FINAL ENVIRONMENTAL IMPACT STATEMENT

Navajo Nation Integrated Weed Management Plan

VOLUME II - APPENDICES

August 2022

FOR MANAGEMENT OF LANDS ON:
THE NAVAJO NATION

BUREAU OF INDIAN AFFAIRS NAVAJO REGION
NAVAJO NATION
USDA NATURAL RESOURCES CONSERVATION SERVICE – ARIZONA
USDA ANIMAL AND PLANT HEALTH INSPECTION SERVICE
NAVAJO NATION SOIL AND WATER CONSERVATION DISTRICTS
NATIONAL PARK SERVICE
ARIZONA DEPARTMENT OF TRANSPORTATION
UTAH DEPARTMENT OF TRANSPORTATION
BUREAU OF LAND MANAGEMENT - NEW MEXICO
SAN JUAN SOIL AND WATER CONSERVATION DISTRICT

Estimated Lead Agency Total Costs Associated with Development of this EIS: $534,000

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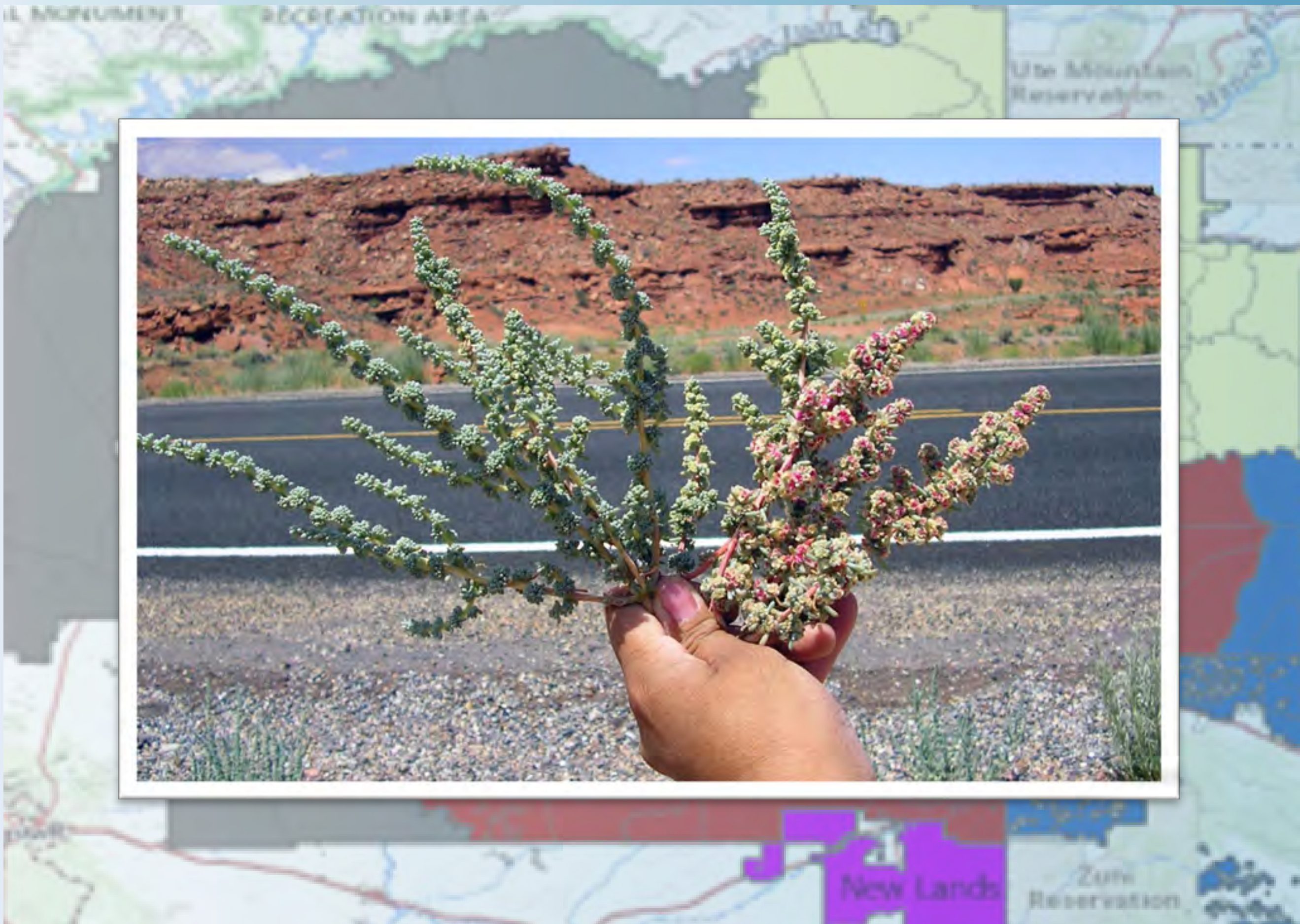
Appendix A. Navajo Nation Integrated Weed Management Plan



Navajo Nation Integrated Weed Management Plan

FINAL

August 2022

FOR MANAGEMENT OF LANDS ON:
THE NAVAJO NATION

UNITED STATE DEPARTMENT OF THE INTERIOR
BUREAU OF INDIAN AFFAIRS NAVAJO REGION

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NAVAJO NATION INTEGRATED WEED MANAGEMENT PLAN

August 2022

U.S. Department of the Interior
Bureau of Indian Affairs
Navajo Region

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Cover photo by Renee Benally, Bureau of Indian Affairs Western Navajo Agency Natural Resource Specialist, of a halogeton sample collected along Highway 163.

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1.0 Introduction

Controlling noxious/invasive weeds, or more appropriately, undesirable non-native vegetation, has long been a serious concern for land users. According to the Federal Noxious Weed Act of 1974 (P.L. 93-629), noxious or invasive weed species are plants "classified as undesirable, noxious, harmful, exotic, injurious, or poisonous" and does "not include plants indigenous to an area where control measures are to be taken." Noxious weeds have little value and often have negative impacts on desired native plants and wildlife. Noxious weeds occupy space across the landscape, absorb sunlight, and utilize soil moisture that would otherwise be available for native plants. Many noxious weeds can directly change a site, making it difficult to re-establish desired native plants. In addition, noxious weeds can harm livestock, wildlife, and humans; thereby, resulting in economic, cultural, and social impacts.

On the Navajo Nation, the number and cover of noxious weed species has increased in recent years. Noxious plants were introduced through various activities, including:

- Road construction & maintenance,
- Use of hay and feed with weeds,
- Transportation of weed seeds by livestock and wildlife to remote locations,
- Infrastructure development (i.e., waterline, gas lines, powerlines, and fiber optics),
- Flowing streams, wildlife and the wind which contribute to seed dispersal, and
- A lack of grazing limits, which can put additional pressure on native vegetation, allowing noxious weeds to outcompete native plants.

Disturbed habitats facilitate the establishment of noxious weeds. Disturbance can introduce weeds along roads and rights-of-way from vehicles that carry seeds and plant materials, construction material, or garbage. These linear corridors provide a thoroughfare for rapid weed expansion to adjacent wild, agricultural or range lands. Rights-of-way also provide access points for weeds to spread to riparian corridors from runoff or road crossings.

The expansion of noxious weeds on the Navajo Nation contributes to the decline of forage production, native grassland community quality, wildlife habitat quality, and overall ecological health of the region. Noxious weeds impact every habitat on the Navajo Nation, which affects the economic, historic, and cultural livelihood of the Navajo people. Control of these weeds will improve rangeland and agricultural land quality by improving growth of native forbs and grasses that benefit subsistence ranching and farming, increase native plant diversity in riparian corridors, protect water resources and water quality, prevent the spread of additional weeds to unaffected land and property, and maintain and improve wildlife habitat.

1.1 Background

The Bureau of Indian Affairs (BIA) Noxious Weed program was initiated in December 1988 in response to Congressional directives to improve management on Indian lands. A task force and 10-Year Management Plan were developed and included in the BIA Range and Agriculture Handbook. The Acting Deputy Commissioner of Indian Affairs issued an Interim Policy in 1991 for the Noxious Weed Control Program. This policy directed on-the-ground work and allocated funds directly for weed control projects. Program standards and oversight are provided by BIA Branch of Agriculture and Rangeland Development based on input from BIA Regional Noxious Weed Coordinators.

The BIA Navajo Region has initiated various projects to control specific target noxious weeds on the Navajo Nation using various methods. The target noxious weeds treated to date on the Navajo Nation include:

- Tamarisk (*Tamarix* spp.)
- Russian olive (*Elaeagnus angustifolia*)
- Russian knapweed (*Acroptilon repens*)
- Camelthorn (*Alhagi camelorum*)
- Halogeton (*Halogeton glomeratus*)
- Musk thistle (*Carduus nutans*)

While these efforts support the goals of the Noxious Weed Control Program, the Navajo Regional Office (NRO) determined the need for an integrated and coordinated management plan which used methodical, science-based strategies to actively monitor and control noxious weeds. In conjunction with developing a weed management plan, NRO determined that compliance with the National Environmental Policy Act (NEPA) was necessary to facilitate discussions with the public regarding potential impacts of a weed management plan. By completing one wholesale environmental compliance effort for integrated weed control, the BIA can streamline planning and compliance processes and encourage large-scale cooperative projects.

To address the need for a more balanced approach to weed management, NRO initiated development of a weed management plan. This Navajo Nation Integrated Weed Management Plan (NNIWMP) identifies weed species of concern; details weed removal strategies; and consolidates the best management practices available for weed control. Best management practices that were limited in the past are now an integral component of the Region's weed management efforts, such as early detection and eradication, prevention, and education. This plan will encompass a 10-year period but will be reviewed after five years. After 10 years, the BIA may opt to keep the NNIWMP in place or update the plan based on updated data and project planning needs. The NNIWMP, however, will remain in place if no plans are developed to replace it. Repeated treatments will be necessary until the desired control objective is reached for most species as seeds can be viable for 10 or more years.

1.2 Project Goals

1. Develop the best control techniques described for the target weed species in a planned, coordinated, and economically feasible program to limit the impact and spread of noxious weeds.
2. Use adaptive management strategies to incorporate successful projects from completed weed projects when developing new initiatives.
3. Identify and prevent the expansion of existing target weed species, and quickly prevent the spread of new high priority weed species.
4. Coordinate weed removal efforts with adjacent landowners, land managers, and/or federal agencies to prevent the further spread of weeds.
5. Provide and promote economic opportunities for the Navajo people to improve rangeland and farmland productivity and to remove noxious weeds.
6. Develop a public education program focused on weed identification, prevention, and removal techniques for local communities and non-profit organizations.

2.0 Project Area

The Navajo Nation covers approximately 16.3 million acres across northeastern Arizona, southeastern Utah, and northwestern New Mexico and (**Figure 2-1**). The BIA Navajo Region is divided into five BIA agencies including (acres indicate total size of areas managed by each agency):

- Western Navajo Agency (Tuba City, Arizona, 5.2 million acres)
- Eastern Navajo Agency (Crownpoint, New Mexico, 2.3 million acres)
- Fort Defiance Agency (3.3 million acres)
- Shiprock / Northern Navajo Agency (2.7 million acres)
- Chinle / Central Navajo Agency (1.4 million acres)

The Navajo Partitioned Lands (Pinon, Arizona, 910,000 acres) and the New Lands Area (310,000 acres) contain an additional 1.2 million acres. At the date of this writing, New Lands is managed by the Office of Hopi and Navajo Indian Relocation but may come under the BIA in the foreseeable future. Thus, the New Lands Area is included in the project area. Additionally, there are approximately a million acres of land that may be in transition to allotment or trust lands on the Navajo Nation as part of land buy backs. For this document, the project area refers to the entire Navajo Nation as defined above with project sites referring to individual weed project locations.

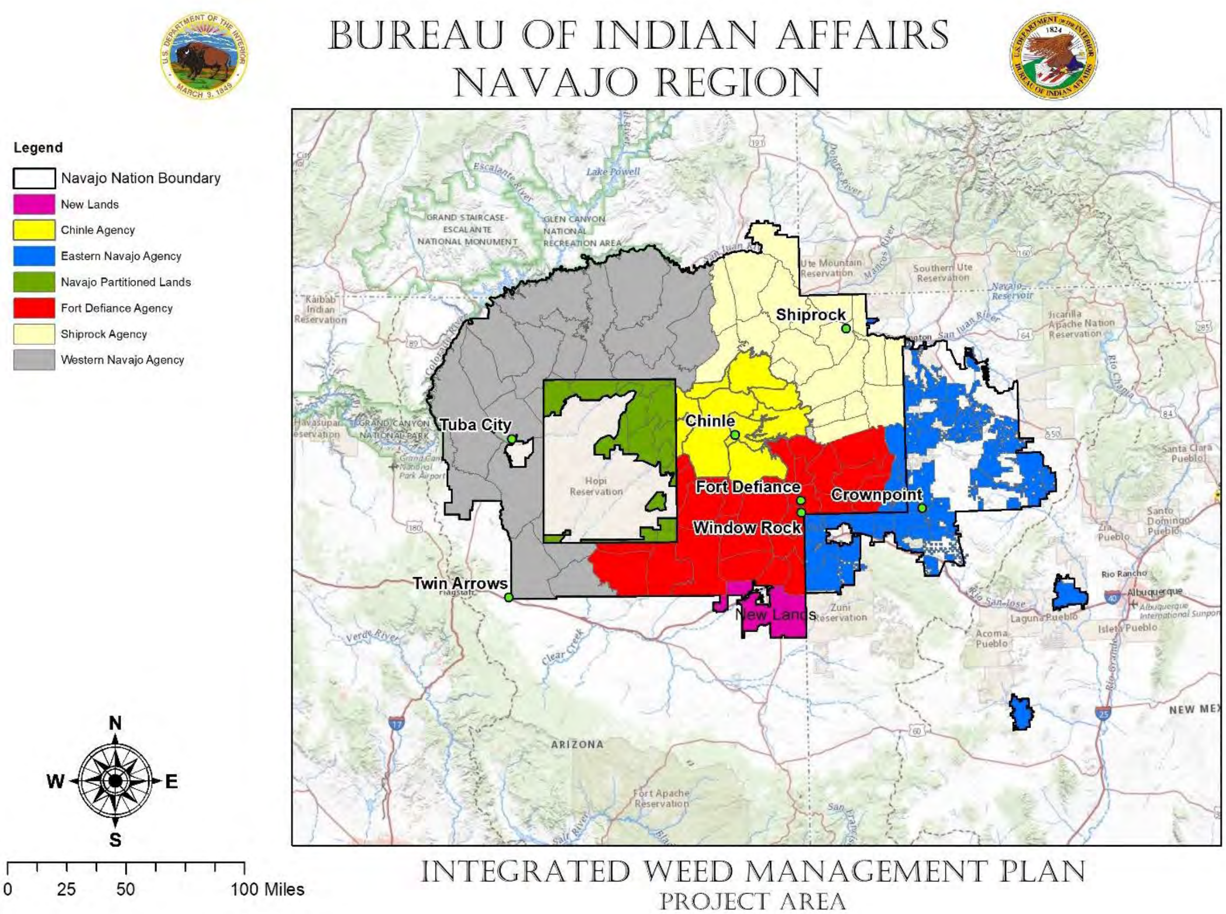

Figure 2-1. Project area of the Navajo Nation divided by BIA Navajo Regional Agencies.

This plan addresses lands under the direct administration of the NRO, which includes all Navajo Indian Allotments and Navajo trust land. Priority areas were identified to direct weed treatments where noxious weeds cause significant issues for land users and land managers (Appendix B). These areas were selected based on general land use types where a majority of weed management projects have been planned or coordinated. Priority areas include:

- Navajo Nation, BIA, federal, state, and county roads
- Riparian areas
- Navajo Nation-designated Community Development Areas
- Rights-of-way
- Designated rangeland
- Designated farmlands
- Navajo Agricultural Products Industry (NAPI) lands

All weed treatment projects shall be conducted in close coordination with local communities, Chapter Houses, and the Navajo Nation.

Roads are a primary contributor of noxious weed populations on the Navajo Nation and are a priority area for weed treatment. In 2018, the Navajo Nation DOT assumed full responsibility for the administration and management of the Tribal Transportation Program (TTP), including the BIA Navajo Region Branch of Transportation (NRBOT) Force Account Program. There are numerous paved and unpaved public roads managed under the TTP. For roads managed by state transportation agencies, vegetation is treated approximately 300 ft from the center of the road for interstates and between 50-100 ft from the center of the road or to the right-of-way fence on state highways. Agencies responsible for management of public roads include Navajo Nation Department of Transportation (Navajo DOT, 5,174 miles); Bureau of Indian Affairs Branch of Transportation (6,086 miles); County Roads (1,512 miles); and state and federal routes managed by Arizona Department of Transportation (ADOT), Utah Department of Transportation (UDOT) and New Mexico Department of Transportation (NMDOT). Treatments may also occur along tribal forest roads, which will require coordination with Navajo Forestry Department and the BIA Branch of Forestry.

Riparian areas are distinct ecosystems surrounding perennial and intermittent surface water bodies, such as lakes, rivers, and streams. These areas are hotspots of biodiversity in the region and cover approximately 1.3 million acres on the Navajo Nation. Water bodies are classified based on the major watershed basin they are located in. Five sub-regional watershed basins occur on the Navajo Nation and include the Rio Grande (710,367 acres), Upper Colorado (980,449 acres), San Juan (8.54 million acres), Lower Colorado (723,528 acres), and Little Colorado (6.67 million acres). These major watersheds are divided into 32 drainage basins on the Navajo Nation. Noxious weeds have been identified in all drainage basins on the Navajo Nation. Riparian habitats in these watersheds have been most impacted by noxious trees, such as Russian olive (*Elaeagnus angustifolia*) and tamarisk (*Tamarix spp.*). Weed populations in these habitats often serve as seed sources to downstream habitats and degrade valuable habitat for wildlife populations, including federally and tribally listed species.

Community Development Areas (CDAs) are defined by the Navajo Nation Department of Fish and Wildlife as "areas in and around towns with few or no restrictions on development." Planning for these areas is done through the Navajo Nation Department of Community Development with local Navajo Chapters. These areas are deemed unsupportive for Navajo species of concern with few restrictions on development. CDAs can be hotspots for weeds as construction, road work, and development activities spread seeds and plant parts to neighboring communities and natural areas.

Rights-of-way (ROWs) occur along all utility transmission lines, homesite leases, and roads on the Navajo Nation. Utility ROWs on the Navajo Nation are Indian Trust Land and maintained by utility companies who manage the lines. These include transmission lines for electricity, water, sewage, internet, phone, and natural gas. Most lines are managed by the NTUA, who provide utility service to residents on the Navajo Nation. BIA Realty currently estimates over 14,000 acres of approved rights-of-way across the Navajo Nation.[1] In addition to NTUA and a few local service providers, Arizona Public Service, Public Service Company of New Mexico, and the Salt River Project also maintain transmission lines on the Navajo Nation but may not provide direct service to trust lands. Federal law requires grantees to control and prevent weeds as part of their right-of-way (25 CFR §169.5). Land disturbance from installation or repair of utility lines can encourage the growth and introduction of many of noxious weed species.

Designated rangeland are areas managed for livestock grazing. These areas are administered by the Navajo Nation either through the Department of Agriculture (NNDA) or the BIA. There are currently around 11,000 active grazing permits on the Navajo Nation. All range permits and range units are managed by the BIA, while NNDA manages enforcement and oversight. These lands encompass roughly 2.6 million acres. The highly disturbed nature of designated rangelands has promoted the growth of many noxious weeds.

Designated farmlands are set aside either through land lease agreements or permits by the Navajo Nation (3 N.N.C. 1) and the BIA (25 CFR § 162 and 167). Designated farmlands comprise approximately 57,900 acres of the Navajo Nation under an estimated 5,000 customary land use permits. Farmlands are categorized as either dryland farms or irrigated farms. Irrigated farms are located near open water used to irrigate fields. Dryland farms are located further away from open water and receive water through irrigation, pumping, and seasonal precipitation.

Commercial farmlands cover areas managed by the Navajo Agricultural Products, Inc. (NAPI) and the Navajo Indian Irrigation Project (NIIP), which provide irrigation and agricultural products for the Navajo Nation. The BIA is responsible for NAPI and NIIP project oversight and ensures they remain in compliance with environmental concerns. The Navajo Nation is responsible for overall management and operations. NAPI lands comprise approximately 110,000 acres along the border between Shiprock / Northern Navajo Agency and Eastern Navajo Agency south of Farmington, New Mexico. In 2019, 66,490 acres were in active production, and 7,000 acres were inactive or fallow. The remaining 36,510 acres are inactive due to delays in the construction of the NIIP irrigation delivery system to the site.

Although the BIA will focus on weed treatments in these priority areas, weed treatments may occur in non-priority areas based on ecological and economic impacts and need. If a site matches the site prioritization criteria outlined in Section 5.0, and serious concern exists for the ecological and economic impacts of existing weed populations, efforts should be made to treat and manage weeds in those areas.

Weed inventory and mapping will be conducted concurrently as part of this plan to identify weed populations in the project area and to prioritize control efforts. Recent efforts in the past 5 years

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[1] Based on BIA TAMS data compiled on January 15, 2021 recently transferred and requires additional clean up and categorization to determine road vs. right of way data. Estimate is likely higher due to undigitized records.

have documented over 70,000 acres of noxious weeds. All areas with identified weed infestations should be ranked and prioritized based on criteria outlined in Section 4.0.

3.0 Priority Weed Species

Forty-five noxious weed species are prioritized for control in this plan. The priority weed species were identified through previous weed mapping efforts by the BIA and the Southwest Exotic Plant Information Clearinghouse (SWEPIC) managed by the U.S. Geological Survey (USGS) Colorado Plateau Research Station (**Table 3-1**). These weeds were selected and ranked based on variety of factors, such as weed occurrence data and priority status in nearby states. The BIA also proposes implementing a weed mapping program as part of the Plan to assess and monitor weeds cover and impacts on the Navajo Nation. Weed inventory and mapping is discussed further in Section 6.0. Information, including photos, names, and management concerns for each species can be found in Appendix L of the PEIS associated with this plan.

These 45 weed species were categorizing into Category A, B, or C with help from the San Francisco Peaks Weed Management Area Working Group (**Table 3-1**, Morse, et al. 2004). Category A noxious weeds are not currently present or have limited distribution on the Navajo Nation but may occur in neighboring areas. The management goal for Category A weeds is to prevent new infestations and eradicate existing ones. For Category A species, the BIA will emphasize eradication, prevention, education, awareness, identification, monitoring, and treatment. Category B noxious weeds are limited in range across the Navajo Nation and the management goal is to contain existing infestations and stop further spread. For Category B species, the BIA will emphasize immediate control, prevention of seed spread, and eradication. Category C noxious weeds are widespread and well established on the Navajo Nation, and the management goal is to locally contain infestations and monitor populations. Management of Category C species is determined at the local level and is based on the feasibility of control and level of infestation. For Category C species, the BIA will emphasize management, education, awareness, and identification/monitoring.

Under this plan:

- **Prevention** means minimizing introductions of a weed species in the project area and is usually combined with eradication to allow the elimination of small populations as they arise.
- **Eradication** means to eliminate a species from the project area.
- **Contain** means preventing seed production in a target patch and reducing the area covered by a species.

  Long-term eradication means an attempt to eliminate a species from the project area over several years. The “contain” and “long-term eradication” strategies are combined as different sized populations may be found in different areas. Some populations may be controlled in a manner to eventually achieve eradication within the project area.

- **Local contain** means local weed management teams will identify the species to contain in localized sites and implement monitoring.

- **Monitoring** means making observations to detect changes in a population using qualitative or quantitative techniques. Monitoring can help prioritize noxious weed removal activities by identifying increases in existing populations, presence of new infestations, and invasion from new noxious weed species.
    - Qualitative techniques involve monitoring methods that do not include measurements or statistics (i.e. photo monitoring and general ocular observations).
    - Quantitative techniques involve using a systematic empirical investigation of plant community characteristics via statistical, mathematical, or computational methods.

Table 3-1. Noxious weeds of concern and proposed management strategy goals.

CATEGORY A - HIGH		
COMMON NAME	**SPECIES**	**MANAGEMENT GOAL**
African rue	Peganum harmala	Prevent
Blue mustard	Chorispora tenella (Pall.) DC.	Eradicate
Bull thistle	Cirsium vulgare	Eradicate
Canada thistle	Cirsium arvense	Eradicate
Common Mediterranean grass	Schismus barbatus	Eradicate
Dalmatian toadflax	Linaria dalmatica	Eradicate
Fountaingrass	Pennisetum setaceum	Prevent
Leafy spurge	Euphorbia esula	Prevent
Musk thistle	Carduus nutans	Eradicate
Perennial pepperweed	Lepidum latifolium	Eradicate
Ravenna grass	Saccharum ravennae	Eradicate
Sahara mustard	Brassica tournefortii	Eradicate
Scotch thistle	Onopordum acanthium	Eradicate
Spotted knapweed	Centaurea maculosa, C. stoebe	Eradicate
Squarrose knapweed	Centaurea virgata	Prevent
Sulphur cinquefoil	Potentilla rect L.	Eradicate
Tall Whitetop	Cardaria draba	Eradicate
Tamarisk (other species)	Tamarix spp., including hybrids	Eradicate
Tree of Heaven	Ailantus altissima	Prevent
Uruguyan pampas grass	Cortaderia sellonana	Eradicate
Yellow nutsedge	Cyperus esculentus	Eradicate
Yellow starthistle	Centaurea solstitialis	Eradicate
CATEGORY B - MEDIUM		
COMMON NAME	**SPECIES**	**MANAGEMENT GOAL**
Camelthorn	Alhagi camelorum	Eradicate
Diffuse knapweed	Centaurea diffusa	Contain & Long term eradicate
Halogeton	Halogeton glomeratus	Contain & Long term eradicate
Johnsongrass	Sorghum halepense	Contain & Long term eradicate
Russian knapweed	Acroptilon repens	Contain & Long term eradicate
Russian Olive	Elaeagnus angustifolia	Contain & Long term eradicate
Siberian elm	Ulmus pumila	Contain & Long term eradicate
Tamarisk, Saltcedar	Tamarix ramosissima	Contain & Long term eradicate
CATEGORY C - LOW		
COMMON NAME	**SPECIES**	**MANAGEMENT GOAL**
Bald brome	Bromus racemosus	Local Contain & Monitor
California burclover	Medicago polymorpha	Local Contain & Monitor
Cheatgrass	Bromus tectorum	Local Contain & Monitor
Field bindweed	Convolvulus arvensis	Local Contain & Monitor
Field brome	Bromus arvensis	Local Contain & Monitor
Horehound	Marrubium vulgare	Local Contain & Monitor
Jointed goatgrass	Aegilops cylindrica	Local Contain & Monitor
Kochia	Bassia scoparia	Local Contain & Monitor
Puncturevine	Tribulus terrestris	Local Contain & Monitor
Red brome	Bromus rubens	Local Contain & Monitor
Rescuegrass	Bromus catharticus	Local Contain & Monitor
Ripgut brome	Bromus diandrus	Local Contain & Monitor
Russian thistle	Salsola kali, S. collina, S. paulsenii, S. tragus	Local Contain & Monitor
Smooth brome	Bromus inermis	Local Contain & Monitor
Spreading wallflower	Erysimum repandum	Local Contain & Monitor

4.0 Implementation Strategy

The BIA proposes completing up to 50,000 acres of weed treatments across the Navajo Nation annually. Noxious weed treatments will be prioritized for the priority areas described above including roads; riparian areas; Navajo Nation Designated Community Development Areas; utility rights-of-way; designated rangeland; designated farmlands; and Navajo Agricultural Products Industry (NAPI) lands. BIA has identified priority Demonstration Projects in these areas (see Section 12.0) based on completed weed mapping efforts and on-going projects, which will be initiated upon approval of this plan. To assist BIA in selecting and ranking new noxious weed projects, the following implementation prioritization strategy was developed. Since funding is limited, the number of projects and acres treated per year will likely vary.

The tasks outlined below provide the essential steps for implementing successful weed removal projects. For the long-term sustainability of weed removal efforts, a Weed-Free Policy should be developed and enforced by the Navajo Nation and BIA to prevent the further spread of noxious weeds. The Weed-Free Policy should require use of certified-weed free hay, seed, ballast, and road material on the Navajo Nation to prevent further spread and establishment of noxious weed species. A checklist is provided in Appendix C, which outlines all steps necessary for weed projects.

Task 1. Initiate demonstration projects near communities. These projects are shovel ready projects that will provide public outreach and educational opportunities, obtain public support for the broader goals of the Plan, and engage the local community in weed removal efforts. The demonstration projects provide information about the distribution of noxious weeds, effective removal methods, project costs, and effective monitoring and maintenance. Proposed demonstration projects are listed in Section 12.0 Demonstration Projects.

Task 2. Meet with local communities and nearby federal agencies. Engagement with the public should determine potential concerns or issues that may affect local communities, such as public health concerns, treatment preferences, or treatment conflicts. Meeting with local residents, community leaders, and agencies will determine the scope of the weed treatment project, identify concerns and challenges, and inform each project's goals and objectives. These concerns can include but are not limited to identifying culturally important plants and/or collection sites, health concerns, and access issues.

Task 3. Map and inventory noxious weeds. A regular workshop will be conducted with the BIA Weed Coordinators to establish a standardized approach to consolidate and coordinate mapping efforts. Mapping provides information on the species present, the size of the infestation, and location.

Task 4. **Apply the site and species approaches.** Actions are prioritized using the site and species approaches to select the best sites to initiate weed management (see Section 5.0). This applies to all new weed management projects.

Task 5. Develop a site-specific plan to implement weed removal efforts for projects. The plan will provide information on weed species present; a map of the treatment area; the removal efforts selected, including detailed information on equipment; native plant restoration; and proposed project costs. If the treatment is located within forestlands a silvicultural prescription may be required.

Task 6. Obtain required permits, clearances, and funding. Acquire permits and support from the tribe and BIA, develop landowner access agreements, obtain funding, and build capacity. Required permits and clearances may include but are not limited to: Forest product harvest permit or contract, burn permit, consent of the majority Indian interest of the beneficial Indian owner(s), Biological Resource Compliance Form from NNDFW, the Cultural Resource Compliance Form from Navajo Nation Historic Preservation Department (NNHPD), and a tribal resolution from the local Chapter House(s) and/or Grazing Committee(s) affected by the project. Finally, all projects should complete a project-specific EA based on the analysis provided in the Programmatic EIS prepared for this plan. See Appendix C for more details on these processes.

This plan can be incorporated into other Navajo nation land management projects or plans by citing either the BIA NEPA reference number or by an in-text citation (i.e., BIA 2022). By incorporating this plan, it is agreed that the subsequent plans or projects will abide by the methods, planning requirements, and mitigation measures outlined in this document.

5.0 Approach for Prioritizing Actions and Sites

To successfully work toward the Plan's goals, an organized approach is essential to prioritize weed removal actions and sites. While the Navajo Nation is a large land base, focused weed removal efforts in targeted areas will help prevent the spread of noxious weeds. A two-pronged approach was developed to prioritize noxious weed removal actions: Site Approach (**Table 5-1**) and Species Approach (**Figure 5-1**).

The Site and Species Approaches are tools used to first prioritize sites and then prioritize the species for removal within a given site. In some cases, all noxious weeds occurring at a site could be removed. This should be determined on a case-by-case basis.

There are five fundamental requirements that dictate the feasibility of a successful weed removal project at any given site. The characteristics listed below must be met for weed removal to proceed:

1. Funding is available to complete the project, including for monitoring and maintenance.
2. The land user/manager is interested and willing. The land user(s)/manager(s) should agree to the removal project and cooperate with weed removal activities, goals, monitoring, and long-term maintenance.

3. Permits are obtained. Noxious weed removal work cannot start without all required permits and environmental clearances. Any projects implemented under this plan will require compliance with the National Environmental Policy Act (NEPA), Section 106 of the National Historic Preservation Act (NHPA), and Section 7 of the Endangered Species Act (ESA) coverage. Additional permits and clearance may be necessary to comply with Navajo Nation regulations as managed by the Navajo Nation Environmental Protection Agency (NNEPA), Navajo Forestry Department, and the U.S. Army Corps of Engineers, as well as coordination with local communities, Navajo Nation Programs, and neighboring land management agencies. Permits and additional compliance are explained further in Section 7.0 Permitting.

4. There is capacity to conduct work at project sites. A trained work force and a logistic plan are necessary to implement a successful and timely noxious weed removal project.

5. The site is accessible. Site accessibility will affect the cost of the noxious weed removal efforts. Difficulty employing certain removal techniques, monitoring, and long-term maintenance should be considered based on the accessibility of the site.

5.1 Site Approach

The site prioritization criteria listed in **Table 5-1** is used to select sites where weed treatments will be most effective at preventing the spread of noxious weed infestations.

Table 5-1. Criteria for site prioritization.

Criteria	Criteria Objective
A. Sites upwind of prevailing wind direction or higher in elevation	Prevent seed or vegetative source from infesting sites downwind of the prevailing wind direction.
B. Sites upstream in the watershed	Prevent seed or vegetative source from infesting downstream sites.
C. Sites with high economic value	Removal efforts can be focused in areas of economic value (i.e. range and farmland) if noxious weed species compromise their functionality.
D. Sites with potential for high mobility (i.e. roads, rights-of-way)	Prevent the spread of noxious weeds along roads or other developed linear corridors that have high mobility potential.
E. Presence of Category A species	These species occupy minimal habitat and are feasible to remove. These species should be prevented from further spread.
F. Coordinated project efforts	Removal efforts can be focused in areas where adjacent land management agencies (e.g., Bureau of Land Management, Forest Service, Hopi Tribe, National Park Service, etc.) have similar noxious weed removal projects.

Criteria	Criteria Objective
G. Greater than 10% total canopy cover of noxious trees.	Maintain noxious trees cover below 10 percent.
H. Greater than 20% total canopy cover of herbaceous and grass invasive species	Maintain herbaceous and grass noxious weed cover below 20 percent.
I. Presence of isolated small populations of Class A or B species	Isolated populations of Class A or B weeds are feasible to remove to prevent further infestation. Priority Class A or B weeds should be identified using the Species Prioritization Flow Chart (**Figure 5-1**).
J. Potential for wildfire	Reduce wildfire risk for damage to property, human safety and wildlife habitat.
K. Herbaceous weed control where plants interfere with passive or active revegetation	Control noxious herbaceous species if they have the potential to serve as secondary weeds when woody noxious weed species have been removed.
L. Sites with high wildlife value	Removal efforts can be focused in areas with high wildlife value if noxious weeds are compromising their habitat.

5.2 Species Approach

The species prioritization approach is adapted from the U.S. Forest Service (USFS) Region 3 Invasive Weed Classification System and the Coconino National Forest (**Figure 5-1**). A species prioritization approach provides a plan for treating and managing different target weed species on a site based by species category, infestation size, risk, or potential of spread, and available resources.

5.2.1 Risk Assessment

An essential consideration when prioritizing species is to determine factors that may facilitate the spread of noxious weeds to other areas, such as the species' mechanism of establishment or colonization (seed, vegetatively, spread via flood events, wind, water, etc.), its location at a site, and site characteristics. Weeds classified as Category A (**Table 3-1**) are highly aggressive but may be a lower priority than a Category B species because the site factors are not conducive to spread, whereas the Category B species may have the appropriate site conditions to spread. For example, a patch of saltcedar (A) located on flat or isolated area off the river corridor may be less of a priority than camelthorn (B) located on the riverbank. While saltcedar is a highly aggressive species, the camelthorn may have a higher risk of spreading through flood events. Risk assessments should be conducted in the field by qualified professionals.

5.2.2 Pre-Field Review

The species prioritization process should begin with a review of existing weed data for each area of interest. Areas of interest include those that may serve as a noxious weed seed source to downstream or downwind areas, developed linear corridors (roads, fences, utility easements), areas with high quality range, agricultural lands, or riparian habitat (dominated by >90% native species), and areas with high fire risk. The following is a list of considerations when preparing existing data.

1. Review geographic information system (GIS) maps of all existing information for an area, weed data, hydrology, roads and travel corridors, vegetation type, and primary use of the land.

2. Check with local BIA weed coordinators, county/state weed specialist, and the Southwest Exotic Mapping Program at Northern Arizona University to determine if noxious weed species are present on or adjacent to the area. For noxious weeds along non-forest roads and highways, contact ADOT, NMDOT, and/or UDOT. For tribal forest roads contact the Navajo Forestry Department (NFD) and BIA Branch of Forestry. Develop a list of possible species present.

3. Compare the habitat requirements for noxious weeds to the project area to determine if potential habitat for noxious weeds exists.

4. Determine the accessibility of the site and complete a habitat evaluation if necessary.

5. Determine if plant gathering sites could be affected by treatments based on input from the community.

Figure 5-1. Flow Chart Species Prioritization

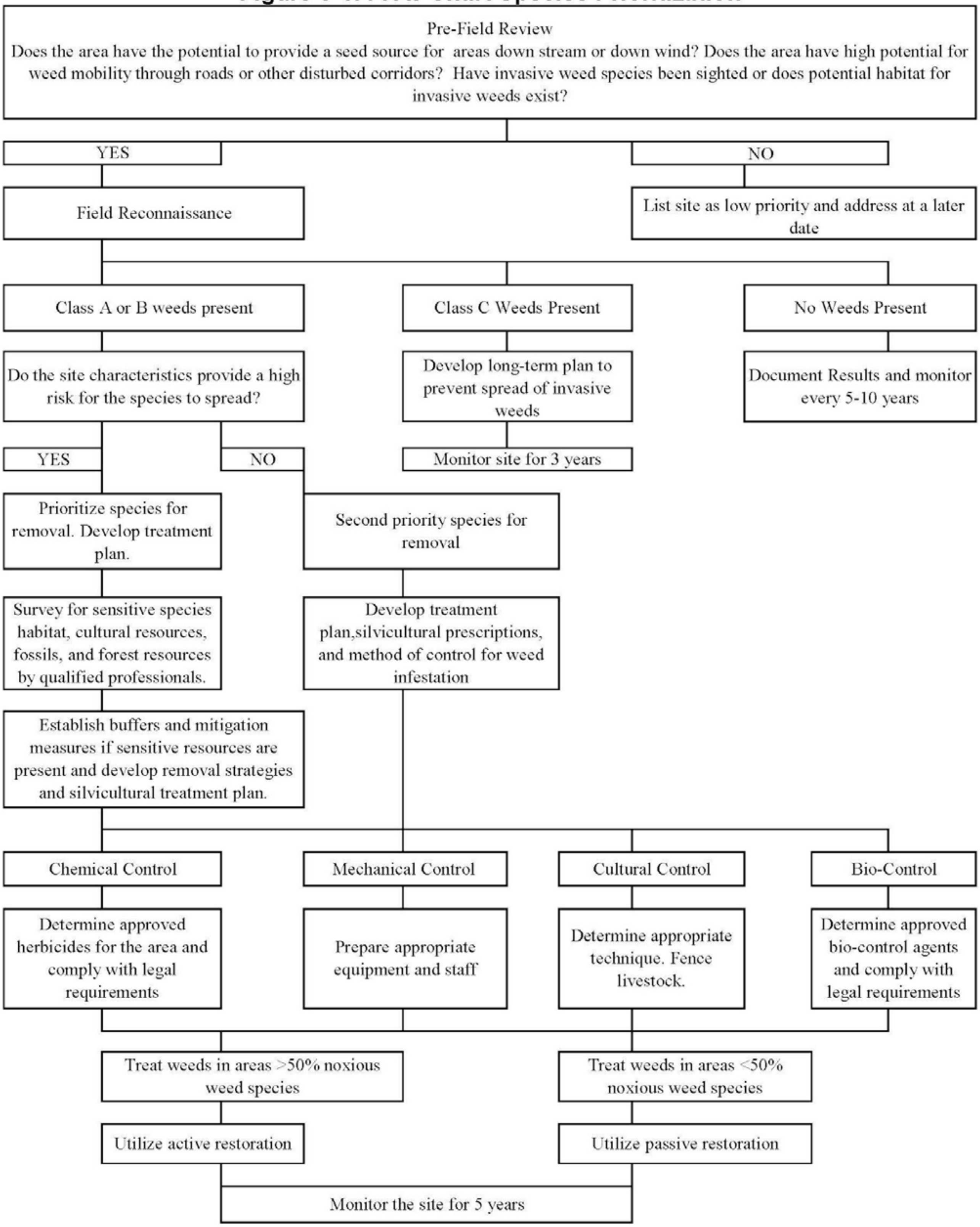

Figure 5-1. Flow chart for prioritizing noxious weeds identified at a project area.

6. Conduct a field reconnaissance to determine the presence of noxious weeds and their habitats in the area are indicated by the pre-field review (See 5.2.3 Field Reconnaissance).

7. Summarize results, including a list of the species considered and sources used to identify habitat in area.

5.2.3 Field Reconnaissance

Field reconnaissance should be conducted to determine the presence and distribution of noxious weed infestations and to evaluate spread risk if a weed inventory has not already been completed. If an inventory involves any of the listed invasive tree species (i.e. tamarisk, Russian olive, Siberian elm, or tree of heaven), a forest stand exam is required. Stand exams will provide an estimate on trees per acre of all trees species identified. They should also provide volume estimates for any native tree species that occur. Stand exams can evaluate the entire project area or provide an estimate based on at least 10% of the proposed project area. Consultation with BIA Forestry should be conducted to determine specific inventory requirements, especially if a silvicultural prescription is required.

A reliable sampling design should be used, such as a systematic search using transects or plots to cover as much of the area as possible. If the area is large, a sub-sample of the area using transects can be used. The surveyor should walk the distance of the transects and map all noxious weeds with a Global Positioning System (GPS) handheld unit. Infestation data should include the name of the species encountered, a unique population identifier, and the species spread risk. Surveys should be conducted during the growing season for proper plant identification. When conducting field reconnaissance, note changes in weather conditions that may affect noxious weed growth at the site. Some noxious weeds may not be obvious or may not occur at certain times of the year (i.e. delayed monsoon season, early spring emergence). Site characteristics should also be noted, such as landform type, existing hydrology, and land use history.

The results from the field reconnaissance can be used to develop a removal strategy (e.g. silvicultural prescription) and include control methods, re-planting of native species, and monitoring. These inventories provide baseline information on the species present and size and location of the infestation.

The field reconnaissance should guide the following weed management actions based on noxious weed class and the risk of spread:

Category A or B weeds are present:

1. Develop and implement treatment measures to eliminate weeds, based on the following:
    a. Most effective removal techniques: chemical, mechanical, and biological control (Appendix E).
    b. Approved herbicides for the area.

c. Legal requirements for herbicides.
d. Active restoration in areas with >50% noxious weeds.
e. Obtain applicable permits and coverage based on federal, tribal, and state requirements (Appendix C).
f. Develop fire and safety plans.

8. Monitor management measures (qualitative and quantitative) for 5 years.

Category C weeds are present:

9. Develop and implement treatment measures to prevent spread or eliminate weeds.
10. Monitoring treatment area for 3 years.

No weeds are present

1. Document results.
2. Monitor every 5 – 10 years.

6.0 Weed Inventory and Mapping

Of the 17 million acres across the Navajo Nation, 3,600,015 acres (or 21% of the land area) have been inventoried for noxious weeds. Weed inventory and mapping can identify and monitor weed populations in project areas. Weeds in each project site should be mapped starting with field reconnaissance to assess the size and scale of existing infestations and to provide valuable information for developing weed control projects. After treatments, populations should be monitored annually to determine the effectiveness of weed control efforts.

Figure 6-1. A field infested with musk thistle on the Navajo Nation. Photo courtesy of R. Benally.

Weed mapping should be conducted in priority weed areas at least every 5 - 10 years to inform project planning and to document changes to previously treated areas. Data should be no older than 5 years old when planning projects. The BIA Navajo Region plans to develop a website for the Navajo Region's Noxious Weed Program to inform the public on the location of current weed populations, planned projects, and post-project monitoring and updates. The GIS features on the site will also streamline the data collection process for future weed inventory projects and provide updates on the status of existing populations. The public can use the site for information on planned, current, and past projects, to see the extent of existing mapping efforts, or to report new weed populations as part of the BIA's early detection efforts.

Weed mapping is an important tool for land managers to effectively manage weeds on the Navajo Nation. While it is impossible to map every single weed, mapping is a critical tool for identifying and monitoring problem populations. Regular weed mapping should be done in areas identified for treatment and management and should provide information on weed cover in project areas. Site-specific mapping, as described above in Field Reconnaissance, should be conducted at least every 5 to 10 years to identify new populations for treatment by weed coordinators, range managers, or members of the community. While field reconnaissance will provide initial information to develop treatment plans, weed mapping focuses on documenting the size, severity, and diversity of weeds in an area.

In addition to mapping, processing the collected data is necessary to provide agency and region-wide assessments of recurring and emerging weed issues on the Navajo Nation. There are a wide array of methods and tools used to map weeds, the following section explains the necessary information to document in a basic weed inventory protocol to assist in prioritizing weed control projects and assessing the effectiveness of control measures. A basic weed mapping protocol is provided in Appendix D.

6.1 Field Mapping

Weed mapping requires field surveys of new and established weed infestations. Field surveys should be conducted annually or semi-annually to determine the presence and distribution of weed infestations and to evaluate spread risk. A reliable sampling design should be developed, such as a systematic search using grid cells or transects to cover as much of the area as possible. If the area is large, define a sub-sample of the area to estimate the coverage and size of observed weed populations. The parameters for defining a sub-sample and its size should be documented. The surveyor should walk the area of the grid cell or the distance of the transect and map all noxious weeds observed. All documented infestations should record the geographic location of the spread, noxious weed species observed, and the size and the density of the population. Weed map data can use point, line, or polygon data depending on the techniques used and the size of infestations. However, it is preferred to document infestations as polygons to make it easier to estimate acres and to assist in project planning. However, if infestations are documented using point or line data, it is recommended that acreage and coverage estimates be included to estimate the overall size of the population.

When conducting field mapping, surveyors should be briefed on the following:

- The size of the property being surveyed including property boundaries or areas to avoid (i.e. private property).
- How to clean off equipment and clothing after a survey is done to avoid inadvertently spreading weeds to other mapping locations.
- How to identify and avoid sensitive plant species (i.e. federally and tribally listed species).
- How to identify priority weed species.

- The best routes for accessing mapping locations and where to park to avoid damage to sensitive areas.

6.1.1 GPS Units

Global Positioning System (GPS) units are commonly used to collect geographic data. GPS units provide real-time data collection and navigation, allowing users to systematically collect data as they survey a project area. GPS units can provide the most accurate geographic location data that can be used to create detailed maps and a variety of spatial analyses. Using GPS units requires training on how to set them up and use them accurately and efficiently. For surveying, it is important that users know how to set up the projection system, navigate to specific locations, and input relevant information and unique identifiers for individual data points or populations.

Some GPS units may save geographic data in different file formats, which may make it difficult to use with GIS mapping software or between different GPS units. The State of Minnesota Department of Natural Resources has developed open-source software called DNRGPS that converts several popular GPS file formats compatible with different GPS models and GIS software (Available online here: http://www.dnr.state.mn.us/mis/gis/DNRGPS/DNRGPS.html).

GPS units can be limited by satellite reception. While widespread use of GPS units has increased their accuracy, it may be hard to get accurate location data in some locations, such as slot canyons or under dense canopy cover, where features can interfere with the unit's reception. It may be necessary to note data points where accuracy is limited or questionable.

6.1.2 Smart Phone Mapping Apps

An array of GPS apps allows surveyors to use their personal phones as GPS devices. These apps use the phone's GPS technology to provide real-time location information and allow data collection. Smart phone apps may reduce the costs for survey equipment and can allow volunteer groups to assist with weed mapping. Apps such as Esri Field Maps, iNaturalist, LandPKS, Fulcrum, and MapIt allow users to collect field data and create custom reports for mapping projects. Esri applications allow easy integration with ArcGIS Online to update data in real-time, reducing the time needed to process and convert data. This method, however, depends on whether field surveyors have access to smart phones. In some instances, the GPS signal on the smart phone may not provide the level of accuracy needed to document individual weed populations and a signal booster or GPS antenna may be needed.

6.1.3 GIS Remote Mapping

GIS, or a Geographic Information System, is a powerful tool for creating geographic data for mapping and project planning. GIS software can compile and analyze data collected in the field. GIS software can identify potential populations through remote sensing or by documenting visible problem areas on aerial imagery. This method works well for noxious weed tree species, such as tamarisk or Russian olive, which can grow in dense stands and have distinctive foliage. For example, dense stands of tamarisk can be delineated when using high resolution aerial imagery based on differences in infrared signals. Remote sensing is recommended where field mapping may not be feasible, such as in canyons or rivers, but may be expensive due to the costs for obtaining high resolution multi-spectral images needed for such analysis. While currently in development, remote sensing for smaller, less dense weed species such as thistles, grasses, or other herbaceous or annual weeds is limited due to their visual similarities to other native populations and the size of individual plants. However, new methods and imagery technology may provide some guidance on how to use remote sensing for large-scale weed mapping projects.

6.2 Data Collection

Whether in digital or paper form, the information below represents the basic required information collected during all weed mapping surveys and will allow the BIA to share weed data with other agencies and weed management groups. This list can be updated as weed mapping efforts develop and evolve. A sample data sheet is provided in Appendix D.

- Agency - As weed mapping is done, field surveys should identify the BIA Agency collecting the data and the weed coordinator managing the mapping effort.
- Date - Mapping surveys should document the month, day, and year the survey was conducted. This information can determine if certain weeds may have been missed due to the timing of the survey. For example, species that emerge in the fall may not be documented if surveys are conducted in the spring.
- Surveyor Information - Record the names and contact information of individuals conducting the survey. Follow-up may be needed to clarify recorded data or fill in missing information.
- Unique ID Code - Each infestation or area should have a unique identifier. It can be a unique combination of letters and numbers that correspond to specific geographic features, agency, date, or sequential numbers. However, they should be unique to each infestation to avoid confusion. The identifiers can be used to track projects over time.
- Information Source - Information source documents how the BIA became aware of the infestation. It can identify previous survey dates, weed coordinators, specific land users, other federal, state, or tribal agencies, community groups, or other BIA Navajo Regional agencies. During the first years implementing the Integrated Weed Management Plan, knowledge of who identified each weed infestation may be incomplete but collecting this information over time can identify community members who can assist with weed management.
- Location Data - All weed inventories should identify where infestations are located. Location information includes the geographic coordinates used to pinpoint the exact location of the infestation. Location data should be recorded for

each infestation during the survey. An infestation represents a distinct population of noxious weeds in a given area. While infestations of solitary plants may be collected, mapping efforts should focus on sites where infestations represent sizeable clusters of noxious weeds. Often this information is automatically collected with the data points.

All GIS data should comply with the Navajo Region's GIS Strategic Plan. They should also meet the FGDC metadata standards. Metadata should include descriptions of the data, an agency point of contact, and when data was collected.

If using GPS, **the geographic projection system on the unit should be set to either NAD1983 UTM Zone 12N (Arizona) or 13N (New Mexico)**, depending on where the survey is conducted. If this projection is not available on the device, coordinates can be recorded in Latitude and Longitude (Degrees, Minutes, Seconds, or Decimal Degrees), which can be converted into UTM coordinates later. To convert coordinates, the following website provides some limited coordinate conversion tools: https://www.earthpoint.us/Convert.aspx

Other location data may include the USGS quad map identifier (if used), state, county, watershed HUC codes, and range, township, and section information. However, such data is not required for basic weed mapping inventories.

- Size of the Survey Area. While weed mapping may focus on a specific area, such as a Land Management District or Range Unit, it is important to document the actual size of the area surveyed, especially of surveys do not cover the entire area. Defining the size of the survey area will allow the BIA to estimate weed cover.
- Weed Species- Weed species should be identified using the U.S. Department of Agriculture (USDA) PLANTS database symbol (http://plants.usda.gov). Individuals conducting field surveys should be trained to identify priority weed species and local vegetation. This training should teach field surveyors to identify sensitive species to avoid collection or damage. If a species is not easily identifiable in the field, a sample may be collected for identification later. A collected plant specimen should include the entire plant, if possible, including flower, roots, stems, and leaves. Collected samples should note the date, location, the unique ID code for the population, and any other pertinent information about where the sample was taken. A data point should be recorded on the GPS unit to denote where the plant was collected.

USDA PLANTS database symbols for the target weed species are provided in Appendix D. The table and symbols should be updated annually so the proper codes are used in the field to identify problem weeds.

- Native Species (for forest land projects) – Projects requiring a silvicultural permit should include an inventory of native tree species at the project site. Consult with a professional forester to determine the level of detail needed to develop weed treatments in forestlands. The distribution of a timber and woodland tree species will determine the appropriate silvicultural system needed to ecologically restore an area or accomplish specific project goals and objectives in line with the current forest management plan. Baseline data collected during a forest inventory include but is not limited to species, diameter at breast height/diameter at root collar, percent canopy cover, height, and basal area, and understory species occupancy.

- Size and Extent- The size of the infestations should be documented in either square feet (for small sites) or an estimated acreage (for large sites). Size estimates for each documented infestation are used to assess the severity and spread of identified weed species. Polygon data is the most accurate way to document the size of the infestation. If point data is collected, surveyors should record a rough estimate of the population's size (e.g. >0.1 acres, 5-10 ft^2, etc.). If line data is collected, surveyors should set a buffer distance for the width of the infestation.

Size and extent should record the size of the infestation for **each species identified** at a recorded site. The size estimate should be an estimate for each weed population found in an area, not an estimate of the size of individual plants. This information can determine which control method to use, how to set up post-treatment monitoring, and how to assess the overall cover of priority weed species on the Navajo Nation.

- Vegetation Cover- Vegetation cover is an estimated percentage of the ground covered by the specified species. Cover is a measure of how densely the plants grow in an area. Some weeds may grow in a large area, but they may be widely spaced, allowing other vegetation to grow in the same area. Other weeds, such as tamarisk, can grow in dense stands or patches, which crowd out other plant species. Cover is best estimated by looking at how much foliage or canopy crown covers the view of the ground. For more detailed information on how to estimate vegetation cover refer to Elzinga et al. 1998 (https://digitalcommons.unl.edu/usblmpub/17/; pp. 178-186).

- Other Information

Additional information to record:

- Nearby water sources or barriers that may limit the size of the infestation
- Locations of wells or wellheads at the site.
- Travel routes to project sites and roads within the site
- Other dominant vegetation
- If unique, sensitive, or protected plants were present
- Problems encountered while collecting the data
- Other sources that may document the infestation (e.g. maps, notes, etc.)
- Photos of infestations along with photo file information

6.2.1 Stand Exams

If the project treats a noxious tree species (i.e. Russian olive, tamarisk, tree of heaven, or Siberian elm), then a stand exam is required to estimate and evaluate stand dynamics of the site. This should include an inventory of all the tree species at the site, including native trees, and an estimate of trees per acre. The stand exam information is used to estimate volume for a harvest document through either the Navajo Nation Forestry Department (if on tribal land) or BIA Forestry (if on allotted land). Stand exams are done by establishing plots within the proposed treatment so that the size and number of plots equates to at least 10% of the total stand area. The stand exam will be used to develop silvicultural prescriptions if the removal project takes place on a Navajo Nation forestland (i.e. timberland or woodland). Stand exams should be updated for each permit to detail the number of trees removed with each phase of treatment.

For any stand exam, a survey plan should be developed before field data collection starts. Project sites should follow the Navajo Forestry Compartment Exam Handbook, especially for establishing the exam layout. See the Navajo Forestry Compartment Exam Handbook (2012) for more details on exam design and terms.

In the field, the following are parameters should be collected for stand exams.

- Plot number – Create a unique identifier for each plot.
- Plot size **–** Record the size of the plots to ensure proper sampling design.
- Location Information – Provide the tract number, Township, Section, and Range information, if available, or latitude and longitude for the center of each plot.
- Tree species – use scientific name or USDA PLANTS code.
- Native Tree Species – Seedlings, saplings, and trees with a DBH/DRC greater than 6” should be inventoried by species per the Navajo Forestry Department Compartment Exam Handbook (2012).

6.3 Data Processing

Once data is collected in the field, it will be compiled and analyzed using GIS software. The software can organize inventory data and use it to assess weed cover and treatment effectiveness. The BIA uses ArcGIS Online to display, collect, and manage weed mapping data for the Noxious Weed Program. The data is managed by each BIA Agency weed coordinator, including management and development of relevant metadata.

Spatial data in the form of vector data should be used to assess and summarize mapping efforts. All field surveys are compiled into a central geodatabase to provide a comprehensive view of all documented weed infestations. Spatial data should include attributes that describe when individual populations were first documents, when they were last updated, if they are part of a specific weed management project, and if they represent an expansion or reduction of weed coverage from previous years (if applicable).

Weed data should be assessed at the agency and regional level on an annual basis. Analyses should look at the size and extent of infestations for all priority species, the effectiveness of treatment methods to reduce the size and cover of target species, and locations where weed projects can make the best use of limited funds. Implementation of a basic weed mapping program will aid planning and long-term management of priority weed species on the Navajo Nation.

7.0 Permitting

The PEIS, Biological Assessment (BA), and Biological Opinion (BO) associated with this plan will provide federal coverage to implement weed management activities on the Navajo Nation. However, some permitting is needed on a project-by-project basis. Prior to implementing a project, the following agencies should be contacted to ensure project compliance and to obtain necessary permits and approvals. Additional information on how to apply or fulfill additional permitting and compliance requirements are outlined in the Weed Project Checklist (Appendix C). Contact information for the agencies is available in Appendix I.

Navajo Nation Department of Fish and Wildlife (NNDFW)

Project sponsors conducting weed projects under this plan shall complete and submit a Data Request Form for the project area to NNDFW Natural Heritage Program, including weed treatment methods proposed and maps of the project area. NNDFW will determine if habitat for Federal or Navajo Listed Endangered, Threatened, or Proposed species or migratory birds exists through the Biological Resource Compliance Form (BRCF). If habitat exists a qualified biologist will conduct species specific surveys during the appropriate season to determine if the species is present or have a qualified biologist on site during construction to identify species locations. To conduct species surveys on the Navajo Nation, a biological research permit must be acquired from the NNDFW. If species are detected on the site, the agency shall implement the species conservation measures outlined in the BA, BO, and PEIS (see Appendix F). Any positive results from the habitat evaluation and species surveys (i.e., occurrences of listed species) should be reported to the NNDFW. If any projects affect wetland or riparian habitats, NNDFW will require a review and approval of the project.

Navajo Nation Historic Preservation Department (NNHPD)

Cultural surveys for individual weed projects will be conducted using the standard Section 106 process established between BIA and NNHPD (see Appendix G). The project sponsor, primarily BIA, will be responsible for obtaining all necessary cultural resource clearances for individual projects. Cultural surveys should be conducted by a qualified cultural resource specialist with an NNHPD approved permit. Prior to conducting surveys, the consultant shall obtain a Class B project-specific permit from NNHPD at least 10 days prior to the start of field work. Surveys will include records searches, ethnographic interviews, and field surveys for cultural resources, including traditional cultural properties (TCPs), for all projects. After a survey is complete the consultant must complete an Archeological Inventory Report based on the NNHPD standards (Appendix G). NNHPD will recommend specific cultural resource mitigations to the BIA NRO Regional Director through a Cultural Resource Compliance Form (CRCF) and as part of the NEPA decision document to avoid adverse effects to historic properties or TCPs. Upon approval by the BIA NRO Regional Director, the project sponsor will distribute the CRCF to all project partners for their records, excluding the cultural resource consultant and the SHPO, who will receive their approved CRCF forms from NNHPD.

Navajo Nation Environmental Protection Agency (NNEPA)

Projects must comply with the Navajo Nation Clean Water Act, Navajo Nation Safe Drinking Water Act, Navajo Clean Air Act, Navajo Environmental Policy Act, and the Navajo Nation Pesticide Act. The following reports may be required to comply with the Navajo Nation EPA:

- Any project using herbicide must submit a Pesticide Use Permit (PUP) for the Navajo Nation EPA Pesticide Program. A weed treatment flyer should be posted to the nearby Chapter House and to the project site to notify the public about the project.
- Due to the size of the Navajo Nation, projects using herbicides near open water must submit an electronic Notice of Intent (eNOI) to the U.S. Environmental Protection Agency (U.S. EPA). Each BIA Navajo Agency will serve as the Decision-Maker and Operator for the eNOI on the U.S. EPA's Region 9 Pesticide General Permit (PGP). The eNOI will provide the U.S. EPA with the project details (herbicides proposed, size of area, weeds managed, potential endangered species and watershed impacted, etc.). Copies of the Notice of Intent must be sent to the NNEPA Surface & Ground Water Protection Department and the NNEPA Pesticide Enforcement and Development Program. Information on the Pesticide General Permit requirements and eNOI submission requirements can be found in Appendix C.
    - Any projects using restricted use pesticides must have certified pesticide applicators who are certified through NNEPA. Project records must record where, when, amount applied, and for whom herbicide was applied. These records will be subject to review by NNEPA to ensure compliance with the Navajo Nation Pesticide Act.
    - Any projects that implement prescribed burns must be planned in coordination with NNEPA and BIA Branch of Fire Management to address air quality concerns when developing the project Burn Plan. An air quality report may be necessary to document the effects of burning on regional air quality for specific communities on the Navajo Nation.
    - Any actions that require a federal permit, license or approval to discharge into federal waters will require a Section 401 permit from the NNEPA Water Quality

Program (not including herbicides which are covered under the PGP). These include projects that excavate or place materials in some waterways and wetlands (i.e. weed removal in a stream or wetland); consultation with the U.S. Army Corps will help determine which wetlands and waterways are subject to this requirement. If necessary, an application for the Section 401 permit should be done at the same time as the Section 404 permit (see below) since these permits are done in conjunction with each other for all projects in riparian or wetland areas.

- If any projects are proposed in wetland or riparian areas, a wetland delineation is required. NNEPA must review and approve all projects that may impact federal or tribal waters along with the NNDFW.
- Projects must survey for wellheads and coordinate activities with NNEPA Public Water Systems Supervision Program (PWSSP) to incorporate wellhead protection measures.

United States Army Corps of Engineers (Corps)

The Corps regulates activities on federal waters and is charged with protecting harbors and navigation channels from destruction and encroachment, and with restoring and maintaining environmental quality. Pursuant to Section 404 of the Clean Water Act, projects along riparian and wetland areas that impact jurisdictional waters require Corps permits. The Corps has an obligation to ensure that permitted projects comply with NEPA, ESA, and NHPA. Weed projects that require mechanized removal of vegetation along riparian corridors or wetlands will require a Section 404 permit. The application for the permit should be submitted to the representative State Corps office (i.e., Arizona, New Mexico, or Utah).

Navajo Nation Forestry Department

The Navajo Nation Forestry Department should issue a forest harvest permit (Appendix K) for any projects that remove noxious trees. Forest permits require a stand exam (Section 6.2.1 Stand Exams) to evaluate current stand composition and an estimate on the number of trees removed. A stand exam will be used to estimate how much volume will be removed during the project. If the project takes place in a Navajo Nation forestland (e.g., riparian woodland, ponderosa pine timberland, etc.), a silvicultural prescription prepared and/or reviewed by a certified silviculturist is required. The prescription should outline the following information:

- Project Location and Property Identification (same as BIA Form 5-5331)
- Name of certified silviculturist
- Date of Preparation
- Stand exam methods
- Woodland type or stand designation number

- Silvicultural system applied
- Cutting method or treatment
- Stand description and forest history
- Management constraints from each project's BRCF, CRCF, and EA.
- Landowner goals and objectives
- Map of the project area
- Detailed description of the prescribed treatment (as outlined in the treatment plan)
- Monitoring needs
- Signature of the certifying silviculturist

This applies to all woodland management areas, which include riparian habitats and commercial forests as described in 53 IAM Handbooks (i.e. where native species are present). Additional planning may be needed to ensure that forest management BMPs and permit special provisions for weed removal projects are followed and existing 638 contracts are enforced. BIA Branch of Forestry can help develop the treatment plans to ensure they include the prescription and permit requirements.

BIA Branch of Forestry

Projects planned and proposed on allotted lands that remove noxious trees should be developed in consultation with the BIA Navajo Region Branch of Forestry. Noxious tree treatments within allotment lands require consent of the majority Indian interest of the beneficial Indian owner(s), documented by their signature(s) on a Power of Attorney for the Sale of Allotment Timber, contract or permit. Stand exams should also be completed to document the estimated number of trees being removed. If the projects take place in timberlands and woodlands, a silvicultural prescription is required with the same elements as above (a certified silviculturist is not required, however). Refer to 25 CFR Part 163, IAM Part 53 Chapter 3 – Harvest of Forest Products, IAM Part 53 Chapter 9 – Silviculture, and other IAM's and handbooks for forestland management activities on Indian lands for additional guidance.

BIA Branch of Fire Management

Projects that used prescribed or pile burning to remove invasive weeds should be developed in consultation with the BIA Navajo Region Branch of Fire Management. The Branch of Fire Management will assist in developing the required burn plans, including required fire modeling and smoke management mitigations. The Branch can ensure that all fires and burn plans align with the BIA's Wildlife Prevention Plan for the Navajo Region. They can also assist with public notifications and additional coordination with Navajo Nation Programs, local fire departments, tribal forestry programs, and other local fire management programs.

8.0 Mitigation Measures

The following measures are required when implementing weed management projects. These measures should be printed and checked off when implementing projects.

8.1 General Measures

Project Planning

- Complete all necessary permits and authorizations prior to implementing a project (see Section 7.0 and Appendix C).
- If treatments are planned for allotment lands, the project sponsor must obtain consent from the Indian owner(s) as the law requires.
- Noxious tree treatments require consent of the majority Indian interest of the beneficial Indian owner(s), documented by their signature(s) on a Power of Attorney for the Sale of Allotment Timber, contract, or permit.
- Surveys and clearance for paleontological resources are required before any surface disturbing activities, mechanical treatments, or chemical treatments in coordination with the Navajo Nation Minerals Department.
- Conduct surveys for cultural resources by a qualified cultural resource specialist before treatments in coordination with the Navajo Nation Historic Preservation Department (NNHPD).
- Conduct ethnographic inquiries with local community members to identify plant gathering sites and other traditional cultural properties (TCPs) that may be affected by weed treatments. If TCPs and gathering sites are identified, the project sponsor will work with the community to identify alternative sites, treatment options, or other mitigation measures.
- Complete and submit two copies of the Archaeological Inventory Report and all site forms to the NNHPD Cultural Resource Compliance Section for review. The BIA NRO Regional Director will approve the CRCF to provide Section 106.
- Avoidance of all cultural resources is the preferred mitigation measure to avoid adverse effects, as well as identifying alternative plant gathering areas. All work must be coordinated with NNHPD to ensure compliance with Section 106 and NHPA.
- Complete and submit a Data Request Form for the project area to NNDFW (https://www.nndfw.org/nnhp/drs2012.pdf) and obtain a Biological Resource Compliance Form (BRCF).
- If potential habitat for endangered or threatened species is present, conduct a habitat assessment by a qualified biologist. If potential habitat is found, protection measures, including species buffers will be applied to the habitat or additional surveys for species presence will be conducted by a qualified biologist. If the species is present at the site,

species protection measures will be employed, NNDFW will be notified, and a biological monitor will be present during all phases of project implementation (Appendix F).

- Develop a Safety and Communications Plan that identifies specific safety measures for all treatment methods used in the project, including equipment handling, required Personal Protection Equipment (PPE), and emergency response communication protocols.
- Removal of noxious trees requires a forest product harvesting permit or contract and may require a silvicultural prescription to authorize a treatment in forestlands, including woodlands. Special provisions associated with the harvest document(s) should be reviewed and modified when appropriate to address unforeseen resource issues associated with the harvesting activities.
- All project personnel will be trained on the use of Personal Protection Equipment (PPE), equipment handling, and safety protocols. Personnel will be required to use PPEs during herbicide and mechanical (chainsaw, control burn, etc.) applications.

Prior to Project Implementation

- Designate staging areas and/or equipment wash stations for cleaning and prep work before and after treatments. These sites will be used to mix herbicides, refuel equipment and vehicles, and store materials for the duration of the treatment. Equipment wash stations may be temporary and will have a filter system, for example at least 6 inches of large cinder or gravel spread over an area 10 feet x 30 feet. Filter cloth may be used for temporary stations. The area will be a perched drainage to allow excess moisture to drain after being filtered and will be located at least 300 feet away from surface water, natural drainages or wellheads.
- Notify adjacent landowners, authorized land users, local authorities, and/or the public of treatments, treatment duration, and post-treatment measures before implementation to prevent exposure and limit re-infestations through education and outreach with the local grazing official, posting public notices, radio announcements, and/or chapter meeting announcements. Weed treatment flyer and/or forest harvest sales permit should be posted locally before projects start.
- To reduce the risk of weed spread, access routes will avoid heavy infestation areas. Access routes will be closed when the project is completed.
- Clearly mark boundaries of treatment sites (such as posting visible flags or signs) before and during treatments.
- Sites will be inspected, and potential hazards removed, to ensure safety prior to treatments.

During Project Implementation

- Vehicles will use only established roads for accessing project sites. Vehicles will be parked at designated parking spots near established roadways during treatments.

- If camping, project personnel will use designated and established campsites with approval from NNHPD or a qualified archeologist.
- On-site safety briefings will be given prior to any treatments to review required PPE, safety, and emergency response measures, and what to do in the case of an injury or emergency.
- Inspect and clean equipment, heavy machinery, and clothing after treatments for mud, dirt, and plant parts to prevent spread to other project sites by the field crew.
- Minimize soil disturbance to the extent practical.
- No mechanical treatments or use of heavy mechanized equipment will be used in archeological sites or traditional cultural property boundaries.
- If potential habitat for an endangered or threatened species is present, a qualified biological monitor will be on site during all phases of project implementation.
- Vehicles and equipment should be turned off if periods between use are longer than 15 minutes.

Post Project Implementation

- Post-treatment monitoring will evaluate treatment effectiveness, potential re-infestations or new introductions, and impacts to resources (Section 11.0)
- Limit the number of people and trips to sensitive areas for follow-up treatments and/or monitoring.

8.2 Chemical Treatments

Project Planning

- The on-site Pesticide Applicator will develop a Spill Contingency Plan that meets the minimum requirements specified by the BIA to eliminate contamination of water or soil resources in the case of accidental spills.
- If using herbicide, notify NNEPA Pesticide Enforcement of project, including location, herbicides used, and treatment dates. Submit a Pesticide Use Proposal (PUP) for approval.
- If wellheads or source water areas are identified within the project area, notify NNEPA Public Water System Safety Program to determine protection zones for herbicide applications and alternative treatment methods to be used in the protection area.
- For aerial herbicide treatments, native vegetation communities in or near treatment sites should be documented with GPS, especially cottonwood-willow woodlands and native sagebrush communities.

Prior to Project Implementation

- All herbicides must be U.S. EPA approved and mixed and applied according to label instructions.
- Treatment sites will be closed according to label specifications when limiting exposure to humans, livestock, and pets is recommended.

During Project Implementation

- All herbicides will be used according to the U.S. EPA approved label.
- Certified Pesticide Applicators must be on site to supervise projects during herbicide treatments. Pesticide Applicators must be certified by the U.S. EPA for the Navajo Nation.
- Use dye markers with herbicides to identify the physical spray location on weeds.
- When herbicides are used, an emergency spill kit must be available to contain, absorb, and dispose of spill materials.
- Material Safety Data Sheets (MSDS) for herbicides and adjuvants must be accessible in the event of accidental exposure or spill.
- Avoid applying chemicals during times of high wind speeds, high temperature, and low humidity to prevent chemical drift to areas off site. Read the herbicide label for specific conditions.
- Use Water Quality Protection Zones (WQPZ) set by the NNEPA for mechanical treatments and broadcast herbicide treatments when using a vehicle in or near riparian and wetland areas. The WQPZ is at least 200 feet unless a greater buffer is needed for a listed species or if indicated on the herbicide label. Refer to the Water Quality Protection Guidelines for the Navajo Nation Forest (2000) and the Navajo Nation Aquatic Resource Protection Program Guidance (1994) on distance guidelines. Wells and wellheads will also require a 100-foot buffer based on the NNEPA PWSSP's Source Water-Wellhead Protection Guidance.
- *Near riparian areas,* only aquatic formulations of 2,4-D, glyphosate, triclopyr, and imazapyr will be used within 25 ft of the daily high-water mark. They must be applied using spot treatment methods in this zone.
- Herbicides that are practically non-toxic to fish and mollusks (White 2007) require a 25-foot (7.6 m) buffer from the daily high-water mark, including: aminopyralid, chlorsulfuron methyl, clopyralid, imazapic, and thifensulfuron-methyl. They must be applied using spot treatment methods in this zone.
- Native plant communities, such as cottonwood-willow woodlands and native sagebrush, require a 300-foot buffer during aerial herbicide treatments.
- Aerial herbicide treatments should use GPS monitoring to track their position, provide a record of where herbicide was applied, and ensure all applicable avoidance buffers are enforced.

- Non-aquatic approved and moderate to high aquatic toxicity herbicides (White 2007) require a 300-foot (91 m) buffer from the daily high-water mark.
- Only aquatic approved herbicides will be used for aerial applications by either fixed wing or rotary aircraft applications.
- Water for mixing herbicide and cleaning herbicide equipment will be potable water obtained off-site or through a Water Use Permit. For remote sites, there is a possibility of a Water Use Permit with the local water code. An anti-siphon and back flow preventer device are required to prevent contamination of the water source.
- Store equipment and materials away from riparian areas in safe and secure upland sites in close proximity of the project site. Herbicide containers and equipment must be stabilized with straw bales, filter cloth, or other appropriate means to prevent release into waterways or wetlands.
- Herbicides will be stored in a secondary containment storage unit with impermeable materials such as concrete or metal so leaks, and spills do not reach soils. Storage containers will be coordinated with BIA Safety Officer and Environmental Services.

Post Project Implementation

- Herbicide containers and application equipment will be triple rinsed at designated washing stations to minimize chemical residues left as per the MSDS and herbicide labels. Do not pour rinse water from empty containers or sprayer cleaning onto ground or any drainage system. Dispose as hazardous waste.
- Properly dispose of pesticide waste and containers according to federal, state, and tribal regulations.

8.3 Mechanical

Prior to Project Implementation

- If mechanical treatments increase the risk of erosion near waterways, erosion control measures will be implemented to stabilize and limit erosion.
- Establish and implement a burn plan if prescribed burning is used as a control method.
- Prescribed burning will not be conducted during migratory bird breeding season.

During Project Implementation

- Keep areas without vegetation wet to prevent fugitive dust. This can be accomplished with a sprayer mounted to a water truck.
- Use lightest/smallest off-road vehicle, utility vehicle, or tractors will be a priority for treatments. No such equipment will be used on wet soils or cryptobiotic soil crusts.
- No mechanical treatments within 200 feet of open water sources.

8.4 Cultural

During Project Implementation

- Projects using targeted grazing treatments will develop a grazing treatment plan for review by NNHP.
- Targeted grazing must use fencing around the perimeter of the treatment area to contain livestock.
- Use targeted grazing only in sites where weeds are palatable and non-toxic and where desired native species will not be damaged.
- After targeted grazing is implemented, livestock will be placed in a separate fenced location for 48 hours to collect animal waste. Animal waste will be burned to destroy plant parts and seeds.
- Targeted grazing will not exceed more than 10 days on a range and/or wildland project site or 365 days on a cropland site.
- Targeted grazing will not be used in areas where weed comprise less than 50% of total vegetative cover.
- Passive restoration is preferred when native vegetation comprises >75% of the treated area. If natural re-vegetation fails, then active restoration is necessary. Active restoration includes planting of native species poles, root stocks, and seeds.
- Reseeding will be timed with precipitation events and at least 7 days after herbicide treatments are completed. Reseed disturbed areas with native vegetation to minimize opportunities for weed establishment and soil erosion.
- Only native vegetation, certified weed-free and preferably locally sourced, will be used for restoration activities.

Post Project Implementation

- Livestock grazing will be deferred during the growing season or until seeding has established.

9.0 Weed Management Techniques

An integrated weed management approach uses a combination of treatment methods to control aggressive and adaptable weed species. No single control method or any 1-year treatment program will achieve effective control of any weed-infested area. The fast growth, extensive root system and high reproductive capacity of weeds requires long-term cooperative and integrated management programs and planning to contain and reduce weed populations on the Navajo Nation. Weed removal efforts should coordinate resources with adjacent agencies (e.g., NTUA, ADOT, BLM) who conduct weed treatments to maximize cost effectiveness of weed treatments.

Additionally, use of multiple, appropriately timed methods will increase the effectiveness of weed management projects while reducing the risk of harmful impacts. Mechanical and/or manual treatments followed by a chemical treatment is more effective than implementing each treatment by itself. Chemical treatments followed by seeding or planting native understory species, such as grasses, will help restore native plant diversity. Prior to noxious weed seed set, hand pulling is effective for small infestations followed with a mechanical or chemical treatment to ensure no target weeds germinate that year. Appropriate timing of weed control techniques is the most important factor to improve effectiveness. Most annual and biennial plants should be treated early in the season before the plants bolt and flowering occurs. In contrast, many perennials are effectively treated with systemic herbicides in the fall when plants actively transport nutrients to their root system. The methods described below are recommendations for treating noxious weeds based on techniques used in areas outside the Navajo Nation. Appendix E outlines the best option for control for each priority weed species.

Biological control agents will not eliminate an infestation; however, they will enhance control and reduce the rate of expansion of large existing infestations. Biological control is most effective on large populations where other control methods are limited due to the size and scale of the infestation. The use of herbicides in combination with biological control is successful on large populations of several weed species. A more detailed discussion of the proposed weed treatments for the Navajo Nation is discussed below. Comprehensive weed management methods for each target weed species can be found in USDA Forest Service Southwest Region Weed Field Guides (https://www.fs.usda.gov/detail/r3/forest-grasslandhealth/invasivespecies/?cid=stelprd3813522) and in the University of California, Davis Cooperative Extension and Agricultural Experiment Station (https://wric.ucdavis.edu/information/info_spec_weed.htm)

Treatment method selection should consider several factors. Local community engagement should identify public health concerns, economic impacts, cultural resources (such as plant collection areas), and community-based goals for removing the infestations. Impacts to natural resources such as sensitive plant and animal populations, soil erosion, and water quality, should also be evaluated. Projects should determine, based on the size, density, and the specific weed species, a reasonable level of treatment needed to reduce the population while minimizing impacts. For example, widespread but patchy clusters of yellow starthistle may be controlled with less intense treatments such as biological control or targeted grazing while dense isolated populations of Canada thistle may require more intensive mechanical removal followed by chemical treatments. Treatments should also prioritize the least harmful methods by selecting non-herbicide techniques where feasible and using the least toxic herbicide available for treating the targeted weed species (Appendix E) paired with other control methods to reduce the amount of herbicide needed to effectively reduce and minimize regrowth. These considerations ensure that projects address a wide array of concerns while maintaining treatment effectiveness through a multi-faceted and integrated management approach.

9.1 Prevention

Prevention is the most effective and least expensive method of control. Establishing a "weed-free" policy to include, but not limited to hay, grain, seed, and ballast, is crucial to reduce weed expansion and to prevent new weed introductions. A "weed-free" policy will require action by the Navajo Nation Tribal Council. Maintenance of a vigorous, competitive native plant community will also reduce noxious weed establishment.

Cleaning tires, boots, hooves, and equipment when leaving infested areas will prevent weed introductions and limit the spread of existing infestations. Extensive disturbance gives noxious weeds an advantage over native plants as most weeds are well adapted to disturbed areas. Revegetating large, disturbed sites with vigorous, hardy, native grass and perennial plants will prevent establishment of new noxious weed populations.

9.2 Early Detection/Rapid Response

The key to preventing new noxious weed introductions involves early detection and rapid response. The longer a species goes undetected during the early, non-invasive stage, the less opportunity there is to intervene. Once weeds are established, control or eradication methods become more expensive and limited in their effectiveness. Education programs on how to recognize noxious weeds may help community members detect infestations when they are still small. Community members can also use the BIA's planned weed program website to report new populations and assist with early detection efforts. Repeated surveys can detect new weed infestations in high priority areas, such as wildlife habitat, areas for collecting traditional plants, or riparian areas. After detecting a new noxious weed on the Navajo Nation, a treatment plan should be developed based on the growth characteristics of each species, size of the infestation, and the personnel and equipment capacity of the BIA. Early detection and rapid response is most successful when new infestations are less than 1 acre in size. Early detection and rapid response to new noxious weed infestations is a high priority.

Since roads and rights-of-way corridors are primary vectors for introducing and spreading weeds, early detection and rapid response in these areas is important. Surveys along roads and rights-of-way and adjacent land can identify new weed populations with the potential to spread. Once these populations are identified, early treatment to maintain linear corridors will prevent or reduce the potential for large scale infestations on adjacent lands.

Early detection and rapid response techniques will follow those established by the U.S. Forest Service in 2005 and the Arizona Invasive Species Advisory Council in the Arizona Invasive Species Management Plan in 2008. Scattered plants and spot infestations around the perimeter of the infestation should be treated first to contain the spread of the infestation. To limit seed dispersal, treatment of infestations along roads should be done at the same time as treatment around the infestation perimeter. Treatments should then move inward toward the core of the infestation. Treatments should be repeated until the seed bank is depleted. Treatments along linear corridors (roads and rights-of way) will be treated in a linear fashion in right-of-way easements. Linear corridors serve as both the core and/or the perimeter of the infestation and weed removal activities on adjacent infested areas should be done at the same time.

9.3 Manual Control

Photo courtesy of Fred Phillips Consulting.

Manual control techniques include the use of hand tools to cut, clear, or prune herbaceous or woody species. A maximum of 30 people (typically between 7-20 people) will conduct manual treatments. Manual treatments involve cutting undesirable plants above ground level; pulling, grubbing, or digging out root systems to prevent sprouting and regrowth; and removing competing plants around desired species. Manual control is conducted with hand tools, including handsaws, loppers, axes, shovels, rakes, machetes, grubbing hoes, mattocks (combination of cutting edge and grubbing hoe), Pulaskis (combination of axe and grubbing hoe), brush hooks, weed whackers, and hand clippers. Manual treatments, such as hand pulling and hoeing, are most effective where weeds are limited and soils allow for complete removal of the plant material, including the root system (Rees et al. 1996).

Annual and biennial plants with shallow root systems that do not re-sprout and plants growing in sandy or gravelly soils will be hand pulled. Vegetation removed manually will be bagged and sent to a certified incinerator to prevent reinfestation from seeds or other plant materials. Repeated treatments will be necessary as seeds remain in the ground for multiple years. Manual techniques are most effective for small areas (<1 acre), areas where burning or herbicide treatments are not appropriate, areas that may be inaccessible to ground vehicles, and in areas where species of concern exist. For the most effective control, manual techniques will be used in combination with chemical techniques.

9.4 Mechanical Control

Mechanical control involves the use of power tools and heavy machinery to remove noxious weeds. The techniques described are adapted from the Bureau of Land Management (BLM)'s Vegetation Treatments for 17 Western States (BLM 2007). These techniques are utilized when clearing large areas where weeds are widespread and provide dense coverage, often limiting the growth of native vegetation to very confined areas (**Figure 9-1**). Mechanical equipment should be cleaned before treatments and before leaving the treatment area in designated facilities or equipment wash stations (see 8.0 Mitigation Measures for specifications).

Figure 9-1. Examples of mechanical treatments. *Left*: Tractors grubbing root systems for large tamarisk stands. *Right*: A site cleared of invasive tamarisk using mechanical treatments. Photos courtesy of Fred Phillips Consulting, LLC.

- **Grubbing** - Grubbing removes a plant by digging out its root system. If a species has a shallow root system, a shovel or mower is used to remove the plant. Noxious weeds with deep root systems require the use of a crawler-type tractor and a brush or root rake attachment. Brush is uprooted and roots are combed from the soil by placing the base of the blade below the soil surface. Grubbing disturbs perennial grasses, so grubbed areas will be reseeded to prevent extensive runoff and erosion, if possible. This removal technique requires a maximum of 5 people to drive the heavy machinery and prepare the site. Grubbing will not be used in areas with active prairie dog colonies or in habitats with other burrowing animals.

- **Tillage** - Tilling involves the use of angled disks (disk tilling) or pointed metal-toothed implements (chisel plowing) to uproot, chop, and mulch vegetation. Tilling is done with either a brushland plow, a single axle with an arrangement of angle disks that covers about 10-foot swaths, or an offset disk plow, which consists of multiple rows of disk sets at different angles to each other. These plows are pulled by a crawler-type tractor or a large rubber tire tractor. This technique is best used where complete removal of vegetation or thinning is desired and is followed with seeding. Tilling leaves mulched vegetation near the soil surface, which encourages the growth of newly planted native seeds. This method is also used for removal of sagebrush and similar shrubs and works best on areas with smooth terrain, and deep, rock-free soils. Chisel plowing is used to break up compact soils. This removal technique requires a maximum of 5 people to drive the heavy machinery and prepare the site. Tillage will not be used in areas with active prairie dog colonies or in habitats with other burrowing animals.

- **Mowing -** Mowing tools, such as rotary mowers or straight-edged cutter bar mowers are used to cut herbaceous and woody vegetation, and is most effective on annual and biennial plants, above the ground surface. Power tools such as chainsaws and power brush saws are used for thick-stemmed plants. Mowing is done along highway ROWs to reduce fire hazards, improve visibility, prevent snow buildup, and/or improve the appearance of an area. Weeds are rarely killed by mowing, and an area often needs to be mowed repeatedly for treatments to be effective (Colorado Natural Area Programs 2000). The use of a "wet blade," in which an herbicide flows along the mower blade and is applied directly to the cut surface of the plant, has greatly improved the control of some species. Chipping equipment is used to cut and chip vegetation. This removal technique requires a maximum of 2 - 5 people to operate the chainsaws, power brush saws or Bobcat and to prepare the site. Heavy machinery (Bobcats) with a mowing attachment may require off-road use and have medium ground disturbance (**Figure 9-2**).

Figure 9-2. A Bobcat with a brush hog mower attachment removing noxious weeds. Photo courtesy of Fred Phillips Consulting, LLC.

- **Prescribed Fire** - The use of controlled burns, or prescribed fire, to treat noxious weeds is the intentional application of fire under specified conditions. Controlled burns can provide many benefits to an area by controlling vegetation, enhancing growth, reproduction, and vigor of desired vegetation, reducing fuel loads, and maintaining some vegetation communities. Pile burning is an effective method to reduce fuel loads after mechanical treatments. A Burn Plan must be developed for each project prior to implementing this technique. The Burn Plan may include but will not be limited to 1) project objectives; 2) prescription; 3) scheduling; 4) pre-burn considerations and weather; 5) site assessment and topography considerations; 6) organization and equipment; 7) communication; 8) public and personnel safety and medical information 9) smoke management plan; 10) ignition and holding plans; 11) contingency plan; 12) mop up plan, and 13) restoration plan. Prescribed fire will be followed by habitat restoration.

Photo courtesy of Fred Phillips Consult LLC

Prescribed fires will be used in areas where there is no threat to human life or property to maintain ecosystems that are functioning within a normal fire regime. Prescribed fires are evaluated for potential risks and implemented with adequate fire management personnel and equipment. Prescribed fires will follow the guidelines outlined in the BIA NRO Programmatic Pile Burn Agreement with the Navajo Nation and all permits and authorizations will be obtained prior to implementing this technique. Prescribed fires minimize soil disturbance and will not be conducted during the migratory bird breeding season.

- **Heavy Machinery**- Heavy machinery includes large chipping equipment or masticators, roller chopping tools, feller-bunchers, bulldozers, and extracting equipment and requires special training for operation. Bulldozers or extracting equipment is used to uproot dense woody vegetation or tree species. Large chippers, or "tub-grinders" and masticators, are used to chip the limbs, bark, and trunks of trees to generate mulch or biomass. Feller-bunchers are used to cut trees at the base, pick them up, and move them into a pile or onto the bed of a truck (Bonneville Power Administration [BPA] 2000). Rolling chopping tools are heavy bladed drums that cut and crush vegetation up to 5 inches in diameter with a rolling action. The drums are pulled by crawler-type tractors, farm tractors, or a special type of self-propelled vehicle designed for forest or range improvement projects. Blading uses a crawler-type tractor with a blade shear attachment to cut small brush at ground level and scrape topsoil with the brush to pile into windrows. Blading is only employed in areas where the degradation of the soil is acceptable, such as along ROWs or in borrow ditches. Heavy machinery highly disturbs soils. This technique requires a maximum of 5 people to operate the heavy machinery and prepare the site.

9.5 Cultural Control

Cultural treatments include targeted grazing, replanting native species (see Chapter 10), cultivation and crop rotation, using weed-free hay, and mulching around desired vegetation to limit competition with undesired plants. Targeted grazing uses specific livestock species at a determined season, duration, and intensity to accomplish defined vegetation or landscape goals (Daines 2006). Targeted grazing can be used around Community Development Areas, in agricultural fields, in riparian habitats, and in Highly Sensitive and Moderately Sensitive RCP Areas. However, it may not be used where sensitive species do occur because of the high degree of ground disturbance. All targeted grazing treatments conducted outside of Community Development Areas require a grazing treatment plan that must be reviewed by the Navajo Nation

Heritage Program (NNHP). Targeted grazing alone will not eradicate a weed population and must be used in combination with other methods as a long-term land management strategy (Daines 2006). Targeted grazing should aim to reduce growth and vigor of established weed populations, increasing the effectiveness of more direct removal and control methods. To successfully implement target grazing at a local level, public outreach and education, workshops, and training on identification, reporting, and monitoring weeds is necessary.

The key to success with targeted grazing is selecting the most appropriate animal to browse or graze the target weed species (**Table 9-1,** Daines 2006). Additionally, weeds must be consumed at the most appropriate life stage to be palatable to livestock and livestock should be specifically trained to consume weed species. Livestock will avoid plants that are novel, low in nutrients, or high in toxins (Daines 2006). Timing and intensity of targeted grazing should be designed to maximize damage to the target weed while minimizing impacts to native vegetation. Targeted grazing requires containing livestock in an isolated area with fencing for up to 24 hours after grazing treatments to isolate and collect defecated seed. Feces will be collected, bagged, and destroyed by incineration. A robust monitoring program is also required to understand the effectiveness of the targeted grazing treatment and should include the following metrics: livestock type, performance, and/or weight gain, consumption of vegetation (utilization and residue), and changes in vegetation structure (biomass, canopy cover or basal area, and plant density) (see11.1. Treatment Effectiveness Monitoring). Targeted grazing has limited effects on field brome, common Mediterranean grass, camelthorn, several annual brome grasses, and jointed goatgrass and is not recommended to control these species. The Society for Range Management maintains a website with research, management recommendations, and training on updated information (https://targetedgrazing.org/).

Table 9-1. Targeted grazing by weed species, livestock class, grazing objective, plant growth stage, and potential effectiveness (Daines 2006). Only the weed species listed in the table were reduced by targeted grazing treatments. Weeds not listed are not recommended for target grazing.

Target Weed	Livestock Class	Grazing Objective	Growth Stage for Treatment	Potential Effectiveness
Bull Thistle (*Cirsium vulgare*)	Sheep, Goats, and Cattle	Prevent seed production, reduce plant size and vigor	Graze heavily during rosette to bolting stage. Repeat grazing at approximately 2-week intervals. May need to graze once a season if in early flowering stage. 3 consecutive years needed.	Cattle will not graze beyond late bud stage. Grazing works best when combined with a fall herbicide treatment. Grazing reduced plant size, density, and reproductive efficiency.
Canada Thistle (*Cirsium arvense*)	Sheep, Goats, and Cattle	Begin grazing when rosettes are green and begin to sprout. Remove animals when grazing shifts to desirable species and re-graze new sprouts	Graze during seedling to late vegetative stage with regular removal of top growth throughout the season. Graze to prevent flowering. Repeat at least 3 years.	Goats will graze all stages. Sheep and cattle prefer when young before spines develop. Most effective with repeated treatments for multiple seasons to prevent seed production and prevent root reserves. Best results when combined with herbicide treatments.

Target Weed	Livestock Class	Grazing Objective	Growth Stage for Treatment	Potential Effectiveness
Cheatgrass (*Bromus tectorum*)	Sheep, Goats, and Cattle	Intense flash grazing to remove biomass, decrease plant density, and suppress flowering.	Graze when green, as early as possible, without harming desirable perennial plants. Repeat to prevent seed production. Minimum of 2 treatments per year for 2 or more years to suppress populations.	Heavy repeated grazing for 2 or more years will reduce plant density, size and seed production. Grazing must be closely monitored to avoid damage to desirable perennial plant species. Can be used in conjunction with mechanical, herbicides, and controlled burn.
Diffuse knapweed (*Centaurea diffusa*)	Sheep, Goats, Cattle	Graze heavily at least twice each year for three or more years.	Sheep - rosette or bolted stage. Goats - all growth stages Cattle - before bolting stage	Reduce plant vigor, size, and flower production. Remove livestock for about 2 weeks and re-graze to prevent seed head formation. Grazing most effective when combined with herbicide treatments.
Leafy Spurge (*Euphorbia esula*)	Sheep and Goats	Remove 95% of top growth; graze regrowth after 1st treatment; prevent flowering and seed production	Graze in vegetative to flowering stage. Sheep - prefer young plants Goats - eat all growth stages	Effective at reducing biomass on an annual basis when grazed moderate to heavy from vegetative to flowering growth stages. Grazing effectiveness can be low 1st year. Suppression of high-density infestations will occur after 4 or more consecutive years of grazing. Used in combination with herbicides and biological control may be an effective strategy for long-term management.
Musk Thistle (*Carduus nutans*)	Sheep, Goats, Cattle	Prevent seed production, reduce plant size and vigor.	Graze heavily during the rosette to bolting stage. Repeat grazing at two-week intervals to prevent flowering and seed production. May need to graze once a season if in early flowering stage and site conditions limit regrowth. Graze at least 3 consecutive years.	Grazing reduces plant size, density, and reproductive efficiency. Cattle will not graze beyond early bud stage. Works best when combined with fall herbicide treatment.
Perennial Pepperweed (*Lepidium latifolium*)	Sheep and Goats	Remove 85% of top growth with repeated grazing (every 3-4 weeks)	Graze until early flowering stage, with preference for early vegetative stages. Repeat grazing for several years is necessary.	Repeat, intensive grazing can reduce biomass, density, and height in single season, but root system replenishes infestation. Grazing must be continued for several years. Can be combined with herbicide spraying.

Target Weed	Livestock Class	Grazing Objective	Growth Stage for Treatment	Potential Effectiveness
Russian Knapweed (*Acroptilon repens*)	Sheep (particularly dry ewes) and goats	Removal of 80% biomass	Early vegetative to flowering. Graze at least 3 times per season, allowing 8-10 in. of regrowth between treatments. 3 or more years necessary.	Graze repeatedly multiple times each season for several years. May result in reduced biomass and density of plants but may return to pre-gazing density when grazing ceases. Long-term management requires integrated program with herbicides and competitive planting.
Saltcedar (*Tamarix ramosissima*) **Russian olive** (*Elaeagnus angustifolia*)	Goats	Severe defoliation to deplete root reserves and prevent establishment of new plants	Prefer young shoots but will browse 4-year-old shoots. Repeated browsing is needed to limit resprouting and remove new seedlings.	Browsing is effective to reduce size and density of trees and eliminate from specific sites. Goats must consume most or all resprouts and seedlings for at least 3-5 years. Maintain native perennial grass understory to prevent seedling establishment for long-term management.
Scotch Thistle (*Onopordum acanthium*)	Sheep, Goats, Cattle	Prevention of flowering and reduction of stem density.	Graze at the rosette to bolting stage. Heavy to severe utilization, using short-duration, high-intensity grazing provides the best results when repeated for several years to deplete seedbank.	Grazing is effective at suppressing flowering and reducing stem density 30 to 50%. Several years may be needed to reduce populations. Native perennial grass competition is essential. Effective when used in combination with follow-up herbicide treatment.
Spotted Knapweed (*Centaurea maculosa*)	Sheep and Goats	Graze to prevent seed production and reduce biomass.	Graze heavily during the rosette or bolting stage. Two grazing periods per year during rosette to bolting and bud stages provide best control.	Grazing can reduce plant vigor, density, size, flower stems, and seed production. Sheep digestive systems may suffer if diets are composed of >70% knapweed. Most effective when combined with herbicide treatments.
Tall Whitetop (*Cardaria draba*)	Sheep and Goats	Prevent flowering and maintain removal of 85% of top growth during growing season.	Graze before flowering. Repeat at least 2 times a year for at least 3 years.	Repeated grazing may reduce plant vigor and flower production.
Yellow Starthistle (*Centaurea solstitialis*)	Sheep, Goats, and Cattle	Graze heavily at least twice a year to prevent flowering and for several years to deplete seedbank and reduce plant density.	Sheep and goats will graze at all growth stages. Cattle will graze in the rosette to bolting stage. 2-3 treatments are needed if grazed in rosette or bolting stage, goats grazing during or after flowering may require 1 year.	Goats are most effective. Grazing reduces plant vigor and plant size and suppresses flower production. Graze twice a year over several years to prevent flower and seed production.

9.6 Biological Control

Biological control agents are U.S. Department of Agriculture (USDA)-approved insects and pathogens that undergo rigorous testing prior to availability for release. Initial testing occurs in quarantined laboratories to determine their effectiveness in controlling the target organism and host specificity. Testing includes potential effects on economic crops, rare plants, and similar species found in North America. An agent is approved for release only after it is determined that it is unlikely to feed or cause injury to any native or agricultural species. It generally takes between 15-20 years for an agent to be cleared for release. Prior to the release of a new agent, an environmental analysis is prepared by USDA APHIS (Agricultural Plant Health Inspection Service). The analysis assumes that agents will spread throughout North America following release. The BIA is using only those biological agents approved by APHIS as listed in **Table 9-2**.

The BIA will not consider the release of the tamarisk leaf beetle (*Diorhabda carniulata*). This species was released near Moab, Utah in 2004 along the Colorado River with the expectation that it could not migrate below the 38º N latitude. However, the beetles moved and infiltrated sites south of the 38º N latitude, migrating down the Colorado River past Lake Mead. This unexpected migration decimated the nesting habitat of the endangered Southwestern Willow Flycatcher, which has affected the reproductive success of this species. The leaf beetle occurs in riparian areas across the Navajo Nation. The BIA NRO monitors the leaf beetle to document its extent and impact on the Navajo Nation.

Table 9-2. Target noxious weeds and proposed biological control agents.

Target Weed Common Name	Proposed Control Agents by Scientific Name	Proposed Control Agents by Common Name
Dalmatian toadflax	*Brachypterolus pulicarius* *Calophasia lunula* *Eteobalea intermediella* *Eteobalea serratella* *Mecinus janthinus* *Gymnetron antirrhini* *Gymnetron linariae*	Flower feeding beetle Toadflax moth Root-boring moth Root-boring moth Stem-mining weevil Seed capsule weevil Root-galling weevil
Diffuse knapweed	*Bangasternus fausti* *Bangasternus orientalis* *Cyphocleonus achates* *Larinus minutus*	Seed head feeding weevil Seed head feeding weevil Root feeding weevil Seed head feeding weevil
Field bindweed	*Aceria malherbae* *Tyta luctuosa*	Bindweed gall mite Bindweed moth
Leafy spurge	*Aphthona abdominalis* *Aphthona cyparissiae* *Aphthona czwalinae* *Aphthona flava* *Aphthona lacertosa* *Aphthona nigriscutis*	Minute flea beetle Brown dot flea beetle Black flea beetle Copper flea beetle Brown-legged flea beetle Black dot flea beetle
Puncturevine	*Microlarinus lypriformis*	Puncturevine seed feeding weevil
Russian knapweed	*Subanguina picridis* *Jaapiella ivannikovi* *Urophora kasachstanica* *Urophora xanthippe*	Nematode Diptera: Cecidomyiidae Flower gall fly Flower gall fly
Spotted knapweed	*Bangasternus fausti* *Bangasternus orientalis* *Cyphocleonus achates* *Larinus minutus* *Larinus obtusus*	Seed head feeding weevil Seed head feeding weevil Root feeding weevil Seed head feeding weevil Seed head feeding weevil

Target Weed Common Name	Proposed Control Agents by Scientific Name	Proposed Control Agents by Common Name
Yellow starthistle	*Eustenopus villosus* *Bangasternus orientalis* *Chaetorellia australis* *Urophora sirunaseva*	Starthistle hairy weevil Starthistle bud weevil Starthistle peacock fly Starthistle gall fly

The BIA and Cooperating Agencies will consult with Navajo Nation Department of Fish and Wildlife (NNDFW) on a project-by-project basis to approve the use of biological control agents. Also, prior to the release of any biological control agent, the BIA will obtain a permit from APHIS. The Coconino, Kaibab, and Prescott National Forests and the City of Flagstaff have conducted biological control treatments near the Navajo Nation for Dalmatian toadflax, diffuse and spotted knapweed, yellow starthistle, and leafy spurge (Dewey Murray, personal communication 2013). The greatest success has occurred with biological controls released to control diffuse knapweed.

