



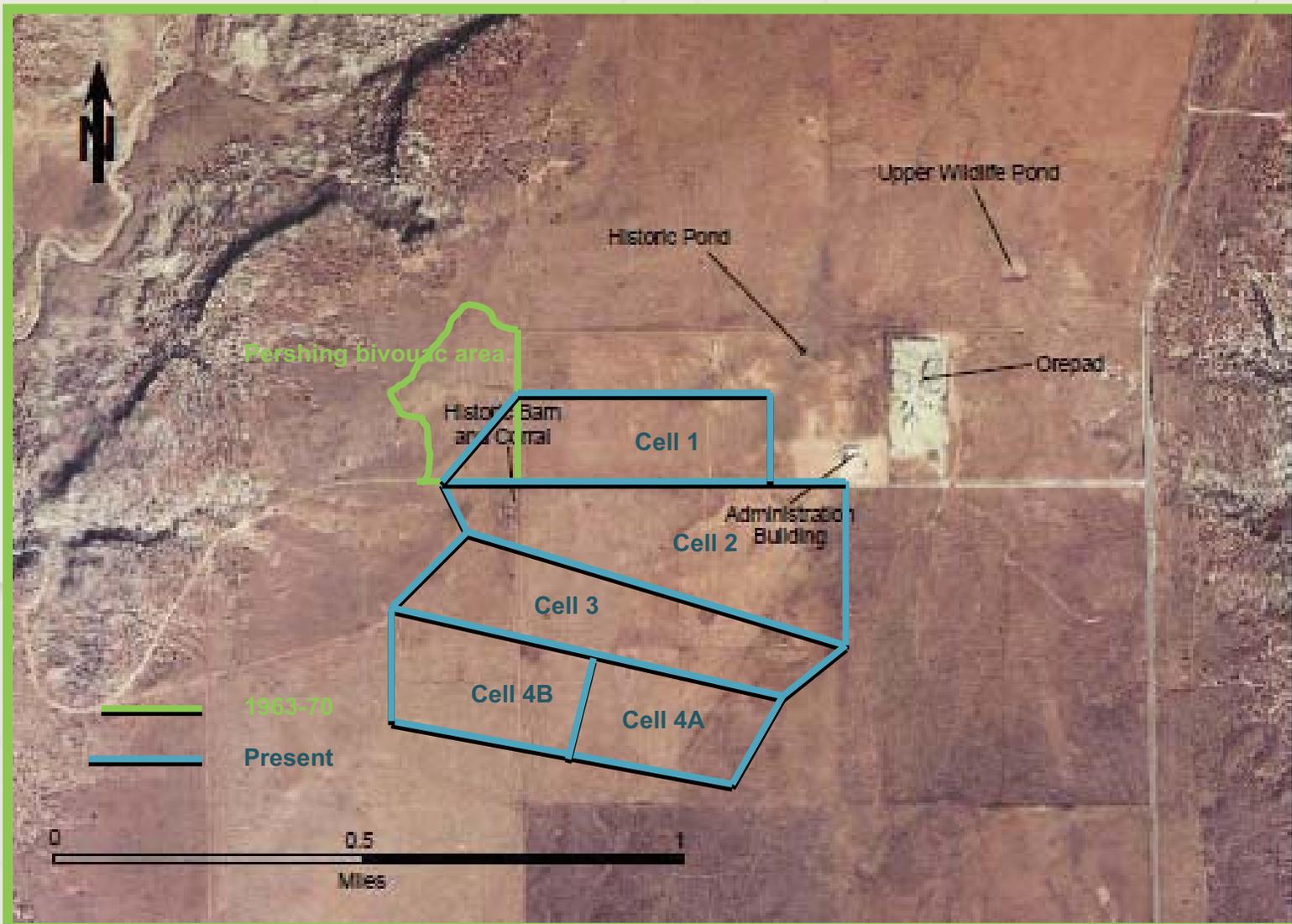
**WORK PLAN AND
SCHEDULE FOR
SUPPLEMENTAL
CONTAMINANT
INVESTIGATION
REPORT FOR
WHITE MESA MILL
NITRATE
INVESTIGATION**

