

MODELING RECLAMATION PRIORITIES OF ABANDONED MINES IN NEW MEXICO

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Linda S. DeLay, Susan A. LucasKamat, and Zoe R. Isaacson

Contact: LDeLay@state.nm.us

New Mexico Mining and Minerals Division
Energy, Minerals and Natural Resources Department

Abandoned Mine Land Program, New Mexico Mining and Minerals Division



We are collaborating with state, federal and tribal agencies to inventory and prioritize the reclamation of abandoned coal and legacy uranium mines in New Mexico.



Introduction

New Mexico has a legacy of abandoned or inactive uranium and coal mine sites.

We use the results of ESRI GIS spatial analyses and model building as preliminary decision- making tools in planning site risk assessments and reclamation.



Analysis Approach

Projects

- ◉ Legacy Uranium Mine Inventory Project
- ◉ Gallup Coal Inventory Project

Two scales of analysis for each project

- ◉ State-wide
- ◉ Regional site assessments

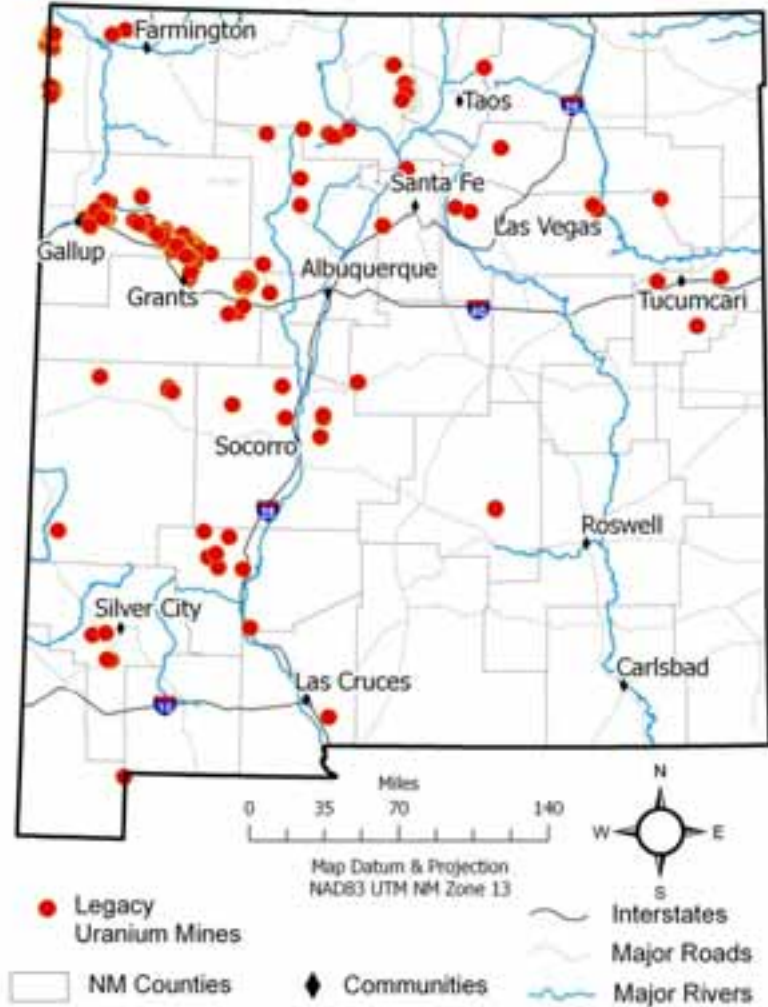


Legacy Uranium Mine (LUM) Inventory Project

Collapsed shaft



Waste piles

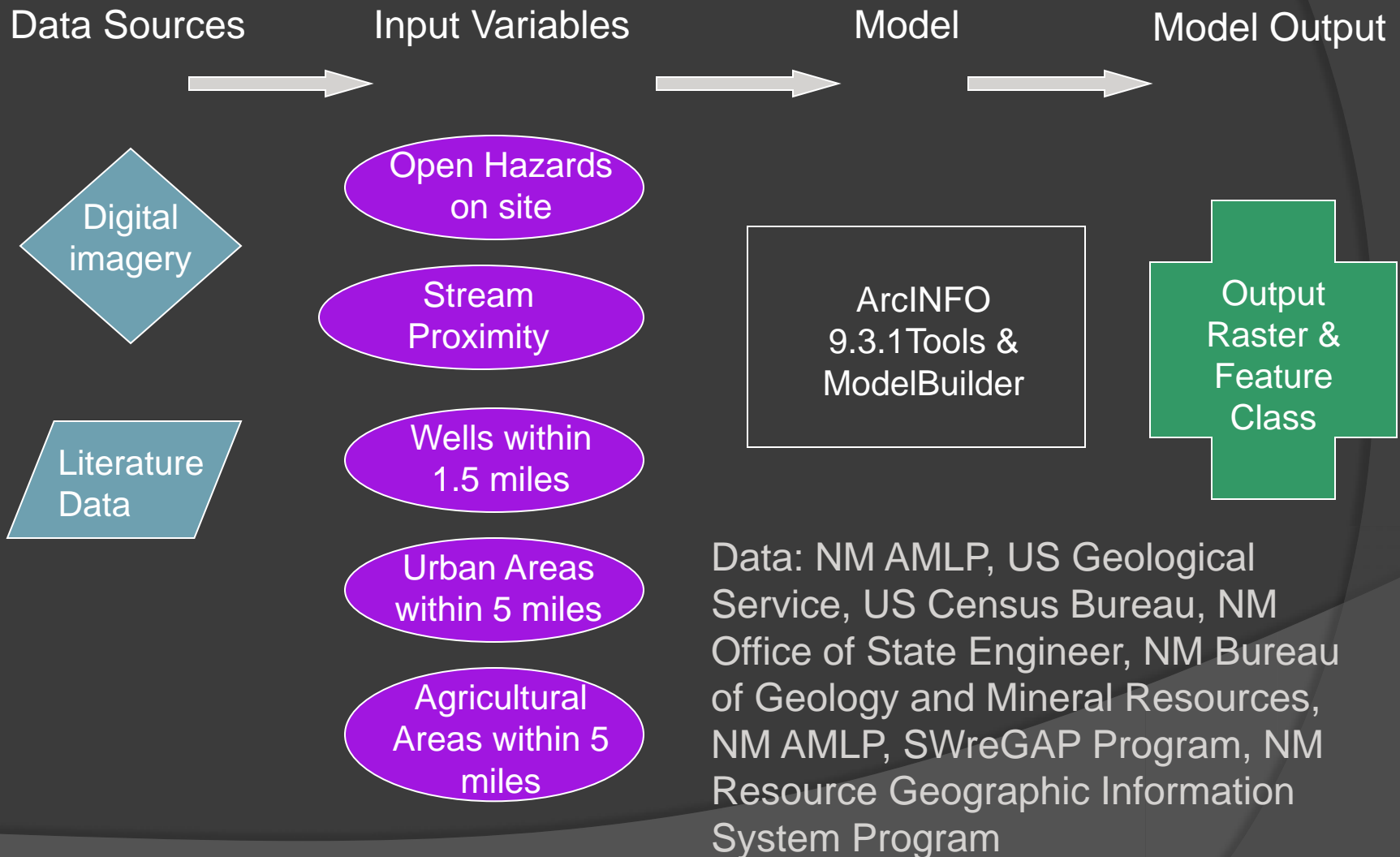


Background

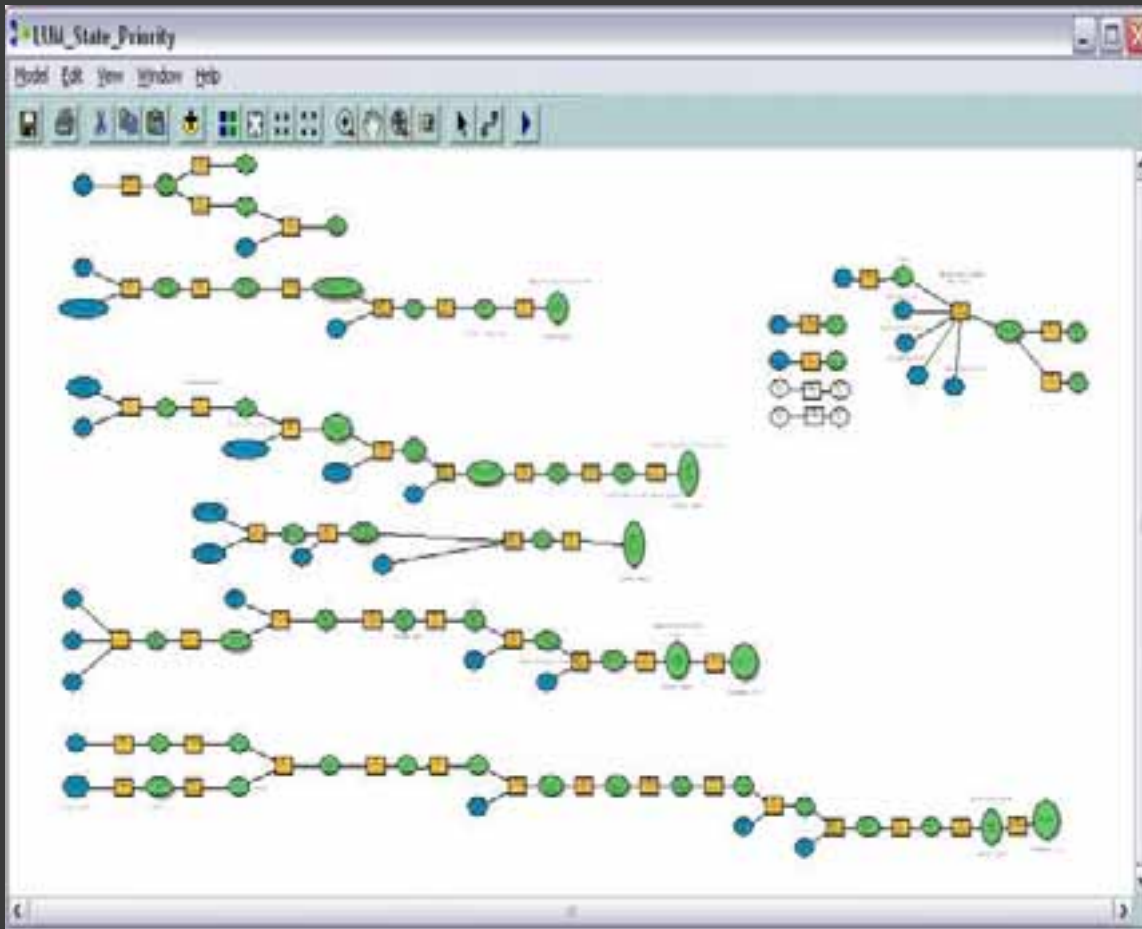
- Over 333 million pounds of U_3O_8 mined 1940-2002 in New Mexico.
- Most uranium mines operated and closed with no reclamation requirements or guidelines, leaving a legacy of radiological contamination.
- Inventory purpose: determine the extent & magnitude of the occurrence of LUMS in NM, especially those that have not been previously addressed by a tribal, federal or state entity.
- Goal: determine appropriate means/remedy for rendering sites safe to humans & returning sites to beneficial use, including a self sustaining ecosystem