9.7 Chemical Control

Chemical methods include the use of herbicides to control noxious weeds. Herbicides are categorized as selective or non-selective. Selective herbicides kill only a specific type of plant. For example, a selective herbicide for broad-leaved plants will not affect grasses. Non-selective herbicides will kill all vegetation that it contacts. Therefore, it is important not to spray desirable vegetation when using non-selective herbicides. The herbicides for use on the Navajo Nation are listed in **Table 9-3**.

Photo courtesy of Fred Phillips Consulting.

There are several herbicide application methods. The method chosen for a particular project site may depend on the size of the infestation, the species present, accessibility to the site, topography, resources and equipment available, and finances. All herbicides will be used according to their labels and a Navajo Nation Certified Pesticide Applicator must be on site. Water for mixing herbicide and cleaning herbicide equipment will be potable water obtained off-site or through a Water Use Permit. For remote sites, a Water Use Permit may be obtained with the local water code. An anti-siphon and back flow preventer device are required to prevent contamination of the water source. Up to 30 people are needed to implement chemical treatments. Some herbicide application methods are described below.

- **Cut Stump** - This method uses both chemical and mechanical/manual techniques and is effective on tree species that sparsely populate an area or in areas where heavy machinery is not an option. The plant is cut as close to the ground as possible using a chainsaw or loppers. The cut stump is then immediately (within 15 minutes) sprayed or painted with a systemic herbicide to prevent vigorous resprouting. It is important to cover the entire cut stump with herbicide. For the most effective and safe treatment, skilled sawyers are recommended.

- **Basal Bark** - Basal bark spraying is most effective on dormant and leafless woody plants with less than a 6-inch stem diameter. This method involves spraying the bottom 12-18 inches of a stem with herbicide. Care is taken to apply herbicide around the entire stem. The herbicide is mixed with a penetrating oil that allows it to pass through the bark. This method results in a dead standing snag.
- **Frill or "Hack and Squirt"**- This method involves making spaced cuts around the entire tree trunk with an ax, machete, or hatchet. It is important that the cut penetrates to the cambium layer. Herbicide is then applied to the cuts using a spray bottle or similar tool.
- **Foliar spray** – Foliar sprays are most effective when plants are in full leaf. Foliar spray is applied using a backpack sprayer, spray bottle, a boom or boomless sprayer mounted on an ATV or truck, fixed-wing airplane or helicopter to distribute over a large area.
- **Pelletized Treatment**- Herbicides made into small pellets can be buried around the plant's base.
- **Pre-Emergent Treatment**- This treatment method involves applying herbicide to the soil before the target noxious weed species germinates or emerges.

Herbicide applications require certain precautions and protocols. U.S. Environmental Protection Agency (U.S. EPA) categorizes pesticides as either "unclassified" or "restricted use." A pesticide, or some of its uses, can be classified as restricted if it causes harm to humans (pesticide handlers or other persons) or to the environment. Herbicide applications will comply with the Navajo Nation Pesticide Act as enforced by the Navajo Nation Environmental Protection Agency, which includes annual reporting on projects that use herbicide treatments and proper disposal of unused herbicide. Herbicides must be applied by applicators with a state applicators license and a U.S. EPA Certified Pesticide applicator card for the Navajo Nation. The U.S. EPA Certified Pesticide applicator card can be obtained through the U.S. EPA Region 9 Pacific Southwest Office.

Near riparian areas, only aquatic formulations of 2,4-D, glyphosate, triclopyr, and imazapyr can be used within 25 ft of the daily high-water mark. Herbicides that are practically non-toxic to fish and mollusks (White 2007) require a 25 ft (7.6 m) buffer from the daily high-water mark, including: aminopyralid, chlorsulfuron, clopyralid, imazapic, and thifensulfuron-methyl. Imazapic and imazapyr have no risk to aquatic invertebrates and fish even if there is an accidental direct spray or spill to the aquatic habitat (BLM 2007). Non-aquatic approved and moderate to high aquatic toxicity herbicides (White 2007) require a 300 ft (91 m) buffer from the daily high-water mark. Only aquatic herbicides will be used for aerial applications by either fixed wing or rotary aircraft within riparian areas.

When applying herbicides, weather conditions such as wind speed, wind direction, inversions, humidity, and precipitation should be taken into consideration. Herbicides should always be used as directed on their labels. Caution is required to prevent overspray on non-target species. Extreme caution is used when mixing herbicides. Dermal exposure to a small amount of a concentrated herbicide is equivalent to the exposure received after a full day of working in a treated field. Herbicides are applied using the proper equipment and applicators are required to use personal protective equipment. Application rates for each herbicide are in **Table 9-4.**

Use of herbicides can include concerns about human health, ecological risks, and potential impacts to native plants and animals. Projects using herbicides should always be paired with other treatment methods to (1) improve their effectiveness and (2) reduce the potential for harmful impacts. If more than one herbicide can be used for a project, treatments should prioritize the herbicide with the lowest toxicity. Herbicides are listed by toxicity in Appendix E.

Table 9-3. Herbicides approved for use on the Navajo Nation based on priority treatment areas. * Indicates a Restricted Use Pesticide.

Herbicide	Herbicide Characteristics and Target Vegetation	Riparian	Rangeland	Agricultural Lands	Right-of-Ways	Roadsides	Residence/ Communities
2,4-D	Selective herbicide used to control broadleaf weeds by interfering with plant metabolism. It is moderately to highly mobile in the soil, which restricts its use in and around high ground water tables or open water. Key species include biennial thistles, Canada thistle, diffuse knapweed, leafy spurge, blue mustard, perennial pepperweed, Russian knapweed, squarrose knapweed, sulfur cinquefoil, Dalmatian toadflax, whitetop, halogeton, puncturvine, spreading wallflower, horehound, California burclover, Russian thistle, and yellow starthistles.	X	X	X	X	X	X
Aminopyralid	Selective herbicide used for broadleaf weed control. It is relatively immobile in the soil and remains in upper 12" of soil profile. Target weeds include yellow starthistle, squarrose knapweed, bull thistle, Canada thistle, musk thistle, scotch thistle, spotted knapweed, whitetop, sulfur cinquefoil, diffuse knapweed, Russian knapweed, and Russian olive.	X	X	X	X	X	X
Atrazine*	Selective herbicide that controls pre- and post- emergence broadleaf and grassy weeds. It is mostly absorbed through the roots inhibiting photosynthesis. Atrazine degrades in soil primarily by action of microbes. It is common chemical contaminant in ground and surface water. Key species include red brome and kochia.		X	X			
Chlorsulfuron	Registered for general use to control many broadleaf weeds and some annual grasses. This herbicide inhibits enzyme activity. Chlorsulfuron tends to leach into soils with a textural range from sand to silt loam and degrades more rapidly at higher temperatures with adequate moisture contents. It is broken down to smaller compounds by soil microorganisms. Chlorsulfuron may be used to treat blue mustard, Dalmatian toadflax, perennial pepperweed, puncturevine, Russian thistle, kochia and thistles.		X	X	X	X	X
Clopyralid	Selective post-emergence herbicide controlling broadleaf species. This herbicide affects the target weed by mimicking the plant hormone auxin and causes uncontrolled plant growth and eventual death. Once applied to the ground, it rapidly disassociates, which results in having a high potential to contaminate ground or surface water. It is used to treat biennial thistles, Canada thistle, perennial pepperweed, diffuse knapweed, Russian knapweed, squarrose knapweed, and yellow starthistle.		X	X	X	X	
Dichlobenil	Selective weed control of annual grassy and broad-leafed weeds and certain perennial weeds. It is water soluable and moves slowly in the soil. Can be used to treat leafy spurge, biennial thistles, Canada thistle, perennial pepperweed, Russian knapweed, field bindweed, and kochia.			X	X	X	X
Fluroxypyr	A pyridinoxy acid herbicide used to control annual and perennial broadleaf weeds and woody brush. Potential to leach to groundwater is high and potential for loss on eroded soil is low. Plants take up through leaves and roots and translocated to other plant parts. Target weeds include kochia and knapweeds.		X		X	X	

Herbicide	Herbicide Characteristics and Target Vegetation	Riparian	Rangeland	Agricultural Lands	Right-of-Ways	Roadsides	Residence/ Communities
Fluazifop-P-butyl	Selective herbicide for post-emergence control of annual and perennial grass weeds. Breaks down rapidly in moist soils. It is actively taken up by plants and translocated throughout the plant where it interferes with plant cell's ability to produce energy. Target weeds include: fountaingrass, common Mediterranean grass, and red brome.			X	X	X	
Glyphosate	Broad-spectrum, nonselective herbicide used for control of annual and perennial plants including grasses, sedges, broadleaf weeds, and woody plants. Method of action is to inhibit amino acid and protein synthesis. It is moderately persistent in the soil. Glyphosate is strongly absorbed in most soils and normally does not leach out of the profile. Glyphosate is successful in controlling annual, biennial, and perennial grasses, broadleaf weeds, and woody shrubs and trees.	X	X	X	X	X	X
Imazapic	Selective herbicide for both pre- and post-emergent control of some annual and perennial grasses and broadleaf weeds. It affects plants by inhibiting the production of amino acids that ultimately reduces cell growth. It is considered moderately persistent in soils. Effective in control of biennial thistles, Canada thistle, leafy spurge, Dalmatian toadflax, perennial pepperweed, whitetop, halogeton, jointed goatgrass, red brome, and cheatgrass.		X	X	X	X	X
Imazapyr	Broad-spectrum herbicide that is applied pre- or post-emergence. Absorbed by the leaves and roots and moves rapidly through the plant. It has a strong affinity to bind to soils and rarely moves beyond the top few inches. Low potential for leaching to ground water but may reach surface water during storm events over recently treated land. Imazapyr is effective on African rue, Tree of Heaven, Fountaingrass, yellow starthistle, perennial pepperweed, whitetop, Uruguayan pampas grass, common Mediterranean grass, saltcedar, Siberian elm, camelthorn, Russian knapweed, and Russian olive.		X		X	X	
Indaziflam	Pre-emergent and broad-spectrum control of weed seedlings. It inhibits development and cellulose biosynthesis in roots. It is moderately persistent in soils and does have the potential to contaminate surface water through runoff. Target weed species include: cheatgrass, red brome, bald brome, rescuegrass, ripgut brome, smooth brome, dalmatian toadflax, Halogeton, musk thistle, Canada thistle, Russian thistle, yellow starthistle, puncturevine, jointed goatgrass, California burclover, diffuse knapweed, and kochia.		X		X	X	
Isoxaben	Used for pre-emergence control of broadleaf weeds. It is absorbed through the roots and inhibits cellulose biosynthesis in the cell walls. It is moderately persistent in soil and potential for ground and surface water contamination is low. Target weed species include: kochia, mustards, Russian thistle, and leafy spurge.			X	X	X	

Herbicide	Herbicide Characteristics and Target Vegetation	Riparian	Rangeland	Agricultural Lands	Right-of-Ways	Roadsides	Residence/ Communities
Metsulfuron methyl	Control brush and certain unwanted woody plants, annual and perennial broadleaf weeds, and annual grassy plants. Affects plants by inhibiting cell division in the roots and shoots, thereby stopping growth. It dissolves easily in water and can leach through the soil to contaminate ground water but confined to soils that are either sandy or porous. It can control biennial thistles, Canada thistle, Russian knapweed, African rue, yellow starthistle, blue mustard, perennial pepperweed, halogeton, camelthorn, horehound and whitetop.		X	X	X	X	
Metribuzin	Selective herbicide that inhibits photosynthesis. It controls annual grasses and broadleaf weeds. Highly soluble in water and low tendency to adsorb to most soils. Target weeds include field brome, field sandbur, Johnson grass, puncturevine, bromes, Russian thistle, and kochia.			X			
Paraquat*	Non-selective herbicide that destroys green plant tissue on contact and by translocation within the plant. It is a "Restricted Use" herbicide. Quickly adsorbed by soil particles and is long-lived in soil. Target species include field sandbur.		X	X	X	X	X
Pendimethalin	Selective herbicide used to control most annual grasses and certain broadleaf weeds. It can be used on both pre- and post-emergence weeds. Adsorbs strongly to soil organic matter and clay and does not leach through soil to contaminate ground water. It is used to control puncturevine and kochia.			X	X	X	
Picloram*	A "Restricted Use" herbicide due to its mobility in water combined with the sensitivity of many crops that can be damaged with use. It interferes with the weed's ability to make proteins and nucleic acids. It dissolves easily in water. This herbicide controls biennial thistles, Canada thistle, knapweeds, Dalmatian toadflax, camelthorn, Russian thistle, leafy spurge, Russian knapweed, Scotch thistle, whitetop, and yellow starthistle.		X	X	X	X	
Prodiamine	A selective, pre-emergent herbicide for the control of broadleaf weeds and grasses by inhibiting plant growth. Used for control of kochia, rescuegrass, and Johnsongrass				X	X	X
Thifensulfuron methyl	This is a broad spectrum, post-emergent herbicide for control of broadleaf weeds. Absorbed through foliage of plants to inhibit growth. This herbicide controls spreading wallflower, kochia, and Russian thistle.		X	X	X	X	
Triclopyr	Works by disrupting plant growth. It is absorbed by green bark, leaves, and roots and moves to the meristem of the plant. It has a moderate to low solubility in water and normally binds to clay and organic matter, so it has a slight potential to contaminate ground water. Triclopyr is effective in treatment of yellow starthistle, squarrose knapweed, perennial pepperweed, spotted knapweed, diffuse knapweed, horehound, tamarisk, tree of Heaven, Russian olive, and Siberian elm.	X	X	X	X	X	X

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Table 9-4. Herbicides and recommended application concentrations per acre for priority weed species. Rates listed are general according to label instructions, the USFS Field Guide for Managing Weed Species in the Southwest; Montana, Utah and Wyoming Cooperative Extension Service Weed Management Handbook; and Lake Mead Exotic Plant Management Plan. Herbicides should be applied according to the label instructions by certified pesticide applicators. *Indicates a restricted use pesticide.

Category A - HIGH																		
Noxious Weed		**2,4-D**					**Aminopyralid**			**Atrazine***	**Chlorsulfuron methyl**		**Clopyralid**		**Dichlobenil**		**Fluroxpyr**	**Fluazifop-P-butyl**
Common Name	**Scientific Name**	Various	Grazon P+D (+picloram)	Curtail: (+clopyralid)	GrazonNext (+aminopyralid)	Crossbow (+triclopyr)	Milestone	Chaparral (+metsulfuron)	Milestone + Garlon 4	Aatrex	Telar XP	Cimmaron Plus (+metasulfuron)	Transline	Reclaim	Redeem (+triclopyr)	Casoron	Vista	Fusilade 2000, Fusilade DX
African rue[1]	*Peganum harmala*																	
Blue mustard[3]	*Chorispora tenella* (Pall.) DC.	½ - ¾ pt for 4 lb/gal product									0.125 oz							
Bull thistle[1]	*Cirsium vulgare*		1 - 2 pt	1 - 2 qt	2 pt		3-5 oz						0.33-1.3 pt	0.33-1.3 pt	1.5 - 2 pt	0.92 - 3.84 qt		
Camelthorn[1]	*Alhagi camelorum*												1- 1/3 pt	1- 1/3 pt				
Canada thistle[1]	*Cirsium arvense*	2 qt (based on 1 qt of 4 lb per gal)		6 pints			5-7 oz						0.67-1.3 pt	0.67-1.3 pt	2.5-4 pt	0.92 - 3.84 qt		
Common Mediterranean grass	*Schismus barbatus*																	1-1.5 pt plants;8 oz for seedlings
Dalmatian toadflax[1]	*Linaria dalmatica*										2-2.6 oz							
Fountain grass[1]	*Pennisetum setaceum*																	1-1.5 pt
Leafy spurge[1]	*Euphorbia esula*		2 qts													0.92 - 3.84 qt		
Musk thistle[1]	*Carduus nutans*		2 - 4 pt	1 - qt	1.5 - 2 pt		3-5 oz						0.33-1.3 pt	0.33-1.3 pt	1.5 - 2 pt	0.92 - 3.84 qt		
Perennial pepperweed[1]	*Lepidum latifolium*	1-2 lbs/ac									1-2 oz					0.92 - 3.84 qt		
Ravenna grass[2]	*Saccharum ravennae*																	
Sahara mustard[4]	*Brassica tournefortii*	3-6 pt					¼ to 1/3 pint	2.5-3.3 oz					2-3 qts					
Squarrose knapweed[1]	*Centaurea virgata*	1-2 qt	2-3 qt	4 pt			5-7 oz						⅔- 1 pt	⅓- 1 ⅓ pt	2 pt		8 oz	
Scotch thistle[1]	*Onopordum acanthium*		2 - 4 pt	1 - 2 qt	2 - 2.6 pt		5-7 oz						0.33-1.3 pt	0.33-1.3 pt	1.5 - 2 pt	0.92 - 3.84 qt		
Spotted knapweed[1]	*Centaurea maculosa*	1 - 2 qt	2 - 3 qt	4 pt			5-7 oz						⅔- 1 pt	⅓- 1 ⅓ pt	2 pt		8 oz	
Sulphur cinquefoil[3]	*Potentilla rect L.*		2-4 pt				4-6 oz											
Tall whitetop[1]	*Cardaria draba*							2.5 - 3.33 oz			1 oz	1.25 oz						
Tamarisk, other	*Tamarix* spp., including hybrids																	
Tree-of-Heaven[1]	*Ailantus altissima*																	
Uruguayan pampas grass[6]	*Cortaderia sellonana*																	
Yellow nutsedge[3]	*Cyperus esculentus*																	
Yellow starthistle[1]	*Centaurea solstitialis*	1 qt	2 qt (1:4 mixture)	0.25 - 1 pt			3-5 oz						0.25-0.67 pt	0.25-0.67 pt				

Category A - HIGH																			
Noxious Weed		**Glyphosate**		**Imazapic**		**Imazapyr**			**Indaziflam**		**Isoxaben**	**Metsulfuron methyl**	**Metribuzin**	**Paraquat***	**Pendimethalin**	**Picloram***	**Prodiamine**	**Thifensulfuron-methyl**	**Triclopyr**
Common Name	**Scientific Name**	Rodeo	Round Up	Plateau	Journey (+ Glyphosate)	Arsenal	Arsenal + Rodeo	Chopper	Rejuvra	Esplanade 200 SC	Gallery	Ally, Allie, Gropper, Escort	Sencor	Gramoxone	Pendulum	Tordon 22K	Evade	Volta	Garlon
African rue[1]	*Peganum harmala*					3 pt						3.2 - 6.4 oz							
Blue mustard[3]	*Chorispora tenella* (Pall.) DC.	1.5 pt	11-12 oz									0.125 oz							
Bull thistle[1]	*Cirsium vulgare*			8-12 oz												0.5-2 pt			
Camelthorn[1]	*Alhagi camelorum*					0.75-1.5 qt						1-3 oz				2 qt			
Canada thistle[1]	*Cirsium arvense*								3.5 – 7 oz	3.5 – 7 oz						1 qt			
Common Mediterranean grass	*Schismus barbatus*	1-3 pt						2-3 pt											
Dalmatian toadflax[1]	*Linaria dalmatica*			8-12 oz + 1 qt MSO					3.5 – 7 oz	3.5 – 7 oz						1-2 qt			
Fountain grass[1]	*Pennisetum setaceum*	0.5-1 pt						2-3 pt											
Leafy spurge[1]	*Euphorbia esula*	1 qt	1 qt	8-12 oz + 1.5-2 pt MSO												1-2 qt			
Musk thistle[1]	*Carduus nutans*			8-12 oz					3.5 – 7 oz	3.5 – 7 oz						0.5-2 pt			
Perennial pepperweed[1]	*Lepidum latifolium*	3 qt	1 gal	12 oz				2-3 pt				0.75-1 oz							3 qts
Ravenna grass[2]	*Saccharum ravennae*	5% soln																	
Sahara mustard[4]	*Brassica tournefortii*											0.5-1.0 oz							3 qts
Scotch thistle[1]	*Onopordum acanthium*			8-12 oz												0.5-2 pt			
Spotted knapweed[1]	*Centaurea maculosa*															1-2 pt			
Squarrose knapweed[1]	*Centaurea virgata*															1-2 pt			
Sulphur cinquefoil[3]	*Potentilla rect L.*															1 pt			
Tall whitetop[1]	*Cardaria draba*	3 qt	4 qt	12 oz				2-3 pt				0.75-1 oz							
Tamarisk, Saltcedar[1]	*Tamarix* spp., including hybrids					2 qts	1.5 qt + 1.5 qt												
Tree-of-Heaven[1]	*Ailantus altissima*	2 -5 qt				1-1.5 pt		2-3 pt											3-6 qts
Uruguayan pampas grass[6]	*Cortaderia sellonana*	0.5-1 pt						2-3 pt											
Yellow nutsedge[3]	*Cyperus esculentus*	1-5 qt																	
Yellow starthistle[1]	*Centaurea solstitialis*	4.5-7.5 pt	1.5-4 qt			1 pt			3.5 – oz	3.5 -7 oz		1 oz				1-1.5 pt			3 pts

Category B - MEDIUM

Noxious Weed		2,4-D					Aminopyralid			Atrazine*	Chlorsulfuron methyl		Clopyralid		Dichlobenil		Fluroxypyr	Fluazifop-P-butyl
Common Name	**Scientific Name**	Various	Grazon P+D (+picloram)	Curtail: (+clopyralid)	GrazonNext (+aminopyralid)	Crossbow (+triclopyr)	Milestone	Chaparral (+metsulfuron)	Milestone + Garlon 4	Aatrex	Telar XP	Cimmaron Plus (+metasulfuron)	Transline	Reclaim	Redeem (+triclopyr)	Casoron	Vista	Fusilade 2000, Fusilade DX
Diffuse knapweed[1]	*Centaurea diffusa*	1 - 2 qt	2 - 3 qt	4 pt			5-7 oz						⅔- 1 pt	⅓- 1 ⅓ pt	2 pt		8 oz	
Halogeton[3]	*Halogeton glomeratus*	2 - 2.7 qt																
Johnsongrass[3]	*Sorghum halepense*																	
Russian knapweed[1]	*Acroptilon repens*			1-2 qt			4-6 oz						1- 1 ⅓ pt	1- 1 ⅓ pt		0.92 - 3.84 qt		
Russian olive[1]	*Elaeagnus angustifolia*					2 gal			7 oz + 2 qt									
Siberian elm[1]	*Ulmus pumila*																	
Tamarisk, Saltcedar[1]	*Tamarix ramosissima*																	

Category B – MEDIUM

Noxious Weed		Glyphosate		Imazapic		Imazapyr			Indaziflam		Isoxaben	Metsulfuron methyl	Metribuzin	Paraquat*	Pendimethalin	Picloram*	Prodiamine	Thifensulfuron-methyl	Triclopyr
Common Name	**Scientific Name**	Rodeo	Round Up	Plateau	Journey (+ Glyphosate)	Arsenal	Arsenal + Rodeo	Chopper	Rejuvra	Esplanade 2000	Gallery	Ally, Allie, Gropper, Escort	Sencor	Gramoxone	Pendulum	Tordon 22K	Evade	Volta	Garlon
Diffuse knapweed[1]	*Centaurea diffusa*								3.5 – 7 oz	3.5 -7 oz						1-2 pt			
Halogeton[3]	*Halogeton glomeratus*			4-12 oz					3.5 – 7 oz	3.5 – 7 oz		0.5-1 oz							
Johnsongrass[3]	*Sorghum halepense*												0.5 lb				1		
Russian knapweed[1]	*Acroptilon repens*	3-7.5 pt	4-4.8 qt			2 pt										1-2 qt			
Russian olive[1]	*Elaeagnus angustifolia*	1-5 qt	1.5-3.3 qt			2.4 pt	1.5 qt + 1.5 qt												1-3 qt
Siberian elm[1]	*Ulmus pumila*	3-7.5 pt	1.5-3.3 qt			1-1.5 pt		2-3 pt											3-6 qt
Tamarisk, Saltcedar[1]	*Tamarix ramosissima*					2 qt	1.5 qt + 1.5 qt												

Category C - LOW

Noxious Weed		2,4-D					Aminopyralid			Atrazine*	Chlorsulfuron methyl		Clopyralid		Dichlobenil		Fluroxypyr	Fluazifop-P-butyl
Common Name	**Scientific Name**	Various	Grazon P+D (+picloram)	Curtail: (+clopyralid)	GrazonNext (+aminopyralid)	Crossbow (+triclopyr)	Milestone	Chaparral (+metsulfuron)	Milestone + Garlon 4	Aatrex	Telar XP	Cimmaron Plus (+metasulfuron)	Transline	Reclaim	Redeem (+triclopyr)	Casoron	Vista	Fusilade 2000, Fusilade DX
Bald brome[3]	*Bromus racemosus*																	
California burclover[4]	*Medicago polymorpha*	0.67-4 pt																
Cheatgrass[1]	*Bromus tectorum*																	
Field bindweed[3]	*Convolvulus arvensis*		2-4 pt													0.92 - 3.84 qt		
Field brome	*Bromus arvensis*																	
Horehound[5]	*Marrubium vulgare*	1-4 pt																

Category C - LOW

Noxious Weed		2,4-D					Aminopyralid			Atrazine*	Chlorsulfuron methyl		Clopyralid		Dichlobenil		Fluroxypyr	Fluazifop-P-butyl
Common Name	**Scientific Name**	Various	Grazon P+D (+picloram)	Curtail: (+clopyralid)	GrazonNext (+aminopyralid)	Crossbow (+triclopyr)	Milestone	Chaparral (+metsulfuron)	Milestone + Garlon 4	Aatrex	Telar XP	Cimmaron Plus (+metasulfuron)	Transline	Reclaim	Redeem (+triclopyr)	Casoron	Vista	Fusilade 2000, Fusilade DX
Jointed goatgrass[1]	*Aegilops cylindrica*																	
Kochia[3]	*Bassia scoparia*									3.2-4 pt						0.92 - 3.84 qt	8 oz	
Puncturevine[3]	*Tribulus terrestris*	2 qt																
Red brome[4]	*Bromus rubens*									1-2 pt								1-1.5 pt
Rescuegrass[3]	*Bromus catharticus*																	
Ripgut brome[3]	*Bromus diandrus*																	
Russian thistle[3]	*Salsola kali*	0.75-4 pt											2-4 pt	2-4 pt				
Smooth brome[3]	*Bromus inermis*																	
Spreading wallflower	*Erysimum repandum*	1/4-3/8 lb																

Category C - LOW

Noxious Weed		Glyphosate		Imazapic		Imazapyr			Indaziflam		Isoxaben	Metsulfuron methyl	Metribuzin	Paraquat*	Pendimethalin	Picloram*	Prodiamine	Thifensulfuron-methyl	Triclopyr
Common Name	**Scientific Name**	Rodeo	Round Up	Plateau	Journey (+ Glyphosate)	Arsenal	Arsenal + Rodeo	Chopper	Rejuvra	Esplanade 2000	Gallery	Ally, Allie, Gropper, Escort	Sencor	Gramoxone	Pendulum	Tordon 22K	Evade	Volta	Garlon
Bald brome[3]	*Bromus racemosus*	0.5-3 qt							3.5 – 7 oz	3.5 – 7 oz			0.5-1 pt						
California burclover[4]	*Medicago polymorpha*		24-32 oz						3.5 – 7 oz	3.5 – 7 oz									
Cheatgrass[1]	*Bromus tectorum*	0.5-1 pt		2-12 oz + 1 qt MSO	16-21 oz + 1 qt MSO				3.5 – 7 oz	3.5 – 7 oz									
Field bindweed[3]	*Convolvulus arvensis*		0.25-5 qt													0.5 pt- 2 qt			
Field brome	*Bromus arvensis*	0.5-3 qt							3.5 – 7 oz	3.5 – 7 oz			0.5-1 pt						
Horehound[5]	*Marrubium vulgare*											0.2-1 oz				2-4 pt			2.5- 3.33 pt
Jointed goatgrass[1]	*Aegilops cylindrica*	2.5-3 pt		0.063-0.188 lbs					3.5 – 7 oz	3.5 – 7 oz									
Kochia[3]	*Bassia scoparia*		0.5-5 qt						3.5 – 7 oz	3.5 – 7 oz	16 oz		0.5 lb		1.8-4.8 pt		1 lb		
Puncturevine[3]	*Tribulus terrestris*	0.75-4 pt							3.5 – 7 oz	3.5 – 7 oz					1.2-4.8 qt				
Red brome[4]	*Bromus rubens*	0.5-1 pt		2-12 oz + 1 qt MSO	1⅓- 2 pt				3.5 – 7 oz	3.5 – 7 oz									
Rescuegrass[3]	*Bromus catharticus*	0.5-3 qt							3.5 – 7 oz	3.5 – 7 oz			0.5-0.6 lb				1 lb		
Ripgut brome[3]	*Bromus diandrus*	0.5-3 qt							3.5 – 7 oz	3.5 – 7 oz			0.5-1 pt						
Russian thistle[3]	*Salsola kali*		8 oz- 5 qt						3.5 – 7 oz	3.5 – 7 oz	16 oz		0.25-0.75 pt			1-1.5 oz			
Smooth brome[3]	*Bromus inermis*	0.5-3 qt							3.5 – 7 oz	3.5 – 7 oz			0.5-1 pt						
Spreading wallflower	*Erysimum repandum*																	0.3-0.6 oz	

MSO=Methylated seed oil

9.8 Roads and Rights-of-Way Treatments

While noxious weed treatments on roads and rights-of-way (linear corridors) use the same techniques described above, treatments occur on a regular basis and are aimed at moving quickly to disrupt traffic as little as possible. The techniques used to treat noxious weeds in linear corridors include:

- Chemical spraying using trucks or All-Terrain Vehicles (ATV) for efficient application,
- Mechanical mowing timed to occur prior to seed-head maturation,
- Boom axe or chainsaw used to cut vegetation within 15-30 ft of pavement edge,
- Cut-stump treatments,
- Pile burning of collected plan material,
- Controlled burns, and
- Maintenance of fire guards along road shoulder or fence line.

Other measures used to prevent weed introduction and retain native vegetation along linear corridors include techniques that reduce erosion and other disturbances (keeping equipment off unstable slopes), re-seeding areas with native species, use of weed free materials (straw, wattles, fill, and seed), cleaning vehicles and equipment before beginning treatment and leaving a treatment area, and coordination with landowners to treat weeds on the roads and adjacent areas.

10.0 Native Vegetation Re-Planting

It is highly recommended that native species revegetation occurs after noxious weeds are removed from areas where weeds comprised 50% or more of the vegetation community. Areas dominated by noxious weeds for long periods of time likely do not have the native seed bank necessary for passive native species recolonization. Also, revegetating with native species prevents recolonizing noxious weeds, restores native pastures, and provides habitat for wildlife. Below are recommendations for native species revegetation scenarios based on native to noxious weeds ratios prior to clearing.

10.1 Passive Restoration

Passive restoration can occur in habitats dominated by native vegetation. Noxious weeds can be removed by hand and the native seed bank and surrounding vegetation is left to recolonize cleared areas. These are areas where weeds comprise less than 50% of vegetative cover.

10.2 Active Restoration

Habitats with more than 50% noxious weeds cover prior to treatments require native species replanting after weed treatments occur. If a ground water is deep or no natural flooding occurs on a regular basis, planted vegetation will require supplemental irrigation. Below are different techniques for planting native vegetation.

10.2.1 Direct Seeding

Photo courtesy of Fred Phillips Consulting.

Direct seeding offers many advantages over other techniques. When conditions are optimal, it produces large numbers of plants over an extensive area in a relatively short period. Through sheer volume, seeded plants out-compete recolonizing noxious weeds and survive harsh environmental conditions that would decimate smaller populations. Seeding is less expensive than other native planting techniques, especially for large tracts of land. Grass and herbaceous vegetation establish best from seed. Seeds from regional genetic stock have the most success germinating and surviving in the conditions found on the Navajo Nation. However, many seeds can only be obtained from commercial growers in other regions. USDA Natural Resource Conservation Service (NRCS) can provide information on the most appropriate seeds or seed mix for the desired area (https://www.nrcs.usda.gov/wps/portal/nrcs/main/plantmaterials /pmc/west/azpmc/). Additional native plant seed resources also include the NNDFW Diné Native Plants Program, NNDFW Botanist, State Cooperative Extension programs, local BIA Branch of Natural Resource Office, and the Navajo Nation Department of Agriculture Window Rock Office. Planting locally gathered seeds is successful but requires more time and effort than purchasing seed from a commercial source.

Prior to planting, some seeds with hard seed coats should be scarified mechanically or chemically. Scarification, a pre-germination process, opens the seed coat so water and gas can penetrate. When seeds naturally pass through the digestive tracts of animals, they undergo both chemical and mechanical scarification as part of the digestion process. As a substitute, seeds can be mechanically scarified by grinding them in a blender for about 10 seconds or by scraping a hole in the coat using sandpaper. Chemical scarification uses strong acids or other chemicals to partially open the seed coat; however, it is more dangerous and less effective than mechanical methods.

10.2.2 Propagating Cuttings

Vegetative propagation is more predictable and often quicker than starting with seeds. Desirable traits can be selected—for example, a superior flower color or thornless branch. However, plants propagated from the same stock over a long period may become susceptible to sudden environmental changes, insect attacks, and diseases. Harvesting cuttings from a variety of populations or from different areas ensures greater diversity and resistance to such problems. Native cottonwood and willows have high survival rates when planted as vegetative cuttings.

Cutting Guidelines. Check recommendations for individual species to identify the optimal season to harvest cuttings. In general, the best time to cut is when the plants are dormant—usually from December to early February. Ideally, cuttings are planted within a week of harvesting, after they are submerged in water for at least 7 days. If cuttings are not planted for a few months, refrigerate them at 35ºF to maintain dormancy. Try to select juvenile plants (1-2 years or younger if big enough) for cuttings, especially for woody species like cottonwood and willow. Younger plants are less likely to have growth inhibitors. If you must cut older plants, target the newest, most flexible growth near the base. When possible, prune older plants to generate new growth.

Preparing Cuttings. Before planting (either on site or in pots), re-cut and, for some species, apply rooting hormone. Make a new cut just above the original one but below a leaf node or bud, where concentrations of growth-influencing hormones or auxins are highest. This cut can be diagonal or straight. The diagonal method makes the cutting easier to plant and creates more surface area for water uptake. A straight cut lessens water loss and makes it easier to recognize the top and bottom ends. If rooting hormone is used, dip the cut end into an IBA (Indole-3-butyric acid) rooting hormone, such as Rootone, and gently tap to remove excess powder. This hormone speeds up root development. To prevent contamination, remove and apply the estimated amount of hormone for the cuttings present and discard extra after use. Cuttings from some species, like willow, are soaked for at least 7 days, but no longer than 12-14 days because the roots will begin to grow and will risk breaking off during planting. Once poles are removed from water they should not spend more than 12 hours out of water before planting.

Planting Techniques. Techniques for planting cuttings vary considerably; virtually all are effective for fast-rooting species such as cottonwood and willow. Rooting times vary by species from under a week to several months. Planting areas with a 6-inch – 4-foot depth to water table are recommended for planting cottonwood and willow tree species. Willows can be planted in clusters with 3 poles at least 7 feet in length with a minimum diameter of ½ inch. Holes are augured to a 6-inch diameter and at least 4 feet deep or just below the water table. All poles are planted at least 4 feet deep in the augured holes at the lowest water table of the year. Insert the cutting into the soil with the nodes pointing upward. The above ground portion of the pole is cut at a maximum height of 2 feet high and a minimum height of 18 inches. When planted all poles are slurred in with a water auger leaving no air gaps between pole and soil to maintain maximum soil to stem contact. Coat the tops of all poles with latex paint to seal in moisture. If planted in the ground water, planting areas should not require supplemental irrigation.

10.2.3 Deep Pot Upland Plants

Upland trees benefit from being grown in deep pots. Deep potted plants are planted in a hand augured planting holes that are 4-in wide and deep enough to reach the capillary fringe of the lowest water table of the year. One to three feet of the plant with budding sites above the ground. The plant root ball is not planted in saturated soil, but just right above the saturated soil zone.

10.2.4 Containerized Plants

Containerized plants are available all year and can establish quickly if they have well-established root systems. This method is expensive, time consuming, and difficult to transport, and is not practical for sites that are hard to access. Tree species are often planted in five-gallon containers while shrubs and forbs are planted as one-gallon containers. Herbaceous plants that naturally grow with multiple stems or rhizomatous roots are grown in flats of various sizes. If plants are not planted into the water table, drip irrigation may be necessary.

Augured or excavated 3-18-inch planting holes are dug to the lowest water table of the year. The native soil from the holes is utilized to secure the plant. When the plants are removed from the container, the root ball is pulled apart and loosened prior to planting. Once planted, a water well ring is formed on the surface soil around all tree plantings to enhance water retention. Remove noxious weeds present in the native tree containers prior to planting.

10.2.5 Bioengineering and Erosion Control

Figure 10-1. Harvested willow poles are planted along a bankline to provide additional erosion protection. *Left*: Work crews prep the bundles of willow poles after they have soaked in the Colorado River. *Right*: the same location one year after planting. Photos courtesy of Fred Phillips Consulting.

Bioengineering is implemented to prevent erosion and noxious weed recolonization along stream, wash, and riverbanks (**Figure 10-1**). This technique uses native vegetation poles, bundles, and plugs cut or harvested from local native stock. Poles are collected using the methods discussed above under Propagating Cuttings. They are planted individually or as bundles (approximately 3 poles per bundle) using a power auger or punch to create a narrow hole perpendicular to water flow that extends to the water table. Two rows of poles are planted along the bank line, one at the average low-water mark and one at the average high-water mark. When the water table is reached, a pole or bundle is immediately placed in the hole down to the water table. Soil is packed around the cutting to prevent air pockets.

Willow bundle plantings are good for areas with fluctuating water levels (**Figure 10-2**). To make bundles, 3-5 poles are tied into bundles of approximately 3 to 18 inches in diameter with the growing tips oriented up. The terminal bud is removed so the energy is re-routed to the lateral buds for more efficient root and stem sprouting. Vertical trenches are excavated approximately on 3-foot centers with a slope of 2:1 or more to ensure adequate protections of the bank line and to encourage rapid growth. Ensure that the bottom of the trench is still under water during low flows and place bundles in them with the cut ends in the water. Bundles are secured with a wooden stake and the bundle is back filled with soil.

Figure 10-2. Bundles of fast-growing plants planted along the streambank can provide erosion control when steep banks cannot be re-graded. *Left*: grass bundles installed along a steep bank with willow bundles planted in between to stabilize and capture soils on the bankline. *Right*: The same bankline one year later. Photos courtesy of Fred Phillips Consulting.

The toe of the slope is highly erodible and is planted with fast growing native wetland vegetation plugs if perennial water is present. Wetland plugs are planted during the lowest water flow of the year to ensure that plants are submerged in the water table. A hole is dug at the toe of the slope, in the water table and the wetland plug's roots are submerged in the water.

Other erosion control techniques include the following:

- **Erosion blankets:** This technique helps hold soil and seed in place during inundation and create a microclimate conducive to germination of native grass and forb seeds. Blankets consisting of all-natural materials break down between one to 2 years after vegetation is established and are wildlife friendly. The blanket is installed over the prepared seed bed and staked into place with wooden stakes and/or metal staples by hand crews. The edges of the blanket are buried in a shallow trench.
- **Fiberschines**: This technique uses a coconut-fiber roll product to protect the streambank by stabilizing the toe of the slope and trapping sediment from the sloughing streambank. Cuttings and herbaceous riparian plants are planted into the fiberschine and behind it so that riparian vegetation stabilizes the streambank when the fiberschine decomposes.
- **Brush Layer:** This technique uses bundles of willow cuttings buried in trenches along the slope of an eroding streambank. This willow "terrace" is used to reduce

the length of the slope of the streambank. The willow cuttings will sprout and take root, thus stabilizing the streambank with a dense matrix of roots. Some toe protection such as a wattle, fiberschine, or rock may be necessary with this technique.

- **Mulch Over Reseeding:** Straw mulch consists of wheat, barley, oat or rye straw, hay, and grass cut from native grasses that are "weed free". Straw mulch could be applied at a rate of 2 tons per acre to designated seeding areas to provide a protective environment for seed germination. Mulching will occur in the upper overbank zone and portions of the transition zone.
- **Brush revetment:** This method is used to protect and build the toe of eroding banks. This practice consists of a series of evergreen or other brushy trees tied end to end, placed along the toe of the stream bank, and anchored by bolster rock, earth anchors, or fence posts. The revetment provides temporary structural protection to the toe while vegetation becomes established by slowing velocities and diverting the current away from the bank edges. Over time, fine sediments accumulate, partially burying the degrading material. The mass of tree limbs also has the added benefit of creating aquatic habitat as the revetment material generally does not sprout. Once bank vegetation is established, T-posts are removed.

11.0 Project Maintenance and Monitoring

Monitoring and maintenance are essential to successful weed management projects. Monitoring a site after treatment can determine the effectiveness of the project. Monitoring guides adaptive management and can determine the need for alternative treatments. Maintenance, including follow-up weed treatments and native species planting, is an integral part of an integrated weed management plan. Most weed species require multiple treatments before complete eradication occurs. Often once one weed species is removed from a site, secondary weed infestations can occur. Planting native vegetation can reduce re-colonizing weed species by out-competing them. Follow-up maintenance is critical for reducing the re-colonization of primary and secondary weed species of concern. For noxious tree weed treatments in forestlands, intermediate and maintenance treatments are prescribed for a given rotation age, based on the goals and objectives of each treatment.

11.1 Project Monitoring

Establishing and implementing a monitoring program determines the success of the project activities and a long-term adaptive management strategy. Monitoring is necessary to determine the efficacy of proposed treatments on priority weed species, identify infestations of new and emerging weed species, and better understand the factors that influence weed spread within the Navajo Nation. To determine the effectiveness of treatment activities a monitoring report will be prepared. The monitoring report will include the species controlled, method of treatment(s) used, a map of the treated area, issues encountered, and overall control achieved at the site. If using chemical treatments, the name and amount of herbicide used, dates sprayed, time of day sprayed, wind speed, and temperature at time of herbicide application is also required.

11.1. Treatment Effectiveness Monitoring

Monitoring weed spread and/or treatment effectiveness is conducted through annual weed mapping of treatment sites (see Section 6.0). During the project planning phase, the perimeter of the affected area is mapped (using methods outlined in Section 6.0) and percent cover calculated. If the treatment area is a long linear corridor (road or right-of-way) the infested areas is mapped by vehicle along the corridor. This baseline measurement is used to compare acreage of infestation against future acreage calculations following treatments to determine treatment effectiveness. Results from monitoring will be presented in annual weed monitoring reports. By tracking the size of the weed infestation, BIA can determine if treatment methods are successful, and if objectives are being met. If necessary, treatments will be adjusted through the adaptive management process to ensure that the project objectives are achieved.

If treated weed populations are large, monitoring plots located along transects may be established to sub-sample smaller areas. Plots are established by stretching a 100m tape measure across the treatment area. The start and end points of the transect are recorded with a GPS and the bearing of the transect is recorded to help relocate transects in subsequent surveys. Plots (1 x 0.5m) are established every 10 meters along the transect, and noxious weed cover is estimated using the methods outlined in Elzinga et al. 1998. Multiple transects are necessary if the treatment site is large. Data collected from the plots is measured over time and is compared year-to-year. For long linear corridors (roads and rights-of-way) vehicles will stop at established intervals to estimate vegetation cover in an established larger plot area. An example monitoring plot data sheet located in Appendix H.

11.1.2 Photo Monitoring

Photo monitoring is a qualitative way to show change over time in an area of interest. This is the most effective method for visualizing and capturing landscape conditions at a given point in time. Photo points are established immediately after treatment occurs, marked with permanent markers, and GPS coordinates are recorded. Care is taken to ensure that the photo point locations are described in detail so they can be found during follow-up visits. To relocate points and replicate photos, photos from previous sessions are taken to the field. Photos are immediately transferred to a database and labeled with a unique identifier and description so that information does not get lost with time. An example Photo Monitoring Datasheet is in Appendix H.

11.1.3 Adaptive Management

Adaptive management is a system of management practices based on clearly identified outcomes, monitoring to determine if management actions are meeting outcomes and, if not, facilitating management changes that will best ensure that outcomes are met or to re-evaluate the outcomes. This document is a living document that will revised through adaptive management. Weed populations are dynamic. Revisions to the plan will be done every five years with updates to the priority weed list and revised recommendations for techniques utilized in weed management projects. They decline when managed with integrated weed treatments and expand when no weed treatments occur. Currently, it is unknown how expansive weed populations are across the Navajo Nation without extensive weed mapping efforts. Even if there were extensive weed mapping efforts, weed populations continually change and expand. There are many uncertainties that can occur in a dynamic system due to weed expansion, the effectiveness of a treatment, and different management priorities. Monitoring through adaptive management will help determine if the project objectives are being met and if the treatments are staying within the environmental effects that were anticipated with this PEIS. If the parameters discussed above are not being met, the techniques, timing and frequency of treatments, etc. can be changed through adaptive management. Implementing an integrated weed management program increases the chance of overall success and decreases the risk of any large failures (Sheley and Petroff 1999, Bormann and Kiester 2004).

The BIA is required to involve the public in adaptive management by:

1. Maintaining open channels of information to the public, including transparency of the monitoring process that precedes adaptive management and the decision-making process by which it is implemented.
2. Providing post-activity opportunity for public and affected outside agency review of adaptive management practices, including practices that were exceptions to any resource management plan or that had permitting and/or other regulatory requirements not satisfied by prior coordination.

11.2 Project Maintenance

As discussed above, follow-up maintenance is required to effectively eradicate many weed species. For example, successful long-term management programs for tamarisk require more than five years of treatments using multiple control methods, including: mechanical, fire, and chemical treatments (USFS 2012). Secondary weeds (i.e., camelthorn) may colonize a treatment site once it is cleared. Planting native vegetation at treatment sites reduces re-colonizing noxious weeds. Periodic weeding using hand pulling or spraying or small mechanical tools is necessary until native vegetation matures and creates a canopy. Weed treatments should occur every other month during the growing season (April-September) to treat re-sprouting and secondary infestations. Consistent maintenance after the first treatment is the most cost-effective way to ensure eradication or control of weeds, because less time and materials are required for small, young weed. Treatment sites, especially those planted with native vegetation, should be fenced to prevent livestock from entering so native vegetation can establish and mature. Fencing will require maintenance to ensure that it is effective at preventing livestock intrusions.

12.0 Demonstration Projects

A number of demonstration projects were identified by BIA Navajo Region Agencies to initiate noxious weed treatments and serve as models for future projects (**Table 12-1**). Demonstration projects have completed weed mapping, compliance, permitting, and reporting, and departmental funding has been requested or confirmed. Monitoring and maintenance of these sites will provide valuable information that can improve and enhance weed treatment methods for future projects.

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Table 12-1. Demonstration Projects identified by the five BIA Navajo Region Agencies including Western, Shiprock, Chinle, Eastern (Crownpoint), Navajo Partitioned Land, and Fort Defiance Agencies. The table outlines the weed species mapped at the site, habitat and land use, proposed methods, and funding years for project implementation.

Agency	Project Name	Habitat Type	Methods	Weed Mapping (ac)	Species Mapped	FY
Western	Tsah Bii Kin (Tonalea Lake)	Riparian	Mechanical, Chemical	38	TAMAR	2014 - 2015
Western	Tsegi Canyon	Riparian	Mechanical, Chemical	32	ELAN	2014-2015
Western	San Juan River	Riparian	Mechanical, Chemical, Manual	1850	TAMAR, ELAN, ACRE, ALMA, SARA	2014-2015
Western	Oljato Wash and Parrish Creek (Tyende)	Riparian	Not Specified	52	Not Specified	2014-2015
Western	Nitsin Canyon (Navajo Canyon)	Riparian	Mechanical, Chemical	150	ELAN, TAMAR	2014-2015
Western	Shonto Wash – Phase 1	Riparian	Chemical, Mechanical, Biological	14	TAMAR, ELAN	2020 to 2021
Western	WNA – Phase 2	Rangeland	Mechanical, Chemical, Biological	206,389	ELAN	2014 to 2015
Fort Defiance	Kin Dah Lichi	Sagebrush, Pinon, Juniper	Mechanical, Chemical	1,516	ELAN, BRTE, COAR, SAKA, CANU, CIVU	2014 to 2015
Fort Defiance	New Lands	Stream Corridor	Mechanical, Chemical	227	PEHA, CIVU, LIDA, ONAC, ELAN, TAMAR ALMA13, ULPU, BRTE, COAR4, TRTE, MAVU, SAKA	2015 to 2016
Fort Defiance	District 14	Stream Corridor	Chemical	1,661	ELAN, TAMAR, CIVU, BRTE, COAR, CEIN, HAGL, CANU, TRTE	2016 & 2017
Fort Defiance	Commercial Forest	Forest	Chemical and Mechanical	324	BRRA, ULPU, CIVU, BRTE, SOAR, CANU, TRTE, ACRE, ELAN, SAKA, CIAR	2018-2019
Fort Defiance	District 7 (BIA 15)	Rangeland	Mechanical, Chemical, Biological	4,570	ACRE3, CEDI3, CEBI2, LIDA	2020-2021
Fort Defiance	HWY 264 and 191	Roads	Mechanical, Chemical	21,230	ACRE3, CEDI3, CEBI2, LIDA	2020-2021
Fort Defiance	Colorado Pueblo Wash	Riparian	Mechanical, Chemical	1,821	TAMAR, ELAN	2020-2021
Fort Defiance	Kinlichee	Riparian	Mechanical, Chemical	1,500	TAMAR, ELAN	2020-2021
Northern	LMD 13	Stream Corridor	Mechanical, Chemical, Biological	398,196	TAMA, ELAN, ACRE3, CANU	2020 & 2021
Eastern	Canoncito/Alamo			2,000	Not specified	2015 & 2016
Navajo Partitioned Land	Precinct 1, 2, and 3	Stream Corridor and Rangeland	Chemical and Mechanical	1,500	ACRE, BRTE, TAMA, SALSOL	2015-2016
Chinle	Many Farms Plot	Agricultural field		1,990	TAMAR, ELAN	2020-2021

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Appendix B. List of Preparers

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List of Preparers and Consultants

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Contribution:	BIA Project Team Leader, BIA Contracting Officer Technical Representative,
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Experience	Cultural Resource Management which includes surveys, ethnographic research, and data recovery for 27 years within the Navajo Nation, Federal, and Private Sector. In addition, five years of experience in Behavioral Health Services and Navajo Nation Governmental Services

Harrilene Yazzie, BIA Navajo Regional Office NEPA Specialist

Contribution:	NEPA Compliance Specialist, BIA Project Team Member, BIA Navajo Agency NEPA Coordinator

Calvert L. Curley, BIA Navajo Regional Office, Supervisory Natural Resource Specialist

Contribution:	BIA Resource Project IDT member, Document Review, Natural Resource Management
Experience	Bureau of Indian Affairs: 17 years in natural resource management and planning on the Navajo Nation. 10 years in natural resource and environmental protection

Jordan Piña, BIA Navajo Regional Office, Forester

Contribution:	BIA Resource Project IDT member, Forest Land Management Processes, Document Review.
Experience	Bureau of Indian Affairs: 8 years in Forest Land Management National Park Service: 4 years in Ecological Restoration

Antoine Luxon, BIA Navajo Regional Office, Supervisory Forester

Contribution:	BIA Resource Project IDT member, Forest Land Management Processes, Document Review.
Experience	Bureau of Indian Affairs: 25 years in forest management.

Chaitna Sinha, Department of the Interior, Solicitor's Office

Contribution:	BIA Solicitor, Document Review
Experience	15 years practicing federal Indian law and natural resources law

Anne Minard, Department of the Interior, Solicitor's Office

Contribution:	BIA Solicitor, Document Review
Experience	Fifteen years as a science/environmental journalist; Law Clerk, New Mexico Supreme Court, Assistant Attorney General, New Mexico, natural resources law.

Heidi Trathnigg, EnviroPlan Partners and Fred Phillips Consulting, Principal Biologist

Contribution:	EnviroPlan Environmental Specialist, FPC Project Team Manager, Public Scoping and Cooperating Agency Meeting Planning, Coordination, and Facilitation, Development of Chapters 1 and 2, Resource Analysis for Wildlife, Vegetation, Noise, and Light.
Experience	20 years in environmental planning, biological resource management, project management.

Sabrina Kleinman, EnviroPlan Partners and Fred Phillips Consulting, Principal Ecologist

Contribution:	Public Scoping and Cooperating Agency Meeting Coordination, Resource Analysis for Soils, Air, Water, Vegetation, Agriculture, Public Health, Socioeconomics, Environmental Justice, Areas with Special Designations, Document Review and Preparation, Map Creation, Administrative Record.
Experience	15 years in forestry, soils, vegetation, environmental compliance, and project management

Kevin Dickinson, Fred Phillips Consulting, Wildlife Biologist

Contribution:	Document Review, Final Document Preparation, Administrative Record Documentation.
Experience	15 years in environmental planning, biological resource management, special status species surveys.

Sean Larmore, ERO, Cultural Resource Manager/Principal

Contribution:	Update Resource Analysis Paleontological Resource and Cultural Resources
Experience	25 years in cultural resource management, 16 years as senior principal investigator and cultural resource manager for ERO Resources.

Lynn Neal, Envirosystems Management, Inc., Cultural Resources Program Manager

Contribution:	Programmatic Agreement Coordination, Resource Analysis Paleontological Resource and Cultural Resources
Experience	24 years in cultural resource planning and environmental analysis, and project management.

Stewart Deats, Envirosystems Management, Inc., Archaeologist

Contribution:	Programmatic Agreement Coordination, Resource Analysis for Paleontological Resources and Cultural Resources.
Experience	Envirosystems Management, Inc.:

Appendix C. Literature Cited

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Appendix D. Scoping Report

Navajo Nation **Integrated Weed Management Plan**
Final Environmental Impact Statement

Scoping Report

July 2022

Prepared for:
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1.0 Introduction

The Bureau of Indian Affairs Navajo Region proposes to authorize new treatments of weed infestations spread across the Navajo Indian Reservation and to develop an Integrated Weed Management Plan. The BIA selected 21 priority noxious and invasive weed species that occur within the project area. These weed infestations range in size from single plants to a single species covering several thousand acres. The various methods to be analyzed in the integrated weed management plan include: mechanical (clipping, mowing, tilling, bulldozing, steaming, and burning); cultural control (grazing by livestock, fertilization, seeding or planting of competitive plants, and use of weed seed-free seed mixes, mulches and ballast); biological (approved insects or plant pathogens); and chemical (approved herbicides).

As part of the environmental review process, the BIA held public scoping meetings to obtain public, stakeholder and cooperating agency input required by the National Environmental Policy Act (NEPA) regulations. This scoping report summarizes comments, feedback, and input received prior to the close of scoping on March 20, 2013 and May 29, 2021 for the development of the Integrated Weed Management Plan and Environmental Impact Statement.

1.1 Purpose of Scoping

The Council on Environmental Quality Regulations at 40 CFR 1501.7 requires an early and open process to determine the scope of issues to be addressed and for identifying the significant issues related to a proposed action. This process is termed “scoping.” The scoping process is used to learn the concerns of individuals, groups, and agencies about a proposed project. Scoping is an integral part of the National Environmental Policy Act (NEPA) review process because it allows interested parties an opportunity to help develop a list of issues to be discussed in an Environmental Impact Statement (EIS). The Bureau of Indian Affairs NEPA handbook, 30 BIAM Supplement 1, paragraph 6.3B, identifies that the preparation of an EIS begins with the scoping process. A Notice of Intent to prepare an EIS is required to include the public notice for the scoping process.

2.0 Project Overview

2.1 Project Background

Exotic weed infestations have become an increasing problem on the Navajo Nation. Weeds have been introduced through a variety of methods, with the primary vectors of introduction being weed hay, grain, and seed; construction of roads; transport by livestock and wildlife; contaminated vehicles; and disturbance from infrastructure development. Weed expansion causes a decline in quality grazing habitat, decreases in property values, and declines in wildlife habitat quality.

2.2 Draft Purpose and Need of the Project

The purpose of this project is to contain and control, eradicate, and prevent weed infestations within the project area. The desired goal is to prevent new weed species from becoming established, to contain and control the spread of 11 known invasive species, and to eradicate 10 species that occur in a limited range but have the potential to increase in density and threaten biological diversity within the project area (**Table 1**). Controlling these invasive plants will help improve rangeland and agricultural land health by improving the growth of native forbs and grasses for the benefit of subsistence ranching and farming, increasing the diversity of native riparian trees and understory species in riparian corridors, preventing additional weed infestations to unaffected land and property, and maintaining and improving wildlife habitat. While noxious weeds have been documented throughout the project area, few areas have been inventoried and mapped. Therefore, weed inventory and mapping will be conducted concurrently with implementation of this plan to identify existing weed populations within the project area.

HIGH PRIORITY (A RATING)	
Common Name	**Management Strategy**
Leafy spurge (*Euphorbia esula*)	Prevent/Eradicate
Bull thistle (*Cirsium vulgare*)	Eradicate
Canada thistle (*Cirsium arvense*)	Eradicate
Dalmatian toadflax (*Linaria dalmatica*)	Eradicate
Musk thistle (*Carduus nutans*)	Eradicate
Perennial pepperweed (*Lepidum latifolium*)	Eradicate
Scotch thistle (*Onopordum acanthium*)	Eradicate
Spotted knapweed (*Centaurea maculosa*)	Eradicate
Whitetop (Hoary Cress) (*Cardaria draba*)	Eradicate
Yellow starthistle (*Centaurea solstitialis*)	Eradicate
Camelthorn (*Alhagi camelorum*)	Contain & Control
Tamarisk, Saltcedar (*Tamarix* spp.)	Contain & Control
Diffuse knapweed (*Centaurea diffusa*)	Contain & Control
Russian knapweed (*Acroptilon repens*)	Contain & Control
Russian Olive (*Elaeagnus angustifolia*)	Contain & Control
MEDIUM PRIORITY (B RATING)	
Common Name	Management Strategy
Field Sandbur (Cenchrus incertus)	Contain & Control
Halogeton (Halogeton glomeratus)	Contain & Control
LOW PRIORITY (C RATING)	
Common Name	**Management Strategy**
Cheatgrass (Bromus tectorum)	Contain & Control
Field bindweed (Convolvulus arvensis)	Contain & Control
Jointed goatgrass (Aegilops cylindrica)	Contain & Control
Puncturevine (Tribulus terrestris)	Contain & Control

Table 1. List of 21 targeted weed species for control on the Navajo Nation as prioritized by the BIA in 2009. High Priority Weeds (A Rating) have an imminent potential for widespread expansion. Medium Priority Weeds (B Rating) may occur in isolated patches and are not as a serious problem as the high priority weeds. Low Priority Weeds (C Rating) are wide-spread and well established.

The Bureau of Indian Affairs Navajo Region has Conducted noxious weed inventories that have documented close to 80,000 acres of infestations on the Navajo Nation. With the current spread of exotic weeds across the Navajo Nation there is a need for federal funding to continue and expand these weed removal efforts. This EIS and Weed Management Plan is the first step in obtaining funding and resources to implement exotic weed removal projects using various control methods.

The BIA Navajo Region proposes to authorize new treatments for weed infestations on tribal trust lands administered by the BIA Navajo Regional Office, including Navajo Indian Allotments using any of the proposed methods. The annual combination of methods used would vary depending on site conditions, target weed species, population size, and cost. Repeated treatments or re-treatments would be necessary for most weed species because seeds in the soil can be viable for 10 years or more and many of these invasive weeds have aggressive root systems that are hard to kill after one treatment. Therefore, recurring actions would be authorized until the desired control objective is reached.

2.3 Project Location

The BIA Navajo Region is divided into five BIA agencies including:

- Western Navajo Agency (Tuba City, Arizona, 5.2 million acres),
- Eastern Navajo Agency (Crownpoint, New Mexico, 2.3 million acres),
- Fort Defiance Agency (3.3 million acres),
- Shiprock / Northern Navajo Agency (2.7 million acres),
- Chinle / Central Navajo Agency (1.4 million acres).

The Navajo Partitioned Lands (Pinon, Arizona, 910,000 acres) and the New Lands Area (310,000 acres) contain an additional 1.2 million acres. At the date of this writing, the New Lands Area is managed by the Office of Hopi and Navajo Indian Relocation but may come under the BIA in the foreseeable future. Thus, the New Lands Area is included in the project area. Additionally, there are approximately a million acres of land that may be in transition to allotment or trust lands on the Navajo Nation as part of land buy backs.

2.4 Alternatives Introduced at Scoping

There were three alternatives that were presented by the BIA during scoping. Input received during the scoping period, including comments related to the alternatives listed below, will be considered by the BIA in determining the characteristics and the range of the alternatives when they are prepared for the EIS.

Alternative 1. The Preferred Action

Alternative 1 would authorize new treatments of noxious weeds across the Navajo Nation. The various methods analyzed under an integrated weed treatment approach include: manual, mechanical, cultural, biological and chemical. Under the preferred action every acre on the Navajo Nation will be evaluated for all proposed weed control methods.

Alternative 2. No Action Alternative

The No Action Alternative is required by law (Code of Federal Regulations 1502.8) and would call for no additional Integrated Weed Management treatments applied to any Navajo Nation lands.

Alternative 3. No Chemical Method Alternative

Alternative 3 would rely on all treatment methods for noxious weed removal except for chemical.

2.5 Cooperating Agencies

A cooperating agency is any federal agency that has jurisdiction by law or special expertise with respect to any environmental impact involved in a proposed action. For this proposed project the following agencies have agreed to be cooperating agencies: Navajo Nation, Arizona Department of Transportation (ADOT), Utah Department of Transportation (UDOT), U.S. Fish and Wildlife Service, U.S. Bureau of Land Management, U.S. Department of Agriculture Animal and Plant Health Inspection Service (APHIS), National Park Service, and Soil Water Conservation District (SWCD).

3.0 Scoping Meetings

The BIA held public scoping meetings during February 5-12 and March 11-15, 2013 regarding the preparation of the Navajo Nation Integrated Weed Management Plan (IWMP) and Environmental Impact Statement (EIS). After the project was delayed, the BIA held a second public notice for comment period from April 29 to May 29, 2021, to seek additional comments. Below is a summary of the procedure and events that occurred during the scoping process.

3.1 Notice of Intent

The BIA informed agencies and the public about the IWMP/EIS and solicited their comments to identify issues and questions to consider when developing the integrated weed management plan. A Notice of Intent (NOI) to prepare the programmatic EIS for the Navajo Nation IWMP was published in the Federal Register on January 14, 2013 (Vol. 78, No. 9) with a 45-day comment period as required by NEPA. The original close of scoping date ended on February 27, 2013. However, the scoping period was extended after receiving several comments from the public and stakeholders requesting an extension to allow for additional public scoping meetings and more advertising. The Notice to Extend the Scoping Period to prepare the programmatic EIS for the Navajo Nation IWMP was published in the Federal Register on Friday, March 8, 2013 (Vol. 78, No. 4) with the end of the scoping comment period to close on March 20, 2013. Copies of the NOI and the Notice to Extend the Scoping Period can be found in Appendix A.

Since the project was delayed, another comment period was established from April 29-May 29, 2021 to gather current and additional public feedback on the Integrated Weed Management Plan. The BIA Regional Office provided a Factsheet about the project and Comment Card on their website (https://www.bia.gov/regional-offices/navajo/navajo-nation-integrated-weed-management-plan) to solicit additional comments specific to weed treatment on the Navajo Nation. The availability of the Factsheet and Comment form was advertised on the radio and in newspapers. No additional scoping meetings were provided during this comment period.

3.2 Scoping Meeting Schedule

Scoping meetings were conducted at five locations during the initial scoping period and six more meetings were added during the extended scoping period. Two of the additional six meetings were presented at District Grazing Meetings by BIA Weed Coordinators and were not advertised. The location, dates and times are listed below in **Table 2**.

Initial Scoping Schedule	Extended Scoping Schedule
Crownpoint, NM Chapter House February 5, 2013 5:00 – 7:00 pm MST	Round Rock, AZ Chapter House District 11 Grazing Meeting March 4, 2013 11:00 am DST
Shiprock, NM Chapter House February 6, 2013 5:00 - 7:00 pm MST	Nazalini, AZ Chapter House District 10 Grazing Meeting March 5, 2013
Chinle, AZ Chapter House February 7, 2013 1:00 – 5:00 pm MST	Navajo Nation Museum Highway 264 and Loop Road Window Rock, AZ 86515 March 11, 2013 12:00 – 3:00 pm DST
Fort Defiance, AZ Chapter House February 8, 2013 9:00 am – 12:00 pm MST	Kayenta, AZ Chapter House March 13, 2013 10:00 am – 1:00 pm DST
Tuba City, AZ Chapter House February 12, 2013 3:00 – 6:00 pm MST	Pinon, AZ Chapter House March 14, 2013 10:00 am – 2:00 pm DST
	Many Farms, AZ Chapter House March 15, 2013 1:00 – 5:00 pm DST

Table 2. Scoping meeting locations, dates, and times for the February and March 2013 scoping meetings.

3.3 Public Notification and Advertisement

During the scoping period, the commencement of the IWMP/EIS was announced through various forms of public outlet. The initial scoping meeting locations, dates and times were published in the printed and online events calendars of the following newspapers and radio stations from February 4 - 8, 2013 (Appendix B): Also, emails announcing the public meetings were sent to the Navajo Nation Chapter Houses and Cooperating Agencies.

- Arizona Daily Sun, Flagstaff
- Navajo-Hopi Observer
- Farmington Daily Times
- Durango Herald
- East Valley Tribune News
- Albuquerque Journal
- KNAU (http://www.publicbroadcasting.net/knau/events.eventsmain)

Public flyers announcing the meetings were also placed in public locations around the towns where the scoping meetings were held one week prior to the meeting date (Appendix C). Also, the meeting location and times were published on the BIA Navajo Region website, http://www.bia.gov/WhoWeAre/RegionalOffices/Navajo/index.htm.

The meetings held during the extended scoping period were published as a public service announcement in the following newspapers during the dates listed (Appendix D):

- Arizona Daily Sun, Flagstaff (March 11-15, 2013)
- Farmington Daily Times (March 11-15, 2013)
- Navajo Times (March 14, 2013)
- Cortez Journal (March 12 and 14, 2013)
- Durango Herald (March 11 – 15, 2013)
- Durango Telegraph (March 14 – 15, 2013)
- Albuquerque Journal (March 12 – 15, 2013)
- Gallup Independent (March 11 – 15, 2013)

Also, radio announcements on KTNN discussing the project, scoping meeting locations, dates, and times were aired three times per day from March 10 – 14, 2013. Public flyers announcing the meetings were distributed and posted in public locations in the towns where the public scoping meetings were held one week prior to the meeting date (Appendix E).

The additional public comment period for the Integrated Weed Management Plan on the BIA Navajo Regional website (https://www.bia.gov/regional-offices/navajo/navajo-nation-integrated-weed-management-plan) was advertised on the radio on KTNN and KGAK from April 29 – May 6 two times a day and published as a public service announcement in the following newspapers (Appendix L):

- Navajo Times (May 3 - 14, 2021)

- Navajo Hopi Observer (May 3 - 14, 2021)
- Gallup Sun (May 3 - 14, 2021)
- Gallup Independent (May 3 - 14, 2021)
- Farmington Daily Times (May 3 – 14, 2021)

3.4 Scoping Meeting Format and Content

Each scoping meeting was initiated with a sign-in sheet at the door or at a key access point to the seating locations. Along with the sign-in sheet, participants were encouraged to fill out a name tag and take a scoping meeting agenda and comment card. A copy of the sign-in sheet is located in Appendix Fand the meeting agenda in Appendix G. The local Weed Coordinator for the area's BIA Agency gave an introduction to the project, introduced the consultants and key BIA personnel, described the presentation format, invited people to visit the poster displays, and requested that everyone fill out a comment card and/or voice their comments. Four poster displays were hung in the meeting locations that outlined the integrated weed management plan and EIS and provided information on the 21 priority weed species (Appendix H). A voice-over presentation discussing the development of the EIS and the Integrated Weed Management Plan, including the aspects of NEPA, was presented initially in Navajo and again in English. A PDF of the presentation is located in Appendix I. The two presentations lasted approximately one hour and 45 minutes. After the presentations finished, a question-and-answer session was held for the public.

The public could provide comments on the Integrated Weed Management Plan through various mechanisms. A Navajo Translator was present at each meeting to transcribe comments given in Navajo to English on the comment cards. Comment cards were distributed to the public when they entered the meeting to fill out and submit at the meeting or by mail to the following address:

Renee Benally
Acting Navajo Region Weed Coordinator
Western Navajo Agency
Branch of Natural Resources
P.O. Box 127
Tuba City, AZ 86045

Comment cards were designed to direct participants to provide substantive comments on specific areas of the Integrated Weed Management Plan and EIS (Appendix J). There was also an area for other concerns and comments. The focal areas included: proposed weed removal methods, priority sites for weed management, alternatives, concerns, and other. Verbal comments were accepted, and were not recorded verbatim, but notes were taken to summarize the speakers' comments and statements. Comments were also accepted by Renee Benally via phone, email and fax from January 14- March 20, 2013. A total of 129 people attended as least one of the eleven public scoping meetings during the Scoping Period.

4.0 Scoping Comment Summaries

This section provides an overview of the comments received during the scoping period for the Navajo Nation Integrated Weed Management Plan. Comments were categorized and separated by major issues raised by members of the public or government agencies in the scoping process. Specific issues and questions are discussed in each section and will be further addressed in the EIS. General comments, concerns, and questions not falling within one of the major issues identified, or comments that do not pertain to the scope of the EIS were not included, which is further discussed in section "4.13. Non-EIS Scoping Comments." A total of 45 comments were received, including: 31 written comments, 12 verbal comments, one email comment, and one fax. An additional five comments were received through the email comment form during the April 29 – May 29, 2021, additional Scoping Period.

4.1 Removal Methods

4.1.1 Biological control

Biological control is a method of controlling pests (i.e. invasive plants) by using living organisms. In the case of invasive plant control several living organisms have been identified by U.S. Department of Agriculture Animal and Plant Health Inspection Service (APHIS), including mites, beetles, fungus, wasps, flies, moths, nematodes, and rusts. Several comments discussed interest and concern over bio-control, including:

- One commenter was interested in learning what kind of bio-control would work with different weed species.
- Two commenters were concerned about bio-control agents being difficult to eradicate after the host plant is exterminated and if they will need to do additional treatments to eradicate the bio-control agent.
- One commenter was concerned about bio-control agents being safe around livestock, farmlands, and horticulture.
- One commenter was in support of biological control.

4.1.2 Chemical Control

Chemical control will include using various approved herbicides for treatment of noxious weed species. Several commenters discussed their concerns over the effectiveness of chemical treatments and concern over the effects of chemicals on the community, other plants, and livestock. Another comment addressed elderly traditional concerns with chemical treatments. Other comments on chemical control included:

- Two commenters wanted to know what time of year was best for chemical treatment.

- One commenter inquired about how long after an application of chemical treatments could the area be used for grazing.
- One commenter was interested in the lingering effects of chemical control.
- One commenter was concerned about the effects on underground water contamination from chemical use.
- One commenter was worried about the human health effects of herbicides.

4.1.3 Mechanical Control

Mechanical control refers to the removal or cutting of weeds either by hand or through the use of mechanical tools such as mowers, bulldozers, loppers, etc. Mechanical methods can either trim the above ground portions of the weeds or involve the removal of the entire plant, including the below ground root system. Comments pertaining to mechanical control include:

- One commenter discussed their concern over the effectiveness of digging up weed species, since their experience showed that the weeds re-sprouted after digging.
- One commenter suggested that weeds should be burned in early spring because of the Navajo culture. They had concern over burning ants, lizards, snakes, and spiders.
- One commenter suggested using sheep to control weeds as a better alternative to chemical treatment.
- One commenter suggested using a mini excavator with a biting bucket to pull out saltcedar, recycle for firewood, and have the chapter labor cut it up for the community.
- Removal of thistles in areas around Burnham Chapter.
- One commenter proposed to use cut and burn treatments and recycle the cut material for firewood or mulch.

4.1.4 Cultural Control

As discussed above (Section 1.0), cultural control methods utilize cultural practices that prevent or out-compete invasive weed species. These include the use of grazing, cultural considerations for the timing of weed treatments, and planting native vegetation to outcompete weeds.

- One commenter supports using cultural control.
- One commenter discusses the need to remove livestock from washes to minimize impacts after tamarisk have been removed.
- One commenter noted that in one case a horse ate camelthorn plants to the root and provided a good means for control.

4.1.5 Integrated Weed Control

The proposed weed management plan includes an integrated approach of weed control using the methods described above. Several commenters recognized the need for integrated control of weeds. These comments included:

- Chemical, aerial, and mechanical methods may have to be used depending on effectiveness and accessibility to noxious weed sites.
- Pick an infected area locally and try different eradicating methods to find what works best.
- One commenter supports the integrated treatment of weeds using the methods proposed.

4.1.6 General Comments on Control Methods

The BIA received a number of general comments regarding control methods discussed during the presentation. These comments include:

- One comment discussed methods that they have found effective that they would like to see considered in the IWMP, including a stress method where a pick-up truck is used to drive over weed infested areas to stress the plants.
- Another comment was concerned with the timing of applying treatments.
- One commenter had concern with the effectiveness of any control methods being effective for the long-term control of weeds.
- One comment suggested that the Weed Management Plan consider using the NRCS Herbaceous Weed Control Program for mechanical, chemical, and biological treatment, NRCS Weed Control Practice Code 315.
- Many comments were interested in learning methods to control specific weed species.
- One comment suggested that weed removal will only work if the area is fenced.
- One commenter inquired if the proposed methods of weed extermination were currently being used somewhere else.
- One commenter was concerned about the removal of livestock to another location during weed treatments.
- One comment suggested that rainfall data be collected and used as a factor to determine the appropriate weed treatment methods.
- Some of the general requirements along linear rights-of-way and herbicide spray trucks are not practical such as requiring parking at designated areas during treatment, marking the boundaries of the treatment site, and requiring the use of dye markers when spraying along the roadside.

- ADOT would like to coordinate regarding the procedures and requirements for notifications ahead of treatments on rights-of-way.

4.2 Alternatives

In addition to the three alternatives discussed above, the Navajo Nation Department of Fish and Wildlife, Navajo Natural Heritage Program requested that a fourth alternative be developed to consider weed control using cultural, chemical, and mechanical methods, but not biological control.

4.3 Priority Sites for Weed Control

Originally, the BIA was considering developing a list of priority sites for weed control to be evaluated in the EIS. However, after further discussions with cooperating agencies the BIA decided that every acre on the Navajo Nation would be evaluated for any of the proposed control treatments. Scoping was performed prior to this decision; therefore, the scoping comment card requested a list of priority sites for weed control from the public. While these sites will not be analyzed separately, they will be covered in the EIS. Several commenters provided suggestions for priority sites of weed control. These sites include the following:

- One commenter said that priority sites for weed removal will depend on farmland, home site lease or land use permittees.
- Two comments included range and farmland
- Chinle South Natural Dam and Red Reservoir Earth Dam west of Chinle.
- Watersheds
- Residential and harvest fields in Lupton, Houck, Klagetoh, Wide Ruins, and Sanders area.
- Areas near communities in Ganado, Kayenta, TC, Crownpoint.
- All open rangeland which have no management should be high priority.
- 15 dams in the Fort Defiance community.
- Cow Springs Wash
- Camelthorn around South Tuba City.
- Target Russian olive in water ways.
- Residential areas and homesteads
- Farms and canals
- Round Rock Lake and irrigation canals from the lake.
- Lukachukai, AZ- all the washes that come down from the mountains.

- Three comments suggested farms, lakes, ponds, washes, roads, and rangeland.
- Musk thistle located three miles northwest of Pinion High School and Sanddune Valley.
- Blue Gap Valley
- Bull thistle and cocklebur located three miles north of Pinion around Hwy 41- down Wash Valley. Typical names of the area are Tonikani, Tse Ha Nilii, Sanddune Valley.
- Navajo Partitioned Land and Hopi Partitioned Land
- Many Farms Lake, Chinle Wash. Concerned about Russian olive debris taking out the Chinle Wash Bridge in a big flood event.
- Many Farms Lake and Farm Plot #10-2-46 NW of Sand Cone Spring Art Well.
- Little Colorado River-suggested that BIA should prioritize the Little Colorado River Invasive Species Management Plan.
- San Juan River corridor to treat the overgrowth of Russian Olive.
- Farms should be retired and returned to rangeland.
- Safe removal of saltcedar from earthen dams about 7 miles south of Burnham Chapter.
- Roadsides and riparian areas adjacent to bridges and culverts.
- Dulcon, AZ in the Chimney Butte area is infested with tumbleweed and others. Cheat grass came in during wet winters.

4.4 Re-planting/Restoring Sites after Weed Removal Treatments

Several commenters showed concern about re-seeding and restoring sites after weed removal treatments occurred. Below is a list of the comments and questions that were provided.

- Two commenters discussed the issues of what to do with livestock after an area is replanted with natives, one suggested that fencing should be a priority.
- Areas should be revegetated with more native trees.
- Four commenters were interested in the species of native plants that could be used to replant areas after weed removal.
- One commenter asked when an area can be re-seeded after treatment and where will funding come from.
- One commenter requested that re-seeding should occur.

4.5 Soil Erosion and Disturbance

Several commenters were concerned over the disturbance to soil when invasive weeds are removed and suggested that treated areas should be revegetated with native forage to stabilize soil, wind erosion, and cultural resources.

4.6 Education and Public Outreach

During the scoping presentation, the use of public education and outreach were discussed to help with prevention of new weed infestations.

- Four people commented on the need for greater public outreach and education and community engagement. The comments suggested that public education and outreach should emphasize weed prevention to increase native vegetation for livestock; educational awareness material could be distributed as brochures, fact sheets, and posters; and that more BIA and tribal participation should occur at the Local Work Group meetings.
- Two comments suggested that education be focused through the schools by designing a local projects and have kids participate and provide an avenue for the information to reach the family.
- Two comments requested more information on restoration, weeds, plants, and trees that are removed and on how to control certain invasive weeds.
- One commenter suggested that people should be informed about invasive weeds when they receive their grazing permits.

4.7 Priority Weed Species

The BIA selected 21 priority noxious weed species to focus on in the proposed integrated weed management plan. Many of the priority weeds identified by the commenters were already on the BIA's priority species list, including: Russian olive, saltcedar, camelthorn, spotted knapweed, puncturevine (bullhead), and musk thistle.

- One commenter discussed the dense thickets of Russian olive in washes provides ideal sites for parties, a hiding place for someone running from the law, and an area where cattle can hide from the owners.
- Another commenter discussed their concern of Russian olives taking over three acres of farmland near an artesian well where the community gets their water.Other species that were suggested by commenters to include on the weed priority list include: Russian thistle and cocklebur (*Xanthium strumarium*).
- Three commenters brought up an economic concern with the cocklebur getting stuck in sheep wool and decreasing the market value of the wool.

- Red willow was discussed as a concern by one commenter because they believe that the willow uses too much water.
- Milkweed was a concern of one commenter, because it is poisonous for livestock.
- One commenter suggested that the highest priority should be to create a noxious and invasive weed plant list for the grazing districts with the help of the NRCS Local Work Groups.
- Russian knapweed, camelthorn, and Russian olive are hard to control because of infestations outside of the Navajo Nation and that seeds drop each year and remain in the soil.

4.8 Economic Concerns

One of the resources to be analyzed in the EIS is the impact of the integrated weed management plan on economic concerns.

- One commenter proposed that an effective weed eradication plant could serve to create jobs and potential entrepreneurial opportunities.
- One commenter was concerned about the impact of weeds taking the water from a water source designated for farming and ranching.
- Several commenters were concerned over the impact of invasive weeds on the declined condition of rangeland for their livestock and decreased value of wool from their sheep due to cocklebur entanglement.
- Many commenters would like to see the rangeland restored with native grasses to improve grazing habitat.

4.9 Climate Change

Several commenters were concerned about the impacts of grazing pressure and climate change on the proliferation of weeds, and suggested that climate change be evaluated in the EIS. One commenter suggested that the EIS should analyze and quantify the effects of grazing, weed-infested hay, and drought on the establishment and proliferation of weeds.

4.10 Policy Concerns

Currently, the Navajo Nation allows weed infested hay to be sold and used on the Navajo Nation. This has been a source of exotic weed infestation. Several commenters discussed the need for a Navajo Nation weed law/policy that would only permit the sale and use of certified weed-free hay for livestock.

- One commenter suggested that invasive weeds should be included in a Livestock Management Plan.
- One commenter had concern over the grazing pressure and increase in noxious weeds and suggested that BIA enforce the grazing regulations.

- Two commenters had concern over why overgrazing was not addressed as the cause of the weeds and felt that desertification was advancing.

4.11 Maintenance and Monitoring

- One commenter asked how sites were going to be monitored after areas were treated.

4.12 Cooperating Agencies

As stated above in Section 2.5, a cooperating agency is any federal agency that has jurisdiction by law or special expertise with respect to any environmental impact involved in a proposed action.

- One commenter suggested that the Navajo Nation government, particularly the Agricultural Department, needs to be more involved in this project.
- One commenter suggested that if partnering agencies were able to consider funding this project it would serve to strengthen the resurgence of natural vegetation and wildlife, restore underground water levels and create more favorable conditions for future agricultural initiatives thereby restoring and strengthen Navajo cultural farming traditions.
- USDA Natural Resources Conservation Service (NRCS) does herbaceous weed control. They have a plan and practice standards including biochemical and mechanical controls. They would like to form partnerships with the BIA agencies. One commenter recommended that the BIA incorporate aspects of the NRCS practice standard for control, priority species identification, and community coordination into the proposed integrated weed management plan.

4.13 Other Comments Relating to the EIS

Several commenters during the first round of scoping felt that the scoping period needed to be extended to include more scoping meetings in areas that would also be interested in the project. Also, several commenters suggested that a more aggressive advertising campaign was needed for the meetings. In response to these comments, the scoping period was extended to March 20, 2013 and the scoping presentation was given at four additional meeting locations and at two district grazing meetings (discussed above). The four scoping meetings were publicized in various media outlets, including radio, newspaper, and flyers.

- One commenter was interested in when the integrated weed management plan will take effect.
- One commenter would like it clearly stated what types of activities would fall into the category of ground disturbing activities that require cultural or biological surveys. Herbicide application, mowing, and hand/chain saw removal are not considered ground disturbing activities by ADOT.

4.14 Non-EIS Scoping Comments

NEPA regulations state that all significant issues relative to the proposed project should be addressed in the EIS. The comments and issues discussed above will be addressed in the EIS. However, comments that were beyond the scope of NEPA and CEQA, outside of the proposed project, value-type comments, or not related to the plan or EIS do not need to be addressed in the EIS. Therefore, these comments were not provided in this report.

Appendix A. Notice of Intent and the Notice to Extend the Scoping Period

review, as required by the Paperwork Reduction Act of 1995 (44 U.S.C. Chapter 35, as amended). This Notice is soliciting comments from members of the public and affected agencies concerning the proposed collection of information to: (1) Evaluate whether the proposed collection of information is necessary for the proper performance of the functions of the agency, including whether the information will have practical utility; (2) evaluate the accuracy of the agency's estimate of the burden of the proposed collection of information; (3) enhance the quality, utility, and clarity of the information to be collected; and (4) minimize the burden of the collection of information on those who are to respond, including through the use of appropriate automated collection techniques or other forms of information technology; e.g., permitting electronic submission of responses.

This Notice also lists the following information:

Title of Proposal: Annual Performance Report and Annual Homeless Assessment Report.

OMB Control Number: 2506–0145.

Description of the need for the information and proposed use: This information will enable HUD to assess the performance of individual projects and to determine project compliance with funding requirements. This information assists HUD in understanding homeless clients and service needs at the local level. HUD also uses this information to provide information on overall program performance and outcomes to HUD staff, other federal agencies, the Congress, and the Office of Management and Budget.

Agency Form Numbers: HUD–40118.

Members of the affected public: Grant recipients for the Supportive Housing Program (SHP), Shelter Plus Care (S+C) Program, and the Section 8 Moderate Rehabilitation for the Single Room Occupancy Dwellings (SRO) Program.

Estimation of the total number of hours needed to prepare the information collection including number of respondents, frequency of response, and hours of response: APR Non-Profit recipients (3,250 responses × 1,680 minutes = 91,000 hours per annum) + APR State and Local Government recipients (3,250 responses × 1,680 minutes = 91,000 hours per annum) + AHAR with Automated Software Report (425 responses × 48 hours = 20,400 hours per annum) + AHAR with Manual Software Report (63 responses × 88 hours = 5,544 hours per annum) = 207,944 hours per annum.

Status of proposed information collection: Extension of currently approved package 2506–0145.

Authority: Section 3506 of the Paperwork Reduction Act of 1995, 44 U.S.C. Chapter 35, as amended.

Dated: January 7, 2013.

Clifford Taffet,

General Deputy Assistant Secretary for Community Planning and Development.

[FR Doc. 2013–00564 Filed 1–11–13; 8:45 am]

BILLING CODE 4210–67–P

DEPARTMENT OF THE INTERIOR

Office of the Secretary

Central Utah Project Completion Act; East Hobble Creek Restoration Project Draft Environmental Assessment

AGENCY: Office of the Assistant Secretary for Water and Science, Interior.

ACTION: Notice of availability.

SUMMARY: The draft environmental assessment for the East Hobble Creek Restoration Project is available for public review and comment. The assessment analyzes the anticipated environmental effects of a proposed restoration effort on a portion of Lower Hobble Creek, near Springville, Utah.

DATES: Submit written comments by *February 13, 2013.*

ADDRESSES: Send written comments to Ms. Sarah Sutherland, East Hobble Creek Restoration, 355 W. University Parkway, Orem, UT 84058–7303; by email to *sarah@cuwcd.com;* or by Fax to 801–226–7171.

Copies of the Draft Environmental Assessment are available for inspection at:

• Central Utah Water Conservancy District, 355 West University Parkway, Orem, Utah 84058–7303

• Department of the Interior, Central Utah Project Completion Act Office, 302 East 1860 South, Provo, Utah 84606

In addition, the document is available at *www.cuwcd.com* and *www.cupcao.gov.*

FOR FURTHER INFORMATION CONTACT: Mr. Lee Baxter, Central Utah Project Completion Act Office, at (801) 379–1174; or email at *lbaxter@usbr.gov.*

SUPPLEMENTARY INFORMATION: The Department of the Interior, the Utah Reclamation Mitigation and Conservation Commission, and the Central Utah Water Conservancy District, are evaluating the impacts of the proposed East Hobble Creek Restoration project. The draft environmental assessment, being completed in conjunction with the June Sucker Recovery Implementation Program, will analyze and present the anticipated environmental effects of a proposed restoration effort on a portion of lower Hobble Creek, near Springville, Utah. This restoration effort is intended to facilitate the recovery of the June sucker, a federally listed endangered species, through improvement of spawning habitat and maintenance of stream flow. The effort to be analyzed would include the potential restoration of approximately 2 miles of stream channel, modification or removal of several existing barriers to fish passage, and enhancement of the existing water supply.

Public Disclosure

Before including your address, phone number, email address, or other personal identifying information in your comment, you should be aware that your entire comment—including your personal identifying information—may be made publicly available at any time. While you can ask us in your comment to withhold your personal identifying information from public review, we cannot guarantee that we will be able to do so.

Dated: January 9, 2013.

Reed R. Murray,

Program Director, Central Utah Project Completion Act. Department of the Interior.

[FR Doc. 2013–00656 Filed 1–11–13; 8:45 am]

BILLING CODE 4310–MN–P

DEPARTMENT OF THE INTERIOR

Bureau of Indian Affairs

Notice of Intent To Prepare a Programmatic Environmental Impact Statement (EIS) for the Navajo Nation Integrated Weed Management Plan Within Coconino, Navajo, and Apache Counties, Arizona; McKinley, San Juan, McGill, and Cibola Counties, NM; and San Juan County, UT

AGENCY: Bureau of Indian Affairs, Interior.

ACTION: Notice.

SUMMARY: This notice advises the public that the Bureau of Indian Affairs (BIA) as lead Agency, with the Navajo Nation, National Park Service, and Arizona Department of Transportation serving as cooperating agencies, intends to prepare an EIS for a proposed weed management plan for the Navajo Indian Reservation. This notice also announces the beginning of the public scoping process to solicit public comments and identify issues.

DATES: Comments on the scope of the EIS may be submitted in writing until February 28, 2013. The date(s) and location(s) of any scoping meetings will be announced at least 15 days in advance through local media, including the Navajo Times, Arizona Daily Sun, Farmington Daily Times, Gallup Independent, and the Navajo Hopi Observer.

ADDRESSES: You may mail, email or hand carry comments to Renee Benally, Natural Resource Specialist, Bureau of Indian Affairs, Western Navajo Agency, Branch of Natural Resources, PO Box 127, Tuba City, Arizona 86045; telephone: (928)283–2210; email: *renee.benally@bia.gov.*

FOR FURTHER INFORMATION CONTACT: Renee Benally, Natural Resource Specialist, Bureau of Indian Affairs, Western Navajo Agency, Branch of Natural Resources, PO Box 127, Tuba City, Arizona 86045; telephone: (928)283–2210; email: *renee.benally@bia.gov.*

SUPPLEMENTARY INFORMATION: The BIA is proposing to develop a ten-year integrated weed management plan for the Navajo Indian Reservation. The Navajo Indian Reservation lands are infested with noxious and/or invasive weeds that have social and economic impacts on the Navajo Nation. The BIA, in partnership with cooperating agencies, intends to develop an integrated weed management plan to prevent, control, reduce, and eliminate the detrimental impacts of weed infestations throughout the reservation. The proposed action would authorize new treatments of noxious and invasive weed infestations throughout the Navajo Indian Reservation. The number of infestations and amount of acreage treated will be determined by the annual funding allocations for project implementation. The various methods of noxious/invasive weed control that will be considered during development of alternatives for the integrated weed management plan include, but will not be limited to, mechanical, cultural, biological and herbicidal treatments, and other methods that may be identified during the public scoping process.

The purpose of the public scoping process is to determine relevant issues that will influence the scope of the environmental analysis, including alternatives, and guide the process for developing the EIS. At present, the BIA has identified the following preliminary issues: Surface and ground water quality; environmental justice considerations; cultural and historic resources; biological resources; public health; and socioeconomics.

The BIA will use and coordinate the NEPA commenting process to satisfy the public involvement process for Section 106 of the National Historic Preservation Act (16 U.S.C. 470f) as provided for in 36 CFR 800.2(d)(3). Native American tribal consultations will be conducted in accordance with the Department of the Interior's consultation policy, and tribal concerns will be given due consideration, including impacts on Indian trust assets. Federal, State, and local agencies, along with other stakeholders that may be interested in or affected by the BIA's decision on this project are invited to participate in the scoping process and, if eligible, may request or be requested by the BIA to participate as a cooperating agency.

Directions for Submitting Public Comments: Please include your name, return address and the caption ''Navajo Nation Integrated Weed Management Plan EIS Comments'' at the head of your letter or in the subject line of your email message.

Availability of Comments: Comments, including names and addresses of respondents, will be available for public review at the BIA address shown in the **ADDRESSES** section of this notice during regular business hours, Monday through Friday, except holidays. Before including your address, phone number, email address, or other personal identifying information in your comment, you should be aware that your entire comment—including your personal identifying information—may be made publicly available at any time. While you can ask us in your comment to withhold your personal identifying information from public review, we cannot guarantee that we will be able to do so.

Authority: This notice is published in accordance with sections 1503.1 and 1506.6 of the Council on Environmental Quality Regulations (40 CFR parts 1500 through 1508) implementing the procedural requirements of the National Environmental Policy Act of 1969, as amended (42 U.S.C. 4321 *et seq.*), and the Department of the Interior National Environmental Policy Act Implementation Policy (43 CFR part 46), and is in the exercise of authority delegated to the Assistant Secretary-Indian Affairs by 209 DM 8.

Dated: December 19, 2012.

Kevin K. Washburn,

Assistant Secretary—Indian Affairs.

[FR Doc. 2013–00527 Filed 1–11–13; 8:45 am]

BILLING CODE 4310–W7–P

DEPARTMENT OF THE INTERIOR

National Park Service

[NPS–NRSS–GRD–12018; PPWONRADG0, PPMRSNR1N.NG0000]

Information Collection Request Sent to the Office of Management and Budget (OMB) for Approval; Mining and Mining Claims and Non-Federal Oil and Gas Rights

AGENCY: National Park Service, Interior.

ACTION: Notice; request for comments.

SUMMARY: We (National Park Service, NPS) have sent an Information Collection Request (ICR) to OMB for review and approval. We summarize the ICR below and describe the nature of the collection and the estimated burden and cost. This information collection is scheduled to expire on February 28, 2013. We may not conduct or sponsor and a person is not required to respond to a collection of information unless it displays a currently valid OMB control number. However, under OMB regulations, we may continue to conduct or sponsor this information collection while it is pending at OMB.

DATES: You must submit comments on or before February 13, 2013.

ADDRESSES: Send your comments and suggestions on this information collection to the Desk Officer for the Department of the Interior at OMB–OIRA at (202) 395–5806 (fax) or *OIRA_Submission@omb.eop.gov* (email). Please provide a copy of your comments to the Information Collection Clearance Officer, National Park Service, 1201 I Street NW., MS 1237, Washington, DC 20005 (mail); or *madonna_baucum@nps.gov* (email). Please reference OMB Control Number 1024–0064 in the subject line of your comments.

FOR FURTHER INFORMATION CONTACT: To request additional information about this ICR, contact Edward O. Kassman, Jr., Regulatory Specialist, Energy and Minerals Branch, Geologic Resources Division, National Park Service, P.O. Box 25287, Lakewood, Colorado 80225 (mail); (303) 987–6792 (fax); or *Edward_Kassman@nps.gov* (email). You may review the ICR online at *http://www.reginfo.gov*. Follow the instructions to review Department of the Interior collections under review by OMB.

I. Abstract

The Organic Act of 1916 (NPS Organic Act) (16 U.S.C. 1 *et seq.*) authorizes the Secretary of the Interior to develop regulations for national park influence of liquor/alcoholic beverage, to the extent that control of the person's faculties is impaired shall be guilty of a violation of this ordinance.

.03 Consuming Liquor/Alcohol in Public Conveyance—Any person engaged wholly or in part in the public conveyance business of carrying passengers for hire and every agent, servant, or employee or such person, who knowingly permits any person to drink any liquor/alcohol in any vehicle that carries passengers for hire, while such vehicle in on Tribal land, shall be guilty of a violation of this ordinance. Any person who drinks any liquor/alcohol in any vehicle that carries passengers for hire, while such vehicle is on Tribal land, shall be guilty of a violation of this ordinance.

.04 Liquor/Alcohol may not be given as a prize, gift, premium or consideration for a lottery, contest, game of chance or skill, or competition of any kind.

Section 8.00—Enforcement and Jurisdiction

.01 Enforcement—The Tribe through its Tribal Council and Bishop Paiute Tribal Court (Tribal Court) and duly authorized security personnel, shall have the authority to enforce this Ordinance which shall include confiscating any liquor/alcohol manufactured, introduced, sold or possessed located on Tribal Lands in violation of this ordinance. The Tribal Council shall be empowered to sell confiscated liquor/alcohol for the benefit of the Tribe after receiving Tribal Court approval, and to develop and approve such regulations as may become necessary for the enforcement of this Ordinance.

.02 Jurisdiction—Any violations of this ordinance shall constitute a public nuisance under Tribal law. It shall be the Tribal Council or its duly authorized security personnel who may initiate and maintain an action in the Tribal Court to abate and permanently enjoin any nuisance declared under this ordinance and to enforce any and all provisions and penalties under this ordinance. The Tribal Council shall authorize and implement the development of Court rules and procedures that will ensure due process as to all Tribal Court proceedings under this ordinance. Any actions taken under this section 8 may be in addition to any other penalties provided in this ordinance or adopted by the Tribal Council from time to time. This ordinance when approved by the United States Department of the Interior and published in the **Federal Register** shall fall under the jurisdiction of the Tribal Court.

.03 General penalties—The Tribe through the Tribal Court may implement monetary fines not to exceed $500 for each violation and/or causing the suspension or revocation of a liquor/alcohol license. The Tribal Court may adopt by resolution a separate schedule of fines for each type of violation, taking into account its seriousness and the threat it may pose to the general health and welfare of tribal members. This schedule will include violations for repeat offenders. Any penalties provided herein shall in addition to any criminal penalties, which may be imposed by the Tribal Court through an adopted separate ordinance that conforms to federal law.

.04 Conflicting provisions—Whenever any conflict occurs between the provisions of this ordinance or the provisions of any other ordinance of the Tribe, the stricter of such provisions shall apply.

.05 Severability—If any provision or application of this ordinance is determined invalid such determination shall not invalidate the remaining portions of this ordinance.

Section 9.00—Limited Waiver of Sovereign Immunity

By enacting this ordinance, the Tribe does not waive, or limit or modify its sovereign immunity from unconsented suit or any other judicial or administrative proceeding except as specifically provided herein.

The Tribe agrees and grants a limited waiver of its sovereign immunity solely for the purpose of authorizing the State of California through or on behalf of the California State Department of Alcohol Beverage Control or any other appropriate sState agency to bring an action in courts of appropriate jurisdiction with the State of California or California State Administrative Proceedings, for the purpose of providing the State of California with remedies to enforce all laws, rules, regulations and rights the state has relating to the issuance of a liquor/alcohol beverage license to the Tribe.

Section 10.00—Revocation/Suspension of License

The Tribal Council may revoke or suspend the license for reasonable cause after providing the licensee with notice and an opportunity to participate in a hearing at which time the licensee is given an opportunity to respond to any claims against it alleging a violation of this Ordinance, and to demonstrate why the license should not be revoked or suspended. Any determination of the Tribal Council concerning revocation or suspension of a license is final. The Tribal Council shall direct its authorized representatives to prepare appropriate rules of procedure concerning how a revocation/suspension hearing is to be held and the form of notice to be given to a licensee subject to potential revocation or suspension of its license.

Section 11.00—Inspection of Licensed Premises

The premises on which liquor is sold or distributed shall be open for inspection by the Tribal Council and/or its authorized representative with respect to the enforcement of this Ordinance at all reasonable times for the purpose of ascertaining whether the rules and regulations of the Tribal Council and this Ordinance are being complied with.

[FR Doc. 2013–05499 Filed 3–7–13; 8:45 am]

BILLING CODE 4310–4J–P

DEPARTMENT OF THE INTERIOR

Bureau of Indian Affairs

Extending Scoping Period To Prepare a Programmatic Environmental Impact Statement (EIS) for the Navajo Nation Integrated Weed Management Plan Within Coconino, Navajo, and Apache Counties, AZ; McKinley, San Juan, McGill, and Cibola, Counties, NM; and San Juan County, UT

AGENCY: Bureau of Indian Affairs, Interior.

ACTION: Notice.

SUMMARY: The Bureau of Indian Affairs (BIA) is extending the public scoping period to prepare an EIS for the Navajo Nation Integrated Weed Management Plan on the Navajo Indian Reservation.

DATES: Scoping comments are due on March 20, 2013.

FOR FURTHER INFORMATION CONTACT: Renee Benally at (928) 283–2210; email: *renee.benally@bia.gov.*

SUPPLEMENTARY INFORMATION: The BIA published a Notice of Intent in the **Federal Register** on January 14, 2013, (78 FR 2685) and ended the scoping comment period on February 28, 2013. The BIA is extending the comment period to March 20, 2013. Please refer to the January 14, 2013, (78 FR 2685) Notice of Intent for project details and commenting instructions.

Dated: February 28, 2013.

Kevin K. Washburn,

Assistant Secretary—Indian Affairs.

[FR Doc. 2013–05398 Filed 3–7–13; 8:45 am]

BILLING CODE 4310–W7–P

Appendix B. Newspaper advertisement for the initial scoping meeting locations, dates, and times

azdailysun.com
Serving Flagstaff and northern Arizona

Navajo Region Integrated Weed Management Plan Public Meetings

Event occured on Thu, Feb 7 2013, 1:00 pm - 5:00 pm MST

Department of the Interior - Bureau of Indian Affairs—Navajo Region

Announces Public Scoping meetings for an Integrated Weed Management Plan to tackle invasive weeds on the Navajo Nation.

