# Abandoned Uranium Mine Assessment for the Boyd Site (NM0190)

## FINAL REPORT

**Prepared For:**

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Natural Resources Department
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**Prepared By:**

INTERA

**September 10, 2010**

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# 1.0 INTRODUCTION

INTERA Incorporated (INTERA) has prepared this Abandoned Uranium Mine (AUM) Site Assessment Report for the Mining and Minerals Division (MMD) of the New Mexico Energy, Minerals and Natural Resources Department (EMNRD) in compliance with the Professional Service Agreement dated November 2, 2009. INTERA visited the Boyd Site (AUM Site), MMD ID: NM0190 on August 18, 2010.

## 1.1 PREVIOUSLY KNOWN INFORMATION ABOUT THE SITE

According to Anderson (1980), 73.8 tons of ore averaging 0.05% $U_3O_8$ and 0.05% $V_2O_5$ were shipped from the site in 1955, with one shipment reportedly containing 0.10% $U_3O_8$. Workings at the site consisted of open pit excavation and some rim stripping and blasting of vertical cliffs in Fruitland and Kirtland Formation sandstone beds.

## 1.2 SITE LOCATION AND DIRECTIONS

The AUM Site is located on Bureau of Land Management (BLM) land in the northern half of Section 3, Township 30 North, Range 15 West. The land is leased by the New Mexico Public Service Company (PNM) San Juan Electrical Generating Station and the area immediately to the west of the site is being actively mined to supply coal to the power plant. The AUM site lies within San Juan County, approximately 8 miles north of the town of Kirtland. The location of this Site was provided to INTERA by MMD.

To access the AUM Site from Albuquerque, take I-25 north to Bernalillo and exit US-550. Follow US-550 north 150 miles to Bloomfield and turn left at US-64 toward Farmington. Travel approximately 27 miles west on US-64 and turn right onto the paved road that leads to the San Juan Coal Mine/Generating Station. Upon reaching the generating station, an escort from the San Juan Coal Mine will be required to travel the remaining 4 miles northeast through the mining area to reach the AUM Site. Access and to the site will have to be coordinated beforehand with the San Juan Coal Mine.

## 1.3 SITE GEOLOGY

The AUM Site is located in the northwestern part of the San Juan Basin, a geologic structural basin containing up to 15,000 feet of sedimentary rocks ranging in age from Cambrian to recent (Peterson et al., 1965). Minor sedimentary uranium deposits occur locally within a thin section of bedding near the contact between the Fruitland Formation and the Kirtland Formation (McLemore and Chenoweth, 1989). These late Cretaceous sediments consist of interbedded calcareous sandstones, mudstones, and coal deposits (Lucas et al., 2006). Hematitic alteration and finely disseminated organic material are also associated with uranium mineralization in these sandstones (McLemore et al., 1986).

### 1.4 SITE HYDROGEOLOGY

The AUM Site is located within the Middle San Juan watershed of the San Juan structural basin (San Juan Water Commission, 2003). Surface runoff at the AUM Site flows southeast into Shumway Arroyo, which joins the San Juan River approximately five miles to the southwest.

The major aquifer in the San Juan basin is the Nacimiento-San Jose aquifer. At the AUM Site, this aquifer is unconfined, and consists of a series of Tertiary-age, interbedded, valley-fill sandstone and mudstone deposits (San Juan Water Commission, 2003). Groundwater at the AUM Site flows south and discharges primarily into the San Juan River.

### 1.5 REGIONAL TOPOGRAPHY AND TERRAIN

The AUM Site is found on the Waterflow 7.5 minute United States Geological Survey topographic map at an elevation of approximately 5,600 ft above mean sea level (see Figure 2). The AUM Site is located atop a series of prominent bluffs that overlook the Verde oil field to the west and northwest, and the San Juan Coal Mine to the southwest. These bluffs slope gradually southeast toward Shumway Arroyo.

## 2.0 MINE FEATURES

The mine features described below are based on the features provided to INTERA by MMD in the GIS Data Dictionary (MMD, 2009). INTERA marked the locations of the AUM Site features using a Trimble Global Positioning System (GPS), and entered details about the features into the GPS using the MMD data dictionary. Three open pits, one pile, one disturbance area, and two mine roads were found onsite. Please see the Photo Log in Appendix A for photos of the AUM Site features, Table 1 for a list of the AUM Site features, and Figures 4a and 4b for the locations of the AUM Site features.

### 2.1 MINE SHAFTS, ADITS, AND DECLINES

No shafts, adits or declines were found at the AUM Site.

### 2.2 MINING AND EXPLORATION PITS AND OPEN CUTS

Three open pits were found at the AUM Site. Two of the pits (Pit-1, Pit-2) are shallow excavations into surface alluvium fronting sandstone outcrops (see Photos 9 and 11 in Appendix A). Pit-2 shows evidence of blasting in the adjacent outcrop (see Photo 12 in Appendix A). Pit-3 is an exploration cut into the side of a cliff formed by Kirtland Formation Sandstone (see Photos 15 and 16). All three pits are documented in Anderson (1980). The maximum gamma radiation measurement on these features was 600 µR/hr at 0 ft above ground at radiation survey point Rad-5 in Pit-1.