LUM Prioritization Model

State Scale (133 sites on non-tribal lands)

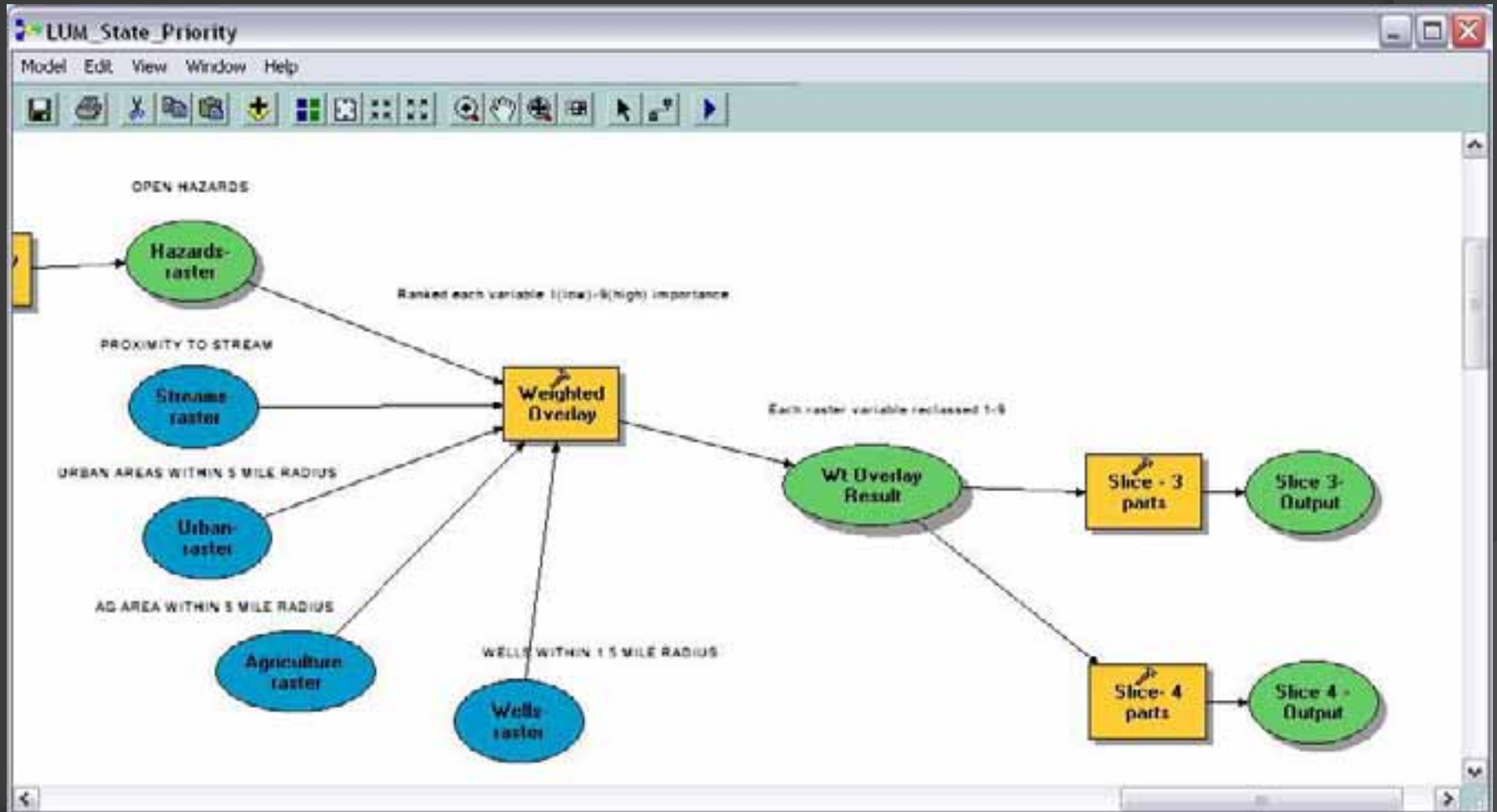


Geoprocessing Flow Involved in the ModelBuilder Creation

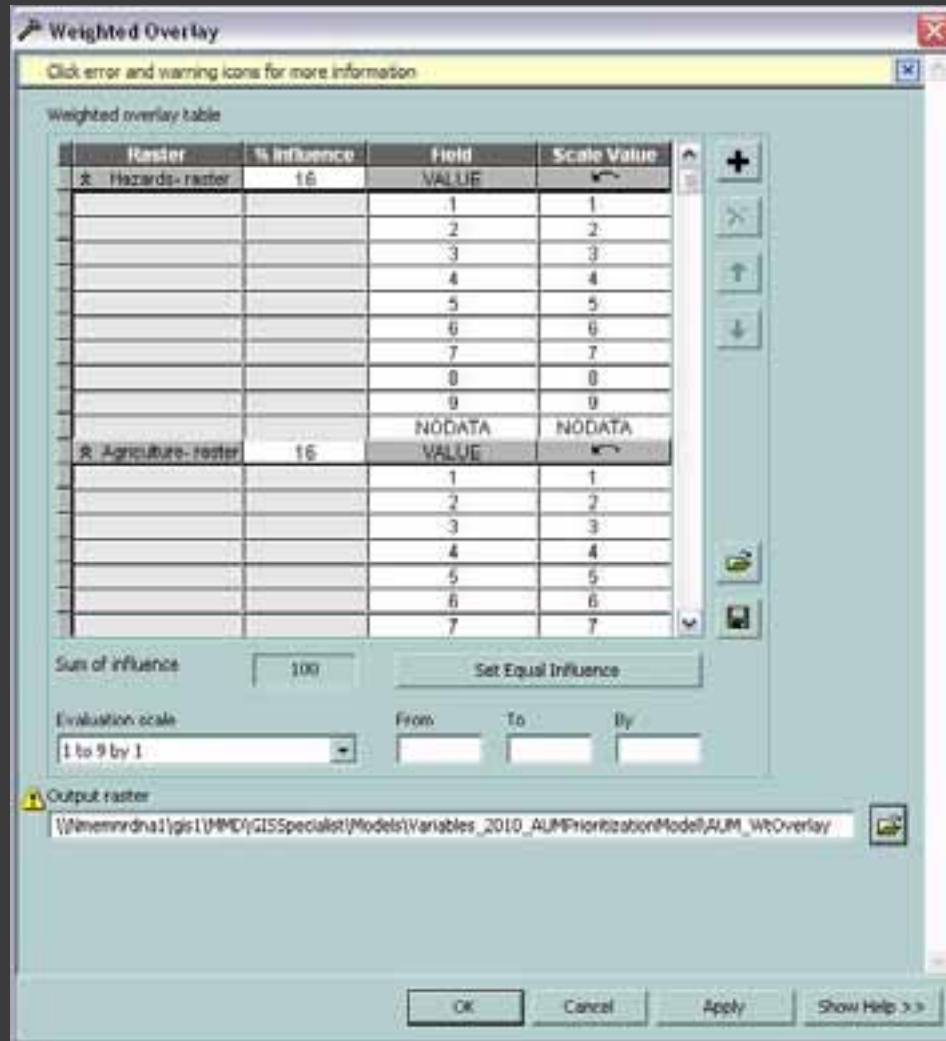


- Documents the process.
- Makes analyses more repeatable. Add new variables, modify spatial statistics and rerun the model.