Meetings will be held at the following Navajo Nation Chapter Houses:

* Crownpoint (Feb 5th 5pm-7pm)

* Fort Defiance (Feb 8th 9am-12noon)

*Shiprock (Feb 6th 5pm-7pm)

* Tuba City (Feb 12th 3pm-6pm)

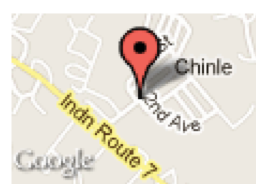
* Chinle (Feb 7th 1pm-5pm)

Call or email BIA Natural Resource Specialist, Renee Benally for more information (928)283-2210, renee.benally@bia.gov

Help us fight weeds on the Navajo Reservation!

Venue

Chinle Chapter House
220 S. Main St.
Chinle, AZ 86503



Cost

This is a **free** event.

Schedule

Event has ended.

Contact Info

Renee Benally

- 9282832210
- renee.benally@bia.gov

More Public Meetings Events

Flagstaff area springs

Flinn Scholars Program to host informational meeting March 28 at NAU

Northern Arizona Audubon Meeting

Flagstaff

Flagstaff Public Library Board Meeting

Flagstaff Communicators meeting

District Advisory Board Meeting

Immigration Awareness Week: Multi-media Presentation

Appendix C. Public flyer announcing the scoping meetings

DEPARTMENT OF THE INTERIOR Bureau of Indian Affairs

Notice of Intent To Prepare a Programmatic Environmental Impact Statement (EIS) for the Navajo Nation Integrated Weed Management Plan Within Coconino, Navajo, and Apache Counties, Arizona; McKinley, San Juan, McGill, and Cibola Counties, NM; and San Juan County, UT

AGENCY: Bureau of Indian Affairs, Interior.

ACTION: Notice.

Summary: This notice advises the public that the Bureau of Indian Affairs (BIA) as lead Agency, with the Navajo Nation, National Park Service, Bureau of Land Management, U.S. Fish and Wildlife Services, and Arizona Department of Transportation serving as cooperating agencies, intends to prepare an EIS for a proposed weed management plan for the Navajo Indian Reservation. This notice also announces the beginning of the public scoping process to solicit public comments and identify issues.

DATES: Comments on the scope of the EIS may be submitted in writing until **February 28, 2013**. The date(s) and location(s) of any scoping meetings will be announced at least 15 days in advance through local media, including the Navajo Times, Arizona Daily Sun, Farmington Daily Times, Gallup Independent, and the Navajo Hopi Observer.

February 05, 2013 – Crownpoint Chapter House	**Crownpoint, NM**	**5:00 PM to 7:00 PM MST**
February 06, 2013 – Shiprock Chapter House	**Shiprock, NM**	**5:00 PM to 7:00 PM, MST**
February 07, 2013 – Chinle Chapter House	**Chinle, AZ**	**1:00 PM to 5:00 PM, MST**
February 08, 2013 – Fort Defiance Chapter House	**Fort Defiance, AZ**	**9:00 AM to 12:00 PM, MST**
February 12, 2013 – Tuba City Chapter House	**Tuba City, AZ**	**3:00 PM to 6:00 PM, MST**

FOR FURTHER INFORMATION CONTACT:
Renee Benally, Natural Resource Specialist,
Bureau of Indian Affairs, Western Navajo Agency, Branch of Natural Resources,
PO Box 127, Tuba City, Arizona 86045;
telephone: (928)283–2210; email: renee.benally@bia.gov.

Dated: December 19, 2012.
Kevin K. Washburn, *Assistant Secretary—Indian Affairs.*
[FR Doc. 2013–00527 Filed 1–11–13; 8:45 am] **BILLING CODE 4310–W7–P**

Appendix D. Public service announcement in newspapers and radio for the extended scoping period

AFFIDAVIT/PROOF OF PUBLICATION

STATE OF ARIZONA

} ss.

County of Coconino

Bobbie Crosby being duly sworn deposes and says:

That she is the legal clerk of the Arizona Daily Sun

a newspaper published at Flagstaff, Coconino County, Arizona; that the

legal 16735

a copy of which is hereunto attached, was first published in said newspaper in its issue dated the 12 day of March, 2013, and was published in each one issue of said newspaper for four consecutive days the last publication being in the issue dated the 15 day of March, 2013.

Subscribed and sworn to before me this 25 day of March, 2013

Wendy Pettay

Notary Public

OFFICIAL SEAL
WENDY PETTAY
NOTARY PUBLIC – STATE OF ARIZONA
COCONINO COUNTY
My commission expires May 28, 2016.

My Commission expires 05/28/2016

Legal No. 16735
Department of the Interior - Bureau of Indian Affairs-Navajo Region
The BIA has extended the Public Scoping period for a Programmatic Environmental Impact Statement for an Integrated Weed Management Plan to control noxious weeds on the Navajo Nation. Comments on the Plan and EIS will be accepted until March 18.
Meetings will be held at the following locations:
* Navajo Nation Museum, Window Rock (March 11th 12pm-3pm DST)
* Kayenta Chapter House (March 13th 10am-1pm DST)
* Pinon Chapter House (March 14th 10am-2pm DST)
* Many Farms Chapter House (March 15th 1pm-5pm DST)
Call BIA Natural Resource Specialist, Renee Benally for more information (928) 283-2210
Help us fight weeds together!
PUB: Mar, 12, 13, 14, 15, 2013
16735

Durango Herald / Cortez Journal

Department of the Interior – Bureau of Indian Affairs
Navajo Region

The BIA has extended the Public Scoping period for a Programmatic Environmental Impact Statement for an Integrated Weed Management Plan to control noxious weeds on the Navajo Nation. Comments on the Plan and EIS will be accepted until March 18.

Meetings will be held at the following locations:

- Navajo Nation Museum, Window Rock (March 11th 12pm-3pm DST)
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- Many Farms Chapter House (March 15th 1pm-5pm DST)

Call BIA Natural Resource Specialist, Renee Benally for more information (928) 283-2210

Help us fight weeds together!

DEPARTMENT OF THE INTERIOR
BUREAU OF INDIAN AFFAIRS
NAVAJO REGION

Farmington Daily Times

The BIA has extended the Public Scoping period for a Programmatic Environmental Impact Statement for an Integrated Weed Management Plan to control noxious weeds on the Navajo Nation. Comments on the Plan and EIS will be accepted until March 18.

Meetings will be held at the following locations:

Navajo Nation Museum, Window Rock
(March 11th 12pm-3pm DST)

Kayenta Chapter House
(March 13th 10am-1pm DST)

Pinon Chapter House
(March 14th 10am-2pm DST)

Many Farms Chapter House
(March 15th 1pm-5pm DST)

Call BIA Natural Resource Specialist, Renee Benally for more information (928) 283-2210

Help us fight weeds together!

Gallup Independent

Affidavit of Publication

STATE OF NEW MEXICO
) SS
COUNTY OF MCKINLEY

REBECCA PAQUIN being duly sworn upon oath, deposes and says:

As LEGAL CLERK of The Independent, a newspaper published in and having a general circulation in McKinley County, New Mexico and in the City of Gallup, New Mexico and having a general circulation in Cibola County, New Mexico and in the City of Grants, New Mexico and having a general circulation in Apache County, Arizona and in the City of St. Johns and in the City of Window Rock, Arizona therein: that this affiant makes the affidavit based upon personal knowledge of the facts herein sworn to. That the publication, a copy of which is hereto attached was published in said newspaper during the period time of publication and said notice was published in the newspaper proper, and not in a supplement thereof, for Three Times, the first publication being on the 13th day of March, 2013, the second publication being on the 14th day of March, 2013, the third publication being on the ______ day of ______, 2013,

and the last publication being on the 15th day of March, 2013. That such newspaper, in which such notice or advertisement was published, is now and has been at all times material hereto, duly qualified for such purpose, and to publish legal notices and advertisements within the meaning of Chapter 12, of the statutes of the State of New Mexico, 1941 compilation,

Rebecca Paquin
Affiant.

Sworn and Subscribed to before me this 18th day of March, A.D., 2013.

____
Notary Public

My commission expires:
June 25th, 2014.

LEGAL NOTICE
Gallup - McKinley County
New Mexico

Department of the Interior - Bureau of Indian Affairs — Navajo Region

The BIA has extended the Public Scoping period for a Programmatic Environmental Impact Statement for an Integrated Weed Management Plan to control noxious weeds on the Navajo Nation. Comments on the Plan and EIS will be accepted until March 18.

Meetings will be held at the following locations:

* **Navajo Nation Museum, Window Rock** (March 11th 12pm-3pm DST)
* **Kayenta Chapter House** (March 13th 10am-1pm DST)
* **Pinon Chapter House** (March 14th 10am-2pm DST)
* **Many Farms Chapter House** (March 15th 1pm-5pm DST)

Call BIA Natural Resource Specialist, Renee Benally for more information (928) 283-2210
Help us fight weeds together!

Legal# 14260 Published in The Independent March 13 & 14 & 15, 2013.

Durango Telegraph Advertisement
March 14th, 2013 edition

classified

fied ads is **Tuesday at noon**. Ads are a bargain at **40 cents per word with a $4 minimum**. Due to an increase in unusually long **URL/email addresses,** these will now be charged **10 cents/character**, with an additional **$1 to provide a link on our web site**. Prepayment is required via cash, credit card or check.
(Sorry, no refunds or substitutions.)
Ads can be submitted via several easy ways:

- E-mail (classifieds@durangotelegraph.com)
- Phone (259-0133)
- 1309 E. 3rd Ave., # 25

Approximate office hours:
Mon., 9ish - 6ish
Tues., 9ish - 6ish
Wed., 9ish - 3ish
Thurs., On delivery
Fri., 10:30ish - 2ish
please call ahead 259-0133.

Found

Gold Ring with a Blue Stone
in Town Plaza Laundromat. Call 303 513-8055 to ID.

Lost

Prescription sunglasses
Grey case, Monday night on 9th Street. 970-769-4248.

Red Fischer Xcountry Skis
and blue poles lost at Falls Creek/Hidden Valley meadow parking area Sun., Feb. 10. Please call Wendy 608-446-6009 with any information.

HelpWanted

Americana rock band
looking for experienced bass player to join band and play gigs. Call John at 769-2113 if interested.

Karyn Gabaldon Fine Arts
Seeking full-time, dynamic sales person with social media and computer skills. Bring resume on Fri. or Sat. only, 10 a.m. - 6 p.m. 680 Main Ave.

Wanted

Used massage tables
970-769-8389.

Reasonably priced, good to excellent condition, 970-946-1478.

Pets

Spring Break is coming!
Make your boarding reservations now! Paws 'N Playtime 970-422-8019.

Got Dog? New Puppy?
Classes by Certified Professional Dog Trainer Juliet Whitfield at the Durango Rec Center. Free class: Your New Dog & You, March 24. www.durangodogs.com 382-2542 Durango Dogs where Dog Training is Fun & Effective.

March Madness is Here!
$5 off all baths and groomings during the month of March. Make your reservations today! Paws 'N Playtime 970-422-8019.

Announcements

Serious Delights Bakehouse
located inside of Nature's Oasis, is now taking orders for wedding and other special occasion cakes! info@seriousdelights.com.

Department of the Interior - Bureau of Indian Affairs - Navajo Region
The BIA has extended the public scoping period for a Programmatic Environmental Impact Statement for an Integrated Weed Management Plan to control noxious weeds on the Navajo Nation. Comments on the Plan and EIS will be accepted until March 18. Meetings will be held at the following locations: Piñon Chapter House (March 14, 10am-2pm DST); Many Farms Chapter House (March 15, 1-5pm DST). Call BIA Natural Resource Specialist Renee Benally for more information (928) 283-2210. Help us fight weeds together!

Cliffside Ski & Bike @ Needles
End of season sale! All ski apparel & accessories for men/women/kids 40-50% off. Demo/rental skis for sale, great prices. 970-385-1461 or info@cliffsideski.com.

Kimonos & Haori Jackets
Upcycled vintage silk @ Verell's, 1021½ Main Ave.

New Treasures are Here
Eco-friendly butterfly earrings. Castille Creation's, 1021½ Main Ave.

Be a massage therapist next ski season
MountainHeart School in Crested Butte! 850 hour, 6-month certification. Starts May 28. 800-673-0539 www.mountainheart.org

Looking for a gift
for your favorite dirtbag climber? Check out Luke Mehall's Climbing Out

Department of the Interior
Bureau of Indian Affairs
Navajo Region

The BIA has extended the Public Scoping period for a Programmatic Environmental Impact Statement for an Integrated Weed Management Plan to control noxious weeds on the Navajo Nation. Comments on the Plan and EIS will be accepted until March 18.

Navajo Times Advertisement

Meetings will be held at the following locations:
* Pinon Chapter House (March 14th 10am-2pm DST)
* Many Farms Chapter House (March 15th 1pm-5pm DST)

Call BIA Natural Resource Specialist, Renee Benally for more information (928) 283-2210
Help us fight weeds together!

3/14/13

Navajo Times Advertisement

ALBUQUERQUE JOURNAL THE SUNDAY JOURNAL

Albuquerque Publishing Company
7777 Jefferson N.E. Albuquerque, New Mexico 87109
P.O. Drawer J-T Albuquerque, New Mexico 87103
(505) 823-7777

Account Number
1042191

Ad Proof / Order Confirmation

Ad Order Number
0001051068

FRED PHILLIPS CONSULTING LLC
401 SOUTH LEROUX ST
FLAGSTAFF AZ 86001

Ordered By	HEIDI TRATHNIGG	**Customer Phone**	928-773-1530	**Pickup #**
Customer EMail		**PO Number**		**Joint Ad #**
Ad Cost	$56.70	**Sales Rep**	dnoel	
Tax Amount	$3.97	**Order Taken by:**	dnoel	
Total Amount	$60.67	**Payment Method**	Credit Card - Visa:8722	
Amount Due	$0.00	**Payment Amount**	$60.67	

Product	Albuquerque Journal	**Placement**	Legal Notices
		Classification	Government-0000
Ad Number	0001051068-01	**Sort Text**	DEPARTMENTOFTHEINTERIORBUREAUOFINDIANAFFAIRSNAVAJOREGIONT
Ad Type	APC-Legals		
Ad Size	: 1.0 X 27 Li		
Color	<NONE>		
Run Dates	3/12/2013, 3/13/2013, 3/14/2013, 3/15/2013		

Affidavits
1

Department of the Interior - Bureau of Indian Affairs- Navajo Region

The BIA has extended the Public Scoping period for a Programmatic Environmental Impact Statement for an Integrated Weed Management Plan to control noxious weeds on the Navajo Nation. Comments on the Plan and EIS will be accepted until March 18. Meetings will be held at the following locations:
* Navajo Nation Museum, Window Rock (March 11th 12pm-3pm DST)
* Kayenta Chapter House (March 13th 10am-1pm DST)
* Pinon Chapter House (March 14th 10am-2pm DST)
* Many Farms Chapter House (March 15th 1pm-5pm DST)

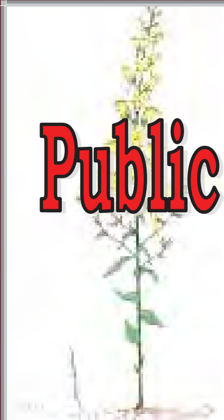
Call BIA Natural Resource Specialist, Renee Benally for more information (928) 283-2210
Journal; March 12-15, 2013

The Bureau of Indian Affairs is conducting scoping meetings to develop an Integrated Weed Management Plan and Environmental Impact Statement to control noxious weeds across the Navajo Nation. The public is invited to participate at the following meetings:

- March 11th from 12:00pm to 3:00pm at the Navajo Nation Museum in Window Rock
- March 13th from 10:00am to 1:00pm at the Kayenta Chapter House
- March 14th from 10:00am to 2:00pm at the Pinon Chapter House, and
- March 15th from 1:00pm to 5:00pm at the Many Farms Chapter House

For more information contact Renee Benally [*Ben-ollie*] at (928) 283-2210.

Appendix E. Public flyer announcing the extended scoping



Public Scoping Meeting for Integrated Weed Management Plan for the entire Navajo Nation:

The BIA is requesting the participation of the public at:

			Daylight Savings Time
March 11, 2013	Window Rock, AZ	Museum	12 pm to 3 pm
March 13, 2013	Kayenta, AZ	Chapter House	10 am to 1 pm
March 14, 2013	Pinon, AZ	Chapter House	10 am to 2 pm
March 15, 2013	Many Farms, AZ	Chapter House	1 pm to 5 pm

The Bureau of Indian Affairs is conducting scoping meetings to discuss the development of the Integrated Weed Management Plan and Environmental Impact Statement to control noxious weeds across the Navajo Nation.

For more information contact Renee Benally at (928) 283-2210.

Appendix F. Scoping meeting sign-in sheet

EIS and IWMP for the Navajo Nation
Interested Participants Sign-In

MEETING: BIA Navajo Region Public Scoping **PLACE:**
DATE: **TIME:**

NAME	ORGANIZATION/ ADDRESS	TELEPHONE NUMBER	E-MAIL

Appendix G. Scoping meeting agenda

Programmatic Environmental Impact Statement for the Navajo Nation Integrated Weed Management Plan

Chinle, AZ

February 7, 2013, 1:00- 5:00 pm

Scoping Meeting Agenda

1:00 PM	Welcome Remarks- Renee Benally, Bureau of Indian Affairs Western Region
1:05 PM	Introduction- Renee Benally
1:10 PM	Integrated Weed Management Plan Environmental Impact Statement Presentations (Navajo/English)
2:40 PM	Closing Remarks
2:45 PM	Provide your comments

Contact Information: Renee Benally, Acting Navajo Region Weed Coordinator, Western Navajo Agency, Branch of Natural Resources, P.O. Box 127, Tuba City, AZ 86045, Renee.Benally@bia.gov, (928) 283-2210

Appendix H. Posters displayed at meeting locations

Integrated Weed Management Plan for Navajo Indian Reservation

Camelthorn
(Alhagi maurorum)
Introduced through contaminated seed and livestock. Can injure livestock and decrease property values. Follows waterways and can penetrate building walls and plumbing.

Knapweed
(*Centaurea* spp.)
Introduced through contaminated seed and ballast. Crowds out native species and forage for livestock. Causes "chewing disease" in horses. Increases surface run-off and sedimentation.

The Integrated Weed Management Plan (IWMP) will be developed by the BIA in order to accomplish noxious/invasive weed control on the Navajo Indian Reservation.

The IWMP will:

1. Comply with the National Environmental Policy Act of 1969 (NEPA) and other associated regulations.
2. Will be a 10-year plan.
3. Can be revised through an adaptive management approach.

The primary purpose of the IWMP is to:

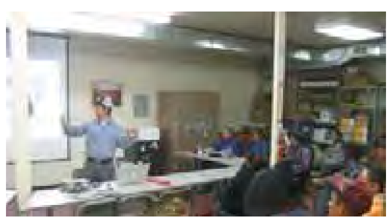
is

- Identify the noxious weeds of concern,
- Evaluate the best management practices for control and eradication,
- Provide procedures and protocols to conduct weed removal,
- Provide an approach to project implementation,
- Identify pilot projects.
- Control Techniques that will be considered include: mechanical, biological, cultural, and chemical treatments

Saltcedar
(*Tamarix* spp.)
Introduced by seed along waterways. Crowds native species and creates single species habitat. Not palatable to many wildlife and range species.

Yellow Starthistle
(*Centaurea solstitalis)*
Introduced through contaminated seed, spread by equipment and animals. Reduces livestock forage. Toxic to horses and sheep.

Education will be an important part of implementing the IWMP and controlling priority invasive weeds across the Navajo Indian Reservation. Fred Phillips Consulting conducted a two-day workshop to educate youth on how to remove invasive species along Ganado Wash.



The different techniques considered for removing invasive weeds include mechanical, biological, cultural, and chemical treatments

Bureau of Indian Affairs
Navajo Region

HIGH PRIORITY INVASIVE WEEDS

These weeds are considered a high priority for eradication and control within the Navajo Nation and Navajo Tribal Trust Lands

MOENKOPI COOPERATIVE WEED MANAGEMENT AREA
NOXIOUS WEED "A" RATING HIGH PRIORITY WEED

WANTED DEAD
SCOTCH THISTLE

SCIENTIFIC NAME:

Onopordum acanthium (L.) - ONAC

FAMILY: Asteraceae (Sunflower)

DESCRIPTION:

Scotch thistle is an aggressive biennial forb that ranges in height from 2 to 12 feet. Rosette leaves area very large (up to 2 feet long and 1 foot wide), spiny, and covered with a dense mat of hairs that give the plant a grayish color. Steam leaves are also hairy, alternate, and coarsely lobed. Flowers area violet to reddish, grow up to 2 inches in diameter, and look like a "shaving brush". Spiny bracts surround each flower head.

Origin: Europe.

Distribution/Comments: It's present in every northern counties in AZ. It's an imposing thistle due to its size and formidable spines which negatively impacts livestock forage production, wildlife habitat, farm land (Shonto Wash), highways (N-16, HWY 87, N-41, N-15), and recreational values.

Control/Methods: Mechanical using shovel for 2 years; herbicide, for more information

http://www.unce.unr.edu/publications/files/nr/2002/FS0257.pdf

http://www.ars.usda.gov/research/publications/publications.htm?seq_no_115=203356

Reference: Non-native Invasive Plants of AZ. 2009. Weeds of the West, 9th Ed. 2002.

Address:

Weed Outta here!!

MOENKOPI COOPERATIVE WEED MANAGEMENT AREA
NOXIOUS WEED "A" RATING HIGH PRIORITY WEED

WANTED DEAD
SPOTTED KNAPWEED

SCIENTIFIC NAME:

Centaurea maculosa (LAM.) - CEBI2

FAMILY: Asteraceae (SUNFLOWER)

DESCRIPTION:

Spotted knapweed is a simple perennial forb that grows 1 to 3 feet tall. It reproduces from seed (primary means of spread) and forms a new shoot each year form a taproot. Basal rosette leaves can be up to 5 inches long and are deeply lobed (similar to diffused knap-weed). Pinkish-purple, lavender, sometimes cream-colored, flower heads are solitary at the end of branches, and are about the same size as diffuse knapweed flowers. Floral bracts area fringed and "comb-like" with stiff dark tips that give, the appearance of "spots". Bracts have obvious vertical veins below the tips and a reduced central spine.

Origin: Eurasia.

Distribution/Comments: Spotted knapweed is sometimes confused with diffuse knapweed but control practices are similar for both species. Both species have been confirmed around **Shonto**, Flagstaff, and are aggressive competitors that displace native vegetation in rangelands, meadows, pastures, wildlife habitat, and recreational areas. One Montana study documented severe soil erosion losses on watersheds infested by this spotted knapweed.

Biological control: Mechanical, Herbicides, Biocontrol using insects

http://www.fcwp.org/BioControl/Spottedknapweed.html

Reference: Non-native Invasive Plants of AZ. 2009. Weeds of the West, 9th Ed. 2002.

Address:

Weed Outta here!!

MOENKOPI COOPERATIVE WEED MANAGEMENT AREA
NOXIOUS WEED "A" RATING HIGH PRIORITY WEED

WANTED DEAD
CAMELTHORN Ch'ilhoshi'

SCIENTIFIC NAME:

Alhagi pseudalhagi (Bieb. Desv.) - ALMA12

FAMILY: Fabaceae (PEA)

DESCRIPTION:

Camelthorn is an aggressive creeping perennial shrub with an extensive root system. It's a "nitrogen fixer" that reproduces by seeds and by extensive, deep-penetrating and horizontally spreading roots. Seeds are housed in jointed seedpods that appear maroon to red in color. Greenish stems are typically tipped with slender greenish-yellow spines that grow 1/4 to 1 3/4 inch long. Leaves are alternate, hairless on the upper surface, but pubescent on the underside.

Origin: Asia, India, Russia.

Distribution/Comments: Camelthorn currently has a scattered distribution throughout the northern counties of AZ. It's especially problematic near the town of Winslow and Holbrook (Tuba City, Leupp, Little Colorado River) where it has caused extensive damage to highways, walkways, and housing foundations. Its creeping root system helps form dense monocultures creating problems for farmers, ranchers, and recreationist.

Control/Methods: Mechanical, Herbicide use (Milestone), no approved biocontrol.

http://www.unce.unr.edu/publications/files/nr/2002/FS0241.pdf

http://www.azdot.gov/Highways/Natural_Resources/Camelthorn.as

Reference: Non-native Invasive Plants of AZ. 2009.

Weeds of the West, 9th Edition. 2002.

Address:

Weed Outta here!!

MOENKOPI COOPERATIVE WEED MANAGEMENT AREA
NOXIOUS WEED "A" RATING HIGH PRIORITY WEED

WANTED DEAD
TAMARISK, SALTCEDAR
K'ei'lichii'its'ooz 3 different names

SCIENTIFIC NAME:

Tamarisk family (LAM.) - TAMAR2

FAMILY: Tamaricaceae

DESCRIPTION:

Deciduous or evergreen shrubs or small trees, 5 to 20 feet tall. Bark on saplings and stems is reddish-brown. Leaves are small and scale-like, on highly branched slender stems. Flowers are pink to white, 5 petalled. Smooth woody stems are dark brown to reddish-brown.

Origin: Eurasia.

Distribution/Comments: Tamarisk family can be found near streams (Little Colorado River, San Juan River, Colorado River, Little Pueblo Colorado Wash and other tributaries), fields, and open areas in AZ. Ranchers, farmers, and highway departments found this as a pest for range and road management which becomes bio-hazard along roads and fire fuel for streams with communities nearby. Wildlife are adapting to this weed infestation as a "natural" habitat, outcompeting native woody species such as willows and cottonwoods. Intermixed with Russian olive, willow, and cottonwoods.

Control/Methods: Mechanical, Herbicide use, Aerial application, for more information

http://agesvr1.nmsu.edu/saltcedar/

Biological Control: Monitoring of the Tamarisk Leaf Beetle, http://www.tamariskcoalition.org/

Reference: Weeds of the West. 9th Edition 2002.

Address:

Weed Outta here!!

MOENKOPI COOPERATIVE WEED MANAGEMENT AREA
NOXIOUS WEED "A" RATING HIGH PRIORITY WEED

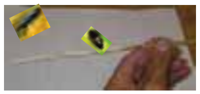
WANTED DEAD
DALMATIAN TOADFLAX

SCIENTIFIC NAME:

Linaria genistifolia ssp dalmatica (L.) - LIDA

FAMILY: Scrophularizceae (Figwort)

DESCRIPTION:



Dalmatian toadflax is a creeping perennial forb with an extensive root system that grows up to 3 feet tall. Even though it's a prolific seed producer that can reproduce both by seed and vegetative reproduction, its deep-penetrating and horizontally spreading root system accounts for much of its spread once seedlings mature. Leaves are alternate, waxy, broad-based, and clasp the stem. Yellow flowers, similar to snapdragons, are borne in the axils of upper leaves. Flowers are striking with an orange bearded throat and a characteristic spur. It prefers dry sites at mid-to-high elevations.

Origin: Europe.

Distribution/Comments: Dalmatian toadflax was probably introduced as an ornamental due to its pretty yellow "snapdragon" flower but looks can be deceiving. It's extremely difficult to control once its creeping root system is established. It is very problematic in communities north of the Mogollon Rim (Flagstaff, Payson, Prescott, N-15, Hwy 98 near Kaibeto, N-59).

Control/Methods: Mechanical, Herbicide use, biocontrol, for more information

http://www.mtweed.org/dalmatian-toadflax/

Reference: Non-native invasive plants of AZ. 2009. Weeds of the West. 9th Edition 2002.

Address:

Weed Outta here!!

MOENKOPI COOPERATIVE WEED MANAGEMENT AREA
NOXIOUS WEED "A" RATING HIGH PRIORITY WEED

WANTED DEAD
RUSSIAN KNAPWEED
Chi'ildich'I'iliba'hi'

SCIENTIFIC NAME:

Acroptilon repens (L.) - ACRE3

FAMILY: Asteraceae (Sunflower)

DESCRIPTION:

Russian knapweed is a creeping perennial forb that forms dense colonies from a deep (up to 20 to 30 feet) spreading root system. Roots are typically black or dark brown. Aboveground portions of the plant grow up to 4 feet. Lower leaves range from entire to lobed. Upper leaves are smaller, entire, and directly attached to the stem. Cone-shaped, pink to lavender flower heads are up to 1/2 inch in diameter and are borne at the end of leafy branches. Floral bracts are papery thin and smooth, greenish with a rounded or pointed margin.

Origin: Eurasia.

Distribution/Comments: It's a serious problem in northeastern (Chinle, Farmington, Dennehotso) and southeastern AZ. Like yellow starthistle, Russian knapweed can cause "chewing disease" in horses. Its deep, perennial root system makes control efforts difficult once established.

Control/Methods: Mechanical, Herbicide use (Milestone), new approved biocontrol, for more information

http://www.fcwp.org/BioControl/Russianknapweed.html

Reference: Non-native invasive plants of AZ. 2009. Weeds of the West. 9th Edition 2002.

Address:

Weed Outta here!!

MOENKOPI COOPERATIVE WEED MANAGEMENT AREA
NOXIOUS WEED "A" RATING HIGH PRIORITY WEED

WANTED DEAD
RUSSIAN OLIVE

SCIENTIFIC NAME:

Elaeagnus angustifolia (L.) - ELAN

FAMILY: Elaeagnaceae (Oleaster)

DESCRIPTION:

Russian olive can grow as a small, thorny shrub or as a deciduous tree that can grow up to 40 feet tall. All parts of the stems, buds, and leaves have a dense covering of silvery to rusty scales. The bark is smooth and gray when young, but develops ridges and furrows with age. The leaves area 1 to 3 inches long and about 1/2 inch wide, are simple, alternate, and are usually egg or lance-shaped with smooth margins. Flowers are aromatic, creamy-yellow, and bell-shaped. Fruits are like silver berry achenes about 1/2 inch long that appear in clusters usually during late summer and early fall.

Origin: Eurasia.

Distribution/Comments: Russian olive can be found near streams, fields and open areas in AZ. Its fruit is readily eaten and disseminated by many species of birds. It has the ability to "fix" nitrogen and is easily established on bare soils and in riparian areas. Establishment and reproduction is primarily by seed although some vegetative propagation also occurs.

Control/Methods: Mechanical, Herbicide use, Aerial application, for more information

http://agesvr1.nmsu.edu/saltcedar/

Reference: Non-native invasive plants of AZ. 2009. Weeds of the West. 9th Edition 2002.

Address:

Weed Outta here!!

Bureau of Indian Affairs
Navajo Region

HIGH PRIORITY INVASIVE WEEDS

Fred Phillips Consulting, LLC
Flagstaff, AZ

These weeds are considered a high priority for eradication and control within the Navajo Nation and Navajo Tribal Trust Lands

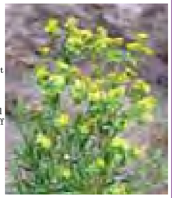
MOENKOPI COOPERATIVE WEED MANAGEMENT AREA
NOXIOUS WEED "A" RATING HIGH PRIORITY WEED

WANTED DEAD
LEAFY SPURGE

SCIENTIFIC NAME:
Euphorbia esula L. - EUES

FAMILY: Euphorbiaceae

DESCRIPTION:
An aggressive creeping, perennial forb with a root system that can extend into the soil as far as 30 feet. Leaves are 1 to 4 inches long, are linear, alternate, and entire (several times long as wide). Stems are thickly clustered and smooth, and exude a milky latex juice when broken. Small, yellow-green flowers are enclosed by paired, heart-shaped yellow-green bracts. The fruiting structure is a 3-celled capsule, with each capsule containing a single seed. Capsules rupture at maturity and disperse seeds as far as 15 feet.



ORIGIN: Eurasia

DISTRIBUTION/COMMENTS:
Widespread throughout most of the United States. This plant can cause severe eye and skin irritations in livestock and in some people. Its encroachment on rangelands has cost millions of dollars due to losses in forage for livestock and habitat for wildlife, and as a result, can diminish recreational values on infested land. It is a serious problem near Flagstaff and Springerville, Arizona. It can invade a variety of areas including pastures, rangeland, woodlands, floodplains, prairies, wastelands, and roadsides.

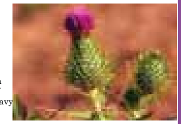
CONTROL/METHODS: Mechanical, biological and HERBICIDE USE.
FOR MORE INFORMATION
http://weeds.nmsu.edu/pdfs/leafy_spurge_factsheet_11-06-05.pdf

REFERENCE:
Non-native Invasive Plants of Arizona. 2009. Weeds of the West. 9th Edition. 2002

MOENKOPI COOPERATIVE WEED MANAGEMENT AREA
NOXIOUS WEED "A" RATING HIGH PRIORITY WEED

WANTED DEAD
BULL THISTLE

SCIENTIFIC NAME:
Cirsium vulgare (Savi Tenore). - CIVU



FAMILY: Asteraceae

DESCRIPTION:
A biennial forb that forms a rosette in its first year and then bolts and produces seed in its second year. Second-year leaf lobes are double toothed and end in a spine. Leaves have wavy margins with prickles on the surface and pubesence on the underside. Stems are very pubescent and have dark purple veins. Flower heads produce red or purple flowers that can grow up to 2 inches wide. The root system is short and fleshy.

ORIGIN: Eurasia

DISTRIBUTION/COMMENTS:
Although widespread in the Southwestern U.S., it is less aggressive than other non-native thistles in the area. It typically grows as a few scattered individual plants or populations, primarily at higher, moister sites above 5000 feet. Bull thistle can invade any type of disturbed area including forest clearcuts, riparian areas, and pastures. It is unpalatable to wildlife and livestock and can reduce forage potential by crowding out native vegetation.

CONTROL/METHODS: Mechanical, Herbicide use, approved bio-control

FOR MORE INFORMATION
http://www.na.fs.fed.us/fhp/invasive_plants/weeds/bull-thistle.pdf

REFERENCE:
Non-native Invasive Plants of Arizona. 2009.

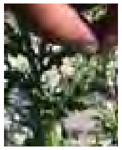
MOENKOPI COOPERATIVE WEED MANAGEMENT AREA
NOXIOUS WEED "A" RATING HIGH PRIORITY WEED

WANTED DEAD
CANADA THISTLE

SCIENTIFIC NAME:
Cirsium arvense (L. Scop.) - CIAR4

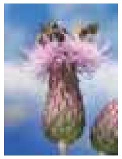
FAMILY: Asteraceae

DESCRIPTION:
An erect perennial forb, which can grow to 1.5 to 4 feet tall, with ridged stems becoming hairy and branching at maturity. Leaves are alternate, lance-shaped, and irregularly lobed with spiny toothed margins. Flowers can be purple or white and typically bloom from June to September. Canada thistle does not have spines on its flowers or stems. Fruits are small flattened brown achenes with bristly plumes. Horizontal roots may extend 15 feet or more and vertical roots may grow 6 to 15 feet deep. Male and female flowers develop on separate plants.



ORIGIN: Eurasia

DISTRIBUTION/COMMENTS:
Widespread throughout the U.S. Vegetative reproduction from its root system contributes to local spread but seeds can contribute to long distance dispersal. Once established, Canada thistle can crowd out and replace native vegetation, reducing rangeland and agricultural land values. It does best in barren disturbed areas such as wastelands, meadows, fields, and streambank sedge meadows.



CONTROL/METHODS: Cultural, Mechanical, Herbicide-use, and approved bio-controls

FOR MORE INFORMATION
http://www.ext.colostate.edu/pubs/natres/03108.html

http://www.nps.gov/plants/alien/fact/ciar1.htm

REFERENCE:
Non-native Invasive Plants of Arizona. 2009.

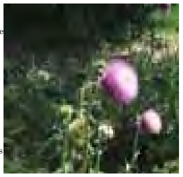
MOENKOPI COOPERATIVE WEED MANAGEMENT AREA
NOXIOUS WEED "A" RATING HIGH PRIORITY WEED

WANTED DEAD
MUSK THISTLE

SCIENTIFIC NAME:
Carduus nutans (L.) - CANU

FAMILY: Asteraceae

DESCRIPTION:
Musk thistle is a biennial forb that can also grow as an annual. It has a thick tap root from which a rosette of basal leaves emerges. Rosettes grow 3 to4 feet in diameter. Leaves are hairless and have deep lobes, are dark green with a light green midrib, and a spiny margin. Leaves extend beyond the stem, giving the appearance of a "winged" stem. Large "powder puff" flowerheads (1.5 to 3 inches in diameter) can be deep rose, purple, or white. Flower head weight bends the stems downward, giving the appearance of a nodding flowerhead in windy weather. It can grow up to 8ft tall with adequate soil moisture.



ORIGIN: Europe

DISTRIBUTION/COMMENTS:
Widespread throughout the U.S. Musk thistle has broad ecological amplitude, growing in dry open rangeland and in wetlands. The key to controlling them is to destroy them before they set seed. Infestations are often spotty in the Southwestern U.S. Musk Thistle is unpalatable to wildlife and livestock. It colonizes disturbed areas such as landslide areas, meadows, and prairies.

CONTROL/METHODS: Mechanical, Biological, Herbicide use, approved bio-control

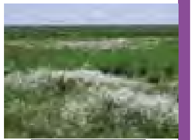
FOR MORE INFORMATION
http://www.nps.gov/plants/alien/fact/canu1.htm

REFERENCE:
Non-native Invasive Plants of Arizona. 2009.

MOENKOPI COOPERATIVE WEED MANAGEMENT AREA
NOXIOUS WEED "A" RATING HIGH PRIORITY WEED

WANTED DEAD
PERENNIAL PEPPERWEED

SCIENTIFIC NAME:
Lepidum latifolium L. - LELA2



FAMILY: Brassicaceae

DESCRIPTION:
Plants are multi-stemmed and grow in erect masses up to 5 ft. in height. Leaves are lanceolate, bright green to gray-green. Basal leaves are long (up to 1ft) and have serrate margins. Flowering occurs from early summer to fall with abundant small white 4-petaled flowers in dense clusters near the stem tips. The base of the stem is semi-wood. Roots can grow up to 6 ft in length and are creeping. It can often be confused with hoary cress (see right).

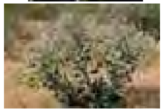
ORIGIN: Eurasia

DISTRIBUTION/COMMENTS:
Widespread throughout the U.S. It can establish in a wide range of habitats and is commonly a problem in disturbed areas such as roadsides, pastures, wetlands, and flood plains. It can rapidly form dense clusters, crowding out native vegetation. Plants can spread quickly along waterways and stream corridors.

CONTROL/METHODS: Mechanical, Cultural, Herbicide use

FOR MORE INFORMATION
http://www.ipm.ucdavis.edu/PMG/PESTNOTES/pn74121.html

http://www.nps.gov/plants/alien/fact/lela1.htm

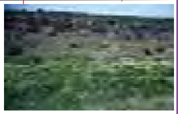


REFERENCE:
Plant Conservation Alliance - Alien Plant Working Group Least Wanted. Perennial Pepperweed. 2009. http://www.nps.gov/plants/alien/fact/lela1.htm

MOENKOPI COOPERATIVE WEED MANAGEMENT AREA
NOXIOUS WEED "A" RATING HIGH PRIORITY WEED

WANTED DEAD
WHITE TOP (HOARY CRESS)

SCIENTIFIC NAME:
Cardaria draba (L. Desv.) - CADR



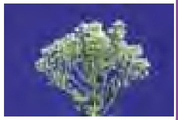
FAMILY: Brassicaceae

DESCRIPTION:
A creeping perennial forb that can grow up to 3 ft. tall. It reproduces by seed and its extensive, deeply penetrating root system. Leaves are elliptical, gray-gree, clasping, and lightly pubescent. Stems are erect and greatly branching near the flower. It has 4-petal small flowers at the top of the plant. Heart-shaped seed pods have a slender, persistent beak in the upper cleft of the seed pods. Two small, flat, reddish brown seeds are contained in each of pods.

ORIGIN: Europe

DISTRIBUTION/COMMENTS:
Distribution is limited to the Four Corners area. It easily establishes in moist sites and is difficult to control once established. It has been introduced in urban settings as a filler for dry flower arrangements. Hoary cress is especially invasive in rangeland and agricultural areas. The plant also produces compounds, known as glucosinolates, which are toxic to cattle.

CONTROL/METHODS: Mechanical, Cultural, Herbicide use, and approved bio-control



FOR MORE INFORMATION
http://sbsc.wr.usgs.gov/research/projects/swepic/factsheets/cadrsf_info.pdf

REFERENCE:
Non-native Invasive Plants of Arizona. 2009.

MOENKOPI COOPERATIVE WEED MANAGEMENT AREA
NOXIOUS WEED "A" RATING HIGH PRIORITY WEED

WANTED DEAD
YELLOW STARTHISTLE

SCIENTIFIC NAME:
Centaurea solstitialis L. - CESO3

FAMILY: Asteraceae

DESCRIPTION:
An aggressive cool season annual forb. It germinates during cooler temperatures and grows 2 to 3 ft tall as temperatures warm. Deeply lobed basal leaves form a rosette, while stem leaves are linear or tapered at both ends and attach directly to the stem. An extension of the leaf runs down the stem, giving a "winged" appearance. Flowers are yellow and are held by bracts that produce stiff, sharp spines that can grow up to 1 in. long. Seeds are produced from ray-shaped flowers and are dark colored and lack bristles.

ORIGIN: Mediterranean Region

DISTRIBUTION/COMMENTS:
Widespread throughout the U.S. Yellow starthistle is found in areas with full sunlight and deep, well-drained soils and is especially common in disturbed sites, such as roadsides, wastelands, and rangelands. Can cause "chewing disease" in horses. As it is a strong invader, it can choke out native vegetation, reducing wildlife habitat and forage.

CONTROL/METHODS: Mechanical, Biological, Herbicide use, approved bio-control

FOR MORE INFORMATION
http://www.nps.gov/plants/alien/fact/ceso1.htm

http://www.ipm.ucdavis.edu/PMG/PESTNOTES/pn7402.html

REFERENCE:
Non-native Invasive Plants of Arizona. 2009.

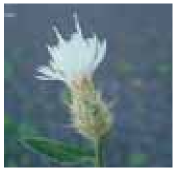
MOENKOPI COOPERATIVE WEED MANAGEMENT AREA
NOXIOUS WEED "A" RATING HIGH PRIORITY WEED

WANTED DEAD
DIFFUSE KNAPWEED

SCIENTIFIC NAME:
Centaurea diffusa (Lam.) - CEDI3

FAMILY: Asteraceae

DESCRIPTION:
Diffuse knapweed can grow as an annual, biennial, or short-live simple perennial forb with multiple branches. It ranges in height from 1 to 3 ft. at maturity and can have white, rose, or purple flowers. Yellow-green bracts are tipped with slender terminal spines that curve outward and are typically light brown with a margin-like a comb. Basal leaves are finely divided while the stem leaves are entire and smaller.



ORIGIN: Eurasia

DISTRIBUTION/COMMENTS:
Widespread throughout the U.S. Diffuse knapweed quickly invades disturbed sites and undisturbed grasslands, shrublands, and riparian habitats. It quickly outcompetes native vegetation and releases allelopathic chemicals that prevents competitive plant growth, allowing it to take over. Its dramatically reduces the productivity of rangelands and forage quality of habitats.

CONTROL/METHODS: Mechanical, Cultural, Herbicide use, approved bio-control

FOR MORE INFORMATION
http://www.ext.colostate.edu/pubs/natres/03110.html

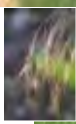
http://parks.state.co.us/SiteCollectionImages/parks/Programs/ParksResourceStewardship/Diffuse%20Knap-weed.pdf

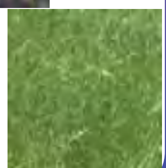
REFERENCE:
Non-native Invasive Plants of Arizona. 2009.

Bureau of Indian Affairs
Navajo Region

MOENKOPI COOPERATIVE WEED MANAGEMENT AREA
NOXIOUS WEED "C" RATING LOW PRIORITY WEED

WANTED DEAD
CHEATGRASS (DOWNY BROME)
Shi'yina'ldzidi'



SCIENTIFIC NAME:

Bromus tectorum (L.) - BRTE

FAMILY: Poaceae (Grass)

DESCRIPTION:

Cheatgrass is a cool-season annual that can grow between 2 inches to 2 feet tall. Like most annuals, it's a prolific seed producer. It germinates during cooler temperatures and rapidly grows and sets seed before most other species. Seedling are bight green with conspicuously hairy (downy) leaves, sheaths, glumes, and lemmas. Seed heads are open, drooping, multiple-branched panicles with moderately awned spikelets. Auricles are absent. At maturity the foliage and seed heads often turn purplish before drying to brown or tan.

Origin: Eurasia.

Distribution/Comments: Cheatgrass is widely adapted and can be found from desert valley bottoms all the way to the highest peaks (i.e. Mt. Lemmon). It quickly invades heavily grazed rangeland, roadsides, waste places, burned areas, and disturbed sites. Cheatgrass can still flower and produce viable seed even when environmental conditions are poor and/or when grazing animals crop the plants. Spikelets readily attach to fur, clothing, & vehicles.

Control/Methods: Mechanical, Herbicide use, for more information

http://extension.usu.edu/range/Grasses/cheatgrass.htm

http://wildlife.utah.gov/watersheds/literature/literaturesub01.php

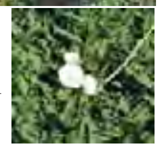
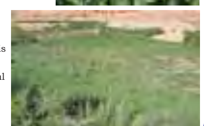
Biocontrol: Using fungal pathogens.

http://www.treesearch.fs.fed.us/pubs/31305

Reference: Non-native invasive plants of AZ. 2009. Weeds of the West. 9th Edition 2002.

MOENKOPI COOPERATIVE WEED MANAGEMENT AREA
NOXIOUS WEED "C" RATING LOW PRIORITY WEED

WANTED DEAD
FIELD BINDWEED

SCIENTIFIC NAME:

Convolvulaceae arvensis (L.) - COAR

FAMILY: Convolvulaceae (Morning glory)

DESCRIPTION:

Field bindweed is a drought tolerant, perennial creeping plant (vine) with climbing stems of 1 to 4 feet. Mature plants form dense tangled mats. Leaves are generally 1 to 2 inches long, are smooth, and shaped like a spade or an arrowhead. Roots reach 20 feet below ground, and extensive lateral roots have buds that initiate new plants. Fruits are small, round capsules, each containing 4 seeds. Flowers are 1 to 1 1/2 inches wide, trumpet-shaped, white or pin in color, typically with 2 small bracts located on the petiole. Flowers close each afternoon and reopen the following day.

Origin: Europe.

Distribution/Comments: Widspread throughout AZ. It's difficult to eradicate due to its extensive & deep root system & seeds remain viable inside the soil for 60+ years.

Control/Methods: Mechanical, Herbicide use, approved bio-control.

http://www.msuextension.org/ruralliving/Dream/PDF/Weed/bindweed.pdf

Bioncontrol: Using insects (gall mites) to control this plant.

http://www.fcwp.org/BioControl/Fieldbindweed.html

Reference: Non-native Invasive Plants of AZ. 2009.

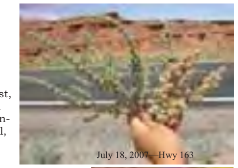
Weeds of the West, 9th Edition. 2002.

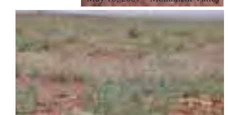
MEDIUM PRIORITY INVASIVE WEEDS

These weeds are considered a medium priority for control and containment on Navajo Nation and Navajo Tribal Trust Lands

MOENKOPI COOPERATIVE WEED MANAGEMENT AREA
NOXIOUS WEED "B" RATING MEDIUM PRIORITY WEED

WANTED DEAD
HALOGETON





SCIENTIFIC NAME:

Halogeton glomeratus (Stephen ex Bieb.) - HAGL

FAMILY: Chenopodiaceae (Goosefoot)

DESCRIPTION:

An annual weed ranging from a 2 to 18 inches. Main stems branch from the base, spreading at first, and then becoming erect. Plants are blue-green in the spring like tumbleweed and early summer, turning red or yellow by late summer. Leaves are small, fleshy, and nearly tubular, ending inconspicuous, borne in leaf axis.

Origin: Asia.

Distribution/Comments: It's a serious problem in alkaline soils and semi-arid environment of high-desert winter livestock range. Spreads rapidly across range near roads/highways (N-15, N-24, Hwy 89, 160, 163, I-40, N-27), highly disturbed areas, waterline (Monument Valley), and power lines. Halogeton produces toxic oxalates which are poisonous to sheep and may affect cattle. Hay produces from Utah are selling infested hay bales at local flea markets since Utah & Colorado have WEED FREE Laws and Navajo Nation does not. Hauling bales of hay spreads the seeds into rangelands. Buyer be aware!!

Control/Methods: Mechanical, Herbicide use, for more information

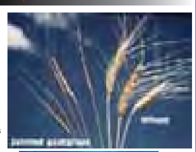
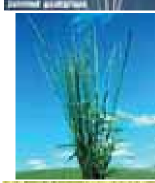
http://www.unce.unr.edu/publications/files/nr/2000/FS0020.pdf

http://extension.usu.edu/range/forbs/halogeton.htm

Reference: Non-native invasive plants of AZ. 2009. Weeds of the West. 9th Edition 2002.

MOENKOPI COOPERATIVE WEED MANAGEMENT AREA
NOXIOUS WEED "C" RATING LOW PRIORITY WEED

WANTED DEAD
JOINTED GOATGRASS


SCIENTIFIC NAME:
Aegilops cylindrical (Host) - AECY

FAMILY: Poaceae

DESCRIPTION:
A winter annual reaching heights of 15 to 30 inches. It is closely related to, and can interbreed with wheat. Its flowering portion is slender and segmented and closely resembles what until spikes appear. Spikelets (joints) contain 1 to 3 viable seeds and disarticulate at maturity. Plants produce 1 to many erect stems. Leave have finely spaced, fine hairs along the leaf edge and the sheath opening.

ORIGIN: Eurasia

DISTRIBUTION/COMMENTS:
Jointed goatgrass is found primarily in the north central part of Arizona and New Mexco in both cultivated and uncultivated areas. It can impede wheat production by outcompeting wheat for resources and seeds can be hard to separate from wheat seeds in the soil. Also commonly grows in areas with disturbed soils such as highway right-of-ways, vacant lots, and abandoned fields. Also common in pasture, wheat crops, waste areas, fence lines, and alfalfa fields.

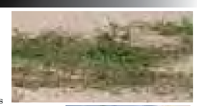
CONTROL/METHODS: Mechanical, Biological, Herbicide use, approved bio-control

For more information
http://www.southwestlearning.org/download_product/1160/0

Reference:
Non-native Invasive Plants of AZ. 2009. Weeds of the West. 9th Edition 2002.

MOENKOPI COOPERATIVE WEED MANAGEMENT AREA
NOXIOUS WEED "C" RATING LOW PRIORITY WEED

WANTED DEAD
PUNCTUREVINE



SCIENTIFIC NAME:
Tribulus terrestris L. - TRTE

FAMILY: Zygophyllaceae

DESCRIPTION:
An annual warm season weed. Plants have several stems up to 3 feet long radiating from the root with opposite leaves divided into 4 to 7 pairs of oblong leaflets 1/8-1/2 inch long. Stems and foliage often have silky bristly silver hairs. Solitary bright yellow flowers have 5 petals and occur on short stalks. The seedpods separate into wedge-shaped burs or nutlets, each with two stout spines 1/8 - 1/4 inch long. Seedlings can produce deep root systems in a few weeks; flowers within 3 weeks of germination and burs within 6 weeks. The seeds remain viable for decades until sufficient moisture is present for germination.

ORIGIN: Europe

DISTRIBUTION/COMMENTS:
Widespread throughout the Southwestern U.S. Their deep root systems make them difficult to erradicate. Large quantities can be toxic to livestock, especially sheep. The seedpods can puncture shoes and bicycle tires. Plants often produce innumerable numbers making it hard to prevents from falling on the ground.

CONTROL/METHODS: Mechanical, Biological, Herbicide use, approved bio-control

For more information
http://cals.arizona.edu/backyards/articles/spring08/p13.pdf

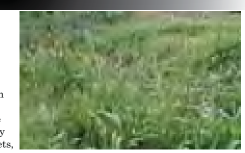
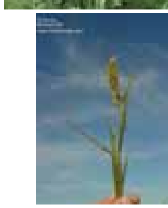
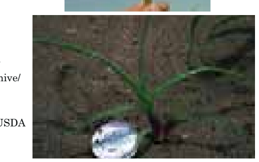
Reference:
McCloskey, W.B. Puncturevine Fact Sheet. University of Arizona. 2008.

LOW PRIORITY INVASIVE WEEDS

These weeds are considered a low priority for control and containment on Navajo Nation and Navajo Tribal Trust Lands

MOENKOPI COOPERATIVE WEED MANAGEMENT AREA
NOXIOUS WEED "B" RATING MEDIUM PRIORITY WEED

WANTED DEAD
FIELD SANDBUR

SCIENTIFIC NAME:
Cenchrus incertus (CAV.) - CESP4

FAMILY: Poaceae

DESCRIPTION:
A warm season annual herb that can sometimes also be a short-lived perennial. Height ranges from 8 to 24 inches. Leaf blade is 2 to 6 inches long and flat. The stem is erect, but can also grow along the ground. The seehead is a raceme with 6 to 20 spiny burs covered with fine har, each enclosing 2 spikelets, and often topped with leaves.

ORIGIN: Southern portion of US (classified as noxious in CA and AZ)

DISTRIBUTION/COMMENTS:
Sandbur growth starts in early spring with seedheads appearing in July. Plants may become semi-dormant when moisture is scarce and green up and produce seeds after a rain. It grows in tufts and dense mats in dry sandy and sandy loam soils. This grass is well-adapted to waste places, old fields, and sandy flood plains. Presence usually indicates severely overused range. The burs are injurious to livestock and can greatly reduce the value of wool and mohair.

CONTROL/METHODS: Mechanical, Biological. Planting competitive grasses and grazing in the spring can control its growth and spread.

For more information
http://plants.usda.gov/factsheet/pdf/fs_cesp4.pdf
http://cals.arizona.edu/yavapai/anr/hort/byg/archive/fieldsandbur.html

Reference:
Percy Magee, Plant Fact Sheet: Mat Sandbur. USDA NRCS National Plant Data. 2002.

Appendix I. Scoping presentation

PEIS and Integrated Weed ch’il Management Plan nahat’á for the Navajo Nation Naabeehó Bináhásdzo

Bureau of Indian Affairs Wááshindoon

U.S. Department of Interior,
Bureau of Indian Affairs- Navajo Region

Yá’át’ééh dóó ahéhee’.

Diné bizaad

‘áká ‘análwo’í

Presentation Outline – t'áá 'íiníáta'ałkąą' siláago

- Project Background baahane' éi 'ałąąjį' dooleeł
- Project Purpose bi'neena
- Project Need a'sin
- Addressing Needs a'sin ee' bahanie
- What is NEPA, EIS and IWMP bibee haz'áanii áádóó nahat'á
- The Scoping Process bi'kei go' oo gal
- Project Timeline bi'kei go' ná'oolkiłí
- Priority Weed Species ch'il ba na te a gee
- Proposed Methods bi'kei go' bi naashii
- Proposed Alternatives haa'ta go' bi nahat'á
- Resources Considered nahasdzáán bi'kai gee bi'ho dił do ti'agee
- Comments and Questions binda'idółkido 'akée'di dooleeł

U.S. Department of Interior,
Bureau of Indian Affairs- Navajo Region

Background of the Plan (nahat’á baahane’)

- Controlling exotic weeds is a concern for land owners
  - Can out-compete native vegetation
  - Can harm livestock (naaldlooshii)
- Weed infestations have increased ch’il dóó yá’át’ééh á’ge ‘ayóo hazlį́į́
  - Roads (‘atiin bikáá’ hóló)
  - Weed hay (tł’oh bą́ą́h hóló) and grain
  - Infrastructure development
  - Natural (wildlife ałchini, wind niłch’l, water to’)
- BIA Navajo Region has currently controlled 16,967 acres
  – Need for federal funding (béeso a’kaa)
  – Various control methods

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What is a noxious weed ch’il dóó yá’át’ééh á’ge hóló?

Photo taken in Shonto Wash.

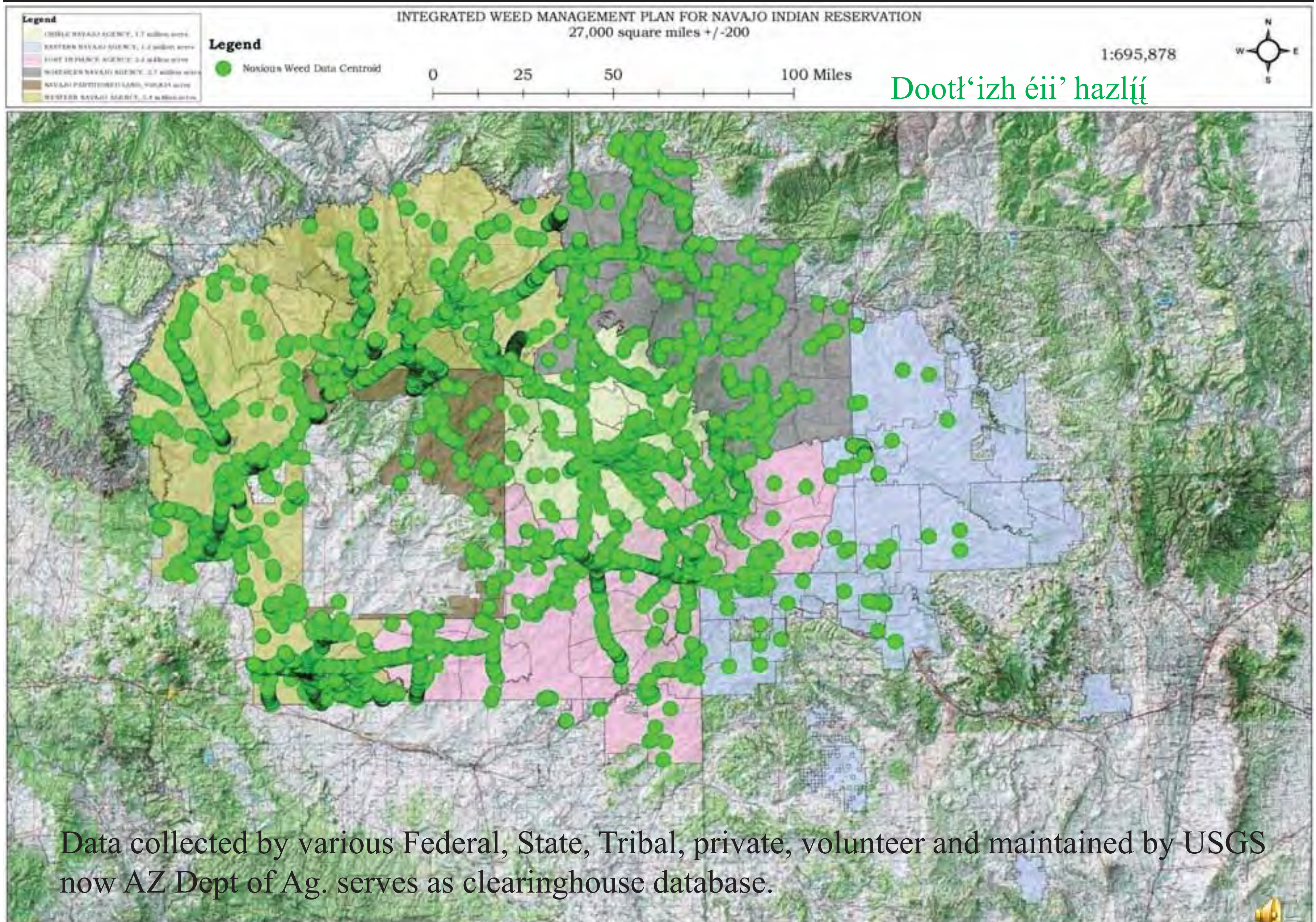
Photo taken in Shonto road.

Tamarisk occurs in drainages throughout Navajo Nation.

Photo taken in Chinle Agency.

Photo taken in Monument Valley.

Photo taken along State Route 98 between Kaibeto and Page



INTEGRATED WEED MANAGEMENT PLAN FOR NAVAJO INDIAN RESERVATION
27,000 square miles +/-200
Legend
Legend
Noxious Weed Data Centroid
0
25
50
100 Miles
1:695,878
N
W
E
S
Dootł'izh éii' hazlį́į́
Data collected by various Federal, State, Tribal, private, volunteer and maintained by USGS now AZ Dept of Ag. serves as clearinghouse database.

Project Need (yii'zin)

U.S. Department of Interior, Bureau of Indian Affairs- Navajo Region

- Control and contain weed infestation
- Maintain livestock forage production
- Maintain high quality wildlife habitat
- Improve and protect native vegetation communities
- Stabilize and protect riparian areas
- Prevent declines in appraised land value dóó a'ílį'da
- Prevent soil (łeezh) loss from erosion due to the loss of cover vegetation
- Obtain federal funding (béeso) to control weeds

In Order to Address Needs (nizin):

- Programmatic Environmental Impact Statement (EIS)
  - Comply with the National Environmental Policy Act of 1969 (NEPA) and Noxious Weed Control and Eradication Act of 2004 (Kin Náhálgaidę́ę́’ Wááshindoon bibee haz’áanii)
  - Develop a Programmatic EIS
  - Section 106 of the National Historic Preservation Act will be completed concurrently with the NEPA process
- Integrated Weed Management Plan (ch’il ba’nahat’á ‘ahiłgó)
  - Developed using the most current and effective data available
  - 10-year plan (neeznáá nááhai nahat’á) that can be revised through adaptive management
  - Living document (iiná naaltsoos liná)

United States Law - Wááshindoon bibee haz'áanii

Executive Order 13327 (2004) – Federal Real Property Asset Management

Executive Order 13287 (2003) - Preserve America

Executive Order 13175 (2000) – Consultation and Coordination with Indian Tribal Govern

Executive Order 13007 (1996) – Sacred Sites

Native American graves Protection and Repatriation Act of 1990 (NAGPRA)

Archaeological Resource Protection Act of 1979 as amended (ARPA)

American Religious Freedom Act (1978)

Archaeological and Historic Preservation Act of 1974

Executive Order 11593 (1972)

National Environmental Policy Act of 1969 (NEPA)

National Historic Preservation Act of 1966 as amended (NHPA)

Reservoir Salvage Act or 1960

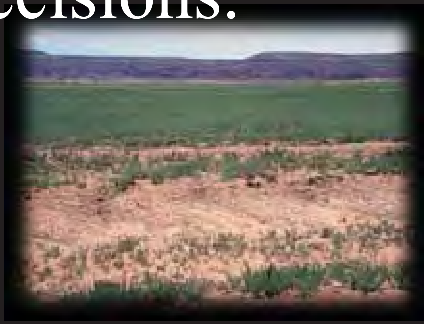
Historic Sites Act of 1935

Antiquities Act of 1906

National Environmental Policy Act of 1969

- Federal law (bee haz'áanii) that requires all Federal agencies to assess the environmental impacts of major Federal projects.

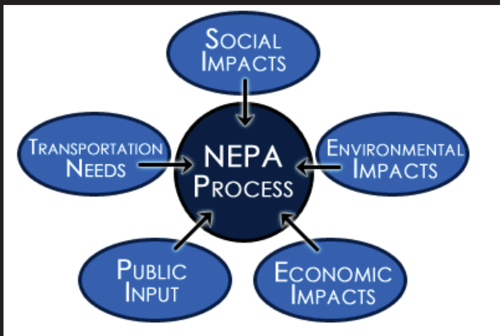
- Evaluation process to help determine if a Federal project has a significant impact on the environment.
- If significant impact is determined an environmental impact statement must be prepared.
- This impact must be considered in making decisions.



- Requires public disclosure of environmental impacts. bila'ashda'ii t'áá ałtsoh bił naha'nie

Environmental Impact Statement

- The document required by NEPA bee haz'áanii that assesses the environmental impact of a significant Federal action that affects the environment.
- BIA is mandated to ensure proper conservation resource management practices on all trust property in compliance with NEPA bee haz'áanii
- Large land base nitsaa keyah hozaa
- Weed control adjacent to residential areas
- Many environmental resources considered



Integrated Weed Management Plan

ch’il dóó yá’át’ééh á’ge bá nahat’á ‘ałah’ge

- A document that enables land managers to be more efficient and cost effective at controlling weeds
- Identify priority invasive weeds across the Navajo Nation
- Evaluate the best management practices for control and eradication
- Provide procedures and protocols to conduct weed removal
- Provide approach to project implementation
- Develop a comprehensive education and prevention strategy that considers climate change

The Scoping Process

- Publication of Notice of Intent is the first step in scoping process
- Scoping is an early an open process to address the significant issues and alternatives of the project
- Identify significant issues and reasonable alternatives
- Eliminate issues that are not potentially significant impacts, not related to the project, or are covered by other environmental documents.

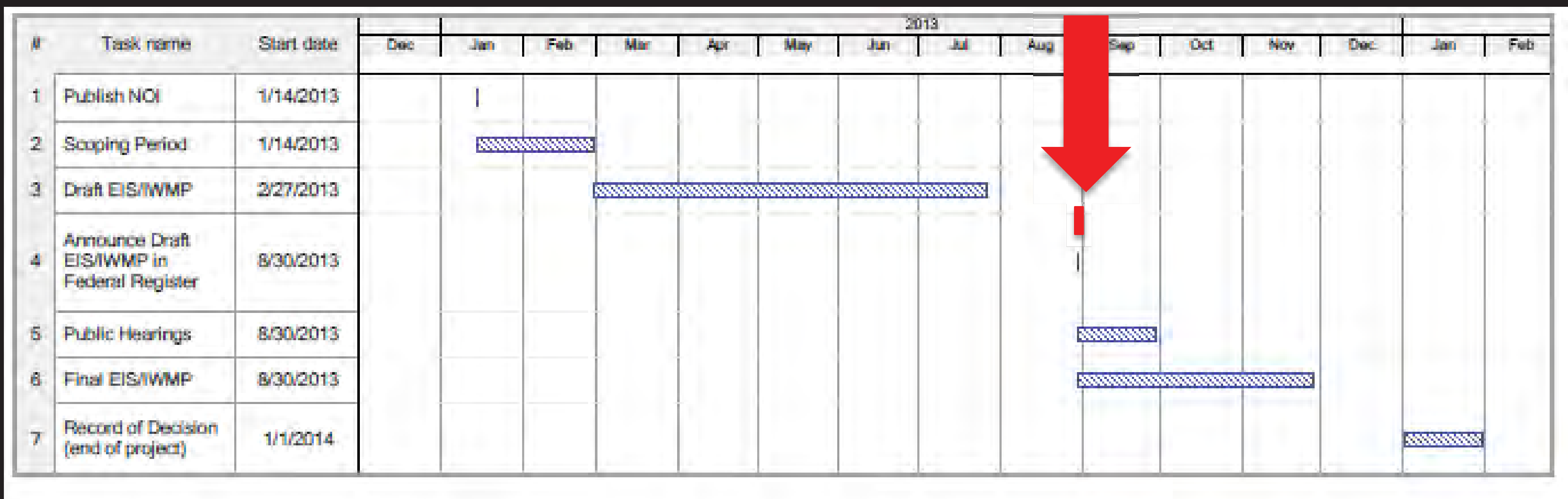
Scoping Schedule – ‘áłah ‘ádooleeł

Scoping Location	Date	Time (ná’oolkiłí)
Crownpoint Chapter House (T’iists’ózí)	February 05, 2013 Atsábiyáázh	5:00 pm – 7:00 pm
Shiprock Chapter House (Naatáaniinééz)	February 06, 2013	5:00 pm – 7:00 pm
Chinle Chapter House (Ch’ínílį)	February 07, 2013	1:00 pm – 5:00 pm
Fort Defiance Chapter House (Tséhootsooí)	February 08, 2013	9:00 am- 12:00 pm
Tuba City Chapter House (Tónaneezdizí)	February 12, 2013	3:00 pm – 6:00 pm

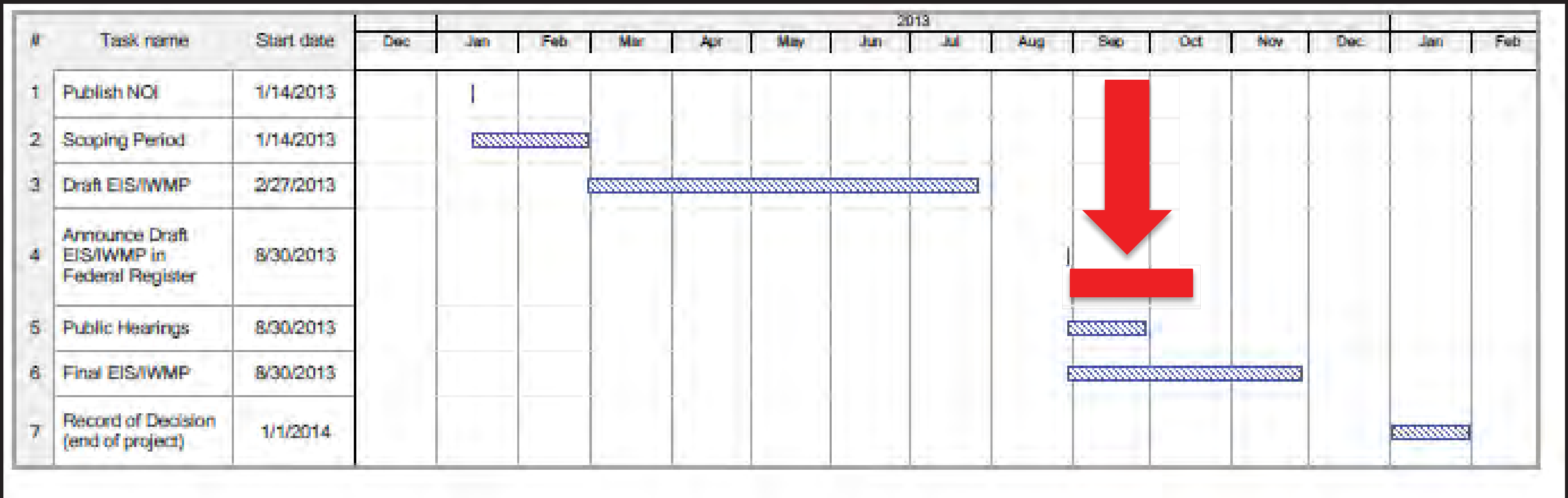
Navajo EIS and (dóó) Integrated Weed Management Plan (nahat’á) Timeline (ná’oolkiłí)

#	Task name	Start date
1	Publish NOI	1/14/2013
2	Scoping Period	1/14/2013
3	Draft EIS/IWMP	2/27/2013
4	Announce Draft EIS/IWMP in Federal Register	8/30/2013
5	Public Hearings	8/30/2013
6	Final EIS/IWMP	8/30/2013
7	Record of Decision (end of project)	1/1/2014

Navajo EIS and (dóó) Integrated Weed Management Plan (nahat’á) Timeline (ná’oolkiłí)



Navajo EIS and (dóó) Integrated Weed Management Plan (nahat’á) Timeline (ná’oolkiłí)



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Priority Noxious Weeds for Navajo

ch'il dóó yá'át'ééh á'ge

High Priority –A RATING		
Common Name	**Navajo Name**	**Management Strategy**
Leafy spurge	Ch'il bizhi'	Prevent/Eradicate
Bull thistle		Eradicate
Canada thistle		Eradicate
Dalmatian toadflax		Eradicate
Musk thistle		Eradicate
Perennial pepperweed		Eradicate
Scotch thistle		Eradicate
Spotted knapweed		Eradicate
Whitetop (Hoary Cress)		Eradicate
Yellow starthistle		Eradicate
Camelthorn	Ch'ilhoshi'	Contain & Control
Tamarisk, Saltcedar	K'ei'lichii'its'ooz	Contain & Control
Diffuse knapweed		Contain & Control
Russian knapweed	Chi'ildich'I'iliba'hi'	Contain & Control
Russian Olive		Contain & Control

Priority Noxious Weeds for Navajo

ch'il dóó yá'át'ééh á'ge

Medium Priority- B RATING		
Common Name	**Navajo Name**	**Management Strategy**
Field sandbur		Contain & Control
Halogeton		Contain & Control

LOW Priority-C RATING		
Common Name	**Navajo Name**	**Management Strategy**
Cheatgrass	Shi'yina'ldzidi'	Contain & Control
Field bindweed		Contain & Control
Jointed goatgrass		Contain & Control
Puncturevine		Contain & Control

Control Methods bee na’anishí ‘ał‘ąą ‘át’é

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- Cultural Control aldóó
  - Planting k’iidiilá dá’ák’eh go’
  - Fertilizing
  - Encouraging growth of desired vegetation
- Biological Control aldóó
  - Approved insects (ch’osh ‘áká ‘análwo’í) or plant pathogens
- Mechanical Control aldóó
  - Hand-pulling or digging up individual plants
  - Picking off flower heads
  - Mowing or Bulldozing chidí naa’na’í
- Chemical Control aldóó
  - Herbicide ch’il bi‘azee’ dóó chi’il bi’jona á’ge

Control Methods - continued

- Prevention Methods aldóó
  - Vehicles (chidí)
  - Contaminated seed ‘ak’ǫ́ǫ́’ doo’ bináá’, hay, livestock
  - Heavy Equipment (chidí naa’na’í)
  - Additional activities that transport weed, seed, dirt (łeezh) or plant parts

- Public Education and Awareness óhoo’aah dóó éé’deetįįh ba’ákonízin
  - Meetings
  - Training (tł‘óódéé óhoo’aah)
  - Workshops (naníísh óhoo’aah)
  - Educational information materials (tł’óódéé óhoo’aah naaltsoos éí bił ałhii’siláago)
  - Early detection/rapid response

Proposed Alternatives

Preferred Action-Alternative 1 t’áála’í ‘ałą́ąjį ei

- BIA would authorize new treatments of noxious weeds ch’il dóó yá’át’ééh á’ge bi’nadiinish

•Types of Method ‘ałąą ‘át’éego bídá’níísh ałdóó baa’áháyą́ą

- Manual
- Mechanical
- Cultural
- Biological
- Chemical

Proposed Alternatives – continued

No Action-Alternative 2 (naaki)

- No Integrated Weed Management treatments applied to any Navajo Nation (Naabeehó Bináhásdzo).

No Herbicide-Alternative 3 (táá)

- All treatment methods except for chemical

Resources to Consider for Environmental Impact Statement - báhas’tił áádóó bił‘ho’dil tił

- Soil, Water and Air
- Watersheds and soils
- Water Quality
- Air Quality
- Climate Change
- Vegetation
- Endangered, Threatened, Candidate, and Sensitive Plant Species
- Endangered, Threatened, Proposed, and Sensitive Fish Species
- Threatened, Endangered, Sensitive and Mangement Wildlife Species
- Public Health
- Social concerns and economic influences - bila’ashda’ii t’áá ałtsoh yiník’ehgo
- Cultural Resources
- Areas with Special Designation
- Critical Habitat

Air niłch'l Quality Effects – báhas'tił áádóó bił'ho'dil tił

Preferred Action

- Minimal impacts to air quality when using chemical treatments
- Broad impacts to vegetation with aerial non-selective chemical spraying
- Temporary impact of increased dust from mechanical treatment

No Action 'éí doodago - No Integrated Weed Management treatments applied

- No expected change to air quality

Climate Change - báhas’tił áádóó biłʻho’dil tił

Preferred Action

- Provide native vegetation an advantage over noxious weeds to expand in density
- Best Management Practices will encourage productive range and wildlife habitat

No Action ’éí doodago - No Integrated Weed Management treatments applied

- Drought tolerant noxious weeds will expand in density
- Noxious vegetation will out-compete native vegetation
- Decrease biodiversity
- Decrease quality range and wildlife habitat

Social and Economic Effects - bila’ashda’ii t’áá ałtsoh yiník’ehgo báhas’tił áádóó bił ho’dil dótił

Preferred Action

- Improve range and agricultural lands
- Protect livestock
- Potential negative effects to livestock from
- Increase property values

No Action ’éí doodago - No Integrated Weed Management

- Continue to reduce forage for livestock
- Continue to pose a threat to livestock
- Decrease productivity of agricultural lands
- Depreciate buildings, property value

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Listed, Proposed, Candidate or Sensitive Species Effect – báhas’tił áádóó bił‘ho’dil tił

Preferred Action

- Disturbance from people or equipment may impact
- No herbicide spraying during breeding season or in areas with L,P,C,S plant species
- Buffer zones and limited application

No Action ’éí doodago - No Integrated Weed Management treatments applied

- Long-term degradation of habitat and weed expansion
- Lowers plant diversity
- Loss of forage ch’il hóyéé’
- Indirect negative effects on food chain

Cultural Resources Effect

naha’se, chá’d éi báhas’tił aadóó bił‘ho’dil tił

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Bureau of Indian Affairs- Navajo Region

Preferred Action

- People or equipment may disturb sites
- Buffer zones around cultural resources
- Minimal application
- Conserve and protect sites

No Action ’éí doodago - No Integrated Weed Management treatments applied

- Prevent access to cultural resources
- Loss of natural heritage and traditional plants
- Potential loss of artifacts from erosion

Surface Water

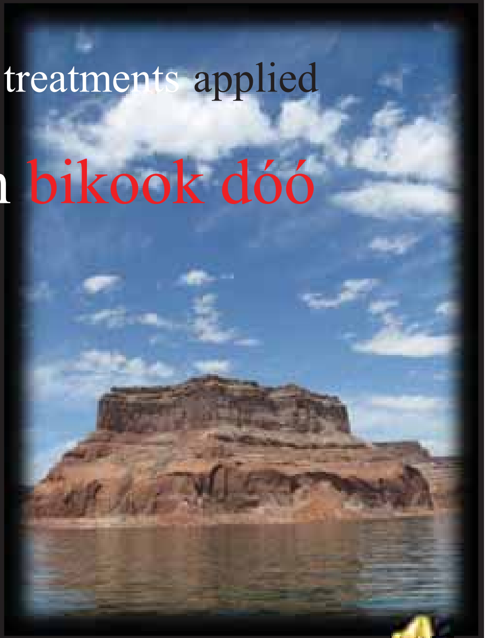
To’ bikáá’góó báhas’tił aadóó bił‘ho’dil tił

U.S. Department of Interior, Bureau of Indian Affairs- Navajo Region

Preferred Action

- Stabilize banks cháshk’eh dó hó’łe da
- Decrease turbidity and increase water quality tó niłtólígó
- Support natural geomorphology and hydroregime

No Action ’éí doodago - No Integrated Weed Management treatments applied



- Continue to increase erosion and bank line incision bikook dóó cháshk’eh ho’łe
- Increase surface runoff tó’ ni’go ‘ayóo’dóóleeh
- Increase water turbidity tó’bi’tsa dóóleeh
- Change in channel geomorphology

Substantive Comments

- We welcome your substantive comments, including:
  - Presents new information to the project and/or alternatives
  - Development of a new alternative not considered
- Comments that are not substantive include:
  - Value-type comments that do not have data to back up (i.e. I do not like biological control)
  - Do not pertain to the Plan (nahat'á)
  - Other comments that do not require response in EIS (i.e. extend scoping period)

Comments and Questions

binda'idółkido dóó nitsáhákees dóó siihasin

Address further comments to:

Renee Benally
Renee.Benally@bia.gov
(928) 283-2210

U.S. Department of Interior, Bureau of Indian Affairs- Navajo Region

Ahé'hee.

Appendix J. Comment Card

COMMENT CARD

Public Scoping Meetings
Bureau of Indian Affairs – Navajo Region
Programmatic Environmental Impact Statement (EIS) and
Integrated Weed Management Plan (IWMP)

Name: ______________________________

Address: ______________________________

____

E-Mail Address: ______________________________

Meeting Location: ______________________________

Date: ______________________________

Please indicate any comments/questions/concerns you may have on the following:

Proposed Weed Removal Methods:______________________________

____

____

____

Priority Sites for Weed Management:______________________________

____

____

____

Alternatives:______________________________

____

____

____

Concerns:______________________________

____

____

Other:______________________________

____

____

PLEASE LEAVE CARD AT THE SCOPING MEETING ***or MAIL TO*****: Renee Benally, Acting Navajo Region Weed Coordinator, Western Navajo Agency, Branch of Natural Resources, P.O. Box 127, Tuba City, AZ 86045, Renee.Benally@bia.gov, (928) 283-2210.**

Appendix K. Additional Public Scoping (April 29 – May 29, 2021) Factsheet and Comment Card

NAVAJO NATION INTEGRATED WEED MANAGEMENT PLAN

Project Information and FAQs

Background

The Bureau of Indian Affairs (BIA) is preparing a Programmatic Environmental Impact Statement (PEIS) to evaluate potential impacts of the proposed Navajo Nation Integrated Weed Management Plan for Navajo Nation tribal trust and allotment lands. The PEIS will be prepared in accordance with the requirements set forth in the National Environmental Policy Act (NEPA). NEPA ensures that federal agencies, in this case the BIA, considers every significant aspect of a proposed action on the human environment, and that the public is informed regarding potential environmental concerns through the agency's decision-making process.

While public scoping for this project was initially conducted in 2013, the BIA would like to provide an additional opportunity for the public to submit substantive comments on this project. This comment period will last for 30-days, beginning on April 29, 2021 through May 29, 2021. More information on the project and information on how to submit a comment are available at the project website here:

https://www.bia.gov/regional-offices/navajo/navajo-nation-integrated-weed-management-plan

What is an Integrated Weed Management Plan?

An integrated weed management plan provides a variety of recommended techniques and approaches for managing and controlling exotic weed species. An integrated approach uses different weed control methods together to provide the greatest level of control. This could mean cutting a dense population with a mower and then applying herbicide immediately after to the cut part of the plant. It can also mean releasing a permitted biological control agent on a remote population for a season before returning to remove dead material and replanting open areas with native plant seeds. Using an integrated approach gives managers options for treating weeds based on various factors including community concerns, project location, weed species present, and avoidance or protection measures to prevent impacts to valuable resources and the environment while still providing effective control.

What weeds will be treated under this plan?

The Bureau of Indian Affairs has identified 45 different weed species for management. These species are all non-native plants that are not naturally occurring in the region. The Bureau of Indian Affairs, as a federal agency, is required to manage non-native species as part of its trust responsibility. All the species identified for control are problematic. Some can cause serious injury to livestock or wildlife. Others displace more desirable native plants, lowering native plant cover and production. There are also some that can increase the frequency and severity of fire on the Navajo Nation in areas where they have become overgrown and dense. While there are a number of native weed species that occur on the Navajo Nation, such as silverleaf nightshade or cocklebur, these species will not be addressed under this plan but may be addressed through other natural resource planning efforts.

Where will weed treatments take place?

The BIA is prioritizing weed treatments in six key areas: designated rangeland, designated farmland, rights-of-way, roads, riparian habitats, and Community Development Areas. Exotic weed populations currently occur in many of these areas and have negatively impacted them, either by increasing maintenance costs, harming production, or impacting important natural processes. Under the Plan, treatments in these areas will be prioritized. However, weed management projects in other areas will still be considered based on their location, size, and which weed species are being treated.

What alternatives are being considered for the Plan?

The BIA is considering three alternatives for weed management on the Navajo Nation. The first is the No Action Alternative, which will continue current weed management efforts on the Navajo Nation. Treatments include the use of herbicide, mechanical, and manual removal treatments with little to no coordination between projects or with other weed management efforts. The second alternative is the main integrated weed management plan. This plan will provide guidance on controlling 45 noxious weed species using manual, mechanical, chemical, biological, and cultural control methods. A key feature of this alternative are requirements for coordination with communities, Navajo Nation Programs, and neighboring federal agencies when planning and implementing projects. The third alternative is similar to the second, with the exception of using biological control agents for weed treatments. Under this alternative, the use of USDA-approved agents would not be used, thus requiring other weed control methods to be used instead.

How does this comment period differ from Public Scoping?

Originally, the BIA conducted public scoping in 2013 through a series of community meetings organized across the Navajo Nation. Since that time, the BIA has prepared initial drafts of both the Plan and the PEIS. However, given the fact that scoping was conducted over 7 years ago, the BIA would like to ensure that it has considered any other comments or concerns the public may have regarding weed management on the Navajo Nation as it finalizes the Plan and the EIS for public review. For these reasons, the BIA has decided to open a brief comment period to solicit additional comments or concerns from the public. As part of this effort, the BIA will not conduct any public meetings or provide any documents for review. However, meetings are planned when the draft Plan and PEIS are available for the public in Summer 2021.

How do I submit a Comment? What is a substantive comment?

You can submit a comment at the project website until **May 29, 2021**:

https://www.bia.gov/regional-offices/navajo/navajo-nation-integrated-weed-management-plan

Click on the “Comment Form” button to submit a comment on weed management or the BIA’s proposed weed management approach.

The BIA will address any substantive comments it receives. A substantive comment is one that presents new information for the project or may develop a new alternative not currently considered. Comments not considered are those that do not pertain to the plan, are value-type comments that do not provide data to support its claims (i.e. I do not like herbicides), or comments that may not require a response.

Written comments may also be sent to:

Bureau of Indian Affairs – Navajo Regional Office
Branch of Environmental Quality Act Compliance and Review
C/O Leonard Notah, NEPA Compliance Specialist
P.O. Box 1060
Gallup, New Mexico 87301

Or by email to

nniwmp@bia.gov

Where can I find out more about the Integrated Weed Management Plan?

You may contact the BIA Navajo Regional Office NEPA Specialist using the information provided below:

Leonard Notah
NEPA Compliance Specialist
Leonard.notah@bia.gov
505-863-8287

Bureau of Indian Affairs
Navajo Region
Gallup, New Mexico

U.S. Department of the Interior
Bureau of Indian Affairs
Navajo Region
@BureauIndAffrs

Public Notice

April 29, 2021

Contact: Leonard Notah (505) 863-8287, Leonard.Notah@bia.gov

BIA Seeks Additional Comments for the Navajo Nation Integrated Weed Management Plan

GALLUP, NM (Navajo Nation) - The Bureau of Indian Affairs is seeking additional public comments to develop an Integrated Weed Management Plan and Programmatic Environmental Impact Statement (PEIS) to control noxious weeds across the Navajo Nation. This project has been in development since 2012, with the Notice of Intent (NOI) published in the Federal Register on January 14, 2013 and Public Scoping completed on March 20, 2013. The plan and PEIS analysis were delayed after scoping was completed and are currently being updated. Due to this delay, BIA is requesting public comment to determine if there are any additional relevant issues that would influence the scope of the environmental analysis, including the alternatives.

The Navajo Indian Reservation lands are infested with noxious weeds that have social and economic impacts on the Navajo Nation. The BIA, in partnership with cooperating agencies, is developing an integrated weed management plan to prevent, control, reduce, and eliminate the detrimental impacts of weed infestations throughout the reservation. The proposed action would authorize new treatments of noxious weed infestations throughout the Navajo Nation. Mitigation measures were developed with Navajo Nation Environmental Protection Agency, Navajo Nation Department of Fish and Wildlife, and U.S. Fish and Wildlife Service to protect air and water quality and listed and sensitive wildlife species during weed treatments. The number of infestations and amount of acreage treated will be determined by annual funding allocations for project implementation.

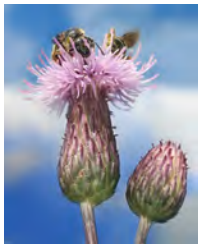
The various methods of noxious weed control considered for the integrated weed management plan include, but are limited to, manual, mechanical, cultural, biological, and herbicide treatments. The BIA will not be considering the use of dicamba as an option for chemical treatment due to the June 8, 2020 Environmental Protection Agency (EPA) cancellation order for dicamba use. The BIA identified the following resources to evaluate the effect of the proposed action: surface and ground water, soils, air, environmental justice considerations, cultural and historic resources, biological resources, public health, resource use, and socioeconomics.

Tribal consultations are being conducted in accordance with the Department of the Interior's Consultation Policy. Tribal concerns will be given due consideration, including impacts on Indian trust assets. Federal, State, and local agencies, along with other stakeholders that may be interested in or affected by the BIA's decision on this project are invited to comment and, if eligible, may request to participate as a cooperating agency.

During the next 30 days, ending on May 29, 2021, the public is invited to provide feedback using the Comment Form posted on the BIA Navajo Region Integrated Weed Management Plan website:

https://www.bia.gov/regional-offices/navajo/navajo-nation-integrated-weed-management-plan

# # # #



Navajo Nation Integrated Weed Management Plan Public Feedback

The Bureau of Indian Affairs Navajo Region is preparing an Integrated Weed Management Plan to address the control, management, and eradication of several non-native invasive weed species on the Navajo Nation. Due to delays in finalizing the plan and conducting the required environmental analysis, the BIA is seeking additional feedback from the public for this project.

Please provide your comments and concern you may have regarding the following topics:

1. Proposed weed removal methods:

2. Priority sites for weed management:

3. Proposed EIS alternatives:

4. Additional weed management concerns:

5. Other topics:

6. Name

7. Address

8. Telephone

9. Email address

10. Would you like to receive updates on this project? (You will only receive electronic emails related to this project. Your information will not be used or sold to outside organizations)

- ○ Yes
- ○ No
- ○ Maybe

Appendix L. Additional Public Scoping (April 29 – May 29, 2021) Radio and Newspaper Advertisements

LEGAL NOTICE
Window Rock - Apache County
Arizona

Department of the Interior - Bureau of Indian Affairs—Navajo Region

The Bureau of Indian Affairs is seeking additional public feedback to develop an Integrated Weed Management Plan and Environmental Impact Statement to control noxious weeds across the Navajo Nation. The methods proposed for weed control, management, and eradication include a combination of cultural, manual, mechanical, chemical, and biological methods. This project has been in development since 2012 but the final plan and analysis were delayed. The public is invited to provide feedback at the following website until May 29, 2021:

https://www.bia.gov/regional-offices/navajo/navajo-nation-integrated-weed-management-plan

Call Leonard Notah, BIA NEPA Coordinator for more information (505) 863-8287
Help us fight weeds together!

Legal# XXXXX Published in The Independent May 3 & 7 & 10 & 14, 2021.

Department of the Interior
Bureau of Indian Affairs
Navajo Region

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at the following website until May 29, 2021:
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Call Leonard Notah, BIA NEPA Coordinator for more information

(505) 863-8287

Help us fight weeds together!

Farmington Daily Times
PART OF THE USA TODAY NETWORK

Affidavit of Publication

Ad # 0004713050

This is not an invoice

BUREAU OF INDIAN AFFAIRS, NAVAJO REGIOI
PO BOX 1060

GALLUP, NM 87305

I, being duly sworn say: **Farmington Daily Times**, a daily newspaper of general circulation published in English at Farmington, said county and state, and that the hereto attached Legal Notice was published in a regular and entire issue of the said DAILY TIMES, a daily newsaper duly qualified for the purpose within the State of New Mexico for publication and appeared in the internet at The Daily Times web site on the following days(s):

05/03/2021, 05/07/2021, 05/10/2021, 05/14/2021

Legal Clerk

Subscribed and sworn before me this May 14, 2021:

State of WI, County of Brown
NOTARY PUBLIC

1-7-25

My commission expires

KATHLEEN ALLEN
Notary Public
State of Wisconsin

Ad # 0004713050
PO #:
# of Affidavits 1

This is not an invoice

Department of the Interior - Bureau of Indian Affairs—Navajo Region
The Bureau of Indian Affairs is seeking additional public feedback to develop an Integrated Weed Management Plan and Environmental Impact Statement to control noxious weeds across the Navajo Nation. The methods proposed for weed control, management, and eradication include a combination of cultural, manual, mechanical, chemical, and biological methods. This project has been in development since 2012 but the final plan and analysis were delayed. The public is invited to provide feedback at the following website until May 29, 2021:
https://www.bia.gov/regional-offices/navajo/navajo-nation-integrated-weed-management-plan
Call Leonard Notah, BIA NEPA Coordinator for more information (505) 863-8287
Help us fight weeds together!
#4713050, Daily Times, May. 3, 7, 10, 14 2021

CONFIRMATION

BUREAU OF INDIAN AFFAIRS, NAVAJO REGION
PO BOX 1060
GALLUP NM 87305-

PO#:

Account	AD#	Ordered By	Tax Amount	Total Amount	Payment Method	Payment Amount	Amount Due
9282832252BURI	0004713050	Alana	$20.01	$258.97	Credit Card	$0.00	$258.97

Ad Order Notes:

Sales Rep: CSauer **Order Taker:** CSauer **Order Created** 04/28/2021

Product	Placement	Class	# Ins	Start Date	End Date
ELP-daily-times.com	ELPW-Legals	Legal Notices	**4**	**05/03/2021**	**05/14/2021**
ELP-FM Daily-Times	ELP-Legals	Legal Notices	**4**	**05/03/2021**	**05/14/2021**

Text of Ad: 04/28/2021

Department of the Interior - Bureau of Indian Affairs—Navajo Region

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Help us fight weeds together!
#4713050, Daily Times, May. 3, 7, 10, 14 2021

Department of the Interior - Bureau of Indian Affairs—Navajo Region

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Call Leonard Notah, BIA NEPA Coordinator for more information (505) 863-8287
Help us fight weeds together!

Navajo Nation Integrated Weed Management Plan

Public Notice for Additional Comments – Social Media

Facebook Post

The Bureau of Indian Affairs Navajo Region is seeking additional public comments for the Navajo Nation Integrated Weed Management Plan. The plan will provide a programmatic approach for the management and control of 45 noxious weed species using manual, mechanical, biological, chemical, and cultural control methods. Visit the project website at: https://www.bia.gov/regional-offices/navajo/navajo-nation-integrated-weed-management-plan to learn more about the project and leave a comment.

Twitter

BIA Navajo Region is seeking additional comments for the Navajo Nation Integrated Weed Management Plan. Learn more at https://www.bia.gov/regional-offices/navajo/navajo-nation-integrated-weed-management-plan.

Photo Credit: Renee Benally – Halogeton along in Monument Valley.

