

# ABANDONED URANIUM MINES PROJECT ATLAS

## ATLAS ORGANIZATION AND STRUCTURE

The following provides a brief description of the Project Atlas organization and structure. The Atlas presents results from the aerial radiation surveys and water sample data collection efforts conducted for the Abandoned Uranium Mines Project. The Atlas is organized into the following seven sections:

Section 1:	Regional Overview
Section 2:	Four Corners Area
Section 3:	Cameron/Tuba City Area
Section 4:	Central Area
Section 5:	Chinle Area
Section 6:	Bidahochi Area
Section 7:	Monument Valley Area

### REGIONAL OVERVIEW

The Regional Overview Section provides a description of the project. Regional maps for the entire project area were prepared to provide the user with an overview of the project data collection activities and the regional environment. Data used in the planning process for selecting sample locations have been shown on regional maps: mines, aerial radiation survey areas, and springs. The locations of the water samples are provided on a regional map. Land ownership, geology, annual precipitation, and physiography maps, and a Landsat satellite image of the region are also presented.

### SURVEY AREA MAPS AND DATA

Sections 2 through 7 provide maps and data for the survey areas listed above. Each section contains the following maps and data tables or legends:

Overview Map
Aerial Radiation Contours - Gross Count
Aerial Radiation Contours - Bismuth <sup>214</sup>
Water Sample Information
Water Sample Analysis for Stable Metals
Water Sample Analysis for Radioactive Metals
Summary of Water Quality Analysis with Respect to Stable and Radioactive Metals
Water Quality Analysis and Bismuth <sup>214</sup> Contours

Atlas users should refer to the Table of Contents for a complete listing of the maps and data tables, and the associated page numbers.

#### Overview Maps

Each section begins with an area description and an overview map. The overview map shows the boundaries of the aerial radiation surveys on a Landsat Multispectral Scanner (MSS) satellite image base. The facing page has a map showing the location of the survey area within the Navajo Nation and photographs that are representative of the ground conditions present in the survey area.

#### Aerial Radiation Contour Maps

The USDOE Remote Sensing Laboratory flew aerial radiation surveys over each of the survey areas. A contour map showing terrestrial exposure rates (gross count) is presented for each survey area. The gross count contours include contributions from all natural terrestrial contributors (potassium, uranium, thorium) and possible man-made contributors. The map shows the gross count contours and the extents of the aerial radiation surveys on a single band Landsat MSS satellite image base (shown in grayscale). Facing the gross count radiation contour map is a figure showing a legend and source statement for the radiation contours. A map showing geologic map units draped on a shaded-relief image with historical uranium mine locations and the extents of the survey areas is also shown.

A contour map showing excess bismuth activity (bismuth is an indicator of uranium) is presented for each survey area. Aerial radiation contours are indicative of uranium concentrations that are higher than the regional levels. The map shows the Bismuth <sup>214</sup> contours and the extents of the aerial radiation surveys on a single band Landsat MSS satellite image base (shown in grayscale). Facing the Bismuth <sup>214</sup> contour map is a figure showing a legend and source statement for the radiation contours, and enlargements of the survey areas where Bismuth <sup>214</sup> contours are present.

#### Water Sample Maps

Water samples were collected at each of the six survey areas. For the water sample data, the format of the Atlas shows a map with a facing page of data. The map shows the water sample locations and the extents of the aerial radiation surveys on a single band Landsat MSS satellite image base (shown in grayscale). Also presented on the map are locations of springs, populated places, hospitals, schools, and churches. A facing data page presents for each water sample location the map identifier, sample name, the type of water source (e.g., spring, wind mill, or home), sample identifier (ID), geographic coordinates (latitude and longitude in degrees, minutes, and seconds), elevation in feet, and the date and time the sample was collected.