ModelBuilder Final Steps– Weighted Overlay Spatial Analysis Tool

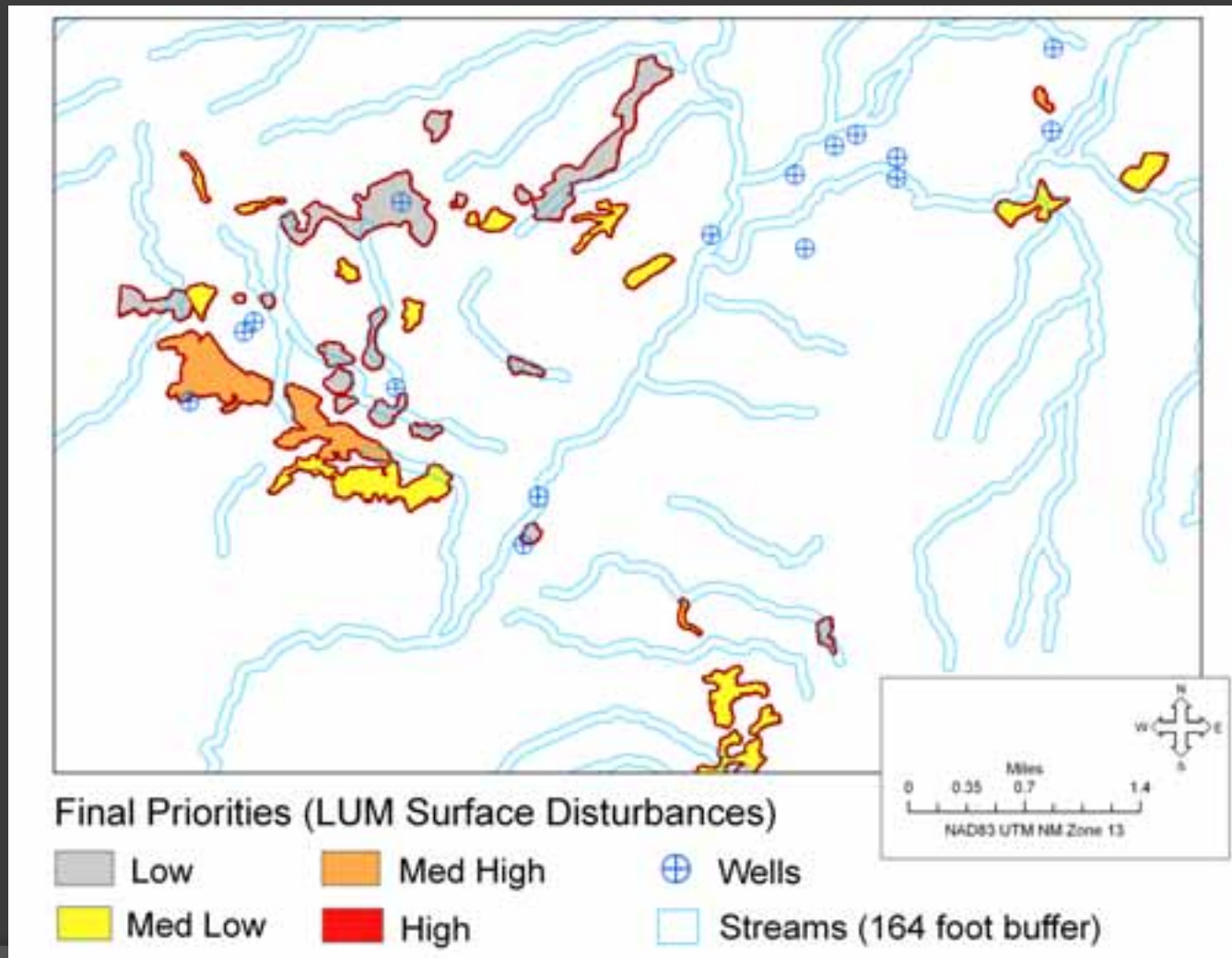


Weighted Overlay Dialog Box

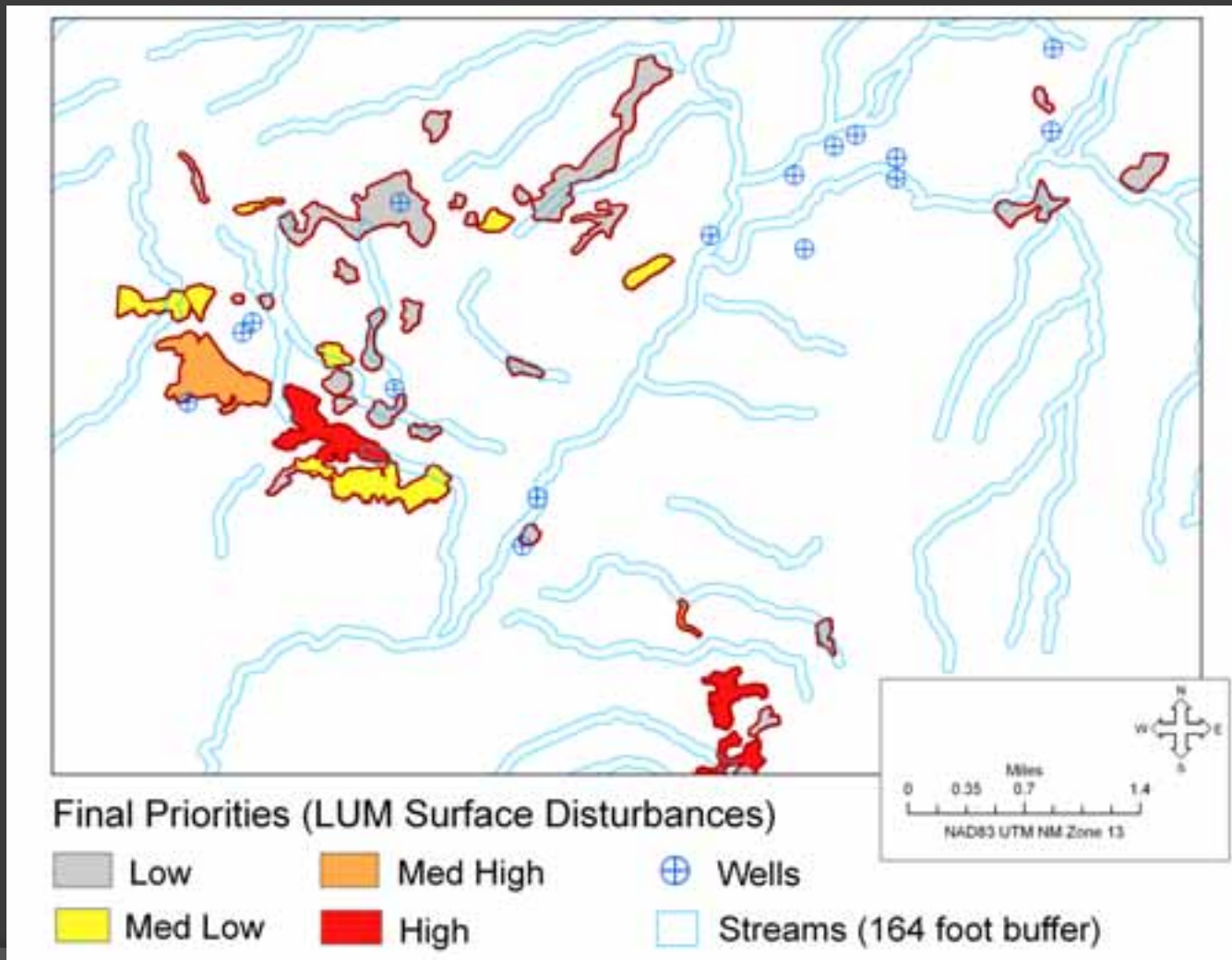


- Overlays all the rasterized variables using common ranking scale.
- Weighted each according to importance (percent influence). Streams and wells received higher weights.

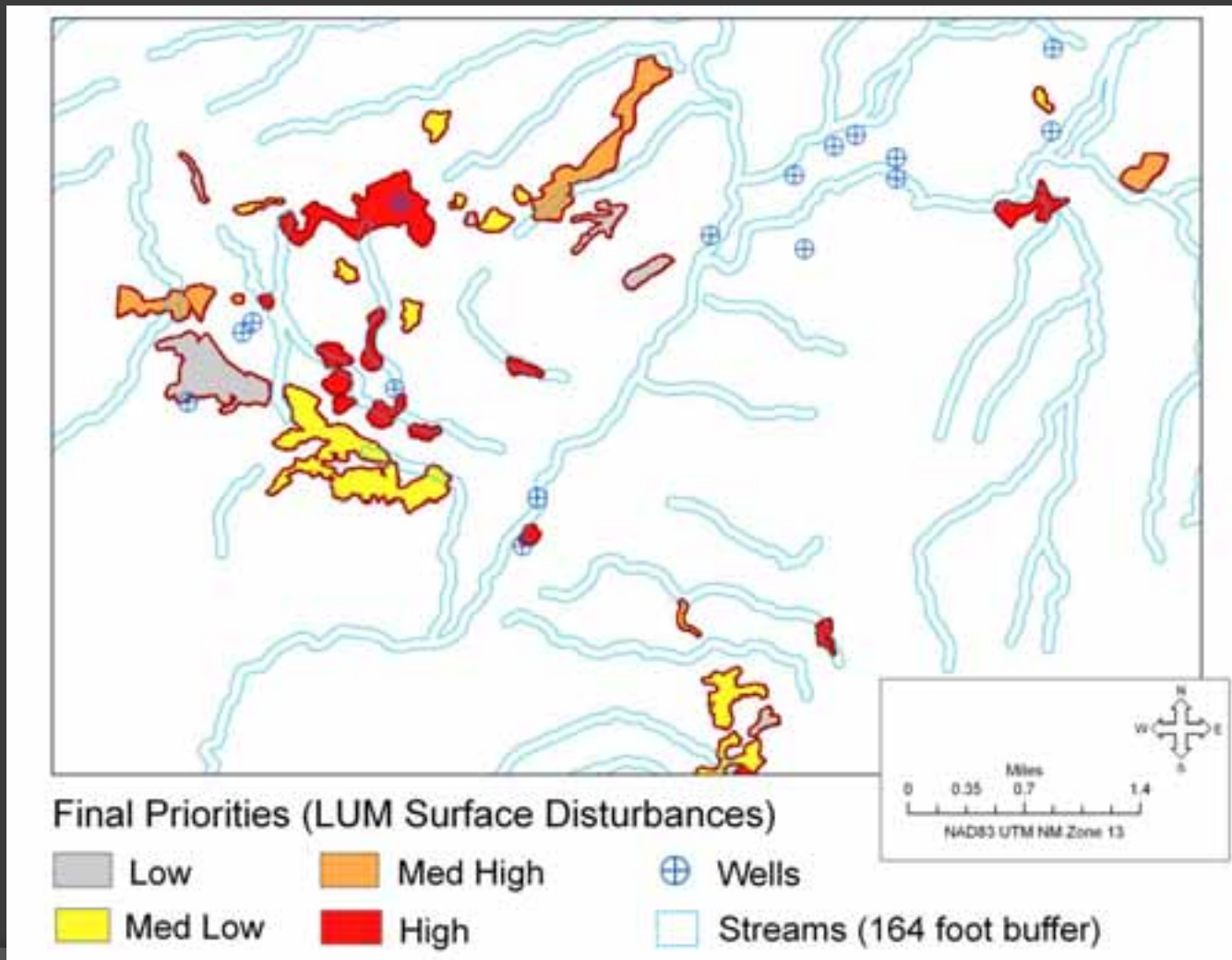
Ambrosia Lake Final Priority Ranking – State-wide Analysis



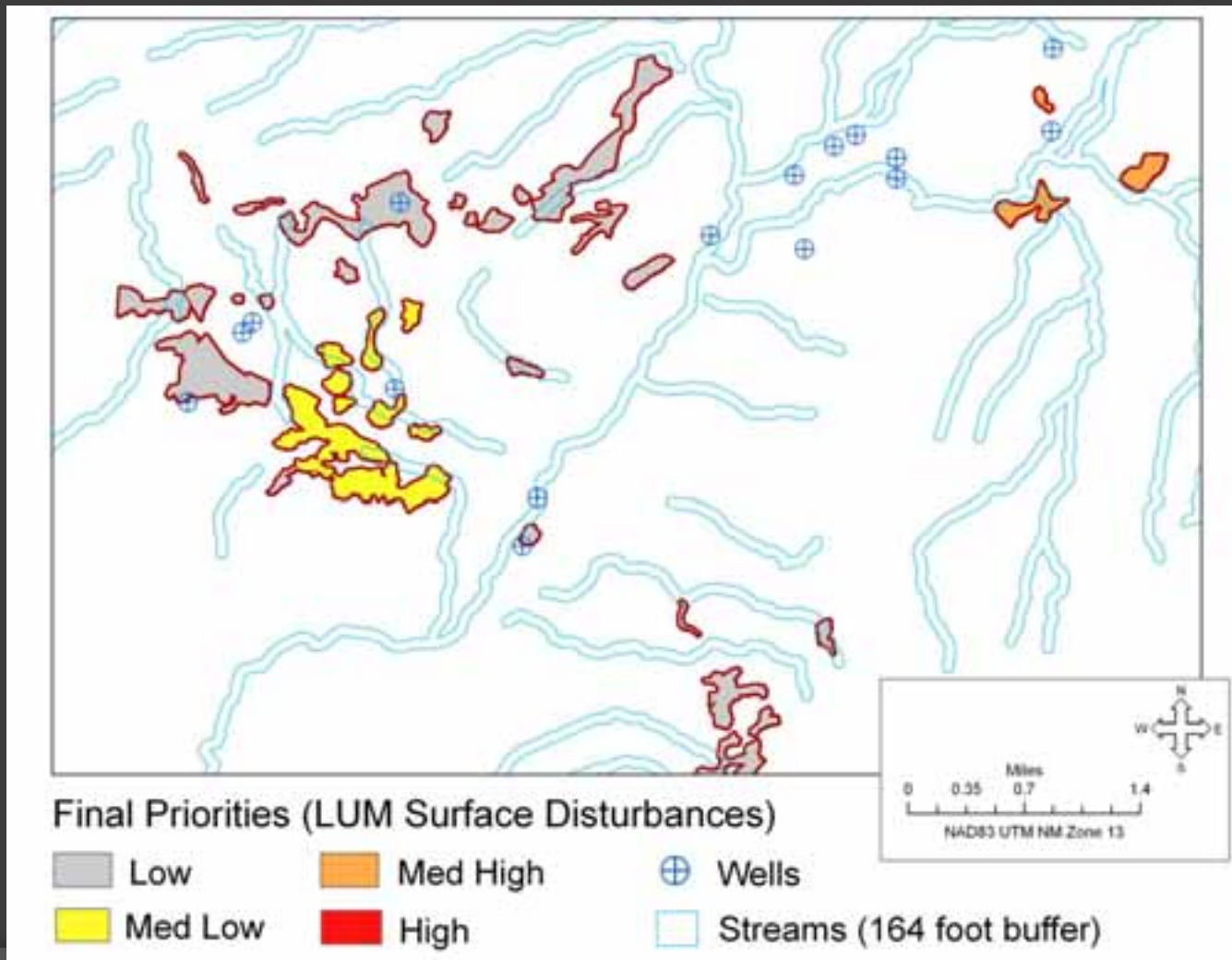
Priority Ranking – Unsafeguarded Hazards