Appendix E. Potential Habitat Maps for Federally and Tribally Listed Species

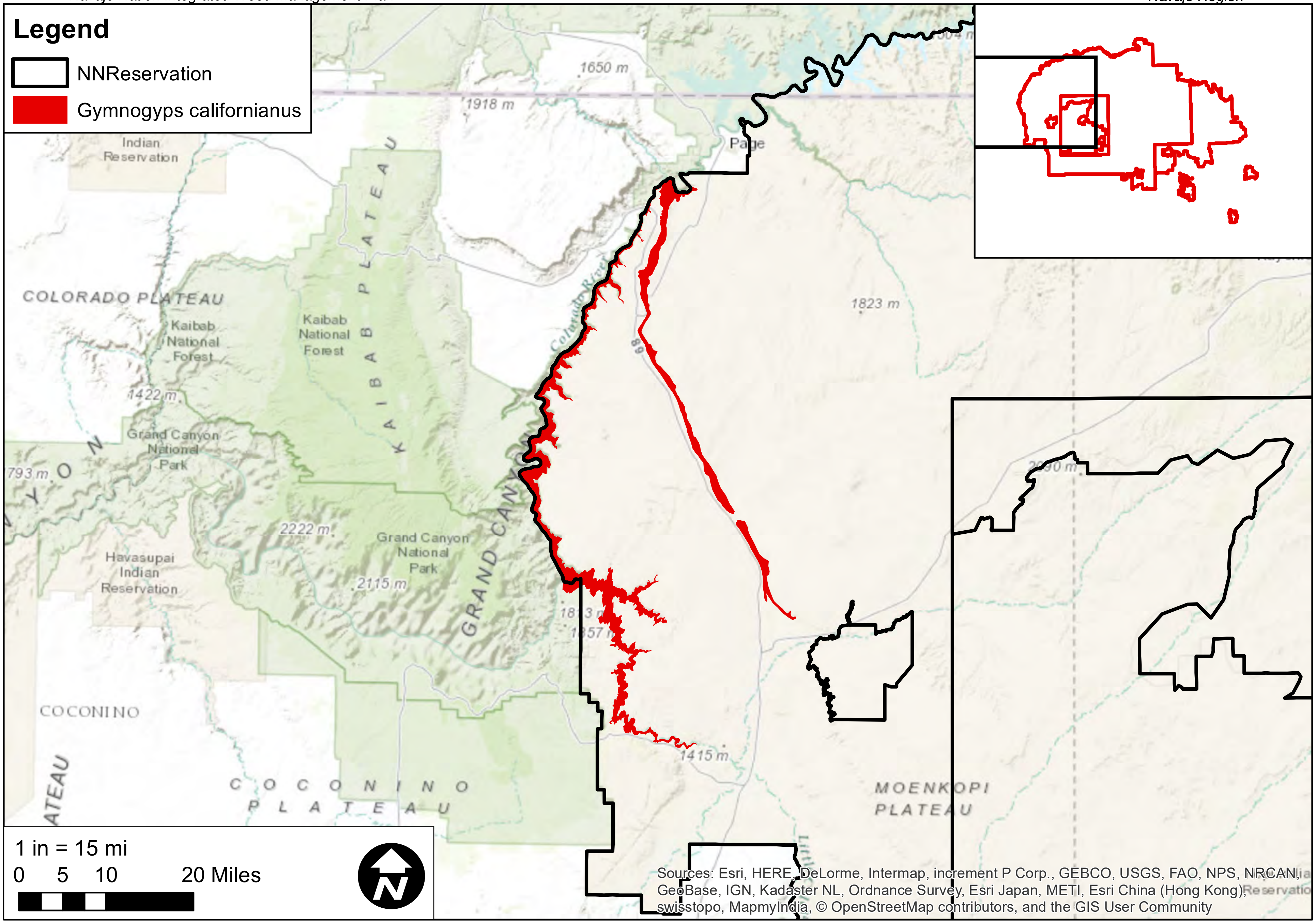

Figure E-1. Potential habitat - California condor

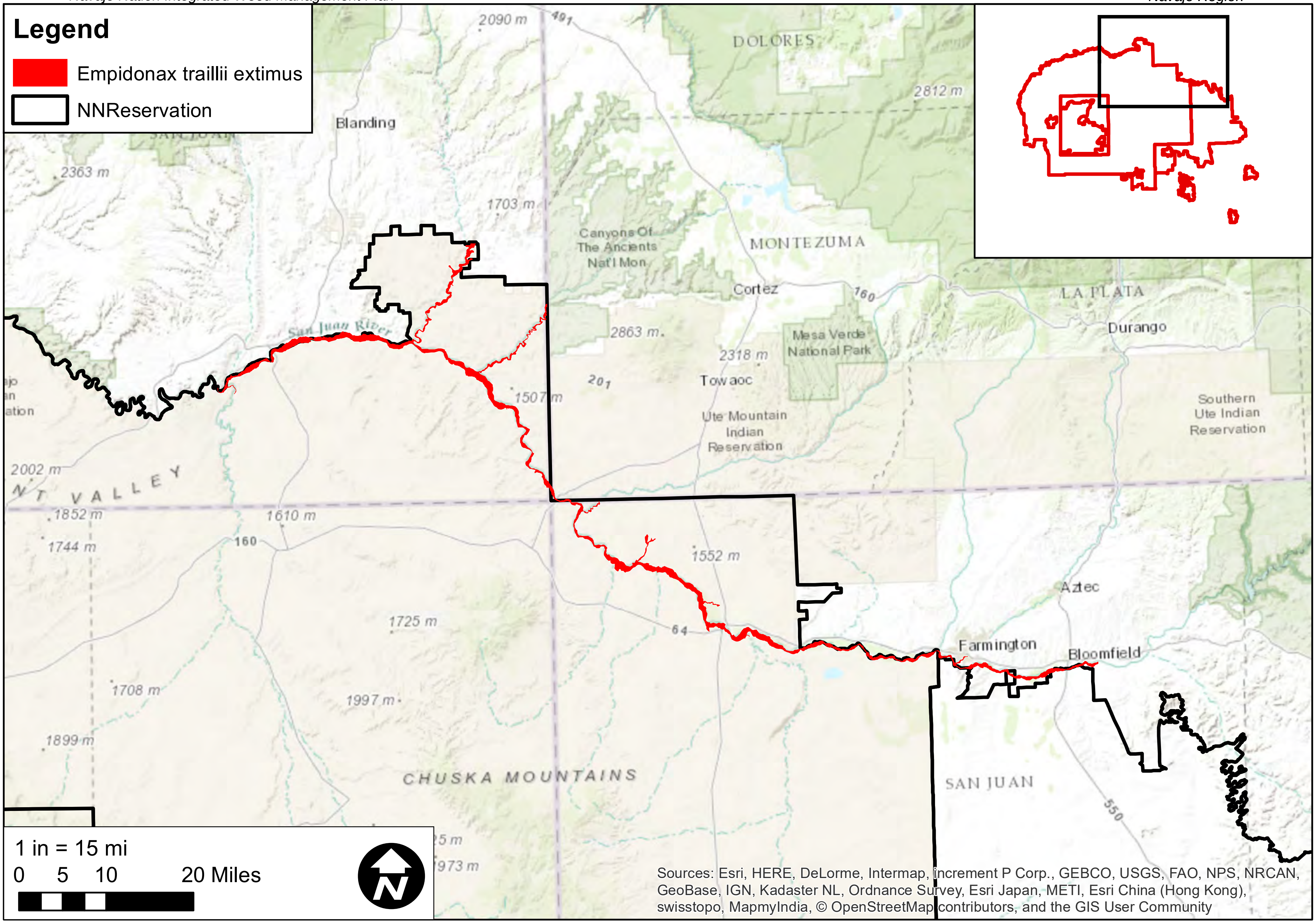

Figure E-2. Potential habitat - Southwestern willow flycatcher

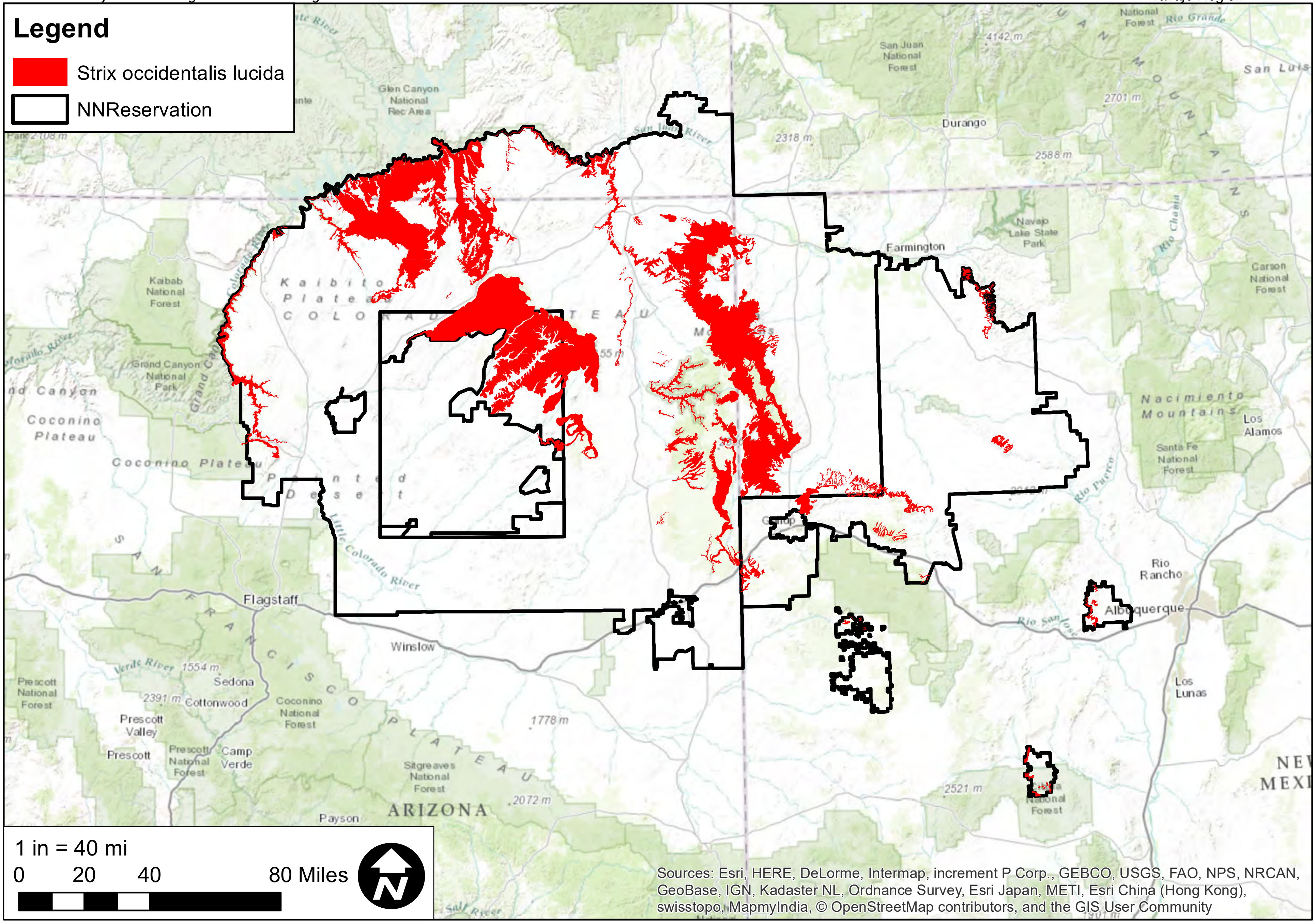

Figure E-3. Potential habitat - Mexican spotted owl

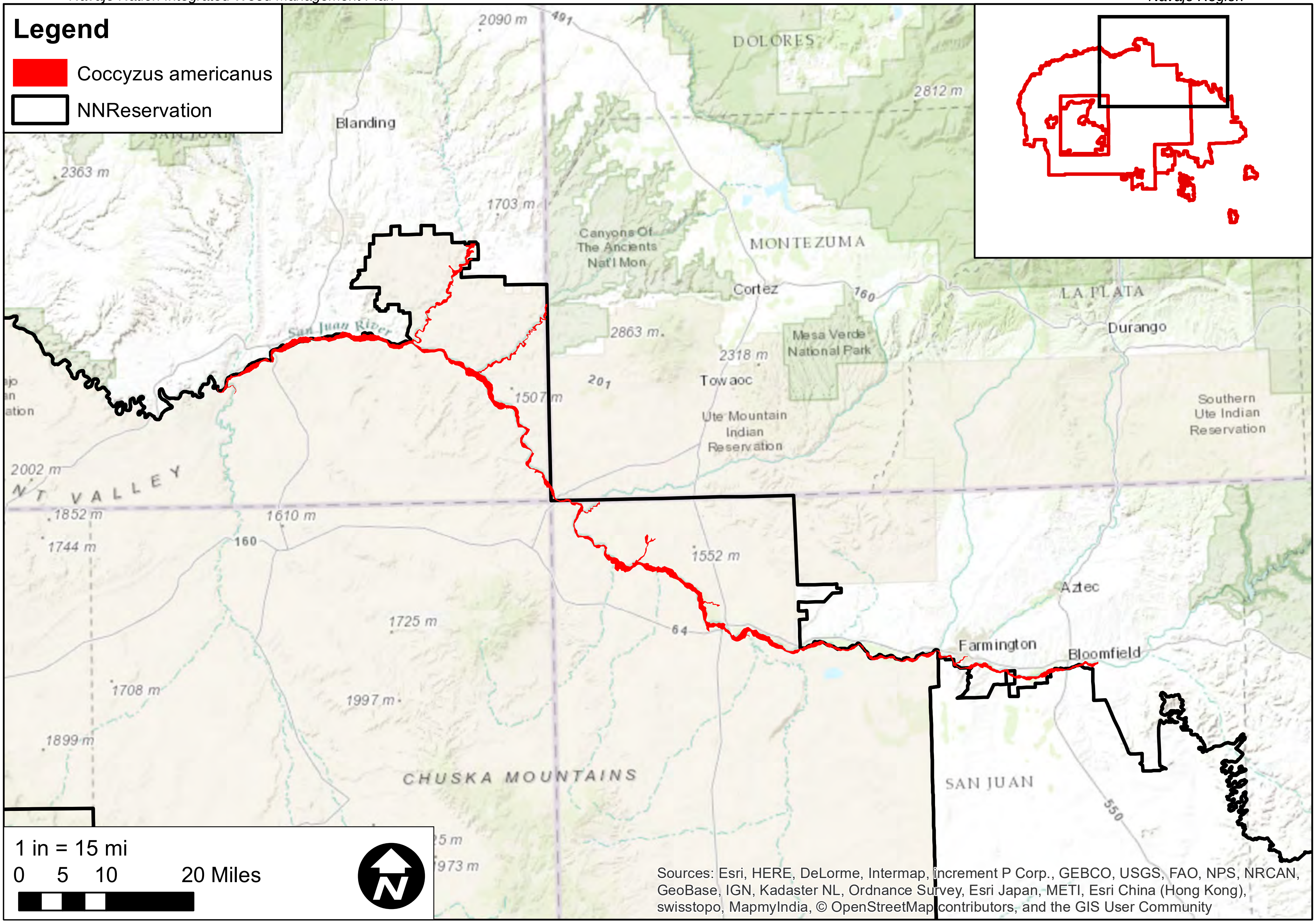

Figure E-4. Potential habitat - Western yellow-billed cuckoo

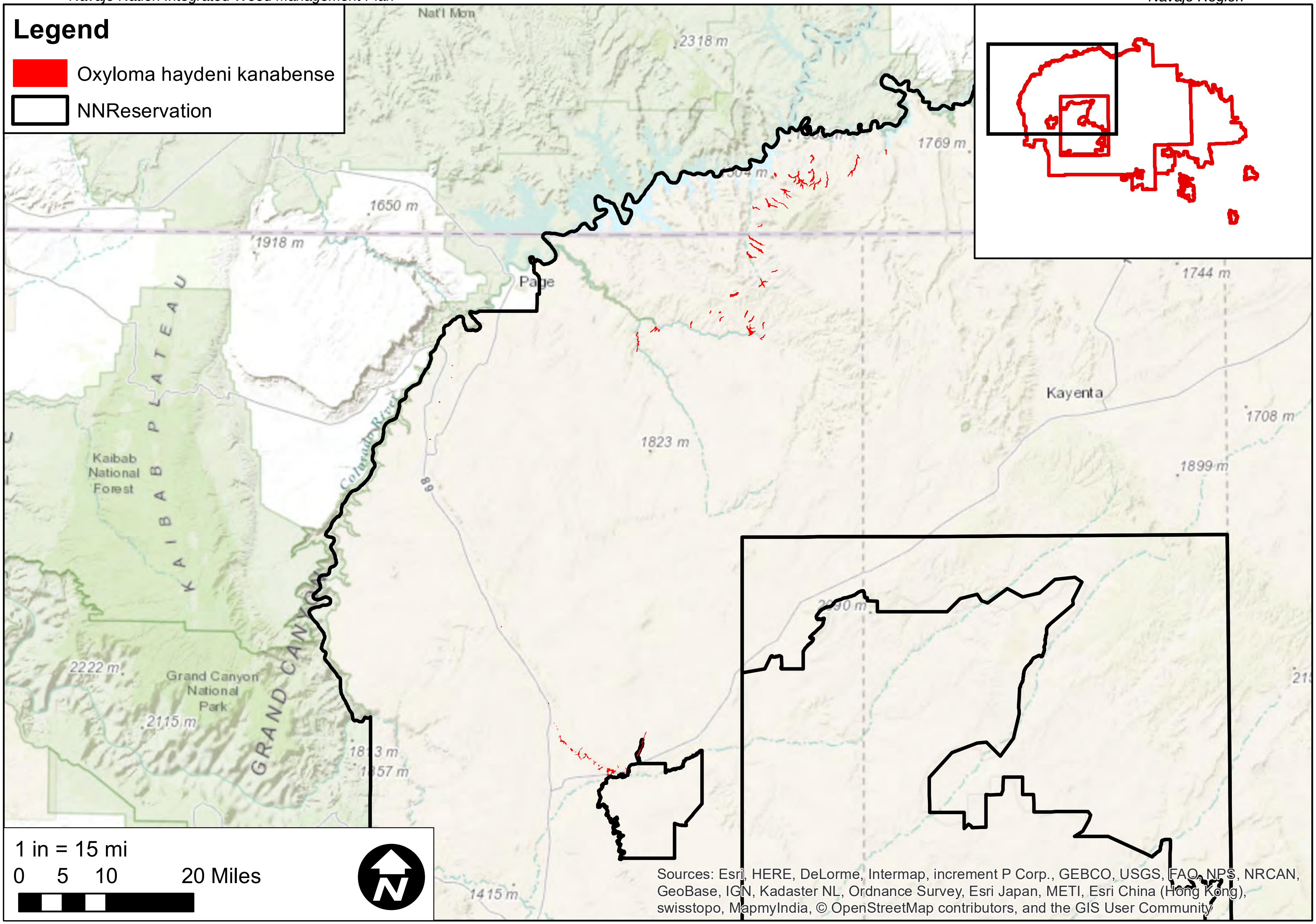

Figure E-5. Potential habitat - Kanab ambersnail

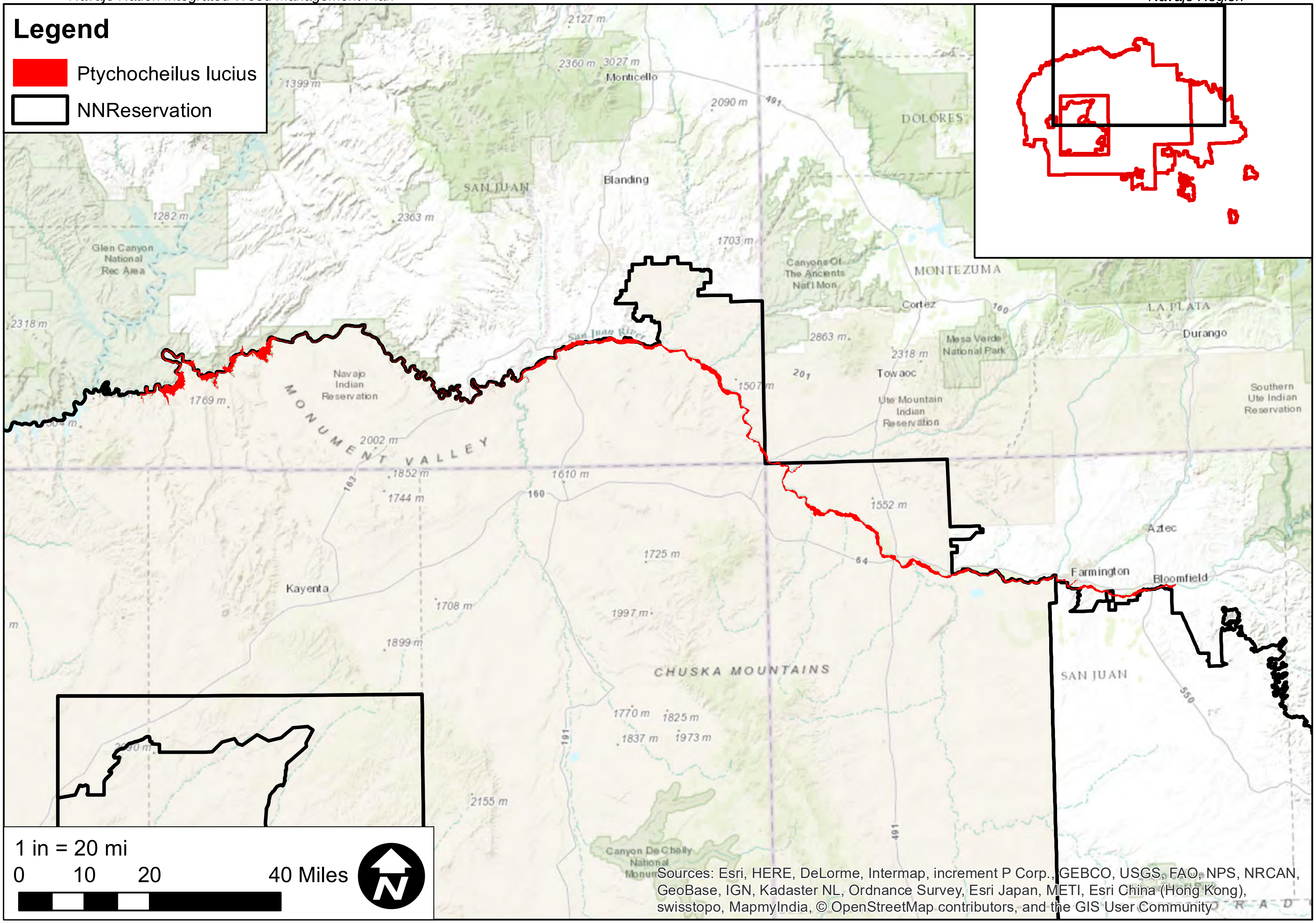

Figure E-6. Potential habitat - Colorado pikeminnow

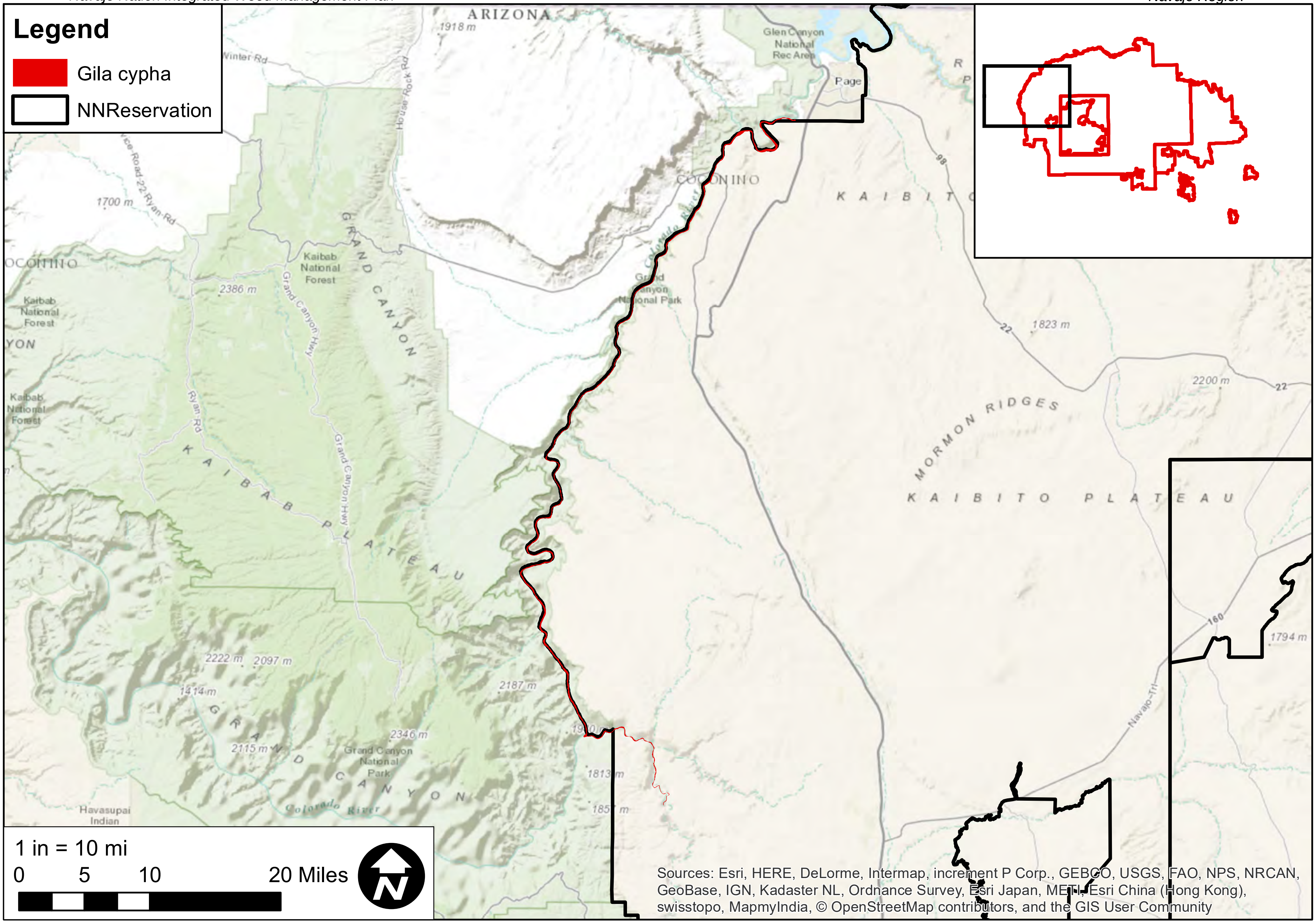

Figure E-7. Potential habitat - Humpback chub

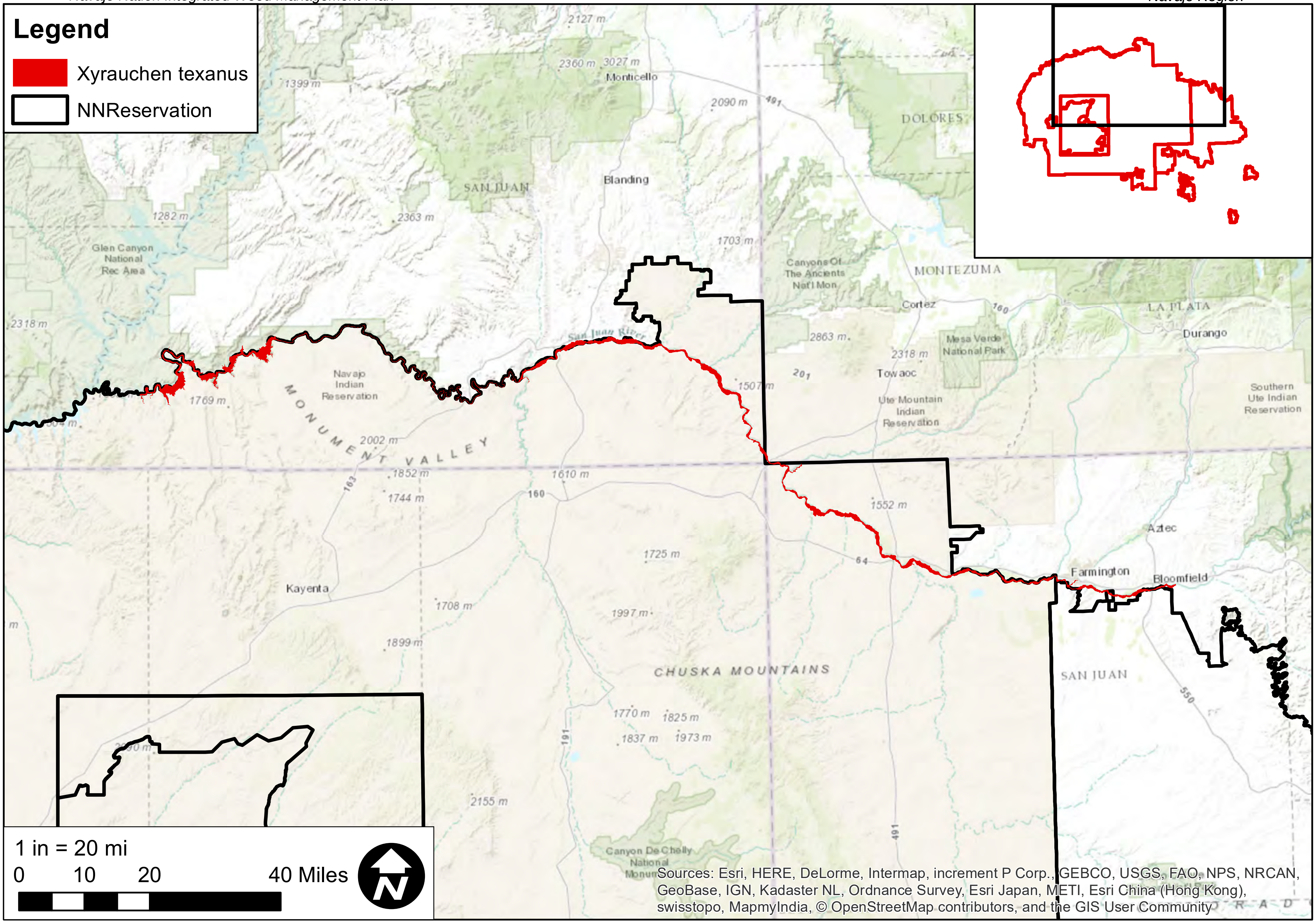

Figure E-8. Potential habitat - Razorback sucker

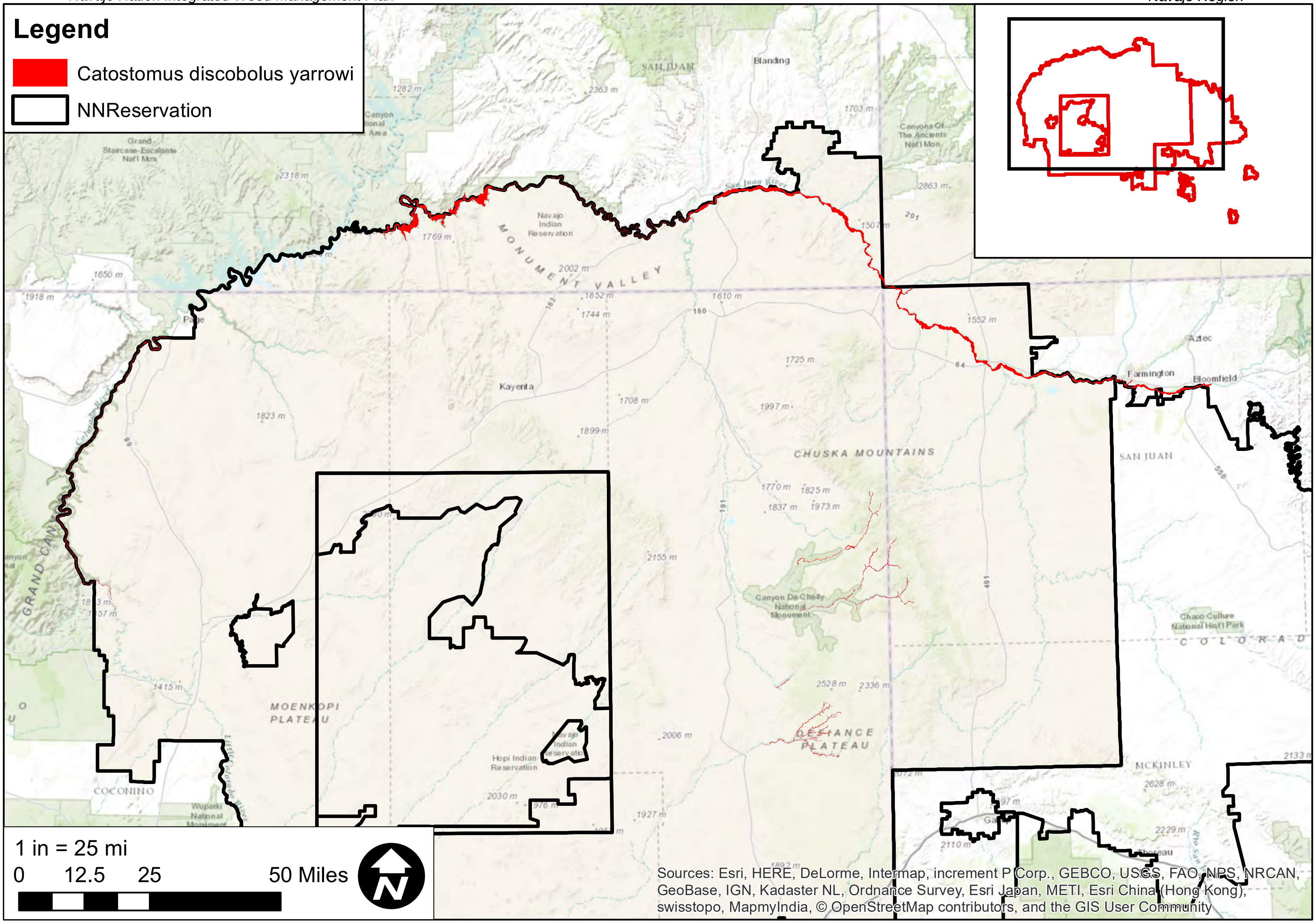

Figure E-9. Potential habitat - Zuni bluehead sucker

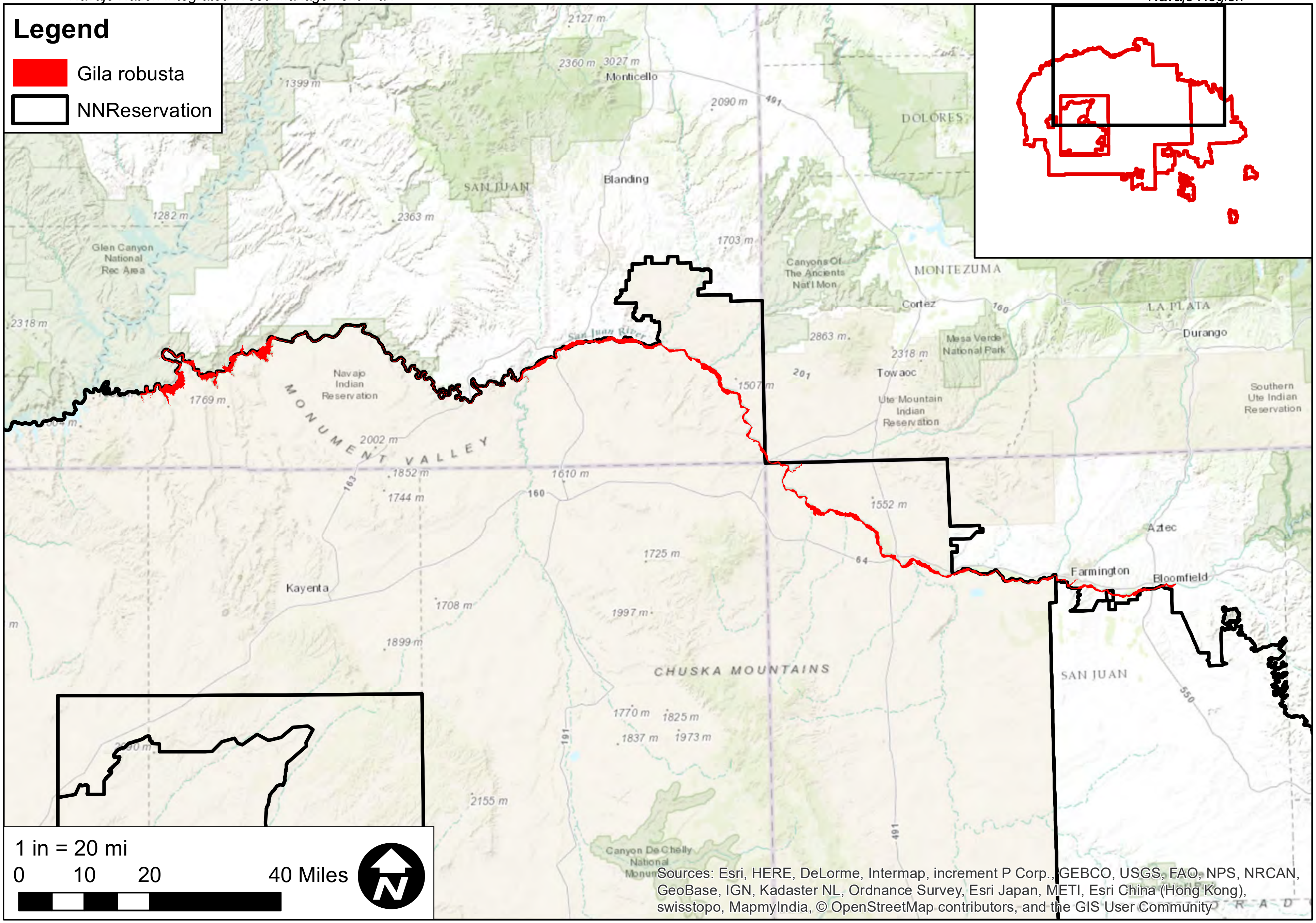

Figure E-10. Potential habitat - Roundtail chub

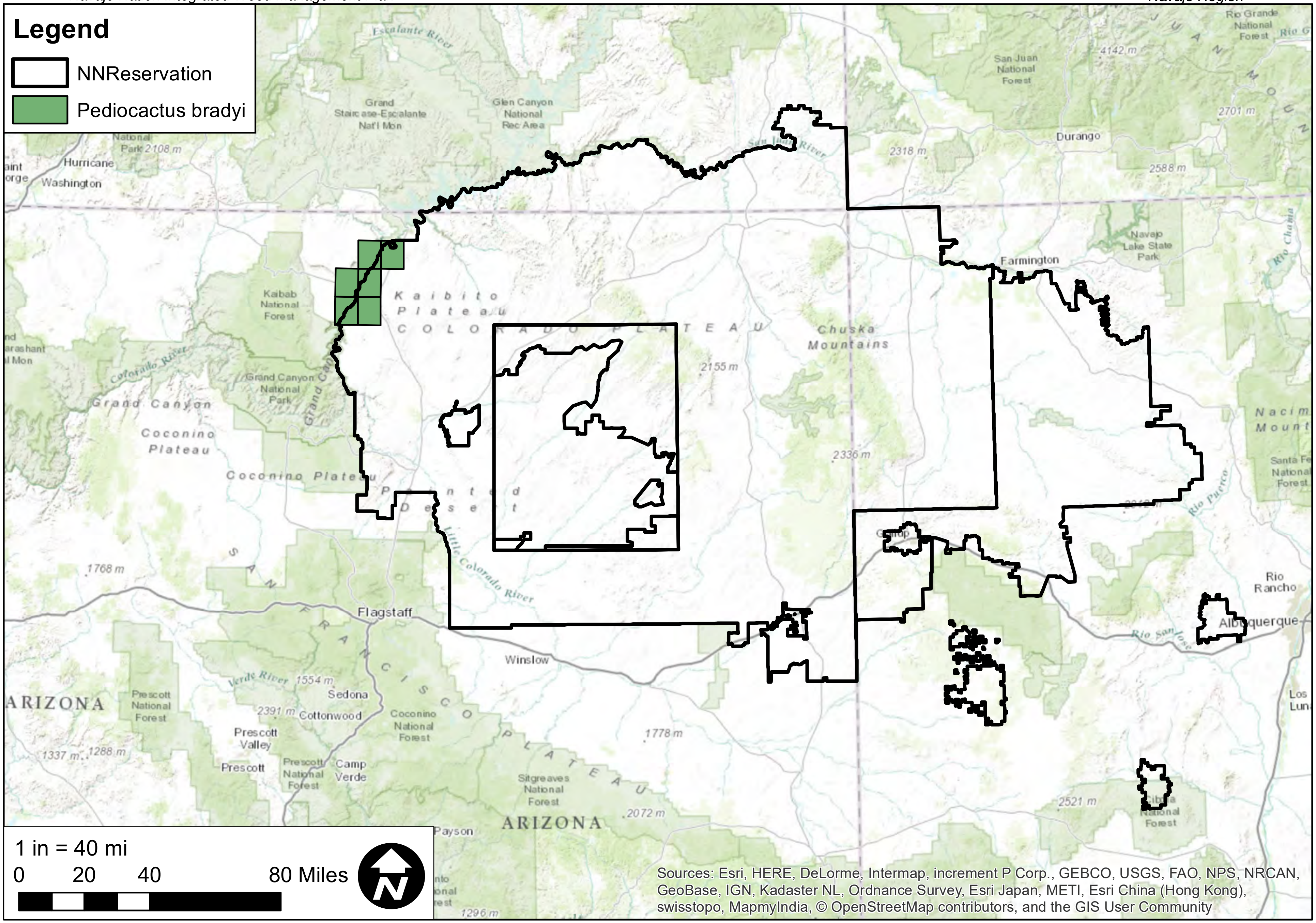

Figure E-11. Potential habitat - Brady pincushion cactus

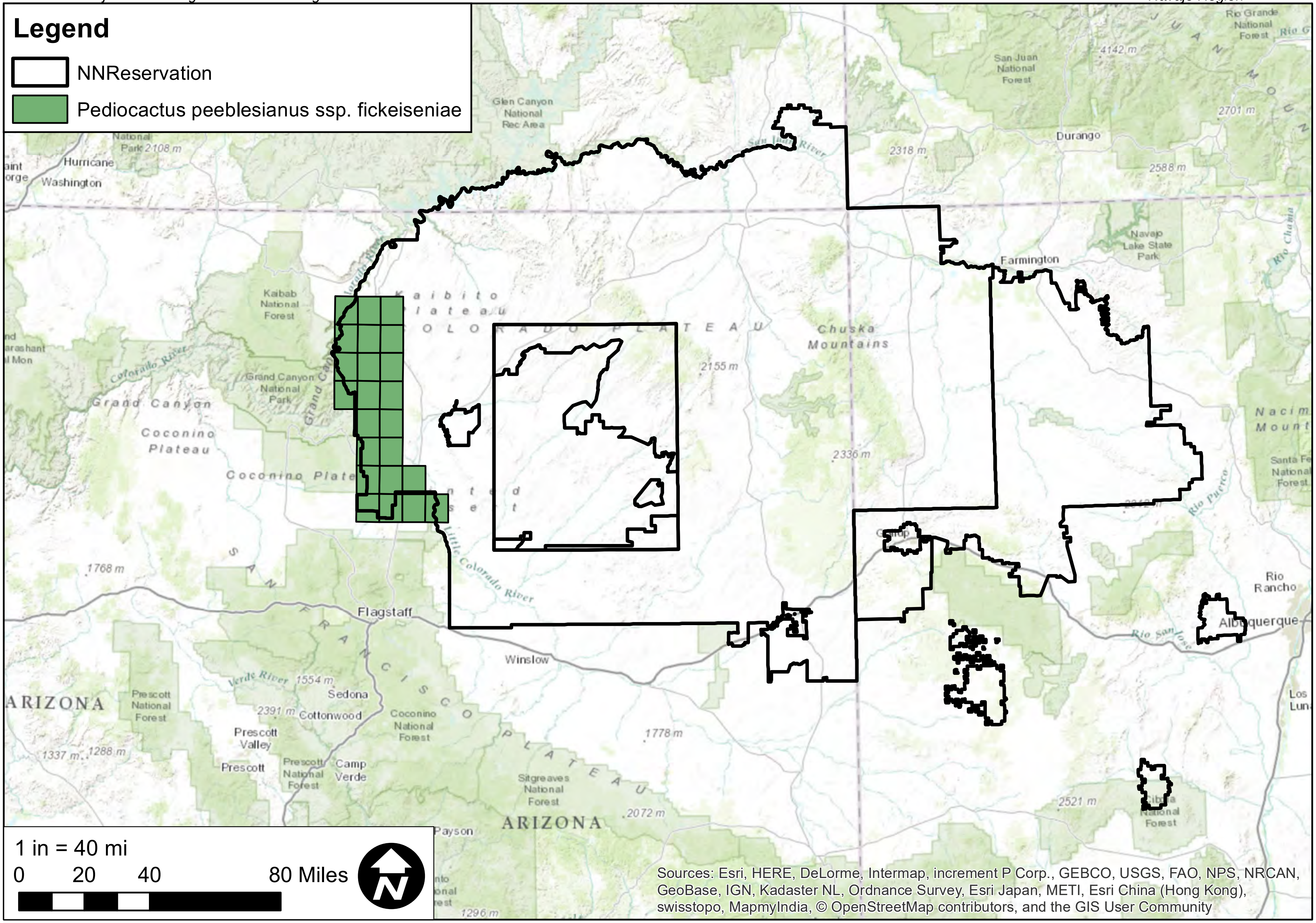

Figure E-12. Potential habitat - Fickeisen Plains cactus

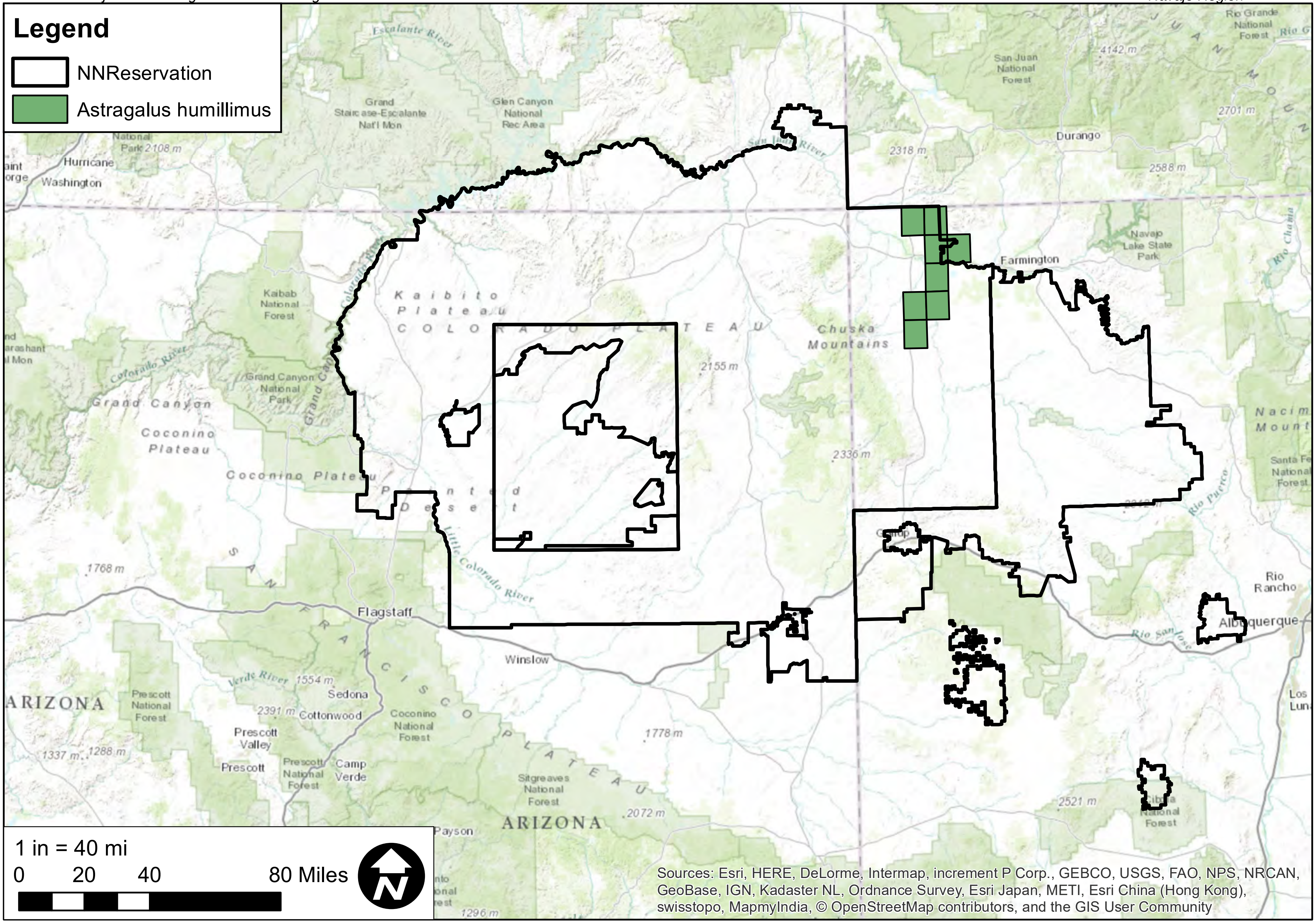

Figure E-13. Potential habitat - Mancos milkvetch

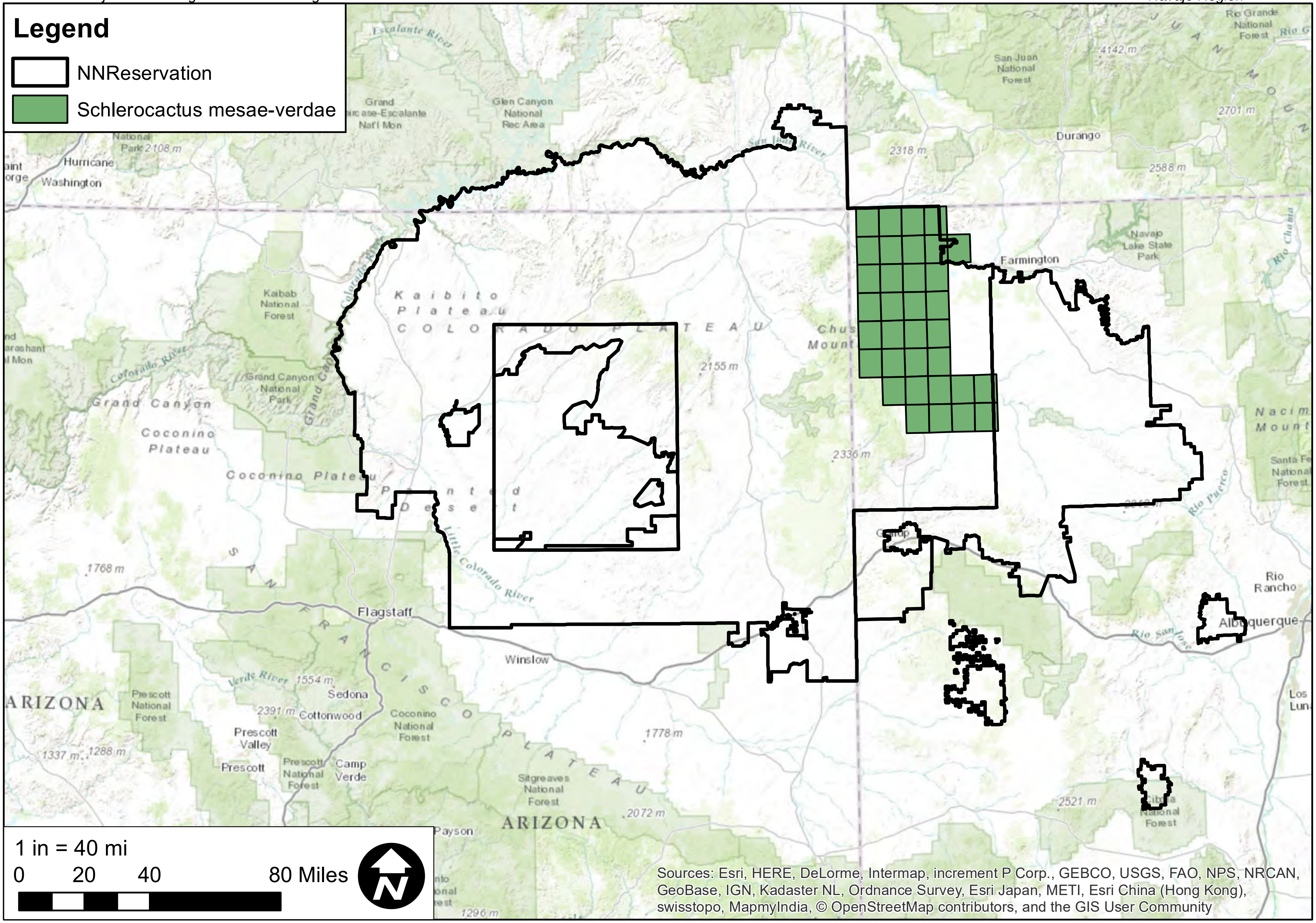

Figure E-14. Potential habitat - Mesa Verde Cactus

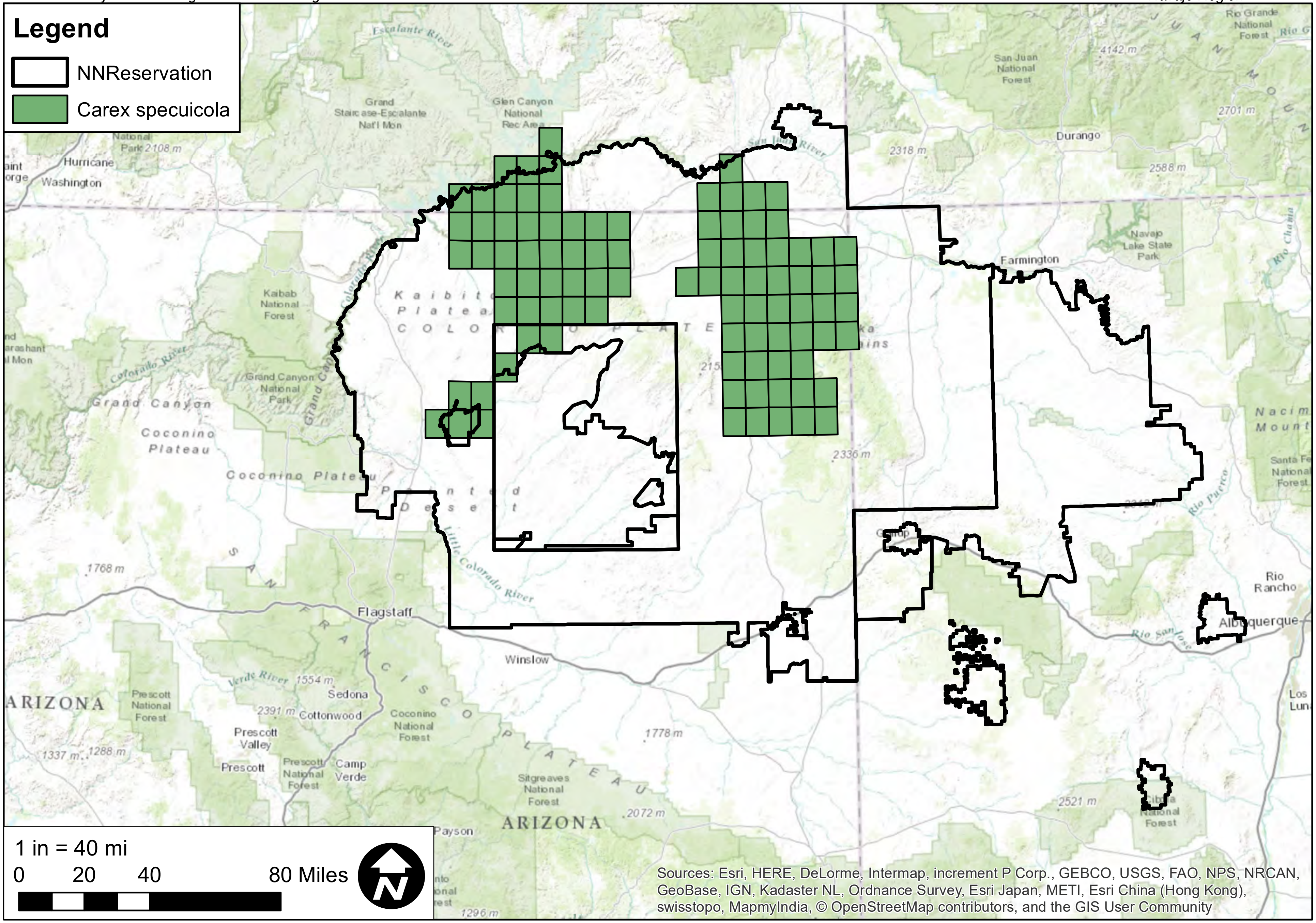

Figure E-15. Potential habitat - Navajo sedge

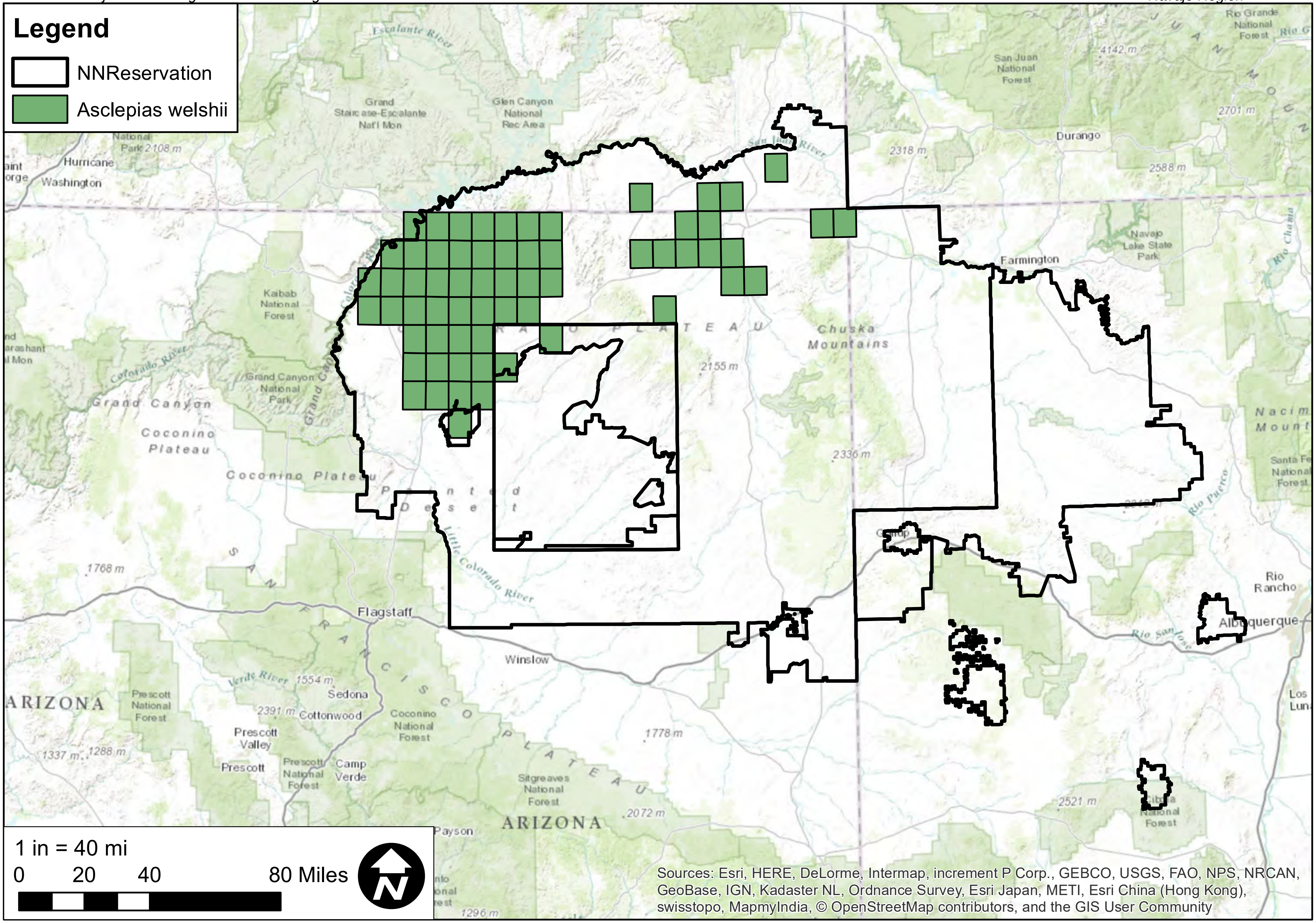

Figure E-16. Potential habitat - Welsh's milkweed

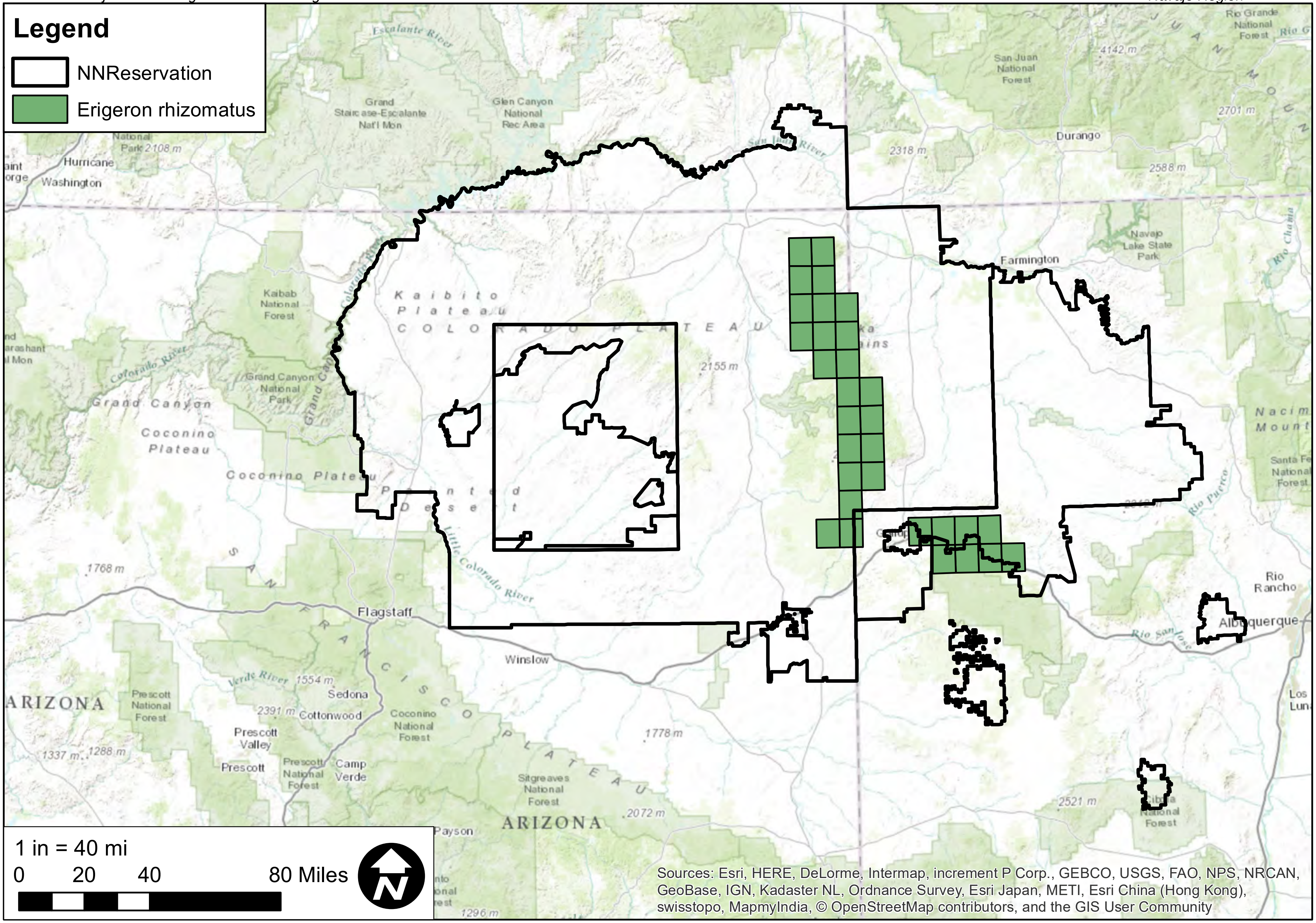

Figure E-17. Potential habitat - Zuni/Rhizome fleabane

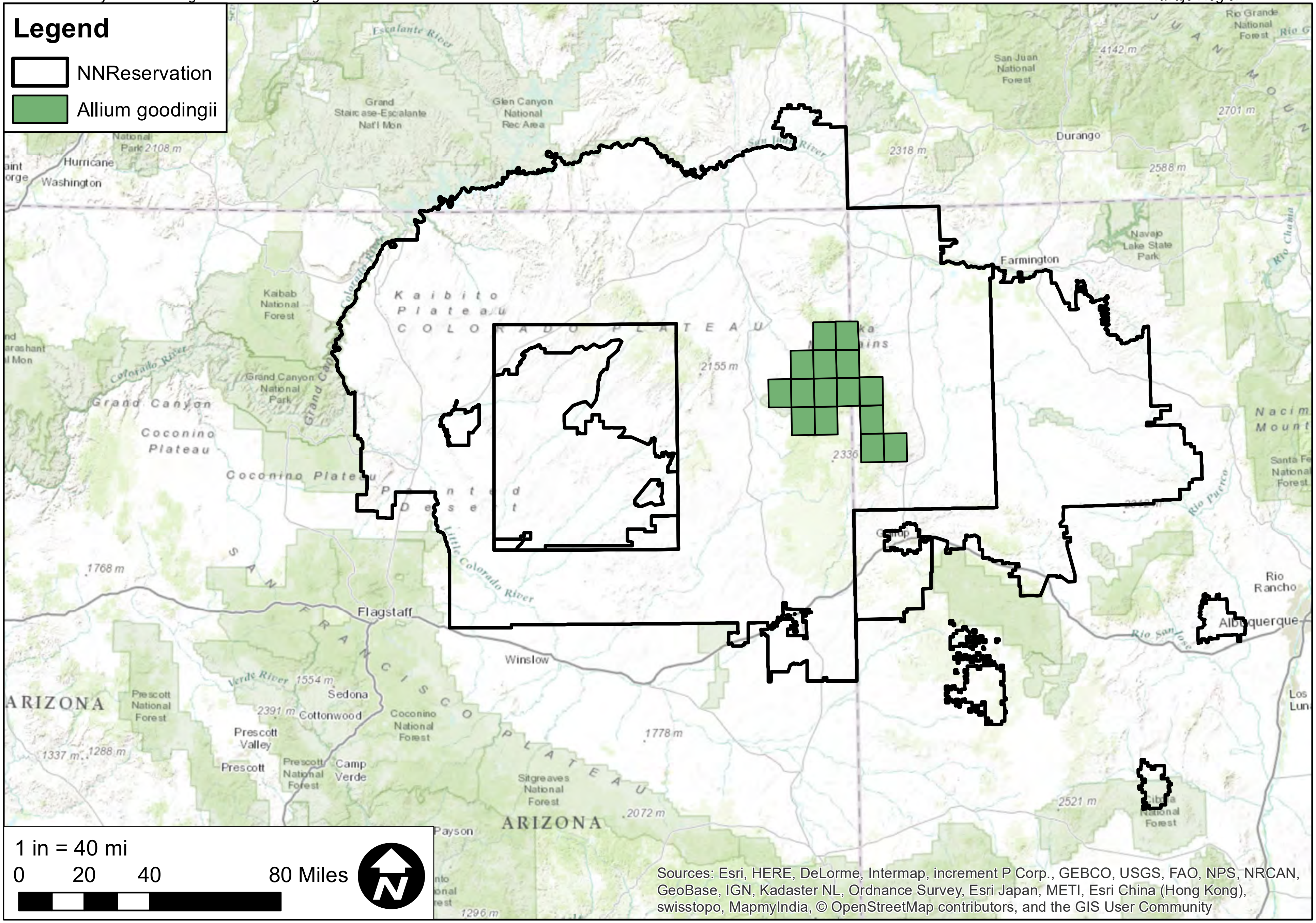

Figure E-18. Potential habitat - Gooding's onion

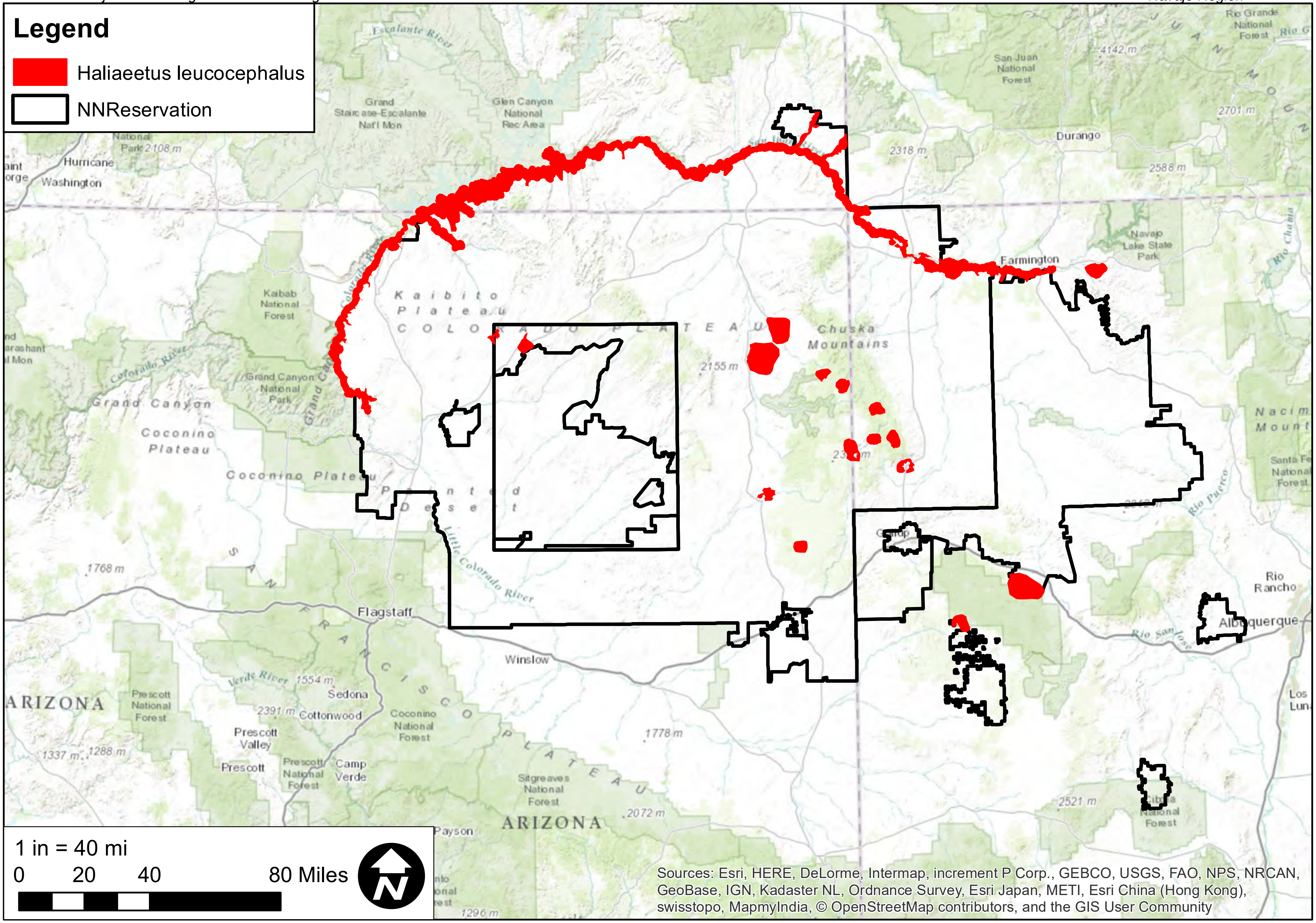

Figure E-19. Potential habitat - Bald eagle (MBTA)

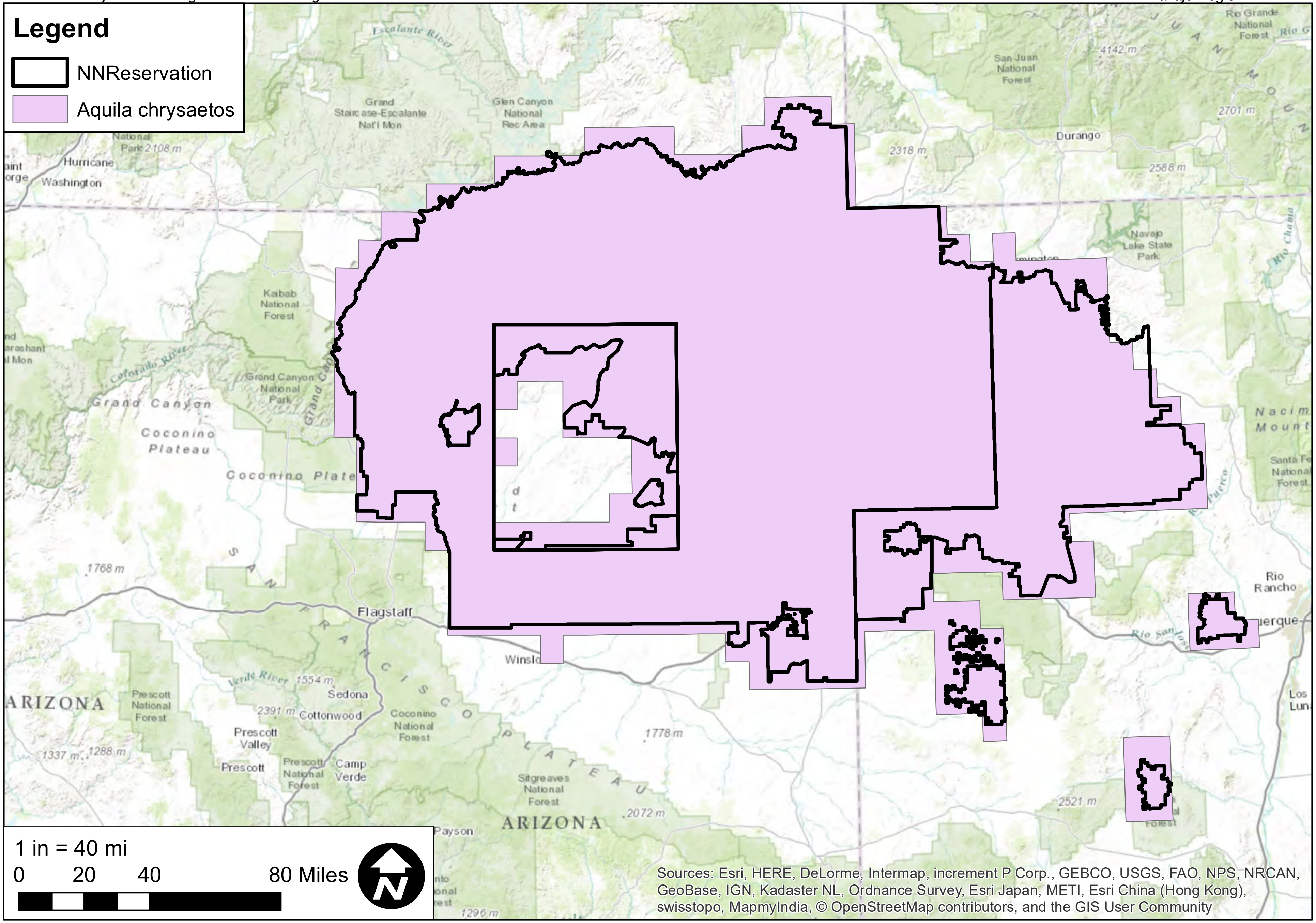

Figure E-20. Potential habitat - Golden eagle (MBTA)

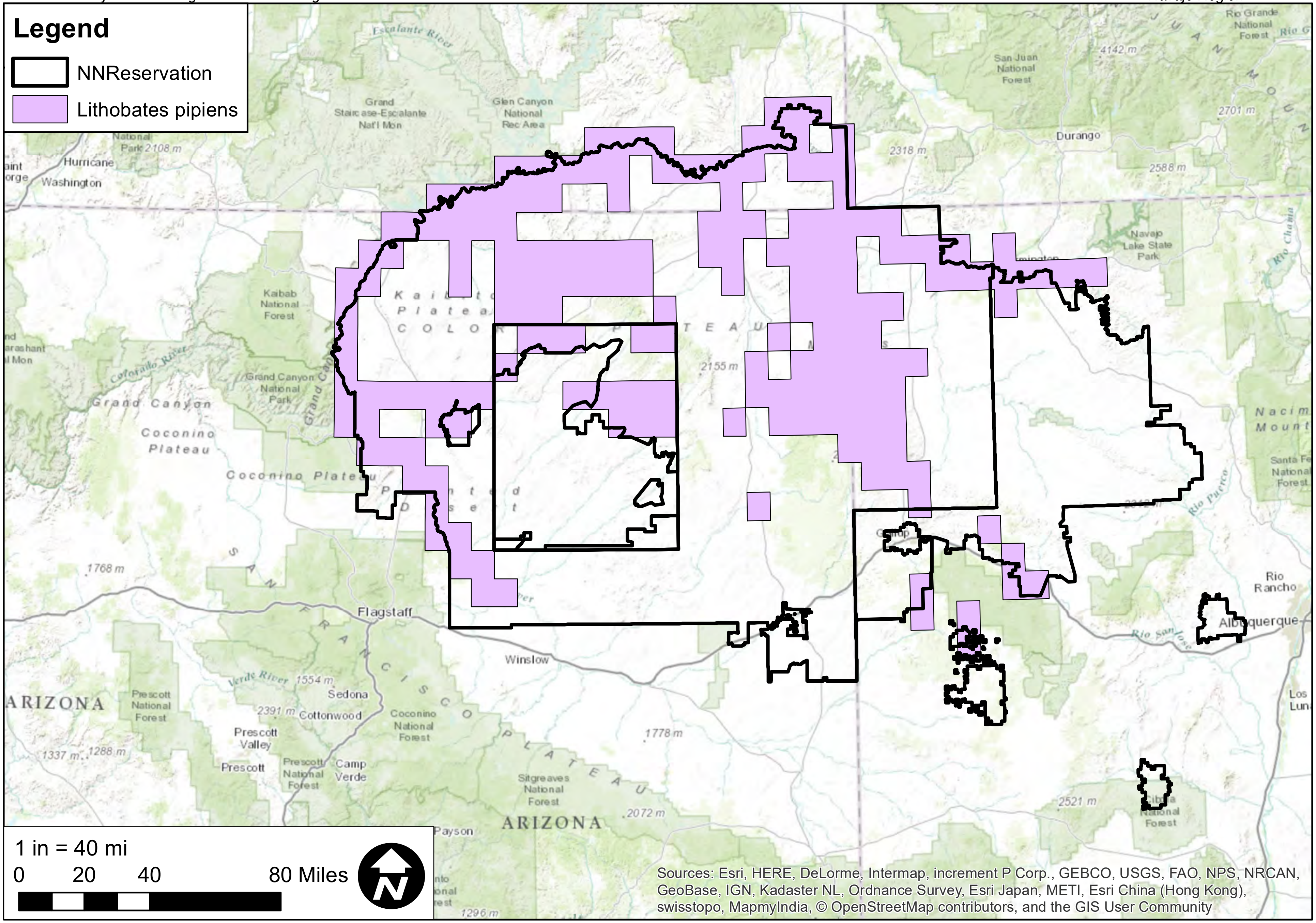

Figure E-21. Potential habitat - Northern leopard frog

Appendix F. Mitigation and Species Conservation Measures

APPENDIX F. MITIGATION AND SPECIES CONSERVATION MEASURES

Mitigation Measures

The following measures are required when implementing weed management projects. These measures should be printed and checked off when implementing a project.

1. General Measures

Project Planning

- Complete all necessary permits and authorizations prior to implementing a project (see Section 7.0 and Appendix C of the NNIWMP).
- If treatments are planned for allotment lands, the project sponsor must contact the landowner(s) and obtain consent from the majority Indian interest of the beneficial Indian owner(s), documented by their signature(s) for the weed project.
- Noxious tree treatments require consent of the majority Indian interest of the beneficial Indian owner(s), documented by their signature(s) on a Power of Attorney for the Sale of Allotment Timber, contract, or permit.
- Conduct surveys for cultural resources by a qualified cultural resource specialist before treatments in coordination with the Navajo Nation Historic Preservation Department (NNHPD).
- Surveys and clearance for paleontological resources are required before any surface disturbing activities, mechanical treatments, or chemical treatments in coordination with the Navajo Nation Minerals Department.
- Conduct ethnographic inquiries with local community members to identify plant gathering sites and other traditional cultural properties (TCPs) that may be affected by weed treatments. If TCPs and gathering sites are identified, the project sponsor will work with the community to identify alternative sites, treatment options, or other mitigation measures.
- Complete and submit two copies of the Archaeological Inventory Report and all site forms to the NNHPD Cultural Resource Compliance Section for review. The BIA NRO Regional Director will approve the CRCF to provide Section 106.
- Avoidance of all cultural resources is the preferred mitigation measure to avoid adverse effects, as well as identifying alternative plant gathering areas. All work must be coordinated with NNHPD to ensure compliance with Section 106 and NHPA.
- Complete and submit a Data Request Form for the project area to NNDFW NNHP (https://www.nndfw.org/nnhp/drs2012.pdf) and obtain a Biological Resource Compliance Form (BRCF) from NNHPD.

- If potential habitat for endangered or threatened species is present, conduct a habitat assessment by a qualified biologist. If potential habitat is found, protection measures, including species buffers will be applied to the habitat or additional surveys for species presence will be conducted by a qualified biologist. If the species is present at the site, species protection measures will be employed, NNDFW will be notified, and a biological monitor will be present during all phases of project implementation (Appendix F of the NNIWMP).
- Develop a Safety and Communications Plan that identifies specific safety measures for all treatment methods used in the project, including equipment handling, required Personal Protection Equipment (PPE), and emergency response communication.
- Removal of invasive trees requires a forest product harvesting permit or contract and may require a silvicultural prescription to authorize a treatment in forest lands, including woodlands. Special provisions associated with the harvest document(s) should be reviewed and modified when appropriate to address unforeseen resource issues associated with the harvesting activities.
- All project personnel will be trained on the use of Personal Protection Equipment (PPE), equipment handling, and safety protocols. Personnel will be required to use PPEs during herbicide and mechanical (chainsaw, control burn, etc.) applications.

Prior to Project Implementation

- Designate staging areas and/or equipment wash stations for cleaning and prep work before and after treatments. These sites will be used to mix herbicides, refuel equipment and vehicles, and store materials for the duration of the treatment. Equipment wash stations may be temporary and will have a filter system, for example at least 6 inches of large cinder or gravel spread over an area 10 feet x 30 feet. Filter cloth may be used for temporary stations. The area will be a perched drainage to allow excess moisture to drain after being filtered and will be located at least 300 feet away from surface water, natural drainages or wellheads.
- Notify adjacent landowners, authorized land users, local authorities, and/or the public of treatments, treatment duration, and post-treatment measures before implementation to prevent exposure and limit re-infestations through education and outreach with the local grazing official, posting public notices, radio announcements, and/or chapter meeting announcements. Weed treatment flyer and/or forest harvest sales permits should be posted locally before projects start.
- To reduce the risk of weed spread, access routes will avoid heavy infestation areas. Access routes will be closed when the project is completed.
- Clearly mark boundaries of treatment sites (such as posting visible flags or signs) before and during treatments.

- Sites will be inspected, and potential hazards will be removed to ensure safety prior to treatments.

During Project Implementation

- Vehicles will use only established roads for accessing project sites. Vehicles will be parked at designated parking spots near established roadways during treatments.
- If camping, project personnel will use designated and established campsites, with approval from NNHPD or a qualified archeologist.
- On-site safety briefings will be given prior to any treatments to review required PPE, safety and emergency response measures, and what to do in the case of an injury or emergency.
- Inspect and clean equipment, heavy machinery, and clothing after treatments for mud, dirt, and plant parts to prevent spread to other project sites by the field crew.
- Minimize soil disturbance to the extent practical.
- No mechanical treatments or use of heavy mechanized equipment will be used in archeological sites or traditional cultural property boundaries.
- If potential habitat for an endangered or threatened species is present a qualified biological monitor will be on site during all phases of project implementation.
- Vehicles and equipment should be turned off if periods between use are longer than 15 minutes.

Post Project Implementation

- Post-treatment monitoring will evaluate treatment effectiveness, potential re-infestations or new introductions, and impacts to resources (Appendix D of the IWMP)
- Limit the number of people and trips to sensitive areas for follow-up treatments and/or monitoring.

2. Chemical Treatments

Project Planning

- The on-site Pesticide Applicator will develop a Spill Contingency Plan that meets the minimum requirements specified by the BIA to eliminate contamination of water or soil resources in the case of accidental spills.
- If using herbicide, notify NNEPA Pesticide Enforcement of project, including location, herbicides used, and treatment dates. Submit a Pesticide Use Proposal (PUP) for approval.

- If wellheads or source water areas are identified within the project area, notify NNEPA Public Water System Safety Program to determine protection zones for herbicide applications and alternative treatment methods to be used in the protection area.

- For aerial herbicide treatments, native vegetation communities in or near treatment sites should be documented with GPS, especially cottonwood-willow woodlands and native sagebrush communities.

Prior to Project Implementation

- All herbicides must be USEPA approved and mixed and applied according to label instructions.
- Treatment sites will be closed according to label specifications when limiting exposure to humans, livestock, and pets is recommended.

During Project Implementation

- All herbicides must be used according to the USEPA approved label.
- Certified Pesticide Applicators must be on site to supervise projects during herbicide treatments. Pesticide Applicators must be certified by the U.S. EPA for the Navajo Nation.
- Use dye markers with herbicides to identify the physical spray location on weeds.
- An emergency spill kit must be present when herbicides are used to contain, absorb, and dispose of spill materials.
- Material Safety Data Sheets (MSDS) for herbicides and adjuvants must be accessible in the event of accidental exposure or spill.
- Avoid applying chemicals during times of high wind speeds, high temperature, and low humidity to prevent chemical drift to areas off site. Read the herbicide label for specific conditions.
- Use Water Quality Protection Zones (WQPZ) set by the NNEPA for mechanical treatments and broadcast herbicide treatments when using a vehicle in or near riparian and wetland areas. The WQPZ is at least 200 feet unless a greater buffer is needed for a listed species or if indicated on the herbicide label. Refer to the Water Quality Protection Guidelines for the Navajo Nation Forest (2000) and the Navajo Nation Aquatic Resource Protection Program Guidance (1994) on distance guidelines. Wells and wellheads will also require a 100 feet buffer based on the NNEPA PWSSP's Source Water-Wellhead Protection Guidance.
- *Near riparian areas,* only aquatic formulations of 2,4-D, glyphosate, triclopyr, and imazapyr will used within 25 ft of the daily high-water mark.
- Herbicides that are practically non-toxic to fish and mollusks (White 2007) require a 25 ft (7.6 m) buffer from the daily high-water mark, including: aminopyralid, chlorsulfuron

methyl, clopyralid, imazapic, and thifensulfuron-methyl. They must be applied using spot treatment methods in this zone.

- Native plant communities, such as cottonwood-willow woodlands and native sagebrush, require a 300-foot buffer during aerial herbicide treatments.
- Aerial herbicide treatments should use GPS monitoring to track the aircraft's position, provide a record of where herbicide was applied, and ensure all applicable avoidance buffers were enforced.
- Non-aquatic approved and moderate to high aquatic toxicity herbicides (White 2007) require a 300-foot (91 m) buffer from the daily high-water mark.
- Only aquatic approved herbicides will be used for aerial applications by either fixed wing or rotary aircraft applications.
- Water for mixing herbicide and cleaning herbicide equipment will be potable water obtained off-site or through a Water Use Permit. For remote sites, there is a possibility of a Water Use Permit with the local water code. An anti-siphon and back flow preventer device are required to prevent contamination of the water source.
- Store equipment and materials away from riparian areas in safe and secure upland sites in close proximity of the project site. Herbicide containers and equipment must be stabilized with straw bales, filter cloth, or other appropriate means to prevent release into waterways or wetlands.
- Herbicides will be stored in a secondary containment storage unit with impermeable materials such as concrete or metal so leaks, and spills do not reach soils. Storage containers will be coordinated with BIA Safety Officer and Environmental Services.

Post Project Implementation

- Herbicide containers and application equipment will be triple rinsed at designated washing stations to minimize chemical residues left as per the MSDS and herbicide labels. Do not pour rinse water from empty containers or sprayer cleaning onto ground or any drainage system. Dispose as hazardous waste.
- Properly dispose of pesticide waste and containers according to federal, state, and tribal regulations.

3. Mechanical

Prior to Project Implementation

- If mechanical treatments increase the risk of erosion near waterways, erosion control measures will be implemented to stabilize and limit erosion.
- Establish and implement a burn plan if prescribed burning is used as a control method.

- Prescribed burning will not be conducted during migratory bird breeding season.

During Project Implementation

- Keep areas without vegetation wet to prevent fugitive dust. This can be accomplished with a sprayer mounted to a water truck.
- Use lightest/smallest off-road vehicle, utility vehicle, or tractors will be a priority for treatments. No such equipment will be used on wet soils or cryptobiotic soil crusts.
- No mechanical treatments within 200 feet of open water sources.

4. Cultural

During Project Implementation

- Projects using targeted grazing treatments will develop a grazing treatment plan for review by NNHP.
- Targeted grazing must use fencing around the perimeter of the treatment area to contain livestock.
- Use targeted grazing only in sites where weeds are palatable and non-toxic and where desired native species will not be damaged.
- After targeted grazing is implemented, livestock will be placed in a separate fenced location for 48 hours to collect animal waste. Animal waste will be burned to destroy plant parts and seeds.
- Targeted grazing will not exceed more than 10 days on a range and/or wildland project site or 365 days on a cropland site.
- Targeted grazing shall not be used in areas where weed comprise less than 50% of total vegetative cover.
- Passive restoration is preferred when native vegetation comprises >75% of the treated area. If natural re-vegetation fails, then active restoration is necessary. Active restoration includes planting of native species poles, root stocks, and seeds.
- Reseeding will be timed with precipitation events and at least 7 days after herbicide treatments are completed. Reseed disturbed areas with native vegetation to minimize opportunities for weed establishment and soil erosion.
- Only native vegetation, certified weed-free and preferably locally sourced, will be used for restoration activities.

Post Project Implementation

- Livestock grazing will be deferred during the growing season or until seeding has established.

Species Conservation Measures

The species conservation measures below are intended for the proposed action and serve as a guide for mitigating impacts to Navajo Endangered species (NESL) and Federally Threatened and Endangered species when conducting weed treatments on Navajo Nation. However, the Navajo Natural Heritage Program (NNHP) encourages treatment of noxious weeds within sensitive species populations as a tool to improve habitat for NESL species, with proper consultation with NNHP and USFWS, as applicable. Therefore, if the goal of the weed treatment project is to improve habitat for threatened and sensitive species, the conservation measures below can be modified for individual species through consultation with NNHP and USFWS on a project-specific basis. Buffers for mechanical, cultural, manual (low impact), and non-aerial herbicide use can be modified on a project-by-project basis with approval from NNHP but will require the presence of a qualified Biologist on-site during all stages of project implementation. Flagging and fencing around listed plant species will also be required.

Species Conservation Measures (Project Design Features)

The Recommended Protection Measures for Pesticide Applications (RPR) in USFWS Region 2 (White 2007) and the Avoidance Measures listed in the Navajo Nation Endangered Species List, Species Accounts (NNDFW 2020) were used as a starting point for the conservation measures. The BIA requires the most conservative avoidance measures of the two documents be implemented for IWMP projects. BIA conducted nine informal discussions with the USFWS and the NNHP, NNDFW to help refine the conservation measures.

Federally Listed Species

General Project BMPs

1. Submit a Biological Consultant Data Request Form to the NNHP NNDFW to initiate the BRCF process prior to project implementation for background information on species habitat and occupancy (the form and instructions can be accessed here: https://www.nndfw.org/nnhp/drs.htm).

2. If preliminary analysis based on maps, aerial photos, and other knowledge of the project site indicates that potential habitat for listed species is present, a qualified biologist will conduct a habitat assessment and a qualified Biologist may be required on site during all stages of project implementation as determined by the BRCF process.

3. If suitable habitat is present, the project will apply the conservation measures, including buffers established for that species or a qualified biologist will conduct additional surveys for species' presence.

4. Obtain federally listed species permits from USFWS and Biological Investigations Permits from NNDFW prior to conducting species surveys on Navajo Nation land.

5. If the species is present at the site, the species-based protection measures will be employed. If protocol surveys do not detect the species, there will be no buffers.
6. Where specified, species breeding season timing restrictions and buffers apply to all treatment methods.
7. Where two or more species' habitats overlap, the more restrictive measures will take priority.

Navajo Nation Endangered Species List

General Project Best Management Practices (BMPs)

1. Include General Project BMPs species conservation measures listed above (2, 4-7).
2. If preliminary analysis based on maps, aerial photos, and other knowledge of the project site indicates that potential for habitat for Group 2 and 3 species is present, a qualified biologist will conduct species surveys.
3. Species surveys are preferred for Group 4 species but not required. A qualified biologist will conduct Group 4 species surveys concurrently with Group 2 and 3 species surveys.
4. Obtain Biological Investigation Permits from NNDFW prior to conducting species surveys.

Table 1. Required species conservation measures for federally listed endangered and threatened and Group 2 and 3 Navajo Nation listed plant species.

Plants (Federally Listed and NNHP G3) – Species Conservation Measures																					
USFWS Status	**E**			**T**				**T**													
NNDFW Group	**G2**	**G3**	**G2**	**G2**	**G3**	**G3**	**G2**	**G2**	**Group 3**												
Conservation Measure	**Brady pincushion cactus** *(Pediocactus bradyi)*	**Fickeisen plains cactus** *(Pediocactus peeblesianus ssp. fickeiseniae)*	**Mancos milk-vetch** *(Astragalus humillimus)*	**Zuni (Rhizome) fleabane** *(Erigeron rhizomatus)*	**Welsh’s milkweed** *(Asclepias welshii)*	**Navajo sedge** *(Carex specuicola)*	**Cutler’s milk-vetch** *(Astragalus cutleri)*	**Mesa Verde cactus** *(Sclerocactus mesae-verdae)*	**Aztec gilia** *(Aliciella formosa)*	**Gooding’s onion** *(Allium goodingii)*	**Alcove death camas** *(Anticlea vaginatus)*	**Marble Canyon milk-vetch** *(Astragalus cremnophytax var. hevronii)*	**Cronquist’s milk-vetch** *(Astragalus cronquistii)*	**Naturita milk-vetch** *(Astragalus naturitensis)*	**Acoma fleabane** *(Erigeron acomanus)*	**Round dunebroom** *(Errazurizia rotundata)*	**Navajo Penstemon** *(Penstemon navajoa)*	**Alcove rock daisy** *(Perityle specuicola)*	**Navajo bladderpod** *(Physaria navajoensis)*	**Alcove bog-orchid** *(Platanthera zothecina)*	**Brack’s hardwall cactus** *(Sclerocactus cloverae ssp. brackii)*
Low and high aerial spraying of herbicides requires a 1-mile (1.6 km) buffer from identified listed species locations.									X	X	X	X	X	X	X	X	X	X	X	X	X
Mechanical, cultural, chemical, and prescribed burn treatments require a 200 ft (60 m) buffer from identified listed plant species locations. A burn plan must be developed for each project using prescribed fire, which will include specific treatment buffers.	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Manual treatments (low impact treatments) require a 20 ft (6 m) buffer from identified listed species locations.	X	X	X	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X	X	X
When doing treatments, workers will place flagging, and/or fencing around listed or sensitive plant populations.	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X

Conservation Measure	**Brady pincushion cactus** *(Pediocactus bradyi)*	**Fickeisen plains cactus** *(Pediocactus peeblesianus* ssp. *fickeiseniae)*	**Mancos milk-vetch** *(Astragalus humillimus)*	**Zuni (Rhizome) fleabane** *(Erigeron rhizomatus)*	**Welsh’s milkweed** *(Asclepias welshii)*	**Navajo sedge** *(Carex specuicola)*	**Cutler’s milk-vetch** *(Astragalus cutleri)*	**Mesa Verde cactus** *(Sclerocactus mesae-verdae)*	**Aztec gilia** *(Aliciella formosa)*	**Gooding’s onion** *(Allium goodingii)*	**Alcove death camas** *(Anticlea vaginatus)*	**Marble Canyon milk-vetch** *(Astragalus cremnophytax var. hevronii)*	**Cronquist’s milk-vetch** *(Astragalus cronquistii)*	**Naturita milk-vetch** *(Astragalus naturitensis)*	**Acoma fleabane** *(Erigeron acomanus)*	**Round dunebroom** *(Errazurizia rotundata)*	**Navajo Penstemon** *(Penstemon navajoa)*	**Alcove rock daisy** *(Perityle specuicola)*	**Navajo bladderpod** *(Physaria navajoensis)*	**Alcove bog-orchid** *(Platanthera zothecina)*	**Brack’s hardwall cactus** *(Sclerocactus cloverae ssp. brackii)*
Vehicles will use only established roads for accessing project sites.	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Vehicles will be parked at previously disturbed parking areas located at least 20 ft (6 m) from known populations when treating. Parking areas will be near established Navajo-BIA, tribal, State, or County roads that receive moderate to heavy use.	X	X	X	X	X	X	X	X													
Treatments occurring in the Mesa Verde Biological Preserves require additional consultation with USFWS and the NNHP botanist. A qualified biological is required on-site to monitor all phases of implementation.								X													
Manual treatments (low impact treatments) require a 50 ft (15 m) buffer from identified listed species locations.								X													

Table 2. Recommended species conservation measures for NNHP Group 4 plants.

NNHP Group 4 Plants – Recommended Species Conservation Measures														
Conservation Measure	**San Juan milkweed** (*Asclepias sanjuanensis*)	**Heils milk-vetch** (*Astragalus heilii*)	**Navajo saltbush** (*Atriplex garrettii* var. *navajoensis*)	**Atwoods camissonia** (*Camissonia atwoodii*)	**Welchs American-aster** (*Symphyotrichum welshii*)	**Arizona rose sage** (*Salvia pachyphylla* ssp. *eremopictus*)	**Rydberg' s thistle** (*Cirsium rydbergii*)	**Utah bladder-fern** (*Cystopteris utahensis*)	**Sivinski' s fleabane** (*Erigeron sivinskii*)	**Sarah' s buckwheat** (*Eriogonum lachnogynum* var. *sarahiae*)	**Bluff phacelia** (*Phacelia indecora*)	**Cave primrose** (*Primula specuicola*)	**Marble Canyon dalea** (*Psorothamnus arborescens* var. *pubescens*)	**Parish' s alkali grass** (*Puccinella parishii*)
Low and high aerial spraying of herbicides require a 1-mile (1.6 km) buffer from identified listed species locations.	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Mechanical, cultural, chemical, and prescribed fire treatments require a 200 ft (60 m) buffer from identified listed plant species locations. A burn plan must be developed for each project using this technique, which will include specific treatment buffers.	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Manual treatments (low impact treatments) require a 20 ft (6 m) buffer from identified listed species locations.	X	X	X	X	X	X	X	X	X	X	X	X	X	X
When doing treatments, workers will place flagging, and/or fencing around listed or sensitive plant populations.	X	X	X	X	X	X	X	X	X	X	X	X	X	X

Table 3. Required species conservation measures for Federally listed endangered, threatened, and experimental population and NNHP Group 2 and 3 bird species.

Birds (NNHP G2, G3, and G4 Exp Pop) – Species Conservation Measures								
USFWS Status	**T**	**E, Exp. Pop.***	**E**	**T**				
NNDFW Group	**G3**	**G4**	**G2**	**G2**	**G2**	**G3**	**G3**	**G3**
Conservation Measure	**Mexican spotted owl** *(Strix occidentalis lucida)*	**California condor** *(Gymnogyps californianus)*	**Southwestern willow flycatcher** (SWFL)** *(Empidonax traillii extimus)*	**Western yellow-billed cuckoo (YBCU)** *(Coccyzus americanus)*	**Bald Eagle** *(Haliaeetus leucocephalus)*	**Golden Eagle** *(Aquila chrysaetos)*	**Ferruginous hawk** *(Buteo regalis)*	**American dipper** *(Cinclus mexicanus)*
Breeding season is March 1 through August 31.	X							
All treatments require a ¼ mile (0.4 km) buffer from protected activity centers (PACs) and suitable nesting habitat during the breeding season. A PAC is approximately 600 acres (240 ha) around an owl activity center (nest, roost, or best roost habitat).	X							
Specified herbicides may be applied along road and utility rights-of-way in MSO PACS during the breeding season, but applicators should make sure that pesticide spray drift does not occur beyond rights-of-way.	X							
Contact NNDFW for background information on known nesting sites, suitable nesting sites, or known communal roosting sites in species habitat.		X						
Mechanical, prescribed fire, and ground application of herbicide treatments require a one-mile (1.6 km) buffer from known nesting sites, suitable nesting sites, or known communal roosting sites in species habitat of canyon lands and mountain ridges.		X						
Aerial applications of herbicides require a 1.5-mile (2.4 km) buffer from release sites, suitable nesting sites, or known communal roosting sites in species habitat of canyon lands and mountain ridges.		X						
If a condor is present all weed treatment activities will cease and NNDFW will be contacted. Field crews will avoid interacting with condors if present on site.		X						
All trash and debris will be disposed of properly off site.		X						
No new populations biological control for saltcedar on the Navajo Nation.			X					
A permitted biologist will confirm occupancy during the breeding season (May 15 through July 17, "SWFL Recovery Plan") within a year prior to conducting treatments to determine suitable habitat, breeding habitat, important migration corridors, or potential territory for occupied habitat.			X					
A qualified SWFL biologist in coordination with NNDFW will determine breeding patch size for nesting areas per the "SWFL Recovery Plan" and identify sites on the ground prior to treatments.			X					

USFWS Status	**T**	**E, Exp. Pop.***	**E**	**T**				
NNDFW Group	**G3**	**G4**	**G2**	**G2**	**G2**	**G3**	**G3**	**G3**
Conservation Measure	**Mexican spotted owl** *(Strix occidentalis lucida)*	**California condor** *(Gymnogyps californianus)*	**Southwestern willow flycatcher** (SWFL)** *(Empidonax traillii extimus)*	**Western yellow-billed cuckoo (YBCU)** *(Coccyzus americanus)*	**Bald Eagle** *(Haliaeetus leucocephalus)*	**Golden Eagle** *(Aquila chrysaetos)*	**Ferruginous hawk** *(Buteo regalis)*	**American dipper** *(Cinclus mexicanus)*
In occupied breeding areas, mechanical and mechanized and low and high aerial chemical treatments require a ¼ mile (0.4 km) buffer from the breeding patch boundary or suitable habitat.			X	X				
Prescribed fires outside of a breeding patch will be conducted outside of the migrating and breeding season. Small pile burns will be conducted outside of the floodplain or 300 ft (90 m) buffer from edge of waterway.			X	X				
Manual treatments will be used up to the breeding patch boundary or suitable habitat.			X	X				
Important migratory corridors for SWFL will be buffered as listed above from May 15 to July 17.			X					
All projects within the riparian zone near occupied habitat will require restoration with native riparian/wetland vegetation following noxious weed removal.			X	X				
A permitted biologist will confirm occupancy during the breeding season (June 15 through August 15) within a year prior to conducting treatments. No activity will occur within ¼ mi (0.4 km) of potential habitat no survey information exists.				X				
A qualified yellow-billed cuckoo (YBCU) biologist, in coordination with NNDFW, will determine breeding patch size for nesting areas and identify sites on the ground prior to treatments.				X				
The breeding season for bald and golden eagles is January 15 – July 15 ('Navajo Nation Golden and Bald Eagle Nest Protection Regulations').					X	X		
Brief activities that occur for up to one hour per day and involve only personnel and passenger or maintenance vehicles (one hour of spot spraying, mechanical, or manual treatments) require a 0.4 mi (600 m) buffer from an active nest.					X	X		
Breeding season occurs March 1 – July 31 (Navajo Nation Endangered Species List: species accounts).							X	
Light activities that occur for up to one day in the same general area and involve up to five vehicles and up to ten personnel (mechanical treatments and mechanized ground chemical treatments) require a 0.5 mi (800 m) buffer from an active nest.					X	X	X	
Heavy activities that exceed at least one of the criteria for Light Activities that involve human activity of up to one visit per week (prescribed fire, low and high aerial chemical treatments) will be conducted outside of the breeding season and ¾ mi (1 km) from a nesting site.					X	X	X	

USFWS Status	**T**	**E, Exp. Pop.***	**E**	**T**				
NNDFW Group	**G3**	**G4**	**G2**	**G2**	**G2**	**G3**	**G3**	**G3**
Conservation Measure	**Mexican spotted owl** *(Strix occidentalis lucida)*	**California condor** *(Gymnogyps californianus)*	**Southwestern willow flycatcher** (SWFL)** *(Empidonax traillii extimus)*	**Western yellow-billed cuckoo (YBCU)** *(Coccyzus americanus)*	**Bald Eagle** *(Haliaeetus leucocephalus)*	**Golden Eagle** *(Aquila chrysaetos)*	**Ferruginous hawk** *(Buteo regalis)*	**American dipper** *(Cinclus mexicanus)*
Brief activities that occur for up to one hour per day and involve only personnel and passenger or maintenance vehicles (one hour of spot spraying, mechanical, or manual treatments) require a ½ mile (0.8 km) buffer from an occupied nest.							X	
Mechanical treatments require a 50–200 ft (15-60 m) buffer from occupied nesting habitat outside of breeding season.								X
No mechanical, mechanized ground, low or high aerial chemical treatments within 1/8 mile (0.2 km) from the active nest during March 15- August 15.								X
Spot chemical spraying or manual treatments require a buffer of 330 ft (0.1 km) from the active nest during March 15- August 15.								X
Small migratory birds- Class 2 or Class 3 herbicides require 30 ft (9 m) buffer for spot and mechanized ground application of herbicide, 150 ft (50 m) with low aerial chemical treatments, and 1/8 mi (200 m) for high aerial chemical treatments near the species habitat.								X

***Exp. Pop = Experimental Population**

****Southwestern willow flycatcher** (*Empidonax traillii extimus*)

<u>Definitions (from "Southwestern Willow Flycatcher Recover Plan ("SWFL Recovery Plan)</u>

Currently suitable habitat is defined as a riparian area with all the components needed to provide conditions suitable for breeding flycatchers. These conditions are generally dense, mesic riparian shrub and tree communities 0.25 acre (0.1 ha) or greater in size within floodplains large enough to accommodate riparian patches at least 33 ft (10 m) wide. Suitable habitat may be occupied or unoccupied.

