

PUBLIC LAND SURVEY SYSTEM (PLSS)

The U.S. Bureau of Land Management (BLM) cadastral survey program is responsible for the official boundary surveys for all federal agencies in the United States. The Public Land Survey System (PLSS), also called the Rectangular Survey System, is the foundation for many survey-based land information systems. In 1785, the Continental Congress enacted the Land Ordinance which set in motion a rectangular survey system to lay out one mile square parcels over all of the federal lands outside the 13 colonies and their western territories. Our present system of public land survey still retains the basic elements set forth in the Land Ordinance of 1785 (BLM, 2003 - S05140305).

Under the cadastral system, the public domain is plotted from a principal meridian (running north and south) and base line (running east and west) into a grid of squares approximately 6 miles to the side, called "townships." The township is further divided into sections of one-mile squares containing 640 acres. Sections are numbered 1-36 from the upper right hand corner. The sections can be further subdivided into quarter sections of 160 acres. The quarters can be divided into half-quarters of 80 acres or into quarter-quarter sections of 40 acres, etc. Many of the references to locations of AUMs or leases/permits are described in terms of the PLSS. Often, the location is described by Township, Range, and Section, or somewhere within a square mile.

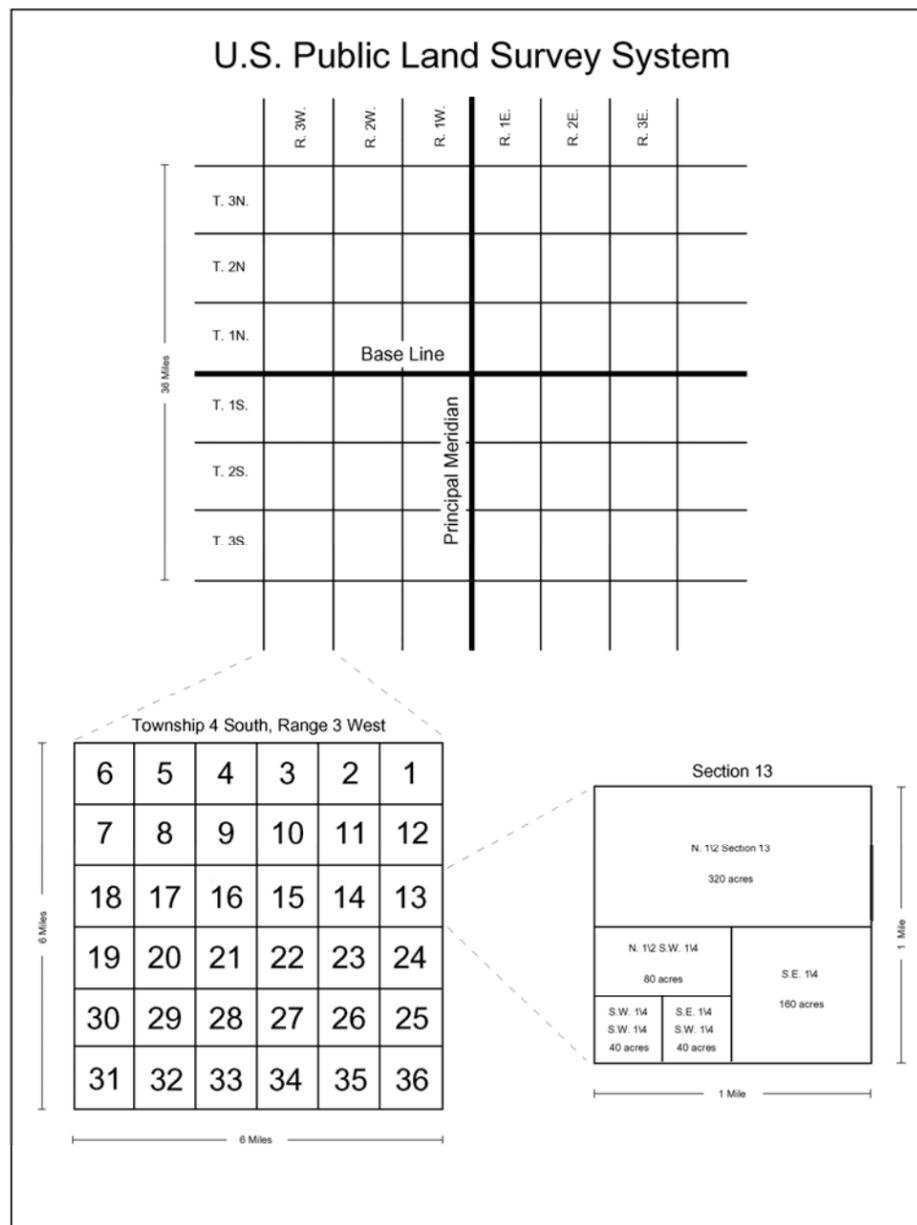
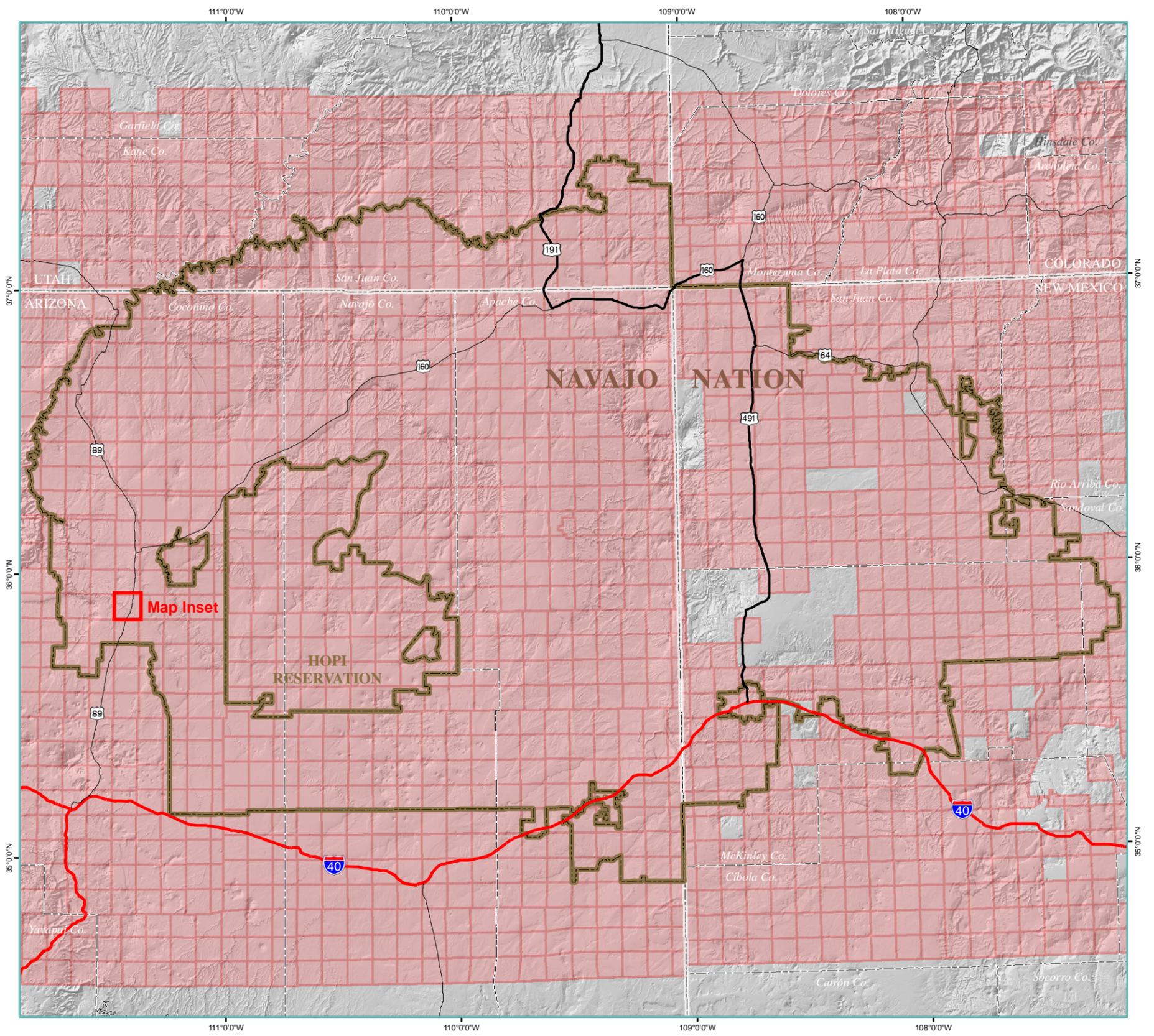