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Unique map identification numbers (Map IDs) were assigned to each sample. The following format for the sample ID was used:

AAyymmddBBCxxx

AA General Area Identifier (e.g., CT = Cameron/Tuba City Area)  
BB Chapter Identifier (e.g., TC = Tuba City)\*  
C Sample Type Identifier (e.g., W = Well)  
yy Year (e.g., 98 = 1998)  
mm Month (e.g., 01 = January)  
dd Day (e.g., 01=1st day of the month)  
xxx Sequential Number of Sample for the Chapter (e.g., 001)

For example, the sample identification number CT980101TCW001 would correspond to the first well sampled in the Tuba City Chapter of the Cameron/Tuba City Area on January 1, 1998.

\* *The Navajo Nation GIS group supplied the chapter boundaries for the area maps. It is recognized that for various reasons, the residents and/or Chapter Officials may have differing ideas of their areas of jurisdiction. Each water sample ID is coded with the chapter from the official who identified the water source.*

The following letter combinations were used as the General Area Identifiers:

BI Bidahochi Area  
CT Cameron/Tuba City Area  
CH Chinle Area\*  
RV Red Valley Area\*\*  
MV Monument Valley Area

\* *When summary maps and tables were produced, the original Chinle Area was divided into the Central Area and the Chinle Area. The sample IDs retained the original unique identifier numbers.*

\*\* *When developing summary tables and maps, the Red Valley Area was renamed the Four Corners Area. The Sample ID retained the original unique identifier numbers.*

The following letter combinations were used as the Chapter Area Identifiers:

BM	Black Mesa Chapter	NZ	Nazlini Chapter
BG	Bodaway/Gap Chapter	OL	Oljato Chapter
CA	Cameron Chapter	RV	Red Valley Chapter
CH	Chilchinbito Chapter*	RR	Rough Rock Chapter
CH	Chinle Chapter*	SH	Shonto Chapter
CM	Coalmine Chapter	SW	Sweetwater Chapter
CV	Cove Chapter	BG	Tachee/Blue Gap Chapter
DE	Dennehotso Chapter	TN	Teec Nos Pos Chapter
DI	Dilkon Chapter	TE	Teesto Chapter
IW	Indian Wells Chapter	TC	Tselani/Cottonwood Chapter**
KY	Kayenta Chapter	TC	Tuba City Chapter**
LG	Lower Greasewood Chapter	WC	White Cone Chapter

\* *Chilchinbito Chapter and Chinle Chapters have the same unique identifier letters, CH. They can be distinguished from one another by the survey area in which they are located. Chilchinbito is in the Kayenta Survey area (KY) and Chinle is in the Chinle Area (CH).*

\*\* *Tselani/Cottonwood Chapter and Tuba City Chapter have the same unique identifier letters, TC. They can be distinguished from one another by the survey area in which they are located. Tselani/Cottonwood Chapter was originally in the Chinle Survey Area (CH). Tuba City is in the Cameron/Tuba City Survey Area (CT).*

The sample identifiers were designated as follows:

W Well  
S Spring  
M Mine  
H Home

### Water Sample Analysis for Stable Metals

Results from the Water Sample Analysis for Stable Metals are presented for each survey area on a map and facing data page. The map shows the water sample locations and the extents of the aerial radiation surveys on a single band Landsat MSS satellite image base (shown in grayscale). Also presented on the map are locations of populated places, hospitals, schools, and churches. A facing data page presents for each water sample the map identifier, sample ID, sample name, and results for aluminum, antimony, arsenic, barium, beryllium, cadmium, chromium, copper, iron, lead, mercury, nickel, selenium, silver, thallium, vanadium, and zinc. Also presented are calculated values of the Incremental Lifetime Cancer Risk with respect to radioactive metals.