Potentially suitable habitat is defined as a riparian system that does not currently have all the components needed to provide conditions suitable for nesting flycatchers, but which could – if managed appropriately – develop these components over time. Potential habitat occurs where the flood plain conditions, sediment characteristics, and hydrological setting provide potential for development of dense riparian vegetation.

Breeding Patch is the area used by breeding flycatchers. Breeding patches include all flycatcher territories, and most flycatcher breeding patches are larger than the sum total of the flycatcher territory sizes at that site.

Table 4. Recommended species conservation measures for NNHP Group 4 bird species and bird species protected under the Migratory Bird Treaty Act.

NNHP Group 4 Bird – Species Conservation Measures																
Conservation Measure	**Northern goshawk** *(Accipiter gentilis)*	**Clarks grebe** *(Aechmophorus clarkia)*	**Northern saw-whet owl** *(Aegolius acadicus)*	**Burrowing owl** *(Athene cunicularia)*	**Belted kingfisher** *(Ceryle alcyon)*	**Mountain plover** *(Charadrius montanus)*	**Dusky grouse** *(Dendragapus obscurus)*	**Yellow warbler** *(Dendroica petechial)*	**Hammond's flycatcher** *(Empidonax hammondii)*	**Northern pygmy-owl** *(Glaucidium gnoma)*	**Flammulated owl** *(Otus flammeolus)*	**Band-tailed pigeon** *(Patagioenas fasciata)*	**American three-toed woodpecker** *(Picoides dorsalis)*	**Tree swallow** *(Tachycineta bicolor)*	**Sora** *(Porzana carolina)*	**Gray vireo** *(Vireo vicinior)*
All treatments require a ¼ mi (0.4 km) buffer from nest site during March 1- August 15 and within 0.20 mi (0.2 km) of nest site year-round.	X			X												
Mechanical treatments require 200 ft (60 m) buffer from lake-side vegetation or within the 100-yr floodplain, whichever is greater.		X														
Prescribed fire, target livestock grazing, and mechanized ground, low and high aerial chemical spraying require a 1/8-mile (0.2km) buffer from the active nest.		X*			X*	X*	X ∞								X ‡	
Chemical spot and manual treatments require a 330 ft (0.1 km) buffer from active nest.		X*			X*	X*	X ∞		X ϕ			X ‡	X ‡	X ‡	X ‡	X***
All treatments require a 1/8- mile (0.2 km) buffer from the nest site year-round or during nesting.			X					X**								
Pesticides that rate as Class 2 or Class 3 in the Predatory Avian, Small Mammal, or Terrestrial Arthropod toxicity groups should have a ½ mile (0.8 km) buffer from occupied nests.			X	X						X	X					
No treatments within nesting habitats year-round.					X	X										
Mechanical treatments require 1/8-mile (0.2 km) buffer from nest site year-round.							X				X					
Mechanical, mechanized ground and low and high aerial chemical treatments require a 1/8-mile (0.2 km) buffer from habitat patches used for breeding or potential habitat year-round.								X	X	X		X	X	X		X

Conservation Measure	**Northern goshawk** *(Accipiter gentilis)*	**Clarks grebe** *(Aechmophorus clarkia)*	**Northern saw-whet owl** *(Aegolius acadicus)*	**Burrowing owl** *(Athene cunicularia)*	**Belted kingfisher** *(Ceryle alcyon)*	**Mountain plover** *(Charadrius montanus)*	**Dusky grouse** *(Dendragapus obscurus)*	**Yellow warbler** *(Dendroica petechial)*	**Hammond' s flycatcher** *(Empidonax hammondii)*	**Northern pygmy-owl** *(Glaucidium gnoma)*	**Flammulated owl** *(Otus flammeolus)*	**Band-tailed pigeon** *(Patagioenas fasciata)*	**American three-toed woodpecker** *(Picoides dorsalis)*	**Tree swallow** *(Tachycineta bicolor)*	**Sora** *(Porzana carolina)*	**Gray vireo** *(Vireo vicinior)*
Chemical spot and manual treatments require a 1/8-mile (0.2 km) buffer from the nest site.										X∞	X #					
Mechanical treatments require 200 ft (60 m) buffer from lakes and Category I wetlands and 150 ft (45 m) of Category II wetlands, per Navajo Natural Heritage Program 1994.															X	

*- nesting period May 1- July 31,
**- nesting period April 15 – July 31
***- nesting period May 1 – August 31
∞- nesting period April 1- July 15
ɸ - nesting period May 15 – August 15
‡ - nesting period May 1 – August 1
# - nesting period May 1 – August 15

Migratory Birds – Species Conservation Measures
Mechanical treatments within the buffer zone will be conducted outside of the breeding season (March through August).
Non-endangered raptors - All treatments require a 490 ft (0.15 km) buffer from the active nest from March-August or until juveniles have left the nest.
Predatory birds - Spot and mechanized ground herbicide treatments with Class 2 or Class 3 liquid formulation herbicides require a 300 ft (90 m) buffer from the active nest from March- August or until juveniles have left the nest. Low and high aerial treatments require a 1/8 mi (200 m) buffer from the active nest.
Small migratory birds - Class 2 or Class 3 herbicides require 30 ft (9 m) buffer for spot and mechanized ground application of herbicide, 150 ft (50 m) with low aerial chemical treatments, and 1/8 mi (200 m) for high aerial chemical treatments near the species habitat.
Waterfowl - avoid using Class 2 or 3 herbicides in areas where waterfowl are concentrated and wait until birds have migrated for the season. Applications of liquid formulations of Class 2 and 3 herbicides require a 30 ft (9m) buffer for spot applications, 60 ft (20 m) for mechanized ground, 200 ft (60 m) for low aerial spraying, and 1/8 mi (200 m) for high aerial spraying.
Prescribed fires outside of a breeding patch will be conducted outside of the migrating and breeding season.

Table 5. Required species conservation measures for federally listed candidate and endangered and NNHP Group 2 fish species and recommended species conservation measures for NNHP Group 4 fish species.

Fish – Species Conservation Measures						
USFWS Status	**E**	**E**	**C**	**E**	**E**	
NNDFW Group	**G2**	**G2**	**G2**	**G2**	**G2**	**G4**
Conservation Measure	**Colorado pikeminnow** *(Ptychocheilus Lucius)*	**Razorback sucker** *(Xyrauchen texanus)*	**Roundtail chub** *(Gila robusta)*	**Humpback chub** *(Gila cypha)*	**Zuni bluehead sucker** *(Catostomus discobolus yarrowii)*	**Bluehead sucker** *(Catostomus discobolus)*
Weed removal projects will require restoration of native vegetation to prevent erosion. Weed removal activities in the riparian zone will be conducted in patches to prevent erosion. Patch size will be determined in consultation with NNDFW.	X	X	X	X	X	X
Best Management Practices (see NNIWMP, BIA 2020) will be used to reduce sedimentation and chemical run-off from mechanical and chemical weed treatments along bank lines within the 100-year floodplain.	X	X	X	X	X	X
Pile burning and prescribed burning will be conducted 300 ft (90 m) outside of the floodplain.	X	X	X	X	X	X
Approved herbicides (aquatic formulations only): 2,4-D, glyphosate, triclopyr and imazapyr will exclusively be used within 25 ft (7.6 m) of the daily high-water mark.	X	X	X	X	X	X
Herbicides with relatively low aquatic toxicity to fish require a 25 ft (7.6 m) buffer from the daily high-water mark in the riparian zone, including: aminopyralid, chlorsulfuron methyl, clopyralid, imazapic, and thifensulfuron-methyl.	X	X	X	X	X	X
Non-aquatic approved and moderate to high aquatic toxicity herbicides require a 300 ft (90 m) buffer from the daily high-water mark (see NNIWMP, EPP 2020).		X	X	X	X	
No surface disturbance year-round within 98 – 200 ft (30 – 60 m) from the top of the stream bank. NNDFW fish biologist will determine exact distance on a case-by-case basis.					X	X
Only the cut-stump method will be used to remove large trees or shrubs in the floodplain. Debris will be piled outside of the floodplain.					X	
Heavy machinery (bulldozers/root plows) mechanical treatments require a 300 ft (90 m) buffer from edge of the waterway.					X	

Table 6. Required species conservation measures for federally listed endangered and NNHP Group 3 invertebrate species and recommended species conservation measures for NNHP Group 4 invertebrate species.

Invertebrates – Species Conservation Measures				
USFWS Status				
NNDFW Group	**G4**	**G3**	**G4**	**G4**
Mitigation Measure	**Kanab ambersnail** (*Oxyloma kanabense*)	**Great Basin silverspot** (*Speyeria nokomis*)	**Rocky mountainsnail** (*Oreohelix strigosa*)	**Yavapai mountainsnail** (*Oreohelix yavapai*)
Mechanized, manual and chemical spot treatments require a 200 ft (60 m) buffer from suitable habitat.	X			
Low aerial spraying requires a 150 ft (50 m) buffer and high aerial spraying requires a 1/8 mile (200 m) buffer from suitable habitat.	X			
Surveys will be conducted from August 1 - September 1.		X		
Avoidance measures will be applied to the host plant, violet.		X		
No chemical or mechanical treatments permitted within 200 ft (60 m) of occupied habitat year-round.		X		
No target livestock grazing in wet areas containing host plants during the mating season.		X		
No broadcast or aerial herbicide applications will be permitted within western seep fritillary habitat or in areas containing host plants.		X		
Mechanical and manual treatments require a 200 ft (60 m) buffer from occupied habitat year-round.			X	X

Table 7. Required species conservation measures for NNHP Group 2 amphibian and reptile species and recommended species conservation measures for NNHP Group 4 amphibian and reptile species.

Amphibians and Reptiles – Species Conservation Measures			
NNDFW Group	**G2**	**G4**	**G4**
Mitigation Measure	**Northern leopard frog** (*Lithobates pipiens*)	**Milk snake** (*Lampropeltis triangulum*)	**Chuckwalla** (*Sauromalus ater*)
Mechanized and manual treatments require a 200 ft (60 m) buffer from open water habitats.	X		
Prescribed fire requires a 200 ft (60 m) buffer zone from the edge of the wetland vegetation.	X		
No applications of herbicides will be used inside occupied or potentially occupied aquatic habitat.	X		
Mitigation measures will be applied in dispersal and migration corridors after rain events.	X		
All projects in riparian/wetland habitats near occupied habitat will require native riparian/wetland vegetation restoration following invasive species removal.	X		
Only herbicides labeled for aquatic use and the cut-stump method on tree species will be used in potential habitat.	X		
No target grazing will be used in the habitat.	X		
All equipment and boots will be cleaned with bleach before and after treatments within 200 ft (60 m) of occupied habitat to prevent the spread of chytrid fungus.	X		
No mechanical treatments (surface disturbance) within occupied habitats.		X	X

Table 8. Required species conservation measures for NNHP Group 3 mammal species and recommended species conservation measures for NNHP Group 4 mammal species.

Mammals – Species Conservation Measures							
NNDFW Group	**G3**	**G4**	**G4**	**G4**	**G4**	**G4**	**G4**
Mitigation Measure	**Pronghorn** *(Antilocapra americana)*	**Townsend's big-eared bat** *(Corynorhinus townsendii)*	**Chisel-toothed kangaroo rat** *(Dipodomys microps)*	**Banner-tailed kangaroo rat** *(Dipodomys spectabilis)*	**Navajo Mountain vole** *(Microtus mogollonensis)*	**Arizona (Wupatki) pocket mouse** *(Perognathus amplus cineris)*	**Kit fox** *(Vulpes macrotis)*
All treatments require a 1-mile (1.6 km) buffer from potential lambing areas from May 1 through June 15.	X						
All treatments require a 200 ft (60 m) buffer from occupied roost site during April 15- August 31.		X					
Mechanical and target grazing treatments require a 200 ft (60 m) buffer from occupied habitats year-round.			X	X	X	X	X
All treatments require a 1/8 mi (0.2 km) buffer from active den during December 1- August 31							X

Black-footed ferret (*Mustela nigripes)* and Northern river otter were extirpated from the Navajo Nation. Both species have been reintroduced in areas adjacent to the Navajo Nation. For black-footed ferret, reintroduction efforts have occurred at Babbitt Ranches, adjacent to the Navajo Nation, and may be considered for other areas within or around the Navajo Nation. Northern river otters were detected in southern Colorado, but no sightings have occurred on the Navajo Nation. If black-footed ferrets and Northern river otters are reintroduced or expand into the Navajo Nation the conservation measures, listed below, for this species would be initiated in addition to the regulations outlined in the reintroduction guidelines.

Table 9. Recommended species conservation measures for NNHP Group 1 mammal species.

Mammals (G1 Extirpated) – Species Conservation Measures		
Mitigation Measure	**Northern river otter *(Lontra canadensis)***	**Black-footed ferret *(Mustela nigripes)***
No activity year-round within 300 ft (100 m) of occupied habitat that could result in destruction of burrows/runways and take of individuals or prevent changes to water chemistry.	X	
Breeding season for black-footed ferret is from mid-March to August, with most sensitive period from mid-March to June. Only occur in medium to large active prairie dog towns (>198 acres (80 hectare (ha), and ≥20 burrows/ha).		X
Notify USFWS and NNDFW of any project that will impact prairie dog towns greater than 200 acres (80 ha).		X
Weed treatments will be scheduled outside of breeding season.		X
No disking, plowing or prescribed burns around habitat during the breeding season (March to September).		X
No herbicide limitations for this project per the RPMPA, pg. 109.		X

Figure 1. Required protection measures for herbicide application in Federally and Navajo Nation listed species habitats.

Species	Herbicides: 2,4-D (acid)	2,4-D (aquatic amine salt)	2,4-D (aquatic ester)	2,4-D (non-aquatic amine salt)	2,4-D (non-aquatic ester)	Aminopyralid	Atrazine
Federally Listed Species							
California condor	No buffer zone in ROW. Spot and mechanized ground treatments- 1/4 mile from suitable nests, roosts, and release sites.	No buffer zone in ROW. Spot and mechanized ground treatments- 1/4 mile from suitable nests, roosts, and release sites. Low and high aerial spraying- 1 1/2 mile from suitable nests, roosts, and release sites. Aerial spraying made in swaths parallel to nest site and aerial buffer zone.		No buffer zone in ROW. Spot and mechanized ground treatments- 1/4 mile from suitable nests, roosts, and release sites.			
Southwestern willow flycatcher and Yellow-billed cuckoo	All treatments require 1/4 mile buffer from habitat patches or potential habitat until surveyed. No activity within migratory habitat from May 1- June 15.						
Mexican spotted owl	All formulations: Spot- 80ft from the PAC during breeding season. Mechanized ground - 1/4 mile from PAC during breeding season. May be sprayed along road or utility ROW during breeding season. May be sprayed in PAC outside the breeding season. No aerial applications.	All formulations: Spot- 80ft from the PAC during breeding season. Mechanized ground, Low aerial and High Aerial- 1/4 mile from PAC during breeding season. May be sprayed along road or utility ROW during breeding season. May be sprayed in PAC outside the breeding season.		All formulations: Spot- 80ft from the PAC during breeding season. Mechanized ground - 1/4 mile from PAC during breeding season. May be sprayed along road or utility ROW during breeding season. May be sprayed in PAC outside the breeding season. No aerial applications.			
Colorado pikeminnow, Humpback chub, Razorback sucker, Roundtail chub, Zuni bluehead sucker	No buffer			Spot applications in following areas: one-half mile upstream (including tributaries), all species habitat, and 300ft downstream of habitat. Spot applications- 300ft buffer from waterway.		No buffer	Spot applications in following areas: one-half mile upstream (including tributaries), all species habitat, and 300ft downstream of habitat. Liquid- 10ft Mechanized ground-80ft No aerial applications.
Welsh's milkweed, Brady pincushion cactus , Fickeisen plains cactus, Zuni/Rhizome fleabane, Navajo sedge, Mesa Verde cactus	Spot and mechanized spraying - 200ft from identified species locations. No aerial applications.	Spot applications from edge of occupied sites: 1/8 mile Mechanized ground: 2 miles, in non-habitat areas can have buffer of 80ft from occupied habitat during flower period if application is made no later than one hour after sunrise or early evening (6pm or later). Low and high aerial: 2 miles; in non-habitat areas can have buffer of 1/4 mile from occupied habitat during flower period if application is made no later than one hour after sunrise or early evening (6pm or later).		Spot applications from edge of occupied sites: 1/8 mile. Mechanized ground: 2 miles, in non-habitat areas can have buffer of 80ft from occupied habitat during flower period if application is made no later than one hour after sunrise or early evening (6pm or later). No aerial applications.		Spot and mechanized spraying - 200ft from identified species locations. No aerial applications.	
Mancos milk-vetch	Spot and mechanized spraying - 200ft from suitable habitat. No aerial applications.	Spot and mechanized spraying - 200ft from suitable habitat. Low and high aerial applications- 1 mile from suitable habitat.		Spot and mechanized spraying - 200ft from suitable habitat. No aerial applications.			
Migratory birds	Spot and mechanized ground applications- 1/4 mile buffer from active nests. No aerial applications.	Spot and mechanized ground applications- 1/4 mile buffer from active nests. No low or high aerial or prescribed burn during breeding season (March-August).		Spot and mechanized ground applications- 1/4 mile buffer from active nests. No aerial applications.			

Figure 1. Required protection measures for herbicide application in Federally and Navajo Nation listed species habitats.

Species	Herbicides			
	Chlorsulfuron methyl	**Clopyralid**	**Dichlobenil**	**Fluroxpyr**
Federally Listed Species				
California condor	No buffer zone in ROW. Spot and mechanized ground treatments- 1/4 mile from suitable nests, roosts, and release sites. No aerial applications.			
Southwestern willow flycatcher and Yellow-billed cuckoo	All treatments require 1/4 mile buffer from habitat patches or potential habitat until surveyed. No activity within migratory habitat from May 1- June 15.			
Mexican spotted owl	All formulations: Spot- 80ft from the PAC during breeding season. Mechanized ground - 1/4 mile from PAC during breeding season. May be sprayed along road or utility ROW during breeding season. May be sprayed in PAC outside the breeding season. No aerial applications.			
Colorado pikeminnow, Humpback chub, Razorback sucker, Roundtail chub, Zuni bluehead sucker	No buffer		Spot applications in following areas: one-half mile upstream (including tributaries), all species habitat, and 300ft downstream of habitat. Liquid- 10ft Mechanized ground-80ft No aerial applications.	Spot applications in following areas: one-half mile upstream (including tributaries), all species habitat, and 300ft downstream of habitat. Liquid- 10ft Mechanized ground-80ft No aerial applications.
Welsh's milkweed, Brady pincushion cactus , Fickeisen plains cactus, Zuni/Rhizome fleabane, Navajo sedge, Mesa Verde cactus	Spot and mechanized spraying - 200ft from identified species locations. No aerial applications.			
Mancos milk-vetch	Spot and mechanized spraying - 200ft from suitable habitat. Low and high aerial applications- 1 mile from suitable habitat.			
Migratory birds	Spot and mechanized ground applications- 1/4 mile buffer from active nests. No aerial applications.			

Figure 1. Required protection measures for herbicide application in Federally and Navajo Nation listed species habitats.

Species	Herbicides				
	Fluazifop-P-butyl	**Glyphosate (aquatic)**	**Glyphosate (non-aquatic)**	**Imazapic**	**Imazapyr (aquatic)**
Federally Listed Species					
California condor	No buffer zone in ROW. Spot and mechanized ground treatments- 1/4 mile from suitable nests, roosts, and release sites. No aerial applications.	No buffer zone in ROW. Spot and mechanized ground treatments- 1/4 mile from suitable nests, roosts, and release sites. Low and high aerial spraying- 1 1/2 mile from suitable nests, roosts, and release sites. Aerial spraying made in swaths parallel to nest site and aerial buffer zone.	No buffer zone in ROW. Spot and mechanized ground treatments- 1/4 mile from suitable nests, roosts, and release sites. No aerial applications.		No buffer zone in ROW. Spot and mechanized ground treatments- 1/4 mile from suitable nests, roosts, and release sites. Low and high aerial spraying- 1 1/2 mile from suitable nests, roosts, and release sites. Aerial spraying made in swaths parallel to nest site and aerial buffer zone.
Southwestern willow flycatcher and Yellow-billed cuckoo	All treatments require 1/4 mile buffer from habitat patches or potential habitat until surveyed. No activity within migratory habitat from May 1- June 15.				
Mexican spotted owl	All formulations: Spot- 80ft from the PAC during breeding season. Mechanized ground - 1/4 mile from PAC during breeding season. May be sprayed along road or utility ROW during breeding season. May be sprayed in PAC outside the breeding season. No aerial applications.	All formulations: Spot- 80ft from the PAC during breeding season. Mechanized ground, Low aerial and High Aerial- 1/4 mile from PAC during breeding season. May be sprayed along road or utility ROW during breeding season. May be sprayed in PAC outside the breeding season.	All formulations: Spot- 80ft from the PAC during breeding season. Mechanized ground - 1/4 mile from PAC during breeding season. May be sprayed along road or utility ROW during breeding season. May be sprayed in PAC outside the breeding season. No aerial applications.		All formulations: Spot- 80ft from the PAC during breeding season. Mechanized ground, Low aerial and High Aerial- 1/4 mile from PAC during breeding season. May be sprayed along road or utility ROW during breeding season. May be sprayed in PAC outside the breeding season.
Colorado pikeminnow, Humpback chub, Razorback sucker, Roundtail chub, Zuni bluehead sucker	Spot applications in following areas: one-half mile upstream (including tributaries), all species habitat, and 300ft downstream of habitat. Spot applications- 300ft buffer from waterway. No aerial applications.	No buffer	Spot applications in following areas: one-half mile upstream (including tributaries), all species habitat, and 300ft downstream of habitat. Liquid- 10ft Mechanized ground-80ft No aerial applications	No buffer	
Welsh's milkweed, Brady pincushion cactus , Fickeisen plains cactus, Zuni/Rhizome fleabane, Navajo sedge, Mesa Verde cactus	Spot and mechanized spraying - 200ft from identified species locations. No aerial applications.	Spot and mechanized spraying - 200ft from identified species locations. Low and high aerial applications- 1 mile from identified species locations.	Spot and mechanized spraying - 200ft from identified species locations. No aerial applications.		Spot and mechanized spraying - 200ft from identified species locations. Low and high aerial applications- 1 mile from identified species locations.
Mancos milk-vetch	Spot and mechanized spraying - 200ft from suitable habitat. Low and high aerial applications- 1 mile from suitable habitat.				
Migratory birds	Spot and mechanized ground applications- 1/4 mile buffer from active nests. No aerial applications.	Spot and mechanized ground applications- 1/4 mile buffer from active nests. No low or high aerial or prescribed burn during breeding season (March-August).	Spot and mechanized ground applications- 1/4 mile buffer from active nests. No aerial applications.		Spot and mechanized ground applications- 1/4 mile buffer from active nests. No low or high aerial or prescribed burn during breeding season (March-August).

Figure 1. Required protection measures for herbicide application in Federally and Navajo Nation listed species habitats.

Species	Herbicides				
	Imazapyr (non-aquatic)	**Indaziflam**	**Isoxaben**	**Metsulfuron methyl**	**Metribuzin**
Federally Listed Species					
California condor	No buffer zone in ROW. Spot and mechanized ground treatments- 1/4 mile from suitable nests, roosts, and release sites. No aerial applications.				
Southwestern willow flycatcher and Yellow-billed cuckoo	All treatments require 1/4 mile buffer from habitat patches or potential habitat until surveyed. No activity within migratory habitat from May 1- June 15. No aerial applications				
Mexican spotted owl	All formulations: Spot- 80ft from the PAC during breeding season. Mechanized ground - 1/4 mile from PAC during breeding season. May be sprayed along road or utility ROW during breeding season. May be sprayed in PAC outside the breeding season. No aerial applications.				
Colorado pikeminnow, Humpback chub, Razorback sucker, Roundtail chub, Zuni bluehead sucker	Spot applications in following areas: one-half mile upstream (including tributaries), all species habitat, and 300ft downstream of habitat. Liquid- 10ft Mechanized ground-80ft No aerial applications				
Welsh's milkweed, Brady pincushion cactus , Fickeisen plains cactus, Zuni/Rhizome fleabane, Navajo sedge, Mesa Verde cactus	Spot and mechanized spraying - 200ft from identified species locations. No aerial applications.				
Mancos milk-vetch	Spot and mechanized spraying - 200ft from suitable habitat. Low and high aerial applications- 1 mile from suitable habitat.				
Migratory birds	Spot and mechanized ground applications- 1/4 mile buffer from active nests. No aerial applications.				

Figure 1. Required protection measures for herbicide application in Federally and Navajo Nation listed species habitats.

Species	Herbicides			
	Paraquat	**Pendimethalin**	**Picloram**	**Prodiamine**
Federally Listed Species				
California condor	No buffer zone in ROW. Spot and mechanized ground treatments- 1/4 mile from suitable nests, roosts, and release sites. No aerial applications			
Southwestern willow flycatcher and Yellow-billed cuckoo	All treatments require 1/4 mile buffer from habitat patches or potential habitat until surveyed. No activity within migratory habitat from May 1-June 15.			
Mexican spotted owl	All formulations: Spot- 80ft from the PAC during breeding season. Mechanized ground - 1/4 mile from PAC during breeding season. May be sprayed along road or utility ROW during breeding season. May be sprayed in PAC outside the breeding season. No aerial applications.			
Colorado pikeminnow, Humpback chub, Razorback sucker, Roundtail chub, Zuni bluehead sucker	Spot applications in following areas: one-half mile upstream (including tributaries), all species habitat, and 300ft downstream of habitat. Spot applications- 300ft buffer from waterway. Mechanized ground - 80 ft. No aerial applications.			
Welsh's milkweed, Brady pincushion cactus , Fickeisen plains cactus, Zuni/Rhizome fleabane, Navajo sedge, Mesa Verde cactus	Spot applications from edge of occupied sites: 1/8 mile Mechanized ground: 2 miles, in non-habitat areas can have buffer of 80ft from occupied habitat during flower period if application is made no later than one hour after sunrise or early evening (6pm or later). No aerial applications.		Spot and mechanized spraying - 200ft from identified species locations. No aerial applications.	Spot applications from edge of occupied sites: 1/8 mile Mechanized ground: 2 miles, in non-habitat areas can have buffer of 80ft from occupied habitat during flower period if application is made no later than one hour after sunrise or early evening (6pm or later). No aerial applications.
Mancos milk-vetch	Spot and mechanized spraying - 200ft from suitable habitat. Low and high aerial applications- 1 mile from suitable habitat.			
Migratory birds	Spot and mechanized ground applications- 1/4 mile buffer from active nests. No aerial applications.			

Figure 1. Required protection measures for herbicide application in Federally and Navajo Nation listed species habitats.

Species	Herbicides		
	Thifensulfuron-methyl	**Triclopyr (amine salt)**	**Triclopyr (ester)**
Federally Listed Species			
California condor	No buffer zone in ROW. Spot and mechanized ground treatments- 1/4 mile from suitable nests, roosts, and release sites. No aerial applications	No buffer zone in ROW. Spot and mechanized ground treatments- 1/4 mile from suitable nests, roosts, and release sites. Low and high aerial spraying- 1 1/2 mile from suitable nests, roosts, and release sites. Aerial spraying made in swaths parallel to nest site and aerial buffer zone.	No buffer zone in ROW. Spot and mechanized ground treatments- 1/4 mile from suitable nests, roosts, and release sites. No aerial applications.
Southwestern willow flycatcher and Yellow-billed cuckoo	All treatments require 1/4 mile buffer from habitat patches or potential habitat until surveyed. No activity within migratory habitat from May 1- June 15.		
Mexican spotted owl	All formulations: Spot- 80ft from the PAC during breeding season. Mechanized ground - 1/4 mile from PAC during breeding season. May be sprayed along road or utility ROW during breeding season. May be sprayed in PAC outside the breeding season. No aerial applications.	All formulations: Spot- 80ft from the PAC during breeding season. Mechanized ground, Low aerial and High Aerial- 1/4 mile from PAC during breeding season. May be sprayed along road or utility ROW during breeding season. May be sprayed in PAC outside the breeding season.	All formulations: Spot- 80ft from the PAC during breeding season. Mechanized ground - 1/4 mile from PAC during breeding season. May be sprayed along road or utility ROW during breeding season. May be sprayed in PAC outside the breeding season. No aerial applications
Colorado pikeminnow, Humpback chub, Razorback sucker, Roundtail chub, Zuni bluehead sucker	No buffer		Spot applications in following areas: one-half mile upstream (including tributaries), all species habitat, and 300ft downstream of habitat. Spot applications- 300ft buffer from waterway. No aerial applications.
Welsh's milkweed, Brady pincushion cactus , Fickeisen plains cactus, Zuni/Rhizome fleabane, Navajo sedge, Mesa Verde cactus	Spot and mechanized spraying - 200ft from identified species locations. No aerial applications.	Spot and mechanized spraying - 200ft from identified species locations. Low and high aerial applications- 1 mile from identified species locations.	Spot and mechanized spraying - 200ft from identified species locations. No aerial applications.
Mancos milk-vetch	Spot and mechanized spraying - 200ft from suitable habitat.	Spot and mechanized spraying - 200ft from suitable habitat. Low and high aerial applications- 1 mile from suitable habitat.	Spot and mechanized spraying - 200ft from suitable habitat.
Migratory birds	Spot and mechanized ground applications- 1/4 mile buffer from active nests. No aerial applications.	Spot and mechanized ground applications- 1/4 mile buffer from active nests. No low or high aerial or prescribed burn during breeding season (March-August).	Spot and mechanized ground applications- 1/4 mile buffer from active nests. No aerial applications.

Figure 1. Required protection measures for herbicide application in Federally and Navajo Nation listed species habitats.

Species	Herbicides						
	2,4-D (acid)	**2,4-D (aquatic amine salt)**	**2,4-D (aquatic ester)**	**2,4-D (non-aquatic amine salt)**	**2,4-D (non-aquatic ester)**	**Aminopyralid**	**Atrazine**
Navajo Listed Species							
Pronghorn	All formulations- 1 mile buffer from potential lambing areas from May 1- June 15						
Townsend's big eared bat	All formulations require a 197ft buffer from occupied roost site.						
Chisel-toothed kangaroo rat, Banner-tailed kangaroo rat, Navajo Mountain vole, Arizona (Wupatki) pocket mouse	No restrictions						
Kit fox	All formulations require a 1/8 mile buffer from active den from December 1- August 31.						
Bald and golden eagles	All formulations: 1/4 mile buffer from active nest during the breeding season January 15- July 15. Buffer zone is unnecessary outside of breeding season for spot and mechanized ground treatments. No aerial applications. If aerial flight over a nest site is necessary, an elevation of 500ft should be maintained over the nest.	All formulations: 1/4 mile buffer from active nest during the breeding season January 15- July 15. Buffer zone is unnecessary outside of breeding season for spot and mechanized ground treatments. Aerial applications should be made in swaths parallels to a nest and 3/4 mile buffer zone. If aerial flight over a nest site is necessary, an elevation of 500ft should be maintained over the nest.		All formulations: 1/4 mile buffer from active nest during the breeding season January 15- July 15. Buffer zone is unnecessary outside of breeding season for spot and mechanized ground treatments. No aerial applications. If aerial flight over a nest site is necessary, an elevation of 500ft should be maintained over the nest.			
Ferruginous hawk	Brief (1hr) spot- 1/2 mile buffer. Mechanized ground- 5/8 mile buffer. No aerial applications.	Brief (1hr) spot- 1/2 mile buffer. Mechanized ground- 5/8 mile buffer. Low and high aerial- 3/4 mile.		Brief (1hr) spot- 1/2 mile buffer. Mechanized ground- 5/8 mile buffer. No aerial applications.			
American dipper	All formulations- spot- 350ft buffer. Mechanized ground - 1/8 mile buffer from active nest during March 15- August 15. No aerial applications.	All formulations- spot- 350ft buffer. Mechanized ground, low or high aerial within 1/8 mile from active nest during March 15- August 15.		All formulations- spot- 350ft buffer. Mechanized ground - 1/8 mile buffer from active nest during March 15- August 15. No aerial applications.			
Northern goshawk	All formulations require 1/4 mile buffer from nest site during March 1- August 15. All formulations require 0.21 mile buffer from the nest site year-round.						
Clark's grebe	All formulations: Spot- 328ft buffer from active nest during May 1-July 31. Mechanized ground - 1/8 mile buffer from active nest during May 1- July 31. No aerial applications.	All formulations: Spot- 328ft buffer from active nest during May 1-July 31. Mechanized ground and low and high aerial- 1/8 mile buffer from active nest during May 1- July 31.		All formulations: Spot- 328ft buffer from active nest during May 1-July 31. Mechanized ground - 1/8 mile buffer from active nest during May 1- July 31. No aerial applications.			
Northern saw-whet owl	All formulations require 1/8 mile buffer from the nest site year-round.						
Burrowing owl	All formulations require 1/4 mile buffer from the active nest burrow during March 1- August 15.						
Dusky grouse	All formulations: Spot- 328ft buffer from active nest during April 1-July 15. Mechanized ground - 1/8 mile buffer from active nest during April 1-July 15. No aerial applications.	All formulations: Spot- 328ft buffer from active nest during April 1-July 15. Mechanized ground and low and high aerial- 1/8 mile buffer from active nest during April 1-July 15.		All formulations: Spot- 328ft buffer from active nest during April 1-July 15. Mechanized ground - 1/8 mile buffer from active nest during April 1-July 15. No aerial applications.			
Yellow warbler	All formulations: Spot- 1/8 mile buffer from active nest from April 15- July 31. Mechanized ground - 1/8 mile buffer year-round. No aerial applications.	All formulations: Spot- 1/8 mile buffer from active nest from April 15- July 31. Mechanized ground and low and high aerial- 1/8 mile buffer year-round		All formulations: Spot- 1/8 mile buffer from active nest from April 15- July 31. Mechanized ground - 1/8 mile buffer year-round. No aerial applications.			

Figure 1. Required protection measures for herbicide application in Federally and Navajo Nation listed species habitats.

Species	**Herbicides**			
	Chlorsulfuron methyl	**Clopyralid**	**Dichlobenil**	**Fluroxpyr**
Navajo Listed Species				
Pronghorn	All formulations- 1 mile buffer from potential lambing areas from May 1- June 15			
Townsend's big eared bat	All formulations require a 197ft buffer from occupied roost site.			
Chisel-toothed kangaroo rat, Banner-tailed kangaroo rat, Navajo Mountain vole, Arizona (Wupatki) pocket mouse	No restrictions			
Kit fox	All formulations require a 1/8 mile buffer from active den from December 1- August 31.			
Bald and golden eagles	All formulations: 1/4 mile buffer from active nest during the breeding season January 15- July 15. Buffer zone is unnecessary outside of breeding season for spot and mechanized ground treatments. No aerial applications. If aerial flight over a nest site is necessary, an elevation of 500ft should be maintained over the nest.			
Ferruginous hawk	Brief (1hr) spot- 1/2 mile buffer. Mechanized ground- 5/8 mile buffer. No aerial applications.			
American dipper	All formulations- spot- 350ft buffer. Mechanized ground - 1/8 mile buffer from active nest during March 15- August 15. No aerial applications.			
Northern goshawk	All formulations require 1/4 mile buffer from nest site during March 1- August 15. All formulations require 0.21 mile buffer from the nest site year-round.			
Clark's grebe	All formulations: Spot- 328ft buffer from active nest during May 1-July 31. Mechanized ground - 1/8 mile buffer from active nest during May 1- July 31. No aerial applications.			
Northern saw-whet owl	All formulations require 1/8 mile buffer from the nest site year-round.			
Burrowing owl	All formulations require 1/4 mile buffer from the active nest burrow during March 1- August 15.			
Dusky grouse	All formulations: Spot- 328ft buffer from active nest during April 1-July 15. Mechanized ground - 1/8 mile buffer from active nest during April 1-July 15. No aerial applications.			
Yellow warbler	All formulations: Spot- 1/8 mile buffer from active nest from April 15- July 31. Mechanized ground - 1/8 mile buffer year-round. No aerial applications.			

Figure 1. Required protection measures for herbicide application in Federally and Navajo Nation listed species habitats.

Species	Herbicides				
	Fluazifop-P-butyl	**Glyphosate (aquatic)**	**Glyphosate (non-aquatic)**	**Imazapic**	**Imazapyr (aquatic)**
Navajo Listed Species					
Pronghorn	All formulations- 1 mile buffer from potential lambing areas from May 1- June 15				
Townsend's big eared bat	All formulations require a 197ft buffer from occupied roost site.				
Chisel-toothed kangaroo rat, Banner-tailed kangaroo rat, Navajo Mountain vole, Arizona (Wupatki) pocket mouse	No restrictions				
Kit fox	All formulations require a 1/8 mile buffer from active den from December 1- August 31.				
Bald and golden eagles	All formulations: 1/4 mile buffer from active nest during the breeding season January 15- July 15. Buffer zone is unnecessary outside of breeding season for spot and mechanized ground treatments. No aerial applications. If aerial flight over a nest site is necessary, an elevation of 500ft should be maintained over the nest.	All formulations: 1/4 mile buffer from active nest during the breeding season January 15- July 15. Buffer zone is unnecessary outside of breeding season for spot and mechanized ground treatments. Aerial applications should be made in swaths parallels to a nest and 3/4 mile buffer zone. If aerial flight over a nest site is necessary, an elevation of 500ft should be maintained over the nest.	All formulations: 1/4 mile buffer from active nest during the breeding season January 15- July 15. Buffer zone is unnecessary outside of breeding season for spot and mechanized ground treatments. No aerial applications. If aerial flight over a nest site is necessary, an elevation of 500ft should be maintained over the nest.		All formulations: 1/4 mile buffer from active nest during the breeding season January 15- July 15. Buffer zone is unnecessary outside of breeding season for spot and mechanized ground treatments. Aerial applications should be made in swaths parallels to a nest and 3/4 mile buffer zone. If aerial flight over a nest site is necessary, an elevation of 500ft should be maintained over the nest.
Ferruginous hawk	Brief (1hr) spot- 1/2 mile buffer. Mechanized ground- 5/8 mile buffer. No aerial applications.	Brief (1hr) spot- 1/2 mile buffer. Mechanized ground- 5/8 mile buffer. Low and high aerial- 3/4 mile.	Brief (1hr) spot- 1/2 mile buffer. Mechanized ground- 5/8 mile buffer. No aerial applications.		Brief (1hr) spot- 1/2 mile buffer. Mechanized ground- 5/8 mile buffer. Low and high aerial- 3/4 mile.
American dipper	All formulations- spot- 350ft buffer. Mechanized ground - 1/8 mile buffer from active nest during March 15- August 15. No aerial applications	All formulations- spot- 350ft buffer. Mechanized ground, low or high aerial within 1/8 mile from active nest during March 15- August 15.	All formulations- spot- 350ft buffer. Mechanized ground - 1/8 mile buffer from active nest during March 15- August 15. No aerial applications		All formulations- spot- 350ft buffer. Mechanized ground, low or high aerial within 1/8 mile from active nest during March 15- August 15.
Northern goshawk	All formulations require 1/4 mile buffer from nest site during March 1- August 15. All formulations require 0.21 mile buffer from the nest site year-round.				
Clark's grebe	All formulations: Spot- 328ft buffer from active nest during May 1-July 31. Mechanized ground - 1/8 mile buffer from active nest during May 1- July 31. No aerial applications.	All formulations: Spot- 328ft buffer from active nest during May 1-July 31. Mechanized ground and low and high aerial- 1/8 mile buffer from active nest during May 1- July 31.	All formulations: Spot- 328ft buffer from active nest during May 1-July 31. Mechanized ground - 1/8 mile buffer from active nest during May 1-July 31. No aerial applications.		All formulations: Spot- 328ft buffer from active nest during May 1-July 31. Mechanized ground and low and high aerial- 1/8 mile buffer from active nest during May 1- July 31.
Northern saw-whet owl	All formulations require 1/8 mile buffer from the nest site year-round.				
Burrowing owl	All formulations require 1/4 mile buffer from the active nest burrow during March 1- August 15.				
Dusky grouse	All formulations: Spot- 328ft buffer from active nest during April 1-July 15. Mechanized ground - 1/8 mile buffer from active nest during April 1-July 15. No aerial applications.	All formulations: Spot- 328ft buffer from active nest during April 1-July 15. Mechanized ground and low and high aerial- 1/8 mile buffer from active nest during April 1-July 15.	All formulations: Spot- 328ft buffer from active nest during April 1-July 15. Mechanized ground - 1/8 mile buffer from active nest during April 1-July 15. No aerial applications.		All formulations: Spot- 328ft buffer from active nest during April 1-July 15. Mechanized ground and low and high aerial- 1/8 mile buffer from active nest during April 1-July 15.
Yellow warbler	All formulations: Spot- 1/8 mile buffer from active nest from April 15- July 31. Mechanized ground - 1/8 mile buffer year-round. No aerial applications.	All formulations: Spot- 1/8 mile buffer from active nest from April 15- July 31. Mechanized ground and low and high aerial- 1/8 mile buffer year-round	All formulations: Spot- 1/8 mile buffer from active nest from April 15- July 31. Mechanized ground - 1/8 mile buffer year-round. No aerial applications.		All formulations: Spot- 1/8 mile buffer from active nest from April 15- July 31. Mechanized ground and low and high aerial- 1/8 mile buffer year-round

Figure 1. Required protection measures for herbicide application in Federally and Navajo Nation listed species habitats.

Species	Herbicides				
	Imazapyr (non-aquatic)	**Indaziflam**	**Isoxaben**	**Metsulfuron methyl**	**Metribuzon**
Navajo Listed Species					
Pronghorn	All formulations- 1 mile buffer from potential lambing areas from May 1- June 15				
Townsend's big eared bat	All formulations require a 197ft buffer from occupied roost site.				
Chisel-toothed kangaroo rat, Banner-tailed kangaroo rat, Navajo Mountain vole, Arizona (Wupatki) pocket mouse	No restrictions				
Kit fox	All formulations require a 1/8 mile buffer from active den from December 1- August 31.				
Bald and golden eagles	All formulations: 1/4 mile buffer from active nest during the breeding season January 15- July 15. Buffer zone is unnecessary outside of breeding season for spot and mechanized ground treatments. No aerial applications. If aerial flight over a nest site is necessary, an elevation of 500ft should be maintained over the nest.				
Ferruginous hawk	Brief (1hr) spot- 1/2 mile buffer. Mechanized ground- 5/8 mile buffer. No aerial applications.				
American dipper	All formulations- spot- 350ft buffer. Mechanized ground -1/8 mile buffer from active nest during March 15- August 15. No aerial applications.				
Northern goshawk	All formulations require 1/4 mile buffer from nest site during March 1- August 15. All formulations require 0.21 mile buffer from the nest site year-round.				
Clark's grebe	All formulations: Spot- 328ft buffer from active nest during May 1-July 31. Mechanized ground - 1/8 mile buffer from active nest during May 1- July 31. No aerial applications.				
Northern saw-whet owl	All formulations require 1/8 mile buffer from the nest site year-round.				
Burrowing owl	All formulations require 1/4 mile buffer from the active nest burrow during March 1- August 15.				
Dusky grouse	All formulations: Spot- 328ft buffer from active nest during April 1-July 15. Mechanized ground - 1/8 mile buffer from active nest during April 1-July 15. No aerial applications.				
Yellow warbler	All formulations: Spot- 1/8 mile buffer from active nest from April 15- July 31. Mechanized ground - 1/8 mile buffer year-round. No aerial applications.				

Figure 1. Required protection measures for herbicide application in Federally and Navajo Nation listed species habitats.

Species	**Herbicides**			
	Paraquat	**Pendimethalin**	**Picloram**	**Prodiamine**
Navajo Listed Species				
Pronghorn	All formulations- 1 mile buffer from potential lambing areas from May 1- June 15			
Townsend's big eared bat	All formulations require a 197ft buffer from occupied roost site.			
Chisel-toothed kangaroo rat, Banner-tailed kangaroo rat, Navajo Mountain vole, Arizona (Wupatki) pocket mouse	No restrictions			
Kit fox	All formulations require a 1/8 mile buffer from active den from December 1- August 31.			
Bald and golden eagles	All formulations: 1/4 mile buffer from active nest during the breeding season January 15- July 15. Buffer zone is unnecessary outside of breeding season for spot and mechanized ground treatments. No aerial applications. If aerial flight over a nest site is necessary, an elevation of 500ft should be maintained over the nest.			
Ferruginous hawk	Brief (1hr) spot- 1/2 mile buffer. Mechanized ground- 5/8 mile buffer. No aerial applications.			
American dipper	All formulations- spot- 350ft buffer. Mechanized ground - 1/8 mile buffer from active nest during March 15- August 15. No aerial applications.			
Northern goshawk	All formulations require 1/4 mile buffer from nest site during March 1- August 15. All formulations require 0.21 mile buffer from the nest site year-round.			
Clark's grebe	All formulations: Spot- 328ft buffer from active nest during May 1-July 31. Mechanized ground - 1/8 mile buffer from active nest during May 1- July 31. No aerial applications.			
Northern saw-whet owl	All formulations require 1/8 mile buffer from the nest site year-round.			
Burrowing owl	All formulations require 1/4 mile buffer from the active nest burrow during March 1- August 15.			
Dusky grouse	All formulations: Spot- 328ft buffer from active nest during April 1-July 15. Mechanized ground - 1/8 mile buffer from active nest during April 1-July 15. No aerial applications.			
Yellow warbler	All formulations: Spot- 1/8 mile buffer from active nest from April 15- July 31. Mechanized ground - 1/8 mile buffer year-round. No aerial applications.			

Figure 1. Required protection measures for herbicide application in Federally and Navajo Nation listed species habitats.

Species	Herbicides		
	Thifensulfuron-methyl	**Triclopyr (amine salt)**	**Triclopyr (ester)**
Navajo Listed Species			
Pronghorn	All formulations- 1 mile buffer from potential lambing areas from May 1- June 15		
Townsend's big eared bat	All formulations require a 197ft buffer from occupied roost site.		
Chisel-toothed kangaroo rat, Banner-tailed kangaroo rat, Navajo Mountain vole, Arizona (Wupatki) pocket mouse	No restrictions		
Kit fox	All formulations require a 1/8 mile buffer from active den from December 1- August 31.		
Bald and golden eagles	All formulations: 1/4 mile buffer from active nest during the breeding season January 15- July 15. Buffer zone is unnecessary outside of breeding season for spot and mechanized ground treatments. No aerial applications. If aerial flight over a nest site is necessary, an elevation of 500ft should be maintained over the nest.	All formulations: 1/4 mile buffer from active nest during the breeding season January 15- July 15. Buffer zone is unnecessary outside of breeding season for spot and mechanized ground treatments. Aerial applications should be made in swaths parallels to a nest and 3/4 mile buffer zone. If aerial flight over a nest site is necessary, an elevation of 500ft should be maintained over the nest.	All formulations: 1/4 mile buffer from active nest during the breeding season January 15- July 15. Buffer zone is unnecessary outside of breeding season for spot and mechanized ground treatments. No aerial applications. If aerial flight over a nest site is necessary, an elevation of 500ft should be maintained over the nest.
Ferruginous hawk	Brief (1hr) spot- 1/2 mile buffer. Mechanized ground- 5/8 mile buffer. No aerial applications.	Brief (1hr) spot- 1/2 mile buffer. Mechanized ground- 5/8 mile buffer. Low and high aerial- 3/4 mile.	Brief (1hr) spot- 1/2 mile buffer. Mechanized ground- 5/8 mile buffer. No aerial applications.
American dipper	All formulations- spot- 350ft buffer. Mechanized ground - 1/8 mile buffer from active nest during March 15- August 15. No aerial applications.	All formulations- spot- 350ft buffer. Mechanized ground, low or high aerial within 1/8 mile from active nest during March 15- August 15.	All formulations- spot- 350ft buffer. Mechanized ground - 1/8 mile buffer from active nest during March 15- August 15. No aerial applications.
Northern goshawk	All formulations require 1/4 mile buffer from nest site during March 1- August 15. All formulations require 0.21 mile buffer from the nest site year-round.		
Clark's grebe	All formulations: Spot- 328ft buffer from active nest during May 1-July 31. Mechanized ground - 1/8 mile buffer from active nest during May 1- July 31. No aerial applications	All formulations: Spot- 328ft buffer from active nest during May 1-July 31. Mechanized ground and low and high aerial- 1/8 mile buffer from active nest during May 1- July 31.	All formulations: Spot- 328ft buffer from active nest during May 1-July 31. Mechanized ground - 1/8 mile buffer from active nest during May 1- July 31. No aerial applications
Northern saw-whet owl	All formulations require 1/8 mile buffer from the nest site year-round.		
Burrowing owl	All formulations require 1/4 mile buffer from the active nest burrow during March 1- August 15.		
Dusky grouse	All formulations: Spot- 328ft buffer from active nest during April 1-July 15. Mechanized ground - 1/8 mile buffer from active nest during April 1-July 15. No aerial applications.	All formulations: Spot- 328ft buffer from active nest during April 1-July 15. Mechanized ground and low and high aerial- 1/8 mile buffer from active nest during April 1-July 15.	All formulations: Spot- 328ft buffer from active nest during April 1-July 15. Mechanized ground - 1/8 mile buffer from active nest during April 1-July 15. No aerial applications.
Yellow warbler	All formulations: Spot- 1/8 mile buffer from active nest from April 15- July 31. Mechanized ground - 1/8 mile buffer year-round. No aerial applications.	All formulations: Spot- 1/8 mile buffer from active nest from April 15- July 31. Mechanized ground and low and high aerial- 1/8 mile buffer year-round	All formulations: Spot- 1/8 mile buffer from active nest from April 15- July 31. Mechanized ground - 1/8 mile buffer year-round. No aerial applications.

Figure 1. Required protection measures for herbicide application in Federally and Navajo Nation listed species habitats.

Species	Herbicides: 2,4-D (acid)	2,4-D (aquatic amine salt)	2,4-D (aquatic ester)	2,4-D (non-aquatic amine salt)	2,4-D (non-aquatic ester)	Aminopyralid	Atrazine
Navajo Listed Species							
Belted kingfisher and Mountain plover	All formulations: No treatments in nesting habitat year-round. Spot- 328ft buffer from active nest during April 15-August 15. Mechanized ground - 1/8 mile buffer from active nest during April 15-August 15. No aerial applications.	All formulations: No treatments in nesting habitat year-round. Spot- 328ft buffer from active nest during April 15-August 15. Mechanized ground and low and high aerial- 1/8 mile buffer from active nest during April 15-August 15.		All formulations: No treatments in nesting habitat year-round. Spot- 328ft buffer from active nest during April 15-August 15. Mechanized ground - 1/8 mile buffer from active nest during April 15-August 15. No aerial applications.			
Hammond's flycatcher	All formulations: Spot- 328ft from active nest during May 15- August 15. Mechanized ground - 1/8 mile from nest year-round. No aerial applications	All formulations: Spot- 328ft from active nest during May 15- August 15. Mechanized ground and low and high aerial- 1/8 mile from nest year-round.		All formulations: Spot- 328ft from active nest during May 15- August 15. Mechanized ground - 1/8 mile from nest year-round. No aerial applications			
Northern pygmy owl	All formulations: spot- 1/8 mile buffer from nest April 1-August 15. Mechanized ground - 1/8 mile from nest site year-round. No aerial applications.	All formulations: spot- 1/8 mile buffer from nest April 1-August 15. Mechanized ground, low and high aerial- 1/8 mile from nest site year-round.		All formulations: spot- 1/8 mile buffer from nest April 1-August 15. Mechanized ground - 1/8 mile from nest site year-round. No aerial applications.			
Flammulated owl	All formulations: spot- 1/8 mile buffer from nest May 1-August 15. Mechanized ground - 1/8 mile from nest site year-round. No aerial applications.	All formulations: spot- 1/8 mile buffer from nest May 1-August 15. Mechanized ground, low and high aerial- 1/8 mile from nest site year-round.		All formulations: spot- 1/8 mile buffer from nest May 1-August 15. Mechanized ground - 1/8 mile from nest site year-round. No aerial applications.			
Band-tailed pigeon, American three-toed woodpecker, Tree swallow	All formulations: spot- 328ft buffer from nest May 1-August 1. Mechanized ground - 1/8 mile from nest site year-round. No aerial applications.	All formulations: spot- 328ft buffer from nest May 1-August 1. Mechanized ground, low and high aerial- 1/8 mile from nest site year-round.		All formulations: spot- 328ft buffer from nest May 1-August 1. Mechanized ground - 1/8 mile from nest site year-round. No aerial applications.			
Sora	All formulations: spot- 328ft buffer from nest May 1-August 1. Mechanized ground - 1/8 mile from nest site May 1-August 1. No aerial applications.	All formulations: spot- 328ft buffer from nest May 1- August 1. Mechanized ground, low and high aerial- 1/8 mile from nest site May 1-August 1.		All formulations: spot- 328ft buffer from nest May 1- August 1. Mechanized ground - 1/8 mile from nest site May 1-August 1. No aerial applications.			
Gray vireo	All formulations: spot- 328ft buffer from nest May 1-August 31. Mechanized ground - 1/8 mile from nest site year-round. No aerial applications.	All formulations: spot- 328ft buffer from nest May 1-August 31. Mechanized ground, low and high aerial- 1/8 mile from nest site year-round.		All formulations: spot- 328ft buffer from nest May 1-August 31. Mechanized ground - 1/8 mile from nest site year-round. No aerial applications.			
Great Basin Silverspot	All formulations require a 60m buffer from occupied habitat						
Rocky mountainsnail, Yavapai mountainsnail, and Kanab ambersnail	No restrictions						

Figure 1. Required protection measures for herbicide application in Federally and Navajo Nation listed species habitats.

Species	Herbicides			
	Chlorsulfuron methyl	**Clopyralid**	**Dichlobenil**	**Fluroxpyr**
Navajo Listed Species				
Belted kingfisher and Mountain plover	All formulations: No treatments in nesting habitat year-round. Spot- 328ft buffer from active nest during April 15-August 15. Mechanized ground - 1/8 mile buffer from active nest during April 15-August 15. No aerial applications.			
Hammond's flycatcher	All formulations: Spot- 328ft from active nest during May 15- August 15. Mechanized ground - 1/8 mile from nest year-round. No aerial applications			
Northern pygmy owl	All formulations: spot- 1/8 mile buffer from nest April 1-August 15. Mechanized ground - 1/8 mile from nest site year-round. No aerial applications.			
Flammulated owl	All formulations: spot- 1/8 mile buffer from nest May 1-August 15. Mechanized ground - 1/8 mile from nest site year-round. No aerial applications.			
Band-tailed pigeon, American three-toed woodpecker, Tree swallow	All formulations: spot- 328ft buffer from nest May 1-August 1. Mechanized ground - 1/8 mile from nest site year-round. No aerial applications.			
Sora	All formulations: spot- 328ft buffer from nest May 1- August 1. Mechanized ground - 1/8 mile from nest site May 1-August 1. No aerial applications.			
Gray vireo	All formulations: spot- 328ft buffer from nest May 1-August 31. Mechanized ground - 1/8 mile from nest site year-round. No aerial applications.			
Great Basin Silverspot	All formulations require a 60m buffer from occupied habitat			
Rocky mountainsnail, Yavapai mountainsnail, and Kanab ambersnail	No restrictions			

Figure 1. Required protection measures for herbicide application in Federally and Navajo Nation listed species habitats.

Species	Herbicides				
	Fluazifop-P-butyl	**Glyphosate (aquatic)**	**Glyphosate (non-aquatic)**	**Imazapic**	**Imazapyr (aquatic)**
Navajo Listed Species					
Belted kingfisher and Mountain plover	All formulations: No treatments in nesting habitat year-round. Spot- 328ft buffer from active nest during April 15-August 15. Mechanized ground - 1/8 mile buffer from active nest during April 15-August 15. No aerial applications.	All formulations: No treatments in nesting habitat year-round. Spot- 328ft buffer from active nest during April 15-August 15. Mechanized ground and low and high aerial- 1/8 mile buffer from active nest during April 15-August 15.	All formulations: No treatments in nesting habitat year-round. Spot- 328ft buffer from active nest during April 15-August 15. Mechanized ground - 1/8 mile buffer from active nest during April 15-August 15. No aerial applications.		All formulations: No treatments in nesting habitat year-round. Spot- 328ft buffer from active nest during April 15-August 15. Mechanized ground and low and high aerial- 1/8 mile buffer from active nest during April 15-August 15.
Hammond's flycatcher	All formulations: Spot- 328ft from active nest during May 15-August 15. Mechanized ground - 1/8 mile from nest year-round. No aerial applications.	All formulations: Spot- 328ft from active nest during May 15-August 15. Mechanized ground and low and high aerial- 1/8 mile from nest year-round.	All formulations: Spot- 328ft from active nest during May 15- August 15. Mechanized ground - 1/8 mile from nest year-round. No aerial applications.		All formulations: Spot- 328ft from active nest during May 15- August 15. Mechanized ground and low and high aerial- 1/8 mile from nest year-round.
Northern pygmy owl	All formulations: spot- 1/8 mile buffer from nest April 1-August 15. Mechanized ground - 1/8 mile from nest site year-round. No aerial applications.	All formulations: spot- 1/8 mile buffer from nest April 1-August 15. Mechanized ground, low and high aerial- 1/8 mile from nest site year-round.	All formulations: spot- 1/8 mile buffer from nest April 1-August 15. Mechanized ground - 1/8 mile from nest site year-round. No aerial applications.		All formulations: spot- 1/8 mile buffer from nest April 1-August 15. Mechanized ground, low and high aerial- 1/8 mile from nest site year-round.
Flammulated owl	All formulations: spot- 1/8 mile buffer from nest May 1-August 15. Mechanized ground - 1/8 mile from nest site year-round. No aerial applications.	All formulations: spot- 1/8 mile buffer from nest May 1-August 15. Mechanized ground, low and high aerial- 1/8 mile from nest site year-round.	All formulations: spot- 1/8 mile buffer from nest May 1-August 15. Mechanized ground - 1/8 mile from nest site year-round. No aerial applications.		All formulations: spot- 1/8 mile buffer from nest May 1-August 15. Mechanized ground, low and high aerial- 1/8 mile from nest site year-round.
Band-tailed pigeon, American three-toed woodpecker, Tree swallow	All formulations: spot- 328ft buffer from nest May 1-August 1. Mechanized ground - 1/8 mile from nest site year-round. No aerial applications.	All formulations: spot- 328ft buffer from nest May 1-August 1. Mechanized ground, low and high aerial- 1/8 mile from nest site year-round.	All formulations: spot- 328ft buffer from nest May 1-August 1. Mechanized ground - 1/8 mile from nest site year-round. No aerial applications.		All formulations: spot- 328ft buffer from nest May 1-August 1. Mechanized ground, low and high aerial- 1/8 mile from nest site year-round.
Sora	All formulations: spot- 328ft buffer from nest May 1- August 1. Mechanized ground - 1/8 mile from nest site May 1-August 1. No aerial applications.	All formulations: spot- 328ft buffer from nest May 1- August 1. Mechanized ground, low and high aerial- 1/8 mile from nest site May 1-August 1.	All formulations: spot- 328ft buffer from nest May 1- August 1. Mechanized ground - 1/8 mile from nest site May 1-August 1. No aerial applications.		All formulations: spot- 328ft buffer from nest May 1- August 1. Mechanized ground, low and high aerial- 1/8 mile from nest site May 1-August 1.
Gray vireo	All formulations: spot- 328ft buffer from nest May 1-August 31. Mechanized ground - 1/8 mile from nest site year-round. No aerial applications.	All formulations: spot- 328ft buffer from nest May 1-August 31. Mechanized ground, low and high aerial- 1/8 mile from nest site year-round.	All formulations: spot- 328ft buffer from nest May 1-August 31. Mechanized ground - 1/8 mile from nest site year-round. No aerial applications.		All formulations: spot- 328ft buffer from nest May 1-August 31. Mechanized ground, low and high aerial- 1/8 mile from nest site year-round.
Great Basin Silverspot	All formulations require a 60m buffer from occupied habitat				
Rocky mountainsnail, Yavapai mountainsnail, and Kanab ambersnail	No restrictions				

Figure 1. Required protection measures for herbicide application in Federally and Navajo Nation listed species habitats.

Species	Herbicides				
	Imazapyr (non-aquatic)	**Indaziflam**	**Isoxaben**	**Metsulfuron methyl**	**Metribuzin**
Navajo Listed Species					
Belted kingfisher and Mountain plover	All formulations: No treatments in nesting habitat year-round. Spot- 328ft buffer from active nest during April 15-August 15. Mechanized ground - 1/8 mile buffer from active nest during April 15-August 15. No aerial applications.				
Hammond's flycatcher	All formulations: Spot- 328ft from active nest during May 15- August 15. Mechanized ground - 1/8 mile from nest year-round. No aerial applications.				
Northern pygmy owl	All formulations: spot- 1/8 mile buffer from nest April 1-August 15. Mechanized ground - 1/8 mile from nest site year-round. No aerial applications.				
Flammulated owl	All formulations: spot- 1/8 mile buffer from nest May 1-August 15. Mechanized ground - 1/8 mile from nest site year-round. No aerial applications.				
Band-tailed pigeon, American three-toed woodpecker, Tree swallow	All formulations: spot- 328ft buffer from nest May 1-August 1. Mechanized ground - 1/8 mile from nest site year-round. No aerial applications.				
Sora	All formulations: spot- 328ft buffer from nest May 1- August 1. Mechanized ground - 1/8 mile from nest site May 1-August 1. No aerial applications.				
Gray vireo	All formulations: spot- 328ft buffer from nest May 1-August 31. Mechanized ground - 1/8 mile from nest site year-round. No aerial applications.				
Great Basin Silverspot	All formulations require a 60m buffer from occupied habitat				
Rocky mountainsnail, Yavapai mountainsnail, and Kanab ambersnail	No restrictions				

Figure 1. Required protection measures for herbicide application in Federally and Navajo Nation listed species habitats.

Species	Herbicides			
	Paraquat	**Pendimethalin**	**Picloram**	**Prodiamine**
Navajo Listed Species				
Belted kingfisher and Mountain plover	All formulations: No treatments in nesting habitat year-round. Spot- 328ft buffer from active nest during April 15-August 15. Mechanized ground - 1/8 mile buffer from active nest during April 15-August 15. No aerial applications.			
Hammond's flycatcher	All formulations: Spot- 328ft from active nest during May 15- August 15. Mechanized ground - 1/8 mile from nest year-round. No aerial applications.			
Northern pygmy owl	All formulations: spot- 1/8 mile buffer from nest April 1-August 15. Mechanized ground - 1/8 mile from nest site year-round. No aerial applications.			
Flammulated owl	All formulations: spot- 1/8 mile buffer from nest May 1-August 15. Mechanized ground - 1/8 mile from nest site year-round. No aerial applications.			
Band-tailed pigeon, American three-toed woodpecker, Tree swallow	All formulations: spot- 328ft buffer from nest May 1-August 1. Mechanized ground - 1/8 mile from nest site year-round. No aerial applications.			
Sora	All formulations: spot- 328ft buffer from nest May 1- August 1. Mechanized ground - 1/8 mile from nest site May 1-August 1. No aerial applications.			
Gray vireo	All formulations: spot- 328ft buffer from nest May 1-August 31. Mechanized ground - 1/8 mile from nest site year-round. No aerial applications.			
Great Basin Silverspot	All formulations require a 60m buffer from occupied habitat			
Rocky mountainsnail, Yavapai mountainsnail, and Kanab ambersnail	No restrictions			

Figure 1. Required protection measures for herbicide application in Federally and Navajo Nation listed species habitats.

Species	Herbicides: Thifensulfuron-methyl	Herbicides: Triclopyr (amine salt)	Herbicides: Triclopyr (ester)
Navajo Listed Species			
Belted kingfisher and Mountain plover	All formulations: No treatments in nesting habitat year-round. Spot- 328ft buffer from active nest during April 15-August 15. Mechanized ground - 1/8 mile buffer from active nest during April 15-August 15. No aerial applications.	All formulations: No treatments in nesting habitat year-round. Spot- 328ft buffer from active nest during April 15-August 15. Mechanized ground and low and high aerial- 1/8 mile buffer from active nest during April 15-August 15.	All formulations: No treatments in nesting habitat year-round. Spot- 328ft buffer from active nest during April 15-August 15. Mechanized ground - 1/8 mile buffer from active nest during April 15-August 15. No aerial applications.
Hammond's flycatcher	All formulations: Spot- 328ft from active nest during May 15- August 15. Mechanized ground - 1/8 mile from nest year-round. No aerial applications.	All formulations: Spot- 328ft from active nest during May 15- August 15. Mechanized ground and low and high aerial- 1/8 mile from nest year-round.	All formulations: Spot- 328ft from active nest during May 15- August 15. Mechanized ground - 1/8 mile from nest year-round. No aerial applications.
Northern pygmy owl	All formulations: spot- 1/8 mile buffer from nest April 1-August 15. Mechanized ground - 1/8 mile from nest site year-round. No aerial applications	All formulations: spot- 1/8 mile buffer from nest April 1-August 15. Mechanized ground, low and high aerial- 1/8 mile from nest site year-round.	All formulations: spot- 1/8 mile buffer from nest April 1-August 15. Mechanized ground - 1/8 mile from nest site year-round. No aerial applications
Flammulated owl	All formulations: spot- 1/8 mile buffer from nest May 1-August 15. Mechanized ground - 1/8 mile from nest site year-round. No aerial applications.	All formulations: spot- 1/8 mile buffer from nest May 1-August 15. Mechanized ground, low and high aerial- 1/8 mile from nest site year-round.	All formulations: spot- 1/8 mile buffer from nest May 1-August 15. Mechanized ground - 1/8 mile from nest site year-round. No aerial applications.
Band-tailed pigeon, American three-toed woodpecker, Tree swallow	All formulations: spot- 328ft buffer from nest May 1-August 1. Mechanized ground - 1/8 mile from nest site year-round. No aerial applications.	All formulations: spot- 328ft buffer from nest May 1-August 1. Mechanized ground, low and high aerial- 1/8 mile from nest site year-round.	All formulations: spot- 328ft buffer from nest May 1-August 1. Mechanized ground - 1/8 mile from nest site year-round. No aerial applications.
Sora	All formulations: spot- 328ft buffer from nest May 1- August 1. Mechanized ground - 1/8 mile from nest site May 1-August 1. No aerial applications	All formulations: spot- 328ft buffer from nest May 1- August 1. Mechanized ground, low and high aerial- 1/8 mile from nest site May 1-August 1.	All formulations: spot- 328ft buffer from nest May 1- August 1. Mechanized ground - 1/8 mile from nest site May 1-August 1. No aerial applications.
Gray vireo	All formulations: spot- 328ft buffer from nest May 1-August 31. Mechanized ground - 1/8 mile from nest site year-round. No aerial applications	All formulations: spot- 328ft buffer from nest May 1-August 31. Mechanized ground, low and high aerial- 1/8 mile from nest site year-round.	All formulations: spot- 328ft buffer from nest May 1-August 31. Mechanized ground - 1/8 mile from nest site year-round. No aerial applications.
Great Basin Silverspot	All formulations require a 60m buffer from occupied habitat		
Rocky mountainsnail, Yavapai mountainsnail, and Kanab ambersnail	No restrictions		

Figure 1. Required protection measures for herbicide application in Federally and Navajo Nation listed species habitats.

Species	**Herbicides**						
	2,4-D (acid)	**2,4-D (aquatic amine salt)**	**2,4-D (aquatic ester)**	**2,4-D (non-aquatic amine salt)**	**2,4-D (non-aquatic ester)**	**Aminopyralid**	**Atrazine**
Navajo Listed Species							
Northern leopard frog	Applications on land below or above high water line of species habitat, one-half mile upstream (including tributaries) and 300ft downstream. Liquid- Spot- 30ft buffer Mechanized- 350ft No aerial applications.	Applications on land below or above high water line of species habitat, one-half mile upstream (including tributaries) and 300ft downstream. Liquid- Spot- 30ft buffer Mechanized- 350ft Low aerial- 450ft High aerial-1/8 mile		Applications on land below or above high water line of species habitat, one-half mile upstream (including tributaries) and 300ft downstream. Liquid- Spot- 30ft buffer Mechanized- 350ft No aerial applications.		Spot applications on land below or above high water line of species habitat, one-half mile upstream (including tributaries) and 300ft downstream.	Applications on land below or above high water line of species habitat, one-half mile upstream (including tributaries) and 300ft downstream. Liquid- Spot- 100ft buffer Mechanized- 400ft
Milk snake and chuckwalla	No restrictions						
Marble Canyon milk-vetch, Cronquist milk-vetch, Naturita milk-vetch, Acoma fleabane, Round dunebroom, Navajo bladderpod, Navajo Penstemon, Alcove rock daisy, Alcove bog-orchid, Alcove death camas, Gooding's onion, Aztec gilia, San Juan milkweed, Heil's milkvetch, Navajo saltbush, Atwood's camissonia, Rydberg's thistle, Utah bladder-fern, Sivinski's fleabane, Sarah's buckwheat, Bluff phacelia, Cave primrose, Marble Canyon dalea, Parish's alkali grass, Arizona rose sage, Brack hardwall cactus, Welsh' American-aster	Spot and mechanized spraying - 200ft from identified species locations. No aerial applications.	Spot and mechanized spraying - 200ft from identified species locations. Low and high aerial applications- 1 mile from identified species locations.		Spot and mechanized spraying - 200ft from identified species locations. No aerial applications.			
Beath's milkvetch, Cutler's milk-vetch	No herbicide treatments permitted in suitable habitat for pre-emergent applications. For post-emergent applications, spot and mechanized spraying - 200ft from identified species locations. No aerial applications.	No herbicide treatments permitted in suitable habitat for pre-emergent applications. For post-emergent applications, spot and mechanized spraying - 200ft from identified species locations. Low and high aerial applications - 1 mile from identified species locations.		No herbicide treatments permitted in suitable habitat for pre-emergent applications. For post-emergent applications, spot and mechanized spraying - 200ft from identified species locations. No aerial applications.		Spot and mechanized spraying - 200ft from identified species locations. No aerial applications.	No herbicide treatments permitted in suitable habitat for pre-emergent applications. For post-emergent applications, spot and mechanized spraying - 200ft from identified species locations. No aerial applications.

Figure 1. Required protection measures for herbicide application in Federally and Navajo Nation listed species habitats.

Species	Herbicides			
	Chlorsulfuron methyl	**Clopyralid**	**Dichlobenil**	**Fluroxpyr**
Navajo Listed Species				
Northern leopard frog	Spot applications on land below or above high water line of species habitat, one-half mile upstream (including tributaries) and 300ft downstream.		Applications on land below or above high water line of species habitat, one-half mile upstream (including tributaries) and 300ft downstream. Liquid- Spot- 30ft buffer Mechanized- 350ft No aerial applications.	
Milk snake and chuckwalla	No restrictions			
Marble Canyon milk-vetch, Cronquist milk-vetch, Naturita milk-vetch, Acoma fleabane, Round dunebroom, Navajo bladderpod, Navajo Penstemon, Alcove rock daisy, Alcove bog-orchid, Alcove death camas, Gooding's onion, Aztec gilia, San Juan milkweed, Heil's milkvetch, Navajo saltbush, Atwood's camissonia, Rydberg's thistle, Utah bladder-fern, Sivinski's fleabane, Sarah's buckwheat, Bluff phacelia, Cave primrose, Marble Canyon dalea, Parish's alkali grass, Arizona rose sage, Brack hardwall cactus, Welsh' American-aster	Spot and mechanized spraying - 200ft from identified species locations. No aerial applications.			
Beath's milkvetch, Cutler's milk-vetch	Spot and mechanized spraying - 200ft from identified species locations. No aerial applications.		No herbicide treatments permitted in suitable habitat.	Spot and mechanized spraying - 200ft from identified species locations. No aerial applications.

Figure 1. Required protection measures for herbicide application in Federally and Navajo Nation listed species habitats.

Species	Herbicides				
	Fluazifop-P-butyl	**Glyphosate (aquatic)**	**Glyphosate (non-aquatic)**	**Imazapic**	**Imazapyr (aquatic)**
Navajo Listed Species					
Northern leopard frog	Applications on land below or above high water line of species habitat, one-half mile upstream (including tributaries) and 300ft downstream. Liquid- Spot- 50ft buffer Mechanized- 350ft No aerial applications.	Spot applications on land below or above high water line of species habitat, one-half mile upstream (including tributaries) and 300ft downstream Liquid- Spot- 30ft buffer Mechanized- 350ft Low aerial- 450ft High aerial-1/8 mile	Applications on land below or above high water line of species habitat, one-half mile upstream (including tributaries) and 300ft downstream. Liquid- Spot- 30ft buffer Mechanized- 350ft No aerial applications.		Spot applications on land below or above high water line of species habitat, one-half mile upstream (including tributaries) and 300ft downstream Liquid- Spot- 30ft buffer Mechanized- 350ft Low aerial- 450ft High aerial-1/8 mile
Milk snake and chuckwalla	No restrictions				
Marble Canyon milk-vetch, Cronquist milk-vetch, Naturita milk-vetch, Acoma fleabane, Round dunebroom, Navajo bladderpod, Navajo Penstemon, Alcove rock daisy, Alcove bog-orchid, Alcove death camas, Gooding's onion, Aztec gilia, San Juan milkweed, Heil's milkvetch, Navajo saltbush, Atwood's camissonia, Rydberg's thistle, Utah bladder-fern, Sivinski's fleabane, Sarah's buckwheat, Bluff phacelia, Cave primrose, Marble Canyon dalea, Parish's alkali grass, Arizona rose sage, Brack hardwall cactus, Welsh' American-aster	Spot and mechanized spraying - 200ft from identified species locations. No aerial applications.	Spot and mechanized spraying - 200ft from identified species locations. Low and high aerial applications- 1 mile from identified species locations.	Spot and mechanized spraying - 200ft from identified species locations. No aerial applications.		Spot and mechanized spraying - 200ft from identified species locations. Low and high aerial applications- 1 mile from identified species locations.
Beath's milkvetch, Cutler's milk-vetch	Spot and mechanized spraying - 200ft from identified species locations. No aerial applications.	Spot and mechanized spraying - 200ft from identified species locations. Low and high aerial applications- 1 mile from identified species locations.	Spot and mechanized spraying - 200ft from identified species locations. No aerial applications.	No herbicide treatments permitted in suitable habitat for pre-emergent applications.For post-emergent applications, apot and mechanized spraying - 200ft from identified species locations. No aerial applications.	No herbicide treatments permitted in suitable habitat for pre-emergent applications. For post-emergent applications, spot and mechanized spraying - 200ft from identified species locations. Low and high aerial applications - 1 mile from identified species locations.

Figure 1. Required protection measures for herbicide application in Federally and Navajo Nation listed species habitats.

Species	Herbicides				
	Imazapyr (non-aquatic)	**Indaziflam**	**Isoxaben**	**Metsulfuron methyl**	**Metribuzin**
Navajo Listed Species					
Northern leopard frog	Applications on land below or above high water line of species habitat, one-half mile upstream (including tributaries) and 300ft downstream. Liquid- Spot- 30ft buffer Mechanized- 350ft . No aerial applications.				
Milk snake and chuckwalla	No restrictions				
Marble Canyon milk-vetch, Cronquist milk-vetch, Naturita milk-vetch, Acoma fleabane, Round dunebroom, Navajo bladderpod, Navajo Penstemon, Alcove rock daisy, Alcove bog-orchid, Alcove death camas, Gooding's onion, Aztec gilia, San Juan milkweed, Heil's milkvetch, Navajo saltbush, Atwood's camissonia, Rydberg's thistle, Utah bladder-fern, Sivinski's fleabane, Sarah's buckwheat, Bluff phacelia, Cave primrose, Marble Canyon dalea, Parish's alkali grass, Arizona rose sage, Brack hardwall cactus, Welsh' American-aster	Spot and mechanized spraying - 200ft from identified species locations. No aerial applications.				
Beath's milkvetch, Cutler's milk-vetch	No herbicide treatments permitted in suitable habitat for pre-emergent applications.For post-emergent applications, apot and mechanized spraying - 200ft from identified species locations. No aerial applications.	No herbicide treatments permitted in suitable habitat.		Spot and mechanized spraying - 200ft from identified species locations. Low and high aerial applications- 1 mile from identified species locations.	No herbicide treatments permitted in suitable habitat for pre-emergent applications.For post-emergent applications, apot and mechanized spraying - 200ft from identified species locations. No aerial applications.

Figure 1. Required protection measures for herbicide application in Federally and Navajo Nation listed species habitats.

Species	Herbicides: Paraquat	Herbicides: Pendimethalin	Herbicides: Picloram	Herbicides: Prodiamine
Navajo Listed Species				
Northern leopard frog	Applications on land below or above high water line of species habitat, one-half mile upstream (including tributaries) and 300ft downstream. Liquid- Spot- 50ft buffer Mechanized- 350ft No aerial applications.			
Milk snake and chuckwalla	No restrictions			
Marble Canyon milk-vetch, Cronquist milk-vetch, Naturita milk-vetch, Acoma fleabane, Round dunebroom, Navajo bladderpod, Navajo Penstemon, Alcove rock daisy, Alcove bog-orchid, Alcove death camas, Gooding's onion, Aztec gilia, San Juan milkweed, Heil's milkvetch, Navajo saltbush, Atwood's camissonia, Rydberg's thistle, Utah bladder-fern, Sivinski's fleabane, Sarah's buckwheat, Bluff phacelia, Cave primrose, Marble Canyon dalea, Parish's alkali grass, Arizona rose sage, Brack hardwall cactus, Welsh' American-aster	Spot and mechanized spraying - 200ft from identified species locations. No aerial applications.			
Beath's milkvetch, Cutler's milk-vetch	No herbicide treatments permitted in suitable habitat for pre-emergent applications.For post-emergent applications, apot and mechanized spraying - 200ft from identified species locations. No aerial applications.		Spot and mechanized spraying - 200ft from identified species locations. No aerial applications.	No herbicide treatments permitted in suitable habitat

Figure 1. Required protection measures for herbicide application in Federally and Navajo Nation listed species habitats.

Species	Herbicides		
	Thifensulfuron-methyl	**Triclopyr (amine salt)**	**Triclopyr (ester)**
Navajo Listed Species			
Northern leopard frog	Spot applications on land below or above high water line of species habitat, one-half mile upstream (including tributaries) and 300ft downstream. No aerial applications.	Applications on land below or above high water line of species habitat, one-half mile upstream (including tributaries) and 300ft downstream. Liquid- Spot- 50ft buffer Mechanized- 350ft Low aerial- 1/8 mile High aerial-1/4 mile	Spot applications on land below or above high water line of species habitat, one-half mile upstream (including tributaries) and 300ft downstream. Liquid Spot - 50 ft. buffer Mechanized - 350 ft. No aerial applications.
Milk snake and chuckwalla	No restrictions		
Marble Canyon milk-vetch, Cronquist milk-vetch, Naturita milk-vetch, Acoma fleabane, Round dunebroom, Navajo bladderpod, Navajo Penstemon, Alcove rock daisy, Alcove bog-orchid, Alcove death camas, Gooding's onion, Aztec gilia, San Juan milkweed, Heil's milkvetch, Navajo saltbush, Atwood's camissonia, Rydberg's thistle, Utah bladder-fern, Sivinski's fleabane, Sarah's buckwheat, Bluff phacelia, Cave primrose, Marble Canyon dalea, Parish's alkali grass, Arizona rose sage, Brack hardwall cactus, Welsh' American-aster	Spot and mechanized spraying - 200ft from identified species locations. No aerial applications.	Spot and mechanized spraying - 200ft from identified species locations. Low and high aerial applications- 1 mile from identified species locations.	Spot and mechanized spraying - 200ft from identified species locations. No aerial applications.
Beath's milkvetch, Cutler's milk-vetch	Spot and mechanized spraying - 200ft from identified species locations.	Spot and mechanized spraying - 200ft from identified species locations. Low and high aerial applications- 1 mile from identified species locations.	Spot and mechanized spraying - 200ft from identified species locations.

Appendix G. Best Management Option for Control by Noxious Weed Species

CATEGORY A - HIGH	
Invasive Weeds	**Best Option for Control**
African Rue	Hand pulling, grubbing, tilling, and prescribed burn are not recommended because the roots are too deep and will promote spread. Grazing is not an option because of the bad smell and taste, livestock will not eat. Treatment should occur when the plant is healthy and robust in the late summer (September-October) when using foliar spray. Using imazapyr alone or in combination with other herbicides provides the best control.
Blue Mustard	Changing crop rotation for heavily infested fields is effective. Tilling before plants produce flowers will reduce amount of seed in seed bank. Herbicide most effective when applied before stems elongate.
Bull thistle	Use integrated treatments. Cut-off seed heads and pull up roots repeatedly. Tillage, mowing and pulling at proper time will be effective. No burning. Livestock will graze young thistle. Biocontrol suitable for remote locations where other methods are not practical. Use biocontrol for large populations. Chemical treatment is effective
Canada thistle	Repeated mechanical control should focus on destroying seed heads and root systems. Tillage provides limited control. Do not burn. Goats and sheep can be used to graze young thistle. Best controlled by a selective post-emergent broadleaf herbicide.
Common Mediterranean Grass	Growth inhibited by shade. Plant dense shrubs. Hand removal is impractical. Plowing, disking or scraping reduces biomass initially then further encourages growth. Can be grazed, although disturbance will encourage growth. Herbicide use can be effective. [##]
Dalmatian toadflax	Mechanical removal should focus on root systems. Hand-pulling and digging can be effective for small populations. Mowing, chopping, and cutting are not recommended. Burning is not recommended. Do not graze, it can be toxic to livestock. Long-term biocontrol effectiveness is unknown. Chemical treatment can be effective with re-seeding efforts if native grasses are not present.
Fountain Grass	Small populations can be hand pulled if roots are extracted. Hand pulling should occur every 1-2 months. Mow or till if infestations are accessible. Prescribed burn is not recommended. Fountain grass is not palatable to livestock, except when very young. Best method is to apply herbicide (glyphosate) spot treatments to actively growing plants annually for good control.
Leafy spurge	Hand-pulling and grubbing are not effective. Tillage should be combined with re-seeding effort. Long-term grazing with sheep and goats can be effective to control (>5 years). Biocontrol most effective when used with chemical control and grazing. Herbicide treatments are effective when done repeatedly.
Musk thistle	Use integrated treatments. Cut-off seed heads and pull up roots repeatedly. Tillage, mowing and pulling at proper time will be effective. No burning. Livestock will graze young thistle. Biocontrol suitable for remote locations where other methods are not practical. Use biocontrol for large populations. Chemical treatment is effective
Perennial pepperweed	Hand-pulling, hoeing, or grubbing are effective for seedlings. Do not mow or till unless used in combination with herbicide. Do not burn. Use grazing with other tools. Goats, sheep, and cattle should graze new foliage growth. Herbicides are effective especially when using with other integrated approaches.
Ravenna Grass	Seed heads can be cut, bagged and incinerated. Remove whole plant by their root and place in a high and dry area. Spray glyphosate on foliage for control of larger populations.
Sahara mustard	Hand pull, particularly seed heads, bag, and incinerate.
Scotch thistle	Use integrated treatments. Cut-off seed heads and pull up roots repeatedly. Tillage, mowing and pulling at proper time will be effective. No burning. Livestock will graze young thistle. Biocontrol suitable for remote locations where other methods are not practical. Use biocontrol for large populations. Chemical treatment is effective.

CATEGORY A - HIGH

Invasive Weeds	Best Option for Control
Spotted knapweed	Hand pulling can be effective for small populations-repeated pulling is necessary. Do not till. Mow young plants. Do not burn. Sheep and goat can graze during spring. Control burning is effective, but hard to keep ignited through a dense monoculture. Biocontrol is highly effective when using other control methods. Herbicide treatment with follow-up treatments are effective.
Squarrose knapweed	Hand pulling can be effective for small populations-repeated pulling is necessary. Do not till. Mow young plants. Do not burn. Sheep and goat grazing can be grazed during spring. Biocontrol is highly effective when using other control methods. Herbicide treatment with follow-up treatments will be effective.
Sulphur Cinquefoil	Best method is prevention. If infestation is small, shovels and tillers can be used to reach below the root crown to destroy plant. Till before the plant goes to seed. Mowing is not suggested. Plant with native seed and plants to reduce population. Chemical control is most effective. ###
Tall whitetop	Hand digging and grubbing may be feasible for small populations. Mowing is not recommended unless combined with herbicide applications. Tilling is effective if done repeatedly. Do not burn. Not recommended for livestock grazing. Bio-control agents are not available. Herbicides will provide effective control but need to be cautious about herbicide selection when spraying near crops.
Tamarisk, saltcedar	Hand removal methods are effective for sprouts/young plants. Mechanical clearing requires repeated applications. A grubbing tool mounted on a tractor will works well to pull root ball out. Mulching and excavating can be used for individual trees. Prescribed fire is not recommended for long term management but can be used to burn brush pile or dead saltcedar. Biological control not approved. Herbicide control can be effective: aircraft, helicopter, tractor, truck, ATV, backpack, etc.
Tree of Heaven	Hand-pull very young seedlings. Grub saplings or young trees if you can remove the root system. Not palatable for grazing. Tree will come back after a controlled burn. Basal spray or girdling with herbicide application with follow-up foliar spot spraying for new seedlings, sprouts and root suckers is a good option. Re-vegetating with native species should occur.
Uruguayan pampas grass	Pulling or hand grubbing seedlings is effective. A pulaski, pickaxe, or shovel can be used to remove clumps. Can use chainsaw or weed whacker to remove the crown, to expose the base of the plant making it easier to remove the root system. It can be controlled with glyphosate in the fall. Top foliage can be removed or burned and the re-growth treated with glyphosate.#
Yellow nutsedge	Controlling the tubers of this plant is important. Remove plants before they have 5-6 leaves by hand or hand hoe. Make sure to remove entire plant. Till only small areas before plants have 6 leaves. Can till and then dry tubers (do not provide irrigation). Can cover an area with polypropylene polymer fabric to suppress nutsedge growth. Few herbicides are effective. Use repeated applications of glyphosate to young and mature plants to kill tubers. Apply chlorsulfuron to nutsedge prior to the fifth-leaf stage. Dichlobenil will reduce number of plants, but needs repeated treatments.*
Yellow starthistle	Reproduces solely by seed so mechanical control should focus on that-hand removal for small populations, tillage can be effective. Mowing can be effective over a 3-year period. Burning can be effective from January to May. Goat and sheep grazing can be effective. Limited experience with biocontrol in AZ. Herbicide spraying is effective.

CATEGORY B - MEDIUM

Invasive Weeds	Best Option for Control
Camelthorn	Do not till, mow or burn. Can pull small populations. Grazing may be effective for young growth. Chemical is the most effective treatment over multiple years.
Diffuse knapweed	Hand pulling can be effective for small populations-repeated pulling is necessary. Do not till. Mow young plants. Do not burn. Sheep and goat grazing can be grazed during spring. Biocontrol is highly effective when using other control methods. Herbicide treatment with follow-up treatments will be effective.
Halogeton	Can be controlled by mechanical tillage but should be followed up by re-seeding. Can be controlled using repeated herbicide treatments. ***
Johnsongrass	Can remove individual plants by hand if you can remove all the roots. Herbicide is the most effective method.[##]
Russian knapweed	Hand-pulling or hoeing can be effective for small populations if repeated over multiple years. Tillage should not be used w/out herbicide application. Burning should not occur, except for debris disposal. Cattle, sheep, and goats can graze during early growth. Toxic to horses. Biocontrol agents can be effective. Best controlled with selective, post-emergent herbicide.
Russian Olive	Hand removal of small trees (shovel, hoe) Can mow sapling stems <1 inch diameter. Repeated tillage is effective in agricultural situations and should be coordinated with reseeding. Excavator can be used to remove trees. Burning is a suppression technique can modestly control saplings and reduce top growth of more mature trees. Mature goats will graze on seedlings and young trees. No biocontrols available. Herbicide treatment is effective especially when used with other methods.
Siberian Elm	Basal spray or cut-surface treatment initially and follow-up with foliar spot spray to control new seedlings, sprouts and root suckers. Can use heavy machinery to grub trees (uproot from ground). Plant dense native shrubs and trees to prevent re-growth.

CATEGORY C - LOW

Invasive Weeds	Best Option for Control
Bald Brome	Hand removal effective if before seed heads are produced; remove roots. May require several return visits. Mowing can occur in winter or early spring before seeds develop to reduce plant size but may cause plant to increase in number of stems produced. Burning can be used with other control methods. Can use grazing but will not provide complete control. Apply herbicide in the fall when the grass has uniform germination and establishment. Once treated, the area should be seeded or planted with native species to out-compete recolonizing brome.
California Burclover	Hand pulling plants may control small populations if roots are removed. Maintain or plant native vegetation for competition. Glyphosate may be effective.
Cheat grass	Hand-pulling or hoeing will work for small infestations. Disking or tilling repeatedly may be effective if seed is buried at least 4-6 inches. Mowing every 2-3 weeks may be effective. Burning is effective when used with other methods. Grazing is effective during 6-8 weeks early in the season. No biocontrols available. Herbicides are effective, however may affect native species.
Field bindweed	Deep tillage of root system and hand removal of top growth can be effective if done repeatedly. Hoeing is partially effective when treated every 2-3 weeks. Herbicides are effective.*
Field Brome	Hand removal effective if before seed heads are produced-remove roots. May require several return visits. Mowing can occur in winter or early spring before seeds are developed can reduce plant size but may cause plant to increase in number of stems produced. Burning can be used with other control methods. Can use grazing but will not provide complete control. Apply herbicide in the fall when the grass has uniform germination and establishment. Once treated the area should be seeded or planted with native species to out-compete recolonizing brome.
Horehound	Hand pull before seeding small populations. Plants do not persist in areas of clean cultivation. Plants can be mowed to the ground as they begin to grow in spring, will need to be repeated. Deep plow ag fields with crop rotation to improve control. Sheep will graze if other feed is scarce but may open up new areas for infestation. Control burn with follow-up treatments for germinating plants. Herbicides will work with follow-up treatments.[!!!]

CATEGORY C - LOW

Invasive Weeds	Best Option for Control
Jointed goatgrass	Hand pulling effective for small populations. Deep tillage can be effective. Mowing can be effective during late winter. Control burn can be effective in agricultural setting but limited for range or non-crop lands. Grazing can be effective in combination with glyphosate spraying. No biocontrol. Effective control with non-selective herbicide.
Kochia	Small infestations can be hand-pulled to remove whole root. Mowing reduces seed production but should be done repeatedly. Deep tillage may prevent seed germination. Can be grazed in small amounts but toxic in large amounts. Will re-grow after grazing. Competitive native vegetation, such as perennial grass plantings, can inhibit establishment. Chemical treatment will work, however there are chemical resistant populations.[!]
Puncturevine	Best controlled by hand-removal or hoeing to cut plant off taproot. Mulch can be used around ornamentals to prevent this species. Biocontrol may be effective. Herbicides are an effective control.*
Red brome	Hand removal effective if before seed heads are produced; remove roots. May require several return visits. Mowing can occur in winter or early spring before seeds develop to reduce plant size but may cause plant to increase number of stems produced. Burning can be used with other control methods. Can use grazing but will not provide complete control. Apply herbicide in the fall when the grass has uniform germination and establishment. Once treated the area should be seeded or planted with native species to out-compete recolonizing red brome.
Rescuegrass	Hand removal effective if before seed heads are produced; remove roots. May require several return visits. Mow in winter or early spring before seeds develop to reduce plant size but could cause increase number of stems produced. Burning can be used with other control methods. Can use grazing but will not provide complete control. Apply herbicide in the fall when the grass has uniform germination and establishment. Once treated the area should be seeded or planted with native species to out-compete recolonizing weeds.
Ripgut Brome	Small populations can be hand pulled if roots are extracted. Hand pulling will need to occur repeatedly. Mowing or cutting should occur regularly. Deep tillage can be effective. Herbicide application can be successful.[@@]
Russian thistle	Mowing or hand-pulling young plants can prevent seed production but must be repeated. Do not burn. Planting competitive native species can prevent establishment. Can use preemergent and post emergent herbicides. Repeated use of a single herbicide should be avoided due to herbicide resistance.*
Smooth brome	Can hand pull small populations. Spray herbicide in fall after a killing freeze for best results. Can use control burn in a field during the dormant period and followed by cattle grazing of re-growth. @
Spreading Wallflower	2,4-D provides good control.

NOTES ON TABLES

Weed management strategies for above-mentioned weeds extracted from USDA Forest Southwestern Region Field Guides for Managing Species (http://www.fs.usda.gov/detail/r3/forest-grasslandhealth/invasivespecies/?cid=stelprdb5228481)

*	Statewide Integrated Pest Management Program at the University of California at Davis (http://ucipm.ucdavis.edu/PMG/PESTNOTES/pn74139.html)
***	USDA NRCS Plant Guide (http://plants.usda.gov/java/)
****	BugwoodWiki- High Plains Integrated Pest Management (http://wiki.bugwood.org/HPIPM)
#	Produced by the USDA Forest Service, Forest Health Staff, Newtown Square, PA. Invasive Plants website: http://www.na.fs.fed.us/fhp/invasive_plants
##	Lake Mead Exotic Plant Management Plan
###	University of Nevada, Cooperative Extension Fact sheet
!	DiTomaso, J.M., G.B. Kyser et al. 2013. Weed Control in Natural Areas in the Western United States. Weed Research and Information Center, University of Califo
@	http://www.ks.nrcs.usda.gov/news/coneds12/brome_grass.html and Restoring Native Grassland Species
!!!	http://sdrsnet.srnr.arizona.edu/data/sdrs/ww/docs/marrvulg.pdf
@@	Montana Utah Wyoming Cooperative Extension Weed Management Handbook

Herbicide Rankings based on Human Toxicity

Herbicides proposed under Alternative 2 ranked based on adverse human health impacts from harmful doses. Herbicides are listed from least toxic to most toxic based on oral ingestion. However, toxicity based on oral or ingest exposure and dermal exposures are also included. LD_{50} corresponds to the dose at which 50% of tested animals died and are reported by the USEPA as part of the pesticide registration process. The order can be used to prioritize herbicide selection, with a preference for herbicides with lower toxicity rates based on exposure method.

Herbicide	Application Rates (lbs a.i./acre)	Oral LD_{50} (mg/kg)	Dermal LD_{50}	Inhalation LD_{50} (mg/L)	Adverse Human Health Effects
Chlorsulfuron	0.047 – 0.062	5,545	>2,000	5.9	Little to no effect on fertility, reproduction, or offspring development. Does not cause genetic damage, cancer, or birth defects.
Aminopyralid	0.03 – 0.11	>5,000	>5,000	>5.79	Causes eye irritation. Potential effects on development and reproduction at high doses. No evidence of carcinogenicity or mutagenicity.
Imazapic	0.0313 – 0.1875	>5,000	>5,000	>2.38	Can cause moderate skin and eye irritation. Not a known carcinogen or mutagen.
Imazapyr	0.45 – 1.5	>5,000	>2,000	>1.3	Can cause moderate skin and eye irritation. Not a known carcinogen or mutagen.
Isoxaben	0.66 – 1.33	>5,000	>2,000	>2.68	Can cause eye irritation and corneal damage. The additive, crystalline silica, is a listed carcinogen. can cause birth defects and adverse effects on reproduction. Classified as a possible human carcinogen and mutagen.
Metsulfuron methyl	0.0125 – 0.15	>5,000	>5,000	>5.3	Mild to moderate skin and eye irritant. Not classed as a carcinogen or mutagen. Not known to impact or inhibit reproduction or development.
Prodiamine	0.75 – 1.5	>5,000	>2,000	>1.81	Does show increased toxicity during pregnancy for fetus and mother. Adverse impacts on liver and thyroid. Classified as a possible human carcinogen.
Thifensulfuron methyl	0.0023 – 0.028	>5,000	>2,000	>5.03	Mild eye irritant. Not carcinogenic or mutagenic. Has little to no effect on reproduction, development, or fertility.
Glyphosate	0.5 – 4	4,320	>2,000	1.6 - 5.63	Possible alteration of intestinal microbial community. Some evidence of endocrine disruption. Linked to increased risk of Non-Hodgkin's Lymphoma for workers.
Clopyralid	0.35 – 1	4,300	>5,000	>3.0	Can cause severe eye damage. Does not cause cancer or genetic mutations. Some evidence of reproductive or developmental effects at higher doses.

Herbicide	Application Rates (lbs a.i./acre)	Oral LD_{50} (mg/kg)	Dermal LD_{50}	Inhalation LD_{50} (mg/L)	Adverse Human Health Effects
Dichlobenil	4 -6	4,250	>2,000	>3.3	Impacts to liver and kidneys with acute exposure. Classed as a possible human carcinogen. Potential endocrine disruptor.
Picloram*	0.125 – 1	4,012	>2,000	>8.11	Acute poisoning can lead to nervous system damage, weakness, and diarrhea. Chronic exposure can cause liver damage. Mild to moderate skin and eye irritant. Chronic exposure can lead to developmental effects. Not a known carcinogen or mutagen.
Fluroxypyr	0.12 – 0.5	2,405	>2,000	>6.2	Can cause damage to the liver at high doses. Potential effects if swimming in or drinking contaminated water. Not likely to be carcinogenic or mutagenic.
Metribuzin	0.17 - 3	2,300	>5,000	0.72	Sub-chronic exposure linked to abnormal liver function and adverse impacts to reproduction. Known endocrine disruptor. Not a known carcinogen or mutagen.
Fluazifop –p-butyl	0.1 – 0.375	>2,000	>2,110	1.7-5.2	Slight eye irritation, moderate skin irritation, and adverse effects to the liver with prolonged exposure. Increased risk to the public from long-term consumption of contaminated vegetation. Not likely to be carcinogenic or mutagenic.
Indaziflam	0.046 – 0.091	>2,000	>2,000	>2.3	Can cause degenerative neuropathology and damage to kidneys, liver, and thyroid with chronic exposure. No evidence of carcinogenicity or genotoxicity.
Atrazine	1-4	1869	>2,000	5.8	Causes endocrine disruption. Most impacts affect pregnant women and children. Known effects include preterm delivery, fetal growth retardation, delayed onset of puberty, and mammary tumors. Not likely to be carcinogenic or mutagenic. Potential endocrine disruptor.
Pendimethalin	1.485 – 1.98	>1050	>2,000	320	Possible human carcinogen affecting the thyroid. Mild skin and eye irritant. Some adverse effects on liver function. Has not been shown to cause birth defects or affect reproduction.
Triclopyr	0.5 - 8	630	>2000	>4.8	Mildly toxic to developing embryos. High doses can cause adverse birth defects and maternal toxicity. Not classified as a human carcinogen. Can cause mutations but with no adverse effects.

Herbicide	Application Rates (lbs a.i./acre)	Oral LD_{50} (mg/kg)	Dermal LD_{50}	Inhalation LD_{50} (mg/L)	Adverse Human Health Effects
2,4-D	0.23 - 9	579 - 1646	>2,000	0.78 – 5.4	Neurological, cardiac, hepatic, and renal toxicity with high doses. Chronic high doses could increase risk of cataracts and retinal degeneration. Some correlation with non-Hodgkin's lymphoma and cervical cancer. Currently classed as not a human carcinogen. Potential endocrine disrupter.
Paraquat	0.07 - 1	283	>2,000	0.001	Toxic if ingested or dermally adsorbed. Known to adversely impact the liver, kidneys, and lungs. Can cause moderate to severe eye irritation and moderate skin irritation. Reclassed as non-carcinogenic but found to be weakly mutagenic.

Appendix H. Navajo Nation Historic Preservation Department Cultural Resource Permit Process Document

THE NAVAJO NATION

PERMIT PACKAGE 2016

Historic Preservation Department

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THE NAVAJO NATION
HISTORIC PRESERVATION DEPARTMENT
Cultural Resource Compliance Section
PO Box 4950, Window Rock, Arizona 86515
TEL: (928) 871-7198 / 7134 **FAX:** (928) 871-7886 **WEBSITE:** hpd.navajo-nsn.gov

Navajo Nation Cultural Resources Permit Holder(s):

Enclosed is the Navajo Nation Historic Preservation Department (HPD) updated 2016 Annual Permit package which explains cultural resources management procedures on Navajo Nation lands. Fulfilling Navajo Nation standards and requirements is the responsibility of each permittee. Please discard any old guidelines you may have received from us. The enclosed information includes:

- Policies Procedures & Requirements for Acquiring Cultural Resource Investigation Permits
- Permit Application Procedures, Forms and Fee Schedule
- Interim Fieldwork, Report Standards and Guidelines
- Guidelines for the Treatment of Historic, Modern & Contemporary Sites
- Navajo Nation Policy to Protect Traditional Cultural Properties (TCPs)
- Navajo Nation Burial Policy and Procedures (Jishchaa Policy)
- Guidelines for the Treatment of Discovery Situations
- Nation Cultural Resources Protection Act (NNCRPA)
- Navajo Nation Policy for the Disposition of Cultural Resource Collections

Introduction

HPD is the Navajo Nation's lead agency for cultural resources preservation, protection and management planning. It operates under the authority of the Navajo Nation Cultural Resources Protection Act [NN Code Title 19, Section 1001 (Chapter 8)]. HPD's role in the Navajo Nation is similar to that of a State Historic Preservation Office (SHPO). On behalf of the Navajo Nation, HPD acts as the Tribal Historic Preservation Office (THPO) in the federal "Section 106" review process. HPD advises federal, state/tribal agencies and project sponsors on protection and management of cultural resources in a manner that reflects the unique preservation concerns of the Navajo Nation. HPD is also responsible for reviewing applications and issuing permits for all archaeological and ethnographic investigations within the exterior boundaries of the Navajo Nation: tribal trust lands, fee lands, allotments, PLO 2198..