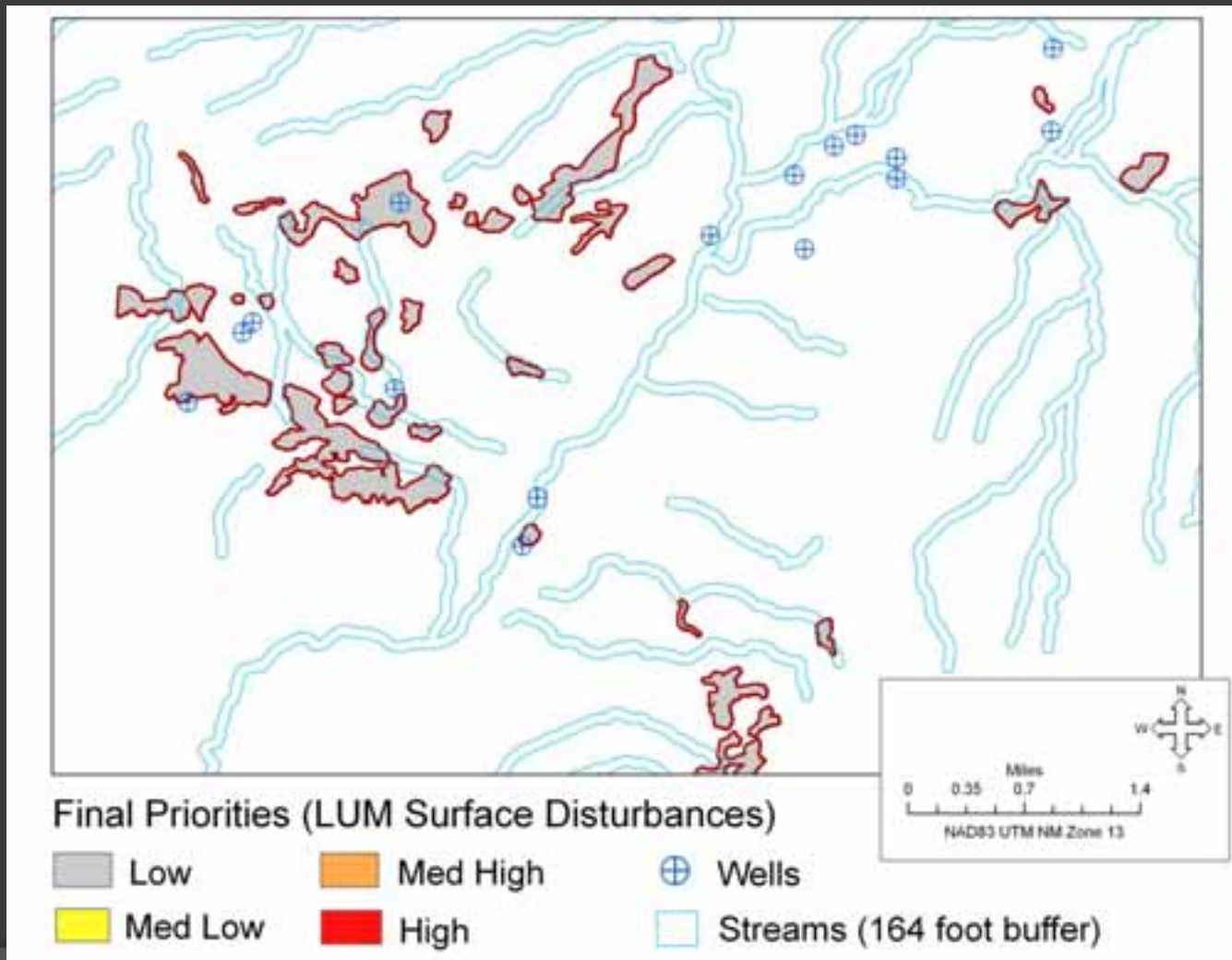
Priority Ranking – Proximity to Streams



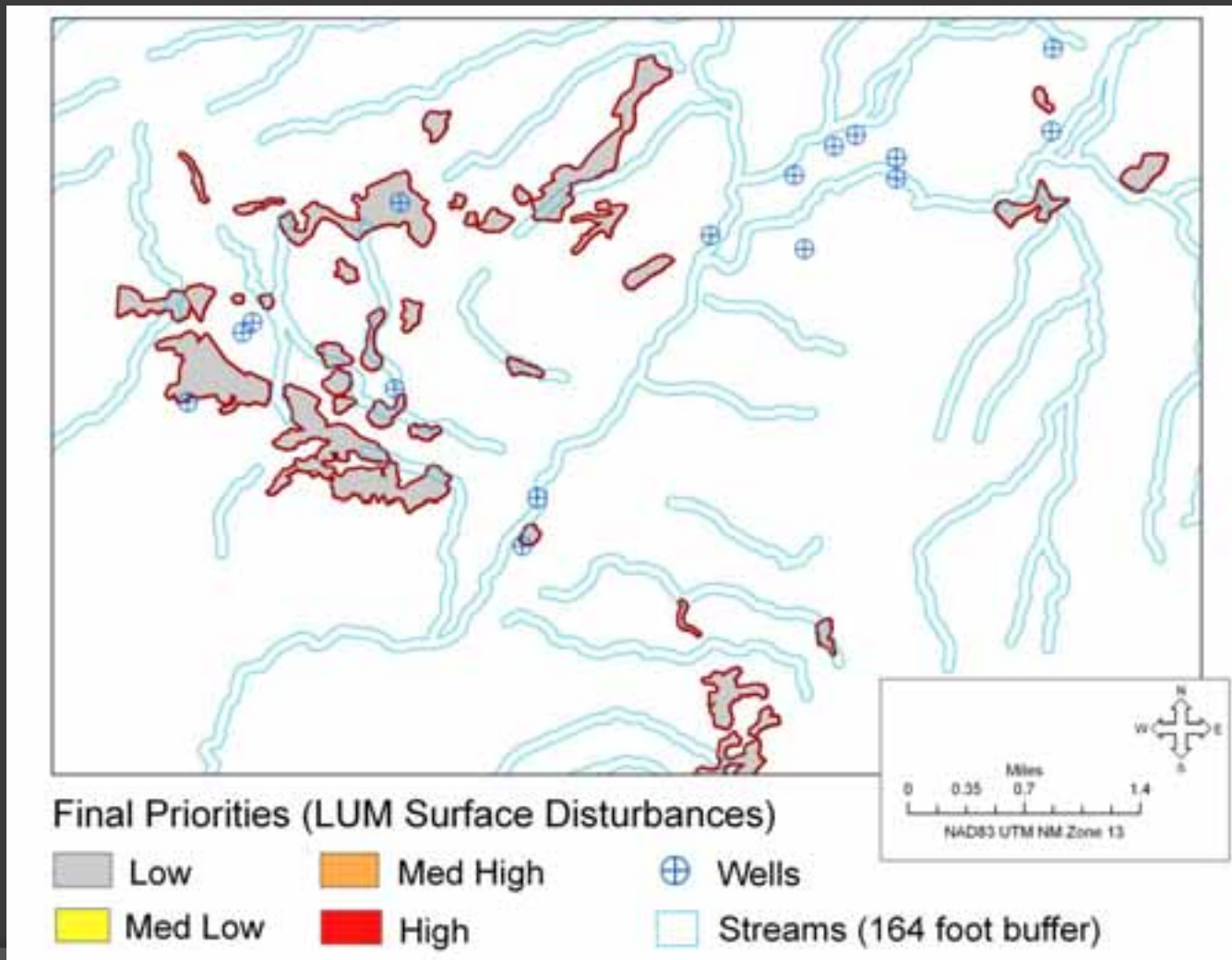
Priority Ranking –Wells within 1.5 miles



