



Blending Indigenous Knowledge and Ecological Restoration in Mine Reclamation

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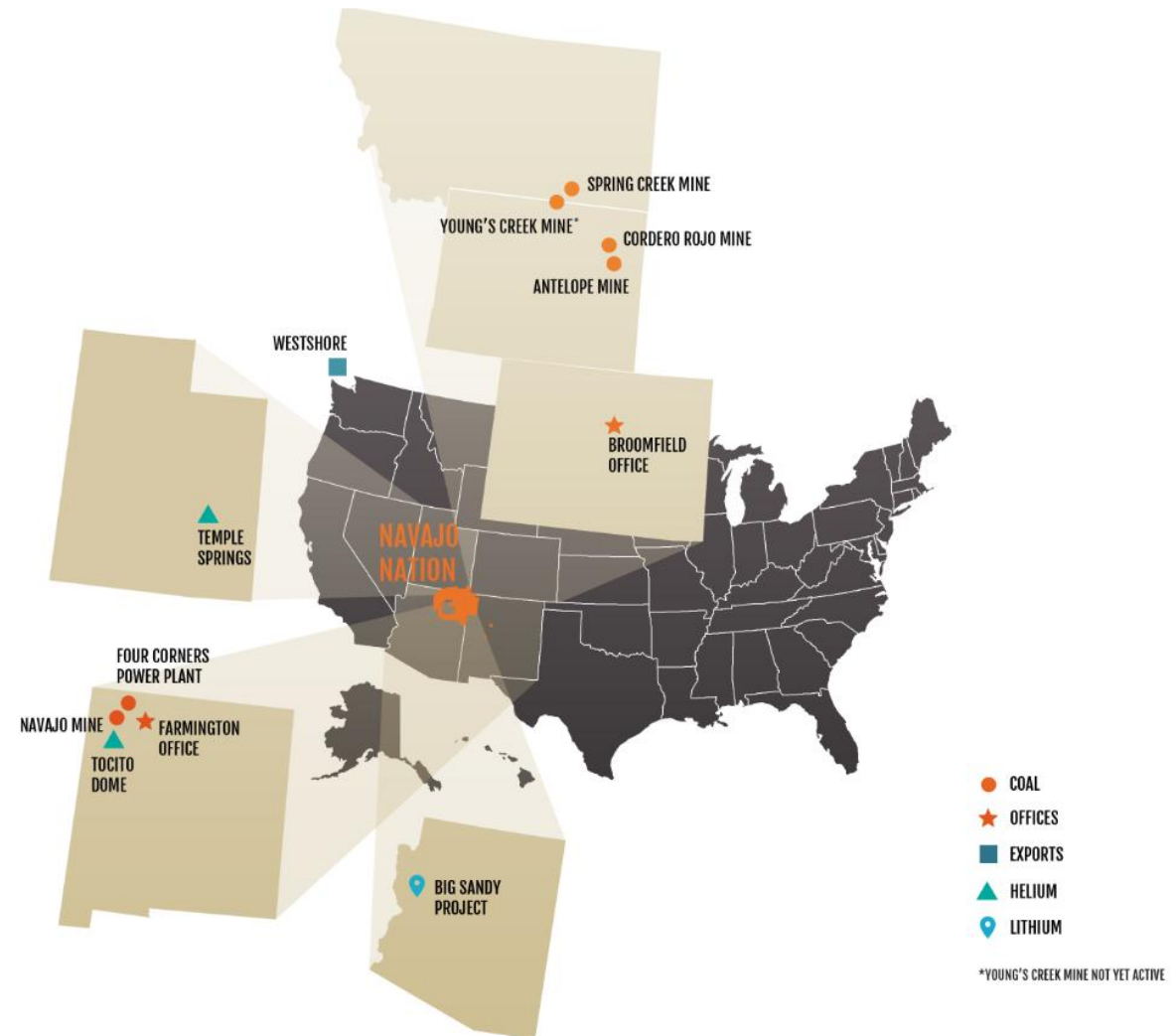
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NTEC - Navajo Mine

- Located on the Navajo Reservation
- Lease obtained in 1957
- Operations began in 1963
- Approximate 35,000 Acre Lease
- Multiple SMCRA permits
 - Navajo Mine (Permit NM-0003H)
 - Pinabete Area (Permit NM-0042B)
- Divided into six Operational or Resource Areas
 - Area 1
 - Area 2
 - Area 3
 - Area 4 North
 - Area 4 South
 - Area 5



