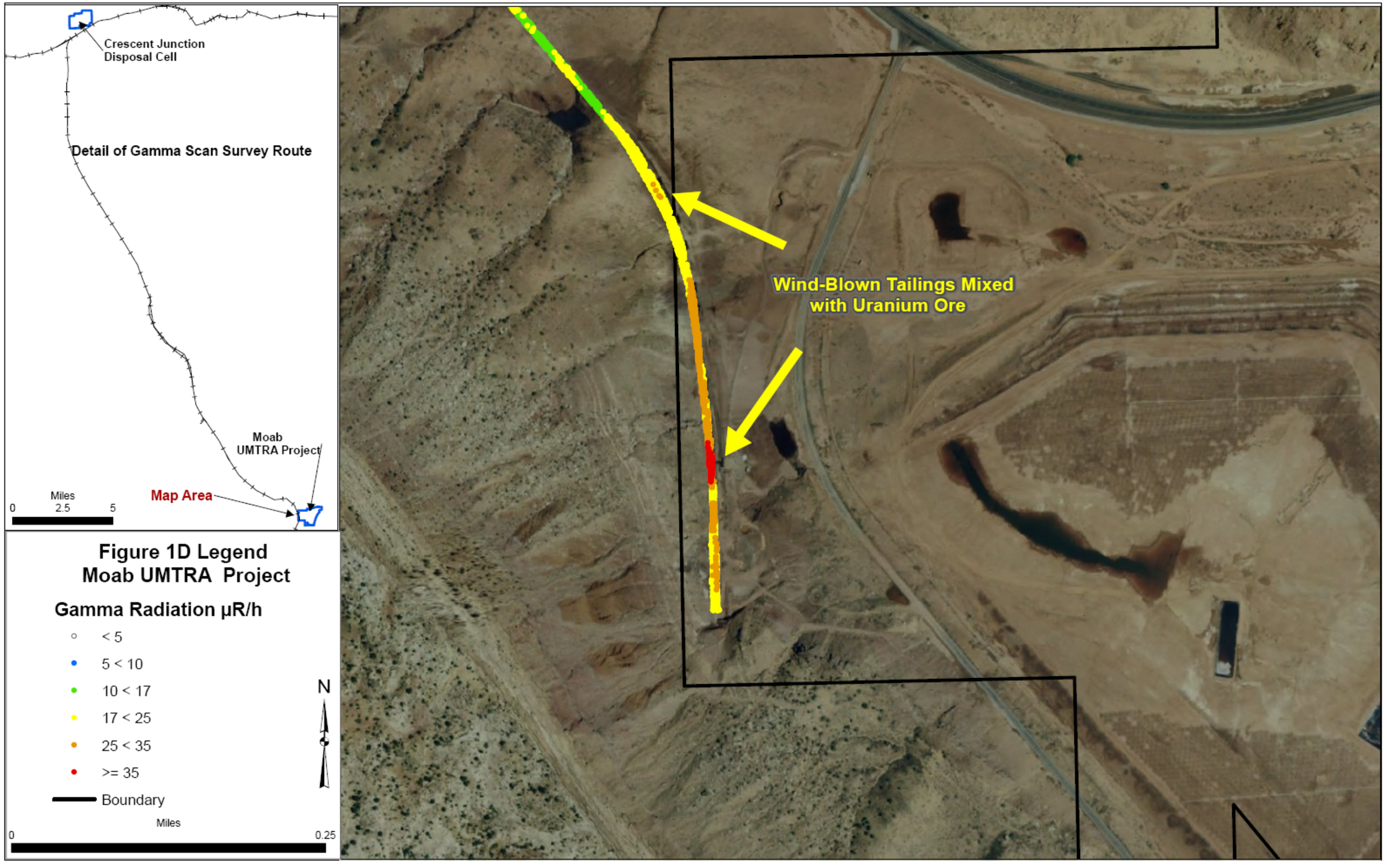

Crescent Junction
Disposal Cell
Detail of Gamma Survey Route
Canyonlands
Airport
Miles
0
2.5
5
Moab
UMTRA Project

Figure 1B Legend
Canyonlands Airport
Gamma Radiation µR/h
< 5
5 < 10
10 < 17
17 < 25
25 < 35
>= 35
N
Miles
0
1


Imported Fill Used
for Rail Bed
Canyonlands Airport
Blue Hills Rd
Klondike Bluffs Trl
Morrison Formation
Outcrop
191


Crescent Junction
Disposal Cell
Detail of Gamma Survey Route
Canyonlands
Airport
Miles
0
2.5
5
Moab
UMTRA Project
Figure 1C Legend
Big Cut
Gamma Radiation µR/h
< 5
5 < 10
10 < 17
17 < 25
25 < 35
>= 35
Miles
0
0.5
N
Chinle Formation
Archs National Park
Old Hwy
191


Crescent Junction
Disposal Cell
Detail of Gamma Scan Survey Route
Moab
UMTRA Project
Map Area
Miles
0
2.5
5
Wind-Blown Tailings Mixed
with Uranium Ore
Figure 1D Legend
Moab UMTRA Project
Gamma Radiation µR/h
< 5
5 < 10
10 < 17
17 < 25
25 < 35
>= 35
Boundary
Miles
0
0.25
N