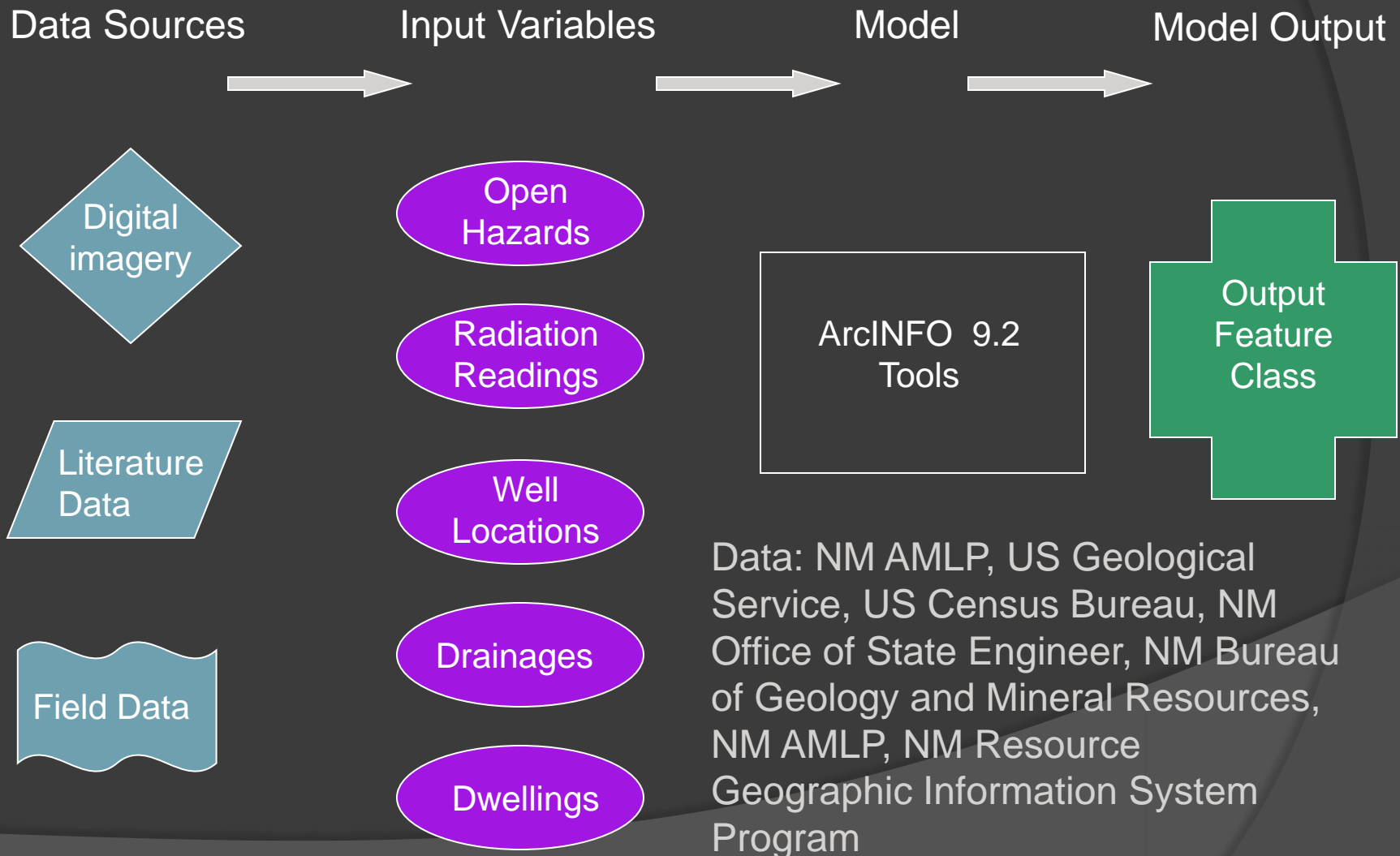
Priority Ranking – Urban Areas within 5 miles



Priority Ranking – Agricultural Areas within 5 miles



LUM Prioritization Model – Site Assessment Scale (Pilot Study 2008-09)



Methods

Additions to the State-wide Analysis

- ⦿ GPS collection of unsafeguarded hazards
- ⦿ Radiation sampling (Gamma exposure rates [mR/h] at ground contact)
- ⦿ Delineation of buildings seen in aerial photos
- ⦿ Delineation of detailed drainage

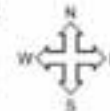
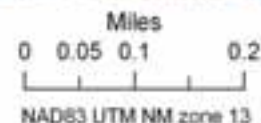
Methodology: Unsafeguarded Hazards Located with GPS



Open Hazards (rank of Num)
(Range 1-6) 1= hi 4=lower priority



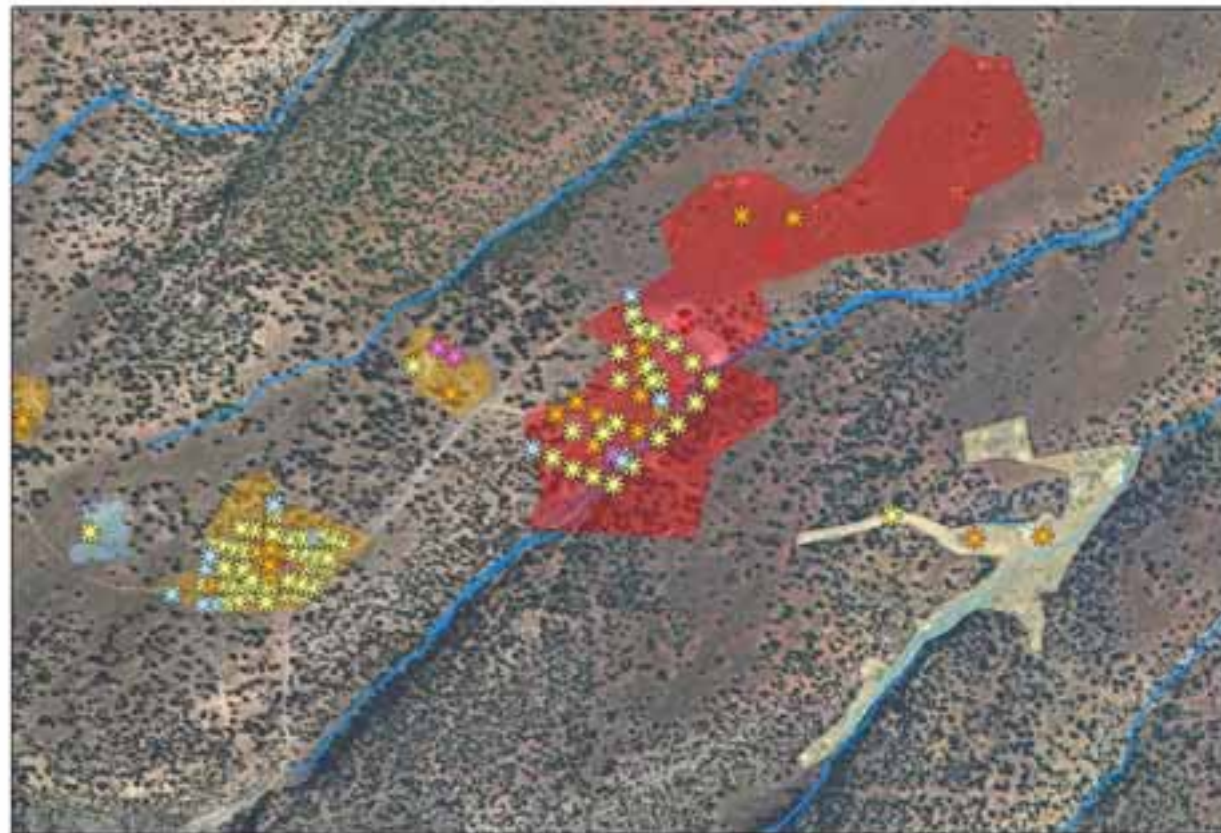
Mine Features



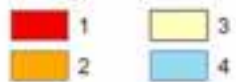
Methodology: Radiation Readings Scoring

| Radiation reading (μ R/hr) | Description | Score |
|------------------------------------|-------------------|-------------------|
| < 15 | Background | 0 |
| 15 – 20 | Background to Low | 10 |
| 21 – 100 | Low to Moderate | 20 |
| 101 – 300 | Moderate to High | 30 |
| 301 – 450 | Moderate to High | 40 |
| > 450 | High | Additional weight |

Methodology: Radiation Readings



Rad Stats at 1 meter
(Range 1-7) 1= hi 4=lower priority



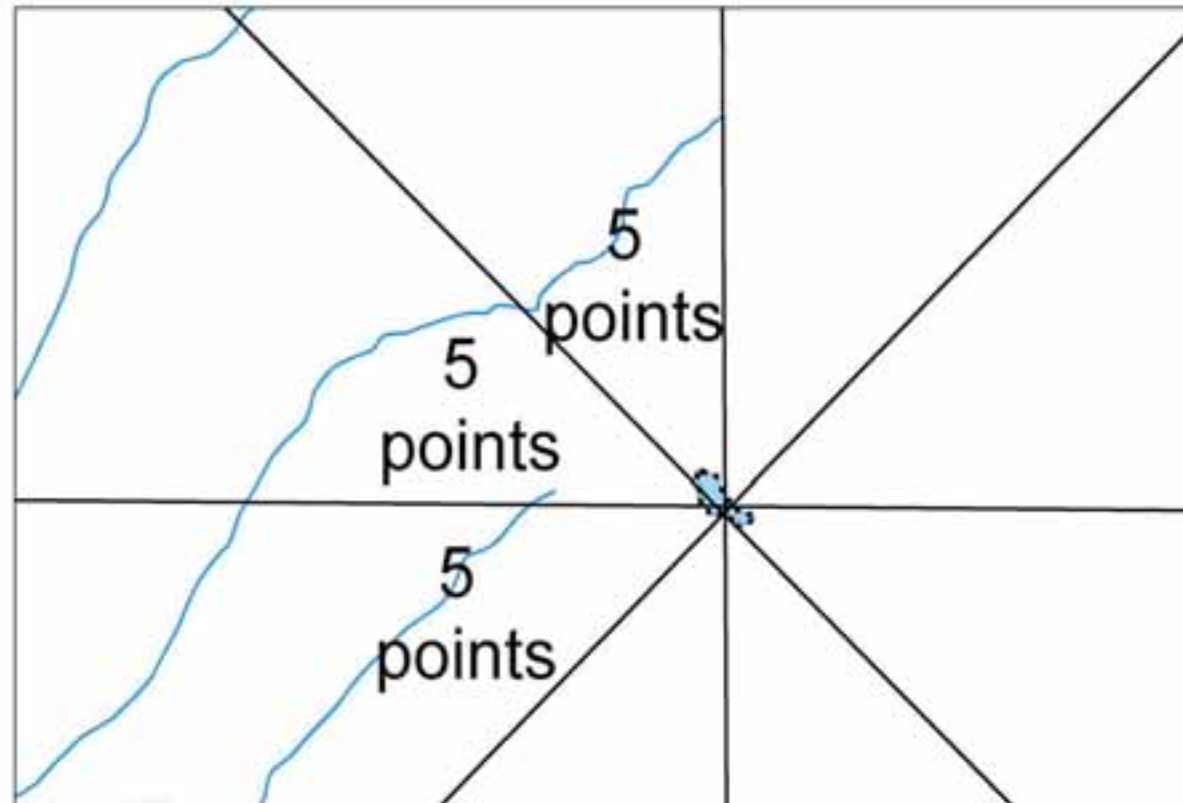
Radiation Counts
(micro R/hr 1 meter above ground)