- **Identify areas that have been subject to agricultural activities**
- **Evaluate land-use practices that may have led to elevated levels of nitrate and other contaminants in groundwater**
- **Historical aerial photography**
- **Historical Landsat satellite imagery**

US Army 2nd Missile Battalion 44th Artillery Installation at White Mesa - 1967



White Mesa Site over Time



US Army Pershing I and Ia Missile Project –Blanding Launch Complex

- **Identified by US Army as “Pershing Project Blanding Launch Complex”:**
- **Three Subsites:**
 - **Staging Site – west of current tailings cells**
 - **Radar Site – east of Mill on Utah Hwy 191**
 - **Launch Site – west of Mill at Black Mesa**

- **Solid-fueled Medium Range Ballistic Missile**
- **Designed for nuclear warhead**
- **Some photo and video information currently declassified**



Stateside test launch at Fort Wingate, Cape Canaveral , or Blanding Launch Complex

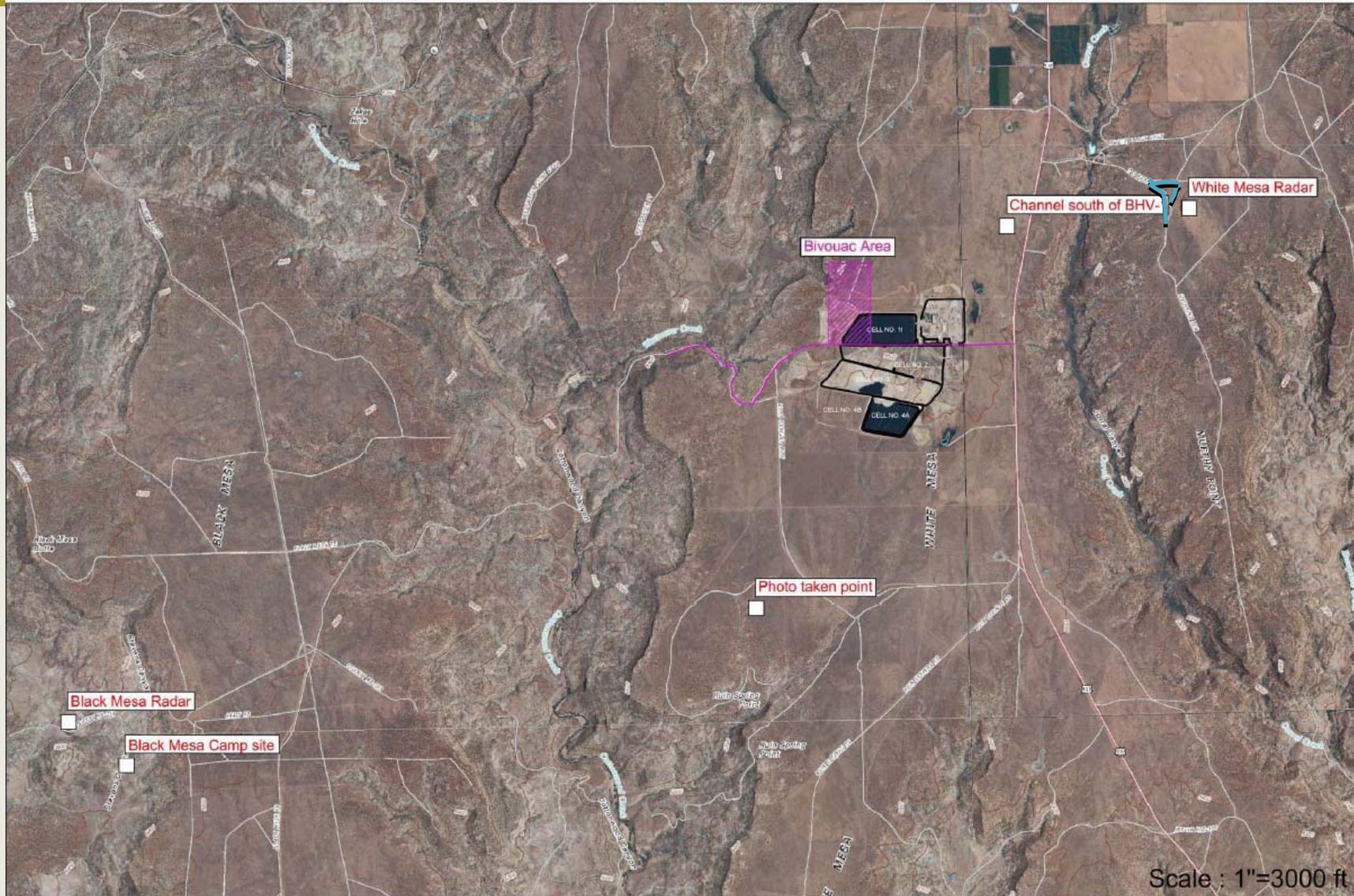
Black Mesa: March 28, 1967 – Triple Launch