Vegetation Background

- Navajo Mine's native vegetation is characterized as the Colorado Plateau salt-desert shrub ecosystem.
- Salt-desert shrub ranges occur in Utah, Nevada, Western Colorado, Northeastern Arizona, and Northwestern New Mexico.
- This ecosystem contains a large number of salt tolerant species and a significant shrub component. Common shrubs present include numerous species of saltbush (*Atriplex* spp.), rabbitbrush (*Chrysothamnus* spp.), Mormon tea (*Ephedra* spp.), and snakeweed (*Gutierrezia sarothrae*).
- Navajo Mine Area is delineated into eight range sites: Alkali Wash, All Sands, Dunes, Badlands, Thin Breaks, and Arroyo Shrub.



Native Seed Mix

- New seed mixture utilizes a menu approach with a total of 45 species and a minimum of 14 species that can be selected based on the time of year when seeding occurs, localized variability in soils or topography, annual climatic variation, and species availability.



Table 37-1: Reclamation Seed Mixture

Scientific Name	Common Name	Method ^{1/} Group ²	Seed Depth	Seeds/ Lb	%	Lb/Ac	PLS/ SF	Standard		
								%	Lb/Ac	PLS/SF
Warm Season Grasses										
Minimum of 4 species				15-45%			7.5-22.5	39%	1.9	19.5
<i>Aristida purpurea</i>	purple threeawn	B/B	<1/4"	300,000	0-5%	0-0.4	0-2.5			
<i>Bouteloua curtipendula</i>	sideoats grama	D/F	1/4"-1/2"	191,000	0-5%	0-0.6	0-2.5			
<i>Bouteloua dactyloides</i>	buffalograss	D/F	1/4"-1/2"	56,000	0-5%	0-2.0	0-2.5			
<i>Bouteloua eriopoda</i>	black grama	D/F	1/4"-1/2"	1,335,000	0-5%	0-0.08	0-2.5			
<i>Bouteloua gracilis</i>	blue grama	D/F	1/4"-1/2"	825,000	5-15%	0.1-0.4	2.5-7.5	12%	0.3	6.0
<i>Pleuraphis jamesii</i>	James' galleta	D/LS	1/2"-1"	159,000	5-15%	0.7-2.1	2.5-7.5	10%	1.4	5.0
<i>Sporobolus airoides</i>	alkali sacaton	B/B	<1/4"	1,758,000	5-15%	0.1-0.2	2.5-7.5	10%	0.1	5.0
<i>Sporobolus compositus</i>	composite dropseed	B/B	<1/4"	759,362	0-5%	0-0.1	0-2.5	2%	0.1	1.0
<i>Sporobolus contractus</i>	spike dropseed	B/B	<1/4"	3,107,000	0-5%	0-0.1	0-2.5			
<i>Sporobolus cryptandrus</i>	sand dropseed	B/B	<1/4"	5,298,000	0-10%	0-0.1	0-5	5%	0.0	2.5
<i>Sporobolus giganteus</i>	giant dropseed	B/B	<1/4"	1,723,000	0-10%	0-0.1	0-5			
Cool Season Grasses										
Minimum of 2 species				5-25%			2.5-12.5	14%	2.1	7.0
<i>Achnatherum hymenoides</i>	Indian ricegrass	D/LS	1/2"-3"	141,000	0-15%	0-2.3	0-7.5	0.05	0.8	2.5
<i>Elymus elymoides</i>	squirreltail	D/LS	1/2"-1"	192,000	0-10%	0-1.1	0-5			
<i>Elymus lanceolatus</i>	thickspike wheatgrass	D/LS	1/2"-1"	155,000	0-10%	0-1.4	0-5	5%	0.7	2.5
<i>Elymus trachycaulus</i>	slender wheatgrass	D/LS	1/2"-1"	159,000	0-10%	0-1.4	0-5	2%	0.3	1.0
<i>Hesperostipa comata</i>	needle and thread	D/F	1/4"-1/2"	137,000	0-5%	0-0.8	0-2.5	2%	0.3	1.0
<i>Koeleria macrantha</i>	prairie Junegrass	B/B	<1/4"	2,300,000	0-5%	0-0.1	0-2.5			
<i>Pascopyrum smithii</i>	western wheatgrass	D/LS	1/2"-1"	110,000	0-10%	0-2.0	0-5			