Figure 43. Diagram Showing the Relationship Between PLSS Township, Range and Sections.

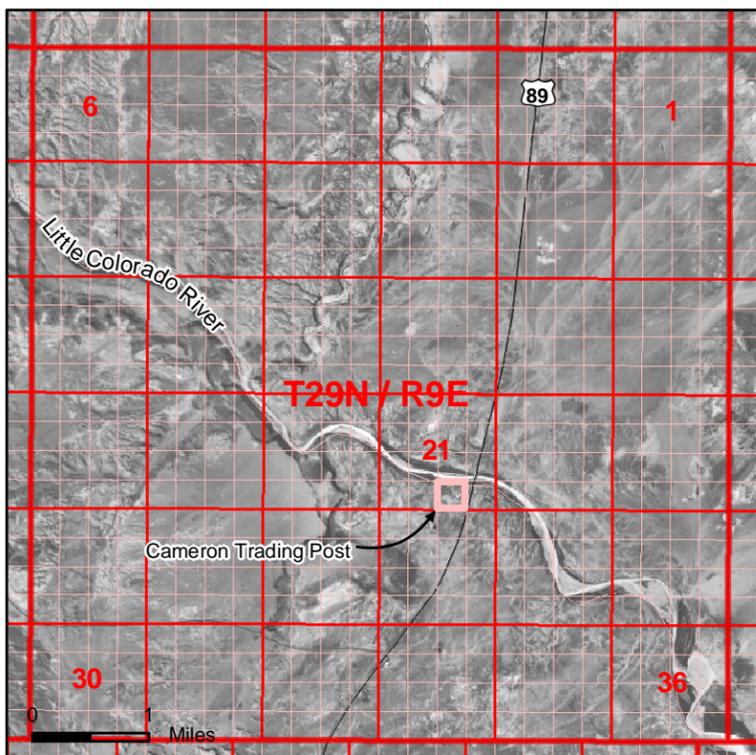
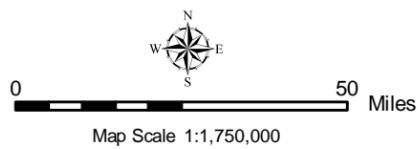
The BLM Geographic Coordinate Data Base (GCDB) is a collection of coordinate values and other descriptive information for corner positions and monuments recorded in the PLSS (BLM, 2003 - S05140306). The collection, analysis, and management of the data is the responsibility of the BLM, Branch of Cadastral Survey. The GCDB grid is computed from BLM survey records (official plats and field notes), local survey records, and geodetic control information. BLM collects the GCDB data on a township basis. The survey boundaries are delineated by computing the geographic positions of township, section, aliquot part, government lot, and special survey corners. Next, official land descriptions are assigned to each land unit in the grid. The records are then reformatted so Geographic Information System (GIS) software can be used to spatially view the PLSS information.

The BLM began collection of the geographic coordinate information in 1989 and the data collection effort continues today. GCDB data has been collected for approximately three quarters of the townships in the Western United States. However, as shown on Figure 44, PLSS and GCDB data are not complete for the New Mexico part of the Navajo Nation. Pink grid cells are where Townships are mapped. The enlargement map on Figure 44 shows an example of the PLSS in the area of the Cameron Trading Post, which is located in the southwest quarter of the southeast quarter of Section 21, Township 29 North, Range 9 East. The Township is shown with thick red lines. Sections are shown by thinner red lines, and quarter and quarter-quarter sections are shown with thin pink lines.