- The Pershing I accomplished a significant first when B Battery, 3d Battalion, 84th Artillery successfully launched two missiles simultaneously and a third missile 30 minutes later from Blanding, Utah, into White Sands Missile Range (WSMR).

Photograph of actual launch at Blanding Launch Complex.

US Army Pershing Project - Blanding Launch Complex



Pershing Project White Mesa Radar Site - 1967



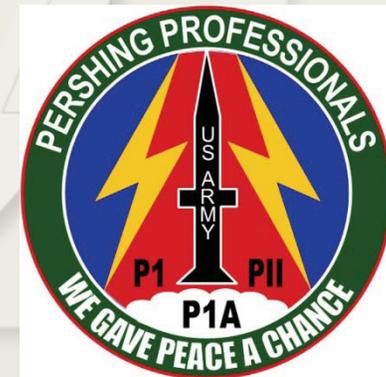
Military Detritus around Blanding Launch Site





Military History of Blanding Launch Site

- **Sept. 24, 1963 to Nov. 24, 1970 - US Army 2nd Missile Battalion, 44th Artillery installation**
- **“Shoot and Scoot” mission training site**
- **Satellite facility of Fort Wingate Depot, NM**
- **80 Pershing Missile launches targeted at White Sands Missile Range, NM**
 - **67 launches Pershing 1**
 - **4 failures of Pershing 1**
 - **9 launches Pershing 1A**



- **Rocket assembly**
- **Rocket loading (trackmobile gantry)**
- **Trackmobile manoeuvres**
- **“Shoot and scoot” drills and launches**
- **Debris control - failed shots**
- **Trackmobile and other Vehicle Maintenance**
- **Latrines**
- **Unknown number of personnel on Blanding Launch site (362 to 438 at Fort Wingate)**

Typical Pershing Site Activities



Typical Pershing 1 Scoot and Shoot Training and Inspection



Typical Pershing 1 Launch Training

Pershing Solid Fuel Missiles

Component	Chemical	Reactive Group
Solid Oxidizers	Ammonium perchlorate	Cl-
	Ammonium nitrate	NH ₃ , NO ₃
	Ammonium dinitramide	NH ₃ , NO ₃
	Nitroformate	COOH, NO ₂ /NO ₃
Energetic	Nitramines: cyclometylenetetramine	NH ₃ , NO ₃
Monopropellants	Nitramines: cyclometylenetetramine	NH ₃ , NO ₃
	Hexanitrohaxaazaisowurtilane	NH ₃ , NO ₃
Binders	Hydroxyl-terminated polybutadiene	COH
	Carboxyl-terminated polybutadiene	COOH
	Polyethylene glycol, polypropylene glycol	COH
	Dichloro diethyl formal polymer	Cl-
	Sodium polysulfide	NaS
	Nitrocellulose, glycidyl azide polymer	N ₃