### 2.3 WASTE AND ORE PILES AND DISTURBANCES

One waste pile and one disturbance area were found onsite. The waste pile, PilePly-1, is a broad, low mound consisting of soil and large boulders (see Photo 13 in Appendix A). The disturbance

area (DistPly-1) was observed near radiation survey point Rad-2, at the location referred to as the "main pit" in Anderson (1980). The area appeared to have been partially excavated and may have been bulldozed (see Photos 1, 2 and 6 in Appendix A). The maximum gamma radiation measurement on these features was 470 µR/hr at 0 ft above ground at radiation survey point Rad-2, within DistPly-1.

### 2.4 MINING RELATED BUILDINGS AND FOUNDATIONS

No mining related buildings or foundations were found at the AUM Site.

### 2.5 OTHER MINE FEATURES

Two mine roads (Rd-1, Rd-2) were found onsite. Rd-1 runs north through the extent of the site in Claims No. 4 and 5 identified in Anderson (1980) and ends at DistPly-1. This road also runs past PilePly-1, Pit-1, and Pit-2 (see photo 8 in Appendix A, and sketch in field notes in Appendix B). Rd-2 diverges from Rd-1 at its southern extent, and runs southeast approximately 1000 ft before ending along the rim of a shallow canyon (see Figures 4a and 4b, and photo 17 in Appendix A).

### 2.6 BOREHOLES

No boreholes were found at the AUM Site.

### 2.7 RECLAMATION ACTIVITIES

No reclamation activities were identified onsite.

## 3.0 ARCHEOLOGICAL SITES

No apparent archeological sites were identified at or near this AUM Site.

## 4.0 SITE GAMMA RADIATION READINGS

One background gamma radiation reading was taken near the AUM Site, recording 18 µR/hr at 0 ft above ground and 18 µR/hr at 4 ft above ground. Please see Table 2 for all of the gamma radiation readings taken at the AUM Site and Figures 4a and 4b for the locations of the radiation readings.

The maximum gamma radiation measured onsite was 600 µR/hr at 0 ft above ground at radiation survey point Rad-5 in Pit-1. A gamma radiation measurement taken within DistPly-1 (radiation survey point Rad-2) recorded 470 µR/hr at 0 ft above ground.

# 5.0 CURRENT LAND USES

## 5.1 HUMAN ACTIVITY AND RECREATIONAL SITE USE

The land at the AUM Site is leased by PNM, and active mining operations take place at the San Juan Coal Mine, less than 0.5 miles to the west of the AUM Site. In addition, a scenic viewpoint has been established atop the cliffs immediately adjacent to the AUM Site, approximately 0.2 miles west of Pit-2. This viewpoint is accessible via a 4x4 trail that heads northwest from the coal mine, however permission to access this point would need to be obtained from PNM and the San Juan Coal Mine management.

## 5.2 NEARBY RESIDENTIAL, COMMERCIAL AND INDUSTRIAL STRUCTURES

No structures were sighted within a mile of the AUM Site.

## 5.3 NEARBY DOMESTIC WELLS

No wells, domestic or otherwise, lie within a mile of the AUM Site.

## 5.4 EVIDENCE OF GRAZING OR AGRICULTURE

No evidence of grazing or agriculture was observed near the AUM Site.

## 5.5 EVIDENCE OF WILDLIFE

Antelope were seen near the AUM Site, as well as ravens, a dove, and several other birds. In addition, rabbit droppings were observed near the AUM Site.

# 6.0 VEGETATION

The Boyd Site is located in the Great Basin Desert Scrub vegetation type. Woody vegetation is dominated by fourwing saltbush and snakeweed. Forb species include annual spurge and mustard species. Halogeton, which is a class B noxious weed for New Mexico, was observed at the AUM Site.

# 7.0 POTENTIAL OFFSITE IMPACTS

## 7.1 EROSION

A steep cliff immediately to the north of DistPly-1 appears to be eroding, and a barbed-wire fence has been constructed (Fenc-1) along the rim of this cliff.

## 7.2 ENVIRONMENTAL IMPACTS

There is no evidence of soil staining from chemicals potentially brought to the AUM Site.

# 8.0 REFERENCES

Anderson, Orin J., 1980. Abandoned or Inactive Uranium Mines in New Mexico. New Mexico Bureau of Mines and Mineral Resources Open File Report 148.

Dick–Peddie, William A, 1999. New Mexico Vegetation: Past, Present, and Future. University of New Mexico Press.

Lucas, Spencer G., Adrian P. Hunt, and Robert M. Sullivan, 2006. *Stratigraphy and Age of the Upper Cretaceous Fruitland Formation, West-Central San Juan Basin, New Mexico*. Albuquerque: New Mexico Museum of Natural History and Science.