These PLSS GIS datasets are provided on the GIS Data DVD under the DB/PLSS directory (NN_GCDB_Twnship.shp; NN_GCDB_Sections.shp; and NN_GCDB_QSections.shp).



**ABANDONED URANIUM MINES AND THE NAVAJO NATION
PUBLIC LAND SURVEY SYSTEM (PLSS)**



Township 29 North (T29N), Range 9 East (R9E). The Cameron Trading Post, Arizona is located in the SW Quarter of the SE Quarter of Section 21.

Legend

- Township
- Sections
- Quarter Sections

Sources

The Township, Section, and Quarter Section datasets were developed by the U.S. Bureau of Land Management.

Filenames:
 NN_GCDB_Twnshp.shp
 NN_GCDB_Sections.shp
 NN_GCDB_QSections.shp

Figure 44. Public Land Survey System (PLSS) of the Navajo Nation.

DIGITAL RASTER GRAPHIC (DRG), ORTHOPHOTO, AND SATELLITE IMAGES

DIGITAL RASTER GRAPHIC (DRG) IMAGES

Topographic maps are the base map series of the U.S. Geological Survey (USGS). USGS topographic maps are available as paper maps and scanned raster files. A Digital Raster Graphic (DRG) is a georeferenced image of a scanned USGS topographic map. The maps were scanned at a resolution of 250 dots per inch. The horizontal and vertical accuracy of the DRG matches the accuracy of the published source map. A DRG may be used as a source or background layer in a Geographic Information System (GIS) to collect, review, and revise other digital data. When the DRG is combined with other digital products, such as a Digital Orthophoto Quarter Quad (DOQQ) or a Digital Elevation Model (DEM), the resulting image provides additional visual information for the extraction and revision of base cartographic information. DRGs can be used to help identify the surface water migration route, nearby wetlands, and sensitive environments (EPA, 1991 - S01230301). DRGs were used to help assess the completeness of digital data that were acquired from various sources for the Navajo Nation GIS Database. DRGs for the Navajo Nation were generated from 1963 to 1997. See the index shapefile for DRG dates on the GIS Data DVD (DB/Index/ NN_Topo24K.shp).

DIGITAL ORTHOPHOTO QUARTER QUADRANGLE (DOQQ) IMAGES

DOQQs are computer-generated images of an aerial photograph in which image displacements caused by terrain relief, camera tilt and lens distortions have been removed. The aerial photographs are scanned and processed to create a georeferenced and planimetrically accurate digital image. The resulting DOQQ combines the image characteristics of a photograph with the geometric qualities of a map. A DOQQ can be used in most any GIS that can manipulate raster images. DOQQs can be used as a cartographic base for displaying other digital spatial data. The accuracy and detail provided by a DOQQ allow users to evaluate their data for accuracy and completeness, make modifications to data, and even generate new thematic layers. DOQQs were used extensively in the review and correction of several spatial datasets prepared for this NAUM Project. The USGS generated DOQQs from black and white aerial photography acquired during the 1990s for the Navajo Nation. Any recent construction after this period, such as new roads or housing developments, will not be evident on the DOQQs. The accuracy and quality of USGS DOQQs meet National Map Accuracy Standards at 1:12,000 scale, and have a 1-meter ground resolution, and accuracy of +/- 33 feet. The U.S. Bureau of Indian Affairs had new digital orthophotos generated for the Navajo Nation using 2005 aerial photography.

County Mosaics

Due to the large number of images (i.e., 515 DRGs and 2,060 DOQQs) and large file sizes (29 megabytes per DRG and 50 megabytes per DOQQ), required to cover the Navajo Nation, it was necessary to acquire county DRG and DOQQ mosaics in compressed format. The county DRG and DOQQ mosaics were developed by the U.S. Natural Resource Conservation Service (NRCS) using LizardTech's MrSID compression software to produce dramatically smaller image sizes (4.4 GB total for the DRG mosaics and 10.7 GB total for the DOQQ mosaics) with little loss in quality. The county DRG and DOQQ mosaics for the Navajo Nation are referenced to the North American Datum of 1983 (NAD83) and use the Universal Transverse Mercator (UTM) projection, Zone 12 for all except the Sandoval County DRG and DOQQ mosaics, which use Zone 13. Table 6 identifies the DVD Name and filenames for the DRG and DOQQ county mosaics that are provided and cover the Navajo Nation.