Pershing Solid Fuel Missiles, continued

Component	Chemical	Reactive Group
Curatives	Isocyanates	NCO
	Epoxides	COC
	Zinc oxide	Zn
Fuels	Beryllium hydride	Metals
	Aluminum borohydride	Metals
	Magnesium hydride	Metals
Plasticizers	Diethyl adipate, diethyl phthalate esters	Metals
	Triacetin, nitroglycerin	NH ₂ , NO ₂ /NO ₃
	Butanetriol trinitrate, trimethylolethane	NO ₃
	Trinitrate esters	NO ₃
Stabilizers	P-rc-methyl nitroaniline	NH ₂ , NO ₃
	Nitrodiphenylamine	NH ₂ , NO ₃
Ballistic Modifiers	Iron oxide, aluminum oxide, oxamide	Metals, NH ₂ -CO
Nozzle Ablatives	Phenolic/epoxy w/polyacrylonitrile fibers	CN
Oxygen source	Butylene oxide in THF	COC

Contaminants of Concern at Other US Army Pershing Missile Facilities

- Fort Wingate Depot, NM
 - Mission: Pershing Missiles
 - COCs: heavy metals, **nitro compounds/nitrate**
- White Sands Missile Range
 - Mission: Missile Target site – Pershing and others
 - COCs: **nitro compounds/nitrate**

Redstone Arsenal, AL

Mission: Pershing Missiles,
Solid Propellant Manufacture
COCs: **nitro compounds/nitrate**

Fort Bliss, TX

Mission: Pershing Missiles,
other artillery
COCs: Arsenic, zinc, lead,
nitro compounds/nitrate

Investigation of Potential Natural Nitrate Reservoir

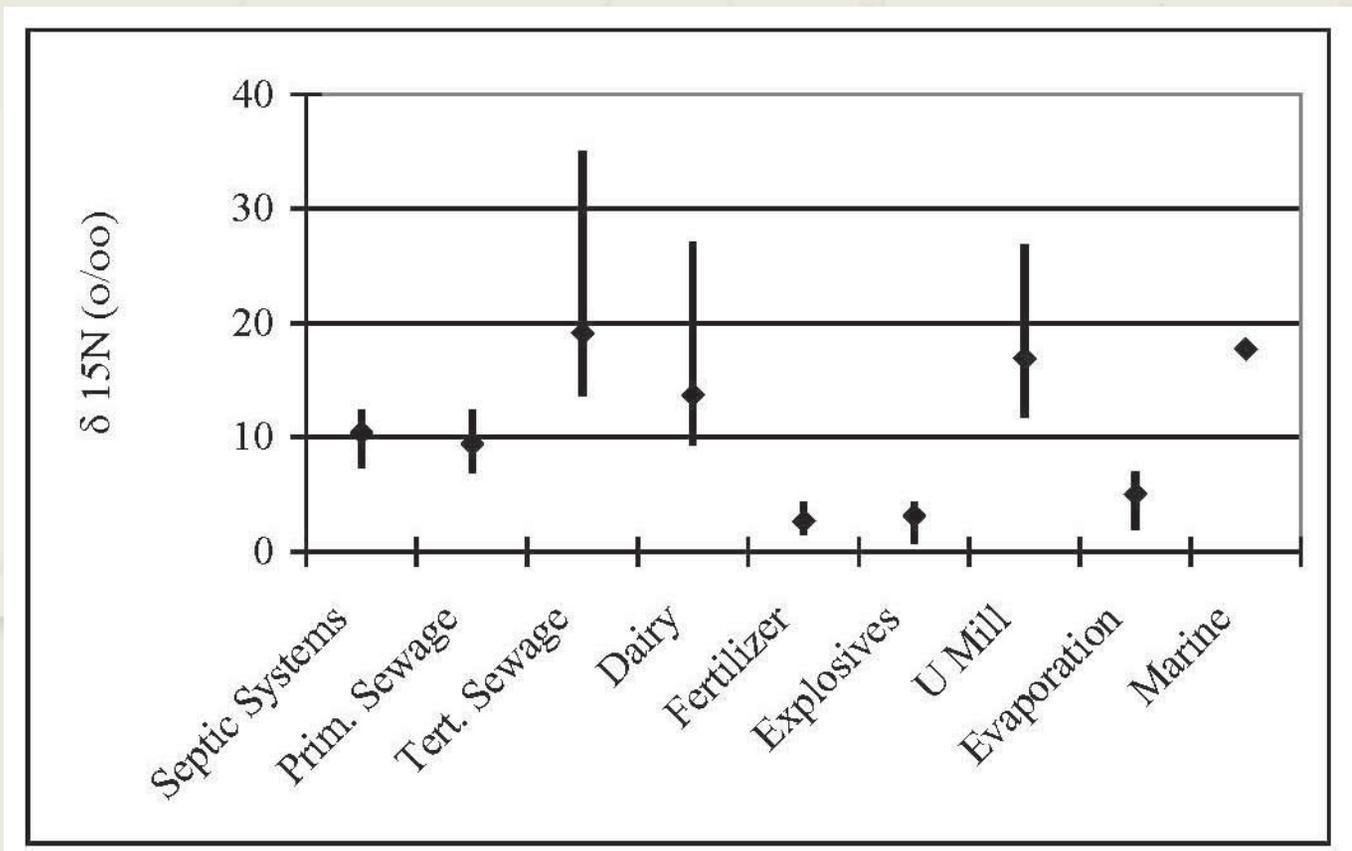
- **Geoprobe alluvial soils for any potential natural subsurface reservoir of nitrogen and chloride**
- **If no reservoir in alluvial soils then up to four bedrock core holes**
- **Samples at regular intervals**
- **Moisture content measured**
- **Analyzed for nitrate and chloride**
- **Mass balance calculations to integrate the mass of nitrate and chloride in soil moisture**