<i>Pseudoroegneria spicata</i>	bluebunch wheatgrass	D/LS	1/2"-1"	135,000	0-5%	0-0.8	0-2.5			
Total Grasses				35-65%			17.5-32.5	53%	4.0	26.5
Perennial Forbs										
Minimum of 2 species				10-20%			5-10	13%	1.2	6.5
<i>Abronia fragrans</i>	snowball sand verbena	B/B	<1/4"	72,000	0-2%	0-0.6	0-1	0.02	0.6	1
<i>Chaenactis douglasii</i>	Douglas' dustymaiden	B/B	<1/4"	342,500	0-2%	0-0.1	0-1			
<i>Gaillardia pinnatifida</i>	red dome blanketflower	B/B	<1/4"	136,200	0-2%	0-0.3	0-1	1%	0.2	0.5
<i>Hymenopappus filifolius</i>	fineleaf hymenopappus	B/B	<1/4"	220,000	0-2%	0-0.2	0-1			
<i>Penstemon palmeri</i>	Palmer's penstemon	B/B	<1/4"	610,000	0-10%	0-0.4	0-5	5%	0.2	2.5
<i>Sphaeralcea coccinea</i>	scarlet globemallow	D/F	1/4"-1/2"	500,000	0-5%	0-0.2	0-2.5			
<i>Sphaeralcea grossulariifolia</i>	gooseberry/leaf globemallow	D/F	1/4"-1/2"	500,000	0-5%	0-0.2	0-2.5	5%	0.2	2.5
<i>Sphaeralcea parvifolia</i>	small-leaf globemallow	D/F	1/4"-1/2"	500,000	0-5%	0-0.2	0-2.5			
Annual/Biennial Forbs										
Maximum of 2 species				0-10%			0-5	2%	0.1	1.0
<i>Cleome lutea</i>	yellow spiderflower	B/B	<1/4"	101,000	0-5%	0-1.1	0-2.5			
<i>Machaeranthera tanacetifolia</i>	tansyleaf tansyaster	B/B	<1/4"	408,000	0-2%	0-0.1	0-1	0.02	0.1	1
<i>Oenothera pallida</i>	pale evening primrose	D/LS	1/2"-1"	512,000	0-5%	0-0.2	0-2.5			
<i>Phacelia crenulata</i>	desert bluebells	D/F	1/4"-1/2"	800,000	0-2%	0-0.1	0-1			
Total Forbs				10-30%			5-15	15%	1.3	7.5
Subshrubs										
Minimum of 1 species				5-15%			2.5-7.5	10%	0.9	5.0
<i>Artemisia ludoviciana</i>	white sagebrush	B/B	<1/4"	4,500,000	0-10%	0-0.05	0-5	0.05	0.02	2.5
<i>Artemisia frigida</i>	fringed sagebrush	B/B	<1/4"	4,536,000	0-10%	0-0.05	0-5			
<i>Eriogonum umbellatum</i>	sulphur-flower buckwheat	B/B	<1/4"	210,000	0-5%	0-0.5	0-2.5			
<i>Krascheninnikovia lanata</i>	winterfat	B/B	<1/4"	123,000	5-10%	0.9-1.8	2.5-5	5%	0.9	2.5
<i>Senecio flaccidus</i>	threadleaf ragwort	B/B	<1/4"	750,000	0-5%	0-0.1	0-2.5			
Shrubs										
Minimum of 3 species				15-35%			7.5-17.5	22%	4.5	11.0
<i>Artemisia filifolia</i>	sand sagebrush	B/B	<1/4"	2,000,000	0-5%	0-0.1	0-2.5			
<i>Atriplex canescens</i>	fourwing saltbush	D/LS	1/2"-1"	52,000	5-10%	2.1-4.2	2.5-5	0.05	2.1	2.5
<i>Atriplex confertifolia</i>	shadscale saltbush	D/LS	1/2"-1"	65,000	0-10%	0-3.4	0-5	2%	0.7	1
<i>Atriplex gardneri</i>	Gardner's saltbush	D/LS	1/2"-1"	111,000	0-5%	0-1	0-2.5	5%	1.0	2.5
<i>Atriplex corrugata</i>	mat saltbush	D/LS	1/2"-1"	60,000	0-5%	0-1.8	0-2.5			
<i>Atriplex obovata</i>	mound saltbush	D/LS	1/2"-1"	207,600	0-5%	0-0.5	0-2.5			
<i>Ephedra viridis</i>	mormon tea	D/LS	1/2"-1"	23,545	0-5%	0-4.6	0-2.5			
<i>Ericameria nauseosa</i>	rubber rabbitbrush	D/F	1/4"-1/2"	400,000	0-10%	0-0.5	0-5	5%	0.3	2.5
<i>Sarcobatus vermiculatus</i>	greasewood	D/LS	1/2"-1"	245,000	0-10%	0-0.9	0-5	5%	0.4	2.5
Total Subshrubs/Shrubs				20-45%			10-22.5	32%	5.4	16.0
Total Seed Mixture							50	100%	10.6	50.0