Table 6. DRG and DOQQ County Mosaics with Corresponding DVD Name, Filenames, and UTM Zone.

County, State	DRG Filename	DVD Name	DOQQ Filename	DVD Name	UTM Zone
Apache, Arizona	Apache_AZ_DRG.sid	DVD_DRG	Apache_AZ_DOQQ.sid	DVD_DOQQ_1	12
Coconino, Arizona	Coconino_AZ_DRG.sid	DVD_DRG	Coconino_N_AZ_DOQQ.sid Coconino_S_AZ_DOQQ.sid	DVD_DOQQ_1	12
McKinley, New Mexico	McKinley_NM_DRG.sid	DVD_DRG	McKinley_NM_DOQQ.sid	DVD_DOQQ_2	12
Navajo, Arizona	Navajo_AZ_DRG.sid	DVD_DRG	Navajo_N_AZ_DOQQ.sid Navajo_S_AZ_DOQQ.sid	DVD_DOQQ_2	12
Sandoval, New Mexico	Sandoval_NM_DRG.sid	DVD_DRG	Sandoval_NM_DOQQ.sid	DVD_DOQQ_3	13
San Juan, New Mexico	San_Juan_NM_DRG.sid	DVD_DRG	San_Juan_NM_DOQQ.sid	DVD_DOQQ_3	12
San Juan, Utah	San_Juan_UT_DRG.sid	DVD_DRG	San_Juan_SW_UT_DOQQ.sid San_Juan_SE_UT_DOQQ.sid	DVD_DOQQ_3	12