The following information has been provided in previous permit packages and will serve as a refresher on the history of the funds allocation and the P.L. 93-638 Contracts between the Navajo Nation Historic Preservation Department and the Bureau of Indian Affairs (BIA).

Congress allocates funds through the Federal Historic Preservation Fund for direct preservation grants to Indian tribes. These grants strengthen tribal historic preservation programs and provide the basis for a centralized data base and geographic information system for cultural resources data throughout the Navajo Nation.

In addition, Pursuant to the Indian Self-determination Act of 1976, as amended (P.L. 93-638, P.L. 100-472), HPD has entered into a contract with the Bureau of Indian Affairs-Navajo Regional Office (BIA-NRO). This "638" contract has resulted in several changes in the structure and scope of services provided by HPD.

HPD, BIA and the "638" Contract

Background

The BIA is the lead federal agency for Section 106 review of the majority of undertakings on the Navajo Reservation. (The Indian Health Service, Department of Housing and Urban Development and the Office of Navajo and Hopi Indian Relocation also act as lead agencies for certain undertakings). The BIA cultural resources program has grown over the last decade to include a review and compliance section which handles all Section 106 review and compliance permit issuance, data base maintenance, etc., and individual archaeology field programs for the BIA branches of forestry, roads, Navajo partition lands, land operations and facilities management. The branch archaeologists are responsible for performing small-scale field projects and/or contracting out larger field projects such as road right-of-way mitigation projects, forest compartment surveys, etc. Each of the programs advises the BIA-NRO Regional Director, who issues final notices to proceed with undertakings or "archaeological clearance" in compliance with the National Historic Preservation Act.

The Indian Self-determination Act was established to direct the federal funds spent on BIA programs to tribes, for programs the tribes wish to operate themselves. Many former BIA schools, for example, are now run by tribes, with the funding provided on a contracted basis by the BIA. Through the same process, HPD has contracted the cultural resource management functions of BIA-NRO, which means that the BIA funding for those programs is provided directly to the Navajo Nation. Now, instead of the BIA making the decisions about cultural resources management for the Navajo Nation, HPD makes the decisions on behalf of the Navajo Nation and advises the BIA-NRO Regional Director. Rather than having two independent review procedures, two sets of permitting requirements, and so forth, all functions are now provided through one centralized office. The BIA still functions as the "lead" federal agency, however, and the Area Director makes the final decisions in matters where federal approval is necessary.

HPD Structure

Under the "638" contract, HPD has grown considerably in size and has been divided into a number of sections. These include review and compliance, facilities management, traditional cultural program, etc. The Review and Compliance Section (Cultural Resources Compliance Section) handles all matters pertaining to Section 106 compliance.

Report Submission

Reports prepared for Section 106 review are to be submitted only to HPD-CRCS. Details regarding the submission of reports are outlined in HPD's *Fieldwork and Report Standards and Guidelines*. HPD requires two copies of each report. In addition, two sets of site forms are required. Report review will be handled according to 36 CFR 800, and final approval will be issued by the BIA-NRO Regional Director.

Conclusion

We look forward to a more efficient program for all of us, and one that will ultimately result in the best possible care of the Navajo Nation's cultural resources. Please feel free to call us if you have any questions or if we can be of any assistance at (928)871-7198 or 871-7134.

THE NAVAJO NATION
HISTORIC PRESERVATION DEPARTMENT
Cultural Resource Compliance Section

POLICIES, PROCEDURES & REQUIREMENTS FOR ACQUIRING CULTURAL RESOURCES INVESTIGATION PERMITS

TYPES OF PERMITS

The Navajo Nation Historic Preservation Department (NNHPD) issues three categories of permits:

Class A:	For site visitation, including personal archaeological research and visitation only
Class B:	For non-collection inventories conducted pursuant to Section 106 of the Nation Historic Preservation Act (NHPA) and/or the Navajo Nation Cultural Resources Protection Act (NNCRPA); activities that are authorized include archaeological inventories as well as ethnographic inquiries that are conducted simultaneously with the archaeological inventories (see 36 CFR Part 800.4, identifying historic properties)
Class C/Type 1:	For archeological excavation or collection purposes (including monitoring), ethnographic inventories conducted as a separate phase of Section 106 and/or NNCRPA, and ethnographic research conducted for the purpose of treating traditional cultural properties pursuant to Section 106 and/or Navajo Nation Policy to Protect Traditional Cultural Properties. An ARPA permit is also required for archeological excavation or collection purposes including monitoring
Class C/Type 2:	For Ethnographic inquiries involving personal/professional research. Ethnographic research includes any systematic collection of oral information from members of the Navajo Nation regardless of differences in academic definitions for specific kinds of ethnography. Explanations regarding ethnographic research appear below in permit-specific contexts

Navajo Nation permits are required on ***all*** lands of the Navajo Nation. Navajo Nation lands are defined as lands of the Navajo Nation, or of Navajo individuals, that either are under the ownership, jurisdiction or control of the Navajo Nation or are held in trust by the United States or subject to a restriction against alienation imposed by the United States, except for subsurface interests not owned or controlled by the Navajo Nation or a Navajo individual. The most common Navajo land statuses are Tribal Trust, Allotted, Fee Lands (Canoncito Band, Alamo Band, Ramah Band), and P.L.O. 2198. Permit requirements for these land statuses are provided in Table 1 at the end of this section. *It is the responsibility of the sponsor and the permittee to ensure correct identification of land status.* **Fieldwork conducted without the proper permit(s) is illegal and will result in prosecution pursuant to NNCRPA (NN Code Title 19, Section 307 and 308.c) and/or the Archaeological Resources Protection Act (43 CFR Part 7).**

PERMIT APPLICATION PROCEDURES

Permit application procedures are described below and are summarized in Tables 1 & 2. Navajo Nation Cultural Resources Investigation Permit Request Forms and Cultural Resource Permit fee schedule are enclosed.

ANNUAL APPLICATION

An application is required at the beginning of each calendar year (see below for permit-specific requirements). If approved, this application allows the contractor to apply for project-specific permits during the calendar year. The information submitted with the initial application does not need to be resubmitted with each project-specific request. A minimum of ten working days is required to/for review of annual application. Information needed for the annual application includes:

- A statement of the organization's qualifications [including facilities and equipment).
- Current resumes of supervisory/specialist personnel (principal investigators, project director(s), crew chief(s), cultural specialist(s), laboratory director(s), analyst(s), and crew members].

The annual application must clearly and unambiguously identify the applicants for the specific position(s) they will hold. Resumes must be in a simple format that provides all of the information required to document the person's qualifications (e.g. education; time spent in the field [distinguishing between survey, excavating, and ethnographic work, as appropriate], laboratory, etc.). Individuals may not assume positions of greater responsibility than those for which they have been approved; violation of this provision may lead to the nullification of a company's annual application, the disapproval of future project-specific permit requests and/or to the suspension of revocation of project-specific permits that have been already issued.

Resumes for additional personnel, or for persons applying for positions of greater responsibility than were originally approved, must be submitted during the year for review, approval and inclusion in the annual application file. Such individuals may not be listed in requests for project-specific permits or authorizations until approved by HPD.

- A letter outlining the kind(s) and scale(s) of projects that are anticipated during the year and any other relevant information.
- A sample report.
- Application fee of $100.00 (see enclosed schedule) should submitted to Navajo Nation Cashier's Department, PO Box 3150, Window Rock, Arizona, 86515. Please include Account #107009-1869.

The past performances of both the company and individuals will be taken into account during the review of the annual application. Performance will be continually evaluated throughout the year and determined by the quality of the product submitted to the HPD. Quality is determined by the information provided in reports, including whether permittee have adhered to *The HPD Policies, Procedures, Standards and Guidelines*. In terms of Section 106 and/or NNCRPA compliance, the ultimate standard of quality is whether reports contain the information necessary for HPD-CRCS personnel to make decisions pursuant to 36 CFR 800 and/or NNCRPA. Report quality is the responsibility of the person in Direct Charge. A poor performance record may lead to disapproval of either a company's or an individual's annual application.

Notification of the approval or disapproval of the application will be sent to the applicant upon review. If approved, the notification will include details about individual applicants and the position(s) for which they have been permitted. The approval remains in effect until the end of the calendar year. A poor performance evaluation after an annual application has been issued may lead to the suspension or revocation of the contractor's annual application, disapproval of project-specific permit requests, and/or the revocation of project-specific permits already issued. Poor performance on the part of an individual may lead alternatively to restrictions on the responsibilities they are allowed to assume in the future. The converse is also true (i.e., superior past performance on the part of an individual may lead to their being approved for positions of greater responsibilities than their level of education and experience otherwise indicates).

PROJECT-SPECIFIC PERMITS

HPD will not review reports for purposes of consultation pursuant to Section 106 of the NHPA or NNCRPA unless a project-specific permit number was issued for the project. The project-specific permit number will not be issued by HPD unless resumes have been received for all of the supervisory/specialist personnel participating in the project and these individuals have been approved for their specific positions. ***Requests for project-specific permits must be received by HPD prior to the start of fieldwork;*** HPD will *not* rush a permit request when fewer than the number of days specified below. The inclusion on the permit request form of individuals not previously approved as a part of the annual application process, and/or the submission of incomplete or inaccurate information about project specifics will lead to delays in the issuance of project-specific permits. When current and accurate information is provided on the permit request form, HPD will make every effort to return the project-specific permit number within the specified number of days; however ***fieldwork may not begin without a project specific permit number.*** If you have not received a response to your request by the specified number of days after its receipt by HPD, you may telephone to inquire as to its status; we will process the permit in as timely a fashion as possible. The project specific permit number must be included on all reports submitted for review. T*he project-specific permit fee must be submitted to the Navajo Nation's Cashier's Department*. See the enclosed fee schedule for the applicable fee for each individual permit (for permits related to the Section 106/CRPA process, fees are based on the cultural resource management costs of the project).

Class A Permits (Site Visitation/Personal Non-collection Archaeological Research)

Class A permits are for visitation and/or personal research on archaeological sites. No collection, disturbance or any activity other than visitation is authorized under Class A permits. Personal ethnographic research is conducted under a Class C permit (see below). No initial annual application is necessary for personal research projects but requests for Class A permits must be made in writing (via the enclosed Class A request form) at least ten days prior to the site visitation. The request must specify:

- The identity and location of site(s) to be visited.
- The proposed date(s) of visitation.
- The names of all individuals visiting archaeological site(s).
- The purpose of visitation.

Except for group tours, there is no fee for personal research or visitation conducted under Class A permits. Formal group site tours require a permit fee (see the enclosed fee schedule). This permit is only for visits to archaeological sites, *other off road trips require back country permits from the Navajo Nation Parks and Recreation Department*. Class A permits are valid only for the dates on the actual permit.

Class B Permits (Inventory for Section 106 and/or NNCRPA Purposes)

Under approval of the annual application, project-specific Class B permits may be requested at any time during the year. The form used to request a Class B permit is enclosed on page 16. Class B authorizes Section 106 and/or NNCRPA non-collection archaeological inventories and ethnographic inquiries conducted simultaneously with archaeological inventories (see 36 CFR Part 800.4, identifying historic properties). While no additional Class C ethnographic permit is necessary for collecting basic ethnographic data in concert with archaeological inventories, the Class B permit application must specify the personnel responsible for the ethnographic data collection (pursuant to the Navajo Nation Policy for the Protection of Traditional Cultural Properties [enclosed in Section Five]) along with the other supervisory/specialist personnel participating in the project. Requests for Class B permits must be received by HPD at least 10 days prior to start of fieldwork.

Class B permits are valid for 90-days from the date of issue (or if requested after October 31st) the permit is valid up until December 31st of that calendar year. An extension may be requested in writing prior to the expiration date. A Class B permit is required for each undertaking unless given special permission by HPD.

Class C Permits - Type 1 (Ethnographic research for Section 106 and/or NNCRPA purposes)

A Class C ethnographic permit is necessary for ethnographic inventories conducted as a separate phase of Section 106 and/or NNCRPA investigations, if data collection is for the purpose of treating cultural resources that are included, or eligible for inclusion, in the Navajo Register of Historic Places or the National Register of Historic Places (that is, when mitigation of damage that is expected to occur to such sites as a result of an undertaking, is required.) If treatment of traditional cultural places and archaeological resources are occurring in a single phase of an undertaking, it is not necessary to request a separate Class C ethnographic permit in addition of a Class C archaeological collection/excavation permit. In such a case, however, the permit request must include detailed information (e.g., a treatment proposal outlining the scope of work, project personnel and qualifications, evidence of logistical support, and the like as detailed below for ARPA permits) as they pertain to both traditional and archaeological resources.

An annual application is required prior to requesting this type of Class C permit. Once the annual application has been approved, these permits may be requested on a case-by-case basis at any time during the calendar year. The form used to request the project-specific permits are enclosed. Neither Navajo-owned company blanket nor indefinite services permits are issued for Class C permits. Requests for permits involving treatment of cultural resources (i.e., those that include research proposals) must be received at least 30 days prior to the initiation of fieldwork, while requests for permits for ethnographic inventories being conducted as a separate phase of Section 106 and/or NNCRPA investigations must be received at least 10 days in advance. See the enclosed fee schedule for applicable fees.

Class C Permits - Type 1 (Archaeological Collection/Excavation and Monitoring for Section 106 and/or NNCRPA Purposes)

An annual application is required prior to requesting Class C archaeological collection/excavation and monitoring permits for Section 106 and/or NNCRPA purposes. Once the annual application has been approved, these permits may be requested on a case-by-case basis at any time during the calendar year; the form used to request them is enclosed. These Class C permit applications must be accompanied by an ARPA permit application with the attendant information (see below). Class C Permit requests must be received at least 30 days prior to the initiation of fieldwork. See the attached fee schedule for applicable fees.

Class C Permits – Type 2 (Personal/ Professional Ethnographic Research)

No annual application is necessary for personal ethnographic research projects. Requests for Class C personal ethnographic research permits require a $100.00 application fee; however, the fee may be waived by special arrangement with the HPD for formal research that will result in data provided to the Navajo Nation. Application must be made in writing (using the request form enclosed) and include the following information:

- A copy of the research design or grant proposal outlining the purpose of the project and the methods to be used (including copies of interview forms and consent forms to be used).
- A resume or other statement of the researcher's qualifications.

- Evidence that the officials of the chapter(s) in which the work is to be conducted have been informed of the proposed research project, i.e. chapter resolution.
- The final report must include evidence that the individuals who were interviewed consented to participating in the research, as well as forms regarding use of the interviewee's name(s) and the information provided by them for publication purposes.

Class C personal ethnographic research permit requests are subject to a 30-day review period, during which time the research proposal will be evaluated in terms of its contribution or benefit to the Navajo Nation.

ARCHEOLOGICAL RESOURCES PROTECTION ACT (ARPA) PERMITS

ARPA permit requests are made to HPD for the BIA on the enclosed ARPA permit application form. They are reviewed by HPD on behalf of the BIA, and they are issued by the BIA. A minimum of 35-40 days should be allowed between application and issuance of an ARPA permit. Application requirements for the ARPA permit include:

- A copy of the research proposal.
- Names, addresses, institutional affiliations and qualifications of individuals responsible for conducting the proposed work and for carrying out the terms of the permit.
- Evidence of logistical support and laboratory facilities.
- Evidence of the curation agreement with the Navajo Nation or a qualified curatorial facility approved by the Navajo Nation (refer to 43 CFR Part 7, Section 6[b] for more detailed information).

Permit Requirements for Common Land Statuses on Navajo Nation Lands

LAND STATUS	ACTIVITY	NN PERMIT	BIA PERMIT
Navajo Tribal Trust	Visitation	Class A	None
	Inventory	Class B or C	None
	Collection/Excavation	Class C	ARPA
	Ethnographic	Class B or C	None
Allotment	Visitation	Class A	None
	Inventory	Class B or C	None
	Collection/Excavation	Class C	ARPA
	Ethnographic	Class B or C	None
Tribal Fee Land	Visitation	Class A	None
	Inventory	Class B or C	None
	Collection/Excavation	Class C	None
	Ethnographic	Class B or C	None
P.L.O. 2198	Visitation	Class A	None
	Inventory	Class B or C	None
	Collection/Excavation	Class C	ARPA
	Ethnographic	Class B or C	None

CLASS A PERMIT

-Casual site visitation for personal non-collection research by professional or serious amateurs - No Fee.

-Group Tours - $5.00/person/day

*****This permit is for trips to archaeological sites only.*** Other off road trips require a back country permit from the Navajo Nation Parks & Recreation Department . Call (928) 871-6647 for more information.

CLASS B PERMIT

-For non-collection archaeological & ethnographic inventory for Section 106 & NNCRPA purposes

***See permit fee schedule below*

CLASS C PERMIT - TYPE 1

-Archaeological testing, excavation & monitoring

-Ethnographic research for treatment of resources or ethnographic Inventory if conducted as a separate phase of work pursuant to Section 106 and/or NNCRPA

***See permit fee schedule below*

ANNUAL APPLICATION

ANNUAL APPLICATION

$100.00/year
Payments should be submitted to the Navajo Nation Cashier's Department, PO Box 3150, Window Rock, Arizona 86515. You must include Account #107009-1869.

Class B & C-Type 1 permits are based on cultural resource management project cost(s):

$100.00 - $999.99	$50.00
$1,000.00 - $4,999.99	Greater of $110.00 or 4%
$5,000.00 - $9,999.99	Greater of $275.00 or 3.5%
$10,000.00 - $24,999.99	Greater of $550.00 or 3%
$25,000.00 - $99.999.99	Greater of $1,100.00 or 1.75%
>$100,000	Greater of $1,650.00 or 0.75%

Table 2 | 2016

Summary of Navajo Nation Permit Requirements

PERMIT CLASS	PURPOSE	ANNUAL APPLICATION	PERMIT FEE	HPD REVIEW PERIOD
Class A	Site Visitation and/or Group tours	No	$5 per day, per person	10 days
	Non-collection: personal research on archaeological sites: i.e. photography, rock art documentation	No	No	10 days
Class B	Non-collection: Archaeological/ethnographic inventory for Section 106/NNCRPA Purposes	Yes	Yes (See Permit Fee Schedule)	10 days
Class C **Type 1**	Archaeological testing, excavation, monitoring for Section 106/NNCRPA requirements	Yes	Yes (See Permit Fee Schedule)	30 Days
	Ethnographic research: for treatment of ethnographic properties/ inventories conducted as a separate phase of work pursuant to Section 106/NNCRPA	Yes	Yes (See Permit Fee Schedule)	30 days
Class C **Type 2**	Ethnographic data collection for personal research or professional research	No	Yes (See Permit Fee Schedule)	30 days

THE NAVAJO NATION
HISTORIC PRESERVATION DEPARTMENT
Cultural Resource Compliance Section

CLASS A PERMITS REQUIREMENTS
VISITATION/PERSONAL NON-COLLECTION ARCHEOLOGICAL RESEARCH

Class A permits are for visitation and/or personal research to archaeological sites. No collection, disturbance or any activity other than visitation and documentation is authorized under Class A permits. Personal ethnographic research is conducted under a Class C permit (see below). No initial annual application is necessary for personal research projects but requests for Class A permits must be made in writing (via the enclosed Class A form) at least ten days prior to the site visitation. The request must specify:

1. The identity and location of site(s) to be visited.
2. The proposed date(s) of visitation.
3. The names of all individuals visiting archaeological site(s).
4. The purpose of visitation/research (e.g., photography, rock art documentation, mapping, etc.).

Except for group tours, there is no fee for personal research or visitation conducted under Class A permits. Formal group site tours require a permit fee (see the enclosed fee schedule).

PERMIT NUMBER	

Type of Permit Requested	**Site Visitation** ☐	**Documentation** ☐
Proposed Starting Date:		
Proposed Ending Date:		
Person in Charge (if applicable):		

Visitation Location	
State:	
County:	
Chapter:	
Legal Location (Township & Range, Section)	
Land Status:	

Description/purpose of visitation/research (e.g. photography, rock art documentation, etc.)

Name of Organization	
Address	**Telephone No./Contact Info.**

Names of Individuals Visiting

Please remit permit fee to Navajo Nation Cashier's Department, PO Box 3150, Window Rock, AZ 86515** ***(Include account #107009-1869 and permit number)

***Return this form to:**
Attn: PERMITTING SECTION
Navajo Nation Historic Preservation Department
Cultural Resource Compliance Section
P.O. Box 4950
Window Rock, AZ 86515
TEL: (928) 871-7198 FAX: (928) 871-7886 Fax

Inventory for Section 106/NNCRPA

PERMIT NUMBER	

Brief Description of Project (including approximate acreage)	
Proposed Starting Date:	
Proposed Ending Date:	

Project Location	
State:	
County:	
Chapter:	
Legal (Township & Range, Section if platted, project if unplatted):	
Land Status:	
Name(s) of U.S.G.S 7.5 minute map(s) (attach map(s) to request form)	

Name of Organization	
Address	Telephone No./Contact Info.

Project Personnel	
Person(s) in General Charge - Principal Investigator[s]:	
Person(s) In Direct Charge - Project Director[s] (specify positions):	

***Please remit permit fee to Navajo Nation Cashier's Department, PO Box 3150, Window Rock, AZ 86515**
(Include account #107009-1869 and permit number)

Return this form to:
Attn: **PERMITTING SECTION**
Navajo Nation Historic Preservation Department
Cultural Resource Compliance Section
P.O. Box 4950
Window Rock, AZ 86515
TEL: (928) 871-7198 FAX: (928) 871-7886

Pursuant to Section 106/NNCRPA

PERMIT NUMBER	

Type of Permit Requested (Refer to Section Two of permit package)	
Section 106/CRPA - Archaeological Collection/Excavation & Monitoring	☐
Section 106/CRPA – Ethnographic Research (Research for treatment of Ethnographic properties/inventories – if conducted as separate phase of work)	☐

Name of Organization	
Address	Telephone No./Contact Info.

Project Personnel	
Person(s) in General Charge - Principal Investigator[s]:	
Person(s) In Direct Charge - Project Director[s] (specify positions):	

Project Location	
State:	
County:	
Chapter:	
Legal (Township & Range, Section if platted, project if unplatted):	
Land Status:	
Name(s) of U.S.G.S 7.5 minute map(s) (attach map(s) to request form)	

Brief Description of Project			
Start Date:		**End Date:**	

***Please remit permit fee to Navajo Nation Cashier's Department, PO Box 3150, Window Rock, AZ 86515**
(Include account #107009-1869 and permit number)

Return this form to:
Attn: **PERMITTING SECTION**
Navajo Nation Historic Preservation Department
Cultural Resource Compliance Section
P.O. Box 4950
Window Rock, AZ 86515
TEL: (928) 871-7198 FAX: (928) 871-7886

The Navajo Nation
Historic Preservation Department
Cultural Resource Compliance Section

CLASS C/Type 2 PERMIT REQUIREMENTS
ETHNOGRAPHIC DATA COLLECTION FOR PERSONAL/PROFESSIONAL RESEARCH

No annual application is necessary for personal/professional ethnographic research projects. Request for Class C/Type 2 personal/professional ethnographic research permits require a $100.00 application fee; however, the fee may be waived by special arrangements with the NNHPD for formal research that will result in data provided to the Navajo Nation. The request must be made in writing along with the enclosed request form. The following information must be included:

1. A copy of the research design or grant proposal outlining the purpose of the project and the methods to be used (include copies of interview forms and consent forms)

2. A resume or other statement of the researcher's qualifications

3. Evidence that the officials of the chapter(s) in which the work is to be conducted have been informed of the proposed research project, i.e. chapter resolution

4. The final report must include evidence that the individuals who were interviewed consented to participating in the research, as well as forms regarding use of the interviewees name(s) and the information provided by them for publication purposes

Class C/Type 2 personal/professional ethnographic research permit requests are subject to thirty day review period, during which time the research proposal will be evaluated in terms of its contributions or benefit to the Navajo Nation.

ETHNOGRAPHIC DATA COLLECTION
FOR PERSONAL/PROFESSIONAL RESEARCH

PERMIT NUMBER	

Type of Permit Requested (Refer to Section Two of permit package)	
Ethnographic Data Collection for Personal Research	☐
Ethnographic Data Collection for Professional Research	☐

Name of Organization/Individual	
Address	Telephone No./Contact Info.

Names of all individuals conducting research

Project Location	
State:	
County:	
Chapter:	

Brief Description of Project

Proposed Starting Date:	
Proposed Ending Date:	

***Please remit permit fee to Navajo Nation Cashier's Department, PO Box 3150, Window Rock, AZ 86515**
(Include account #107009-1869 and permit number)

Return this form to:
Attn: **PERMITTING SECTION**
Navajo Nation Historic Preservation Department
Cultural Resource Compliance Section
P.O. Box 4950
Window Rock, AZ 86515
TEL: (928) 871-7198 FAX: (928) 871-7886

FOR OFFICIAL USE ONLY
Date Received ____________
Sent for Review____________
Control No. _______________

DI Form 1926 (Rev Sept 2004)
OMB No. 1024-0037
Exp. Date (01/31/2008)

United States Department of the Interior

Application for Permit for Archeological Investigations

Under the Authority of
The Archaeological Resources Protection Act of 1979
(16 U.S.C. 470aa-mm; 43 CFR 7);

and/or **The Antiquities Act of 1906**
(P.L. 59-209; 34 Stat. 225; 16 U.S.C. 431-433; 43 CFR 3)

and/or the appropriate **Bureau-specific statute** Such as
The Reclamation Act; The National Park Service Organic Act; The National Wildlife Refuge System Administration Act; The Federal Land Policy and Management Act

Instructions: Complete and return two copies of this application form and required attachments to the appropriate State or Regional Office of the land managing bureau involved. All information requested must be completed before the application will be considered. Use separate pages if more space is needed to complete a section.

1. **Name of applicant** (institution, corporation, partnership, individual, or other entity)

2. **Mailing address**

3. **Telephone number(s)**

4. **Email address(es)**

5. **Nature of archeological work proposed**

☐ Survey and Recordation

☐ Limited Testing and/or Collection (project-specific)

☐ Excavation and/or Removal (project-specific)

6. **Location of proposed work** (attach additional sheets)

a. Description of Federal lands involved. Indicate State, county, and Federal administrative unit. Specify the best available location data, e.g., GPS coordinates, UTM coordinates, township, range and section (cadastral) subdivisions, or metes and bounds. Include a readable copy of a map or plan at an appropriate scale showing specific areas for which permit is desired.

b. Identification of archeological resource(s) or other cultural resource(s) involved (if applicable).

7. **Time of proposed work**

Overall duration of project:	From	To
Estimated duration of fieldwork:	From	To

8. **Principal Investigator**
Name of individual(s) responsible for planning and generally overseeing field projects, including overall supervision of staff and overall responsibility for the professional quality of resource evaluations and recommendations.

Principal Investigator contact information
Telephone number(s):

Email address(es):

9. **Field Director** Name of individual(s) responsible for carrying out field projects, for technical quality of fieldwork through direct on-the-ground supervision of all aspects of fieldwork and data gathering, for proposing resource evaluations and recommendations for further treatment, and for preparing field records and descriptive reports.	**Field Director contact information** Telephone number(s): Email address(es):
10. **Permit Administrator** Name of individual responsible for fulfilling the terms and conditions of the permit (must be legally empowered to obligate applicant organization).	**Permit Administrator contact information** Telephone number(s): Email address(es):

11. **Applicant must include the following attached to the application form**.

a. Description of the purpose, nature, and extent of the work proposed, including how and why it is proposed to be conducted: (include research design, methods, curation);

b. Summary of organizational capabilities, including information on location(s) and description of facilities and equipment, on organizational structure and staffing, and on facilities, equipment and staff to be involved in the proposed work;

c. Summary of organizational history in completing work of the kind proposed, including similar past projects, government contracts, and Federal permits (previously held, currently in force with effective dates, and currently pending or planned, by agency and region/state), reports and/or publications resulting from similar work, and any other pertinent organizational experience;

d. For each individual named in 8 and 9 above, a curriculum vitae or similar resume or summary of education, training, and experience in the kind of work proposed and in the role proposed;

e. Written certification, signed by a properly authorized official of the proposed curatorial facility, attesting to the facility's capability and willingness to accept any collections, as applicable, and records, data, photographs, and other documents generated during the proposed term of the permit, and to assume permanent curatorial responsibility for such materials on behalf of the United States Government pursuant to 36 CFR 79. In the case of an application on Indian lands where the Indian Tribe or Indian owner(s) do not wish to take custody, written consent to undertake curation is required from the Indian Tribe or the Indian owner(s) pursuant to 25 CFR 262.8. Custody of any Native American human remains or cultural items subject to the Native American Graves Protection and Repatriation Act (NAGPRA), 25 USC 3001-3013, removed from public lands or Indian lands shall be determined in accordance with NAGPRA and its implementing regulations, 43 CFR 10.

12. **Proposed outlet(s) for public written dissemination of the results**

13. **Signature of individual named in 10**	14. **Date signed**

Paperwork Reduction Act and Estimated Burden Statement: This information is being collected pursuant to 16 U.S.C. 470cc and 470mm, to provide the necessary facts to enable the Federal land manager (1) to evaluate the applicant's professional qualifications and organizational capability to conduct the proposed archeological work; (2) to determine whether the proposed work would be in the public interest; (3) to verify the adequacy of arrangements for permanent curatorial preservation, as United States property, of specimens and records resulting from the proposed work; (4) to ensure that the proposed activities would not be inconsistent with any management plan applicable to the public lands involved; (5) to provide the necessary information needed to complete the Secretary's Report to Congress on Federal Archeology Programs; and (6) to allow the National Park Service to evaluate Federal archeological protection programs and assess compliance with the Archaeological Resources Protection Act of 1979 (16 U.S.C. 470). Submission of the information is required before the applicant may enjoy the benefit of using publicly owned archeological resources. To conduct such activities without a permit is punishable by felony-level criminal penalties, civil penalties, and forfeiture of property. A federal agency may not conduct or sponsor, and a person is not required to respond to, a collection of information unless it displays a valid OMB control number. Public reporting for this collection of information is estimated to average one hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to the Departmental Consulting Archeologist; NPS; 1849 C Street, NW (2275); Washington, DC 20240-0001.

THE NAVAJO NATION
HISTORIC PRESERVATION DEPARTMENT
Cultural Resource Compliance Section

FIELDWORK, REPORT STANDARDS AND GUIDELINES

The Navajo Nation Historic Preservation Department (HPD) has prepared these guidelines as a fieldwork and reports standards manual for contractors working on Navajo Nation lands. The guidelines contained in this manual replace those dated August 01, 1991. They are not, however, all inclusive.

FIELDWORK

- Prior to any fieldwork, a permit must be acquired from NNHPD (refer to Section 2 of permit package). Fieldwork conducted without the proper permit(s) is illegal and will result in prosecution pursuant to NNCRPA (NN Code Title 19, Section 307 and 308.c) and/or the Archaeological Resources Protection Act (43 CFR Part 7).
- Prior to fieldwork, a thorough records check will be conducted at NNHPD CRCS & TCP Offices.
- Spacing between surveyors or individual transects will not exceed fifteen (15) meters. The minimal area for a block survey is 1 acre. The minimal width of a linear survey is fifteen (15) meters.
- At minimum, a 35 to 50-ft buffer zone will be surveyed around the area of potential effect, i.e. home sites, block surveys, linear surveys.
- All cultural resources encountered in the survey area will be documented completely, even if they are partly outside of the survey boundary. For questions about "historic" resources, refer to the *Navajo Nation Guidelines of the Treatment of Historic, Modern and Contemporary Abandoned Sites.* For traditional cultural properties (sacred sites), refer to the *Navajo Nation Policy to Protect Traditional Cultural Properties* [Section 5], and the National Park Service's National Register Bulletin 38 (The bulletin can be accessed via internet at *www.nps.gov*).

DEFINITIONS

- Site: A site is "the location of a prehistoric or historic occupation or activity, or a building or structure, whether standing or ruined."[1] A site is anything that falls within the preceding definition and is more than an isolated occurrence.

- Traditional Cultural Property (TCP): A location of an event (a ceremony, belief, prayer, sweat lodge, plant gathering areas, and others as defined within the Navajo Nation Policy to Protect Traditional Cultural Properties) where the location itself maintains historic or traditional cultural value regardless of the value of any existing structure. The Navajo Nation requires that a Traditional Cultural Property (TCP) **NOT** be recorded as a site. A burial is **NOT** a TCP and should be recorded as a "Burial" using the Jishchaa' Policy Guidelines in Section 7 of this permit package. However, if the burial is within a historic or prehistoric site, it should be recorded as a part of the site, not as a burial by itself.

- Isolated Occurrence (IO): Any non-structural remains of a single event: alternately, any non-structural assemblage of approximately 10 or fewer artifacts within an area of approximately 10 sq m or less, especially if it is of questionable human origin or if it appears to be the result of fortuitous causes. The number and/or composition of observed artifact classes are a useful rule of thumb for distinguishing between a site and an isolate. It seems unlikely, for example, that the presence of three artifact classes (e.g., lithic debitage, ground stone or sandstone fragments, and pottery) represents the remains of a single event. Similarly, it seems unlikely that two sherds from different vessels or two pieces of debitage from different parent materials, together with a small number of items from a second artifact class represent a single event.

[1]U.S. Department of the Interior N.P.S. Cultural Resources, "How to Apply the National Register Criteria for Evaluation," National Register Bulletin. Washington, D.C. 1997. Pg. 5.

- All sites will be mapped to scale using a tape and compass or surveying instrument. UTM coordinates will be obtained using a GPS unit. "Eyeball" and "paced" maps will **NOT** be accepted.

<u>REPORTS</u>

1. All reports that are submitted will be one-sided and unbound (exceptions paper clips, binder clips and staples).

2. An *Archaeological Inventory Report Documentation Page* (AIRS form) is required for use on small projects. A copy of the form can be found at the end of this section. The form will be used on projects less than 30 acres in size and containing no more than 4 sites. Supplemental pages are expected for most of the categories, particularly items 14, 15 and 16. The minimum acceptable buffer for avoiding eligible historic property(ies) is 15 meters. Mistakes are not tolerated in the title and on section 13-location.

3. A narrative report must be submitted for projects over 30 acres and/or containing more than four sites. The AIRS form will be attached to the front of the narrative report. An example of AIRS form is provided at the end of this section. Each narrative report must be paginated and contain an abstract, table of contents and a list of references cited. Electronic copy (ies) of report(s) that contain more than 15 sites will accompany the hard copy (ies).

4. The following information **must** be included in <u>all</u> reports:

   A. Description of the undertaking. Please give enough detailed information (i.e. widths of right-of-ways, lengths of lines, roads, etc) of the undertaking since Section 106 is driven by the undertaking. HPD needs ample description in order to complete our basic description on the compliance form.
   B. For home sites, make sure name(s) are spelled correctly.
   C. Chapter, Agency, County, State, land status (e.g., Tribal Trust [Canconcito Band Land, Alamo Band Land, Ramah Band Land], Allotment, Fee, PLO 2198, etc.). This information will be provided by the sponsor. If necessary, however, this information may be obtained while conducting the pre-field records check, from the BIA Real Property Management at (505)863-8427, or the Navajo Nation Land Administration Office at (928)-871-6523.
   D. Additional land information required are legal description (including reference to prime meridians), Township and Range (even if unplatted, it must projected), and UTM coordinates. All coordinates should be in NAD 83. DO NOT USE NAVAJO BASELINE, except if project is within Canyon de Chelley National Monument.
   E. UTM coordinates for linear projects are required for all beginning and ending points and major turn points. UTM coordinates are required for the corners of all block surveys greater than 5 acres. Center point UTMs are sufficient for block acres less than 5 acres in size. All UTMs are to be obtained through the use of a GPS unit.
   F. If you have been contacted by HPD for more information, or a correction on a report, a cover letter or a statement on top of the report should read REVISION or CORRECTION.
   G. **PROOFREAD and EDIT ALL REPORTS** before submitting them.

5. The nature of the undertaking and acreage to be affected **must** be described in detail. Acreage must include the area of the undertaking (i.e., the area of direct effect) and the area surveyed (i.e., the area of the undertaking, any buffer zone and any surveyed site areas that extend beyond the buffer). The description of the undertaking will be detailed and will include the length and width of project area and include the area of potential effect. See examples below:

   Example 1-<u>Telephone line</u>: Description of undertaking: X Communications Company proposes to construct two segments of telephone lines that will serve the residents of the Round Rock Chapter, in Apache County, Arizona. The proposed telephone lines contain Location 1, an existing buried line to be upgraded. The second segment, Location 2 is a newly proposed buried telephone line extension. Upgrading and the line extension will involve trenching, laying of cable, and back-filling. Surface and subsurface disturbance will be intensive and extensive within the trenching area. Register eligible sites were encountered in Location 2. Aerial cables will need to be spanned over both sites in order to ensure avoidance of the two site s. The proposed spanned location A will measure a minimum 118 ft.
   in length, and spanned location B will measure a minimum of 65.6 ft. in length. The types of disturbance expected include trenching, drilling at designated pole locations with truck mounted

drilling equipment, and surface disturbance from rubber-tired vehicles used in stringing the cables with truck-mounted pulleys and/or hand carrying cables by construction personnel. In all, a total of 8,292 ft. of proposed telephone lines will be constructed. Location 1 segment measures approximately 2,175 ft. in length with a 30 ft. wide right-of-way, and Location 2 segment measures approximately 6,117 ft. in length with a 30 ft. wide right-of-way. A total area of effect is 5.71 acres. The federal lead agency for this undertaking is the Federal Communications Commission (FCC).

Example 2-Power Line: Description of undertaking: X Utility Company proposes to construct a power line and associated tap lines that will serve the residents of Rock Point and Mexican Water Chapters, Apache County, Arizona. The proposed project consists of two main power lines (Line A and Line B). Line A will have seven associated tap lines and Line B has no associated tap lines. Line A measures a total of 45,664.73 ft. in length with a 30 ft. wide right-of-way, and Line B measures 2,947.08 ft. in length with a 30 ft wide right-of-way. Thus, the total proposed line length measures 48,611.81 ft. In addition, 17 proposed guy anchor locations will be constructed along proposed power line rights-of-way and associated tap lines. Each guy anchor locations measure 50 ft. in length for a total length of 875 ft. In all, a total length of 49,486.81 ft. of power lines, tap lines, and guy anchor locations will be constructed. A total of 34.0 acres of land will be included in the area of effect. The types of disturbance expected include minimal surface blading, drilling at designated pole locations, and surface disturbance from rubber-tired vehicles used in stringing the power cables. Disturbance, both surface and subsurface, with heavy equipment will be extensive and intensive.

Example 3-Roadway: Description of undertaking: This project will involve the construction of 1.9 miles (3.1 km) of paved road with the installation of drainage culverts off of an existing dirt road. The right-of-way (r-o-w) will be 150 feet (45.72) meters) wide. Proposed construction and maintenance activities will include the following: grading and back-filling project length is 1.9 miles (3.1 km). Total area within the project r-o-w is 34.55 acres within the right-of-way, installation of drainage culverts, and paving of road surface. Total (13.99 ha.). The total area surveyed was 69.09 acres (27.96 ha.) within a 300 ft/91 km inventory right-of-way boundary. Ground disturbance with heavy equipment will be extensive and intensive.

6. The "previous research" section shall include sites previously identified within **100 meters** of the current project area. State records (Anthropology Lab, Arizona State Museum, etc.) and scholarly or CRM-related data bases (Museum of Northern Arizona, Highway Department, etc.) should be checked as appropriate to specific project locations/jurisdictions. Basic descriptive information must be provided about these sites, including, at a minimum, site number, cultural affiliation, development phase/date, site type, and the report reference. Be clear in the documentation if the report does not contain the afore-mentioned information. All information obtained can be briefly stated within a few sentences for minor reports. Large reports, with many previously identified sites, may require additional discussion. In extreme cases, where large numbers of known sites might overwhelm an otherwise small project effort, consult with the HPD about the appropriate action. The information may be presented within the text or in tabular form.

7. Site forms that are currently in use by the Navajo Nation Archeology Department (NNAD) will be utilized to document sites. Previously recorded sites will be updated using the NNAD's site update form. Copies of these forms are provided.

8. Navajo Nation site numbers may be requested on a Navajo Nation Site Number Request Form. A request form is located at the end of this section.

9. Only Navajo Nation site numbers will be accepted.

10. Contractors will do a Traditional Cultural Property record search with the NNHPD TCP Program. A TCP Record Verification Form will be filled out and signed by the TCP Reviewer. Form will accompany report.

11. Enough descriptive information on each cultural resource (e.g. sites, including all constituent components); in-use sites/areas; traditional cultural/sacred places should be recorded; however, **burials/graves, in-use sites/areas and traditional cultural/sacred places should not be assigned a site number.** Cultural resource information must be provided in the text of the report to allow the report to stand alone and to permit independent review and evaluation without constant reference to other cultural resource documentation forms.

Isolated occurrences should be referred to in the text under cultural resources; do not include specific IO forms. **Traditional Cultural Properties and Burials need to be documented on an attached confidential appendix at the end of the report** (see guidelines at the end of this section)

12. Project area maps must be 1:1 reproductions of USGS maps and **must not** be photocopied back-to-back with other maps or text pages. Report site planview maps must be drawn to scale and show the location of the project (including, if applicable, the existing and proposed right-of-way and any buffer zone) relative to the resource. All reproductions must be clear and legible.

13. Each resource (including each component comprising individual sites) must be evaluated for its eligibility for inclusion to the National Register of Historic Places (36 CFR Part 60.4). These evaluations must be specific with regard to the resource's integrity and elements of significance.

14. Each resource (including each component comprising individual sites) must be evaluated with respect to its eligibility for protection under the Archaeological Resources Protection Act (ARPA).

15. Each undertaking (project) must be evaluated for its effects on properties considered to be eligible for inclusion to the National Register of Historic Places (36 CFR Part 800.9). It must also be evaluated for its effects on identified Traditional Cultural Properties (TCP's). Adherence to the Navajo Nation Policy to Protect Traditional Cultural Properties, National Register Bulletin 38 and consultation with Navajo Nation Traditional Cultural Program (TCP) office will provide assistance in this area. Mitigation recommendations (i.e., avoidance/redesign, fencing, monitoring, testing, data recovery, and/or cancellation of all or part of the project) must be clear, specific, and consistent within the document.

16. Three factors govern report submissions: Either the sponsor submits the report to the HPD, or the contractor does. There are, however, two ramifications related to the first factor.

    A. IF THE SPONSOR AND THE LEAD AGENCY ARE THE SAME (i.e. IHS and ONHIR): The sponsor/agency must submit the report to the HPD with a cover letter and/or a compliance form stating the evaluations regarding the National Register eligibility and ARPA status of the resources, the evaluation of the undertaking's effect on historic properties, and the proposed mitigative measures (e.g., avoidance/redesign, fencing, testing, and/or mitigation, or cancellation of the undertaking). The sponsor must provide HPD with one complete copy of the report (including site forms). In addition, a separate set of project area maps (one-sided) will be provided. It is the responsibility of the sponsor/agency to obtain from their contractor the number of report copies they require. Finally, it is the sponsor's/agency's responsibility to ensure that the contractor is kept informed of reviewer's comments, and that both the reviewer(s) and contractor are kept informed about the status of the undertaking.

    B. IF THE SPONSOR SUBMITS THE REPORT AND THE SPONSOR AND THE LEAD AGENCY ARE NOT THE SAME: it is the sponsor's responsibility to <u>provide the HPD with two copies of the report and two copies of site forms</u>. In addition, a separate set of project area maps (one-sided) will be provided. These reports should be submitted with a cover letter in which the evaluations regarding the National Register eligibility and ARPA status of the resources, the evaluation of the undertaking's effect on historic and traditional cultural properties, and the mitigative measures (e.g., avoidance/redesign, fencing, testing and/or mitigation, or cancellation of the undertaking) are clearly stated.

    C. IF THE CONTRACTOR SUBMITS THE REPORT (usually when the sponsor and lead agency are not the same), the contractor is acting as the sponsor's agent. As a result, it is the contractor's responsibility to have consulted with the sponsor prior to submission of the report. The evaluations and recommendations presented in the report will therefore indicate the sponsor's position on the National Register eligibility and ARPA status of the resources, the effect of the undertaking on historic and traditional cultural properties, and the mitigative measures to be invoked (e.g., avoidance/redesign, fencing, testing, and/or mitigation, or cancellation of the undertaking). In addition, a separate set of project area maps (one-sided) will be provided. HPD must be provided with two copies of the report and two copies of the site forms. C*opies of the report should be given to the sponsor(s)*.

17. NNHPD's Reporting Guidelines to Protect Burials & TCPs: In order to protect confidential information and better integrate all cultural resource records, the Navajo Nation Historic Preservation Department (NNHPD), has instituted these reporting guidelines. The guidelines are to be utilized by all contractors permitted by the Navajo Nation Historic Preservation Department, Cultural Resource Compliance Section (CRCS).

A. Information on burials (human remains & funerary objects) and confidential Traditional Cultural Properties (TCPs) shall be reported in the following manner:

1. Summarized (with only general location information) in reports submitted for review to HPD/CRCS, and;

2. Given full, detailed to the extent appropriate (including, at minimum, location, and contact data), information about the resource in a separate, and clearly labeled, confidential appendix.

B. As stated in the *Navajo Nation Policy for the Protection of Jischaa': Gravesites, Human Remains & Funerary Items* (NNPPJ), Treatment Plan, VII, C, 4 [upon finding human remains],

> "The results of investigations at a burial site shall be incorporated in to a report as a detachable,] i.e., detached] confidential appendix." and, "Locational information shall be proved to HPD in a confidential appendix. It shall not be retained by the sponsor, its agent, the cultural resource professional, or anyone else."

C. Reports shall include one of the two completed forms for burials (*with* or *without* known lineal descendants) provided in NNPPJ in the appendix, to appear in the separate, confidential appendix.

D. HPD recognizes a wide range of TCPs; some are confidential and/or personal to individuals (example: personal offering places), while others are known to entire communities (example: named landscape features associated with origin stories), and would not necessarily be considered confidential. We also appreciate that the only people qualified to make this determination are those identifying and/or using the resource.

E. It is incumbent on the researcher to determine if their interviewee considers the information confidential.

1. If the interviewee believes that the TCP information should be *treated as confidential*, then only general information about the place, its eligibility for the protection under appropriate laws, and effects and/or appropriate mitigation strategies should appear in the body of the report. Site forms and maps shall be placed in the confidential appendix.

2. If the information is not to be treated as confidential (example: some herb gathering areas), then all information may appear in the body of the report.

F. Bulletin 38 of the *National Register of Historic Places States*, "…information on historic properties, including TCPs, may be kept confidential under the authority of Section 304 of the *National Historic Preservation Act*."

18. HPD will not accept any reports that use the term "ancestral puebloan or puebloan" when referring to the Anasazi or Nihinaazází'. The Navajo Nation is cultural affiliated to the Anasazi people, and reports that make any reference to Navajos as newcomers to the southwest will be returned. It is the responsibility of the Navajo Nation to protect the information relevant to its life ways, history and origins of its People. Navajo ceremonial and oral histories establish that Navajos have been here since time immemorial. This relationship is confirmed in centuries of traditional history and more than 100 years of anthropological literature. This relationship is also confirmed by archaeological, genetic/biological, and linguistic evidence.

19. Reports that are not in accordance with these standards and guidelines will be returned at the sender's expense.

ARCHAEOLOGICAL INVENTORY REPORT (AIRs) DOCUMENTATION PAGE

1. RECEIPIENTS ACCESSION NO.	2. (FOR HPD USE ONLY)	3. HPD REPORT NO.
4. TITLE OF REPORT:		5. FIELDWORK DATES
AUTHOR:		6. REPORT DATE
7. CONSULTANT NAME & ADDRESS General Charge: Org. Name: Org. Address: Phone No.		8. PERMIT NO. 9. CONSULTANT REPORT NO.
10. SPONSOR NAME & ADDRESS: Ind. Responsible: Org. Name: Org. Address: Phone No.		11. SPONSOR PROJECT NO. 12. AREA OF EFFECT: ____ac AREA SURVEYED: ____ac

13. LOCATION

a. Chapter
b. Agency:
c. County
d. State
e. Land Status

f. UTM Center:
g. Area: T___ N/S, R___E/W Sec.___
h. 7.5' Map Name(s):
i. Lead Agency:

14. REPORT OR SUMMARY *(Attach additional pages if necessary)*

a. Description of Undertaking:

b. Existing Data Review:

c. Area of Environmental & Cultural Setting:

d. Field Methods:

15. CULTURAL RESOURCE FINDINGS *(Attach additional pages if necessary)*

a. Location/Identification of each resource:

b. Evaluation of Significance of each resource:

16. MANAGEMENT SUMMARY/RECOMMENDATIONS *(Attach additonal pages if necessary)*

17. CERTIFICATION:

Signature: ______________________________ Date: ______________________

General Charge Name: ______________________________

Signature: ______________________________ Date: ______________________

Direct Charge Name: ______________________________

NAVAJO NATION ARCHAEOLOGY DEPARTMENT
Site Survey and Management Form

SITE NO: FIELD OR OTHER NAME:

DATE RECORDED:

PROJECT NUMBER AND NAME:

ORGANIZATION:

ARCHAEOLOGIST(S):

USGS MAP REFERENCE:

LEGAL LOCATION:

UTM: Zone 12;

STATE: COUNTY: CHAPTER:

LAND STATUS:

GROUND VISIBILITY: KIND AND EXTENT OF COVER?

TOPOGRAPHY:

DRAINAGE:

ELEVATION (ft/m): SLOPE AND DIRECTION:

SEDIMENT TYPE:

OTHER:

VEGETATION PRESENT:

CULTURAL AFFILIATION(S): SITE TYPE:

.
PERIOD(S) OF OCCUPATION (DATE, IF KNOWN):

HOW DATED?

DIMENSIONS OF SITE (L x W): TOTAL AREA (SQ M):

HOW DETERMINED:
ARCHITECTURE PRESENT? DESCRIBE:

ARTIFACTS OBSERVED/COUNTED:

COLLECTION MADE OF WHAT? METHOD:

PHOTO TAKEN? B/W ROLL: FRAME(S): COLOR ROLL: FRAME(S):

SITE DESCRIPTION:

CONDITION OF SITE:

CAUSES OF DISTURBANCE:

LOCATION OF SITE RELATIVE TO PROJECT AREA:

EXTENT OF INVESTIGATION TO DATE:

RESEARCH POTENTIAL:

RECOMMENDATIONS:

SITE ASSESSMENT UNDER 36 CFR 60.4 (NATIONAL REGISTER):

INTEGRITY:
CRITERIA a-d:
50 YEAR GUIDELINE:
EXCLUSIONS:

SITE ASSESSMENT UNDER 43 CFR 7.3 (ARPA):

SITE ASSESSMENT UNDER AMERICAN INDIAN RELIGIOUS FREEDOM ACT:

PROVIDE A SITE MAP (INCLUDING SITE DESIGNATION, NORTH ARROW, RECOGNIZABLE FEATURES, LANDMARKS, AND RELATIONSHIP TO PROJECT AREA).

HOW CAN SITE BE REACHED?

OTHER COMMENTS (ETHNOGRAPHIC DATA, ETC.):

Navajo Nation Archaeology Department
Site Survey and Management Update Form

Site Number: Original Site Number: Date:

Current Project Number and Name:

Update by:

New Location Information:
Legal Description:
UTM Coordinates:
Other:

Location of Site Relative to Current Project Area:

Additional Description (including current condition of site):

Site Assessment (indicate any changes from original evaluation):

36 CFR 60.4 (National Register of Historic Places):
Archaeological Resources Protection Act (ARPA):
American Indian Religious Freedom Act (AIRFA):

Recommendations:

THE NAVAJO NATION
HISTORIC PRESERVATION DEPARTMENT
Cultural Resource Compliance Section

GUIDELINES FOR THE TREATMENT OF HISTORIC, MODERN & CONTEMPORARY ABANDONED SITES

INTRODUCTION

Abandoned cultural sites of recent historic, modern or contemporary age are frequently encountered during cultural resource inventories on Navajo Nation lands. For the purposes of these guidelines, all such sites are referred to as "historic sites." This document provides the Historic Preservation Officer's (HPO) guidelines for recording, reporting and treatment of historic sites on lands of the Navajo Nation.

REPORTING AND RECORDING

For the purposes of reporting and recording, historic sites shall be treated as archeological sites. All historic sites must be fully recorded and reported, UNLESS they are still in use.

<u>In-Use Sites/In-Use Areas</u>
In-use sites require only summary documentation, sufficient to determine if potential historic properties are present and if they be affected by the proposed undertaking. In-use sites require only brief verbal description and, out of respect for the privacy of the occupants, shall not be photographed, recorded, mapped or assigned site numbers.

<u>Archaeological Sites</u>
The professional judgment of the archaeologist must be used to determine what constitutes a historic site. Historic sites are not restricted to those over 50 years old, and those under 50 years old are to be recorded as archaeological sites in the same manners as any other. Conversely, the information to be gained from recently scattered roadside trash, for example is so minimal as to preclude the necessity for recording. Again, the judgment of the archaeologist must be used in determining the level of recording necessary on a case by case basis. However, these decisions should be documented in the report to allow the reviewer an independent evaluation of the field decisions field.

At a minimum, recording and reporting of historic sites must satisfy the Secretary of the Interior's Standards and Guidelines.[1] Recording and reporting must be sufficiently detailed to allow an independent evaluation of the archaeologist's recommendations for National Register of Historic Places (NRHP) eligibility, determination of effect as specified in 36 CFR 800.9 (a) (b), and protection under the American Indian Religious Freedom Act (AIRFA). The information a historic site contains includes what knowledgeable people remember about the site and its constituent features, artifacts and other material remains. <u>If the functions and dates of a historic site and its constituent features are not evident from material remains, the archaeologist must attempt to recover information through on-site interviews in order to evaluate the site's NRHP eligibility and significance under AIRFA.</u> Depending on the nature of the historic site, the information potential may not necessarily be exhausted by recording until ethno historic data are recorded.

Treatment

Two factors must be considered in evaluating historic sites as cultural resources and in making recommendations regarding their treatment. Each historic site must be evaluated:

1. As an archeological site and as a historic property. Can the site contribute archaeologically or historically significant data? Is it associated with important individuals, events or trends in local, regional or national history? If the site is considered archaeologically or historically significant, treatment should be proposed in terms of current, contemporary professional practice, including collection of ethnographic data through on-site interviews.

2. As a locus of traditional cultural practices that is protected by U.S. Constitution and Federal and Tribal law. Navajo home sites, for example, are the location of a variety of ceremonies and related practices that are "sacred." Hogans and sweathouses are usually blessed. Materials used in ceremonies and other items which should not be disturbed are often disposed of within a home site complex. Sites of ceremonial activity such as Enemy-way and other religious observances are also frequently encountered.

If the historic site is not considered NRHP eligible, treatment must still be considered in terms of its significance under AIRFA. If there is any reason to suspect that a project may affect aspect of traditional cultural practices a reasonable effort must be made to locate and interview former users of the historic site. Should it prove impossible to locate former users, knowledgeable local residents should be interviewed. The interviewees should be asked to identify any areas within the historic site that should not be disturbed. However, interviewees should not be pressured to justify their desire to exclude certain areas from construction impacts. Interviewees should be asked to identify any objections to project construction within a historic site due to its impacts on areas important in continuing traditional cultural practices.

If interviewees have no objections to a project proceeding within the boundaries of a historic site that is not considered eligible for nomination to the NRHP, this fact should be noted in the report and project impacts on traditional cultural practices at that location need not be further considered. If specific objections or concerns are expressed, these must be reported and every effort made to design the project in such a way as to avoid impacts to areas of the site about which concerns were expressed.

If interviews are not possible and there is reason to suspect that the site may contain values protected under AIRFA, prudent alternatives to routing the project through the site must be considered. If a feasible alternative project design can be identified that avoids impacts to the site, the alternative design should be utilized.

[1] "Archaeology and Historic Preservation; Secretary of the Interior's Standard Guidelines," Federal Register, 48(190):44716-44742 (Thursday, September 29, 1983).

THE NAVAJO NATION
HISTORIC PRESERVATION DEPARTMENT
Cultural Resource Compliance Section

POLICY TO PROTECT TRADITIONAL CULTURAL PROPERTIES

Introduction

As economic development proceeds in the Navajo Nation, a growing number of places of significance to the Navajo people may be damaged by the land disturbance that accompanies development. In June of 1999, the Navajo National Park Service issued National Register Bulletin 38, titled "Guidelines for Evaluating and Documenting Traditional Cultural Properties." The bulletin defines a "traditional cultural property" as a property that "is eligible for inclusion in the National Register because of its association with cultural practices or beliefs of a living community that (a) are rooted in that community's history, and (b) are important in maintaining the continuing cultural identity of the community."

Most traditional cultural properties significant to Navajos are of the type commonly called "sacred places." Others are locations of other traditional activities, such as home sites and places where weavers gather plants for dyes.

We use the term "traditional cultural property" in this document to make apparent that we talking about the same kinds of places as Bulletin 38, and because this document is geared toward cultural resource managers and related professionals. The term, however, offends many Navajo traditionalists. One reason is that, by containing the word "property," it suggests that such places can be treated as mere commodities, like real estate. Another reason is that the term seems like a long and lackluster euphemism for "sacred places," which corresponds more closely to the Navajo term for such places (hodiyin). "Traditional cultural property" is, indeed, partly a euphemism intended to obscure the "religious" qualities that these places have for people who do not separate the sacred from the secular. Within the present federal legal framework for historic and cultural preservation, such obscurantism seems necessary to keep such places from being found ineligible for protection under federal preservation law because of the doctrine of separation of church and state. We would prefer that, instead of avoiding the term "sacred places," all concerned recognize that the root of what makes a place sacred is its association with aspects of the past that people connect with their present concerns of living. We apologize to traditionalists for perpetuating the use of the term "traditional cultural properties," which we find a practical necessity in certain contexts.

Traditional Cultural Properties Covered by this Policy

This policy covers traditional cultural properties that lack the evidence of human use that qualify them as archaeological sites, historic properties ~~or graves~~. The main emphasis here is on traditional cultural properties significant to the Navajo people. The last section of this policy statement, in addition, addresses such properties significant to other Native American groups that may be located on lands of the Navajo Nation. This policy supersedes the "Draft Proposed Nation Policy to Protect Navajo Sacred Places" (1986). Existing federal, state and tribal laws and rules protect archaeological sites, historic properties and ~~graves~~. These laws and rules include the *Federal Antiquities Act of 1906* (P.L. 59-209); the *National Historic Preservation Act* (P.L. 89-665); the *National Environmental Protection Act of 1969 Executive Order 11953*; "*Protection and Enhancement of the Cultural Environment*," May 13, 1971 (36 C.F.R. 8921); the *Archaeological Resources Protection Act of 1978* (P.L. 95-96); the *American Indian Religious Freedom Act of 1978* (P.L. 95-341); *the Native American Graves Protection and Repatriation Act (NAGPRA); New Mexico and Arizona laws protecting human remains on private lands; the Navajo Nation Policies and Procedures Concerning Protection of Cemeteries, Gravesites and Human Remains of 1986* (ACMA-39-86); and the *Navajo Nation Cultural Resources Protection Act* (CMY-19-88), which supersedes all previously existing Navajo Nation cultural resource preservation legislation.

Cultural resource surveys required by these laws and policies are very likely to detect sites with material evidence of human use (mainly archaeological sites) so that they can be protected. Certain types of Navajo traditional cultural properties are likely to have such evidence. These types include, but are not limited to, sites that may have been blessed such as those with hogans, houses, sweathouses, game corrals (needzii'), eagle traps and so forth; and other sites where ceremonies may have occurred (if evidence of such use, such as the remains of ceremonial structures, is visible); trail shrines; rock art; and both marked and unmarked graves.

Because traditional cultural properties are considered eligible for inclusion in the National Register, such properties are protected by Section 106 of the National Historic Preservation Act, even when they lack clear evidence of human use. Such places are not likely to be detected by conventional surveys, however, and no other way of detecting such places has been used systematically up to now. Navajo traditional cultural properties without clear evidence of human use include, but are not limited to, the following types: places for gathering plants for use in ceremonies and other traditional purposes; places for gathering minerals for ceremonial and other traditional uses; places for gathering contents of sacred bundles; places for gathering other materials for ceremonial and other traditional purposes; ~~unmarked graves(contain material remains but these are not necessarily visible on the surface);~~ prayer offering places; places associated with the origin stories of particular ceremonials; places associated with the general Navajo origin story; places associated with origin stories of particular ceremonials; places associated with the origin of a clan; places associated with the origin of a Navajo custom; places identified as the home of a Holy Being such as Wind, Lightning, Big Snake; location of echoes (Talking Rocks, which convey human words to the Holy People); natural discoloration of rock that has some kind of supernatural power; places where an apparition or other supernatural event occurred; and places that have played a part in the life cycle rituals of individuals (such as the spot where a newborn baby's umbilical cord is placed. Many of these sorts of places are features of the natural landscape, such as mountains, hills, rocky outcrops, springs and individual trees.

This policy outlines procedures for identifying such places, for determining how concerned Navajo people think particular development projects will affect those places, and for learning about the protection measures that concerned Navajo people think should be used. This outline is intended to be used along with National Register Bulletin 38, which offers general guidelines to document and evaluate such properties.

Traditional cultural properties covered by this policy statement may be on land under Tribal, BIA, other Federal (public land) and State jurisdiction. With land owner consent and cooperation, this policy statement will apply to private lands as well.

Identification of Traditional Cultural Properties on Lands Administered by the Navajo Nation for the BIA in Trust for Navajos

To identify Navajo traditional cultural properties, the developer of a proposed project on tribally or BIA administered land must observe the following procedures:

A. The developer shall employ an archaeological contractor or consulting anthropologist who meets the professional standards of the Navajo Nation (or the land manager). That contractor or consultant shall conduct a cultural resources literature search that will include at least the following references for information on places of traditional cultural significance.

SUGGESTED READING LIST

Parker, Patricia L., and Thomas F. King
1990 Guidelines for Evaluating and Documenting Traditional Cultural Properties. National Register Bulletin 38. U.S. Department of the Interior, National Park Service, Interagency Resources Division, Washington, D.C.

Van Valkenburgh, Richard F.
1974 Navajo Sacred Places, ed. Clyde Kluckhohn. In Navajo Indians III, pp. 9 -199. Garland Publishing, New York

1941 Dine Bikeyah. U.S. Department of the Interior, U.S. Indian Service, Navajo Agency, Window Rock, AZ

* *this work may be hard to find. But we suggest using Linford, Navajo Places, History, Legend, Landscape*

Kelley, Klara B.
1994 Navajo Sacred Places. Bloomington: Indiana University Press

Linford, Lawrence D.
2000 Navajo Places, History, Legend, Landscape. University of Utah Press

McPherson, Robert S.
1992 Sacred Land, Sacred View: Navajo Perceptions of the Four Corners. Signature Books

2009 Comb Ridge and Its People. The Ethnohistory of the Rock. United States University Press

****Also the following, if the proposed project is in the Eastern Navajo Nation:***

Carroll, Charles H.
1982 An Ethnographic Investigation of Sites and Locations of Cultural Significance to The Navajo People to be Affected by PNM's Four Corners to Ambrosia to Pajarito 500 kV Transmission Project. Public Service Company of New Mexico, Albuquerque

1983 The Ute Mountain Ethnographic Study. Public Service Company of New Mexico, Albuquerque

Fransted, Dennis
1979 An Introduction to the Navajo Oral History of Anasazi Sites in the San Juan Basin Area. Navajo Aging Services, Fort Defiance, AZ

Roessel, Robert, Jr.
1983 Dinetah: Navajo History. Rough Rock Demonstration School, Rough Rock, AZ

York, Frederick F.
1981 An Ethnographic Study of the Public Service Company of New Mexico's Proposed New Town Site and Its Environs. Human Environmental Resource Services Corporation, Anthropological Series 1, Albuquerque.

York, Frederick F., and Joseph C. Winter
1988 Report of an Ethnographic Study and Archeological Review of Proposed Coal Lease Tracts in Northwestern New Mexico. Office of Contract Archeology, University of New Mexico, Albuquerque

****In addition, the following background readings are strongly recommended for those consultants not thoroughly familiar with them:***

Downer, Alan S.
1989 Anthropology, Historic Preservation and the Navajo: A Case Study in Cultural Resource Management on Indian Lands. Ph.D. Dissertation, Department of Anthropology, University of Missouri, Columbia

Frisbie, Charlotte J.
1987 Navajo Medicine Bundles or Jish: Acquisition, Transmission and Disposition the Past and Present. University of New Mexico Press, Albuquerque.

Gill, Sam D.
1981 Sacred Words: A Study of Navajo Religion and Prayer. Greenwood Press, Westport, Conn

Kelley, Klara B.
1988 San Augustine Coal Area, Archaeological Investigations in West- Central New Mexico, Vol. 2, Historic Cultural Resources. Cultural Resources Series No. 4, U.S. Bureau of Land Management, New Mexico State Office, Santa Fe

Kelley, Roger I., R. W. Lang and Harry Walters.

1972 Navajo Figurines Called Dolls. Museum of Navajo Ceremonial Art, Inc., Santa Fe, NM

Kluckhohn, Clyde and Leland C. Wyman
1940 An Introduction to Navajo Chant Practice. Memoirs of the American Anthropological Association 53

Spencer, Katherine
1957 Mythology and Values, An Analysis of Navajo Chantway Myths. Memoirs of the American Folklore Society 48

Wyman, Leland C.
1970 Blessingway: With Three Versions of the Myth Recorded and Translated from the Navajo by Father Berard Haile, O.F.M. University of Arizona Press, Tucson.

B. For all projects that require more than 1 acre, consultations with Navajo people are also required, (Projects of one acre or less are likely to include, but are not limited to, single home sites, single-business site leases, and isolated utilities installations for single home sites or single business sites.) In addition, consultations with Navajo people are also required for projects of 1 acre or less in certain localities and natural settings with a high probability of having traditional cultural properties. If the developer or anthropological consultant is in doubt about the need for such consultations, they should contact NNHPD. The project developer must demonstrate that a qualified professional anthropologist made a good-faith effort to consult:

1. Present surface user(s): grazing-permit holder(s) (individuals whose consents for right-of-way have been sought by developer); any other residents in or within view of the proposed project area.
2. Chapter(s) within which the proposed project is located: chapter officers and/or delegate(s) to Navajo Nation Council; at the request of any of these individuals, the developer's consulting anthropologist will also make a presentation at a meeting of general chapter membership.
3. Other knowledgeable people recommended by the present surface user(s), chapter officials, and chapter members.

C. Documentation of the concerns of people consulted will normally take the form of a questionnaire or interview schedule administered by the developer's consulting anthropologist and his or her interpreter/field assistant, if any. Documentation of each consultation will normally include the following information (documentation shall include a detailed explanation as why any of this information was not provided):

1. Source of information on traditional cultural properties: names of interviewer and interpreter, date and location of interview, language or interview.
2. Identification of each place by Navajo and English names (English translation of Navajo name if there is no English name) and USGS 1:24,000 or 1:62,500 scale map location;
3. What type of place is it: description of its physical attributes or appearance and its traditional associations or functions (attributes that make it a traditional cultural property)?
4. What impacts, if any does the interviewee expect the proposed project to have on each place?
5. What modification or redesign of the proposed project would the interviewee recommend?
6. If impacts cannot be avoided, what measures to mitigate adverse impacts would the interviewee recommend?

The Navajo Nation Historic Preservation Department Sacred and Traditional Places Documentation Form and guidelines for its use are appended to this policy statement and are recommended for this purpose.

Further documentation of concerns such as general chapter resolution or other written form that the chapter considers appropriate are required.

D. Discoveries of Navajo traditional cultural properties during project development. The procedures set forth above in this section are likely to identify significant Navajo traditional cultural properties before development. No feasible procedure, however, can guarantee the identification of all such properties. There is always the possibility that during project development someone may report that the project area contains a previously unidentified property. This situation is considered analogous to an archaeological "emergency discovery situation" in which the developer encounters previously unreported subsurface archaeological remains. As soon as the developer learns of the presence of a previously unreported traditional cultural property, the developer will cease operations and notify the NNHPD. Normally operations will not resume until the NNHPD has obtained, on its own or through the developer, information adequate to identify and evaluate the reported traditional cultural property and devise a plan for its subsequent treatment, and has notified the developer to resume operations.

Identification of Navajo Traditional Cultural Properties on Lands NOT Administered by the Navajo Nation or BIA in Trust for Navajos

A. In general. If these lands are surrounded by or are near lands used by Navajos, the developer, through a consulting anthropologist who meets the professional requirements of the Navajo Nation and the land manager, must consult the neighboring Navajo chapters and any knowledgeable individuals recommended by the chapters, and document those consultations according to guidelines set forth in the preceding section. If the lands are used by Navajos (for example, BLM-administered lands in the eastern part of the Navajo country), the developer's consulting anthropologist must make a good-faith effort to consult these Navajo users according to the procedures in Section C. above.

B. Dinetah. Dinetah is a special case involving land in eastern San Juan County and western Rio Arriba and Sandoval Counties, New Mexico, much of which is not now used by Navajos. It needs special consideration because it contains so many recorded (and therefore probably many unrecorded) Navajo archaeological sites, sacred places, and other traditional cultural properties; because parts of it are not near any Chapter area; and because parts of it are not near any Chapter area; and because so many of its traditional cultural properties are of potential concern to Navajos all over Navajo land. Most of this land is under BLM jurisdiction, and BLM is required in accordance with the American Religious Freedom Act and Section 106 of the National Historic Preservation Act (and its implementing regulations 36 CFR Part 800) to consult with interested Native American communities about management of cultural resources to be affected by its decisions. The developer's consulting anthropologist therefore must make a good-faith effort to consult neighboring chapters, any Navajo users, and document these consultations according to the guidelines set forth in Section C. above. In addition, the developer's consulting anthropologist must consult with NNHPD.

C. Discoveries of Navajo traditional cultural properties during project development. Procedures set forth in Section C., Item 4. above will be applied here with the following modifications. The developer will normally notify the land manager as well as NNHPD, and the notification to the developer to continue operations will normally come from the land manager with NNHPD concurrence.

Possible Traditional Cultural Properties of Other Native American Groups on Lands Administered by the Navajo Nation or BIA in Trust for Navajos

The NNHPD is committed to protecting traditional cultural properties of other Native American groups on lands under its jurisdiction, with the expectation that other tribes on whose lands Navajo traditional cultural properties are located will make a reciprocal commitment. Therefore, the developer of a proposed project is responsible for consulting other Native American groups when such groups may have traditional cultural properties in the area affected by the developer's project. To determine which other groups, if any, are to be consulted, the developer's anthropological consultant normally will look at material showing the extent of the aboriginal land claims (and subsequent land claims, if appropriate) Before the Indian Claims Commission or U.S. Court of Claims made by those tribes nearest the part of Navajo land where the proposed project is to be located. The developer=s consultant anthropologist will then make a good faith effort to consult any other groups in whose land claim(s) the proposed project area lies. NNHPD considers the land claims areas of other Native American groups to be the maximum areas within which traditional cultural properties of these groups may be identified.

NNHPD does not believe that the land claims neither areas were necessarily used exclusively by these groups nor that they are covered by any particular types of property rights use rights, etc. Nothing in this policy shall be construed as a concession by the Navajo Nation as to the validity of any claim of any other tribe concerning Navajo land. The Navajo Nation is attempting to foster cooperation between tribes on matters of general concern, such as traditional cultural properties, but this spirit of cooperation must not be misinterpreted as any sort of legally binding statement by the Navajo Nation.

The developer's anthropological consultant will be required to contact the appropriate tribal government and/or community representatives and proceed with identification efforts as directed by those entities. The developer's anthropological consultant should first contact NNHPD for referrals to appropriate contact people in the appropriate tribe or community.

Instructions for Using "Navajo Nation Historic Preservation Department's Sacred and Traditional Cultural Places Documentation Form"

This form is intended as a checklist of information required to document consultations with knowledgeable Navajo people about traditional cultural properties that may be impacted by a particular development undertaking. It is not intended to be administered as a questionnaire, although the interviewer may use it that way. The form should be used to present information gained in each interview, with continuation sheets attached for items where the form does not provide enough space. The interviewer will document each interview on a copy of the attached form. Interviewees are NOT to be asked to sign the form. For people contacted who refuse to be interviewed, the interviewer will fill out the top section of the form and indicate that the person refused to be interviewed, It is also important to make clear to the interviewee that the interviewee is under no obligation to be interviewed. If he or she refuses, however, any resources in the area may go unprotected since the people with the authority to protect them won't know about them. Also, during the interview, the interviewee may refuse to provide certain information such as name of a particular medicinal plant. The interviewer should not press the person to reveal such information, but should note on the form that the person did not want to reveal it. Because these inquiries are so sensitive, the staff of NNHPD will be available to help your staff get oriented to conducting these interviews. If you wish, they will meet with the members of your staff who may be conducting these interviews to go over the process and answer any questions. Please call (928)-871-7147 if you have any questions.

SACRED & TRADITIONAL PLACES DOCUMENTATION FORM

PROJECT NUMBER/NAME:

PROJECT LOCATION:

CHAPTER:

LEGAL DESCRIPTION (for large projects, give Township, Range, & Sections only):

UTM COORDINATES (for small project areas only center point):

DATE OF INTERVIEW:

NAME(S) OF INTERVIEWEES:

NAME OF INTERVIEWER:

NAME OF INTERPRETER (if any):

OTHERS PRESENT:

LOCATION OF INTERVIEW (interviewee's home, project area, other specify):

WAS INTERVIEW REFUSED?

1. How was project area identified to interviewee? (Visit to area, map location (specify map), other method (specify):

2. Which of the following types of sacred/traditional places, if any does the interviewee identify? Inside or immediately adjacent to the project area? (Attach continuation sheet with information if necessary.)

a. **Place for gathering plants for use in ceremonies (specify plant and ceremony if interviewee is willing to supply that information:**

b. **Place for gathering plants for other purposes (specify plants and purposes):**

c. **Place for gathering contents of sacred bundles (specify material gathered and typed of bundle, for example, Dzil leezh, Mountain Soil Bundle):**

d. **Place for gathering other materials for traditional purposes (specify materials and purposes):**

e. **Place where ceremony has been held (specify ceremony; also names of sponsors and dates, if possible):**

f. **Former home site location (specify former residents and dates of use, if possible):**

g. **Former sweathouse location (specify former users and dates of use if possible):**

h. Grave (specify name of deceased and relationship to interviewee, if possible; refer to Navajo Nation Policies and Procedures Concerning the Protection of cemeteries, Gravesites, and Human Remains for additional documentation and treatment required by Tribal law).

i. Prayer offering place (specify type of prayer ceremony associated with it, if any, and type of offering, if any):

j. Place associated with general Navajo origin (Emergence) story (indicate which part of the story the place is associated):

k. Place associated with the origin story of a ceremony (specify ceremonial and how place figures in its origin story):

l. Place associated with origin or home of a clan (specify clan and indicate nature of its association with the place):

m. Place identified as home of a Holy Being such as Wind (Nilch'i), Lightning (Ii'ni), Big Snake (Tl'iistosoh) (specify which Holy Being, indicate any associated story):

n. Location of Talking Rocks (Tse Yalti' i--rocks that convey human words to the Holy People):

o. Petroglyph, pictograph or natural discoloration of rock that has some kind of power (specify):

p. Place associated with other traditional story (give story and indicate how place is associated with it):

q. Other type of sacred/traditional place (describe):

____
____
____

3. **Indicate locations of all resources listed above on portions of USGS map and attach copy to this form.**

4. **Does the interviewee consider the proposed development a threat to any of the above types of places?**

   ___ ǂ **NO**

   ___ ǂ **YES (specify nature of threat or perceived impact of proposed project on place):**

5. **If yes, what modification or redesign of the proposed project would the interviewee recommend so as not to threaten the place?**

   a. Avoidance (specify how close redesigned project could come to place

____
____
____

   b. Alternative location (specify - attach portion of USGS map if possible showing location):

____
____
____

   c. Other (specify):

____
____
____

6. **Is there anyone else that the interviewee feels should be consulted (filled out a separate form for each of these interviewees, but list names and locations of homes here:**

____
____
____
____
____

RCO-220-96

RESOLUTION
OF THE RESOURCES COMMITTEE
OF THE NAVAJO NATION COUNCIL

Repealing the Old Navajo Nation Policies and Procedures Concerning the Protection of Cemeteries, Gravesites and Human Remains, Approved by Resolution No. ACMA-39-86, and Approving a New Navajo Nation Burial Policy

WHEREAS:

1. Pursuant to 2 N.N.C. § 691, the Resources Committee of the Navajo Nation Council is established and continued as a standing committee of the Navajo Nation Council; and

2. Pursuant to 2 N.N.C. § 695 (b) (13), the Resources Committee of the Navajo Nation Council is the oversight committee for the Division of Natural Resources, including the Historic Preservation Department; and

3. Pursuant to 2 N.N.C. § 695 (b) (12), the Resources Committee of the Navajo Nation Council is authorized to establish Navajo Nation policy with respect to the optimum utilization of all resources; and

4. The Historic Preservation Department within the Division of Natural Resources is established in accordance with the Plan of Operation approved by the Government Services Committee of the Navajo Nation Council on October 25, 1994, by Resolution No. GSCO-82-94; and

5. Pursuant to section IV (F) of said Plan of Operation, the Director of the Historic Preservation Department is authorized to develop and recommend policies, rules and regulations relating to Navajo land pertaining to the management of cultural, archaeological, historic and scientific resources; and

6. By Resolution No. ACMA-39-86, approved March 13, 1986, the former Advisory Committee of the Navajo Tribal Council approved the Navajo Nation Policies and Procedures Concerning the Protection of Cemeteries, Gravesites and Human Remains; and

7. The Director of the Historic Preservation Department has drafted a new proposed Navajo Nation Burial Policy, a copy of which is attached hereto as Exhibit "A" and incorporated herein, and has recommended to the Resources Committee of the Navajo Nation Council that the old Navajo Nation Policies and Procedures Concerning the Protection of Cemeteries, Gravesites and Human Remains be repealed and the new proposed Navajo Nation Burial Policy be approved in its place; and

8. The Resources Committee of the Navajo Nation Council finds that repealing the old Navajo Nation Policies and Procedures Concerning the Protection of Cemeteries, Gravesites and Human Remains and adopting a new Navajo Nation Burial Policy is in the best interest of the Navajo Nation and its people.

NOW THEREFORE BE IT RESOLVED THAT:

1. The Resources Committee of the Navajo Nation Council hereby repeals the Navajo Nation Policies and Procedures Concerning the Protection of Cemeteries, Gravesites and Human Remains, approved by the former Advisory Committee of the Navajo Tribal Council on March 31, 1986, by Resolution No. ACMA-39-86.

2. The Resources Committee of the Navajo Nation Council hereby approves the new Navajo Nation Burial Policy, a copy of which is attached hereto as Exhibit "A" and incorporated herein.

CERTIFICATION

I hereby certify that the foregoing resolution was duly considered by the Resources Committee of the Navajo Nation Council at a duly called meeting at Window Rock, Navajo Nation (Arizona), at which a quorum was present and that same was passed by a vote of 5 in favor, 0 opposed and 0 abstained, this 31st day of October, 1996.

Pro Temp Chairperson
Resources Committee

Motion: Jones Begay
Second: Harold Tunney

NAVAJO NATION POLICY FOR THE PROTECTION OF *JISHCHAA'*: GRAVESITES, HUMAN REMAINS, AND FUNERARY ITEMS

CONTENTS

I. POLICY STATEMENT

Diné (Navajo) society is based on harmony and beauty. Issues related to death are treated with the utmost respect in our culture. In harmony with the Diné way of life, we do not talk about or discuss death. We avoid burial sites and do not handle materials belonging to one who is deceased. The Diné view is that human remains, associated funerary items, and unassociated funerary items all fit under *jishchaa',* a term that refers to things that are associated with death as well as the burial itself.

Due to the circumstances of modern life, we find it necessary to establish rules and regulations concerning the protection of gravesites, human remains, and funerary items. We do this with complete and full awareness of the wide range of Diné values, beliefs, and practices. We apologize to those who have passed on for the intrusion. We apologize to the living for all the discomfort this subject causes.

This policy outlines procedures based on Diné cultural beliefs. The Navajo Nation is committed to protecting all gravesites, human remains, and funerary items under its jurisdiction. Human remains and funerary items, once interred, should not be disinterred. However, the Navajo Nation recognizes that under certain circumstances disinterment will occur. In these situations the human remains and funerary items must be reinterred as quickly as possible and as near to the original burial location as feasible. Except under extraordinary circumstances, analysis of human remains is restricted to in-field non-destructive visual determinations of age and sex for the purposes of locating lineal descendants. Records about human remains and funerary items or their location shall be maintained and safeguarded in the Cultural Resource Compliance Section (CRCS) at the Navajo Nation Historic Preservation Department for use in project planning and appropriate related activities.

In the absence of identified lineal descendants, all Native American human remains and funerary items identified on Diné lands are the responsibility of the Navajo Nation. The Historic Preservation Officer shall determine the treatment of human remains without identified lineal descendants and/or funerary items in consultation with other tribes, as appropriate. We expect that other tribes will make a reciprocal commitment. The Navajo Nation encourages the development of programmatic agreements with federal agencies and other tribes. The Navajo Nation expects all human remains and funerary items to be treated with the utmost respect from the time they are discovered until their final disposition.

II. AUTHORITY

This policy is implemented pursuant to the Navajo Nation Cultural Resources Protection Act (CRPA, CMY-19-88). It is intended to complement provisions set forth in the Native American Graves Protection and Repatriation Act of 1990 (NAGPRA, P.L. 101-601), the Archaeological Resources Protection Act of 1979 (ARPA, P.L. 96-95), the National Historic Preservation Act of 1966 (NHPA, P.L. 89-665, as amended), and others.

III. DEFINITIONS

For the purpose of this policy, the following definitions apply.

Analysis of human remains - limited to non-destructive, in-field visual determinations of age at death, approximate date of interment (based on context), sex, and cultural affiliation of human remains. No other type of analysis will be allowed.

Analysis of funerary items - limited to non-destructive, in-field, visual determinations of cultural or temporal affiliation

Anaasází - the Diné term for all ancient peoples who inhabited Diné customary lands, including all peoples whom archaeologists call "prehistoric."

Cultural Affiliation - a relationship of shared group identity which can be reasonably traced between the deceased and living people.

Cultural Property - any cultural resource deemed sufficiently important to warrant listing on the Navajo Nation Register of Cultural Resources.

Cultural Resource - any product of human activity, or any object or place given significance by human action or belief.

Cultural Resource Professional - any individual who is authorized by the Navajo Nation to conduct cultural resource investigations. Such individuals may include persons who work in archaeology, anthropology, ethnology, Navajo culture, and other related disciplines, including traditional healers

Diné - the Navajo people.

Federal Agency - any department, agency, or instrumentality of the United States

Funerary Items - items that are reasonably believed to have been associated with the deceased either at the time of death or later, whether or not they are found in direct association with human remains. For Navajo burials, such funerary items may include, but are not limited to, shovels, tinware, saddles, clothing, and jewelry.

Historic Preservation Department (HPD) - the Navajo Nation Historic Preservation Department as established by Section 20 of the CRPA.

Historic Preservation Officer - the Director of the Historic Preservation Department.

Human Remains - the physical remains of a human body, including but not limited to bone, teeth, hair, ashes, or mummified or otherwise preserved soft tissues of a person

Inadvertent Discovery - finding; locating; observing; uncovering; unearthing; learning about through conversation, discussion, or interview; or otherwise detecting human remains, funerary items, or site(s) in which human remains or funerary items are believed to exist when such discovery was not the original intent.

Intentional Excavations - the unearthing of sites, gravesites, human remains, or funerary items for an undertaking or any purpose authorized by the Historic Preservation Department pursuant to CRPA.

Jishchaa' - a location or item associated with death and burial of an individual.

Lineal Descendant - an individual tracing his or her ancestry directly and without interruption to a particular individual. The Diné traditional kinship system shall be used for Diné burials.

Navajo Nation lands (Diné lands) - all lands or interests in land owned or held by the Navajo Nation, whether held by original title, held in trust by the United States, held in fee simple or held under lease, easement, permit or otherwise, whether restricted or unrestricted, and whether within or outside the boundaries of the Navajo Nation.

Site - the location of human activity as indicated by physical or ethnographic evidence.

Sponsor - the agency official or the official in a private capacity who has decision-making authority over a particular undertaking.

Treatment - a thoughtfully developed and respectful plan for taking care of human remains or funerary items, accomplished through consultation with appropriate parties.

Unclaimed - human remains or funerary items for which no lineal descendants can be identified or located.

Undertaking - any project, activity, or program that can or does change the character or use of cultural properties or jishchaa'. The project, activity, or program must be under the direct or indirect supervision of a sponsor.

Unidentified - human remains or funerary items for which lineal descent or cultural affiliation cannot be determined through either consultation or analysis.

IV. TRADITIONAL CONCERNS

Diné traditional and spiritual values shall be observed in dealing with human remains, and associated funerary items, burials, and/or the relocation and transfer of gravesites. Diné teachings discourage the direct handling of human remains. Development projects, such as the construction and maintenance of roads, power lines, and water lines, often disturb burials. In such instances, the Navajo Nation must take steps to ensure the protection of human remains. It must also protect its people from association with human remains. The concerns listed below should therefore be taken into consideration in dealing with gravesites, human remains, and funerary items.

A. All individuals involved in burial issues must be warned that handling human remains or funerary items, direct exposure to gravesites, or discussion of burial issues may affect their overall health in the immediate future or sometime during their lifetime. For example, the soil associated with a burial is considered contaminated by death. Procedures such as brushing bones or funerary items, taking soil samples, and disarticulating bones are therefore considered both offensive and dangerous. Knowledgeable Diné should be consulted regarding appropriate protective measures.

B. Individuals involved with burial issues will come into contact with the Navajo public after they have been in contact with gravesites, human remains, or funerary items and that contact may affect the health of other individuals. They should take measures to protect the public and themselves when disinterring and/or reinterring human remains or when in contact with gravesites. If individuals, sponsors, or their agents need assistance or information regarding protective measures, they should contact the Navajo Nation Historic Preservation Department Traditional Culture Program.

C. Pregnant women, or individuals in daily contact with them, should not be directly involved in the handling, removal, or intimate discussion of gravesites, human remains, or funerary items.

D. Funerary items must be treated with respect. They have been placed with the human remains for essential reasons and should not be handled casually, collected, removed, or separated from the human remains.

E. Traditional Diné avoid gravesites, human remains, and funerary items. They do not talk about someone who has passed on, and they do not carelessly mention or discuss death. Researchers need to be aware that the Diné may be extremely uncomfortable even talking about the topic, may not be willing to visit the gravesite, and should not be interviewed over and over regarding the same topic.

F. Sponsors and others should limit the number of individuals who come into contact with gravesites, human remains, or funerary items.

V. ENCOUNTERING GRAVESITES, HUMAN REMAINS, AND FUNERARY ITEMS

A. The Navajo Nation requires sponsors to make a good faith effort to locate gravesites, human remains, and funerary items within the area of potential effect prior to initiation of an undertaking. Such good faith effort shall include the following:

1. file searches of existing information, including files maintained at HPD (contact CRCS), mission records, and other pertinent materials as appropriate.
2. archaeological inventory and ethnographic interviews with residents of the local community and with other knowledgeable individuals. Navajo Nation permitting procedures require that investigators contact local chapters prior to initiating field activities (Navajo Nation Policy To Protect Traditional Cultural Properties, 1989). Continuing contact may be appropriate to ensure that local concerns are addressed.
3. other approaches, such as traditional diagnostic techniques, as necessary or appropriate. Traditional practitioners may provide such information.

B. When an inadvertent discovery occurs in the context of an undertaking but outside the context of intentional excavation, the sponsor shall adhere to the following procedures.

1. All ground-disturbing activities shall immediately cease within a 50-foot (15.2-meter) radius, using the discovery as the center point.
2. The sponsor or its agent *must* contact CRCS within one (1) business day to arrange for proper evaluation and consultation.
3. The sponsor or its agent shall identify itself and its project and shall supply the following information:

    a. a verbal description of what has been found and the context in which remains are located;
    b. the general location of the gravesite, human remains, and/or funerary items; and
    c. any other pertinent information.

4. Verbal notification shall immediately be followed by written notification. HPD will attempt to respond promptly so as not to cause project delays.

5. Human remains and funerary items *must* be protected in place until treatment measures are implemented. Treatment measures shall be consistent with Part VII of this policy.
6. The sponsor or its agent may resume ground-disturbing activities only after a proposed treatment plan has been agreed upon *and* implemented.

C. When an inadvertent discovery occurs within the context of intentional excavation, the sponsor shall adhere to the following procedures.

1. All trenching, hand excavation, sampling, photography, etc., shall cease within a 10-foot (3-meter) radius of the discovery after the nature and extent of buried remains have been determined.
2. The sponsor or its agent *must* contact CRCS within one (1) business day to arrange for proper evaluation and consultation.
3. The sponsor or its agent shall identify itself and its project and shall supply the following information:

a. a verbal description of what has been found and the context in which remains are located;
b. the general location of the gravesite, human remains, and/or funerary items;
c. a preliminary assessment of the type of burial it is (Diné, Anaasází, other);
d. an assessment of the complexity of the burial(s) and the likelihood of disturbance if left in place;
e. a proposed location for reburial, if applicable; and
f. any other pertinent information.

4. Verbal notification shall immediately be followed by written notification. HPD will attempt to respond promptly so as not to cause project delays.
5. Human remains and funerary items *must* be protected in place until treatment measures are implemented. Treatment measures shall be consistent with Part VII of this policy.
6. The sponsor or its agent may resume ground-disturbing activities only after a proposed treatment plan has been agreed upon *and* implemented.

D. When CRCS is notified of an inadvertent discovery of human remains outside the context of an undertaking:

1. CRCS shall ask the notifying party to provide

a. a verbal description of what was found and the context in which remains are located;
b. the general location of the gravesite, human remains, and/or funerary items; and
c. any other pertinent information, including the name of a contact person.

2. CRCS shall determine on a case-by-case basis whether HPD will assume responsibility for treatment.

VI. Identification of Gravesites, Human Remains, and Funerary Items

A. Once gravesites, human remains, and/or funerary objects are located, a good faith effort shall be made to determine through contextual analysis, interviews, non-destructive visual inspection, and other appropriate means whether the remains represent:

1. a burial with lineal descendants;
2. a Diné burial for which lineal descendants cannot be identified or located;
3. a Native American burial for whom lineal descendants cannot be identified or located (including Anaasází burials, burials of individuals from other tribes, and unidentified burials); or
4. a non-Native American burial for which lineal descendants cannot be identified.

B. Non-destructive visual inspection of human remains shall be limited to determinations of age (of both the individual and the interment), sex, and cultural affiliation. To the greatest extent possible, such visual inspection shall be performed without handling, brushing off, or disarticulating the remains.

C. Initial identification efforts may require consultation with Diné elders and other residents and non-residents who may have knowledge about the identity and/or cultural affiliation of the remains. When the remains are clearly Anaasází, such consultation is not necessary. Chapter officials must be notified prior to initiating local consultation. All identification efforts must respect the culturally sensitive nature of discussions regarding human remains.

D. In cases where no lineal descendants have been identified, the sponsor (in the case of an undertaking) must use all information available, including physical evidence as well as word of mouth, to determine the probable age at death and of interment and the sex of the individual buried at this location. Specialists such as physical anthropologists may be required to collect and analyze this information. One should err in the direction of greater age estimates for the date of interment when no firm data are available. Following the provisions of ARPA and the Resolution of the Parks Commission, Navajo Tribal Council (April 8, 1980), remains shall be considered "archaeological resources" only if they are, or are suspected to be, 100 years of age or older.

VII. Procedures for Treatment of Human Remains and Funerary Items

The policy of the Navajo Nation is that gravesites, human remains, and funerary items should not be disturbed. In cases where disturbance is unavoidable, treatment procedures will vary depending on the results of consultation with lineal descendants, culturally affiliated tribes, or appropriate entities. In the case of an undertaking, all costs related to treatment shall be borne by the sponsor.

In all cases, only non-destructive, in-field visual analysis to determine age and sex of individuals shall be allowed. At no time shall the remains or funerary items leave the project area. All analysis shall take place on site. No soil samples of any kind shall be taken from within one foot (0.3 m) of human remains. Human remains shall not be brushed unless absolutely necessary to make age and sex determinations. Depictions (sketches, drawings, etc.) of gravesites, human remains, and funerary items shall not appear in the body of any report; however, a map showing the orientation of the remains and associated funerary items shall be provided in a confidential appendix. Site maps in the body of the report should identify all features, including burials, but detailed illustrations are not allowed.

Photographs of gravesites and human remains are prohibited. In cases where funerary items are to be reinterred and may be susceptible to theft, photographs of the funerary items may be permitted in consultation with HPD. All photographs and negatives shall become the property of HPD; to be kept on file should ARPA investigations be necessary.

If circumstances require that human remains be disinterred, an ARPA permit is required if the burial is at least 100 years old. ARPA permits are issued through the Bureau of Indian Affairs with the consent of the Navajo Nation. A Class "C" Navajo Nation Cultural Resources Investigation Permit also is required. It may take up to 30 days to obtain ARPA and/or Class "C" permits. Navajo Nation employees engaged in Navajo Nation business and Navajo traditional healers are exempt from permit requirements.

A. Burials with Lineal Descendants

If the deceased has known lineal descendants, regardless of cultural affiliation, consultation shall be conducted directly with the lineal descendants. Cultural resource professionals should take traditional Diné kinship into account when they determine lineal descendants. If the deceased was a member of another tribe, consultation with lineal descendants shall proceed only after contacting HPD and only after HPD has initiated government-to-government relations with such other tribes.

In consultation with HPD, the sponsor or its agent shall document the concerns of lineal descendants regarding the burial and shall record their wishes regarding treatment of the human remains and/or funerary items on a Statement of Wishes form (see Attachments). This form *must* be used to record the wishes of lineal descendants regarding treatment of the burial.

Results of consultation with lineal descendants shall be held in confidence among the sponsor, cultural resource professional, HPD, and the lineal descendants. Sponsors and their agents shall not provide any information collected during consultation with lineal descendants to anyone other than HPD (and the lineal descendants, as requested). Upon completion of the project, sponsors and their agents shall turn over all records to HPD.

Documentation shall be provided to HPD that the decision made by the closest lineal descendant was made without any improper influence or pressure and was based upon full knowledge of all options available to them. This documentation must be initiated and performed by the sponsor or its agent, in the presence of or with the participation of a trained cultural resource professional approved by HPD. The cultural resource professional should work closely with any and all appropriate local residents, officials, elders, and traditional healers; should be familiar with policies related to the protection of human remains; should be knowledgeable regarding local history and customs; and must abide by professional standards and ethics. The cultural resource professional shall act as a witness to the documentation. Statement of Wishes forms is available from CRCS.

B. Diné Burials without Lineal Descendants

In cases where Diné burials are identified but where it is not possible to locate lineal descendants, the local chapter may serve as proxy for lineal descendants. In order to determine whether the Chapter wishes to serve as proxy, the sponsor or its agent, in consultation with HPD, shall consult with Chapter officials to determine procedures to be followed regarding presenting information to the Chapter as a whole.

Normally, this determination should be made within five (5) working days. If the Chapter determines that it wishes to serve as proxy, the sponsor shall follow the procedures delineated in Section VII.A. If the Chapter determines that it does not wish to serve as proxy, the sponsor or its agent shall consult with HPD, and HPD shall make decisions regarding treatment in accordance with procedures established in Section VII.C. All costs related to treatment shall be borne by the sponsor. Upon completion of the project, the sponsor and its agent shall turn over all records to HPD.

C. Other Native American Burials without Lineal Descendants

In the absence of lineal descendants, all Native American human remains identified on Diné lands are the responsibility of the Navajo Nation [NAGPRA, 1990: Sec. 3(a)(2)(A)]. Such human remains may include Anaasází burials, non-Diné burials without lineal descendants but for whom cultural affiliation is known and unidentified Native American burials. In cases where consultation with other tribes is required, consultation shall occur in coordination with HPD and treatment shall remain consistent with this policy. ARPA and Class "C" permits must be in hand before initiating excavation. Navajo Nation employees engaged in Navajo Nation business and Navajo traditional healers are exempt from permit requirements.

Treatment Plan

Human remains and funerary items, once interred, should not be disinterred. If the burial is in no danger of impact, its location shall be documented and remains shall be protected as necessary. Documentation shall be provided to HPD. If the burial is in danger of impact, sponsors must exhaust all reasonable alternatives before disinterring. The following treatment plan shall be used in all cases where disinterment is necessary. The treatment plan shall insure the rapid reburial of human remains.

1. Notification, Consultation, and Excavation:

    a. Upon discovery of human remains or funerary items, the cultural resource professional shall immediately determine the nature and extent of the burial and/or funerary items, while leaving the remains in place and protected. All other activities must immediately cease within a 10-foot (3-meter) radius unless a previously approved data recovery plan is in place. When human remains or funerary items are encountered in the context of an approved data recovery plan, the cultural resource professional may continue investigations outside the immediate burial area.
    b. HPD must be notified immediately that human remains have been encountered.
    c. Remains must be kept in place on site until a determination is made by HPD regarding appropriate treatment. When security is a problem, the sponsor or its agent must consult with HPD regarding protective measures.
    d. Analysis shall proceed according to Section VI.B, above.
    e. The location of the remains shall be thoroughly documented. The location shall be described and recorded on the appropriate 7.5-minute USGS topographic map. Locational information shall be provided to HPD in a

confidential appendix. It shall not be retained by the sponsor, its agent, the cultural resource professional, or anyone else.

2. Human Remains Identified in the Laboratory. If human remains are discovered along with faunal remains or other samples during laboratory analysis, the sponsor or its agent must contact HPD and then shall rebury the remains consistent with the plan noted in Section 3, below.

3. Reburial

   a. Reinterrment should take place immediately following removal of remains, unless there are extenuating circumstances.
   b. The reburial location shall be situated as close to the site of origin as possible, but far enough away from earth-disturbing and erosion activities so as to eliminate the likelihood of future impact. Selection of a reburial site will depend upon construction design plans, depth of soil, the security of the location, approval of land users (if needed), and other pertinent factors.
   c. An identification number shall be assigned to the gravesite. To obtain a grave identification number, contact CRCS.
   d. The new location shall be described and recorded on the appropriate 7.5-minute USGS topographic map. Recordation shall include a 50-foot (15.2-meter) radius buffer zone for the gravesite. Locational information shall be provided to HPD in a confidential appendix. HPD may provide to others on a need-to-know basis. It shall not be retained by the sponsor, its agent, the cultural resource professional, or anyone else.
   e. The remains and funerary items shall be reburied in the same orientation and position as originally found. For relocation purposes, the location of the reburial and a sketch map depicting the position of the remains shall be prepared. Upon request, a skeletal illustration form is available from HPD to inventory the completeness of the human remains. This information shall immediately be turned over to, and shall become the property of, HPD.
   f. The sponsor or its agent shall ensure that the reburial location is reclaimed to conform to the natural landscape and that protective measures are implemented, as necessary, to avoid future impacts to the reburial site (protective fencing, stabilization, reseeding, etc.).

4. Reporting. The results of investigations at a burial site shall be incorporated into a report as a detachable, confidential appendix. This report shall be submitted to the CRCS. None of the information regarding the location of burials shall be retained by the sponsor or its agent. Confidential appendices shall only be distributed to appropriate parties, as determined by HPD.

D. Non-Native American Burials without Lineal Descendants

In the rare instance that non-native human remains without lineal descendants are encountered on Diné lands, HPD shall initiate consultation with the appropriate entities.