McLemore, Virginia T., Ronald F. Broadhead, William L. Chenoweth, Kevin Cook, James M. Barker, Gretchen Roybal, Robert M. North, Peter Copeland, John S. Hingtgen, Mark R. Bowie, Kris Klein, and Karen B. Brown, 1986. *A Preliminary Mineral-Resource Potential of San Juan County, Northwestern New Mexico*. Socorro: New Mexico Bureau of Mines and Mineral Resources, Open-file Report 232.

McLemore, Virginia T., and William L. Chenoweth, 1989. *Uranium Resources in New Mexico*. Socorro: New Mexico Bureau of Mines & Mineral Resources.

Mining and Minerals Division (MMD), 2009. Mine Feature Data Dictionary.

Peterson, James A., Allan J. Loleit, Charles W. Spencer, and Richard A. Ullrich, 2010. "Sedimentary history and economic geology of San Juan Basin." *AAPG Bulletin* 49 (1965): 2076-2119.

San Juan Water Commission, 2003. *San Juan Basin Regional Water Plan Volume III*. Prepared for the New Mexico Interstate Stream Commission.

# TABLES

**Table 1**
**Site Features**

**Boyd-NM0190**
**Abandoned Uranium Mine Assessments**

| Feature Name | On Site? | Feature Type | Associated Feature | Material | Height or Depth (ft) | Width or Diameter (ft) | Length (ft) | Open | Collapsed | Closure Type | Associated Photos | Notes |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Access-1 | No | Access | -- | Dirt Nonmaintained | -- | -- | -- | -- | -- | -- | -- | -- |
| DistPly-1 | Yes | -- | -- | -- | -- | 50 | 150 | -- | -- | -- | NM0190_001 NM0190_002 | photo 1 site photo, photo 2 looking south at disturbed area |
| Fenc-1 | Yes | Barbwire | -- | Metal | 4 | -- | 150 | -- | -- | -- | NM0190_004 | photo 4 looking southwest along fenc-1 |
| PilePly-1 | Yes | Waste | -- | Rock | 5 | 20 | 30 | -- | -- | -- | NM0190_013 | photo 13 looking southwest |
| Pit-1 | Yes | Exploration | -- | -- | 3 | 5 | 10 | Yes | -- | -- | NM0190_009 | photo 9 looking northwest at pit-1 |
| Pit-2 | Yes | Exploration | -- | -- | 8 | 15 | 30 | Yes | -- | -- | NM0190_011 NM0190_012 | photo 11 looking west, photo 12 closeup of outcrop |
| Pit-3 | Yes | Exploration | -- | -- | 20 | 25 | 30 | Yes | -- | -- | NM0190_015 NM0190_016 | photo 15 looking southwest, photo 16 looking west |
| Rd-1 | Yes | Dirt | -- | Dirt Nonmaintained | -- | -- | -- | -- | -- | -- | NM0190_008 | photo 8 looking east from northern end of road |
| Rd-2 | Yes | Dirt | -- | Dirt Nonmaintained | -- | -- | -- | -- | -- | -- | NM0190_017 | photo 17 looking north from above at south-eastern end of rd-2 |