Miles
0 0.05 0.1 0.2
NAD83 UTM NM zone 13



Methodology: Proximity to Nearest Drainage

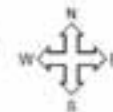


Proximity to Nearest Stream
(Range 1-6) 1= hi 4=lower priority

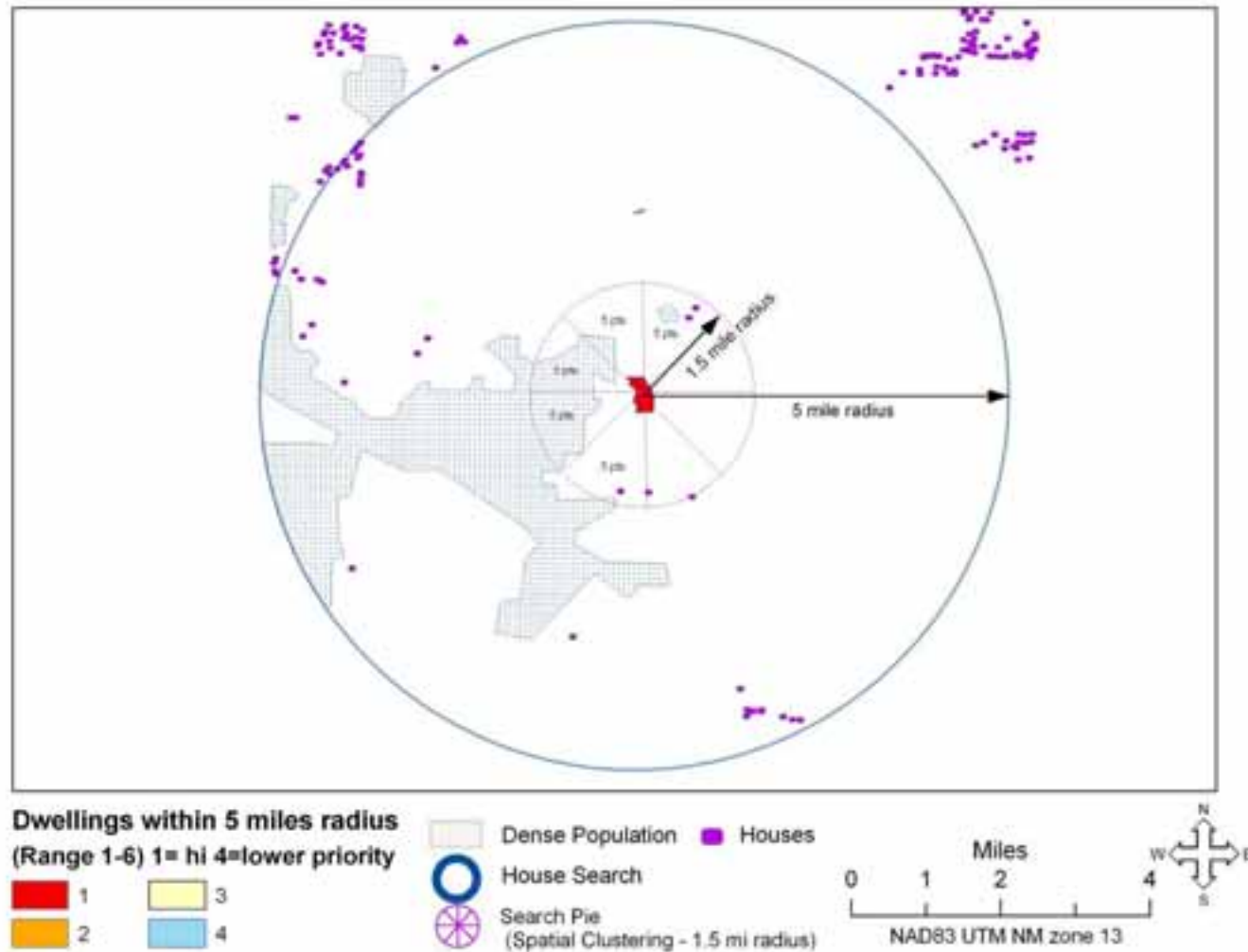


• Perimeter - 30 m spacing
One-eighth Divisions
(1.5 mi radius)

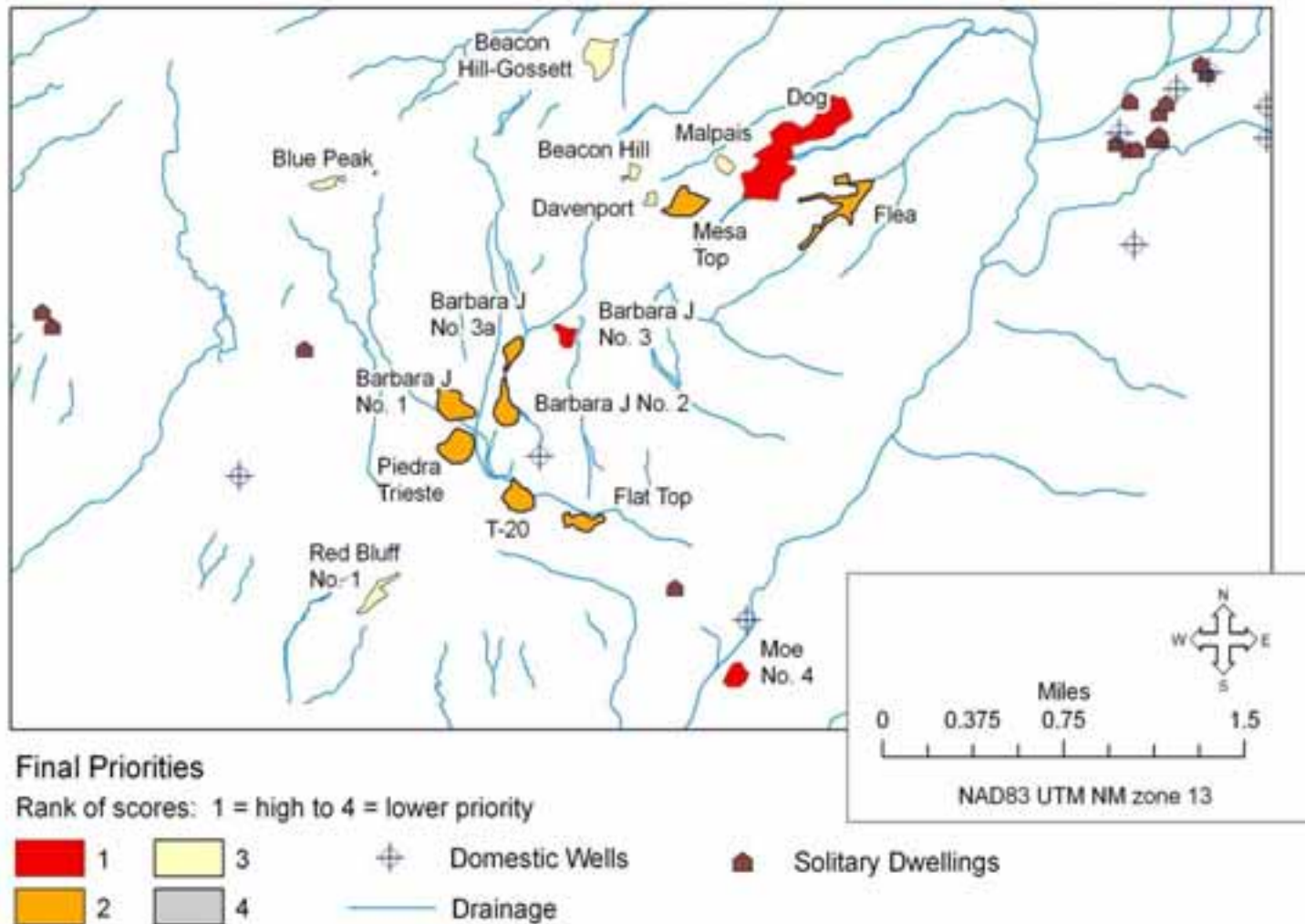
Miles
0 0.1 0.2 0.4
NAD83 UTM NM zone 13



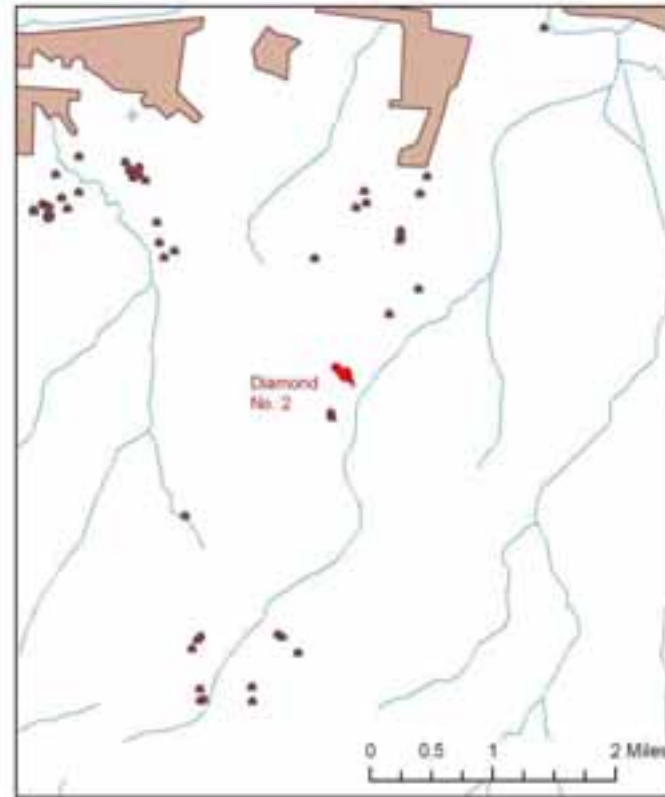
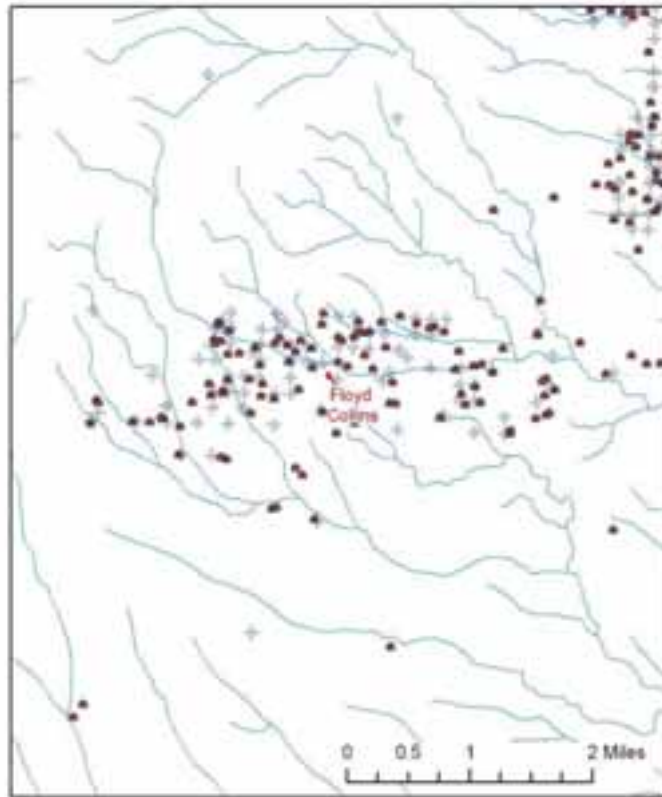
Methodology: Proximity to Dwellings