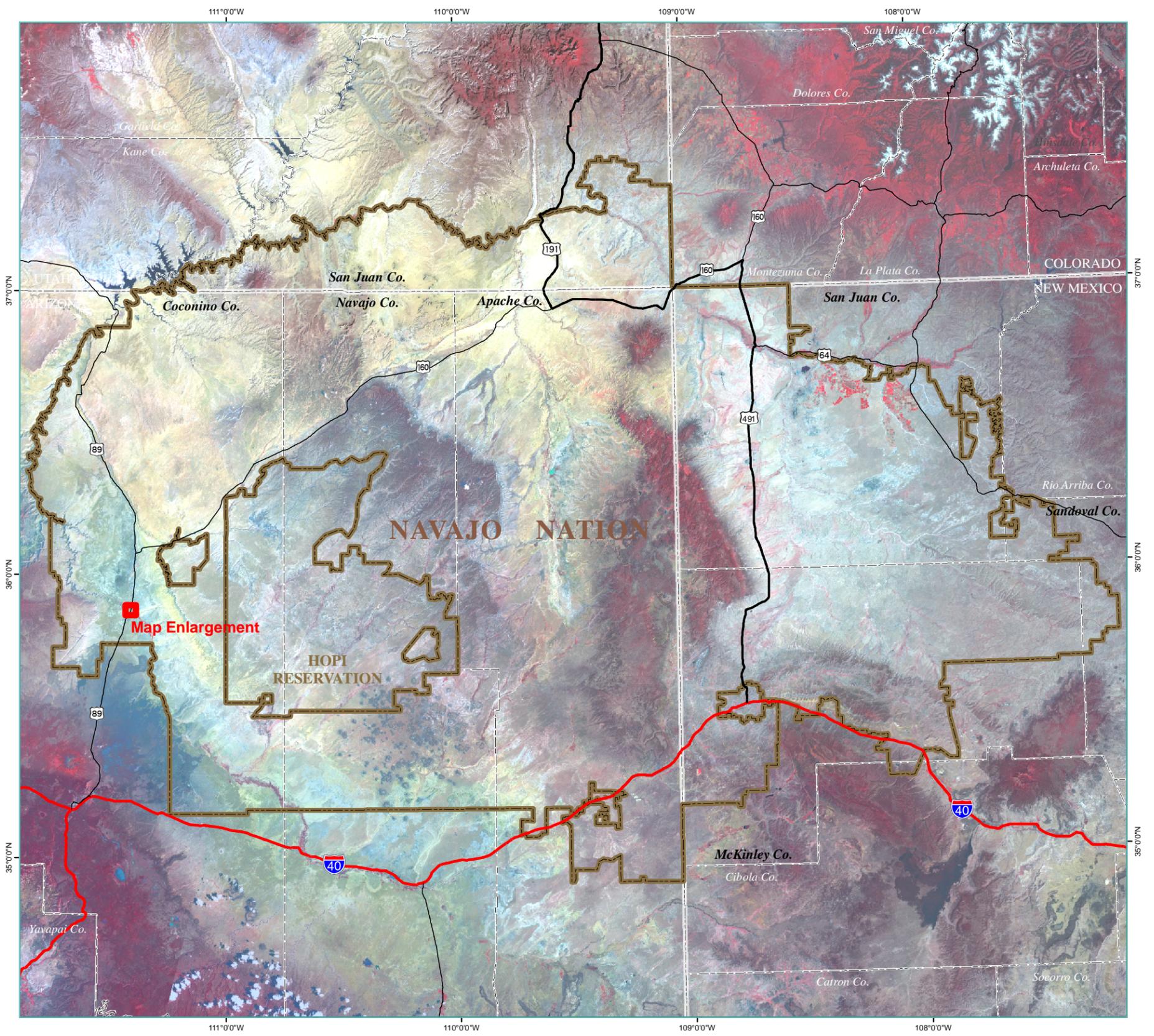
SATELLITE IMAGES

The Landsat satellites are earth observing instruments that were designed to provide consistently calibrated Earth imagery to support monitoring of changes in the Earth's land surface and associated environment. They detect spectrally-filtered radiation at visible, near-infrared, short-wave, and thermal infrared frequency bands from the sun-lit Earth. The imagery can be used in a variety of applications, including land and water management, global change research, oil and mineral exploration, agricultural forecasting, pollution monitoring, change detection, and cartographic mapping.