### Water Sample Analysis for Radioactive Metals

Results from the Water Sample Analysis for Radioactive Metals are presented for each survey area on a map and facing data page. The map shows the water sample locations and the extents of the aerial radiation surveys on a single band Landsat MSS satellite image base (shown in grayscale). Also presented on the map are locations of populated places, hospitals, schools, and churches. A facing data page presents for each water sample the map

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identifier, sample ID, sample name, and results for alpha, beta, lead<sup>210</sup>, radium<sup>226</sup>, thorium<sup>228</sup>, thorium<sup>232</sup>, uranium<sup>235</sup>, and uranium<sup>238</sup>. Also presented are calculated values of the Incremental Lifetime Cancer Risk with respect to radioactive metals.

#### Summary of Water Quality Analysis with Respect to Stable and Radioactive Metals

Results from the Summary of Water Quality Analysis with Respect to Stable and Radioactive Metals are presented for each survey area on a map and facing data page. The map shows the water sample locations and the extents of the aerial radiation surveys on a single band Landsat MSS satellite image base (shown in grayscale). Also presented on the map are locations of populated places, hospitals, schools, and churches. A facing data page presents for each water sample the map identifier, sample ID, sample name, total cancer risk, Hazard Index (HI), arsenic, lead, and total uranium. Also presented are the risk categories and risk ranking for each sample.

#### Water Quality Analysis and Bismuth Contours

The last two maps of each section show the water sample sites by risk ranking and the aerial radiation contours for Bismuth<sup>214</sup>. One map is presented on a single band Landsat MSS satellite image base (shown in grayscale), and the second map shows the same information on a scanned topographic map base.

### BASEMAPS

There are three primary basemaps presented in the Atlas, ranging from regional to local scale. The regional maps shown in Section 1 cover the surveyed area of the Navajo Nation and are presented at a scale of 1:1,400,000 (one inch represents approximately 22 miles). Each regional map covers an area approximately 345 miles (550 km) wide by approximately 185 miles (300 km) high.

Overview maps shown at the beginning of Sections 2 through 7 cover the area surrounding the survey area and are presented at a scale of 1:600,000 (one inch represents approximately 9.5 miles). Each overview map covers an area approximately 150 miles (240 km) wide by approximately 80 miles (130 km) high.

Survey area maps in Sections 2 through 7 cover the immediate survey area and are presented at a scale of 1:350,000 (one inch represents approximately 5.5 miles). Each survey area map covers an area approximately 85 miles (135 km) wide by approximately 45 miles (70 km) high.

The projection used for all of the basemaps is Universal Transverse Mercator, Zone 12, meters, NAD27.

Each basemap shows political, administrative, and project boundaries, transportation, and cultural features. A legend showing the symbology used throughout the Atlas is presented on the next page. Appendix B provides map source information.

### DESCRIPTION OF APPENDICES

#### Appendix A Project Summaries

The following project summaries are presented from the USACE "Data Quality Assurance Summary Report" dated November 2000, and other documents produced during the investigations and at the close-out of the project. These summaries provide an overview of the data collection and data management processes and procedures used for this project.

- A.1 Summary of the Characterization of Risk Leading to Exposure Reduction
- A.2 Community Information and Education Summary
- A.3 USDOE Aerial Measuring System Summary
- A.4 USACE Water Sampling and Other Field Sampling
  - A.4a USACE Project History Summary
  - A.4b USACE Field Operations Summary
  - A.4c USACE Data Management Summary

#### Appendix B Data References

Appendix B provides bibliographic citations for the spatial datasets used to generate the maps presented in the Project Atlas.

#### Appendix C Gazetteer

Appendix C provides the names of geographic features within the Abandoned Uranium Mines Project area. Also provided are the type of feature and location in latitude and longitude. The Gazetteer is derived from data available from the U.S. Geological Survey's Geographic Names Information System (GNIS) digital files and Environmental Systems Research Institute (ESRI).

#### Appendix D Glossary

A list of terms and definitions used on the Abandoned Uranium Mines Project.

#### Appendix E Acronyms

A list of acronyms and abbreviations used on the Abandoned Uranium Mines Project.

#### Appendix F References

A bibliography of publications and references used on the Abandoned Uranium Mines Project.