VIII. DISPUTE RESOLUTION

HPD shall consider disputes within or between families, within a community, between tribes, or with federal agencies related to the treatment of gravesites, human remains, and funerary items on a case-by-case basis. Disputes among lineal descendants may be referred to the Navajo Peacemaker Courts (*Hózhóójí Naa'táanii*), as appropriate.

IX. ATTACHMENTS/FORMS

A. Identification of Gravesites, Human Remains, and Funerary Items *and* Statement of Wishes: Burials *with* Lineal Descendants

B. Identification of Gravesites, Human Remains, and Funerary Items: Burials *without* Lineal Descendants

Identification of Gravesites, Human Remains, and Funerary Items *and*
Statement of Wishes for
Burials *WITH* Lineal Descendants

****CONFIDENTIAL****

(NOTE: Complete one form for each individual encountered)

DATE:

NAME OF DECEASED:

DESCRIPTION:

Clan (Maternal):	
Clan (Paternal):	
Sex:	
Age of Death:	
Date of Death (if known):	

REPORT NO.:

SITE NO.:

REPORT AUTHOR(S):

REPORT TITLE:

LOCATION OF BURIAL:

Chapter:	UTM Zone: N E
Agency:	Land Status:
County:	Township/Range:
State:	USGS 7.5 Minute Map:

REINTERRNMENT LOCATION (if applicable):

Chapter:	**UTM Zone: N E**
Agency:	**Land Status:**
County:	**Township/Range:**
State:	**USGS 7.5 Minute Map:**

DESCRIPTION OF UNDERTAKING IN RELATION TO BURIAL:

NAME OF LINEAL DESCENDANT/RESPONSIBLE PARTY:

NAME OF LINEAL DESCENDANT/RESPONSIBLE PARTY:

RELATIONSHIP OF LINEAL DESCENDENAT/RESPONSIBLE PARTY TO THE DECEASED:

CLANS OF RESPONSIBLE PARTY:

Maternal Clan	
Paternal Clan	

ADDRESS/LOCATION OF RESIDENCE FOR LINEAL DECENDANT/RESPONSIBLE PARTY:

NAME/ORGANIZATION ADDRESS OF FIELD RECORDER:

LANGUAGE IN WHICH INTERVIEW WAS CONDUCTED:

NAME/ORGANIZATION/ADDRESS OF INTERPRETER (if any):

NAMES OF OTHERS PRESENT DURING INTERVIEW:

DESCRIPTION OF BURIAL **(i.e. markers, headstone, funerary items, other):**

ENVIRONMENTAL SETTING:

FIELD METHODS:

Add supplemental sheets if necessary.

STATEMENT OF LINEAL DESCENDANT/RESPONSIBLE PARTY

On, ______________________________
(date)

I, ______________________________
(name of lineal descendant/responsible party)

Was told by: ______________________________
(name & address of field recorder)

____

____

That the burial was in danger of being disturbed by the following undertaking :

____

____

____

(title of report/description of undertaking)

I understand that the following treatment alternatives are available to me, according to the Navajo Nation Policy for the Protection of Jishchaa': Gravesites, Human Remains, and Funerary Items:

1. The human remains and funerary items may be left in place and shall be avoided forever, without stigma or other sanctions placed against the relatives. To this end, a 50-foot (15.2-meter) radius buffer zone measured horizontally shall be maintained, and the local environment shall be reclaimed and/or stabilized at the end of the disturbance activities. A larger or smaller buffer zone may be delineated with approval of the lineal descendants.

2. The human remains and funerary items may be relocated to a location of the lineal descendant's choice (and with the consent of the land-user at the location of reburial). The integrity of the human remains and funerary items shall be maintained, and they shall be treated with all due respect. Witnesses from the Navajo Nation Historic Preservation Office and/or others may be present, especially if desired by the lineal descendant(s), to ensure that the rights of the lineal descendant(s) are protected. The lineal descendant(s) also has the right to request who should participate in the process of disinterment and reburial. In the case of an undertaking, all costs related to treatment shall be borne by the sponsor.

3. The lineal descendant(s) may request that the grave not be protected from any disturbance. However, if the grave is more than 100 years old or is located within an archaeological site, the Navajo Nation has the responsibility to protect the grave from disturbance. Determination of eligibility for protection shall be made with reference to the Archaeological Resource Protection Act (ARPA), the National Historic Preservation Act (NHPA, as amended), the Native American Grave Protection and Repatriation Act (NAGPRA), the American Indian Religious Freedom Act (AIRFA), the Navajo Nation Cultural Resource Protection Act (CRPA; CMY-19-88), and other relevant tribal and federal policies.

4. The lineal descendant(s) may decline to specify wishes regarding treatment of the grave.

Recordation of Wishes:

(Note to field recorder: Record the concerns and wishes of the lineal descendants/responsible party fully. If reburial is chosen, the lineal descendants may specify location of the new burial site and any witnesses desired. They may also specify concerns regarding fencing, stabilization, and maintenance of the new burial site. Supplemental sheets may be added if necessary.)

I understand that information on this form shall be held in confidence among the sponsor or its agent (in the case of an undertaking), HPD, and the lineal descendants. Neither the sponsor nor its agent shall provide any information collected during consultation with lineal descendants to anyone other than HPD. Upon completion of the project, sponsors shall turn over all records to HPD and to the lineal descendants, as requested.

Signature/Thumbprint: Date

Witness(es): Date

Signature of Interpreter Date

Signature of Field Recorder: Date:

Identification of Gravesites, Human Remains, and Funerary Items *and* Statement of Wishes for Burials WITHOUT Lineal Descendants

****CONFIDENTIAL****

(NOTE: Complete one form for each individual encountered)

DATE:

REPORT NO.:

SITE NO.:

REPORT AUTHOR(S):

REPORT TITLE:

LOCATION OF BURIAL:

Chapter:	**UTM Zone: N E**
Agency:	**Land Status:**
County:	**Township/Range:**
State:	**USGS 7.5 Minute Map:**

DATE OF DISCOVERY:

ADDRESS/LOCATION OF RESIDENCE FOR LINEAL DECENDANT/RESPONSIBLE PARTY:

NAME/ORGANIZATION ADDRESS OF FIELD RECORDER:

DESCRIPTION OF UNDERTAKING IN RELATION TO BURIAL:

SPONSOR OF PROJECT:

DESCRIPTION OF BURIAL (i.e. markers, headstone, funerary items, single or multiple burials, flex positioning, orientation, other):

ENVIRONMENTAL SETTING:

APPROXIMATE DATE OF INTERMENT (AD/BC):

AGE AND SEX OF INDIVIDUAL(S):

Individual:	1	2	3	4	5	6	7	8
Age of individual:								
Sex of Individual:								
Skeleton: Complete (C) or Partial (P) [chose one]								

IF PARTIAL SKELETONS ARE ENCOUNTERED, DESCRIBE BELOW. INCLUDE IDENTIFYING NUMBER FOR SKELETONS DESCRIBED. Use supplementary sheets if necessary.

TYPE OF BURIAL (e.g. cist, crevice, midden):

Photographs of funerary items are permitted only in situations where there is a risk of ARPA violations. Photographs require prior permission from NNHPD. All sketches, photographs, negatives, and photo logs must be attached to this form.

WERE PHOTOGRAPHS TAKEN OF FUNERARY ITEMS?

☐ NO
☐ YES

NAME/TITLE OF INDIVIDUAL AT NNHPD WHO PROVIDED PERMISSION TO TAKE PHOTOGRAPHS:

FIELD METHODS:

DATE OF DISITERRMENT (if applicable):

DATE OF REINTERRMENT (if applicable):

REINTERRNMENT LOCATION (if applicable):

Chapter:	**UTM Zone: N E**
Agency:	**Land Status:**
County:	**Township/Range:**
State:	**USGS 7.5 Minute Map:**

NOTE: Reburial location must be mapped on a USGS 7.5-minute topographic map (attached).

NAME/ORGANIZATION/ADDRESS OF INDIVIDUAL(S) WHO CONDUCTED THE DISINTERRMENT:

NAME/ORGANIZATION/ADDRESS OF INDIVIDUAL(S) WHO CONDUCTED THE REINTERRMENT:

WITNESS(ES) TO REINTERRMENT:

REASON FOR RELOCATION OF BURIAL:

Supplemental sheets may be added if necessary.

GUIDELINES FOR THE TREATMENT OF DISCOVERY SITUATIONS

INTRODUCTION

The Bureau of Indian Affairs, Navajo Area Office (BIA) and the Navajo Nation have entered into a contract pursuant to the Indian Self-determination and Education Act (P.L. 93-638, as amended) under which the Navajo Nation Historic Preservation Department (HPD) performs selected historic preservation functions as the agent of the BIA, including Section 106 consultations.

Pursuant to 36 CFR 800.11(a), these *Guidelines* will be complied with in the event of discovery of cultural and historic properties, and human remains; or unanticipated effects on identified cultural and historic properties, and human remains during the course of an undertaking or any other activity funded or permitted by the BIA within the boundaries of the Navajo Nation.

The BIA, through HPD, is responsible for ensuring identification of both previously recorded and unrecorded cultural and historic properties, and human remains, and evaluation of the effect(s) a project will have on such properties.

These *Guidelines* require adherence to the following policies, standards, and guidelines in addition to relevant cultural and historic preservation laws and regulations:

1. Secretary of the Interior's Standards and Guidelines for Archeology and Historic Preservation.
2. Advisory Council on Historic Preservation's Treatment of Archeological Properties: A Handbook.
3. Navajo Nation Interim Fieldwork and Report Standards and Guidelines.
4. Navajo Nation Policy and Procedures for the Protection of Cemeteries, Gravesites and Human Remains.
5. Navajo Nation Historic Preservation Department Guidelines for the Treatment of Historic, Modern, and Contemporary Abandoned Sites.
6. Navajo Nation Policy to Protect Traditional Cultural Properties.
7. Native American Graves Protection and Repatriation Act (NAGPRA).
8. National Register Bulletin 38.

The BIA is ultimately responsible for compliance with 36 CFR 800.

DEFINITIONS

1. The term "discovery" refers to finding; locating; observing; uncovering; unearthing; learning about through conversation, discussion, or interview; or otherwise detecting human remains or any kind of cultural or historic property, as defined below.

2. A "historic property" is defined in Section 301(5) of the National Historic Preservation Act, as amended (1992), as any prehistoric or historic district, site, building, structure, or object included in, or eligible for inclusion in, the National Register, including artifacts, records, and material remains related to such a property or resource.

Pursuant to *National Register Bulletin* 38 and Section 101(d) (6) (A) of the National Historic Preservation Act, as amended (1992), "historic property" includes properties of traditional religious and cultural importance to an Indian tribe.

3. "Cultural properties" as defined by Section 10(c) of the Navajo Nation Cultural Resources Protection Act (NNCRPA, CMY-19-88) will also be identified and protected. The types of properties and landmarks eligible for listing on the Navajo Nation Register of Cultural Properties and Cultural Landmarks are defined in Section 101(a-c) of the NNCRPA.

4. The term "contemporary" refers to sites, properties, places, or burials that are 50 years of age or less.

5. The term "historical" refers to sites, properties, places, or burials that post-date 1539.

6. The term "prehistoric" refers to sites, properties, places, or burials that pre-date 1539.

7. The term "scope-of-work" refers to a plan that includes one or more of the following procedures, which may be necessary to identify, evaluate, and mitigate adverse effects on cultural and historic properties.

    A. Archaeological work may include:

        1. Identification and evaluation of archaeological properties, including recommendations of eligibility for nomination to the National Register of Historic Places;
        2. Testing of potentially eligible historic properties for a determination of significance and eligibility for nomination to the National Register of Historic Places;
        3. Testing of historic properties to determine the nature and extent of cultural deposits;
        4. Data recovery.

    B. Ethnographic work may include

        1. Identification and evaluation of traditional cultural properties, other cultural properties, and burial sites, including, as applicable, recommendations of eligibility for nomination to the National Register of Historic Places;
        2. Treatment of the sites and properties;
        3. Conflict resolution.

PROTOCOL

These guidelines must be followed in any situation involving the discovery of any kind of cultural or historic property, including historical and prehistoric archaeological sites and traditional cultural properties, and human remains, whether previously identified or unknown.

In the event of a discovery, the project sponsor will inform the project contractor to temporarily cease work within 50 feet of the site. A 100-foot-radius avoidance zone will be maintained around discoveries containing human remains.

HPD will be contacted within one (1) working day at (928) 871-7198 or 7134 to arrange for proper evaluation of any discovery.

When a cultural or historic property is discovered:

1. HPD will make a determination of effect and significance of the cultural or historic property (ies) by the most efficient and expeditious means and notifies the BIA of these determinations.

2. HPD will consult with interested parties, including other Indian tribes, during development of a scope-of-work and will take into account comments from interested parties into the scope-of-work.

3. In the event of a dispute concerning the disposition of human remains discovered on the Navajo Nation, the Navajo Nation Historic Preservation Officer will make all final decisions regarding resolution of disputes in accordance with Navajo Nation policies.

ADMINISTRATIVE PROCEDURES

In the event of a declaration of a discovery, the following the actions will be taken.

1. For discovery situations where a scope-of-work has been approved:

   A. HPD will define a 50-foot-radius avoidance zone around the discovery (100-foot-radius if the discovery contains human remains) to remain in effect for the duration of investigations at the site.

   B. HPD will make recommendations regarding significance and eligibility for nomination to the National Register of Historic Places for each discovered property.

   C. If the property is eligible, HPD will establish a schedule to complete treatment.

   D. HPD will implement or direct its contractor to implement the scope-of-work at each discovery consistent with the approved scope-of-work for the undertaking.

   E. The methods of excavation, recordation, conservation, analysis, preservation, storage, interviewing or consultation with knowledgeable individuals and interested parties, and reporting of discoveries shall be consistent with the scope-of-work, the general and specific methods of treatment outlined below, and stipulations of any existing memorandum of agreement or programmatic agreement applicable to the undertaking.

   F. HPD will simultaneously notify the BIA and all declared interested parties upon the completion of treatment.

   G. The BIA will wait three (3) working days after work is completed at the discovery before letting the project contractor continue work in the avoidance zone. This period will enable consulting and interested parties to submit comments.

   H. The results of the investigations at a discovery will be incorporated into the draft technical report. Confidential data resulting from the ethnographic assessment and provenience data for all cultural and historic sites will be provided in one or more detachable appendices. Confidential appendices will only be distributed to appropriate parties.

   I. The contractor will finalize the technical report, incorporating or addressing comments received from HPD.

2. For discoveries situations where a scope-of-work has not been approved:

   A. HPD will define a 50-foot-radius avoidance zone around the discovery (100-foot-radius if the discovery contains human remains) to remain in effect for the duration of investigations at the discovery.

   B. HPD will make recommendations regarding significance and eligibility for nomination to the National Register of Historic Places for each discovered property.

   C. If the property is eligible, HPD will establish a schedule to complete treatment.

D. HPD will prepare or direct a cultural resource management contractor to provide a scope-of-work within five (5) working days of the request.

E. The methods of excavation, recordation, conservation, analysis, preservation, storage, consultation, and reporting of discoveries shall be consistent with the scope-of-work, the general and specific methods of treatment outlined below, and stipulations of any existing memorandum of agreement or programmatic agreement applicable to the undertaking.

F. Upon approval of the scope-of-work by HPD, HPD will direct its contractor to implement the plan.

G. HPD will simultaneously notify the BIA and all declared interested parties upon the completion of treatment.

H. BIA will wait three (3) working days after work is completed at the discovery before letting the project contractor continue work in the avoidance zone.

I. The results of investigations at a discovery will be incorporated into a draft technical report. Confidential data resulting from the ethnographic assessment and provenience data for all cultural and historic sites will be provided in one or more detachable appendices. Confidential appendices will only be distributed to appropriate parties.

J. The contractor will finalize the technical report, incorporating or addressing comments received from HPD.

GENERAL METHODS OF TREATMENT

In all discovery situations the existing ground surface in the vicinity of the discovery will be mapped to show the relationship of the discovery to the project area, topographic features, cultural features, and surface artifacts. The map will be prepared using, at a minimum, a compass and measuring tape.

ARCHAEOLOGICAL METHODS: Assessment and treatment of cultural resources may be accomplished using archaeological methods. Data recovery strategies for historic properties may include in situ preservation, scientific testing and excavation, and documentation. This information will be used to develop a scope-of-work for treatment of affected properties. The plan will be implemented after approval of HPD.

The general process for treatment of archaeological components of historic properties is as follows:

1. Assessment of situation by a qualified archaeologist.

2. Development of a strategy to determine the significance of the property if significance is not explicit from visible evidence. Initiate a testing program if necessary.

3. Development of a strategy for data recovery and implementation of the plan for data recovery.

ETHNOGRAPHIC METHODS: Assessment and treatment of cultural resources and burials may be accomplished using ethnographic methods. Methods include conducting interviews with chapter officials, local and customary land users, and other knowledgeable individuals to elicit information regarding these surface features. This information will be used to develop a scope-of-work for treatment of affected properties. The plan will be implemented after approval of HPD.

The general process for treatment of traditional cultural properties, historical sites, and burials (not found in the context of a historic property) is as follows:

1. Assessment of situation by a qualified anthropologist and/or cultural specialist.

2. Consultation with chapter officials, local and customary land users, and other knowledgeable individuals.

3. In the case of unclaimed human remains, consultation with interested parties, including officials from other Indian tribes.

4. Development of a scope-of-work, in consultation with HPD.

5. Implementation of the scope-of-work upon approval by HPD.

6. Preparation of a technical report; confidentiality of information will be ensured.

Burials not found in the context of a historic property will be treated in accordance with the Navajo Nation Policies and Procedures Concerning the Protection of Cemeteries, Gravesites and Human Remains and the Native American Graves Protection and Repatriation Act.

SPECIFIC METHODS OF TREATMENT

The following methods of treatment are offered for situations in which a research design or scope-of-work has not been approved for the undertaking. If a research design or scope-of-work has been approved for a specific undertaking, discovered historic and cultural properties, and human remains, shall be treated in a manner consistent with the research design or scope-of-work, using the following treatment methods as a guideline.

ASH STAINS, HEARTHS, AND OTHER THERMAL FEATURES: The location will be mapped and the feature will be profiled and photographed. Excavated fill will be screened through quarter-inch or smaller mesh. If it appears that the feature can be dated through association of artifacts or stratigraphy, appropriate samples may be taken, including charcoal fragments for radiocarbon dating. Should the feature appear likely to yield botanical remains, pollen and flotation samples may be collected. HPD must be consulted before any samples are analyzed.

STORAGE PITS: The location will be mapped and the feature will be profiled and photographed. The feature will be fully excavated, and the fill must be screened through quarter-inch or smaller mesh screen. If it appears that the feature can be dated through association of artifacts or stratigraphy appropriate samples may be taken. Should the feature appear likely to yield botanical remains, pollen and flotation samples may be collected. All artifacts will be collected. HPD must be consulted before any samples are analyzed.

BURIED OR PARTIALLY BURIED STRUCTURES, MIDDENS, AND OTHER FEATURES: Examples of buried or partially buried features include pit structures, pothouses, and kivas. The location will be mapped and the feature will be profiled and photographed. Treatment of buried or partially buried features is a two-stage process involving (1) nature and extent testing within the area of effect to define the boundary of the feature and detect the presence of additional features and (2) data recovery within the area of effect. Systematic trenching in conjunction with 1 by 1 m test units, or other subsurface investigative techniques, may be used within the area of effect. Consultation with HPD is required after the initial recording has been completed for review of the data recovery plan.

Excavated fill will be screened through quarter-inch or smaller mesh. If it appears that the feature can be dated through association of artifacts or stratigraphy, or by radiographic or archeomagnetic dating, appropriate samples may be taken. Should the feature appear likely to yield botanical remains, pollen and flotation samples may be collected. HPD must be consulted before any samples are analyzed.

MISCELLANEOUS PREHISTORIC FEATURES: Examples of miscellaneous features include buried cultural horizons and agricultural features. The location will be mapped and the feature will be profiled and photographed. The strategy for treatment of miscellaneous prehistoric features is the same as that for buried or partially buried features.

SURFACE FEATURES: Examples of surface features include field houses, jacal structures, ramadas, masonry structures, historical, contemporary, and modern structures, and various types of historic landscapes. The location will be mapped and the feature(s) will be photographed. Treatment of surface features may be a multistage process involving (1) intensive and extensive documentation of the property to define the boundary of the feature and detect the presence of additional features, (2) consultation with local and customary users, and other knowledgeable individuals, in order to determine the nature of the site, place, property, or feature and recommend a treatment plan, and (3) implementation of data recovery or the treatment plan within the area of effect.

The strategy discussed above for treatment of buried or partially buried features may be the appropriate way to treat some surface features and should be used as a guideline for data recovery. Alternatively, the strategy espoused below for traditional cultural properties and historical sites may be more appropriate and should be used as a guideline for treatment.

TRADITIONAL CULTURAL PROPERTIES (TCPS) AND HISTORICAL SITES: Examples of traditional or historical features include named landscape features, mineral or herb gathering areas, offering areas, hogans, trail markers, cairns, sheep corrals, ceremonial sites (e.g., Enemy Way sites), sweathouses, and tepee grounds. If a TCP or historical site is encountered, or information about a possible site is provided to the project sponsor or their agent by any knowledgeable or concerned individual, the project sponsor must ensure that work is discontinued within a 50-foot-radius of the property and contact HPD within one (1) day of the discovery. Treatment of TCPs or historical sites is a two-stage process involving (1) consultation with HPD along with local and customary users, and other knowledgeable individuals, in order to determine the nature of the site, place, property, or feature and recommend a scope-of-work and (2) implementation of the scope-of-work. Examples of treatment include, but are not limited to, the following:

1. Avoiding the remaining portion of the property through use of protective fencing or redesign of the undertaking or project.

2. Monitoring the remaining portion of the property during construction and/or erection of protective fencing to ensure protection.

3. Moving material remains of the TCP. This activity may include participation of local medicine men or women for ceremonial blessings.

4. Restricting construction activities to certain seasons or times of the day.

5. Conducting ceremonies for the well-being of properties that have been affected.

HPD will recommend the best possible treatment as guided by interviews and consultation.

HUMAN REMAINS: If human remains (whether modern, contemporary, historical, or prehistoric) are encountered at *any* phase of work, the project sponsor shall immediately take steps to preserve and protect the remains in situ. Work must cease within a 100-foot-radius of the remains and HPD must be contacted within one (1) working day of the discovery. Treatment of the human remains shall be dependent upon consultation with HPD. *Under no circumstances* shall the project sponsor or the project contractor further disturb human remains except under the formal direction of HPD. All human remains must be treated in accordance with the laws of the Navajo Nation. Claimed human remains shall not be disturbed without the consent of the next-of-kin. Unclaimed human remains shall be treated according to the provisions of the Navajo Nation Policies and Procedures Concerning the Protection of Cemeteries, Gravesites and Human Remains and the Native American Graves Protection and Repatriation Act.

THE NAVAJO NATION
CULTURAL RESOURCES PROTECTION ACT
(NNCRPA)
TRIBAL COUNCIL RESOLUTION CMY-19-88

CONTENTS

§ 1001. Findings

A. This Act may be cited as the “Navajo Nation Cultural Resources Protection Act”.

B. The Navajo Tribal Council finds and declares that:

1. The spirit and direction of the Navajo Nation are founded upon and reflected in its cultural heritage;

2. The cultural heritage of the Navajo Nation should be preserved as a living part of our community life and development in order to give a sense of orientation to the Navajo People;

3. Cultural properties of the Navajo Nation are being lost or substantially altered, often inadvertently, with increasing frequency;

4. The preservation of this irreplaceable cultural heritage is in the interest of the Navajo Nation and its people so that its vital legacy of cultural, educational, esthetic, inspirational, economic, and energy benefits will be maintained and enriched for future generations of Navajos;

5. In the face of ever increasing energy development, economic development, sanitation and public health developments, the present Tribal governmental and non-Tribal governmental programs to preserve the Navajo Nation’s cultural resources are inadequate to ensure future generations a genuine opportunity to appreciate and enjoy the rich heritage of the Navajo Nation;

6. Increased knowledge of our cultural resources, the establishment of better means of identifying and administering them, and fostering their preservation will improve the planning of federal, Tribal, state and other projects and will assist economic growth and development and expeditious project implementation; and

7. Although the major role in cultural resource preservation has been borne by the federal and state governments, and both must continue to play a role, it is nevertheless essential that the Navajo Nation expand and accelerate its cultural resource preservation programs and activities.

§1002. Policy

It shall be the policy of the Navajo Nation, in cooperation with the states, federal government, other Indian Tribes, and private organizations and individuals to:

A. Use appropriate measures to foster conditions under which our modern society and our cultural resources can coexist in productive harmony and fulfill the social, economic and other requirements of present and future generations;

B. Provide leadership in the preservation of cultural resources of the Navajo Nation;

C. Administer Navajo Nation-owned, administered or controlled cultural resources in a spirit of stewardship and for the inspiration of present and future generations;

D. Contribute to the preservation of non-Navajo Nation-owned cultural resources and give maximum encouragement to organizations and individuals undertaking preservation by private means;

E. Encourage the public and private preservation and utilization of usable elements of the Navajo Nation’s stock of historic buildings and structures.

§ 1003. Definitions

As used throughout this Act, the term:

A. "Archaeology Department" means the Navajo Nation Archaeology Department.

B. "Building" means any structure made by man primarily to provide shelter.

C. "Cultural property" means any cultural resource deemed to be important enough to warrant listing in the Navajo Register.

D. "Cultural resource" means any product of human activity, or any object or place given significance by human action or belief.

E. "Department" means the Navajo Nation Historic Preservation Department.

F. "District" means any discrete area comprising buildings, objects, sites or structures that form a recognizable, unified whole.

G. "Indian" or "Indian person" mean any enrolled member of an Indian Tribe recognized by the Secretary of the Interior.

H. "Lands in which the Navajo People have a historical interest" means all lands historically or traditionally used by the Navajo People.

I. "Navajo Lands" means those lands held in Trust for the benefit of the Navajo Nation and those lands which the Navajo Nation holds in fee simple or in which it has a legal interest.

J. "Navajo Landmarks" means those cultural properties that are of significance to the entire Navajo Nation.

K. "Navajo Register" means the Navajo Nation Register of Cultural Properties.

L. "Object" means a product of human activity or an item given significance or meaning by human activity or belief.

M. "Place" refers to an identifiable location at which an event occurred or a location given significance by human action or belief.

N. "Preservation Officer" means the Navajo Nation Historic Preservation Officer, who is the Director of the Navajo Nation Historic Preservation Department.

O. "Site" means the location of the physical remains of human activity.

P. "Sponsor" means the agency official or the official in a private capacity that has decision making authority over a particular undertaking.

Q. "Structure" means construction resulting from human activity, the primary purpose of which is other than to provide shelter.

R. "Tribal Archaeologist" means the Navajo Tribal Archaeologist, who is the director of the Archaeology Department.

S. “Undertaking” means any project, activity, or program that can result in changes in the character or use of cultural properties, if any such cultural properties are located in the area of potential effects. The project, activity or program must be under the direct or indirect jurisdiction of a Sponsor. Undertakings include new and continuing projects, activities or programs not previously considered under the authority of this Act.

§ 1004. Historic Preservation Department

The Navajo Nation Historic Preservation Department (hereafter referred to as the “Department”) within the Division of Resources shall be the Navajo Nation’s agency responsible for the protection, preservation and management planning for the Navajo Nation’s cultural resources. The department shall be directed by the Navajo Nation Historic Preservation Officer (hereafter referred to as the “Preservation Officer”) who shall advise the President of the Navajo Nation, the Navajo Nation Tribal Council, the divisions, departments, programs, agencies, authorities, enterprises and any other instrumentalities of the Navajo Nation, the federal, state and local governments, private organizations and individuals on matters pertaining to cultural resource preservation to achieve the goals of this Act on Navajo lands, and on lands in which the Navajo people have a historical interest. The Department shall conduct such other activities authorized in accordance with the Department’s approved Plan of Operation.

§ 1005. Archaeology Department

The Navajo Nation Archaeology Department (hereafter referred to as the “Archaeology Department”) within the Division of Resources shall be the Navajo Nation’s agency for providing cultural resources services to project sponsors. The Archaeology Department shall be directed by the Navajo Tribal Archaeologist (hereafter referred to as the “Tribal Archaeologist”), who shall be responsible for organizing and providing cultural resource services to sponsors, including instrumentalities of the Navajo Nation, Navajo people, other agencies and industry in need of cultural resources services both on and off the Navajo Reservation. The Tribal Archaeologist shall also organize and implement, in consultation with the Preservation Officer, a program of archaeological and anthropological research designed to enhance and benefit the Navajo Nation’s cultural resources. The Archaeology Department shall conduct such other activities authorized in accordance with its approved Plan of Operation.

§ 1006. Navajo Nation Museum

The Navajo Tribal Museum shall be the repository for all cultural resources collected on Navajo Lands. The Navajo Tribal Museum shall conduct such other activities authorized in accordance with its approved Plan of Operation

§ 1011. Navajo Nation register of cultural properties and cultural landmarks

A. The Preservation Officer shall create, expand, maintain and administer a Navajo Nation Register of Cultural Properties (hereafter referred to as the “Navajo Register”) comprising buildings, districts, objects, places, sites and structures significant in Navajo Nation history, architecture, archaeology, engineering, and culture.

B. The Preservation Officer shall create, expand, maintain and administer a program for designation of Navajo Nation Cultural Landmarks (hereafter referred to as “Navajo Landmarks”), which shall include those cultural properties of significance to the entire Navajo Nation.

C. Cultural properties on Navajo lands shall be deemed to be included in the Navajo Register if, as of the date of enactment of the Navajo Nation Cultural Resources Protection Act, they are

1. Historic properties listed in the National Register of Historic Places;

2. Historic properties designated National Historic Landmarks;

3. Natural areas designated National Natural Landmarks;

4. Cultural properties included in the National Park System at Navajo National Monument, Canyon de Chelly National Monument, and Chaco Canyon National Historical Park; and

5. Archaeological sites designated as Chaco Protection Sites pursuant to P.L. 96-550.

D. The Preservation Officer shall establish a program to locate, inventory, and evaluate cultural resources on Navajo lands and to list all such resources as may be eligible in the Navajo Register and to designate such properties as may qualify as Navajo Landmarks.

§ 1021. Protection of Cultural Properties

In order to ensure the protection of the cultural properties of the Navajo Nation, the Sponsor of any undertaking must obtain the approval of the Preservation Officer prior to implementation or authorization of any undertaking by the Sponsor.

§ 1031: Prohibited Activities

No cultural property may be visited or investigated on Navajo Lands, except those cultural properties designated as open to the public within the boundaries of a Navajo Nation Park or a National Park or Monument; nor may any person alter, damage, excavate, deface, destroy or remove, any cultural properties on Navajo lands. No person may sell, purchase, exchange or transport cultural resources from Navajo lands. No person may engage in ethnographic research on Navajo lands: Except that such activities may be conducted under the authority of and in accordance with the stipulations of a valid Navajo Nation Cultural Resources Permit issued by the Preservation Officer under the authority of § 1032.

§ 1032. Permits

A. There shall be three classes of Permits.

1. *Class A* permits shall be issued for activities involving casual visitation and inspection of cultural properties.

2. *Class B* shall be issued for cultural resource inventory activities involving no collection or disturbance of cultural resources.

3. *Class C* shall be issued for cultural resource investigations involving alteration, collection, excavation, removal or any disturbance of cultural resources or for ethnographic research.

B. Permits shall be issued only on a case-by-case basis, except that organization qualifying for a Class 1 or 3 under Navajo preference pursuant to Navajo Nation Code may be granted blanket Class B permits. The Preservation Officer may waive this requirement whenever he or she finds that issuance of a blanket Class B permit is in the best interests of the Navajo Nation and its people.

C. Permits shall not be issued for periods to exceed 12 months, except when necessary to cover the duration of a single project.

§ 1033. Exceptions

A. The prohibition against visitation of cultural resources does not apply to enrolled members of the Navajo Nation or to Navajo Nation employees engaged in official activities.

B. The prohibition against alteration, collection, disturbance, excavation or removal of cultural resources or collection of ethnographic data do not apply to:

1. Navajo traditional practitioners engaging in activities directly relating to the practice of traditional Navajo religion; or

2. To Navajo Nation employees engaged in official business, relating to cultural resources management activities approved in accordance with Departmental rules and procedures.

§ 1034. Permit requirements

Any person proposing to visit or inspect cultural resources, undertake cultural resources inventory, alter, collect, excavate or remove cultural resources or engage in ethnographic research, who is not exempted pursuant to § 1033 of this Act, shall apply to the Preservation Officer for a Navajo Cultural Resources Permit for the proposed activity. The Preservation Officer may issue a Permit to any qualified individual, subject to appropriate terms and conditions.

§ 1035. Suspension of permits

A. The Preservation Officer may suspend a Permit without cause upon determining that continuation of activities under a permit would not be in the best interests of the Navajo Nation or its people. Such a suspension is made without liability to the Navajo Nation, its agents or employees. Such a suspension shall not prejudice the ability of the permit holder to hold or obtain other permits.

B. The Preservation Officer may suspend a permit for cause upon determining that any term or condition of a permit is not being met by the permit holder.

§ 1036. Revocation of permits

A. The Preservation Officer may revoke a permit without cause upon determining that continuation of a permit is not in the interests of the Navajo Nation or its People. Such a revocation is made without liability to the Navajo Nation, its agents and employees. Such revocations shall not prejudice the ability of the permit holder to hold or obtain other permits.

B. The Preservation Officer may revoke a permit for cause upon finding that:

1. Any of the terms or conditions of a permit has been willfully violated;
2. A permit-holder has engaged in activities prohibited by this Act; and
3. A permit-holder has engaged in activities that resulted in the prior suspension of a permit.

§ 1037. Criminal Penalties

Any Indian person violating the provisions of §1301 of this Act shall be subject to criminal penalties.

A. Any Indian person who:
   1. Engages in cultural resource inventory activities except under the authority of a Class B permit, or
   2. Who alters, collects, damages, destroys, excavates or removes cultural resources except under the authority of Class C permit or under the exception provided by § 1033 of this Act, shall upon conviction, be guilty of a misdemeanor and subject to punishment of up to one year in jail and a fine of up to one thousand dollars ($1000).

§ 1038. Civil assessments

Individuals violating the prohibitions in § 1031 or § 1037 of this Act shall be subject to civil assessments. Civil assessments shall be imposed by the Resources Committee of the Navajo Nation Council (hereafter referred to as the Resources Committee"), in accordance with procedures adopted by the Resources Committee expressly for this purpose. The Resources Committee shall adopt such procedures within 90 days of the adoption of this Act.

A. Violation of the provisions of § 1031 or § 1037 of this Act by any person, who does business on the Navajo Nation, shall be grounds for withdrawal of the privilege of doing business on the Navajo Nation. The Resources Committee shall consider whether or not to recommend to the Navajo Nation Council that any individual found to have violated § 1031 or § 1037shall lose the privilege of doing business on the Navajo Nation.

B. Any non-Indian who visits or inspects cultural resources on Navajo lands without a valid Class A permit shall be committing trespass. Such individuals determined to be in trespass after a hearing before the Resources Committee of the Navajo Nation Council, shall be assessed a civil forfeiture of not more than one hundred dollars ($100.00) for the first offense and not more than five hundred dollars ($500.00) for each subsequent offense. For the purposes of this part, each visit to or inspection of a cultural resource on Navajo Lands shall be considered a separate offense. The Resources Committee may, at its discretion, recommend to the Navajo Nation Council that any person found to be in trespass be excluded from the Navajo Nation.

C. Any non-Indian who engages in cultural resources inventory activities on Navajo lands, except under the authority of a valid Class B permit shall be committing trespass. Any individual determined to be in trespass after a hearing before the Resources Committee, shall be assessed a civil forfeiture of not more than one thousand dollars ($1000) for each offense. For the purposes of this part, each inventory on Navajo lands shall be considered a separate offense. The Resources Committee shall consider whether or not to recommend to the Navajo Nation Council that any individual found to have violated this prohibition shall be excluded from the Navajo Nation.

D. Any individual within Navajo lands who alters, collects, damages, defaces, destroys, excavates, removes or sells cultural resources or who collects ethnographic data without a valid Class C permit, or as permitted under the exceptions detailed in § 1033, or who engages in activities in violation of the terms and conditions of a valid permit shall be liable, after a hearing before the Resources Committee, to the Navajo Nation for civil damages as determined by the Resources Committee as follows:

   1. Assessment of Actual Damages. The Resources Committee shall impose the civil assessments based upon actual damages in accordance with "Standards for Assessing Damages to Cultural Properties" that the Resources Committee shall adopt expressly for this purpose. The "Standards for Assessing Damages to Cultural Resources" shall include, but need not necessarily limit consideration to:

a. Full costs of restoration of the cultural resource;
b. Enforcement and administrative costs associated with the civil action;
c. Costs of disposition of cultural resources, including as appropriate, costs of curation in perpetuity;
d. Costs associated with documentation, testing and evaluation of the cultural resource in order to assess the characteristics of the cultural resource and plan for its restoration; and
e. Costs of any additional mitigation measures the Resources Committee deems appropriate to implement.

2. Assessment of Treble Damages. In addition to the actual damages, the Resources Committee may, at its discretion, assess damages of up to three (3) times the amount of the actual damages.

3. Seizure of Equipment and Cultural Resources. The citing officer shall seize all cultural resources in the possession of any individual cited under § 1031 of this Act, together with any other property used for or related to the violation in the possession of the individual cited, as the officer may deem necessary to obtain payment of any civil assessment.

4. Forfeiture of Cultural Resources and Property. After hearing before the Resources Committee:
a. Any cultural resources obtained in violation of this Act shall be forfeited to the Navajo Nation;
b. Any other property seized in accordance with § 1038(D) (3), shall be released to the owner upon timely payment of any related civil assessments;
c. Any seized property shall be forfeited to the Navajo Nation if the assessment has not been paid within 15 days of the hearing at which the civil assessment was levied or pursuant to this Act, whichever is later. Any such forfeiture shall be limited to the amount of the civil assessment. Any property remaining after forfeiture of property up to the value of the assessment shall be returned to the owner.

E. Civil assessments imposed under this part shall be reserved solely for the purposes of restoring damaged cultural resources and for meeting the purposes of this Act and shall be deposited in the Historic Preservation Revolving Account for disbursement in accordance with Tribal budgetary procedures.

F. Any individual assessed by the Resources Committee pursuant to § 1038of this Act shall have the right to appeal the decision of the Resources Committee to the Navajo Nation District Court as follows:
1. Any appeal must be filed in writing with the Navajo Nation District Court within thirty days of notification of the action of the Resources Committee;

2. The review by the Navajo Nation District Court shall be limited to:
a. Ensuring that the appellant received due process of law; and
b. Ensuring that any rights the individual may have under the Navajo Nation Bill of Rights and the Indian Civil Rights Act (25 U.S.C. § 1301-1341) were observed; and
3. Consideration by the Navajo Nation District Court shall be limited to review of the administrative record created before the Resources Committee during the hearing before it.

§ 1041. Appeals

A. Any administrative action taken by the Preservation Officer pursuant to this Act which is a final action made on behalf of the Navajo Nation may be appealed by any party directly and adversely affected by such action. Notice of appeal must be filed within 30 days of notification of the Preservation Officer's action.

B. Within 90 days of the adoption of this Act, the Preservation Officer shall establish regulations governing appeals of administrative decisions reached under the authority of this Act. The regulations shall specify the

procedures governing appeals, identify who may appeal, detail notification requirements, establish time limits for action on the part of all parties, enumerate documentation requirements, and include any other elements necessary to carry out the purposes of this Section.

C. Any appellant adversely affected by the outcome of an appeal under regulations promulgated pursuant to § 1041(B) of this Act shall be entitled to review of the action in Navajo Nation District Court as follows:

1. Notice of an appeal under the provisions of this part must be filed with the Navajo Nation District Court within 30 days of receipt of notice of a final action by the Division of Natural Resources;

2. Judicial review by the Navajo Nation District Court shall be limited to:
   a. Ensuring that the appellant received due process of law, and
   b. Ensuring that all rights of the appellant under the Navajo Nation Bill of Rights and the Indian Civil Rights Act (25 U.S.C. 1301-1341) were observed.

3. Judicial review by the Navajo Nation District Court shall be limited to review of the administrative record created during the administrative appeals process.

§ 1051. Regulations, procedures, standards and guidelines

The Preservation Officer shall develop, promulgate, publish and implement such regulations, procedures, standards and guidelines necessary to implement the requirements of or to achieve the purpose of this Act.

§ 1061. Severability

If any provision of this Act or the application thereof to any person, court or circumstances is held invalid by a Navajo Nation or federal court, the invalidity shall not affect other provisions of this Act which can be given effect without the invalid provision or application and to this end; the provisions of this Act are severable.

NAVAJO NATION

POLICY FOR THE DISPOSITION OF CULTURAL RESOURCES COLLECTIONS

NAVAJO NATION
HISTORIC PRESERVATION DEPARTMENT

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1. INTRODUCTION

This policy establishes definitions, standards, procedures and guidelines to be followed for the disposition of cultural resources collections recovered on Navajo Nation Lands.

2. POLICY STATEMENT

It is the policy of the Navajo Nation to protect all cultural resources that it owns or that are under its jurisdiction. Under its obligation to the *Diyin diné'é* (Holy People) and as an expression of its sovereignty, the Navajo Nation will treat its cultural resources in a manner consistent with *Diné* (Navajo) values.

Hózhó, a natural state of harmony, beauty, and balance, is the very heart of the *Diné* way of life. The disturbance and/or removal of cultural resources disrupts *hózhó*. In order to avoid unnecessary disturbance to *hózhó*, it is the policy of the Navajo Nation to strongly discourage the excavation, disturbance or removal of any cultural resources unless there is a compelling need. When such disturbance occurs either accidentally or out of necessity, it is Navajo Nation policy to implement all prudent and feasible measures to return its' cultural resources to the cultural landscape.

Accordingly, the excavation of cultural resources may be permitted only after all alternative treatment measures (e.g., avoidance, protective fencing, project redesign, etc.) have been exhausted. When excavation or disturbance of cultural resources can not be avoided, such activities shall be carried out in the least intrusive and most expeditious manner possible.

When removal of material remains is completed, all appropriate analysis approved by the Historic Preservation Officer has been completed, and the resulting technical report accepted by the Historic Preservation Officer or his designee, the remains are to be promptly returned to the cultural landscape in accordance with this Policy.

The Navajo Nation Historic Preservation Department shall act on behalf of the Navajo Nation to achieve these objectives through the implementation of this Policy.

3. AUTHORITY

In accordance with Navajo Nation law and federal laws, including but not limited to: the Treaty of June 1, 1868 between the Navajo Nation and the United States, 156 Stat. 667; various United States statues and executive orders expanding the Navajo Indian reservation or otherwise confirming Navajo Nation ownership of Navajo Nation lands and all resources appurtenant thereto; the Archaeological Resources Protection Act of 1979, 16 U.S.C. 470aa-mm (ARPA); the National Historic Preservation Act of 1966, 16 U.S.C. 470. *et seq*. (NHPA); and the Native American Graves Protection and Repatriation Act, 25 U.S.C. 3001, *et seq*. (NAGPRA), the Navajo Nation owns all material remains located on, discovered on, excavated, collected or

removed from Navajo Nation Lands, except under limited circumstances where such law or laws expressly provide that such items are owned by private individuals.
Navajo Nation law and federal law further provide that the Navajo Nation controls the ultimate disposition of material remains owned by the Navajo Nation. Nothing in federal law severs the Navajo Nation's ownership and control of cultural resources from Navajo Nation lands, even when those items have been collected under properly approved federal permits issued under the Antiquities Act of 1906 or ARPA.

Where associated records/archival materials are or have been prepared and assembled pursuant to the Navajo Nation Cultural Resources Protection Act, 19 N.N.C. 1001 *et seq*. (CRPA) or in the absence of a valid permit under ARPA, the Antiquities Act or other applicable law, the Navajo Nation owns such associated records/archival materials. Where associated records/archival materials are or have been prepared and assembled pursuant to a valid Navajo Nation cultural resources permit (and where applicable, a federal permit), the Navajo Nation retains ownership both of those associated materials and any and all intellectual property rights relating to those items.

In accordance with these rights of ownership of material remains, associated records/archival materials, and the cultural heritage and intellectual property of the Navajo Nation this policy reflects Navajo Nation law concerning the disposition of material remains and associated records/archival materials in the possession of the United States, which nevertheless remain subject to the paramount rights of the Navajo Nation.

4. DEFINITIONS

For the purpose of this policy,

4.1. Associated Records/Archival Materials means original records (as well as any copies thereof) that were or are prepared, assembled, etc. to document efforts to locate, evaluate, document, study, preserve or recover cultural resources.

4.2. Collection means material remains that are excavated, collected or removed from a cultural resource, along with any associated records/archival materials. Some collections may consist of archival materials only.

4.3. Cultural Landscape (*Diné Bikéyah*) means the places that embody cultural meaning for the Diné, whether located within or outside the boundaries of the Navajo Nation. For the purpose of this policy, "cultural landscape" includes Diné individuals and communities.

4.4. Cultural Patrimony means objects having ongoing historical, traditional or cultural importance central to Diné traditional practitioners or clans (rather than property owned by an individual under the principles of Navajo common law) and which, therefore, cannot be alienated, appropriated or conveyed by any individual.

4.5. Cultural Property means any cultural resources deemed to be important enough to warrant listing in the Navajo Register, 19 N.N.C.1011.

4.6. Cultural Resource means any product of human activity or any object or place given significance by human action or belief, 19 N.N.C. 1003.D.

4.7. Curation/Curatorial Services means managing and preserving a collection according to professional museum and archival practices, including;

(i) Inventorying, accessioning, labeling, and cataloging a collection;

(ii) Identifying, evaluating, and documenting a collection;

(iii) Storing and maintaining a collection using appropriate methods and containers, and under appropriate environmental conditions and physical security controls;

(iv) Periodically inspecting a collection and taking such actions as may be necessary to preserve it;

(v) Providing access to and facilities for study of a collection; and

(vi) Handling, cleaning, stabilizing and conserving a collection in such a manner as may be necessary to preserve it.

4.8. Deaccession means to formally and permanently withdraw material remains from a collection.

4.9. Diné means the Navajo People.

4.10. *Hataa_ii* means a traditional Diné chanter/healer/practioner recognized as such by his or her community.

4.11. Historic Preservation Department (HPD) means the Navajo Nation Historic Preservation Department as established by CRPA 19 N.N.C. 1004.

4.12. Historic Preservation Officer means the Department Manager of the Historic Preservation Department or his/her designee.

4.13. Inadvertent Discovery means finding, locating, observing, uncovering, unearthing, learning about through conversation, discussion or interview or otherwise detecting cultural resources when such discovery was not the original intent of the activity.

4.14. Intentional Excavation means the removal of material remains from their original context for any purpose authorized by the HPD pursuant to CRPA.

4.15. Material Remains means artifacts, objects, specimens, and other physical evidence that are excavated or removed in connection with efforts to locate, evaluate, document, study, preserve or recover a prehistoric or historic cultural resource.

4.16. Museum Director means the Director of the Navajo Nation Museum.

4.17. Navajo Nation Lands means all lands or interests in land owned by or held by the Navajo Nation, whether held by original title, held in fee simple or held in trust by the United States, whether restricted or unrestricted, and whether within or outside the boundaries of the Navajo Nation.

4.18. Navajo Nation Museum means the museum established within the Historic Preservation Department by the Navajo Nation Museum Plan of Operation approved November 14, 1995, by Resolution No. GSCN-92-95.

4.19. Offering means a gift made to Diyin diné'é (the Holy People) or at holy places including, but not limited to; precious gems, feathers, songs, prayers, carved items, incense/smoke, pollen, cornmeal, botanical items, water or minerals.

4.20. Repository means a facility such as a museum, archaeological center, laboratory or storage facility managed by a university; college, museum, other educational or scientific institution; a Federal, State, or local Government agency or Indian Tribe that can provide professional, systematic, and accountable curatorial services.

4.21. Sacred Objects means specific ceremonial objects that either have been offered to Diyin diné'é or are needed for the practice of healing ceremonies or traditional Native American religions by their present-day adherents.

4.22. Site means the location of the physical remains of human activity, 19 N.N.C. 1003.O.

4.23. Special Collection means any collection or portion of a collection that requires special disposition, such as sensitive information; confidential information; fragile items; items that should only be viewed/used by persons of a particular age or gender, and/or items that can only be viewed/used at certain seasons of the year.

4.24. Sponsor means the agency official or an individual in a private capacity who has decision-making authority over a particular undertaking, 19 N.N.C. 1003.

4.25. Tribal Archaeologist means the Department Manager of the Navajo Nation Archaeology Department, 19 N.N.C. 1005.

4.26. Undertaking means any project, activity or program that can result in changes in the character or use of cultural properties. The project, activity or program must be under the direct or indirect jurisdiction of a Sponsor, 19 N.N.C. 1003.S.

5. COMPONENTS OF COLLECTIONS

Collections include material remains that are excavated or removed from a prehistoric or historic cultural resource, along with associated records/archival materials that are prepared or assembled in connection with the survey, excavation, removal or other study. Some collections may consist of archival materials only.

5.1. Material Remains

Classes of material remains (and illustrative examples) that may be in a collection include, but are not limited to:

(i) Components of structures and features (such as houses, pit structures, sweathouses, hornos, hearths, mills, fortifications, raceways, earthworks, and mound(s);

(ii) Intact or fragmentary artifacts of human manufacture (such as tools, weapons, pottery, basketry, and textiles);

(iii) Intact or fragmentary objects used by humans (such as rock crystals, feathers, and pigments);

(iv) By-products, waste products or debris resulting from the manufacture or use of cultural or natural material (such as slag, dumps, fire-cracked rock, cores, and debitage);

(v) Organic material (such as plant and animal remains);

(vi) Components of petroglyphs, pictographs, intaglios or other works of artistic or symbolic representation:

(vii) Environmental and chronometric specimens (such as pollen, seeds, wood, shell, bone, charcoal, tree core samples, soil, sediment cores, obsidian, volcanic ash, and baked clay); and

(viii) Paleontological specimens that are found in direct physical relationship with a cultural resource.

5.2. Associated Records/Archival Materials

Depending on the type of project, the following classes of associated records/archival material are illustrative examples of the materials that may be in a collection:

(i) Records relating to the identification, evaluation, documentation, study, preservation or recovery of a cultural resource, such as, site forms, field notes, drawings, maps, photographs, slides, negatives, films, video and audio tapes, oral histories, artifact inventories, laboratory reports, computer cards and tapes, computer disks and diskettes, information stored on other forms of electronic media, printouts of computerized data, manuscripts, reports, and accession, catalog, and inventory records;

(ii) Records collected by ethnographic means, such as interview notes, genealogies, tape recordings, video recordings, oral histories, and photographs;

(iii) Records relating to the identification of a cultural resource using remote sensing methods and equipment, such as, satellite or aerial photography and imagery, side scan sonar, magnetometers, and ground penetrating radar;

(iv) Public records essential to understanding the cultural resources, such as, deeds; survey plats; military and census records; birth, marriage, and death certificates; immigration and naturalization papers; tax forms and reports;

(v) Archival records necessary to understanding the cultural resources, such as historical maps, drawings and photographs; manuscripts; architectural and landscape plans; correspondence; diaries; ledgers; catalogs; and receipts; and

(vi) Administrative records relating to the survey, excavation or other study of the cultural resource, such as scopes of work, requests for proposals, research proposals, contracts, antiquities or ARPA permits, reports, popular summaries, documents relating to compliance with section 106 of the NHPA, and National Register of Historic Places nomination and determination of eligibility forms.

Oral history material forms a special class of associated records/archival materials. These materials include tape-recorded and/or video-recorded interviews or transcripts of interviews with individuals or group of individuals that provide information on Diné life stories or local community history.

6. ACQUISITION OF COLLECTIONS

The Navajo Nation assumes responsibility for cultural resource collections in a variety of ways. Such collections may be the result of intentional archaeological excavation, inadvertent discovery, and/or ethnographic investigation. Cultural resource collections may also be returned to the Navajo Nation by museums, libraries, researchers, federal and other agencies, private individuals, contractors, and others. Some collections may be obtained as a result of legal proceedings (e.g., the return of confiscated material).

6.1. Intentional Excavation and Inadvertent Discovery

(i) Intentional Excavation. (a) The excavation of cultural resources may only occur after all alternative treatment measures (e.g., avoidance, protective fencing, project redesign, etc.) have been considered and found to be infeasible. When mitigation is necessary, it shall be carried out in the least intrusive and most expeditious manner possible

(b) Sponsors and their agents shall consult with HPD and obtain the proper permits prior to collecting and/or conducting excavation and removal of cultural resources. To the extent feasible, research designs shall take into account the principles and traditional concerns inherent in this Policy. Sponsors and their agents shall utilize sampling and other strategies as appropriate and feasible in order to minimize disturbance of cultural resources and to minimize the size of collections. All mitigation measures for archaeological resources must be archaeologically justified, necessary and defensible, systematic, thorough, as well as culturally respectful.

(ii) Inadvertent Discovery. Sometimes cultural resources are discovered inadvertently, i.e., during the course of activities which are not otherwise intended identification, evaluate, and/or treat cultural resources. When cultural resources are inadvertently discovered, (a) all work in the vicinity (within 50 feet/15 meters) of the resource shall be halted and the resource secured from further damage. (b) The Historic Preservation Officer shall be consulted regarding the importance of the resource and feasible means to avoid damage to it. (c) If the resource can not be avoided, damage to the resource shall be mitigated in accordance with the decision of the Historic Preservation Officer and under the terms of a permit issued, as necessary, in accordance with section 6.1(i)(b) above.

6.2. Ethnographic Acquisition

Sponsors and their agents shall consult with HPD and obtain the proper permits before initiating ethnographic activities. To the extent feasible, research designs shall take into account the principles and traditional concerns inherent in this Policy.

Sacred and ceremonial information is held in trust by individuals for the Navajo Nation as a whole. Information regarding sensitive cultural practices, the location of sacred or culturally significant places is transmitted orally and is not intended to be written down. Traditional Diné do not make permanent records or representations of sacred or ceremonial stories, songs and sandpaintings because such permanent records might fall into the hands of people without proper instruction or individuals who might misuse the knowledge and, in either instance, may consequently harm themselves or others. Similar concerns surround the collection of personal information in life histories. Some kinds of information should never be collected or disseminated. Other types of information can only be shared during particular seasons of the year or with persons of a particular age, maturity level or gender, etc. Individuals who are required to collect and to disseminate such culturally sensitive information through necessary technical reports shall consult with *and* obtain prior written consent from the Historic Preservation Officer

Personal information provided by an interviewee belongs to that individual. Such information shall only be collected *after* obtaining the informed written consent of the interviewee and with their full understanding of its intended use and, if applicable, the nature, type and degree to which that information may have to be disseminated.

Confidential information shall not be released by Sponsors, their agents or others without both the informed written consent of the individual who provided it *and* the prior written approval of the Historic Preservation Officer. Confidential and other sensitive information (including locational data) shall be included in reports only as removable, confidential appendices. Audio and/or video tapes of interviews, transcripts, field notes, and other records and materials directly derived from the project shall not be retained by the Sponsor, its agent or others but shall become the property of the Navajo Nation and shall be submitted to the Historic Preservation Officer for appropriate disposition. Interviewees shall be made aware that information they provide will become part of collections and may be maintained in perpetuity.

6.3. Return of Pre-existing Collections

There are numerous collections of both sacred and culturally significant Navajo Nation materials in the possession of universities and colleges, museums, libraries, federal agencies, other agencies, researchers, private individuals, contractors, and other individuals. Such collections are of interest and concern to the Navajo Nation. It is the intent of the Navajo Nation to return portions or all of these collections for appropriate disposition or curation by the Navajo Nation. The repatriation of human remains, associated funerary items, and sacred objects will addressed in a separate Policy.

6.4. Return of Confiscated Collections

Disposition of collections obtained as a result of legal proceedings (e.g., confiscated items) shall be dealt with by the Historic Preservation Officer.

7. PROSCRIBED COLLECTIONS

In addition to general Diné prohibitions regarding disturbance of prehistoric remains, and a preference for leaving the cultural landscape intact, there are also traditional prohibitions regarding certain types of material that should *never, under any circumstances*, be collected; including items that (1) are sacred or of a ceremonial nature; (2) appear to be part of a ceremonial offering; or (3) are in any way related to human burial, including associated and isolated funerary remains such as ceramic vessels, ornaments, wash basins, eating utensils, broken shovels, etc. Sponsors, their agents, and others shall pay particular attention to locations and shall also avoid disturbance of remains that are or appear to be out of the ordinary, such as cairns, shrines or grouped pieces of precious stones.

To avoid inadvertent collection of sacred or ceremonials objects, Sponsors, their agents, and others shall conduct necessary surface collections with great care. As part of the research process, Sponsors, their agents, and others shall make a reasonable and good faith effort to gather appropriate and adequate contextual information (usually by way of ethnographic interviews) on locations which may be sacred, ceremonial or where other culturally sensitive materials might be thought to be present.

Sponsors, their agents, and others shall not collect the following:

1. *Hadaa_t'é ánídaalyaa'ígíí,* figurines typically constructed out of wood, cornmeal, gourd, clay, and/or other botanical materials. These figurines maybe anthropomorphic forms or representations of quadrupedal, reptilian or amphibian beings, which have been created to heal ailments for a specific Navajo person. Such figurines are not to be touched, handled or removed. However, should removal appear to be absolutely necessary for the purposes of an undertaking, an *hataa_ii* must be consulted for advice regarding appropriate treatment, and the removal and disposition must be specially approved in writing by the

Historic Preservation Officer. Evidence of the consultation, together with the *hataa_ii*'s advice or opinion must be provided to the Historic Preservation Officer.

2. Offerings of any kind; including; any grouping of *nt_'iz* – pieces of shell, turquoise, and jet, which may be found in association other minerals and with botanicals; *k'eet'áán*- botanical stems or pegs noticeably cut, notched, and decorated in association with the ladder, feathers, and cotton, and beads. Such offerings are not to be touched, handled or removed. However, should removal appear to be absolutely necessary for the purposes of an undertaking, a hataa_ii must be consulted for advice regarding appropriate treatment. The removal and disposition must be specially approved in writing by the Historic Preservation Officer. Evidence of the consultation, together with the hataa_ii's advice or opinion must be provided to the Historic Preservation Officer.
3. Retired *Jish* – sacred objects; examples include but are not limited to, items showing evidence of manufacture or human alteration, wood products, cut, carved, and/or shaped; pieces of prepared buckskin or leather-thongs, strips, pouches, bags, etc.; lithics; pottery; tobacco pipes; botanicals; gourds; animal and bird parts-hide, claws, horns, hooves, feathers, bone, etc.; shells; cotton string; yarn; etc. Such objects are not to be touched, handled or removed. However, should removal appear to be absolutely necessary for the purposes of an undertaking, a hataa_ii must be consulted for advice regarding appropriate treatment, and the removal and disposition must be specifically approved in writing by the Historic Preservation Officer. Evidence of the consultation, together with the hataa_ii's advice or opinion must be provided to the Historic Preservation Officer.

4. Human remains in any context.

5. Funerary items, including items potentially associated with human burials such as shovel heads, broken shovels, dishware of all sorts, saddles or portions of saddles, burned or unburned clothing, wash basins, etc.

6. Collection of information through ethnographic interviews can occur only after obtaining the interviewee's informed, written consent.

Sacred objects and offerings shall not be photographed or sketched without the prior written permission of the Historic Preservation Officer. Should removal or relocation of sacred objects or offerings be unavoidable, the Sponsor or its agent shall consult with and obtain the prior written approval of the Historic Preservation Officer.

8. ITEMS OF CULTURAL PATRIMONY

In accordance with NAGPRA and upon notice and formal request of the governing council or properly authorized representative of another federally recognized Indian tribe, government-to-government negotiation shall be initiated to return to such tribe objects of cultural patrimony belonging to that tribe that are in the possession of the Navajo Nation. Sacred objects and objects of cultural patrimony shall be expeditiously returned where (1) the requesting party is either the individual who originally owned the object or a direct lineal descendant of an individual who owned the object; or (2) the requesting Indian tribe can show that the object was owned or controlled by the tribe; or (3) the requesting Indian tribe can show that the object was owned or controlled by a member thereof, and that no identifiable lineal descendants have made a claim for the object. The place and manner of return of such objects shall be negotiated on a case-by-case basis. Each requesting Indian tribe shall afford the Navajo Nation reciprocity consistent with this policy.

9. OBTAINING INFORMATION AND ASSISTANCE

If Sponsors, their agents or others need assistance or information regarding sacred or culturally sensitive material, measures for protecting themselves or others against the potential ill effects of contact with sacred items (some of which are imbued with "power" that may be dangerous if inappropriately handled), traditional concern, interview methods, "culturally appropriate" activities or behavior, the role of Hataa_ii, and etc., they should contact the Historic Preservation Department.

10. DISPOSITION OF CULTURAL RESOURCES COLLECTIONS

10.1. Collection Disposition

Normally, collections of material remains will not be curated but will be returned to the cultural landscape. The Navajo Nation will curate or archive records. When the Navajo Nation accepts a collection for curation or archiving, it shall collect a fee to cover the expenses associated with that activity and the maintenance of the collection.

10.2 Collection Repository

The Navajo Nation Museum shall be the repository of cultural resources for those collections or parts of collections not returned to the cultural landscape that are obtained on Navajo Nation Lands. Records detailing disposition of collections shall be maintained and safeguarded by the Historic Preservation Officer or the Navajo Nation Museum.

10.3 Accessioning Collections

Sponsors, their agents, and others shall ensure that all parts of a collection to be accessioned by the Navajo Nation Museum are properly prepared for accessioning. Procedures for inventorying, identifying, evaluating, handling, cleaning, analyzing, labeling, cataloging, packaging, and storing collections shall be in accordance with standard professional practices. The Museum Director shall provide information including guidelines for preparing the collection for accessioning, as necessary. Collections deposited with the Navajo Nation shall include all information derived from the project that produced them.

Navajo Nation sacred and ceremonial objects shall only be dealt with in the context of repatriation activities. In the event that sacred or ceremonial objects are inadvertently collected, Sponsors, their agents, and others shall contact the Historic Preservation Officer and proceed as directed.

10.4 Collection Disposition Fee Schedule

The Museum Director shall develop and maintain a schedule of fees that shall assessed for collections accepted by the Navajo Nation Museum pursuant to this Policy. Fees shall be used to defray the cost of collection disposition. Fees may be waived by the Museum Director with the concurrence of the Historic Preservation Officer.

10.5 Disposition Process

Prior to making any decisions regarding disposition, the Museum Director shall ensure that the collection is properly assembled, inventoried, and accessioned. If material remains or associated records are missing, it shall be the project Sponsors', their agents or others responsibility to make a good faith effort to located the missing items and append them to the collection.

Some collections consist exclusively of original records (or copies thereof) that are prepared, assembled, and document efforts to locate, evaluate, document, study, preserve or recover a cultural resource; that is, of archival materials only (including audiovisual recordings). Such collections shall be curated in their entirety. The Museum Director shall insure that these collections are managed and preserved according to professional museum and archival practices. Collection management shall take into consideration traditional concerns, as appropriate.

Most cultural resource collections will include both material remains and associated records/archival materials. If the collection contains material remains that the Historic Preservation Officer determines should be held in perpetuity (e.g., items of exceptional historical or cultural significance, unusual items, museum quality items or representative samples from collections that may be important to maintain), the Museum Director shall ensure that these items are properly curated. All associated records shall be curated. Such collections (or portions thereof) shall be managed and preserved according to professional museum and archival practices. Collection management shall take into account appropriate Diné traditional concerns.

If the Historic Preservation Officer determines that certain material remains (e.g., sacred objects, ceremonial items, complete projectile points, complete tools, or complete ground stone implements) should be transferred to *Hataalii* or others for cultural reuse, the Historic Preservation Officer shall identify the appropriate recipient(s) and shall document the process by which the items are transferred. All documentation, including a Transfer of Caretaker Responsibility Form, shall be appended to the associated records for the collection and properly curated/archived.

10.6 Disposition Within the Project Area

To the greatest extent possible, material remains that are intentionally excavated as part of an undertaking shall be returned to the cultural landscape. Material remains should be replaced within the boundaries of the project area but outside the construction zone and in locations that are unlikely to be disturbed in the future. Material remains should be placed far enough below the surface of the earth so that items will neither be visible nor exposed by erosion or other disturbance.

They should not be placed in containers of any sort but should be allowed to continue to weather naturally. The items should be permanently marked in a manner approved by the Historic Preservation Officer to make it clear that they have been reburied. Sponsors or their agents are responsible for returning material remains to the cultural landscape unless the Historic Preservation Officers determines that the Navajo Nation will take responsibility for this activity. The Historic Preservation Officer shall ensure that the actual procedures used for reburial of materials remains are fully documented, including preparation of maps showing the locations of the reburied items. All documentation (including maps) shall be appended to the associated records for the collection and properly curated/archived.

To the greatest extent possible, material remains that were obtained through means other than intentional excavation (e.g., inadvertent discovery, return of pre-existing collections, or confiscation) shall also be returned to the cultural landscape. In such cases, the Historic Preservation Officer shall determine the appropriate location and process for disposition. The Historic Preservation Officer shall ensure appropriate involvement of individuals with surface use rights (if any); as well as the actual procedures used for return of the remains to the cultural landscape are fully documented (including maps, if appropriate.) All documentation (including maps) shall be appended to the associated records for the collection and properly curated/archived.

10.7 Disposition Outside of Established Project Boundaries

It is Navajo Nation policy to return remains to the cultural landscape as near as possible to the location from which they were removed. When it is not prudent or feasible to rebury within the approved project boundaries, the Sponsor or its agents must identify a suitable area for reburial. The location selected is subject to the approval of the Historic Preservation Officer.

The Sponsor or its agent must obtain the written consent of individuals (if any) with surface use rights recognized by the Navajo Nation when an area outside the project boundaries is proposed for reburial. The Sponsor or its agents must submit documentation of land user consent when requesting approval of the reburial location.

If there are no individuals with surface use rights legally recognized by the Navajo Nation, the Sponsor is responsible for obtaining the approval of the Chapter in which the proposed reburial is to be located.

11. ACCESS TO COLLECTIONS

The Historic Preservation Officer shall be responsible for establishing procedures and policies related to access to collections. Collections shall be made available for educational, scientific and traditional uses, subject to such terms and conditions as are necessary to protect and preserve the condition, research potential, religious or sacred importance, and uniqueness of the collection. Access to sacred, confidential, and other highly sensitive information may be limited on a seasonal or other basis. Access information shall be made available to individuals requesting access.

Collections (or portions thereof) may be loaned to other repositories, institutions or individuals for educational purposes, research, training, display, or other culturally appropriate purpose. Written loan agreements shall be prepared between the repository and the borrower that specify (a) the collection or item being loaned; (b) the purpose of the loan; (c) the length of the loan; (d) and restrictions on use of the collection or item; (e) the manner in which the collection or item must be handled; (f) requirements for insuring the collection or item being borrowed against loss, damage or destruction during transit or while the borrower's possession; and (g) any fees or charges associated with the loan and use of the collection or item.

In certain circumstances, the Historic Preservation Officer may decide to limit access to all or parts of the curated collection because it includes particularly sensitive information, confidential data, fragile items, items that should only be viewed or used during certain seasons of the year or by persons of a particular age or sex, and so forth. Such decisions shall be documented.

1. IDENTIFY UNDERTAKING

Pursuant to NNC 19 § 1021, "Prior to any ground disturbing activities, an archaeological clearance survey must be conducted." Undertakings include: installation of power/water, construction, homesite/ business site leases, road construction, assistance from federal agencies (Housing Improvement, NTUA),new construction/ demolition, utilization of federal money (NTUA, HUD, NAHASDA, IHS, etc.,

2. HIRE CONSULTANT

Consultant/Permittee listing can be requested from NNHPD at 928.871.7880 or tbillie@navajo-nsn.gov

3. CONSULTANT RESPONSIBILITY

1. Archaeologist will request Class "B" Permit from NNHPD.
2. It is illegal to survey on Navajo Nation Lands without a valid permit pursuant to NNC 19 §1034

4. REPORT PREPARATION PROCESS

1. Collection of project information
   a. Records check of files & maps at NNHPD
   b. Legal Survey Plat
2. Fieldwork
   a. In-field Survey
   b. Ethnographic data collection
   c. Site recording/mapping (if necessary)
3. Report Preparation (Copies should be distributed to sponsor)

5. NAVAJO NATION HISTORIC PRESERVATION (NNHPD)

1. Receive & Log in the report
2. Assign HPD Number
3. Review report (Usually 30-days from receipt date)
4. Issue Compliance Form

6. BUREAU OF INDIAN AFFAIRS

1. Cultural Resource Compliance Form received from NNHPD.
2. Reviewed by Area Archaeologist
3. Archaeological Approval granted by Navajo Regional Director (Signature)

7. NNHPD

1. The signed Compliance Resource Compliance Form is returned to NNHPD
2. HPD distributes copies to contractor, SHPO, Sponsor
3. Sponsor is responsible for submitting compliance form to Land Dept., Housing, NTUA, etc.
4. The process from Step 5 is approximately 6-8 weeks.

THE NAVAJO NATION
HISTORIC PRESERVATION DEPARTMENT
Cultural Resource Compliance Section

PO Box 4950, Window Rock, Arizona 86515
TEL: (928) 871-7198 / 7134 **FAX:** (928) 871-7886 **WEBSITE:** hpd.navajo-nsn.gov

To All Permittees and/or Contractors:

The Navajo Nation Historic Preservation Department, Cultural Resource Compliance Section is the caretaker of a unique collection of data for the Navajo Nation and the Navajo People. Due to the disappearance of cultural resource reports, archival maps, and in order to preserve this unique data, HPD is implementing the following copy policy:

1. There will be no Xerox copying of the USGS Quadrangle maps by archaeological contractors or researchers. **NO EXCEPTIONS**. Copying includes, scanning or any other electronic data collection or the use of personal copying machines.

2. Copying of the cultural resource reports will be limited to the following.
   A. Small Reports (i.e. AIRS form reports)
      a. The AIRs form
      b. Site forms
      c. Site maps
      d. Compliance document

   B. All other reports (narratives)
      a. Title page
      b. Site forms
      c. Site maps
      d. Compliance document

Failure to conform to these conditions may result in suspension or revocation of this privilege and may affect the permittee's ability to obtain annual and project specific-permits from the Historic Preservation Department.

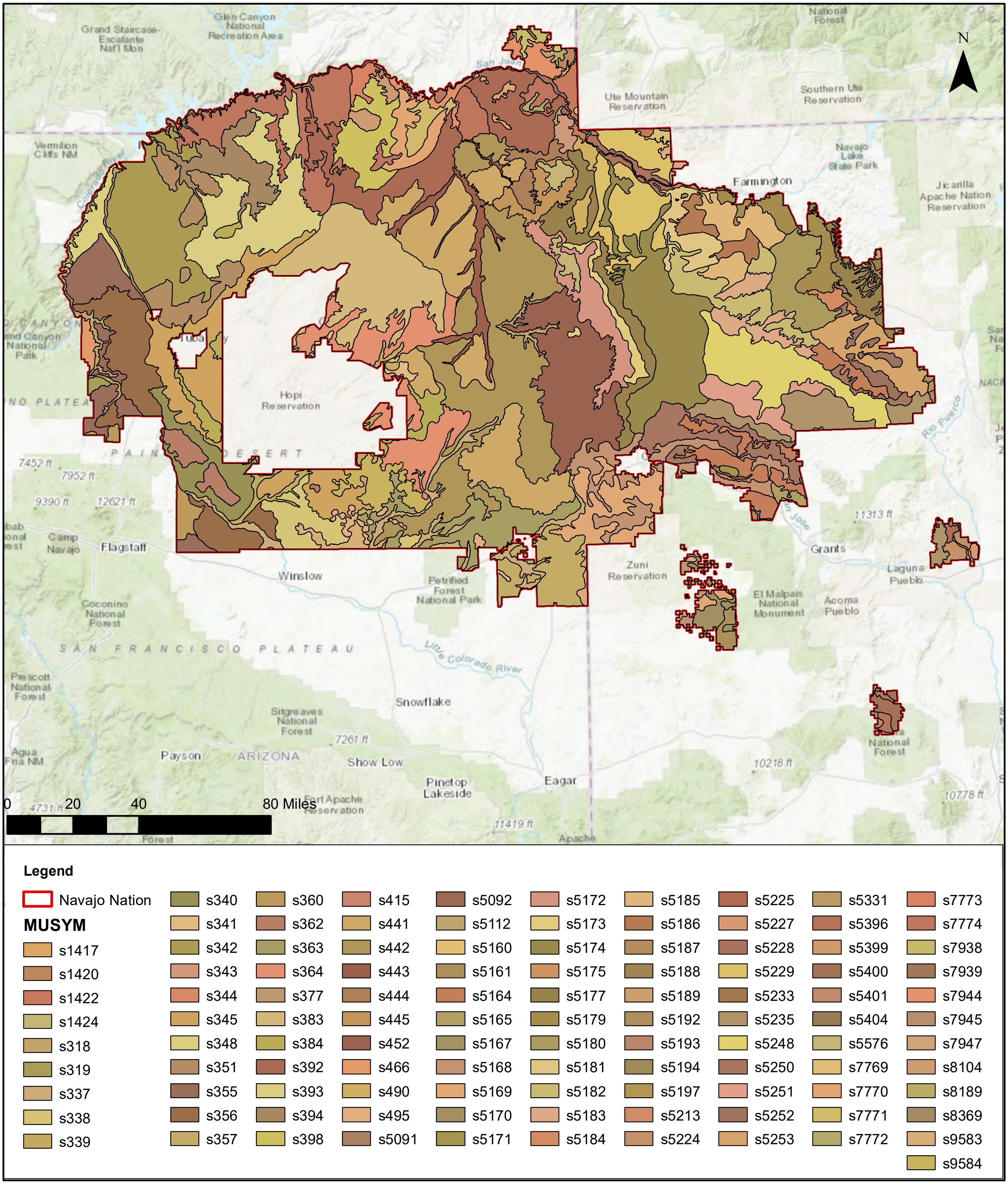
If you have any concerns or questions, please do not hesitate to contact our office.

Sincerely,
HPD/CRCS

Appendix I. Biological Assessment / Evaluation

Appendix J. Navajo Nation Soils

Navajo Nation Soils
Order 5 Soils
U.S. General Soils Map 2020



Order 5 Soils Names and Size on Navajo Nation

MUSYM	Map Unit Name	Acres on Navajo Nation
s318	Torriorthents-Rock outcrop (s318)	123,164.41
s319	Tovar-Toqui-Deama (s319)	13,327.62
s337	Tours saline-Sodic-Riverwash-Jocity saline-Sodic-Ives saline-Sodic-Burnswick (s337)	196,317.82
s338	Marcou-Jocity saline-Sodic-Burnswick (s338)	180,238.46
s339	Wepo-Polacca-Jocity-Jeddito (s339)	57,695.49
s340	Sheppard sodic-Sheppard-Joraibi-Jocity (s340)	213,763.50
s341	Torriorthents-Tewa-Sheppard-Jeddito (s341)	24,873.45
s342	Rock outcrop-Moenkopie (s342)	589,336.63
s343	Nakai-Monue-Blackston (s343)	34,897.05
s344	Purgatory-Epikom-Claysprings-Badland (s344)	1,903.33
s345	Sheppard-Nakai-Monue (s345)	566,221.70
s348	Pennell-Pagina-Kinan (s348)	96,330.44
s351	Wayneco-Sazi-Rock outcrop-Rizno-Palma-Mespun (s351)	244,619.37
s355	Winona-Tusayan-Boysag (s355)	295,913.41
s356	Rock outcrop-Needle-Epikom (s356)	466,884.26
s357	Sheppard-Palma-Hubert-Clovis (s357)	248,512.98
s360	Wupatki-Wukoki-Tuweep (s360)	59,905.86
s362	Rock outcrop (s362)	103,947.40
s363	Sheppard-Grieta (s363)	304,580.94
s364	Ustic Torriorthents-Penistaja-Mido-Begay (s364)	495,889.06
s377	Thunderbird-Springerville-Rudd-Cabezon (s377)	1,843.37
s383	Zyme-Tonalea-Kydestea (s383)	690,721.66
s384	Torriorthents-Badland (s384)	133,782.90
s392	Sogzie-Sheppard-Rock outcrop-Aneth (s392)	583,806.61
s393	Shedado-Rock outcrop-Mespun-Begay-Anasazi (s393)	569,018.64
s394	Ustollic Haplargids-Rock outcrop-Namon (s394)	238,125.41
s398	Sheppard-Rock outcrop-Monue-Moepitz (s398)	222,118.89
s415	Typic Haplustalfs-Rock outcrop-Eutric Glossoboralfs (s415)	935.71
s441	Rock outcrop-Piute-Bluechief (s441)	900,030.13
s442	Uzona-Shumbegay-Escavada (s442)	1,239,395.03
s443	Millett-Farview-Doakum (s443)	180,035.60
s444	Mido-Blanding-Arches (s444)	83,748.85
s445	Tunitcha-Klizhin-Akhoni (s445)	116,133.39
s452	Telescope-Royosa-Augustine (s452)	616,959.06
s466	Quintana-Kopie (s466)	32,690.00
s490	Nakai-Monue-Blackston (s490)	55,728.56
s495	Torriorthents-Calciorthids-Badland (s495)	45,472.48
s1417	Youngston-Torrifluvents	4,932.27
s1420	Rock outcrop-Redlands-Myton family-Moenkopie-Mack-Farb-Badland	12,704.13
s1422	Uzona-Rock outcrop-Myton family-Claysprings (s1422)	55,238.62
s1424	Romberg-Rock outcrop-Rizno-Littlenan-Cragola-Bodot	36.77
s5091	Typic Ustochrepts (s5091)	85.96
s5092	Typic Ustochrepts-Lithic Ustochrepts (s5092)	889.97
s5112	Cumulic Haplustolls (s5112)	493.39
s5160	Viuda-Rock outcrop-Penistaja (s5160)	1,096.93
s5161	Millpaw-Cantina-Cabezon (s5161)	32,493.90
s5164	Rock outcrop-Laporte (s5164)	260,423.61
s5165	Sparank-San Mateo-Penistaja-Mespun (s5165)	24,142.40
s5167	Raton-Lava flows-Charo (s5167	9,784.59
s5168	Rock outcrop-Flugle-Catman (s5168)	303,552.22
s5169	Rock outcrop-Nogal (s5169)	299,130.70
s5170	Teco-Rock outcrop-Montecito-Cabezon-Atarque (s5170)	55,540.54
s5171	Valnor-Techado-Rock outcrop-Mirabal-Kenray-Cinnadale (s5171)	9,074.98
s5172	Stout-Kiln-Hesperus (s5172)	238,820.84
s5173	Telescope-Royosa (s5173)	83,706.97

Order 5 Soils Names and Size on Navajo Nation

MUSYM	Map Unit Name	Acres on Navajo Nation
s5174	Kimbeto-Farb-Denazar (s5174)	644,144.82
s5175	Turley-Fruitland (s5175)	8,389.02
s5177	Weska-Travessilla-Rock outcrop-Oelop (s5177)	407,321.13
s5179	Persayo-Farb-Blancot-Badland (s5179)	169,652.11
s5180	Shiprock-Sheppard-Doak-Blancot (s5180)	231,275.97
s5181	Sheppard-Badland (s5181)	137,561.11
s5182	Sheppard-Notal-Huerfaco (s5182)	233,756.56
s5183	Rock outcrop-Badland(s5183)	158,926.59
s5184	Persayo-Fruitland-Blancot-Badland (s5184)	31,243.06
s5185	Shiprock-Sheppard-Avalon (s5185)	197,963.12
s5186	Uffens-Shiprock-Sheppard-Doak (s5186)	99,239.93
s5187	Orlie-Gobernador (s5187)	3,540.06
s5188	Sparank-San Mateo-Pinavetes-Florita (s5188)	26,838.67
s5189	Sedale-Penistaja (s5189)	9,309.01
s5192	Royosa-Pinitos (s5192)	6,946.88
s5193	Tsosie-Lybrook (s5193)	7.77
s5194	Ruson-Nalivag(s5194)	14.59
s5197	Menefee-Calendar-Berryman(s5197)	3,716.08
s5213	Tome-Bluepoint-Armijo-Adelino (s5213)	4,000.77
s5224	Silver-Penistaja (s5224)	29,700.83
s5225	Shingle-Kim (s5225)	8,982.82
s5227	Vinton-Kokan-Kim-Badland (s5227)	8,678.64
s5228	Tocito-Mesa-Cudei-Badland (s5228)	74,207.63
s5229	Persayo-Nataani-Littlehat-Awet (s5229)	376,595.22
s5233	Sparank-Sandoval-Querencia (s5233)	620.80
s5235	Zia-Sandoval-Rock outcrop (s5235)	303,160.59
s5248	Sparank-Sheppard-Fajada (s5248)	412,606.64
s5250	Rock outcrop-Mion-Atarque (s5250)	268,740.83
s5251	Kiki-Doak (s5251)	152,562.76
s5252	Doakum-Betonnie (s5252)	80,784.38
s5253	Tsosie-Councelor-Blancot (s5253)	213,977.92
s5331	Thunderbird-Rudd-Hubbell-Cabezon (s5331)	1,303.59
s5396	Loarc-Guy-Dioxice-Datil (s5396)	17,374.32
s5399	Rock outcrop-Motoqua-Mion-Abrazo (s5399)	1,980.25
s5400	Travessilla-Rock outcrop-Puertecito (s5400)	35,352.95
s5401	Lapdun-Datil-Celsosprings-Cascajo (s5401)	4,551.58
s5404	Weska-Travessilla-Rock outcrop-Dulce (s5404)	1,411.74
s5576	St. Thomas-Rock outcrop-Kyler (s5576)	70,678.24
s7769	Witt-Sharps-Ruinpoint-Rizno-Cahona (s7769)	16,144.60
s7770	Sheppard-Rock outcrop-Oljeto-Neskahi-Mota (s7770)	134,124.26
s7771	Rock outcrop-Piute-Moenkopie-Hoskinnini (s7771)	62,785.29
s7772	Whit-Sogzie-Sheppard-Rock outcrop (s7772)	26,900.82
s7773	Rock outcrop-Piute-Pickrell-Badland (s7773)	40,399.04
s7774	Rock outcrop-Lithic Torriorthents-Badland (s7774)	585,279.84
s7938	Ruinpoint-Rizno-Cahona (s7938)	25,800.26
s7939	Rock outcrop-Rizno-Mellenthin-Littlenan-Bodot (s7939)	4,327.91
s7944	Rock outcrop-Myton family-Moenkopie (s7944)	116,040.84
s7945	Nakai-Limeridge-Bluechief (s7945)	0.03
s7947	Sheppard-Rock outcrop-Piute (s7947)	260.62
s8104	Tosser-Sitar-Hiko Peak (s8104)	47,917.65
s8189	Rock outcrop-Clapper-Badland (s8189)	1.57
s8369	Water (s8369)	51,543.06
s9583	Torriorthents-Marcou-Claysprings-Burnswick-Badland (s9583)	50,877.44
s9584	Strych-Rock outcrop-Monue (s9584)	149,398.88

Component Legend

United States

Map unit symbol and name	Pct. of map unit	Component name	Component kind	Pct. Slope		
				Low	RV	High
s318: Torriorthents-Rock outcrop (s318)						
	90	Rock outcrop	Miscellaneous area	0	50	99
	10	Torriorthents	Taxon above family	35	67	99
s319: Tovar-Toqui-Deama (s319)						
	70	Deama	Series	0	4	8
	15	Toqui	Series	0	4	8
	15	Tovar	Series	15	38	60
s337: Tours saline-Sodic-Riverwash-Jocity saline-Sodic-Ives saline-Sodic-Burnswick (s337)						
	23	Tours	Series	1	2	3
	21	Burnswick	Series	1	3	5
	17	Jocity	Series	1	2	3
	11	Ives	Series	0	1	1
	11	Riverwash	Miscellaneous area	0	3	5
	6	Trail	Series	0	2	3
	6	Typic Torrifluvents	Taxon above family	0	3	5
	4	Navajo	Series	1	2	3
	1	Rock outcrop	Miscellaneous area	1	11	20
s338: Marcou-Jocity saline-Sodic-Burnswick (s338)						
	42	Burnswick	Series	1	3	5
	28	Marcou	Series	1	5	8
	22	Jocity	Series	1	2	3
	7	Claysprings	Series	1	6	10
	1	Rock outcrop	Miscellaneous area	1	11	20

Component Legend

United States

Map unit symbol and name	Pct. of map unit	Component name	Component kind	Pct. Slope		
				Low	RV	High
s339: Wepo-Polacca-Jocity-Jeddito (s339)						
	25	Jocity	Series	0	2	3
	20	Polacca	Series	0	2	3
	16	Wepo	Series	0	2	3
	13	Jeddito	Series	0	3	5
	9	Tewa	Series	1	3	5
	8	Sheppard	Series	1	5	8
	7	Monue	Series	1	5	8
	2	Rock outcrop	Miscellaneous area	5	33	60
s340: Sheppard sodic-Sheppard-Joraibi-Jocity (s340)						
	30	Sheppard	Series	1	8	15
	28	Sheppard	Series	1	5	8
	21	Jocity	Series	0	2	3
	10	Joraibi	Series	0	1	2
	6	Jocity	Series	0	1	2
	5	Torriorthents	Taxon above family	10	23	35
s341: Torriorthents-Tewa-Sheppard-Jeddito (s341)						
	31	Jeddito	Series	0	3	5
	23	Tewa	Series	1	3	5
	15	Sheppard	Series	1	5	8
	10	Torriorthents	Taxon above family	10	23	35
	9	Mido	Series	1	8	15
	6	Monue	Series	1	5	8

Component Legend

United States

Map unit symbol and name	Pct. of map unit	Component name	Component kind	Pct. Slope		
				Low	RV	High
s341: Torriorthents-Tewa-Sheppard-Jeddito (s341)						
	6	Rock outcrop	Miscellaneous area	5	33	60
s342: Rock outcrop-Moenkopie (s342)						
	50	Rock outcrop	Miscellaneous area	2	5	8
	25	Moenkopie	Series	2	5	8
	5	Bluechief	Series	2	5	8
	5	Casmos family	Family	2	5	8
	5	Monue family	Family	2	5	8
	5	Nakai	Series	2	5	8
	5	Sheppard	Series	2	5	8
s343: Nakai-Monue-Blackston (s343)						
	40	Monue	Series	2	4	6
	40	Nakai	Series	1	5	8
	20	Blackston	Series	0	1	2
s344: Purgatory-Epikom-Claysprings-Badland (s344)						
	48	Purgatory	Series	1	5	8
	23	Claysprings	Series	1	6	10
	15	Badland	Miscellaneous area	1	16	30
	11	Epikom	Series	1	7	12
	3	Rock outcrop	Miscellaneous area	1	11	20
s345: Sheppard-Nakai-Monue (s345)						
	32	Sheppard	Series	1	5	8
	26	Monue	Series	1	5	8

Component Legend

United States

Map unit symbol and name	Pct. of map unit	Component name	Component kind	Pct. Slope		
				Low	RV	High
s345: Sheppard-Nakai-Monue (s345)						
	24	Nakai	Series	1	3	5
	9	Typic Torriorthents	Taxon above family	10	23	35
	7	Tewa	Series	1	3	5
	2	Rock outcrop	Miscellaneous area	0	50	99
s348: Pennell-Pagina-Kinan (s348)						
	50	Kinan	Series	4	10	15
	35	Pennell	Series	4	10	15
	15	Pagina	Series	1	8	15
s351: Wayneco-Sazi-Rock outcrop-Rizno-Palma-Mespun (s351)						
	30	Palma	Series	2	5	8
	20	Mespun	Series	2	9	15
	15	Sazi	Series	2	5	8
	10	Rizno	Series	3	9	15
	10	Rock outcrop	Miscellaneous area	2	16	30
	10	Wayneco	Series	2	3	3
	5	Mellenthin	Series	4	17	30
s355: Winona-Tusayan-Boysag (s355)						
	65	Winona	Series	1	6	10
	20	Tusayan	Series	1	3	5
	15	Boysag	Series	1	6	10
s356: Rock outcrop-Needle-Epikom (s356)						
	61	Epikom	Series	1	7	12
	26	Rock outcrop	Miscellaneous area	1	6	10

Component Legend

United States

Map unit symbol and name	Pct. of map unit	Component name	Component kind	Pct. Slope		
				Low	RV	High
s356: Rock outcrop-Needle-Epikom (s356)						
	13	Needle	Series	1	6	10
s357: Sheppard-Palma-Hubert-Clovis (s357)						
	45	Clovis	Series	1	2	3
	25	Palma	Series	0	4	8
	20	Sheppard	Series	1	5	8
	10	Hubert	Series	0	4	8
s360: Wupatki-Wukoki-Tuweep (s360)						
	40	Tuweep	Series	0	8	15
	35	Wukoki	Series	1	8	15
	25	Wupatki	Series	0	8	15
s362: Rock outcrop (s362)						
	80	Rock outcrop	Miscellaneous area	2	36	70
	3	Arches	Series	2	9	15
	3	Batterson	Series	2	24	45
	3	Bond family	Family	1	6	10
	3	Lava flows	Miscellaneous area	2	14	25
	3	Magotsu	Series	2	11	20
	3	Yaki	Series	3	19	35
	2	Cinder land	Miscellaneous area	15	45	75
s363: Sheppard-Grieta (s363)						
	62	Grieta	Series	3	7	10
	38	Sheppard	Series	1	7	12

Component Legend

United States

Map unit symbol and name	Pct. of map unit	Component name	Component kind	Pct. Slope		
				Low	RV	High
s364: Ustic Torriorthents-Penistaja-Mido-Begay (s364)						
	31	Begay	Series	1	5	8
	29	Penistaja	Series	1	5	8
	19	Mido	Series	1	8	15
	14	Ustic Torriorthents	Taxon above family	10	23	35
	7	Rock outcrop	Miscellaneous area	5	33	60
s377: Thunderbird-Springerville-Rudd-Cabezon (s377)						
	60	Thunderbird	Series	2	16	30
	15	Cabezon	Series	2	16	30
	15	Rudd	Series	0	8	15
	10	Springerville	Series	0	10	20
s383: Zyme-Tonalea-Kydestea (s383)						
	41	Kydestea	Series	5	28	50
	17	Zyme	Series	5	28	50
	14	Tonalea	Series	5	13	20
	9	Ustic Torriorthents	Taxon above family	5	33	60
	7	Rock outcrop	Miscellaneous area	5	33	60
	6	Begay	Series	1	5	8
	6	Penistaja	Series	1	5	8
s384: Torriorthents-Badland (s384)						
	57	Torriorthents	Taxon above family	10	23	35
	29	Badland	Miscellaneous area	8	29	50
	6	Monue	Series	1	5	8

Component Legend

United States

Map unit symbol and name	Pct. of map unit	Component name	Component kind	Pct. Slope		
				Low	RV	High
s384: Torriorthents-Badland (s384)						
	5	Sheppard	Series	1	5	8
	3	Rock outcrop	Miscellaneous area	5	33	60
s392: Sogzie-Sheppard-Rock outcrop-Aneth (s392)						
	45	Aneth	Series	0	4	8
	35	Sheppard	Series	3	8	12
	10	Rock outcrop	Miscellaneous area	0	15	30
	10	Sogzie	Series	1	5	8
s393: Shedado-Rock outcrop-Mespun-Begay-Anasazi (s393)						
	25	Begay	Series	1	8	15
	25	Shedado	Series	1	7	12
	20	Anasazi	Series	3	9	15
	15	Mespun	Series	0	10	20
	15	Rock outcrop	Miscellaneous area	0	8	15
s394: Ustollic Haplargids-Rock outcrop-Namon (s394)						
	40	Namon	Series	3	27	50
	30	Rock outcrop	Miscellaneous area	0	40	80
	30	Ustollic Haplargids	Taxon above family	10	25	40
s398: Sheppard-Rock outcrop-Monue-Moepitz (s398)						
	35	Monue	Series	1	5	8
	25	Moepitz	Series	1	5	8
	25	Sheppard	Series	3	8	12
	10	Rock outcrop	Miscellaneous area	2	7	12

Component Legend

United States

Map unit symbol and name	Pct. of map unit	Component name	Component kind	Pct. Slope		
				Low	RV	High
s398: Sheppard-Rock outcrop-Monue-Moepitz (s398)						
	5	Deleco	Series	2	11	20
s415: Typic Haplustalfs-Rock outcrop-Eutric Glossoboralfs (s415)						
	40	Eutric Glossoboralfs	Taxon above family	40	60	80
	40	Typic Haplustalfs	Taxon above family	40	45	50
	20	Rock outcrop	Miscellaneous area	0	50	99
s441: Rock outcrop-Piute-Bluechief (s441)						
	55	Piute	Series	3	17	30
	30	Bluechief	Series	1	5	8
	15	Rock outcrop	Miscellaneous area	1	36	70
s442: Uzona-Shumbegay-Escavada (s442)						
	40	Shumbegay	Series	0	13	25
	35	Uzona	Series	0	2	3
	25	Escavada	Series	0	1	1
s443: Millett-Farview-Doakum (s443)						
	60	Farview	Series	1	6	10
	25	Millett	Series	3	9	15
	15	Doakum	Series	0	5	9
s444: Mido-Blanding-Arches (s444)						
	50	Arches	Series	2	9	15
	35	Blanding	Series	2	6	10
	15	Mido	Series	0	5	10

Component Legend

United States

Map unit symbol and name	Pct. of map unit	Component name	Component kind	Pct. Slope		
				Low	RV	High
s445: Tunitcha-Klizhin-Akhoni (s445)						
	55	Akhoni	Series	3	17	30
	25	Tunitcha	Series	45	53	60
	20	Klizhin	Series	1	33	65
s452: Telescope-Royosa-Augustine (s452)						
	45	Augustine	Series	1	4	6
	40	Telescope	Series	0	5	10
	15	Royosa	Series	0	8	15
s466: Quintana-Kopie (s466)						
	60	Kopie	Series	1	8	15
	40	Quintana	Series	0	8	15
s490: Nakai-Monue-Blackston (s490)						
	40	Monue	Series	2	4	6
	40	Nakai	Series	1	5	8
	20	Blackston	Series	0	1	2
s495: Torriorthents-Calciorthids-Badland (s495)						
	60	Badland	Miscellaneous area	1	26	50
	25	Torriorthents	Taxon above family	3	27	50
	15	Calciorthids	Taxon above family	10	20	30
s1417: Youngston-Torrifluvents (s1417)						
	70	Youngston	Series	0	3	6
	30	Torrifluvents	Taxon above family	0	2	3

Component Legend

United States

Map unit symbol and name	Pct. of map unit	Component name	Component kind	Pct. Slope		
				Low	RV	High
s1420: Rock outcrop-Redlands-Myton family-Moenkopie-Mack-Farb-Badland (s1420)						
	20	Farb	Series	3	8	12
	20	Mack	Series	0	3	6
	15	Redlands	Series	0	3	6
	15	Rock outcrop	Miscellaneous area	3	42	80
	10	Badland	Miscellaneous area	10	55	99
	10	Moenkopie	Series	2	11	20
	10	Myton family	Family	12	41	70
s1422: Uzona-Rock outcrop-Myton family-Claysprings (s1422)						
	65	Claysprings	Series	3	34	65
	15	Myton family	Family	12	41	70
	10	Rock outcrop	Miscellaneous area	12	46	80
	10	Uzona	Series	3	8	12
s1424: Romberg-Rock outcrop-Rizno-Littlenan-Cragola-Bodot (s1424)						
	20	Cragola	Series	6	43	80
	20	Rizno	Series	3	9	15
	20	Romberg	Series	6	28	50
	15	Littlenan	Series	3	12	20
	15	Rock outcrop	Miscellaneous area	6	43	80
	10	Bodot	Series	20	35	50
s5091: Typic Ustochrepts (s5091)						
	100	Typic Ustochrepts	Taxon above family	15	18	20

Component Legend

United States

Map unit symbol and name	Pct. of map unit	Component name	Component kind	Pct. Slope		
				Low	RV	High
s5092: Typic Ustochrepts-Lithic Ustochrepts (s5092)						
	60	Typic Ustochrepts	Taxon above family	0	8	15
	40	Lithic Ustochrepts	Taxon above family	1	18	35
s5112: Cumulic Haplustolls (s5112)						
	100	Cumulic Haplustolls	Family	2	4	5
s5160: Viuda-Rock outcrop-Penistaja (s5160)						
	40	Viuda	Series	2	6	10
	39	Penistaja	Series	1	3	5
	13	Rock outcrop	Miscellaneous area	0	50	99
	4	Aparejo	Series	1	3	5
	4	Venadito	Series	1	3	5
s5161: Millpaw-Cantina-Cabezon (s5161)						
	33	Cabezon	Series	1	4	7
	24	Cantina	Series	1	2	3
	17	Millpaw	Series	0	3	5
	8	Montecito	Series	1	3	5
	7	Rock outcrop	Miscellaneous area	0	50	99
	3	Bandera	Series	20	33	45
	3	Ildefonso	Series	20	35	50
	3	Torreon	Series	15	25	35
	2	Loarc	Series	1	6	10
s5164: Rock outcrop-Laporte (s5164)						
	54	Laporte	Series	3	12	20
	36	Rock outcrop	Miscellaneous area	0	50	99

Component Legend

United States

Map unit symbol and name	Pct. of map unit	Component name	Component kind	Pct. Slope		
				Low	RV	High
s5164: Rock outcrop-Laporte (s5164)						
	4	Vessilla	Series	3	9	15
	2	Atarque	Series	2	6	10
	2	Flugle	Series	1	5	8
	2	Mion	Series	3	29	55
s5165: Sparank-San Mateo-Penistaja-Mespun (s5165)						
	30	Penistaja	Series	1	2	3
	18	Sparank	Series	1	2	3
	15	San Mateo	Series	1	2	3
	10	Mespun	Series	3	8	12
	9	Palma	Series	1	4	7
	7	Rock outcrop	Miscellaneous area	0	50	99
	6	Mikim	Series	1	3	5
	3	Venadito	Series	0	1	1
	2	Mion	Series	15	40	65
s5167: Raton-Lava flows-Charo (s5167)						
	30	Raton	Series	2	6	10
	27	Charo	Series	1	3	5
	27	Lava flows	Miscellaneous area	0	45	90
	6	Rock outcrop	Miscellaneous area	0	50	99
	5	Bandera	Series	30	38	45
	5	Borrego	Series	2	6	10
s5168: Rock outcrop-Flugle-Catman (s5168)						
	25	Flugle	Series	3	6	8

Component Legend

United States

Map unit symbol and name	Pct. of map unit	Component name	Component kind	Pct. Slope		
				Low	RV	High
s5168: Rock outcrop-Flugle-Catman (s5168)						
	13	Rock outcrop	Miscellaneous area	0	50	99
	11	Catman	Series	1	3	5
	7	Celacy	Series	1	3	5
	7	Quintana	Series	5	10	15
	6	Silkie	Series	3	7	10
	6	Teco	Series	1	3	4
	5	Mion	Series	3	29	55
	5	Vessilla	Series	3	29	55
	4	Atarque	Series	2	6	10
	4	Goesling	Series	1	5	8
	4	Venadito	Series	0	3	5
	3	Hickman	Series	2	4	6
s5169: Rock outcrop-Nogal (s5169)						
	22	Rock outcrop	Miscellaneous area	0	50	99
	13	Nogal	Series	1	6	10
	9	Galestina	Series	1	5	8
	9	Mion	Series	3	29	55
	9	Pinitos	Series	2	6	10
	9	Vessilla	Series	3	29	55
	6	Ribera	Series	1	6	10
	5	Flugle	Series	3	6	8
	5	Montecito	Series	1	8	15
	5	Teco	Series	1	3	4

Component Legend

United States

Map unit symbol and name	Pct. of map unit	Component name	Component kind	Pct. Slope		
				Low	RV	High
s5169: Rock outcrop-Nogal (s5169)						
	4	Catman	Series	1	2	3
	4	Hickman	Series	2	4	6
s5170: Teco-Rock outcrop-Montecito-Cabezon-Atarque (s5170)						
	40	Teco	Series	2	4	5
	17	Cabezon	Series	2	6	10
	15	Atarque	Series	1	5	8
	14	Montecito	Series	1	3	5
	11	Rock outcrop	Miscellaneous area	0	50	99
	3	Torreon	Series	15	25	35
s5171: Valnor-Techado-Rock outcrop-Mirabal-Kenray-Cinnadale (s5171)						
	19	Cinnadale	Series	1	8	15
	17	Valnor	Series	2	5	7
	15	Techado	Series	5	15	25
	12	Kenray	Series	3	9	15
	10	Mirabal	Series	2	9	15
	10	Rock outcrop	Miscellaneous area	0	50	99
	8	Abersito	Series	5	8	10
	3	McGaffey	Series	1	3	5
	3	Stout	Series	3	7	10
	3	Stout	Series	3	9	15
s5172: Stout-Kiln-Hesperus (s5172)						
	45	Stout	Series	3	9	15