**Notes:**
-- designates no information

# Table 2
# Gamma Radiation Survey Results

## Boyd-NM0190
## Abandoned Uranium Mine Assessments

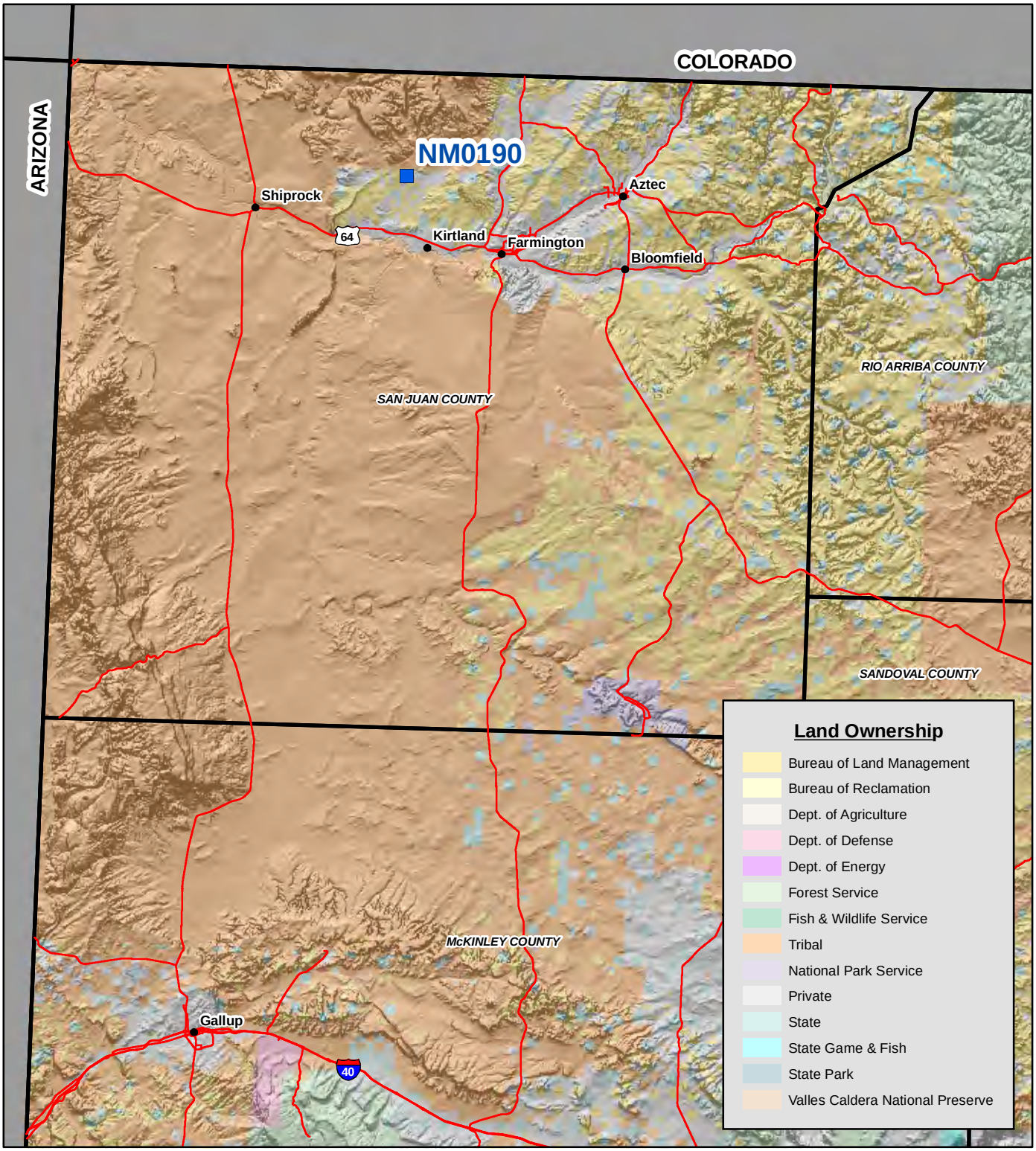
| Reading ID | Associated Features | 0 ft (µR/hr) | 4 ft (µR/hr) | Associated Photos |
|---|---|---|---|---|
| Rad-1 | distply-1 | 150 | 70 | NM0190_003 |
| Rad-2 | distply-1 | 470 | 150 | NM0190_005 |
| Rad-3 | -- | 140 | 60 | NM0190_007 |
| Rad-4 | rd-1 | 44 | 28 | NM0190_008 |
| Rad-5 | pit-1 | 600 | 110 | NM0190_010 |
| Rad-6 | pit-2 | 300 | 80 | -- |
| Rad-7 | pit-2 | 38 | 40 | -- |
| Rad-8 | pileply-1 | 80 | 60 | -- |
| Rad-9 | rd-1/rd-2 | 100 | 85 | -- |
| Rad-10 | -- | 380 | 130 | NM0190_014 |
| Rad-11 | pit-3 | 150 | 55 | -- |
| RadBack-1 | -- | 18 | 18 | -- |