Ambrosia Lake Final Priority Ranking

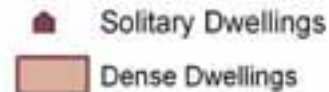


Other Top Priority Ranking Sites



Two High Priority Sites

Rank of scores: 1 = high to 4 = lower priority



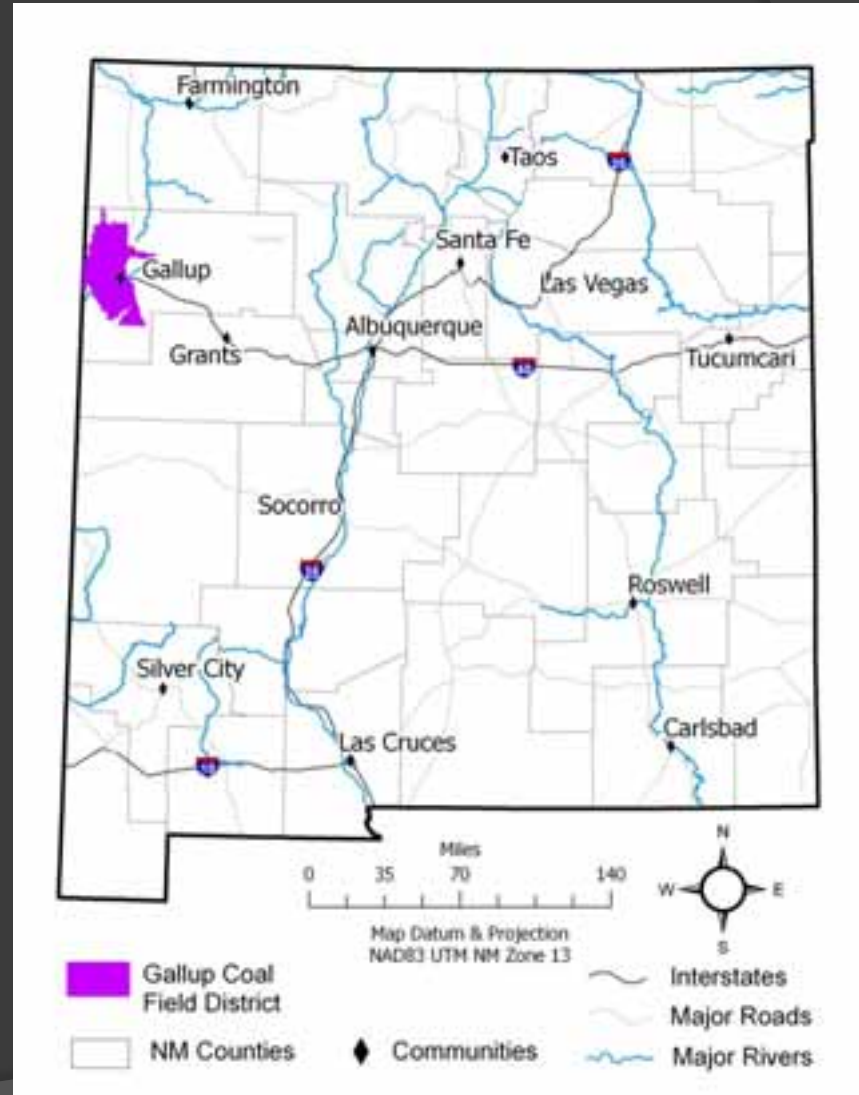
NAD83 UTM NM zone 13

Gallup Coal Inventory Project



Weaver Mine, Gallup, NM
circa 1910

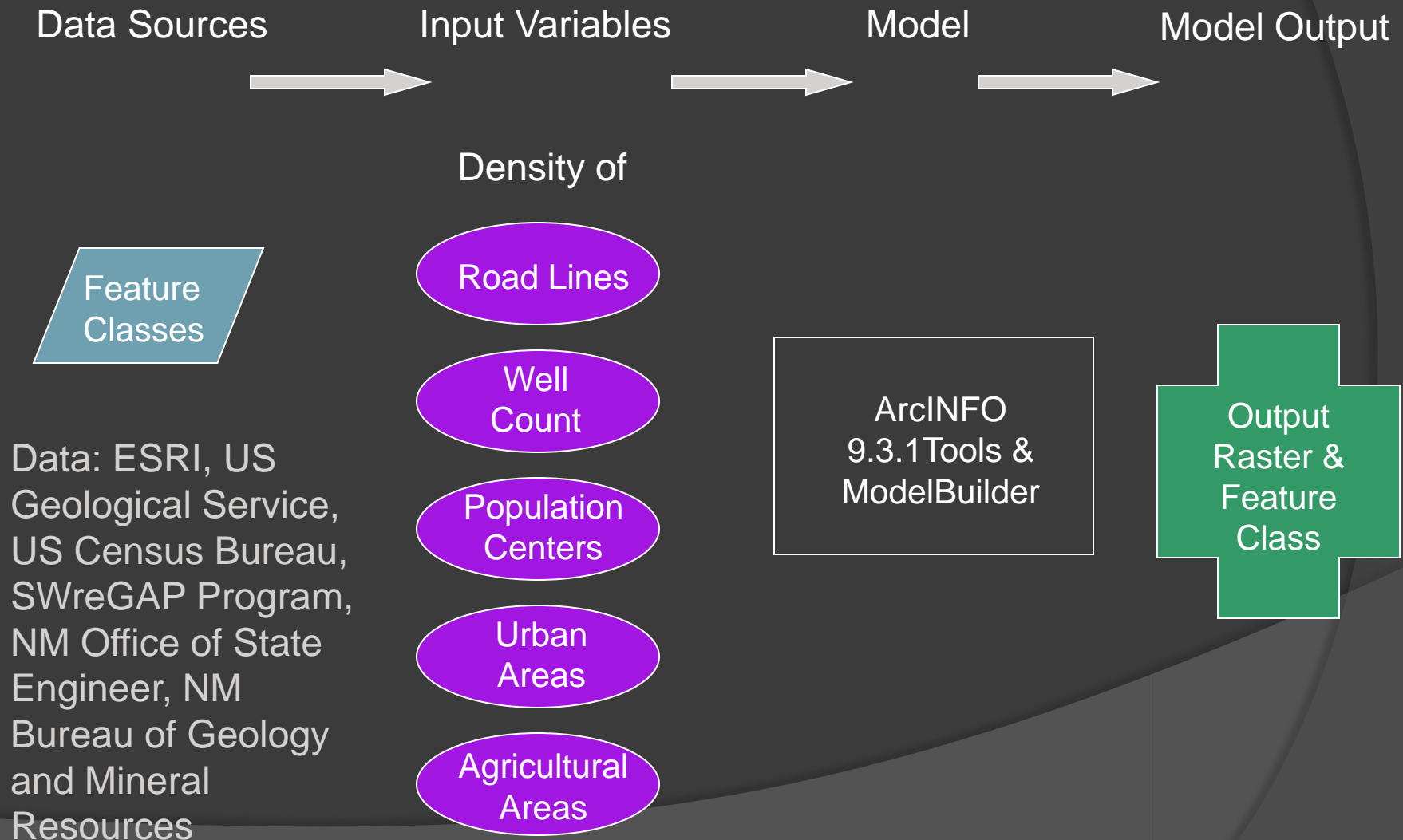
(Courtesy of New Mexico Bureau of
Geology & Mineral Resources)



Background

- ◉ Estimated more than 15,000 abandoned mines in New Mexico. Much of the state needs to be inventoried.
- ◉ The Gallup Coal Field District was the site of underground coal mining in the early 1880's to late 1950's.
- ◉ Old workings within and outside of Gallup city limits. Subsidence a problem since the 1980's.
- ◉ At this site, reclamation work done by NM AMLP in the 1980-1990's needed revisiting.

AML Coal Inventory Prioritization Model – State Scale Analysis of Coal Mining Districts

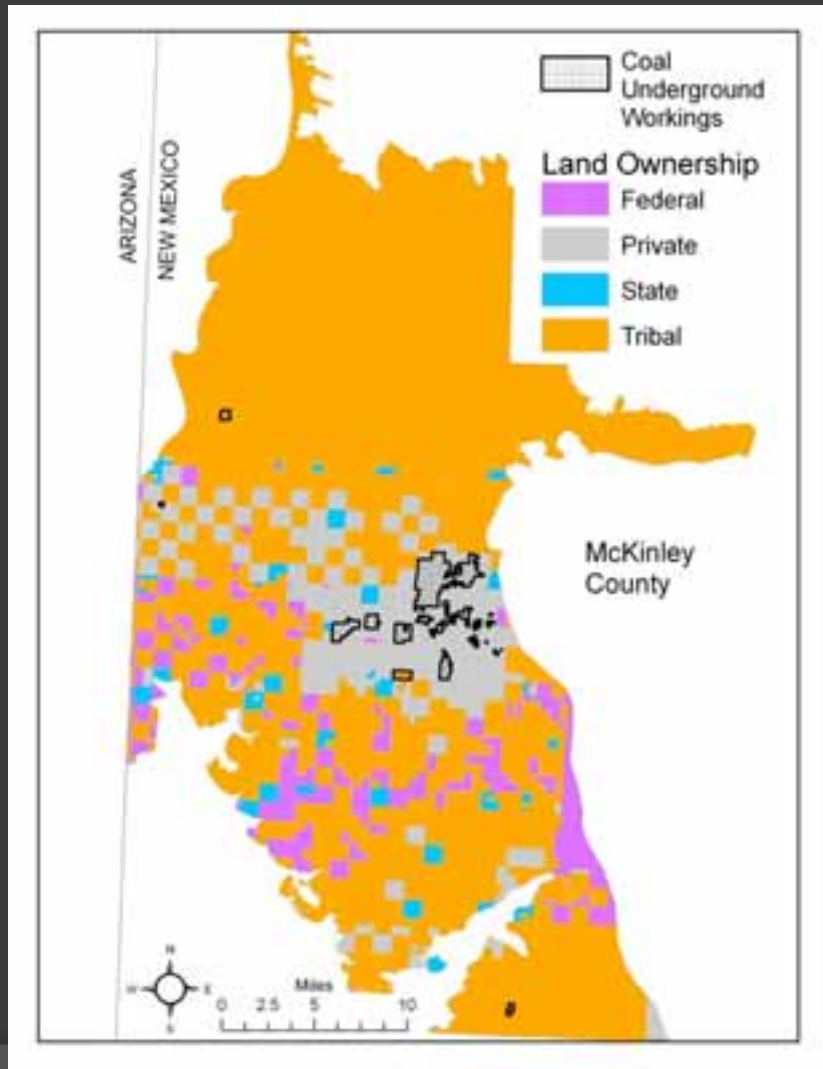


Results – Priority Coal Districts



- Gallup Coal Field District ranked medium-high in priority based on un-weighted sum of model variables.
- Chosen by NM AMLP for mine feature inventory and reclamation prioritization.
- Factors that elevated rank – AMLP previous work locale, the Gallup population and the subsidence issues of old Coal mine workings.