Investigation of Potential Nitrate Source Locations

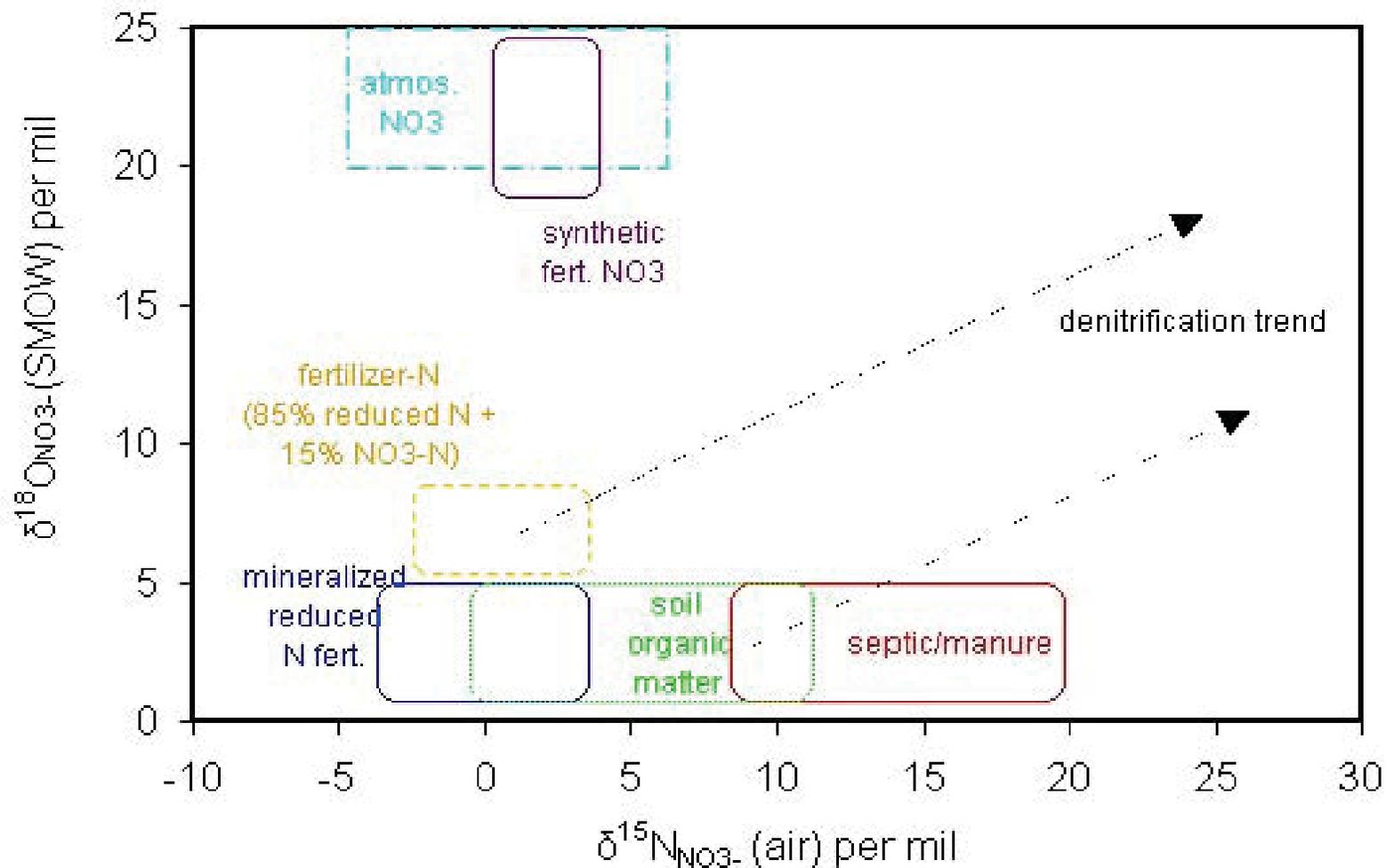
- **Geoprobe samples from alluvial soils in or around 15 specific potential sources**
- **If nitrate-chloride above background core to groundwater for evidence of transport**
- **Analyzed as cores for natural nitrate reservoir**