**Notes:**

All gamma readings at this site taken by Ludlum 192 µR/Ratemeter

µR/hr=microroetgens per hour

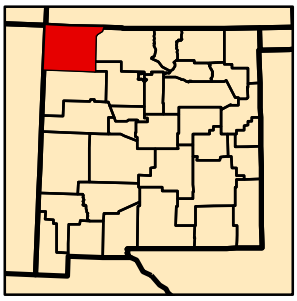
# FIGURES




Map Source(s):
Ownership - BLM, 2008

0 7.5 15 30
Miles

NORTH

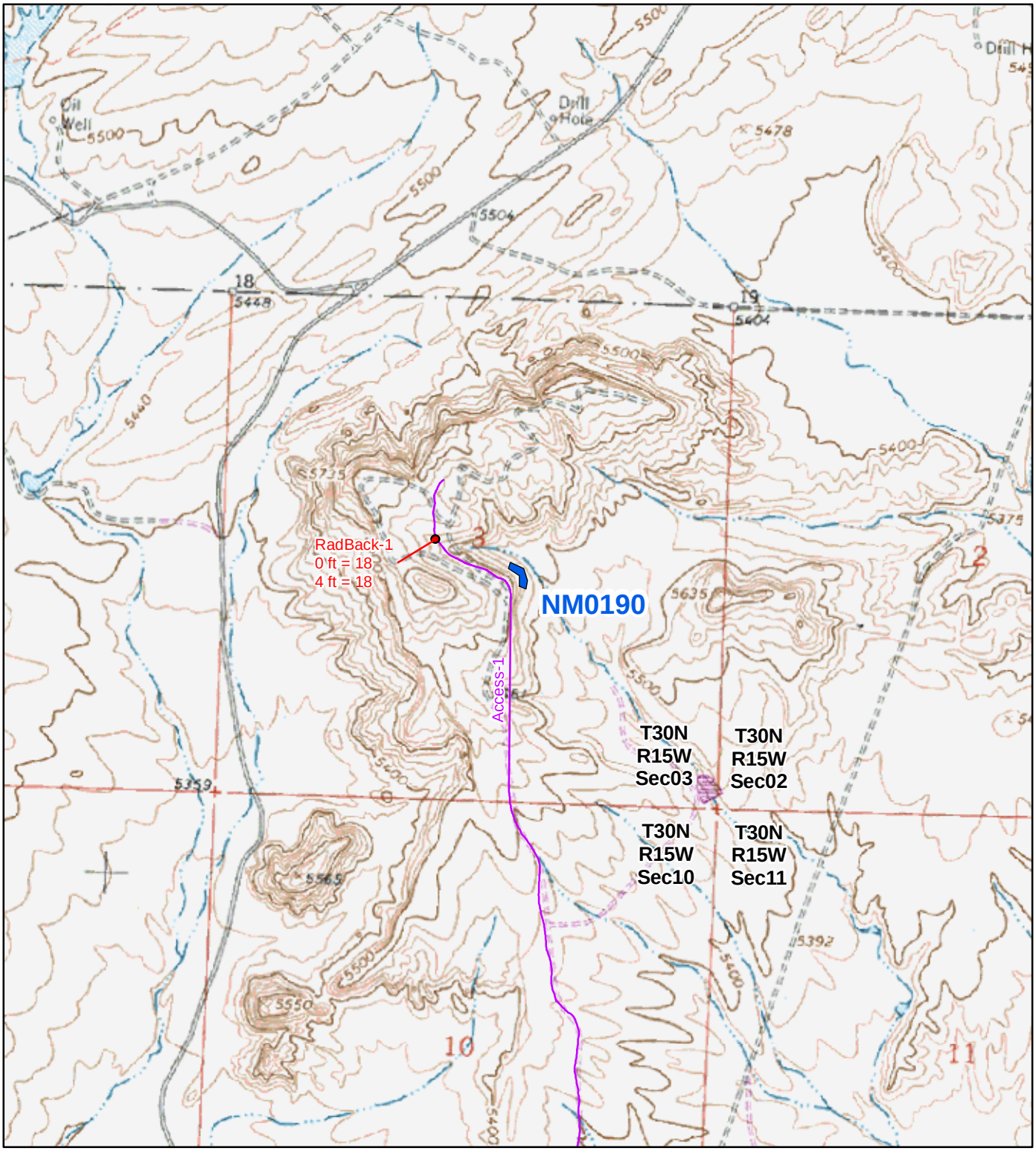


## Legend

- AUM Location
- Road
- County Boundary

**Figure 1**
**Site Location Map**
**NM0190-Boyd**
Abandoned Uranium Mine Assessment

File: S:\Projects\EMMD-001_Abandoned Uranium Mine Assessment\Sites\NM0190-Boyd\GIS\Maps\Site_Map_Boyd_CP.mxd 08/20/2010




Map Source(s):
U.S. Geological Survey 7.5-Minute
Topographic Map
-Waterflow, 1979

0 750 1,500 3,000
Feet

NORTH

## Legend

- Radiation Readings (µR/hr)
- Access Route
- AUM Location Boundary (MMD Provided)

Note:
There are no wells within 1 mile of the Site.

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**Figure 2**
**Topographic Map**
**NM0190-Boyd**
Abandoned Uranium
Mine Assessment

File: S:\Projects\EMMD-001_Abandoned Uranium Mine Assessment\Sites\NM0190-Boyd\GIS\Maps\Topo_Map_Boyd_CP.mxd 08/20/2010


Map Source(s):
U.S. Geological Survey 7.5-Minute
DOQQ County Mosaic
-San Juan County, 2009