* Species included on menu are based on historic seed mixtures, species observed during monitoring of surrounding native areas, and plant availability.

¹ Seeding method: B = broadcast. D = drilled

Revegetation Efforts



Native Plants - Navajo Name and Cultural Uses

- How can we connect the reclamation efforts to the local community? How can we build an understanding with the community that we are planting native plants?
- Acknowledging the Navajo names and cultural uses for these plants.
 - Collected plants from reclaimed areas
 - Pressed and framed
 - Created ID cards that have the common name, scientific name, Navajo Name, & cultural uses.
- Plants hold important cultural, spiritual, medicinal, and practical value in many Native American communities.
- Restoring native vegetation supports ecological function while also preserving traditional ecological knowledge, cultural heritage, and the long-standing connection between Indigenous people and the land.



Native Plants - Collection 2025



Native Plants - Navajo Name and Cultural Uses

Pale Evening Primrose
Oenothera pallida

Diné name: Tł'ohchin nilchiin

Traditional uses: Used as a lotion for boils. Used as poultice on spider bites, and the ground plant is used as a dusting powder on sores. Also used with flax and nodding Eriogonum to treat kidney disease. Used in the Bead Way emetic and Big Star Way, Red Ant Way and Blessing Way ceremonies.

(Nanise', 1989)

Location collected: Reclaim Yazzie Redo Area

Year seeded: 2023

Collectors: Morris, Mia; Shundeen; Emily
07/8/2025



Native Plants - Navajo Name and Cultural Uses

Giant Dropseed *Sporobolus giganteus*

Diné name: Tł'ohyilzólítsoh

Traditional uses: Used as a brush by bunching together, about a foot, tied with string or yucca fiber. (Vestal, Paul, 1952)

Location collected: South Barber-Stockpile Area

Year seeded: N/A

Collectors: Smith, Shundeen; Emily; Mia
07/8/2025



Native Plants - Navajo Name and Cultural Uses

Four-wing Saltbush *Atriplex canescens*

Diné name: Díwózhiilbéíí

Traditional uses: Used as forage for cattle and sheep, especially during winter time. Leaves and twigs are also used for dying wool yellow for weaving. (Elmore, 1944, p.43)

Location collected: Reclaim Yazzie Area

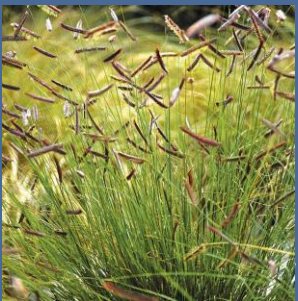
Year seeded: 2023

Collectors: Smith, Shundeen; Emily; Anna
05/29/2025



Others Collected and Framed

- Needle and Thread (*Stipa comata*)
 - Navajo name: Ch'il Bilata dee'ni'ni
- James Galleta (*Hilaria jamesii*)
 - Navajo name: Tl'ohdich'izhi
- Winterfat (*Krascheninnikovia lanata*)
 - Navajo name: Gahtsohdaa'
- Shadescale (*Atriplex confertifolia*)
 - Navajo name: Da'ak'oozhdijooli
- James Galleta (*Hilaria jamesii*)
 - Navajo name: Tl'ohdich'izhi
- Western Wheatgrass (*Pascopyrum smithii*)
 - Navajo name: Tl'oh nitl'izi
- Greasewood (*Sarcobatus vermiculatus*)
 - Navajo name: Diwozhiishjiin
- Small-leaf Globemallow (*Sphaeralcea parvifolia*)
 - Navajo name: Azee' nitl'inii
- Indian Ricegrass (*Eriocoma hymenoides*)
 - name: Ndidlidii