Gallup Coal District and Land Ownership

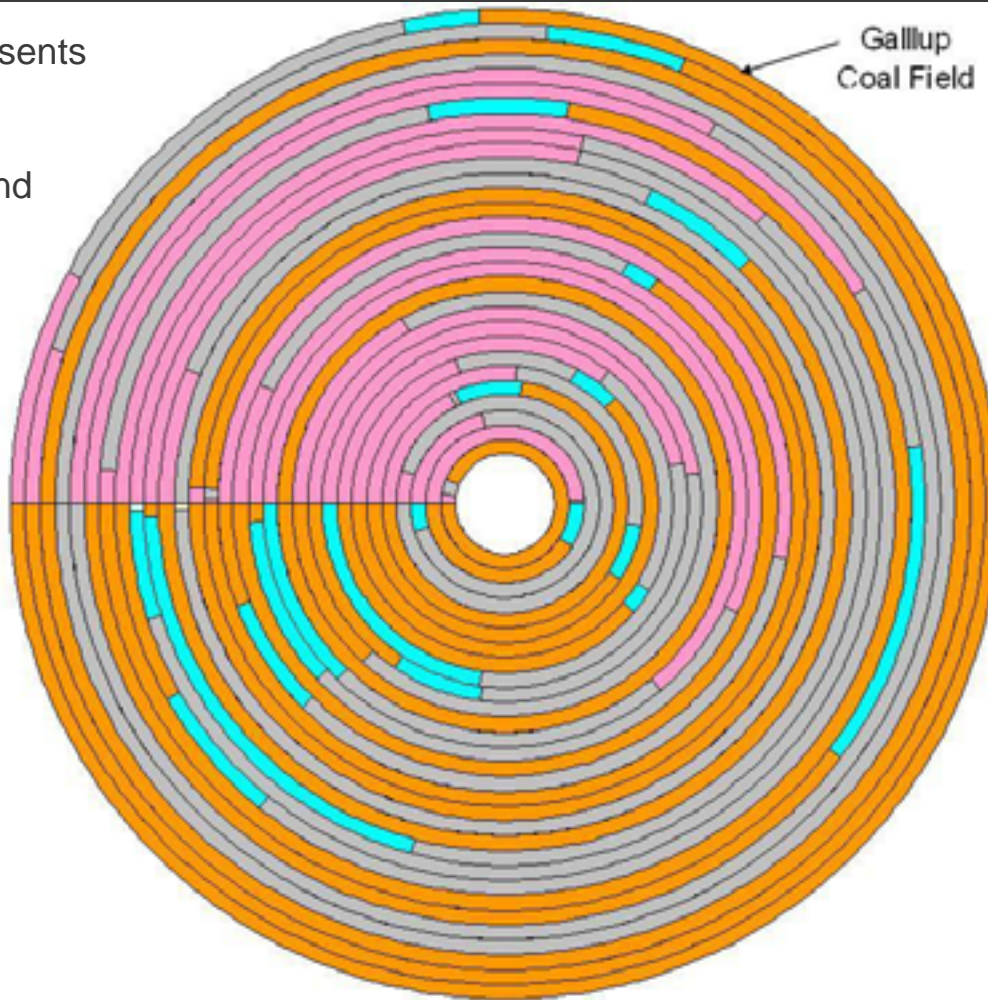
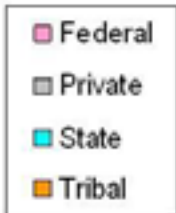


Surface ownership and percent of the district area.

Federal – 8%
Private – 14%
State – 2%
Tribal – 76%

Landownership Composition of Gallup Coal Field Compared to All Coal Districts (n=30)

Each ring represents a Coal Mining District and the proportion of land ownership.



- Gallup Coal Field District is one of six coal districts in which Tribal Lands comprise > 75% of its area.

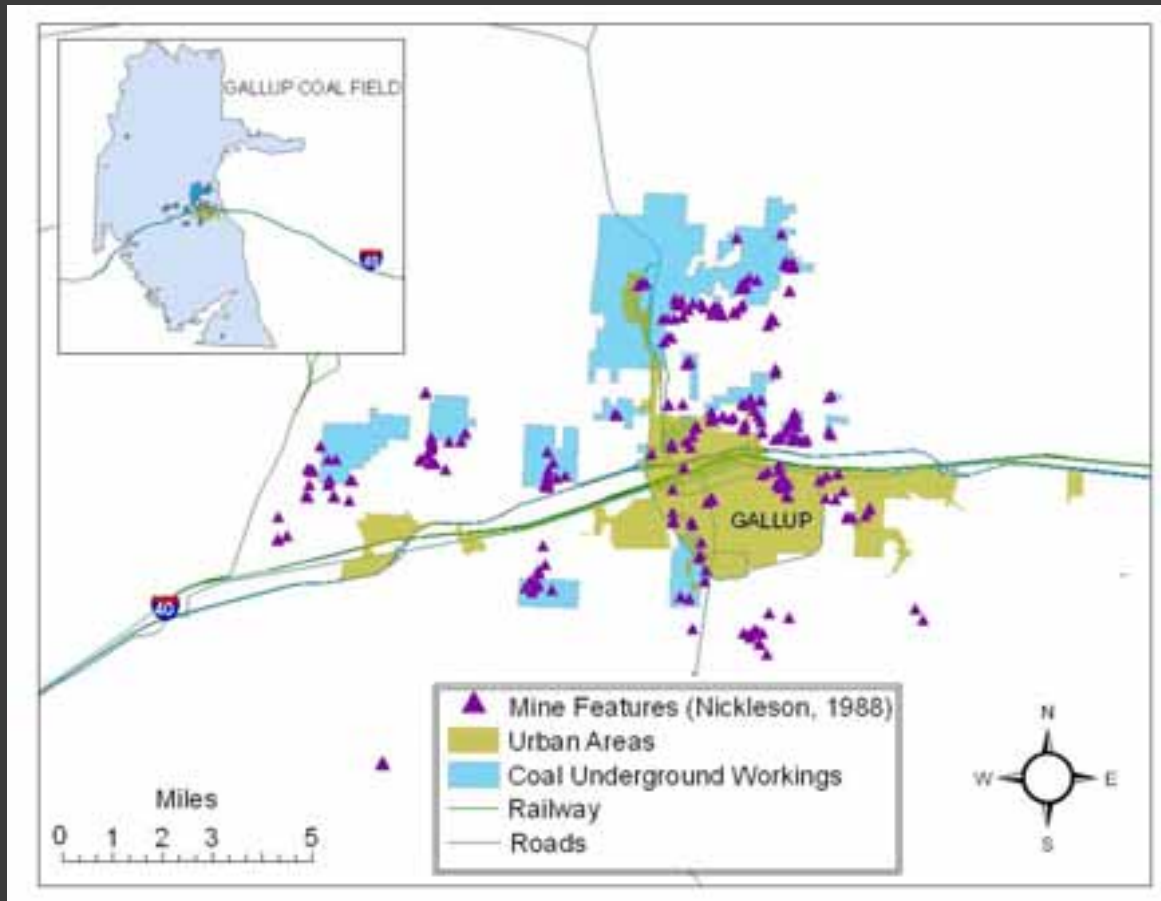
Tetra Tech Albuquerque Contracted to Inventory and Prioritize Gallup Coal Field

Goals are to record location data of mine features with GPS (global positioning system) and prioritize sites for purpose of mitigating hazards.

Tasks:

- Preplan data collection and arrange access to sites
- Locate, GPS, photograph and document
- Create data management system
- Prioritize, rank and report findings

Map of Gallup Area – In-progress Site Assessments



- Mine features previously inventoried
(H.B. Nickelson, 1988. One hundred years of coal mining in the San Juan Basin, New Mexico. New Mexico Bureau of Mines & Mineral Resources. Bulletin 111. pp. 227)
- Features will be revisited and the coal field district inventoried.

Prioritization Criteria Development by Tetra Tech and NM AMLP.

Two tiered prioritization

- ④ Ranking based on Federal (Office of Surface Mining Reclamation and Enforcement) scoring criteria.
- ④ NM AMLP detailed criteria based on geospatial measurements.

Inventory Data Management



- Field forms integrated with the inventory database (MS Access)
- Geodatabase to store GIS features
- Automatic priority ranking system

Feature Details

Feature: Portal Site Name: Allison
 Type: [dropdown] Mining Type: [dropdown]
 Description: edit Choose a previously used description or write in a new one.
 Mine Name: Casna Allison Mine Problem Area Number: 000069 Name: ALLISON
 Alias: Mulholland-Casna Mine
 Label: GW-45b
 Nickerson ID: GW-45

| PWAL, PWALC | S | General Welfare | Owner(s) | UMF | EH | Sample Results |
|--|--------|--|-------------|---|-------------|----------------|
| Location | Access | Inspection & Photo Log | Photographs | Ranking | CS, CSL, DI | DS |
| GIS ID: [text] Length: [text] Width: [text] feet [dropdown] square ft [dropdown] Latitude: 35° 31' 21.3" Depth: [text] feet Longitude: -102° 47' 16.0" Height: [text] feet Highwall Criteria - is it greater than 6 feet? <input type="checkbox"/> Feature could not be located at given coordinates. Location: Slight depression surrounded by berm, but no open portal. Photo taken of gob area Description: [text] | | | | | | |
| Proximity to human activity (describe nearest / most relevant in each category) | | | | | | |
| Residential Area: | | Description | | Distance | | |
| [text] | | [text] | | [text] feet [dropdown] | | |
| | | | | Yes No Unknown NA | | |
| | | Are there "numerous" residences? | | [radio] [radio] [radio] [radio] | | |
| | | Number of residences (may skip if numerous): | | [text] | | |
| Occupied Structure | | [text] | | [text] feet [dropdown] | | |
| | | | | Usual criteria: 300 and 500 feet | | |
| Recreation Area | | [text] | | [text] feet [dropdown] | | |
| Public Facility | | [text] | | [text] feet [dropdown] | | |
| | | | | Are children likely to be present at any of the above residences, structures, recreation area, or facilities? | | |
| | | | | Present Potential No Unknown | | |
| | | | | [radio] [radio] [radio] [radio] | | |
| Improved Road | | [text] | | [text] feet [dropdown] | | |
| Unimproved Road or Trail | | [text] | | [text] feet [dropdown] | | |
| Note: In the case of overlap, please fill in all values. For example, a school with a playground would appear in occupied structure, recreation area, and public facility. | | | | | | |
| Previous | | Next Feature | | 31/38 | | Exit |

Future Work

- ◉ Expand the regional input variables in the model to include the number and volume of waste rock piles, depth to groundwater, location up/down gradient to wells and radiation at surface contact.
- ◉ Investigate and include variables of site accessibility, land ownership and geographic proximity.
- ◉ Expand AML Coal Inventory to other districts.



Acknowledgements



- Office of Surface Mining Reclamation and Enforcement, Technical Innovation and Professional Services (OSMRE/TIPS), for support.
- Navajo Abandoned Mine Land Reclamation Department for sponsoring a training session on health physics and radiation survey meter calibration.
- U.S. Environmental Protection Agency for further health physics training.
- All the private land owners who have provided site access.
- Our Team of Contractors – Tetra Tech Albuquerque and their GIS Manager, Simon Cardinale (Coal Inventory) and INTERA and their GIS Specialist Chris Park (LUM Inventory).
- All photos were taken by the Ne Mexico Abandoned Mine Land Program.