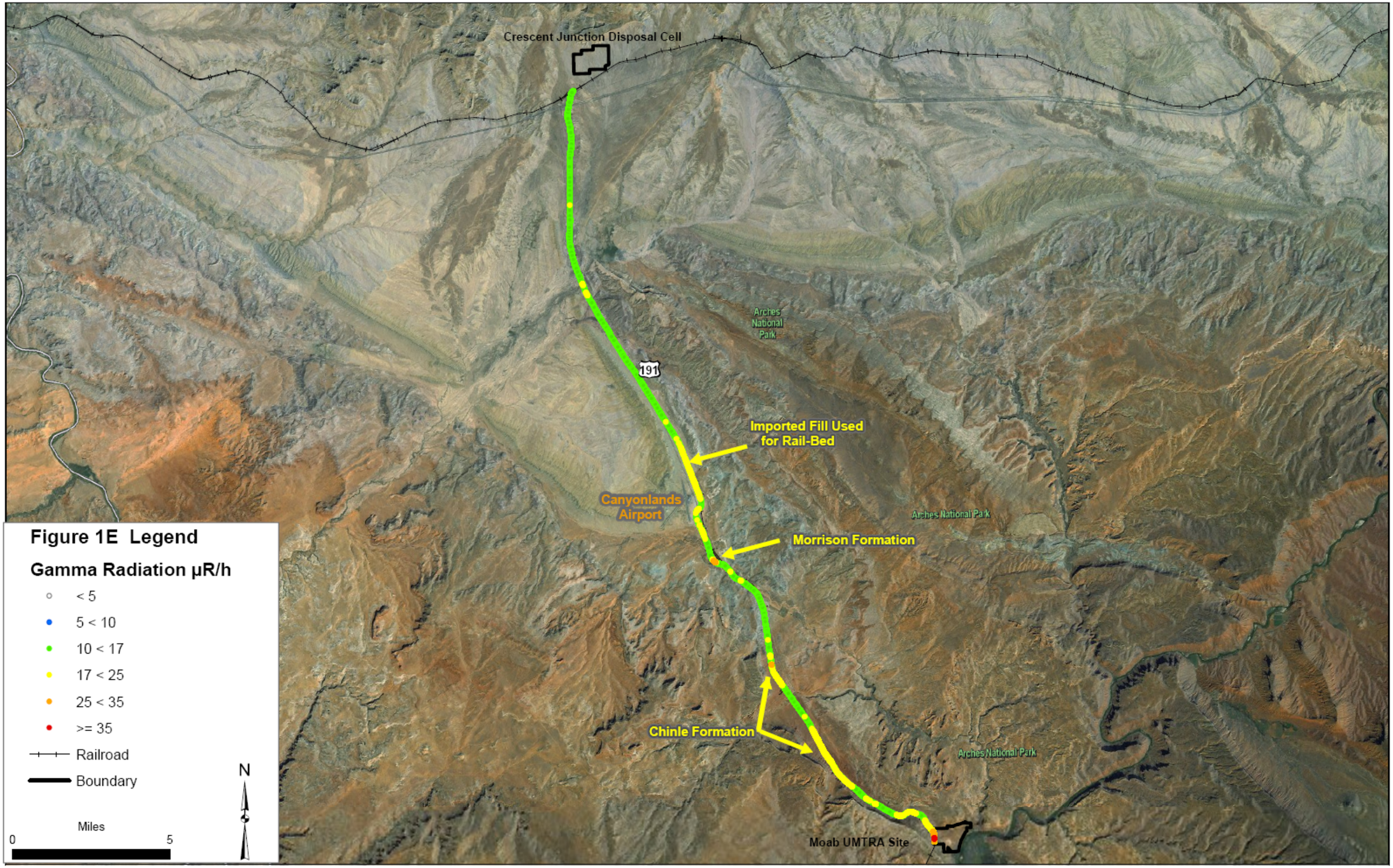

Crescent Junction Disposal Cell
Arches National Park
191
Imported Fill Used for Rail-Bed
Canyonlands Airport
Arches National Park
Morrison Formation
Chinle Formation
Arches National Park
Moab UMTRA Site
Figure 1E Legend
Gamma Radiation µR/h
< 5
5 < 10
10 < 17
17 < 25
25 < 35
>= 35
Railroad
Boundary
Miles
0
5
N

Photo 2A. Hy-Rail Truck with Gamma Radiation Exposure Rate Survey Equipment Attached

Photo 2B. Imported Granite Ballast and Riprap Fill – Looking East

Photo 2C. Imported Clay Fill Materials Mixed with Igneous Ballast Rock. North of Canyonlands Field Airport – Looking North

Photo 2D. Morrison Formation South of Canyonlands Field Airport – Looking Southeast

Photo 2E. Morrison Formation. South of Canyonlands Field Airport – Looking East

Photo 2F. Seven-mile Hill – Looking North

Photo 2G. Big Cut Through the Chinle Formation – Looking South

Photo 2H. Bootlegger Tunnel and Portal – Looking South