- **Groundwater and identified sources**
 - **total Kjeldal nitrogen**
 - **Chloride**
 - **$\delta^{15}\text{N}_{\text{nitrate}}$ and $\delta^{18}\text{O}_{\text{nitrate}}$**
 - **$\delta^{18}\text{O}_{\text{water}}$ and $\delta\text{D}_{\text{water}}$ (D = ^2H , Deuterium)**

$\delta^{15}\text{N}$ results from sampling of various sources of nitrate contamination



Plot of $\delta^{18}\text{O}$ versus $\delta^{15}\text{N}$



- **Need sufficient water or other fluid to travel through the vadose zone**
- **Need sufficient nitrate and chloride in the source to account for the nitrate and chloride mass observed in the groundwater**
- **Supports a synthesis of data collected in previous studies**

Work Plan Schedule

Table 1. Work Plan Schedule

Denison White Mesa Mill Nitrate and Chloride Investigation

Task No.	Task and Subtask Description	Month													
		1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	HISTORICAL LAND USE AND GEOMORPHIC STUDY	█	█	█	█										
	Order and evaluate satellite imagery	█	█	█											
2	GEOPROBE INVESTIGATION OF POTENTIAL NATURAL NITRATE RESERVOIR, 20 LOCATIONS		█	█	█	█									
	Borings, field tests		█	█											
	Laboratory analysis SPLP				█	█									
3	GEOPROBE BORINGS IN POTENTIAL NITRATE SOURCE LOCATIONS, 13 BORINGS, 2 INFLUENT WATER SAMPLES		█	█	█	█									
	Borings, field tests		█	█											
	laboratory analysis SPLP and influent water				█	█									
4	CORING STUDY TO EXPLORE FOR NATURAL NITRATE RESERVOIR				█	█	█	█							
	Core up to 4 locations				█	█	█	█							
	Laboratory preparation and SPLP analysis						█	█							
5	CORING STUDY IN POTENTIAL NITRATE SOURCE LOCATIONS				█	█	█	█							
	Core up to 13 locations				█	█	█	█							
	Up to 13 locations, core to laboratory for preparation and SPLP						█	█							
6	STABLE ISOTOPE STUDY, LABORATORY ANALYSIS		█	█	█	█	█	█							
	Water sampling from 6 existing well locations, coordinate with quarterly groundwater monitoring event		█	█	█										
	Laboratory analysis					█	█	█							
7	MASS BALANCE CALCULATIONS									█	█				
	Integrate information from other studies and evaluate potential sources									█	█				
8	REPORT OF FINDINGS											█	█	█	█
	Draft and Denison Review											█	█	█	█