Others Collected and Framed



Resources

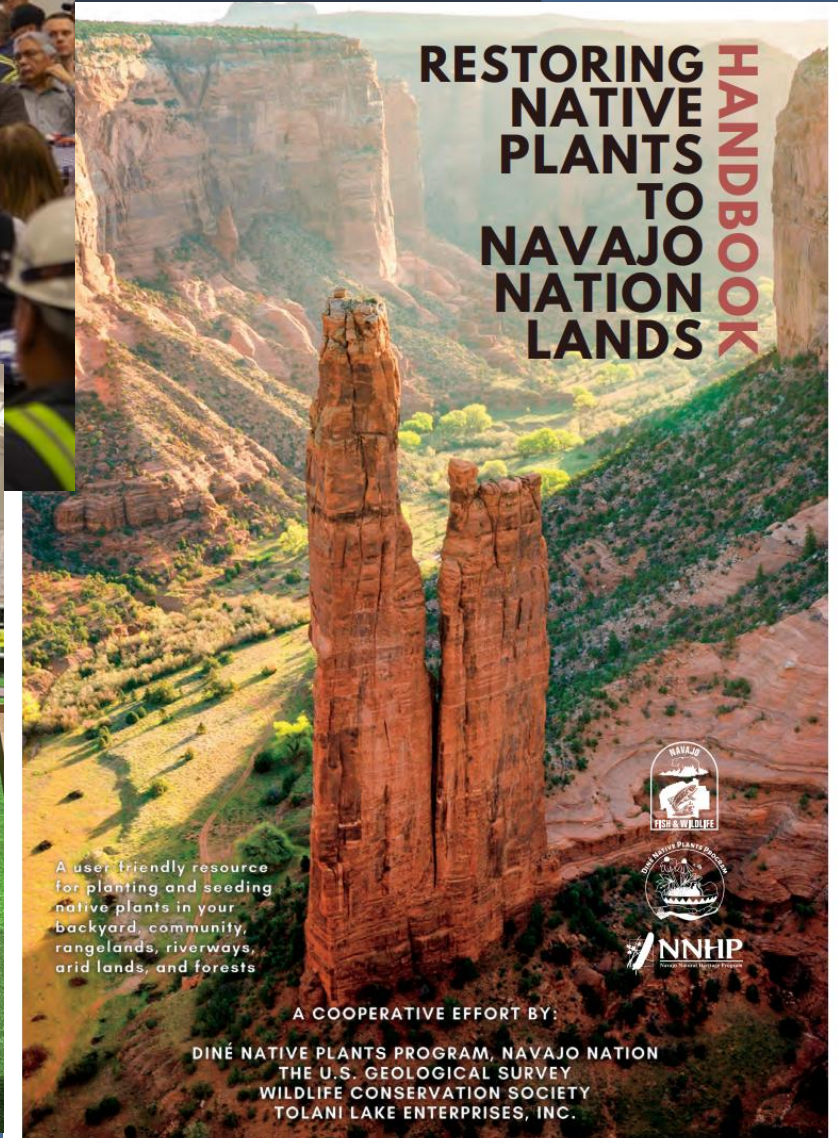
ETHNOBOTANY of the NAVAJO



FRANCIS H. ELMORE, A.A., A.B., M.S.

A MONOGRAPH
of
THE UNIVERSITY OF NEW MEXICO
and
THE SCHOOL OF AMERICAN RESEARCH

THE UNIVERSITY OF NEW MEXICO PRESS
1944



Looking Ahead

- Add to Navajo Mine's Plant Library
 - Expand documentation of Traditional Ecological Knowledge (TEK) related to native plant identification, harvesting methods, seasonal use, and long-term stewardship practices within Navajo communities.
- Collaborative research with interns and elders to gain and preserve knowledge on Navajo Plant specimens.
- Community Outreach
 - Carbon Rocks
- Teaching opportunities to visitors at Navajo Mine



Ahehee (Thank you)