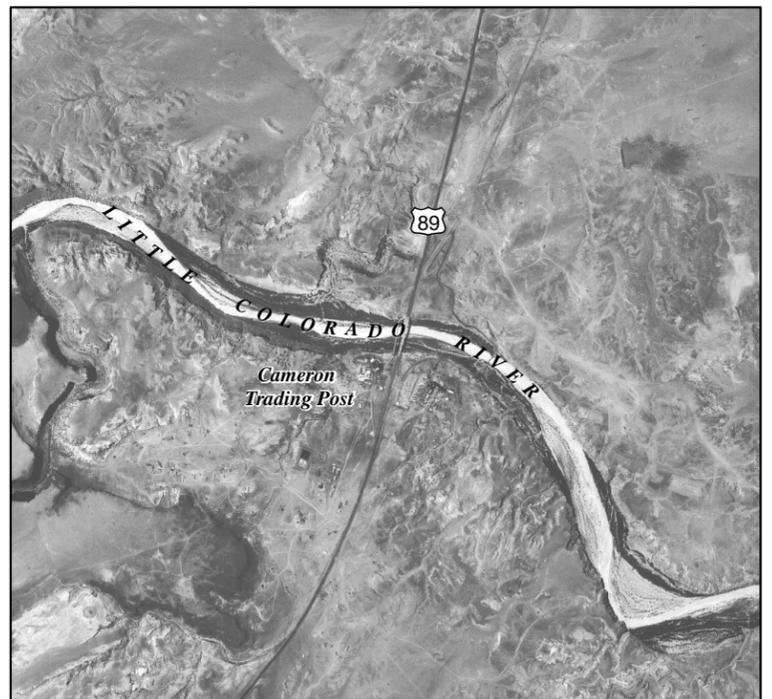
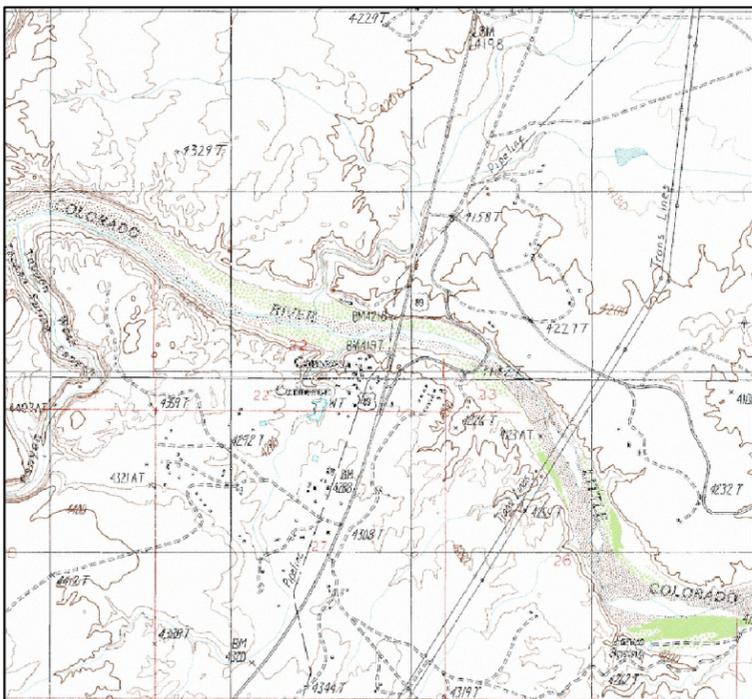
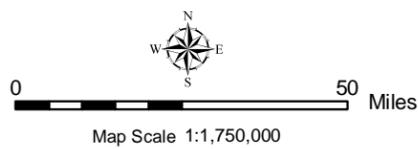
Figure 45 shows a Landsat MultiSpectral Scanner (MSS) image mosaic. It was developed from North American Landscape Characterization (NALC) Triplicate Data that uses precision (i.e. ground control points) and terrain corrected Landsat 4 and 5 MSS images. The four images that comprise the mosaic were acquired by Landsat between June 18, 1992 and September 5, 1992. The MSS bands 4 (Near-Infrared wavelength), 3 (Red wavelength), and 2 (Green wavelength) are displayed with red, green, and blue, respectively, producing a False Color Infrared composite image, wherein vegetation is red.

Landsat 7 is a later generation earth observing satellite that uses the Enhanced Thematic Mapper Plus (ETM+). It produces enhanced spectral and spatial resolution satellite imagery. Its panchromatic band 8 provides black and white imagery with a spatial resolution of 15 meters. Thirteen Landsat 7 ETM+ panchromatic band 8 (visible light) images were acquired from the Global Land Cover Facility (GLCF). Dates of the imagery range between June 6, 2000 and August 26, 2002. These orthorectified images were mosaiced together to provide a single 15 meter resolution black and white image of the entire Navajo Nation.

The two (2) satellite images are provided on the DVD named "DVD_DOQQ_3" (Satellite/NN_Landsat_ETM_Pan.img and Satellite/Nav_MSS.img).



ABANDONED URANIUM MINES AND THE NAVAJO NATION
**LANDSAT, DIGITAL RASTER GRAPHIC (DRG), AND
 DIGITAL ORTHOPHOTO QUARTER QUADRANGLE (DOQQ) IMAGERY**



The map enlargements above show portions of a County DRG mosaic (left) and County DOQQ mosaic (right) of the Cameron Trading Post and Little Colorado River area. The County mosaics were acquired from the Natural Resources Conservation Service.

The Landsat MultiSpectral Scanner (MSS) image mosaic in the top map was developed from four EROS Data Center 1992 North American Landscape Characterization (NALC) Triplicate images. The counties named with black text identify the DRG and DOQQ County Mosaics that are provided on DVDs with this document.

Figure 45. Landsat, Digital Raster Graphic, and Digital Orthophoto Quarter Quadrangle Imagery of the Navajo Nation.

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Dumping muck, Frank No. 1 mine.
Photo courtesy of William L. Chenoweth.



Portals at the Mesa 1 mine, Lukachukai Mountains, Arizona.
Photo courtesy of William L. Chenoweth.