0 750 1,500 3,000
Feet

NORTH

## Legend

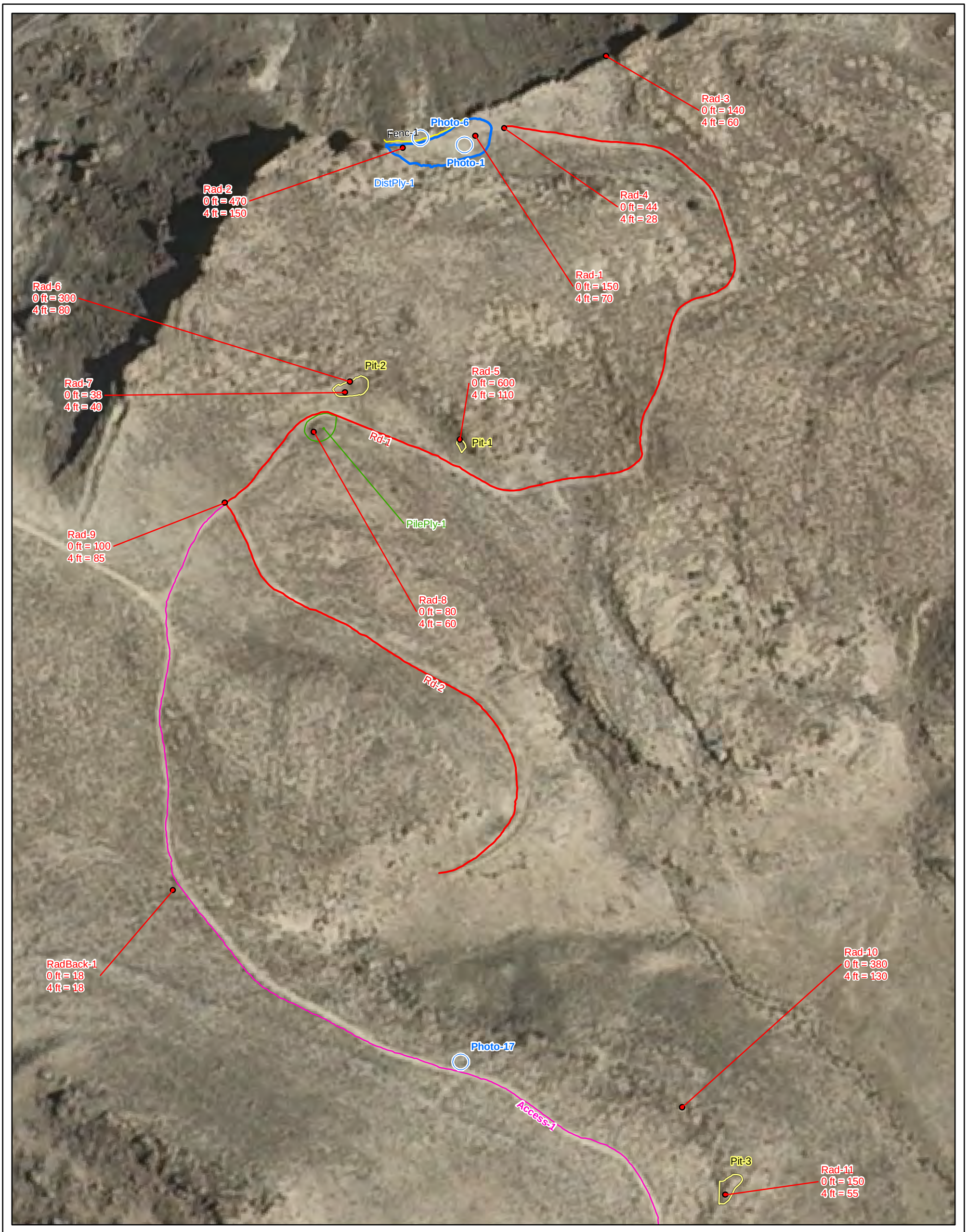
- Radiation Readings (µR/hr)
- Access Route
- AUM Location Boundary (MMD Provided)
- Section Boundary
- Township/Range Boundary

Note:
There are no wells within 1 mile of the Site.

INTERA

**Figure 3**
**Aerial Photo**
**NM0190-Boyd**
Abandoned Uranium
Mine Assessment

File: S:\Projects\EMMD-001_Abandoned Uranium Mine Assessment\Sites\NM0190-Boyd\GIS\Maps\Aerial_Map_Boyd_CP.mxd 08/20/2010




Map Source(s):
U.S. Geological Survey 7.5-Minute
DOQQ County Mosaic
-San Juan County, 2009

0 75 150 300
Feet

NORTH

## Legend

- Radiation Readings (µR/hr)
- Photo Location
- Mine Road
- Fence
- Access Route
- Pile Boundary
- Pit Boundary
- Other Disturbance Area

**Figure 4a**
**Site Map on**
**Aerial Photo**
**NM0190-Boyd**
Abandoned Uranium
Mine Assessment

File: S:\Projects\EMMD-001_Abandoned Uranium Mine Assessment\Sites\NM0190-Boyd\GIS\Maps\CloseUpAerial_Map_Boyd_CP.mxd 08/23/2010

Rad-3
0 ft = 140
4 ft = 60

Photo-6

Fenc-1

Photo-1

DistPly-1

Rad-2
0 ft = 470
4 ft = 150

Rad-4
0 ft = 44
4 ft = 28

Rad-1
0 ft = 150
4 ft = 70

Rad-6
0 ft = 300
4 ft = 80

Pit-2

Rad-7
0 ft = 38
4 ft = 40

Rad-5
0 ft = 600
4 ft = 110

Pit-1

Rd-1

PilePly-1

Rad-9
0 ft = 100
4 ft = 85

Rad-8
0 ft = 80
4 ft = 60

Rd-2

RadBack-1
0 ft = 18
4 ft = 18

Rad-10
0 ft = 380
4 ft = 130

Photo-17

Access-1

Pit-3

Rad-11
0 ft = 150
4 ft = 55

Map Source(s):
Ownership - BLM, 2008

0 75 150 300
Feet

NORTH

## Legend

- Radiation Readings (µR/hr)
- Photo Location
- Mine Road
- Fence
- Access Route
- Pile Boundary
- Pit Boundary
- Other Disturbance Area

**Surface Ownership**

- Bureau of Land Management

**Figure 4b**
**Site Map with**
**Surface Ownership**
**NM0190-Boyd**
Abandoned Uranium
Mine Assessment

File: S:\Projects\EMMD-001_Abandoned Uranium Mine Assessment\Sites\NM0190-Boyd\GIS\Maps\CloseUpOwnership_Map_Boyd_CP.mxd 08/23/2010

# APPENDIX A

# PHOTO LOG

Note: Gaps in the numbering sequence of the photos is the result of removing photos not suitable for the report. A full set of photos is provided in the electronic deliverable.


Photo 1-Site location photo, looking southwest at “main pit” (Claim No. 5) labeled in Anderson Report.

Photo 2-Looking south-southeast at DistPly-1.


Photo 3-At Rad-1, closeup of gray sandstone.

Photo 4-Looking southwest at Fenc-1.

Photo 5-Closeup of ore-bearing sandstone outcrop, location of Rad-2.

Photo 6-Looking southwest at outcrop, replicating Anderson photo B.

Photo 7- Looking northeast at outcrop in northern part of Claim No. 4, location of Rad-3.

Photo 8- Looking east at Rd-1, location of Rad-4.

Photo 9- Looking northwest at Pit-1 in southern part of Claim No. 4, replicating Anderson photo C.

Photo 10-At Rad-5, looking at black staining on gray sandstone outcrop.

Photo 11-Looking west at Pit-2 in southern part of Claim No. 5, replicating Anderson photo A.

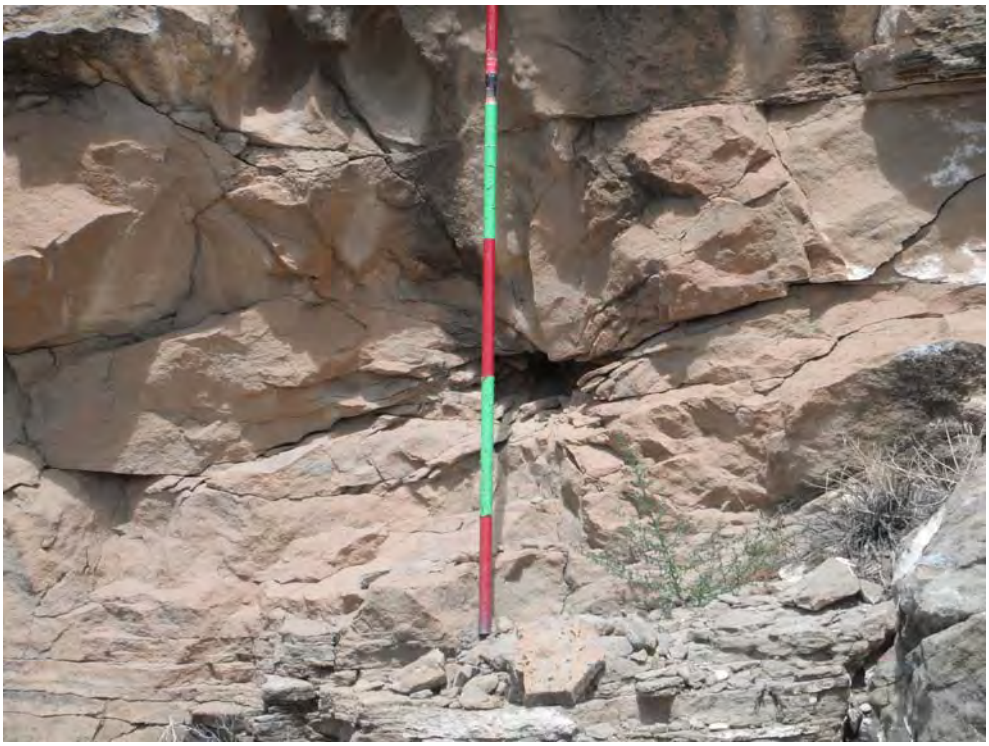


Photo 12-Blast hole in outcrop at Pit-2.

Photo 13-Looking southwest at Pileply-1.

Photo 14-Looking southeast at Rad-10.

Photo 15-Looking southwest at Pit-3, replicating Anderson Photo A.

Photo 16-Looking west at Pit-3.

Photo 17-Looking north from above at southeastern end of Rd-1.

Photo 18-Vegetation at AUM Site.

Photo 19-Vegetation at AUM Site.

Photo 20-Vegetation at AUM Site.

Photo 21-Vegetation at AUM Site.

Photo 22-Vegetation at AUM Site.

Photo 23-Vegetation at AUM Site.

Photo 24-Vegetation at AUM Site.

Photo 25-Vegetation at AUM Site.

Photo 26-Vegetation at AUM Site.

Photo 27-Vegetation at AUM Site.

# APPENDIX B

# FIELD NOTES

8/18/2010 ALT Abandoned Uranium Mines

Site Name: NM0190, Boyd

Objective: Site Assessment

Personnel: Annelia Tinklenberg
Alex Resovsky

Equipment: Rental truck, Trimble GeoXM (SN:4948447O7, 2008 Series), Ludlum 192 (SN:234149), Fuji Film digital camera (No:OTB31259), backup Garmin GPS, field laptop

5:30 am Leaving Albuquerque

8:50 - At San Juan Coal to meet Micky Ginn. Micky is running late so we check in and go through the mine safety procedures, including watching a safety video. Micky Ginn c. 505-793-6438

930 Micky arrives to drive us to the site

1045 Arrive at AUM site

Photo 1 - site location photo looking southwest at "main pit" (Claim No 5) labeled in Anderson Report replicating Photo B

DistPly-1 - 50' wide, 150' long; described as "main pit" in Anderson.

Photo 2 - DistPly-1 looking south, southeast

Rad 1 - DistPly-1 north end. Om 150 uR/h; 1m - 70 uR/h on grey sandstone

Photo 3 - grey sandstone at Rad 1, looking south

Fenceln-1 - 150' long barbed wire, along cliff edge

Photo 4 - Fenceln-1 looking southwest



Rad 2 - DistPly-1 outcrop off south side; Om-470 uR/h; 1m-150uR/h

Photo 5 - outcrop, ore-bearing rock grey sandstone/limestone

Photo 6 - outcrop looking southwest, replicating Anderson Photo B

Rad 3 - Claim No. 4, no visible mine features; Om - 140 uR/h; 1m-60uR/h

Photo 7 - outcrop at Claim No. 4, no visible mine features

Rad 4 - Rd-1, near "main pit"; Om-44 uR/h; 1m - 28 uR/h

Photo 8 - MineRd-1 looking east

MineRd-1 - from claim No. 5 and claim No. 4, northwest extents

Pit-1 - 5' wide, 10' long, 3' depth; Photo C from Anderson

Photo 9 - Pit-1 looking northwest in southern part of Claim No 4, replicating Anderson Photo C

Rad 5 - Pit-1; Om - 600 uR/h; 1m - 110 uR/h

Photo 10 - Rad 5; black staining on grey sandstone

Pit-2 - 8' deep (outcrop), 15' wide, 30' long, south end of Claim No 5

Photo 11 ALT - Pit-2 looking west in southern part of Claim No 5, replicating Anderson Photo D

Rad 6 - Pit-2 outcrop; Om - 300 uR/h; 1m - 80 uR/h

Photo 12 - blast hole in outcrop in Pit 2

Rad 7 - Pit 2 on grey soil; Om - 38 uR/h; 1m - 40 uR/h

Pile-1 - 5' high, 20' wide, 30' long, 10% slope; waste rock + soil

Photo 13 - Pile-1 looking southwest

Rad 8 - Pile-1; Om - 80 uR/h; 1m - 60 uR/h

Rad 9 - MineRd 1 & Rd 2 intersection; Om - 100 uR/h; 1m - 85 uR/h

1215

Rad 10 - northern part of polygon; Om - 380 uR/h, 1m - 130 uR/h

Photo 14 - Rad 10 looking southeast, no visible mine features

8/18/2010 AUT Abandoned Uranium Mines

Pit 3 - on eastern end of claim No 10, may be natural cave
20' deep, 25' wide, 30' long

Photo 15 - looking sw at Pit 3, replicating Anderson Photo A.

Photo 16 - looking west at Pit 3

Rad-11 - Pit 3; 0m-150 nR/h; 1m-55 nR/h

Photo 17 - looking north from above at southeastern end of Mine Rd-2 - may be "rim stripping" referred to in Anderson report.

1240 Vegetation Samples
Photos 18 - 24 vegetation

Background Rad - 0m-18 nR/h; 1m-18 nR/h

Access-1 Road to site, unmaintained dirt

Photos 25 - 26 vegetation

1310 Hiking back along Access-1 to meet up with Micky to be escorted out.

Soils: Tan-grey, thin and rocky; sandy.

Rocks: Tan Entrada Limestone, contacts with grey sandstone and limestone below; locally with blue-grey shale and limestone at DistPly-1

Wildlife: small dove, ravens, rabbit droppings, antelope

Human Activities: Mining to the west, below the mesa. Scarce cow droppings.

AUT