Component Legend

United States

Map unit symbol and name	Pct. of map unit	Component name	Component kind	Pct. Slope		
				Low	RV	High
s5172: Stout-Kiln-Hesperus (s5172)						
	35	Hesperus	Series	3	5	6
	20	Kiln	Series	3	6	8
s5173: Telescope-Royosa (s5173)						
	45	Royosa	Series	5	15	25
	30	Royosa	Series	5	15	25
	25	Telescope	Series	0	5	10
s5174: Kimbeto-Farb-Denazar (s5174)						
	15	Kimbeto	Series	0	2	4
	11	Denazar	Series	1	2	3
	10	Farb	Series	2	14	25
	8	Tocito	Series	1	2	3
	7	Jeddito	Series	0	2	3
	6	Tewa	Series	1	2	3
	5	Huerfano	Series	0	2	3
	5	Shiprock	Series	1	3	5
	4	Benally	Series	1	2	3
	4	Werito	Series	1	2	3
	3	Badland	Miscellaneous area	1	50	99
	3	Brimhall	Series	1	2	3
	3	Genats	Series	15	30	45
	3	Nakai	Series	1	5	8
	3	Rock outcrop	Miscellaneous area	0	50	99
	2	Benally	Series	0	1	2

Component Legend

United States

Map unit symbol and name	Pct. of map unit	Component name	Component kind	Pct. Slope		
				Low	RV	High
s5174: Kimbeto-Farb-Denazar (s5174)						
	2	Mack	Series	1	3	4
	2	Mesa	Series	1	3	4
	2	Suwanee	Series	1	2	3
	1	Notal	Series	0	1	2
	1	Sheppard	Series	1	5	8
s5175: Turley-Fruitland (s5175)						
	37	Fruitland	Series	2	4	5
	29	Turley	Series	1	2	3
	8	Garland	Series	0	2	3
	8	Walrees	Series	0	1	2
	6	Apishapa	Series	0	1	1
	6	Werlog	Series	0	1	1
	4	Green River	Series	0	1	1
	2	Youngston	Series	0	1	1
s5177: Weska-Travessilla-Rock outcrop-Oelop (s5177)						
	30	Rock outcrop	Miscellaneous area	0	50	99
	27	Travessilla	Series	20	30	40
	19	Weska	Series	20	30	40
	13	Oelop	Series	0	3	5
	3	Blancot	Series	0	3	5
	3	Notal	Series	0	1	2
	3	Twick	Series	0	13	25
	2	Silver	Series	0	5	10

Component Legend

United States

Map unit symbol and name	Pct. of map unit	Component name	Component kind	Pct. Slope		
				Low	RV	High
s5179: Persayo-Farb-Blancot-Badland (s5179)						
	20	Badland	Miscellaneous area	1	50	99
	16	Persayo	Series	3	17	30
	12	Farb	Series	3	17	30
	10	Blancot	Series	0	3	5
	8	Rock outcrop	Miscellaneous area	0	50	99
	7	Blackston	Series	8	24	40
	7	Fruitland	Series	0	4	8
	6	Sheppard	Series	0	8	15
	5	Stumble	Series	0	4	8
	4	Notal	Series	0	1	2
	3	Riverwash	Miscellaneous area	0	1	2
	2	Shiprock	Series	0	3	5
s5180: Shiprock-Sheppard-Doak-Blancot (s5180)						
	35	Doak	Series	0	3	5
	25	Sheppard	Series	5	18	30
	12	Shiprock	Series	0	3	5
	11	Blancot	Series	0	3	5
	7	Fruitland	Series	5	18	30
	6	Notal	Series	0	1	2
	2	Persayo	Series	5	18	30
	1	Badland	Miscellaneous area	1	50	99
	1	Stumble	Series	0	4	8

Component Legend

United States

Map unit symbol and name	Pct. of map unit	Component name	Component kind	Pct. Slope		
				Low	RV	High
s5181: Sheppard-Badland (s5181)						
	44	Badland	Miscellaneous area	1	50	99
	11	Sheppard	Series	5	7	8
	9	Monierco	Series	0	4	8
	7	Rock outcrop	Miscellaneous area	0	50	99
	5	Fruitland	Series	5	18	30
	5	Huerfano	Series	0	2	3
	4	Notal	Series	0	1	2
	3	Avalon	Series	3	4	5
	3	Doak	Series	0	2	3
	3	Persayo	Series	3	17	30
	2	Blancot	Series	0	3	5
	2	Shiprock	Series	0	3	5
	2	Uffens	Series	0	2	3
s5182: Sheppard-Notal-Huerfano (s5182)						
	27	Sheppard	Series	0	8	15
	26	Huerfano	Series	0	2	3
	14	Notal	Series	0	1	2
	8	Shiprock	Series	0	3	5
	6	Muff	Series	0	4	8
	4	Blancot	Series	0	3	5
	3	Avalon	Series	0	3	5
	3	Badland	Miscellaneous area	1	50	99
	3	Doak	Series	0	2	3

Component Legend

United States

Map unit symbol and name	Pct. of map unit	Component name	Component kind	Pct. Slope		
				Low	RV	High
s5182: Sheppard-Notal-Huerfano (s5182)						
	3	Uffens	Series	0	2	3
	2	Monierco	Series	0	4	8
	1	Rock outcrop	Miscellaneous area	0	50	99
s5183: Rock outcrop-Badland (s5183)						
	65	Badland	Miscellaneous area	1	50	99
	22	Rock outcrop	Miscellaneous area	0	50	99
	8	Riverwash	Miscellaneous area	0	1	2
	3	Blancot	Series	0	3	5
	2	Notal	Series	0	1	2
s5184: Persayo-Fruitland-Blancot-Badland (s5184)						
	45	Badland	Miscellaneous area	1	50	99
	17	Fruitland	Series	5	18	30
	11	Blancot	Series	0	3	5
	11	Persayo	Series	3	17	30
	9	Sheppard	Series	0	8	15
	7	Notal	Series	0	1	2
s5185: Shiprock-Sheppard-Avalon (s5185)						
	38	Shiprock	Series	0	3	5
	33	Avalon	Series	5	7	8
	15	Sheppard	Series	0	8	15
	9	Mayqueen	Series	0	1	2
	5	Doak	Series	0	3	5

Component Legend

United States

Map unit symbol and name	Pct. of map unit	Component name	Component kind	Pct. Slope		
				Low	RV	High
s5186: Uffens-Shiprock-Sheppard-Doak (s5186)						
	35	Doak	Series	0	3	5
	21	Uffens	Series	0	3	5
	12	Sheppard	Series	0	8	15
	11	Shiprock	Series	0	3	5
	9	Avalon	Series	0	3	5
	7	Mayqueen	Series	0	1	2
	3	Fruitland	Series	5	18	30
	1	Huerfano	Series	0	2	3
	1	Monierco	Series	0	4	8
s5187: Orlie-Gobernador (s5187)						
	60	Gobernador	Series	0	1	2
	35	Orlie	Series	1	3	5
	5	Sparham	Series	0	2	3
s5188: Sparank-San Mateo-Pinavetes-Florita (s5188)						
	32	Sparank	Series	0	2	3
	26	Pinavetes	Series	0	2	3
	21	San Mateo	Series	0	1	2
	17	Florita	Series	2	4	6
	4	Riverwash	Miscellaneous area	0	1	2
s5189: Sedale-Penistaja (s5189)						
	73	Penistaja	Series	2	5	8
	13	Sedale	Series	5	13	20

Component Legend

United States

Map unit symbol and name	Pct. of map unit	Component name	Component kind	Pct. Slope		
				Low	RV	High
s5189: Sedale-Penistaja (s5189)						
	7	Menefee	Series	5	13	20
	4	Rock outcrop	Miscellaneous area	0	50	99
	3	Hosta	Series	3	4	5
s5192: Royosa-Pinitos (s5192)						
	70	Pinitos	Series	2	6	10
	30	Royosa	Series	1	5	8
s5193: Tsosie-Lybrook (s5193)						
	65	Lybrook	Series	0	1	2
	35	Tsosie	Series	1	2	3
s5194: Ruson-Nalivag (s5194)						
	60	Nalivag	Series	2	5	8
	40	Ruson	Series	0	2	3
s5197: Menefee-Calendar-Berryman (s5197)						
	50	Berryman	Series	3	7	10
	30	Menefee	Series	2	16	30
	20	Calendar	Series	5	20	35
s5213: Tome-Bluepoint-Armijo-Adelino (s5213)						
	34	Armijo	Series	0	1	1
	20	Tome	Series	0	1	1
	15	Bluepoint	Series	1	5	9
	15	Tome	Series	0	2	3
	11	Adelino	Series	0	2	3
	5	Adelino	Series	1	2	3

Component Legend

United States

Map unit symbol and name	Pct. of map unit	Component name	Component kind	Pct. Slope		
				Low	RV	High
s5224: Silver-Penistaja (s5224)						
	67	Penistaja	Series	1	3	5
	13	Silver	Series	0	1	2
	6	Otero	Series	1	5	8
	5	Shingle	Series	2	5	8
	5	Travessilla	Series	1	8	15
	4	Badland	Miscellaneous area	1	50	99
s5225: Shingle-Kim (s5225)						
	48	Kim	Series	1	5	8
	36	Shingle	Series	2	5	8
	6	Badland	Miscellaneous area	1	50	99
	6	Gila	Series	0	1	2
	4	Hantz	Series	0	1	2
s5227: Vinton-Kokan-Kim-Badland (s5227)						
	39	Kokan	Series	10	25	40
	34	Vinton	Series	1	2	3
	11	Badland	Miscellaneous area	1	50	99
	11	Kim	Series	1	5	8
	5	Pajarito	Series	1	3	5
s5228: Tocito-Mesa-Cudei-Badland (s5228)						
	20	Badland	Miscellaneous area	1	26	50
	20	Cudei	Series	15	33	50
	12	Tocito	Series	1	2	3
	9	Blackston	Series	2	4	5

Component Legend

United States

Map unit symbol and name	Pct. of map unit	Component name	Component kind	Pct. Slope		
				Low	RV	High
s5228: Tocito-Mesa-Cudei-Badland (s5228)						
	9	Kimbeto	Series	0	3	5
	6	Mesa	Series	0	1	1
	5	Fruitland	Series	1	2	3
	5	Water	Miscellaneous area	---	---	---
	4	Mesa	Series	0	1	1
	3	Camac	Series	15	38	60
	3	Turley	Series	1	2	3
	2	Rock outcrop	Miscellaneous area	0	25	50
	1	Riverwash	Miscellaneous area	0	1	2
	1	Sheppard	Series	3	4	5
s5229: Persayo-Nataani-Littlehat-Awet (s5229)						
	27	Littlehat	Series	1	8	15
	25	Persayo	Series	1	3	5
	12	Lawet	Series	1	2	3
	10	Nataani	Series	1	3	5
	7	Nakai	Series	1	2	3
	4	Badland	Miscellaneous area	1	8	15
	4	Gyptur	Series	0	1	2
	4	Tsebitai	Series	1	2	3
	3	Benally	Series	1	2	2
	2	Rock outcrop	Miscellaneous area	0	8	15
	1	Gullied land	Miscellaneous area	0	50	99
	1	Tocito	Series	1	2	3

Component Legend

United States

Map unit symbol and name	Pct. of map unit	Component name	Component kind	Pct. Slope		
				Low	RV	High
s5233: Sparank-Sandoval-Querencia (s5233)						
	44	Querencia	Series	1	5	8
	35	Sandoval	Series	3	9	15
	14	Sparank	Series	0	2	3
	2	San Mateo	Series	0	2	3
	2	Skyvillage	Series	3	12	20
	2	Zia	Series	2	5	8
	1	Rock outcrop	Miscellaneous area	0	50	99
s5235: Zia-Sandoval-Rock outcrop (s5235)						
	40	Rock outcrop	Miscellaneous area	0	50	99
	20	Zia	Series	8	17	25
	11	Sandoval	Series	3	9	15
	6	San Mateo	Series	0	2	3
	5	Penistaja	Series	1	3	5
	5	Saido	Series	5	23	40
	5	Skyvillage	Series	3	12	20
	4	Hagerman	Series	1	3	5
	3	Sparank	Series	0	1	1
	1	Querencia	Series	2	5	8
s5248: Sparank-Sheppard-Fajada (s5248)						
	50	Sheppard	Series	1	5	8
	30	Fajada	Series	1	3	5
	20	Sparank	Series	0	3	5

Component Legend

United States

Map unit symbol and name	Pct. of map unit	Component name	Component kind	Pct. Slope		
				Low	RV	High
s5250: Rock outcrop-Mion-Atarque (s5250)						
	50	Mion	Series	3	24	45
	30	Rock outcrop	Miscellaneous area	0	50	99
	20	Atarque	Series	1	5	8
s5251: Kiki-Doak (s5251)						
	60	Doak	Series	0	3	5
	40	Kiki	Series	3	6	8
s5252: Doakum-Betonnie (s5252)						
	60	Doakum	Series	1	3	5
	40	Betonnie	Series	2	5	8
s5253: Tsosie-Councelor-Blancot (s5253)						
	50	Blancot	Series	1	2	3
	30	Councelor	Series	2	6	10
	20	Tsosie	Series	1	2	3
s5331: Thunderbird-Rudd-Hubbell-Cabezon (s5331)						
	16	Cabezon	Series	3	14	25
	13	Hubbell	Series	1	5	9
	12	Thunderbird	Series	3	9	15
	10	Rudd	Series	3	9	15
	9	Veteado	Series	1	3	4
	8	Modyon	Series	3	9	15
	8	Penistaja	Series	1	3	5
	7	Celsosprings	Series	3	6	8
	5	Ceniza	Series	1	8	15

Component Legend

United States

Map unit symbol and name	Pct. of map unit	Component name	Component kind	Pct. Slope		
				Low	RV	High
s5331: Thunderbird-Rudd-Hubbell-Cabezon (s5331)						
	3	Abrazo	Series	2	6	10
	3	Apache	Series	6	11	15
	3	Flaco	Series	1	5	8
	3	Gatlin	Series	1	8	15
s5396: Loarc-Guy-Dioxice-Datil (s5396)						
	33	Datil	Series	1	13	25
	15	Loarc	Series	1	7	12
	11	Guy	Series	1	8	15
	10	Dioxice	Series	1	5	8
	6	Millpaw	Series	0	4	7
	4	Gustspring	Series	1	4	7
	4	Hiarc	Series	1	3	5
	3	Amenson	Series	1	4	7
	3	Joachem	Series	3	9	15
	3	Landavaso	Series	1	3	5
	3	Pena	Series	2	5	8
	3	Ralphston	Series	1	5	9
	2	Rock outcrop	Miscellaneous area	0	50	99
s5399: Rock outcrop-Motoqua-Mion-Abrazo (s5399)						
	30	Rock outcrop	Miscellaneous area	0	50	99
	26	Motoqua	Series	15	33	50
	17	Mion	Series	2	16	30

Component Legend

United States

Map unit symbol and name	Pct. of map unit	Component name	Component kind	Pct. Slope		
				Low	RV	High
s5399: Rock outcrop-Motoqua-Mion-Abrazo (s5399)						
	12	Abrazo	Series	15	33	50
	5	Gustspring	Series	5	10	15
	4	Travessilla	Series	2	16	30
	3	Goldust	Series	15	23	30
	3	Parquat	Series	5	10	15
s5400: Travessilla-Rock outcrop-Puertecito (s5400)						
	44	Puertecito	Series	5	30	55
	25	Rock outcrop	Miscellaneous area	0	50	99
	18	Travessilla	Series	1	6	10
	5	Mion	Series	2	6	10
	4	La Fonda	Series	1	3	5
	4	San Mateo	Series	1	3	5
s5401: Lapdun-Datil-Celsosprings-Cascajo (s5401)						
	14	Datil	Series	5	13	20
	13	Lapdun	Series	1	16	30
	12	Cascajo	Series	15	23	30
	11	Celsosprings	Series	1	5	8
	9	Majada	Series	1	5	8
	8	Millett	Series	1	8	15
	6	Sedillo	Series	1	8	15
	5	Alegros	Series	1	6	10
	5	Hickman	Series	1	2	3

Component Legend

United States

Map unit symbol and name	Pct. of map unit	Component name	Component kind	Pct. Slope		
				Low	RV	High
s5401: Lapdun-Datil-Celsosprings-Cascajo (s5401)						
	5	Ladron	Series	1	8	15
	4	Goldust	Series	2	5	8
	4	Loarc	Series	2	5	8
	4	Magdalena	Series	3	8	12
s5404: Weska-Travessilla-Rock outcrop-Dulce (s5404)						
	25	Dulce	Series	6	28	50
	20	Rock outcrop	Miscellaneous area	6	28	50
	20	Travessilla	Series	6	28	50
	10	Weska	Series	0	15	30
	8	Mikim	Series	3	8	12
	7	Buckle	Series	1	4	6
	5	Florita	Series	3	5	6
	5	Yenlo	Series	1	3	5
s5576: St. Thomas-Rock outcrop-Kyler (s5576)						
	35	St. Thomas	Series	15	33	50
	20	St. Thomas	Series	30	40	50
	15	Rock outcrop	Miscellaneous area	1	26	50
	10	Kyler	Series	30	40	50
	5	Pookaloo	Series	15	23	30
	5	St. Thomas	Series	30	53	75
	5	Tonopah	Series	2	3	4
	5	Weiser	Series	2	5	8

Component Legend

United States

Map unit symbol and name	Pct. of map unit	Component name	Component kind	Pct. Slope		
				Low	RV	High
s7769: Witt-Sharps-Ruinpoint-Rizno-Cahona (s7769)						
	25	Rizno	Series	3	9	15
	25	Witt	Series	1	7	12
	20	Ruinpoint	Series	1	5	8
	15	Cahona	Series	1	7	12
	15	Sharps	Series	2	7	12
s7770: Sheppard-Rock outcrop-Oljeto-Neskahi-Mota (s7770)						
	50	Mota	Series	1	5	8
	20	Neskahi	Series	1	5	8
	10	Oljeto	Series	1	5	8
	10	Rock outcrop	Miscellaneous area	0	5	10
	10	Sheppard	Series	1	6	10
s7771: Rock outcrop-Piute-Moenkopie-Hoskinnini (s7771)						
	40	Moenkopie	Series	3	14	25
	25	Hoskinnini	Series	1	7	12
	20	Rock outcrop	Miscellaneous area	0	13	25
	10	Piute	Series	3	17	30
	5	Deleco	Series	2	16	30
s7772: Whit-Sogzie-Sheppard-Rock outcrop (s7772)						
	50	Whit	Series	1	5	8
	25	Sogzie	Series	1	5	8
	15	Sheppard	Series	3	6	8
	10	Rock outcrop	Miscellaneous area	0	4	8

Component Legend

United States

Map unit symbol and name	Pct. of map unit	Component name	Component kind	Pct. Slope		
				Low	RV	High
s7773: Rock outcrop-Piute-Pickrell-Badland (s7773)						
	45	Piute	Series	3	17	30
	25	Pickrell	Series	1	5	8
	15	Rock outcrop	Miscellaneous area	2	21	40
	10	Badland	Miscellaneous area	10	25	40
	5	Sheppard	Series	0	8	15
s7774: Rock outcrop-Lithic Torriorthents-Badland (s7774)						
	50	Rock outcrop	Miscellaneous area	10	45	80
	30	Lithic Torriorthents	Taxon above family	40	60	80
	20	Badland	Miscellaneous area	10	45	80
s7938: Ruinpoint-Rizno-Cahona (s7938)						
	57	Ruinpoint	Series	1	5	8
	22	Rizno	Series	3	9	15
	21	Cahona	Series	1	3	5
s7939: Rock outcrop-Rizno-Mellenthin-Littlenan-Bodot (s7939)						
	38	Rizno	Series	3	9	15
	25	Littlenan	Series	3	12	20
	13	Bodot	Series	20	35	50
	12	Mellenthin	Series	4	15	25
	12	Rock outcrop	Miscellaneous area	3	27	50
s7944: Rock outcrop-Myton family-Moenkopie (s7944)						
	42	Moenkopie	Series	2	11	20
	37	Rock outcrop	Miscellaneous area	2	26	50

Component Legend

United States

Map unit symbol and name	Pct. of map unit	Component name	Component kind	Pct. Slope		
				Low	RV	High
s7944: Rock outcrop-Myton family-Moenkopie (s7944)						
	21	Myton family	Family	30	40	50
s7945: Nakai-Limeridge-Bluechief (s7945)						
	44	Nakai	Series	1	4	6
	31	Limeridge	Series	4	8	12
	25	Bluechief	Series	2	4	6
s7947: Sheppard-Rock outcrop-Piute (s7947)						
	41	Rock outcrop	Miscellaneous area	2	9	15
	35	Piute	Series	4	10	15
	24	Sheppard	Series	2	9	15
s8104: Tosser-Sitar-Hiko Peak (s8104)						
	50	Tosser	Series	3	9	15
	30	Hiko Peak	Series	3	8	12
	20	Sitar	Series	3	9	15
s8189: Rock outcrop-Clapper-Badland (s8189)						
	35	Badland	Miscellaneous area	10	20	30
	30	Rock outcrop	Miscellaneous area	20	55	90
	10	Clapper	Series	2	16	30
	5	Bluechief	Series	2	5	8
	5	Myton family	Family	8	12	15
	5	Rairdent family	Family	3	6	8
	5	Rizno	Series	3	9	15
	5	Wayneco	Series	2	16	30

Component Legend

United States

Map unit symbol and name	Pct. of map unit	Component name	Component kind	Pct. Slope		
				Low	RV	High
s8369: Water (s8369)						
	100	Water	Miscellaneous area	---	---	---
s9583: Torriorthents-Marcou-Claysprings-Burnswick-Badland (s9583)						
	44	Badland	Miscellaneous area	1	16	30
	14	Torriorthents	Taxon above family	1	16	30
	12	Burnswick	Series	1	3	5
	12	Claysprings	Series	1	6	10
	12	Marcou	Series	1	5	8
	6	Rock outcrop	Miscellaneous area	20	40	60
s9584: Strych-Rock outcrop-Monue (s9584)						
	45	Strych	Series	25	43	60
	18	Rock outcrop	Miscellaneous area	25	43	60
	14	Monue	Series	1	3	5
	6	Begay	Series	1	5	8
	6	Kinan	Series	2	7	12
	6	Penistaja	Series	1	5	8
	5	Mido	Series	1	5	8

Taxonomic Classification of the Soils

United States

Soil name	Family or higher taxonomic classification
Abersito	Clayey-skeletal, mixed, active, frigid Typic Paleustalfs
Abrazo	Fine, mixed, superactive, mesic Aridic Argiustolls
Adelino	Fine-loamy, mixed, superactive, thermic Typic Haplocambids
Akhoni	Loamy, mixed, superactive, frigid Lithic Haplustolls
Alegros	Clayey over sandy or sandy-skeletal, smectitic, mesic Typic Haplustalfs
Amenson	Loamy, mixed, superactive, mesic, shallow Petrocalcic Paleustolls
Anasazi	Coarse-loamy, mixed, superactive, mesic Ustic Haplocalcids
Aneth	Sandy, mixed, mesic Typic Torriorthents
Apache	Loamy, mixed, superactive, mesic Lithic Haplustolls
Aparejo	Fine-loamy, mixed, superactive, calcareous, mesic Aridic Ustifluvents
Apishapa	Fine, smectitic, calcareous, mesic Vertic Fluvaquents
Arches	Mixed, mesic Lithic Torripsamments
Armijo	Fine, smectitic, thermic Chromic Haplotorrerts
Atarque	Loamy, mixed, superactive, mesic Lithic Haplustalfs
Augustine	Fine-loamy, mixed, superactive, mesic Aridic Haplustalfs
Avalon	Fine-loamy, mixed, superactive, mesic Typic Haplocalcids
Bandera	Ashy-skeletal over fragmental or cindery, mixed, frigid Vitrandic Haplustolls
Batterson	Sandy, mixed, mesic Lithic Ustic Torriorthents
Begay	Coarse-loamy, mixed, superactive, mesic Ustic Haplocambids
Benally	Fine-loamy, mixed, active, mesic Typic Natrigypsids
Berryman	Fine-loamy, carbonatic, mesic Haplocalcidic Haplustepts
Betonnie	Coarse-loamy, mixed, superactive, mesic Ustic Haplargids
Blackston	Loamy-skeletal, mixed, superactive, mesic Typic Haplocalcids
Blancot	Fine-loamy, mixed, superactive, mesic Ustic Haplargids
Blanding	Fine-silty, mixed, superactive, mesic Ustic Haplargids
Bluechief	Coarse-loamy, mixed, superactive, mesic Typic Haplocalcids
Bluepoint	Mixed, thermic Typic Torripsamments
Bodot	Fine, smectitic, calcareous, mesic Torrertic Ustorthents
Bond family	Loamy, mixed, superactive, mesic Lithic Ustic Haplargids
Borrego	Clayey, mixed, active, frigid Lithic Haplustalfs
Boysag	Clayey, mixed, superactive, mesic Lithic Calciargids
Brimhall	Coarse-loamy, mixed, active, mesic Typic Calcigypsids
Buckle	Fine-loamy, mixed, superactive, mesic Ustic Haplargids
Burnswick	Fine-loamy, mixed, superactive, mesic Typic Haplocambids
Cabezon	Clayey, smectitic, mesic Lithic Argiustolls
Cahona	Fine-silty, mixed, superactive, mesic Calcidic Haplustalfs
Calciorthids	Haplocalcids
Calendar	Fine, mixed, superactive, mesic Aridic Haplustepts
Camac	Fine-loamy, mixed, active, mesic Typic Haplocambids
Cantina	Fine, mixed, superactive, mesic Aridic Argiustolls
Cascajo	Sandy-skeletal, mixed, mesic Ustic Haplocalcids
Casmos family	Loamy, mixed (calcareous), mesic Lithic Torriorthents
Catman	Very-fine, smectitic, mesic Aridic Haplusterts
Celacy	Fine-loamy, mixed, superactive, mesic Aridic Haplustalfs
Celsosprings	Fine, mixed, superactive, mesic Aridic Argiustolls
Ceniza	Cindery, mesic Pachic Haplustolls
Charo	Fine, mixed, superactive, frigid Typic Argiustolls
Cinnadale	Loamy-skeletal, mixed, superactive, frigid Lithic Haplustepts
Clapper	Loamy-skeletal, mixed, superactive, mesic Ustic Haplocalcids
Claysprings	Clayey, smectitic, calcareous, mesic, shallow Typic Torriorthents

Taxonomic Classification of the Soils

United States

Soil name	Family or higher taxonomic classification
Clovis	Fine-loamy, mixed, superactive, mesic Ustic Calciargids
Councelor	Coarse-loamy, mixed, superactive, calcareous, mesic Ustic Torriorthents
Cragola	Loamy-skeletal, mixed, active, calcareous, mesic, shallow Ustic Torriorthents
Cudei	Cambids
Cumulic Haplustolls	Fine-loamy, mixed, superactive, mesic Cumulic Haplustolls
Datil	Fine-loamy, mixed, superactive, mesic Aridic Argiustolls
Deama	Loamy-skeletal, carbonatic, mesic Lithic Calciustolls
Deleco	Loamy-skeletal, carbonatic, mesic, shallow Typic Petrocalcids
Denazar	Sandy, mixed, mesic Typic Haplocalcids
Dioxice	Fine-loamy, mixed, superactive, mesic Aridic Calciustolls
Doak	Fine-loamy, mixed, active, mesic Typic Haplargids
Doakum	Fine-loamy, mixed, superactive, mesic Ustic Haplargids
Dulce	Loamy, mixed, superactive, calcareous, mesic, shallow Ustic Torriorthents
Epikom	Loamy, mixed, superactive, mesic Lithic Haplocambids
Escavada	Sandy, mixed, mesic Ustic Torrifluvents
Eutric Glossoboralfs	Clayey-skeletal, mixed, frigid Typic Glossudalfs
Fajada	Fine-loamy, mixed, superactive, mesic Typic Natrargids
Farb	Loamy, mixed, superactive, calcareous, mesic Lithic Torriorthents
Farview	Loamy, mixed, active, calcareous, mesic Lithic Ustic Torriorthents
Flaco	Fine-loamy, mixed, superactive, mesic Ustic Calciargids
Florita	Coarse-loamy, mixed, superactive, nonacid, mesic Ustic Torriorthents
Flugle	Fine-loamy, mixed, superactive, mesic Aridic Haplustalfs
Fruitland	Coarse-loamy, mixed, superactive, calcareous, mesic Typic Torriorthents
Galestina	Fine, mixed, superactive, mesic Aridic Paleustalfs
Garland	Fine-loamy over sandy or sandy-skeletal, mixed, superactive, mesic Typic Haplargids
Gatlin	Cindery, mixed, mesic Vitritorrandic Haplustolls
Genats	Fine, mixed, active, nonacid, mesic Typic Torriorthents
Gila	Coarse-loamy, mixed, superactive, calcareous, thermic Typic Torrifluvents
Gobernador	Fine, smectitic, calcareous, mesic Vertic Ustorthents
Goesling	Fine-loamy, mixed, superactive, mesic Aridic Haplustalfs
Goldust	Clayey-skeletal, mixed, superactive, mesic Aridic Argiustolls
Green River	Coarse-loamy, mixed, superactive, calcareous, mesic Oxyaquic Torrifluvents
Grieta	Fine-loamy, mixed, superactive, mesic Typic Calciargids
Gustspring	Fine-loamy over sandy or sandy-skeletal, mixed, superactive, mesic Aridic Argiustolls
Guy	Coarse-loamy, mixed, superactive, mesic Aridic Calciustolls
Gyptur	Fine-silty, mixed, active, mesic Leptic Haplogypsids
Hagerman	Fine-loamy, mixed, superactive, mesic Ustic Haplargids
Hantz	Fine, mixed, superactive, calcareous, thermic Vertic Torrifluvents
Hesperus	Fine-loamy, mixed, superactive, frigid Pachic Argiustolls
Hiarc	Fine-loamy, mixed, superactive, mesic Aridic Argiustolls
Hickman	Fine-loamy, mixed, superactive, calcareous, mesic Aridic Ustifluvents
Hiko Peak	Loamy-skeletal, mixed, active, mesic Xeric Haplocalcids
Hoskinnini	Loamy, mixed, superactive, mesic Lithic Haplargids
Hosta	Fine, mixed, superactive, mesic Aridic Haplustalfs
Hubbell	Ashy, mesic Typic Ustorthents
Hubert	Loamy-skeletal, mixed, superactive, mesic Typic Calciustolls
Huerfano	Loamy, mixed, superactive, mesic, shallow Typic Natrargids
Ildefonso	Loamy-skeletal, mixed, superactive, mesic Ustic Haplocalcids
Ives	Coarse-loamy, mixed, superactive, calcareous, mesic Typic Torrifluvents
Jeddito	Coarse-loamy, mixed, superactive, calcareous, mesic Typic Torriorthents

Taxonomic Classification of the Soils

United States

Soil name	Family or higher taxonomic classification
Joachem	Loamy, mixed, superactive, mesic Lithic Argiustolls
Jocity	Fine-loamy, mixed, superactive, calcareous, mesic Typic Torrifluvents
Joraibi	Fine-loamy over sandy or sandy-skeletal, mixed, superactive, calcareous, mesic Typic Torrifluvents
Kenray	Mixed, frigid Typic Ustipsamments
Kiki	Fine-loamy, mixed, superactive, mesic Typic Haplargids
Kiln	Loamy, mixed, superactive, frigid Lithic Argiustolls
Kim	Fine-loamy, mixed, active, calcareous, mesic Ustic Torriorthents
Kimbeto	Fine-loamy, mixed, active, mesic Typic Calciargids
Kinan	Coarse-loamy, mixed, superactive, mesic Typic Haplocalcids
Klizhin	Coarse-loamy, mixed, superactive, frigid Pachic Haplustolls
Kokan	Sandy-skeletal, mixed, thermic Typic Torriorthents
Kopie	Loamy, mixed, active, mesic Lithic Haplustepts
Kydestea	Loamy-skeletal, mixed, superactive, calcareous, mesic Aridic Lithic Ustorthents
Kyler	Loamy-skeletal, carbonatic, mesic Lithic Xeric Torriorthents
La Fonda	Fine-loamy, mixed, superactive, mesic Ustic Haplocambids
Ladron	Loamy-skeletal, carbonatic, mesic Ustic Haplocalcids
Landavaso	Fine-loamy over sandy or sandy-skeletal, mixed, superactive, mesic Aridic Argiustolls
Lapdun	Loamy-skeletal, carbonatic, mesic Aridic Calciustolls
Laporte	Loamy, carbonatic, mesic Lithic Haplustolls
Lawet	Fine-loamy, mixed, superactive, mesic Typic Calciaquolls
Limeridge	Loamy, mixed, superactive, mesic, shallow Calcic Petrocalcids
Lithic Torriorthents	Lithic Torriorthents
Lithic Ustochrepts	Loamy-skeletal, mixed, thermic Lithic Haplustepts
Littlehat	Fine-silty, mixed, semiactive, mesic Sodic Haplocambids
Littlenan	Fine, smectitic, mesic Ustertic Haplocambids
Loarc	Fine-loamy, mixed, superactive, mesic Aridic Argiustolls
Lybrook	Fine, mixed, superactive, calcareous, mesic Ustic Torriorthents
Mack	Fine-loamy, mixed, superactive, mesic Typic Calciargids
Magdalena	Clayey-skeletal, mixed, superactive, mesic Calcic Paleargids
Magotsu	Clayey, smectitic, mesic, shallow Petrocalcic Paleustolls
Majada	Loamy-skeletal, mixed, superactive, mesic Aridic Argiustolls
Marcou	Coarse-loamy, mixed, superactive, calcareous, mesic Typic Torriorthents
Mayqueen	Coarse-loamy, mixed, superactive, mesic Typic Haplargids
McGaffey	Fine-loamy, mixed, superactive, frigid Cumulic Haplustolls
Mellenthin	Loamy-skeletal, mixed, superactive, mesic Lithic Ustic Haplocalcids
Menefee	Loamy, mixed, active, calcareous, mesic, shallow Aridic Ustorthents
Mesa	Fine-loamy, mixed, superactive, mesic Typic Calciargids
Mespun	Siliceous, mesic Ustic Torripsamments
Mido	Mixed, mesic Ustic Torripsamments
Mikim	Fine-loamy, mixed, superactive, calcareous, mesic Ustic Torriorthents
Millett	Fine-loamy, mixed, superactive, mesic Ustic Calciargids
Millpaw	Fine, mixed, superactive, mesic Pachic Argiustolls
Mion	Clayey, mixed, superactive, calcareous, mesic, shallow Ustic Torriorthents
Mirabal	Loamy-skeletal, mixed, superactive, nonacid, frigid Typic Ustorthents
Modyon	Loamy-skeletal, mixed, superactive, mesic Aridic Calciustolls
Moenkopie	Loamy, mixed, superactive, calcareous, mesic Lithic Torriorthents
Moepitz	Coarse-loamy, mixed, superactive, calcareous, mesic Typic Torriorthents
Monierco	Loamy, mixed, superactive, mesic, shallow Typic Haplargids
Montecito	Fine, mixed, superactive, mesic Aridic Haplustalfs
Monue	Coarse-loamy, mixed, superactive, mesic Typic Haplocambids

Taxonomic Classification of the Soils

United States

Soil name	Family or higher taxonomic classification
Monue family	Typic Haplocambids
Mota	Coarse-silty, mixed, superactive, mesic Typic Haplocalcids
Motoqua	Loamy-skeletal, mixed, superactive, mesic Lithic Argiustolls
Muff	Fine-loamy, mixed, superactive, mesic Typic Natrargids
Myton family	Loamy-skeletal, mixed (calcareous), mesic Typic Torriorthents
Nakai	Coarse-loamy, mixed, superactive, mesic Typic Haplocalcids
Nalivag	Fine-loamy, mixed, superactive, calcareous, mesic Typic Ustorthents
Namon	Loamy-skeletal, mixed, superactive, frigid Typic Haplustalfs
Nataani	Coarse-silty, mixed, semiactive, mesic Typic Haplogypsids
Navajo	Fine, mixed, superactive, calcareous, mesic Vertic Torrifluvents
Needle	Mixed, mesic Lithic Torripsamments
Neskahi	Coarse-loamy, mixed, superactive, calcareous, mesic Typic Torrifluvents
Nogal	Fine, mixed, superactive, mesic Aridic Haplustalfs
Notal	Fine, mixed, active, calcareous, mesic Typic Torriorthents
Oelop	Fine-loamy, mixed, superactive, mesic Ustic Haplargids
Oljeto	Sandy-skeletal, mixed, mesic Typic Haplocalcids
Orlie	Fine-loamy, mixed, superactive, mesic Aridic Haplustalfs
Otero	Coarse-loamy, mixed, superactive, calcareous, mesic Aridic Ustorthents
Pagina	Coarse-loamy, mixed, superactive, mesic Typic Haplocalcids
Pajarito	Coarse-loamy, mixed, superactive, thermic Typic Haplocambids
Palma	Coarse-loamy, mixed, superactive, mesic Ustic Calciargids
Parquat	Clayey-skeletal, mixed, superactive, mesic Aridic Argiustolls
Pena	Loamy-skeletal, mixed, superactive, mesic Aridic Calciustolls
Penistaja	Fine-loamy, mixed, superactive, mesic Ustic Haplargids
Pennell	Loamy, mixed, superactive, mesic Lithic Haplocalcids
Persayo	Loamy, mixed, active, calcareous, mesic, shallow Typic Torriorthents
Pickrell	Sandy, mixed, mesic Lithic Haplocalcids
Pinavetes	Mixed, mesic Ustic Torripsamments
Pinitos	Fine-loamy, mixed, superactive, mesic Aridic Haplustalfs
Piute	Sandy, mixed, mesic Lithic Torriorthents
Polacca	Fine-loamy over sandy or sandy-skeletal, mixed, superactive, mesic Typic Haplocambids
Pookaloo	Loamy-skeletal, carbonatic, mesic Lithic Xeric Haplocalcids
Puertecito	Loamy-skeletal, mixed, superactive, mesic Lithic Ustic Haplargids
Purgatory	Fine-loamy, gypsic, mesic Leptic Haplogypsids
Querencia	Fine-loamy, mixed, superactive, mesic Ustic Haplocambids
Quintana	Fine-loamy, mixed, superactive, mesic Typic Calciustepts
Rairdent family	Typic Haplogypsids
Ralphston	Fine-loamy, mixed, superactive, mesic Torriorthentic Haplustolls
Raton	Clayey-skeletal, smectitic, frigid Lithic Argiustolls
Redlands	Fine-loamy, mixed, superactive, mesic Typic Haplargids
Ribera	Fine-loamy, mixed, superactive, mesic Aridic Haplustalfs
Rizno	Loamy, mixed, superactive, calcareous, mesic Lithic Ustic Torriorthents
Romberg	Loamy-skeletal, mixed, superactive, mesic Ustic Haplargids
Royosa	Mixed, mesic Aridic Ustipsamments
Rudd	Loamy-skeletal, mixed, superactive, mesic Lithic Calciustolls
Ruinpoint	Fine-silty, mixed, superactive, mesic Ustic Haplocambids
Ruson	Fine, mixed, superactive, calcareous, mesic Typic Ustorthents
Saido	Coarse-silty, gypsic, mesic Leptic Haplogypsids
San Mateo	Fine-loamy, mixed, superactive, calcareous, mesic Ustic Torrifluvents
Sandoval	Loamy, mixed, superactive, calcareous, mesic, shallow Ustic Torriorthents

Taxonomic Classification of the Soils

United States

Soil name	Family or higher taxonomic classification
Sazi	Coarse-loamy, mixed, superactive, mesic Ustic Haplocalcids
Sedillo	Loamy-skeletal, mixed, superactive, mesic Ustic Calciargids
Sharps	Fine-silty, mixed, superactive, mesic Aridic Haplustalfs
Shedado	Coarse-loamy, mixed, superactive, calcareous, mesic Ustic Torriorthents
Sheppard	Mixed, mesic Typic Torripsamments
Shingle	Loamy, mixed, superactive, calcareous, mesic, shallow Ustic Torriorthents
Shiprock	Coarse-loamy, mixed, superactive, mesic Typic Haplargids
Shumbegay	Sandy, mixed, mesic Typic Torriorthents
Silkie	Fine, mixed, superactive, mesic Vertic Haplustalfs
Silver	Fine, mixed, superactive, mesic Ustic Haplargids
Sitar	Loamy-skeletal, mixed, superactive, mesic Xeric Haplocalcids
Skyvillage	Loamy, mixed, superactive, calcareous, mesic Lithic Ustic Torriorthents
Sogzie	Coarse-loamy, mixed, superactive, mesic Typic Calciargids
Sparank	Fine, mixed, superactive, calcareous, mesic Ustic Torrifluvents
Sparham	Fine, mixed, superactive, calcareous, mesic Aridic Ustifluvents
Springerville	Fine, smectitic, mesic Aridic Haplusterts
St. Thomas	Loamy-skeletal, carbonatic, thermic Lithic Torriorthents
Stout	Loamy, mixed, superactive, frigid Lithic Haplustepts
Strych	Loamy-skeletal, mixed, superactive, mesic Ustic Haplocalcids
Stumble	Mixed, mesic Typic Torripsamments
Suwanee	Fine-loamy, mixed, superactive, calcareous, mesic Ustic Torrifluvents
Techado	Clayey, mixed, superactive, nonacid, frigid, shallow Typic Ustorthents
Teco	Fine, mixed, superactive, mesic Aridic Haplustalfs
Telescope	Coarse-loamy, mixed, superactive, mesic Haplocalcidic Haplustepts
Tewa	Fine-loamy, mixed, superactive, mesic Typic Haplocambids
Thunderbird	Fine, smectitic, mesic Aridic Argiustolls
Tocito	Fine-silty, mixed, active, calcareous, mesic Typic Torriorthents
Tome	Fine-silty, mixed, superactive, calcareous, thermic Typic Torriorthents
Tonalea	Mixed, mesic Typic Ustipsamments
Tonopah	Sandy-skeletal, mixed, thermic Typic Haplocalcids
Toqui	Clayey, smectitic, mesic Lithic Haplustalfs
Torreon	Fine, smectitic, mesic Calcidic Argiustolls
Torrifluvents	Torrifluvents
Torriorthents	Torriorthents
Tosser	Sandy-skeletal, mixed, mesic Xeric Haplocalcids
Tours	Fine-silty, mixed, superactive, calcareous, mesic Typic Torrifluvents
Tovar	Fine, smectitic, mesic Vertic Paleustalfs
Trail	Sandy, mixed, mesic Typic Torrifluvents
Travessilla	Loamy, mixed, superactive, calcareous, mesic Lithic Ustic Torriorthents
Tsebitai	Coarse-silty, mixed, active, mesic Typic Haplocambids
Tsosie	Fine-loamy, mixed, superactive, calcareous, mesic Ustic Torriorthents
Tunitcha	Fine-loamy, mixed, superactive, frigid Typic Haplustalfs
Turley	Fine-loamy, mixed, active, calcareous, mesic Typic Torriorthents
Tusayan	Loamy-skeletal, carbonatic, mesic Ustic Haplocalcids
Tuweep	Fine-loamy, mixed, superactive, mesic Ustic Calciargids
Twick	Clayey, mixed, superactive, mesic, shallow Ustic Haplargids
Typic Haplustalfs	Fine, mixed, mesic Typic Haplustalfs
Typic Torrifluvents	Typic Torrifluvents
Typic Torriorthents	Typic Torriorthents
Typic Ustochrepts	Loamy-skeletal, mixed, mesic Typic Haplustepts

Taxonomic Classification of the Soils

United States

Soil name	Family or higher taxonomic classification
Typic Ustochrepts	Fine-loamy, mixed, mesic Typic Haplustepts
Uffens	Fine-loamy, mixed, superactive, mesic Typic Natrargids
Ustic Torriorthents	Ustic Torriorthents
Ustollic Haplargids	Haplargids
Uzona	Fine, smectitic, mesic Typic Haplosalids
Valnor	Fine, mixed, superactive, frigid Typic Haplustalfs
Venadito	Very-fine, smectitic, mesic Chromic Haplotorrerts
Vessilla	Loamy, mixed, active, calcareous, mesic Aridic Lithic Ustorthents
Veteado	Fine, mixed, superactive, mesic Ustic Paleargids
Vinton	Sandy, mixed, thermic Typic Torrifluvents
Viuda	Clayey, mixed, superactive, mesic Lithic Ustic Haplargids
Walrees	Fine-loamy over sandy or sandy-skeletal, mixed, superactive, calcareous, mesic Oxyaquic Ustifluvents
Wayneco	Loamy, mixed, superactive, mesic Lithic Ustic Haplocalcids
Weiser	Loamy-skeletal, carbonatic, thermic Typic Haplocalcids
Wepo	Fine, mixed, superactive, mesic Vertic Haplocambids
Werito	Fine, mixed, active, mesic Sodic Haplocambids
Werlog	Fine-loamy, mixed, active, calcareous, mesic Aquic Ustifluvents
Weska	Loamy, mixed, superactive, nonacid, mesic, shallow Ustic Torriorthents
Whit	Fine-silty, mixed, superactive, mesic Typic Calciargids
Winona	Loamy-skeletal, carbonatic, mesic Lithic Ustic Haplocalcids
Witt	Fine-silty, mixed, superactive, mesic Ustic Calciargids
Wukoki	Ashy-skeletal over fragmental or cindery, mixed, mesic Vitrandic Haplocambids
Wupatki	Cindery, mixed, mesic, shallow Argiduridic Durustolls
Yaki	Loamy-skeletal, carbonatic, mesic Lithic Ustic Haplocalcids
Yenlo	Fine-loamy, mixed, superactive, mesic Ustic Haplargids
Youngston	Fine-loamy, mixed, superactive, calcareous, mesic Typic Torrifluvents
Zia	Coarse-loamy, mixed, superactive, calcareous, mesic Ustic Torriorthents
Zyme	Clayey, smectitic, calcareous, mesic, shallow Ustic Torriorthents

Chemical Soil Properties

United States

[Absence of an entry indicates that data were not estimated]

Map symbol and soil name	Depth	Cation-exchange capacity	Effective cation-exchange capacity	Soil reaction	Calcium carbon-ate	Gypsum	Salinity	Sodium adsorption ratio
	In	*meq/100 g*	*meq/100 g*	*pH*	*Pct*	*Pct*	*mmhos/cm*	
s318:								
Rock outcrop	0-60	---	---	---	---	---	---	---
Torriorthents	0-60	---	---	---	---	---	---	---
s319:								
Deama	0-4	---	---	7.9 - 8.4	---	---	0.0-2.0	---
	4-12	---	---	7.9 - 8.4	---	---	0.0-2.0	---
	12-16	---	---	---	---	---	---	---
Toqui	0-3	5.0-15	---	6.1 - 7.3	0	0	0.0-2.0	0
	3-15	10-20	---	6.6 - 8.4	5-45	0	0.0-2.0	0
	15-19	10-20	---	7.4 - 8.4	5-45	0	0.0-2.0	0
	19-23	---	---	---	---	---	---	---
Tovar	0-3	8.8-17	---	6.1 - 7.8	---	---	---	---
	3-8	---	---	6.6 - 8.4	---	---	---	---
	8-35	---	---	6.6 - 8.4	---	---	---	---
	35-39	---	---	---	---	---	---	---
s337:								
Tours	0-6	10-25	---	7.9 - 9.0	5-15	0-5	16.0-32.0	13-30
	6-47	10-25	---	7.9 - 9.0	10-20	0-5	16.0-32.0	13-30
	47-60	3.0-10	---	7.9 - 9.0	10-20	0-5	16.0-32.0	13-30
Burnswick	0-3	10-20	---	7.9 - 9.0	1-5	0	0.0-4.0	6-20
	3-16	10-20	---	7.9 - 9.0	1-15	0	0.0-8.0	6-20
	16-41	10-20	---	8.5 - 9.0	1-15	0	0.0-8.0	13-30
	41-53	2.0-10	---	8.5 - 9.0	1-15	0	0.0-8.0	13-30
	53-60	10-20	---	8.5 - 9.0	1-15	0	0.0-8.0	13-30
Jocity	0-9	10-20	---	7.9 - 9.0	1-15	0	4.0-32.0	4-13
	9-41	10-20	---	7.9 - 9.0	1-15	0	4.0-32.0	4-13
	41-60	2.0-10	---	7.9 - 9.0	1-15	0	4.0-32.0	4-13
Ives	0-13	5.0-10	---	7.9 - 9.0	1-5	0	4.0-32.0	1-13
	13-55	4.0-10	---	7.9 - 9.0	1-10	0	4.0-32.0	1-13
	55-62	1.0-5.0	---	7.9 - 9.0	1-10	0	4.0-32.0	4-30
Riverwash	0-59	---	---	---	---	---	---	---
Trail	0-3	2.0-5.0	---	7.9 - 8.4	1-3	0	0.0-2.0	0
	3-60	2.0-5.0	---	7.9 - 9.0	1-3	0	0.0-8.0	0-5
Typic Torrifluvents	0-60	---	---	---	---	---	---	---

Chemical Soil Properties

United States

Map symbol and soil name	Depth	Cation-exchange capacity	Effective cation-exchange capacity	Soil reaction	Calcium carbon-ate	Gypsum	Salinity	Sodium adsorption ratio
	In	*meq/100 g*	*meq/100 g*	*pH*	*Pct*	*Pct*	*mmhos/cm*	
s337:								
Navajo	0-5	20-35	---	7.9 - 9.0	1-10	0	16.0-32.0	0-13
	5-60	20-35	---	7.9 - 9.0	1-10	0	16.0-32.0	0-13
Rock outcrop	---	---	---	---	---	---	---	---
s338:								
Burnswick	0-3	10-20	---	7.9 - 9.0	1-5	0	0.0-4.0	6-20
	3-16	10-20	---	7.9 - 9.0	1-15	0	0.0-8.0	6-20
	16-41	10-20	---	8.5 - 9.0	1-15	0	0.0-8.0	13-30
	41-53	2.0-10	---	8.5 - 9.0	1-15	0	0.0-8.0	13-30
	53-60	10-20	---	8.5 - 9.0	1-15	0	0.0-8.0	13-30
Marcou	0-6	1.0-5.0	---	7.9 - 8.4	1-10	0	0.0-8.0	2-13
	6-47	5.0-10	---	8.5 - 9.0	1-10	0	2.0-8.0	13-30
	47-54	10-25	---	8.5 - 9.0	1-10	0	2.0-8.0	13-30
	54-60	1.0-5.0	---	8.5 - 9.0	5-20	0	2.0-8.0	13-30
Jocity	0-9	10-20	---	7.9 - 9.0	1-15	0	4.0-32.0	4-13
	9-41	10-20	---	7.9 - 9.0	1-15	0	4.0-32.0	4-13
	41-60	2.0-10	---	7.9 - 9.0	1-15	0	4.0-32.0	4-13
Claysprings	0-3	20-30	---	7.4 - 9.0	1-10	0	0.0-16.0	0-13
	3-18	15-35	---	7.4 - 9.0	1-10	0	0.0-16.0	0-13
	18-28	---	---	---	---	---	---	---
Rock outcrop	---	---	---	---	---	---	---	---
s339:								
Jocity	0-3	5.0-10	---	7.4 - 8.4	0-5	0	0.0-2.0	0
	3-84	10-20	---	7.9 - 8.4	0-10	0-5	0.0-2.0	0
Polacca	0-3	10-25	---	7.4 - 8.4	5-15	0	0.0-2.0	0
	3-33	10-30	---	7.4 - 8.4	5-15	0	0.0-2.0	0
	33-84	1.0-5.0	---	7.4 - 8.4	1-10	0	0.0-2.0	0
Wepo	0-3	15-25	---	7.4 - 8.4	0-10	0	0.0-2.0	0
	3-32	15-25	---	7.4 - 8.4	5-15	0	2.0-8.0	0
	32-84	15-25	---	7.4 - 8.4	5-15	0	2.0-8.0	0-15
Jeddito	0-2	2.0-5.0	---	7.4 - 8.4	0-5	0	0.0-2.0	0
	2-9	4.0-10	---	7.4 - 8.4	0-5	0	0.0-2.0	0
	9-27	4.0-10	---	7.4 - 8.4	0-5	0	2.0-4.0	0
	27-84	4.0-10	---	7.4 - 8.4	0-5	0	2.0-4.0	0

Chemical Soil Properties

United States

Map symbol and soil name	Depth	Cation-exchange capacity	Effective cation-exchange capacity	Soil reaction	Calcium carbon-ate	Gypsum	Salinity	Sodium adsorption ratio
	In	*meq/100 g*	*meq/100 g*	*pH*	*Pct*	*Pct*	*mmhos/cm*	
s339:								
Tewa	0-1	5.0-15	---	7.4 - 7.8	1-5	0	0.0-2.0	0
	1-25	10-20	---	7.4 - 8.4	1-15	1-5	0.0-2.0	0
	25-31	5.0-10	---	7.4 - 8.4	1-15	1-5	0.0-2.0	0
	31-84	10-20	---	7.4 - 8.4	1-15	0-3	0.0-2.0	0-4
Sheppard	0-2	2.0-5.0	---	7.4 - 8.4	0-1	0	0.0-2.0	0
	2-84	1.0-5.0	---	7.4 - 8.4	0-5	0	0.0-2.0	0
Monue	0-5	5.0-10	---	7.4 - 8.4	0-2	0	0.0-2.0	0
	5-84	5.0-10	---	7.9 - 9.0	1-5	0	0.0-2.0	0
Rock outcrop	0-60	---	---	---	---	---	---	---
s340:								
Sheppard	0-2	2.0-5.0	---	7.4 - 8.4	0-1	0	0.0-2.0	0
	2-84	1.0-5.0	---	7.4 - 8.4	0-5	0	0.0-2.0	0
Sheppard	0-1	2.0-4.0	---	7.4 - 8.4	0-1	0	0.0-2.0	10-15
	1-84	2.0-5.0	---	7.9 - 9.0	0-5	0	0.0-2.0	10-15
Jocity	0-3	5.0-10	---	7.4 - 8.4	0-5	0	0.0-2.0	0
	3-84	10-20	---	7.9 - 8.4	0-10	0-5	0.0-2.0	0
Joraibi	0-2	10-25	---	7.9 - 9.0	1-10	0	2.0-16.0	20-45
	2-23	5.0-10	---	7.9 - 9.0	1-10	0	2.0-16.0	20-45
	23-54	0.0-5.0	---	7.9 - 9.0	1-10	0	2.0-16.0	20-45
	54-84	5.0-20	---	7.4 - 9.0	1-10	0	2.0-16.0	20-45
Jocity	0-1	10-20	---	7.9 - 11.0	0-5	0	8.0-16.0	13-35
	1-24	10-20	---	7.9 - 11.0	1-10	0-5	8.0-16.0	13-35
	24-84	10-30	---	7.4 - 9.0	1-10	0-5	8.0-16.0	13-35
Torriorthents	0-20	---	---	---	---	---	---	---
	20-60	---	---	---	---	---	---	---
s341:								
Jeddito	0-2	2.0-5.0	---	7.4 - 8.4	0-5	0	0.0-2.0	0
	2-9	4.0-10	---	7.4 - 8.4	0-5	0	0.0-2.0	0
	9-27	4.0-10	---	7.4 - 8.4	0-5	0	2.0-4.0	0
	27-84	4.0-10	---	7.4 - 8.4	0-5	0	2.0-4.0	0
Tewa	0-1	5.0-15	---	7.4 - 7.8	1-5	0	0.0-2.0	0
	1-25	10-20	---	7.4 - 8.4	1-15	1-5	0.0-2.0	0
	25-31	5.0-10	---	7.4 - 8.4	1-15	1-5	0.0-2.0	0
	31-84	10-20	---	7.4 - 8.4	1-15	0-3	0.0-2.0	0-4

Chemical Soil Properties

United States

Map symbol and soil name	Depth	Cation-exchange capacity	Effective cation-exchange capacity	Soil reaction	Calcium carbon-ate	Gypsum	Salinity	Sodium adsorption ratio
	In	*meq/100 g*	*meq/100 g*	*pH*	*Pct*	*Pct*	*mmhos/cm*	
s341:								
Sheppard	0-2	2.0-5.0	---	7.4 - 8.4	0-1	0	0.0-2.0	0
	2-84	1.0-5.0	---	7.4 - 8.4	0-5	0	0.0-2.0	0
Torriorthents	0-20	---	---	---	---	---	---	---
	20-60	---	---	---	---	---	---	---
Mido	0-3	1.0-5.0	---	7.4 - 9.0	0-2	0	0.0-2.0	0
	3-84	1.0-4.0	---	7.4 - 9.0	1-5	0	0.0-2.0	0
Monue	0-5	5.0-10	---	7.4 - 8.4	0-2	0	0.0-2.0	0
	5-84	5.0-10	---	7.9 - 9.0	1-5	0	0.0-2.0	0
Rock outcrop	0-60	---	---	---	---	---	---	---
s342:								
Rock outcrop	0-60	---	---	---	---	---	---	---
Moenkopie	0-3	5.0-12	---	7.4 - 9.0	1-10	---	0.0-2.0	---
	3-8	3.0-14	---	7.4 - 9.0	1-10	0-1	0.0-2.0	0-2
	8-12	---	---	---	---	---	---	---
Bluechief	0-3	---	---	7.9 - 8.4	---	---	0.0-2.0	---
	3-25	---	---	7.9 - 9.0	---	---	0.0-2.0	---
	25-38	---	---	8.5 - 9.0	---	---	0.0-2.0	---
	38-42	---	---	---	---	---	---	---
Casmos family	0-2	---	---	7.9 - 8.4	---	---	0.0-2.0	---
	2-8	---	---	7.9 - 8.4	---	---	0.0-2.0	---
	8-11	---	---	7.9 - 8.4	---	---	0.0-2.0	---
	11-15	---	---	---	---	---	---	---
Monue family	0-3	---	---	7.9 - 8.4	---	---	0.0-2.0	---
	3-31	---	---	7.9 - 8.4	---	---	0.0-2.0	---
	31-35	---	---	---	---	---	---	---
Nakai	0-3	---	---	7.4 - 8.4	---	---	0.0-2.0	---
	3-51	---	---	7.3 - 9.6	---	---	0.0-2.0	---
	51-55	---	---	---	---	---	---	---
Sheppard	0-12	1.4-4.0	---	7.4 - 8.4	0-5	---	---	---
	12-60	0.0-10	---	7.4 - 9.0	0-10	---	0.0-2.0	---
s343:								
Monue	0-3	2.0-5.0	---	7.9 - 8.4	1-3	---	0.0-2.0	1-5
	3-60	3.0-11	---	7.9 - 9.0	3-10	---	0.0-2.0	1-5

Chemical Soil Properties

United States

Map symbol and soil name	Depth	Cation-exchange capacity	Effective cation-exchange capacity	Soil reaction	Calcium carbon-ate	Gypsum	Salinity	Sodium adsorption ratio
	In	*meq/100 g*	*meq/100 g*	*pH*	*Pct*	*Pct*	*mmhos/cm*	
s343:								
Nakai	0-18	---	---	7.9 - 9.0	---	---	0.0-2.0	---
	18-34	---	---	7.9 - 9.0	---	---	0.0-2.0	---
	34-60	---	---	7.9 - 9.0	---	---	2.0-8.0	---
Blackston	0-3	5.0-10	---	7.9 - 8.4	1-5	---	0.0-2.0	0-5
	3-9	5.0-10	---	7.9 - 9.0	5-10	---	0.0-2.0	5-13
	9-15	10-20	---	7.9 - 9.0	10-15	---	2.0-4.0	5-13
	15-35	5.0-10	---	7.9 - 8.4	5-10	---	2.0-4.0	0-5
	35-70	0.0-5.0	---	7.9 - 8.4	1-5	---	0.0-2.0	---
s344:								
Purgatory	0-1	5.0-10	---	7.4 - 8.4	0-15	0-10	2.0-8.0	0
	1-20	5.0-15	---	7.4 - 8.4	0-15	30-55	2.0-8.0	0
	20-27	15-20	---	7.4 - 8.4	0-15	30-55	2.0-8.0	0
	27-60	---	---	---	---	20-80	---	---
Clraysprings	0-3	20-30	---	7.4 - 9.0	1-10	0	0.0-16.0	0-13
	3-18	15-35	---	7.4 - 9.0	1-10	0	0.0-16.0	0-13
	18-28	---	---	---	---	---	---	---
Badland	0-1	---	---	---	1-15	0-90	2.0-16.0	1-30
	1-60	---	---	---	1-15	0-90	2.0-16.0	1-30
Epikom	0-1	2.0-10	---	7.9 - 8.4	1-10	0	0.0-2.0	0
	1-10	5.0-10	---	7.9 - 8.4	1-10	0	0.0-2.0	0
	10-14	5.0-10	---	7.9 - 8.4	5-15	0	0.0-2.0	0
	14-24	---	---	---	---	---	---	---
Rock outcrop	---	---	---	---	---	---	---	---
s345:								
Sheppard	0-2	2.0-5.0	---	7.4 - 8.4	0-1	0	0.0-2.0	0
	2-84	1.0-5.0	---	7.4 - 8.4	0-5	0	0.0-2.0	0
Monue	0-5	5.0-10	---	7.4 - 8.4	0-2	0	0.0-2.0	0
	5-84	5.0-10	---	7.9 - 9.0	1-5	0	0.0-2.0	0
Nakai	0-3	5.0-15	---	7.4 - 9.0	1-10	0	0.0-2.0	0
	3-30	3.0-10	---	7.9 - 9.0	1-15	0	0.0-2.0	0-6
	30-84	10-20	---	7.9 - 9.0	15-40	0	0.0-2.0	15-30
Typic Torriorthents	0-20	---	---	---	---	---	---	---
	20-60	---	---	---	---	---	---	---

Chemical Soil Properties

United States

Map symbol and soil name	Depth	Cation-exchange capacity	Effective cation-exchange capacity	Soil reaction	Calcium carbon-ate	Gypsum	Salinity	Sodium adsorption ratio
	In	*meq/100 g*	*meq/100 g*	*pH*	*Pct*	*Pct*	*mmhos/cm*	
s345:								
Tewa	0-1	5.0-15	---	7.4 - 7.8	1-5	0	0.0-2.0	0
	1-25	10-20	---	7.4 - 8.4	1-15	1-5	0.0-2.0	0
	25-31	5.0-10	---	7.4 - 8.4	1-15	1-5	0.0-2.0	0
	31-84	10-20	---	7.4 - 8.4	1-15	0-3	0.0-2.0	0-4
Rock outcrop	0-60	---	---	---	---	---	---	---
s348:								
Kinan	0-1	2.0-10	---	7.4 - 8.4	2-10	---	0.0-2.0	---
	1-13	2.0-10	---	7.4 - 8.4	5-15	---	0.0-2.0	---
	13-27	2.0-10	---	7.9 - 8.4	15-30	---	0.0-2.0	---
	27-60	2.0-10	---	7.9 - 8.4	15-30	---	0.0-2.0	---
Pennell	0-4	2.0-10	---	7.9 - 8.4	2-10	---	0.0-2.0	---
	4-7	2.0-10	---	7.9 - 8.4	5-15	---	0.0-2.0	---
	7-14	2.0-10	---	7.9 - 8.4	10-20	---	0.0-2.0	---
	14-19	2.0-10	---	7.9 - 8.4	15-25	---	0.0-2.0	---
	19-23	---	---	---	---	---	---	---
Pagina	0-2	0.0-10	---	7.9 - 8.4	0-5	---	0.0-2.0	---
	2-22	0.0-10	---	7.9 - 8.4	5-15	---	0.0-2.0	---
	22-39	2.0-10	---	7.9 - 8.4	15-25	---	0.0-2.0	---
	39-43	---	---	---	---	---	---	---
s351:								
Palma	0-4	4.0-10	---	7.4 - 8.4	0-2	0	0.0-2.0	0-5
	4-60	4.0-15	---	7.3 - 9.6	0-10	0	0.0-2.0	0-5
Mespun	0-18	2.6-6.4	---	6.1 - 7.8	---	---	---	---
	18-60	2.0-6.1	---	6.1 - 7.8	---	---	---	---
Sazi	0-4	7.3-13	---	7.4 - 8.4	---	---	---	---
	4-17	---	---	7.4 - 9.0	---	---	---	---
	17-32	---	---	7.8 - 9.6	---	---	0.0-2.0	---
	32-36	---	---	---	---	---	---	---
Rizno	0-2	5.0-10	---	7.4 - 8.4	5-15	---	0.0-2.0	---
	2-8	5.0-10	---	7.9 - 9.0	5-15	---	0.0-2.0	---
	8-10	5.0-10	---	7.4 - 9.0	5-15	---	0.0-2.0	---
	10-14	---	---	---	---	---	---	---
Rock outcrop	0-60	---	---	---	---	---	---	---

Chemical Soil Properties

United States

Map symbol and soil name	Depth	Cation-exchange capacity	Effective cation-exchange capacity	Soil reaction	Calcium carbon-ate	Gypsum	Salinity	Sodium adsorption ratio
	In	*meq/100 g*	*meq/100 g*	*pH*	*Pct*	*Pct*	*mmhos/cm*	
s351:								
Wayneco	0-3	5.6-9.1	---	7.9 - 8.4	1-5	---	---	0
	3-9	4.1-8.6	---	7.9 - 8.4	1-5	---	---	0
	9-19	4.0-12	---	7.9 - 9.0	15-30	---	0.0-2.0	0
	19-23	---	---	---	---	---	---	---
Mellenthin	0-4	5.0-10	---	7.9 - 8.4	---	---	0.0-2.0	---
	4-15	10-20	---	7.9 - 8.4	---	---	0.0-2.0	---
	15-18	5.0-10	---	7.9 - 8.4	---	---	0.0-2.0	---
	18-22	---	---	---	---	---	---	---
s355:								
Winona	0-2	9.5-17	---	7.4 - 8.4	---	---	---	---
	2-15	---	---	7.4 - 8.4	---	---	---	---
	15-19	---	---	---	---	---	---	---
Tusayan	0-10	---	---	7.4 - 8.4	---	---	0.0-2.0	---
	10-29	---	---	7.4 - 8.4	---	---	0.0-2.0	---
	29-33	---	---	---	---	---	---	---
Boysag	0-3	8.9-17	---	6.6 - 7.8	---	---	---	---
	3-13	---	---	7.4 - 8.4	---	---	---	---
	13-16	---	---	7.4 - 8.4	---	---	---	---
	16-20	---	---	---	---	---	---	---
s356:								
Epikom	0-1	2.0-10	---	7.9 - 8.4	1-10	0	0.0-2.0	0
	1-10	5.0-10	---	7.9 - 8.4	1-10	0	0.0-2.0	0
	10-14	5.0-10	---	7.9 - 8.4	5-15	0	0.0-2.0	0
	14-24	---	---	---	---	---	---	---
Rock outcrop	0-60	---	---	---	---	---	---	---
Needle	0-7	0.0-5.0	---	7.4 - 8.4	0	0	0.0-2.0	0
	7-9	0.0-10	---	7.4 - 8.4	0	0	0.0-2.0	0
	9-19	---	---	---	---	---	---	---
s357:								
Clovis	0-5	5.0-10	---	7.4 - 8.4	0	0	0.0-2.0	0-4
	5-25	10-25	---	6.6 - 8.4	0-15	0	0.0-2.0	0-4
	25-60	4.0-10	---	7.9 - 8.4	15-60	0-1	0.0-2.0	0-4
Palma	0-7	8.9-17	---	6.6 - 8.4	---	---	---	---
	7-60	---	---	7.4 - 8.4	---	---	0.0-2.0	---

Chemical Soil Properties

United States

Map symbol and soil name	Depth	Cation-exchange capacity	Effective cation-exchange capacity	Soil reaction	Calcium carbon-ate	Gypsum	Salinity	Sodium adsorption ratio
	In	*meq/100 g*	*meq/100 g*	*pH*	*Pct*	*Pct*	*mmhos/cm*	
s357:								
Sheppard	0-2	---	---	7.4 - 8.4	---	---	0.0-2.0	---
	2-60	---	---	7.4 - 8.4	---	---	0.0-2.0	---
	60-70	---	---	7.4 - 8.4	---	---	0.0-2.0	---
Hubert	0-10	---	---	7.4 - 8.4	---	---	---	---
	10-15	---	---	7.4 - 8.4	---	---	---	---
	15-48	---	---	7.9 - 8.4	---	---	0.0-2.0	---
	48-60	---	---	7.9 - 8.4	---	---	0.0-2.0	---
s360:								
Tuweep	0-3	---	---	7.4 - 8.4	---	---	0.0-2.0	---
	3-34	---	---	7.4 - 8.4	---	---	0.0-2.0	---
	34-60	---	---	7.4 - 8.4	---	---	0.0-2.0	---
Wukoki	0-10	5.0-20	---	7.4 - 8.4	0-5	0	0.0-2.0	0
	10-18	5.0-20	---	7.4 - 8.4	0-5	0	0.0-2.0	0
	18-65	0.0-1.0	---	7.4 - 8.4	0-5	0	0.0-2.0	0
Wupatki	0-6	---	---	7.4 - 8.4	---	---	0.0-2.0	---
	6-16	---	---	7.4 - 8.4	---	---	0.0-2.0	---
	16-20	---	---	---	---	---	---	---
	20-60	---	---	7.4 - 8.4	---	---	0.0-2.0	---
s362:								
Rock outcrop	0-60	---	---	---	---	---	---	---
Arches	0-4	2.6-6.4	---	7.4 - 8.4	0-5	---	---	---
	4-13	0.0-10	---	7.4 - 9.0	0-10	---	0.0-2.0	---
	13-15	0.0-15	---	7.4 - 9.0	0-10	---	0.0-2.0	---
	15-19	---	---	---	---	---	---	---
Batterson	0-4	1.8-7.8	---	7.9 - 8.4	---	---	---	---
	4-15	1.4-7.4	---	7.9 - 8.4	1-4	---	---	---
	15-19	---	---	---	---	---	---	---
Bond family	0-2	8.9-17	---	7.4 - 7.8	---	---	---	---
	2-16	---	---	7.9 - 8.4	---	---	0.0-2.0	---
	16-20	---	---	---	---	---	---	---
Lava flows	0-60	---	---	---	---	---	---	---
Magotsu	0-5	---	---	6.6 - 7.8	---	---	0.0-2.0	---
	5-17	---	---	6.6 - 7.8	---	---	0.0-2.0	---
	17-21	---	---	---	---	---	---	---
	21-25	---	---	---	---	---	---	---

Chemical Soil Properties

United States

Map symbol and soil name	Depth	Cation-exchange capacity	Effective cation-exchange capacity	Soil reaction	Calcium carbon-ate	Gypsum	Salinity	Sodium adsorption ratio
	In	*meq/100 g*	*meq/100 g*	*pH*	*Pct*	*Pct*	*mmhos/cm*	
s362:								
Yaki	0-2	---	---	7.9 - 9.0	---	---	0.0-2.0	---
	2-19	---	---	7.9 - 9.0	---	---	0.0-2.0	---
	19-23	---	---	---	---	---	---	---
Cinder land	0-60	---	---	---	---	---	---	---
s363:								
Grieta	0-3	5.0-10	---	7.9 - 8.4	1-5	0	0.0-2.0	0
	3-20	10-20	---	7.9 - 8.4	1-15	0	0.0-2.0	0
	20-44	10-20	---	7.9 - 8.4	15-30	0	0.0-2.0	0
	44-60	5.0-10	---	7.9 - 8.4	5-30	0	0.0-2.0	0
Sheppard	0-60	2.0-5.0	---	7.4 - 8.4	0-2	0	0.0	0
s364:								
Begay	0-4	4.0-15	---	7.4 - 8.4	0-2	0	0.0-2.0	0
	4-57	2.0-10	---	7.4 - 8.4	0-5	0	0.0-2.0	0
	57-84	2.0-10	---	7.4 - 8.4	1-5	0	0.0-2.0	0
Penistaja	0-2	5.0-15	---	6.6 - 8.4	0	0	0.0-2.0	0
	2-18	10-25	---	6.6 - 8.4	0-5	0	0.0-2.0	0
	18-58	5.0-15	---	6.6 - 8.4	3-10	0	0.0-2.0	0
	58-84	1.0-5.0	---	6.6 - 8.4	3-10	0	0.0-2.0	0-5
Mido	0-3	1.0-5.0	---	7.4 - 9.0	0-2	0	0.0-2.0	0
	3-84	1.0-4.0	---	7.4 - 9.0	1-5	0	0.0-2.0	0
Ustic Torriorthents	0-31	---	---	---	---	---	---	---
	31-41	---	---	---	---	---	---	---
Rock outcrop	0-60	---	---	---	---	---	---	---
s377:								
Thunderbird	0-2	15-30	---	6.6 - 7.8	0-15	---	0.0-2.0	---
	2-31	15-35	---	6.6 - 8.4	5-15	---	0.0-2.0	---
	31-35	---	---	---	---	---	---	---
Cabezon	0-4	20-32	---	6.1 - 7.3	---	---	---	---
	4-12	---	---	6.1 - 7.3	---	---	---	---
	12-16	---	---	---	---	---	---	---
Rudd	0-10	17-23	---	7.4 - 8.4	---	---	---	---
	10-13	---	---	7.9 - 8.4	---	---	0.0-2.0	---
	13-17	---	---	---	---	---	---	---

Chemical Soil Properties

United States

Map symbol and soil name	Depth	Cation-exchange capacity	Effective cation-exchange capacity	Soil reaction	Calcium carbon-ate	Gypsum	Salinity	Sodium adsorption ratio
	In	*meq/100 g*	*meq/100 g*	*pH*	*Pct*	*Pct*	*mmhos/cm*	
s377:								
Springerville	0-4	26-46	---	7.4 - 8.4	---	---	---	---
	4-35	---	---	7.4 - 8.4	---	---	---	---
	35-42	---	---	7.4 - 8.4	---	---	---	---
	42-46	---	---	---	---	---	---	---
s383:								
Kydestea	0-1	10-25	---	7.4 - 7.8	0-10	0	0.0-2.0	0
	1-5	10-25	---	7.4 - 8.4	5-15	0	0.0-4.0	0
	5-15	10-25	---	7.4 - 8.4	5-15	0	0.0-4.0	0
	15-19	---	---	---	---	---	---	---
Zyme	0-1	15-30	---	7.4 - 8.4	1-5	0	0.0-2.0	0
	1-18	15-30	---	7.4 - 8.4	1-10	0-5	0.0-2.0	0
	18-22	---	---	---	---	---	---	---
Tonalea	0-3	0.0-15	---	7.4 - 7.8	0	0	0.0-2.0	0
	3-24	0.0-15	---	7.4 - 8.4	0-10	0	0.0-2.0	0
	24-26	---	---	---	---	---	---	---
	26-30	---	---	---	---	---	---	---
Ustic Torriorthents	0-20	---	---	---	---	---	---	---
	20-60	---	---	---	---	---	---	---
Rock outcrop	0-60	---	---	---	---	---	---	---
Begay	0-4	4.0-15	---	7.4 - 8.4	0-2	0	0.0-2.0	0
	4-57	2.0-10	---	7.4 - 8.4	0-5	0	0.0-2.0	0
	57-84	2.0-10	---	7.4 - 8.4	1-5	0	0.0-2.0	0
Penistaja	0-2	5.0-15	---	6.6 - 8.4	0	0	0.0-2.0	0
	2-18	10-25	---	6.6 - 8.4	0-5	0	0.0-2.0	0
	18-58	5.0-15	---	6.6 - 8.4	3-10	0	0.0-2.0	0
	58-84	1.0-5.0	---	6.6 - 8.4	3-10	0	0.0-2.0	0-5
s384:								
Torriorthents	0-31	---	---	---	---	---	---	---
	31-41	---	---	---	---	---	---	---
Badland	0-60	---	---	---	1-15	0-90	2.0-16.0	1-30
Monue	0-5	5.0-10	---	7.4 - 8.4	0-2	0	0.0-2.0	0
	5-84	5.0-10	---	7.9 - 9.0	1-5	0	0.0-2.0	0
Sheppard	0-2	2.0-5.0	---	7.4 - 8.4	0-1	0	0.0-2.0	0
	2-84	1.0-5.0	---	7.4 - 8.4	0-5	0	0.0-2.0	0

Chemical Soil Properties

United States

Map symbol and soil name	Depth	Cation-exchange capacity	Effective cation-exchange capacity	Soil reaction	Calcium carbon-ate	Gypsum	Salinity	Sodium adsorption ratio
	In	*meq/100 g*	*meq/100 g*	*pH*	*Pct*	*Pct*	*mmhos/cm*	
s384:								
Rock outcrop	0-60	---	---	---	---	---	---	---
s392:								
Aneth	0-2	0.0-10	---	7.9 - 8.4	0-5	---	0.0-2.0	---
	2-60	0.0-10	---	7.4 - 8.4	0-10	---	0.0-2.0	---
Sheppard	0-12	1.4-4.0	---	7.4 - 8.4	0-5	---	---	---
	12-60	0.0-10	---	7.4 - 9.0	0-10	---	0.0-2.0	---
Rock outcrop	0-60	---	---	---	---	---	---	---
Sogzie	0-5	---	---	8.5 - 9.0	---	---	0.0-2.0	---
	5-21	---	---	7.9 - 9.0	---	---	0.0-2.0	---
	21-80	---	---	7.9 - 8.4	---	---	0.0-2.0	---
s393:								
Begay	0-3	2.1-9.3	---	7.4 - 8.4	3-15	0-2	---	1-10
	3-42	5.0-10	---	7.4 - 9.0	5-20	0-2	0.0-2.0	1-10
	42-60	5.0-10	---	7.9 - 9.0	5-20	0-2	0.0-2.0	1-10
Shedado	0-7	5.0-12	---	6.6 - 8.4	10-25	---	0.0-2.0	---
	7-15	2.0-6.0	---	6.6 - 7.3	10-25	---	0.0-2.0	---
	15-35	2.0-12	---	6.6 - 8.4	10-25	---	0.0-2.0	---
	35-39	---	---	---	---	---	---	---
Anasazi	0-4	---	---	7.4 - 8.4	---	---	0.0-2.0	---
	4-24	---	---	7.4 - 9.0	---	---	0.0-2.0	---
	24-28	---	---	---	---	---	---	---
Mespun	0-18	1.4-7.4	---	6.1 - 7.8	---	---	---	---
	18-60	2.0-6.1	---	6.1 - 7.8	---	---	---	---
Rock outcrop	0-60	---	---	---	---	---	---	---
s394:								
Namon	0-5	7.6-14	---	6.1 - 7.3	---	---	---	---
	5-21	---	---	6.6 - 7.8	---	---	---	---
	21-48	---	---	6.6 - 7.8	---	---	---	---
	48-52	---	---	---	---	---	---	---
Rock outcrop	0-60	---	---	---	---	---	---	---
Ustollic Haplargids	0-8	6.9-14	---	7.4 - 8.4	---	---	---	---
	8-24	---	---	7.4 - 8.4	---	---	---	---
	24-60	---	---	7.4 - 9.0	---	---	0.0-2.0	---

Chemical Soil Properties

United States

Map symbol and soil name	Depth	Cation-exchange capacity	Effective cation-exchange capacity	Soil reaction	Calcium carbon-ate	Gypsum	Salinity	Sodium adsorption ratio
	In	*meq/100 g*	*meq/100 g*	*pH*	*Pct*	*Pct*	*mmhos/cm*	
s398:								
Monue	0-13	---	---	7.9 - 8.4	---	---	0.0-2.0	---
	13-46	---	---	8.4 - 9.6	---	---	0.0-2.0	---
	46-50	---	---	---	---	---	---	---
Moepitz	0-10	---	---	7.4 - 8.4	---	---	0.0-2.0	---
	10-22	---	---	8.5 - 9.0	---	---	0.0-2.0	---
	22-30	---	---	7.4 - 8.4	---	---	0.0-2.0	---
	30-34	---	---	---	---	---	---	---
Sheppard	0-12	1.4-4.0	---	7.4 - 8.4	0-5	---	---	---
	12-60	0.0-10	---	7.4 - 9.0	0-10	---	0.0-2.0	---
Rock outcrop	0-60	---	---	---	---	---	---	---
Deleco	0-3	---	---	8.5 - 9.0	---	---	0.0-2.0	---
	3-7	---	---	8.5 - 9.0	---	---	0.0-2.0	---
	7-10	---	---	8.5 - 9.0	---	---	0.0-2.0	---
	10-14	---	---	---	---	---	---	---
	14-45	---	---	9.0 - 9.6	---	---	0.0-2.0	---
s415:								
Eutric Glossoboralfs	0-2	11-15	---	6.6 - 7.3	---	---	---	---
	2-16	8.7-14	---	6.6 - 7.3	---	---	---	---
	16-35	16-24	---	6.1 - 6.5	---	---	---	---
	35-67	19-26	---	6.1 - 6.5	---	---	---	---
Typic Haplustalfs	0-7	13-22	---	6.6 - 7.3	---	---	---	---
	7-30	---	---	7.4 - 7.8	---	---	0.0-2.0	---
	30-41	---	---	7.4 - 7.8	---	---	0.0-2.0	---
	41-48	---	---	7.9 - 8.4	---	---	0.0-2.0	---
	48-60	---	---	7.4 - 7.8	---	---	0.0-2.0	---
Rock outcrop	0-60	---	---	---	---	---	---	---
s441:								
Piute	0-9	---	---	7.4 - 8.4	---	---	0.0-2.0	---
	9-13	---	---	---	---	---	---	---
Bluechief	0-3	---	---	7.9 - 8.4	---	---	0.0-2.0	---
	3-25	---	---	7.9 - 9.0	---	---	0.0-2.0	---
	25-38	---	---	8.5 - 9.0	---	---	0.0-2.0	---
	38-42	---	---	---	---	---	---	---
Rock outcrop	0-60	---	---	---	---	---	---	---

Chemical Soil Properties

United States

Map symbol and soil name	Depth	Cation-exchange capacity	Effective cation-exchange capacity	Soil reaction	Calcium carbon-ate	Gypsum	Salinity	Sodium adsorption ratio
	In	*meq/100 g*	*meq/100 g*	*pH*	*Pct*	*Pct*	*mmhos/cm*	
s442:								
Shumbegay	0-2	1.0-3.0	---	7.9 - 9.0	1-3	---	0.0-2.0	0-13
	2-6	3.0-5.0	---	8.5 - 9.0	1-3	---	0.0-2.0	13-30
	6-10	1.0-3.0	---	8.5 - 9.0	1-3	---	0.0-2.0	5-30
	10-80	2.0-4.0	---	8.5 - 9.0	1-3	---	0.0-2.0	5-30
Uzona	0-1	---	---	7.4 - 8.4	---	---	8.0-16.0	---
	1-45	---	---	7.9 - 9.0	---	---	16.0	---
	45-58	---	---	8.4 - 9.6	---	---	16.0	---
	58-60	---	---	8.4 - 9.6	---	---	16.0	---
Escavada	0-2	2.0-10	---	7.4 - 8.4	1-5	---	0.0-2.0	0-5
	2-70	1.0-5.0	---	7.4 - 9.0	1-5	---	4.0-8.0	0-5
s443:								
Farview	0-2	5.4-9.7	---	7.4 - 8.4	5-10	---	---	---
	2-6	5.0-10	---	7.9 - 8.4	15-20	---	2.0-4.0	---
	6-10	---	---	---	---	---	---	---
Millett	0-4	---	---	6.6 - 8.4	---	---	0.0-2.0	---
	4-12	---	---	7.4 - 9.0	---	---	0.0-2.0	---
	12-50	---	---	8.5 - 9.0	---	---	0.0-2.0	---
	50-60	---	---	8.5 - 9.0	---	---	0.0-2.0	---
Doakum	0-5	---	---	7.9 - 8.4	---	---	0.0-2.0	---
	5-17	---	---	7.9 - 8.4	---	---	2.0-4.0	---
	17-60	---	---	8.5 - 9.0	---	---	4.0-8.0	---
s444:								
Arches	0-4	2.6-6.4	---	7.4 - 8.4	0-5	---	---	---
	4-13	0.0-10	---	7.4 - 9.0	0-10	---	0.0-2.0	---
	13-15	0.0-15	---	7.4 - 9.0	0-10	---	0.0-2.0	---
	15-19	---	---	---	---	---	---	---
Blanding	0-4	---	---	7.9 - 8.4	---	---	0.0-2.0	---
	4-60	---	---	7.4 - 8.4	---	---	0.0-2.0	---
Mido	0-2	5.0-10	---	7.9 - 8.4	3-15	0-1	0.0-2.0	1-5
	2-60	5.0-10	---	7.9 - 9.0	1-5	0-1	0.0-2.0	0-1
s445:								
Akhoni	0-6	15-20	---	6.1 - 7.3	---	---	0.0-2.0	---
	6-18	15-20	---	6.1 - 7.3	---	---	0.0-2.0	---
	18-22	---	---	---	---	---	---	---

Chemical Soil Properties

United States

Map symbol and soil name	Depth	Cation-exchange capacity	Effective cation-exchange capacity	Soil reaction	Calcium carbon-ate	Gypsum	Salinity	Sodium adsorption ratio
	In	*meq/100 g*	*meq/100 g*	*pH*	*Pct*	*Pct*	*mmhos/cm*	
s445:								
Tunitcha	0-5	8.9-16	---	6.6 - 7.3	---	---	---	---
	5-8	8.9-16	---	6.6 - 7.3	---	---	---	---
	8-38	16-22	---	6.1 - 7.3	---	---	---	---
	38-57	8.6-15	---	6.1 - 7.3	---	---	---	---
	57-61	---	---	---	---	---	---	---
Klizhin	0-2	3.1-11	---	6.1 - 7.3	---	---	---	---
	2-40	3.0-16	---	6.1 - 7.3	---	---	---	---
	40-60	2.9-15	---	6.1 - 7.3	---	---	---	---
s452:								
Augustine	0-3	7.3-15	---	6.6 - 7.8	---	---	---	---
	3-37	---	---	7.4 - 7.8	---	---	---	---
	37-60	---	---	7.9 - 8.4	---	---	0.0-2.0	---
Telescope	0-3	2.6-9.4	---	6.6 - 7.8	---	---	---	---
	3-19	---	---	7.4 - 7.8	---	---	---	---
	19-45	---	---	7.9 - 8.4	---	---	0.0-2.0	---
	45-55	---	---	7.9 - 8.4	---	---	0.0-2.0	---
Royosa	0-4	1.9-5.3	---	6.6 - 7.8	---	---	---	---
	4-43	---	---	6.6 - 7.8	---	---	---	---
	43-45	---	---	6.6 - 7.8	---	---	---	---
	45-49	---	---	---	---	---	---	---
s466:								
Kopie	0-2	---	---	7.4 - 8.4	---	---	0.0-2.0	---
	2-6	---	---	7.4 - 8.4	---	---	0.0-2.0	---
	6-14	---	---	7.4 - 8.4	---	---	0.0-2.0	---
	14-18	---	---	---	---	---	---	---
Quintana	0-6	13-22	---	7.4 - 7.8	---	---	---	---
	6-33	---	---	7.4 - 8.4	---	---	---	---
	33-41	---	---	7.9 - 8.4	---	---	0.0-2.0	---
	41-60	---	---	7.9 - 8.4	---	---	0.0-2.0	---
s490:								
Monue	0-3	2.0-5.0	---	7.9 - 8.4	1-3	---	0.0-2.0	1-5
	3-60	3.0-11	---	7.9 - 9.0	3-10	---	0.0-2.0	1-5
Nakai	0-18	---	---	7.9 - 9.0	---	---	0.0-2.0	---
	18-34	---	---	7.9 - 9.0	---	---	0.0-2.0	---
	34-60	---	---	7.9 - 9.0	---	---	2.0-8.0	---

Chemical Soil Properties

United States

Map symbol and soil name	Depth	Cation-exchange capacity	Effective cation-exchange capacity	Soil reaction	Calcium carbon-ate	Gypsum	Salinity	Sodium adsorption ratio
	In	*meq/100 g*	*meq/100 g*	*pH*	*Pct*	*Pct*	*mmhos/cm*	
s490:								
Blackston	0-3	5.0-10	---	7.9 - 8.4	1-5	---	0.0-2.0	0-5
	3-9	5.0-10	---	7.9 - 9.0	5-10	---	0.0-2.0	5-13
	9-15	10-20	---	7.9 - 9.0	10-15	---	2.0-4.0	5-13
	15-35	5.0-10	---	7.9 - 8.4	5-10	---	2.0-4.0	0-5
	35-70	0.0-5.0	---	7.9 - 8.4	1-5	---	0.0-2.0	---
s495:								
Badland	0-60	---	---	---	---	---	---	---
Torriorthents	0-60	---	---	7.9 - 9.0	---	15-90	2.0-8.0	---
Calciorthids	0-5	---	---	7.4 - 8.4	---	---	0.0-2.0	---
	5-60	---	---	7.4 - 8.4	---	---	0.0-2.0	---
s1417:								
Youngston	0-10	10-20	---	7.4 - 7.8	0-5	---	0.0-4.0	---
	10-43	5.0-20	---	7.4 - 8.4	4-15	---	0.0-4.0	---
	43-60	5.0-20	---	7.4 - 8.4	4-15	---	0.0-4.0	---
Torrifluvents	0-6	---	---	---	---	---	---	---
	6-60	0.0-7.8	---	6.6 - 7.8	0-5	---	---	---
s1420:								
Farb	0-7	11-16	---	7.4 - 8.4	---	---	---	---
	7-10	---	---	7.4 - 8.4	---	---	0.0-2.0	---
	10-14	---	---	---	---	---	---	---
Mack	0-4	5.0-10	---	6.6 - 8.4	0-5	---	0.0-2.0	---
	4-18	5.0-20	---	6.6 - 8.4	0-5	---	0.0-2.0	---
	18-36	5.0-15	---	7.9 - 8.4	15-40	---	2.0-8.0	---
	36-60	5.0-15	---	7.9 - 8.4	15-40	---	2.0-8.0	---
	60-70	5.0-15	---	7.9 - 9.0	10-15	---	2.0-8.0	0-10
Redlands	0-7	13-17	---	7.4 - 8.4	---	---	---	---
	7-18	---	---	7.4 - 8.4	---	---	---	---
	18-60	---	---	7.9 - 9.0	---	---	0.0-2.0	---
Rock outcrop	0-60	---	---	---	---	---	---	---
Badland	0-60	---	---	---	---	---	---	---
Moenkopie	0-3	2.0-12	---	7.4 - 9.0	1-10	---	0.0-2.0	---
	3-8	3.0-14	---	7.4 - 9.0	1-10	0-1	0.0-2.0	0-2
	8-12	---	---	---	---	---	---	---

Chemical Soil Properties

United States

Map symbol and soil name	Depth	Cation-exchange capacity	Effective cation-exchange capacity	Soil reaction	Calcium carbon-ate	Gypsum	Salinity	Sodium adsorption ratio
	In	*meq/100 g*	*meq/100 g*	*pH*	*Pct*	*Pct*	*mmhos/cm*	
s1420:								
Myton family	0-6	12-19	---	7.9 - 8.4	5-15	---	---	---
	6-60	4.0-12	---	7.9 - 9.0	15-30	0-1	0.0-2.0	---
s1422:								
Claysprings	0-3	10-20	---	7.9 - 9.0	1-15	0-5	0.0-4.0	0-10
	3-18	15-35	---	7.8 - 9.6	1-15	0-10	0.0-4.0	0-10
	18-22	---	---	---	---	---	---	---
Myton family	0-6	12-19	---	7.9 - 8.4	5-15	---	---	---
	6-60	4.0-12	---	7.9 - 9.0	15-30	0-1	0.0-2.0	---
Rock outcrop	0-60	---	---	---	---	---	---	---
Uzona	0-1	10-20	---	7.4 - 8.4	1-5	---	2.0-4.0	0-10
	1-45	15-35	---	7.4 - 9.0	1-15	0-5	4.0-16.0	15-50
	45-60	10-25	---	7.4 - 9.0	1-15	0-15	4.0-16.0	15-50
s1424:								
Cragola	0-2	11-19	---	7.4 - 7.8	0-5	---	---	---
	2-18	10-20	---	7.4 - 8.4	1-15	---	0.0-2.0	---
	18-22	---	---	---	---	---	---	---
Rizno	0-2	5.0-10	---	7.4 - 8.4	5-15	---	0.0-2.0	---
	2-5	5.0-10	---	7.9 - 9.0	5-15	---	0.0-2.0	---
	5-7	5.0-10	---	7.9 - 9.0	5-15	---	0.0-2.0	---
	7-14	5.0-10	---	7.9 - 9.0	5-15	---	0.0-2.0	---
	14-18	---	---	---	---	---	---	---
Romberg	0-2	13-22	---	6.6 - 7.8	---	---	---	---
	2-20	---	---	7.4 - 8.4	---	---	0.0-2.0	---
	20-60	---	---	7.4 - 8.4	---	---	0.0-2.0	---
Littlenan	0-3	---	---	7.9 - 8.4	---	---	0.0-2.0	---
	3-29	---	---	7.9 - 9.0	---	---	2.0-4.0	---
	29-33	---	---	---	---	---	---	---
Rock outcrop	0-60	---	---	---	---	---	---	---
Bodot	0-6	---	---	7.9 - 8.4	---	---	0.0-2.0	---
	6-15	---	---	7.9 - 8.4	---	---	0.0-2.0	---
	15-36	---	---	7.9 - 8.4	---	---	0.0-2.0	---
	36-40	---	---	---	---	---	---	---

Chemical Soil Properties

United States

Map symbol and soil name	Depth	Cation-exchange capacity	Effective cation-exchange capacity	Soil reaction	Calcium carbon-ate	Gypsum	Salinity	Sodium adsorption ratio
	In	*meq/100 g*	*meq/100 g*	*pH*	*Pct*	*Pct*	*mmhos/cm*	
s5091:								
Typic Ustochrepts	0-9	7.7-12	---	7.9 - 8.4	---	---	---	---
	9-37	---	---	7.9 - 8.4	---	---	---	---
	37-60	---	---	7.9 - 8.4	---	---	---	---
s5092:								
Typic Ustochrepts	0-6	7.3-12	---	7.4 - 7.8	---	---	---	---
	6-33	---	---	7.4 - 8.4	---	---	---	---
	33-41	---	---	7.9 - 8.4	---	---	0.0-2.0	---
	41-60	---	---	7.9 - 8.4	---	---	0.0-2.0	---
Lithic Ustochrepts	0-3	9.2-13	---	6.6 - 8.4	---	---	---	---
	3-11	---	---	6.6 - 8.4	---	---	---	---
	11-15	---	---	---	---	---	---	---
s5112:								
Cumulic Haplustolls	0-14	9.1-21	---	6.6 - 7.8	---	---	---	---
	14-60	---	---	7.4 - 8.4	---	---	0.0-2.0	---
	60-70	---	---	7.4 - 8.4	---	---	0.0-2.0	---
s5160:								
Viuda	0-3	8.6-17	---	7.4 - 7.8	---	---	---	---
	3-16	---	---	7.9 - 8.4	---	---	0.0-2.0	---
	16-19	---	---	7.9 - 8.4	---	---	0.0-2.0	---
	19-23	---	---	---	---	---	---	---
Penistaja	0-4	8.0-16	---	6.6 - 8.4	---	---	0.0-2.0	---
	4-28	13-19	---	6.6 - 8.4	5-10	---	0.0-2.0	---
	28-60	10-16	---	6.6 - 8.4	5-10	---	0.0-2.0	---
Rock outcrop	0-60	---	---	---	---	---	---	---
Aparejo	0-2	---	---	7.9 - 8.4	---	---	2.0-4.0	---
	2-18	---	---	7.9 - 8.4	---	---	2.0-4.0	---
	18-60	---	---	7.9 - 8.4	---	---	2.0-4.0	---
Venadito	0-3	20-35	---	7.9 - 8.4	5-10	0-2	0.0-2.0	0-5
	3-60	40-55	---	7.9 - 8.4	5-10	0-2	2.0-4.0	0-10
s5161:								
Cabezon	0-2	7.8-18	---	6.1 - 7.8	---	---	---	---
	2-18	---	---	6.1 - 7.8	---	---	---	---
	18-22	---	---	---	---	---	---	---

Chemical Soil Properties

United States

Map symbol and soil name	Depth	Cation-exchange capacity	Effective cation-exchange capacity	Soil reaction	Calcium carbon-ate	Gypsum	Salinity	Sodium adsorption ratio
	In	*meq/100 g*	*meq/100 g*	*pH*	*Pct*	*Pct*	*mmhos/cm*	
s5161:								
Cantina	0-2	13-17	---	6.6 - 7.3	---	---	---	---
	2-9	---	---	6.6 - 7.3	---	---	---	---
	9-31	---	---	7.4 - 8.4	---	---	0.0-2.0	---
	31-54	---	---	7.9 - 8.4	---	---	0.0-2.0	---
	54-58	---	---	---	---	---	---	---
Millpaw	0-4	16-21	---	7.4 - 7.8	---	---	---	---
	4-35	---	---	7.4 - 7.8	---	---	---	---
	35-60	---	---	7.4 - 8.4	---	---	0.0-2.0	---
Montecito	0-3	21-24	---	6.6 - 7.8	---	---	---	---
	3-24	---	---	7.4 - 8.4	---	---	0.0-2.0	---
	24-60	---	---	7.4 - 8.4	---	---	0.0-2.0	---
Rock outcrop	0-60	---	---	---	---	---	---	---
Bandera	0-9	10-18	---	6.6 - 8.4	0	0	0.0-2.0	0-4
	9-16	8.0-16	---	6.6 - 8.4	0-5	0	0.0-2.0	0-4
	16-60	1.0-5.0	---	6.6 - 8.4	0-5	0	0.0-2.0	0-4
Ildefonso	0-3	7.1-16	---	7.4 - 7.8	---	---	---	---
	3-60	---	---	7.9 - 8.4	---	---	0.0-2.0	---
Torreon	0-2	11-25	---	6.6 - 7.3	---	---	---	---
	2-25	---	---	6.6 - 7.8	---	---	---	---
	25-60	---	---	7.4 - 8.4	---	---	0.0-2.0	---
Loarc	0-14	8.9-13	---	6.6 - 7.3	---	---	---	---
	14-23	---	---	6.6 - 8.4	---	---	---	---
	23-36	---	---	6.1 - 9.0	---	---	0.0-2.0	---
	36-60	---	---	6.1 - 9.0	---	---	0.0-2.0	---
s5164:								
Laporte	0-3	---	---	7.9 - 8.4	---	---	0.0-2.0	---
	3-11	---	---	7.9 - 8.4	---	---	0.0-2.0	---
	11-15	---	---	---	---	---	---	---
Rock outcrop	0-60	---	---	---	---	---	---	---
Vessilla	0-2	5.4-11	---	6.6 - 8.4	5-10	---	---	---
	2-11	5.0-10	---	7.4 - 8.4	5-10	---	0.0-2.0	---
	11-15	---	---	---	---	---	---	---

Chemical Soil Properties

United States

Map symbol and soil name	Depth	Cation-exchange capacity	Effective cation-exchange capacity	Soil reaction	Calcium carbon-ate	Gypsum	Salinity	Sodium adsorption ratio
	In	*meq/100 g*	*meq/100 g*	*pH*	*Pct*	*Pct*	*mmhos/cm*	
s5164:								
Atarque	0-2	8.6-15	---	6.6 - 7.3	---	---	---	---
	2-16	---	---	6.6 - 7.8	---	---	---	---
	16-22	---	---	---	---	---	---	---
Flugle	0-3	4.8-9.3	---	6.6 - 7.3	---	---	---	---
	3-25	---	---	6.6 - 8.4	---	---	---	---
	25-60	---	---	7.4 - 8.4	---	---	0.0-2.0	---
Mion	0-4	17-23	---	7.4 - 8.4	---	---	---	---
	4-14	---	---	7.4 - 8.4	---	---	0.0-2.0	---
	14-18	---	---	---	---	---	---	---
s5165:								
Penistaja	0-4	8.0-16	---	6.6 - 8.4	---	---	0.0-2.0	---
	4-28	13-19	---	6.6 - 8.4	5-10	---	0.0-2.0	---
	28-60	10-16	---	6.6 - 8.4	5-10	---	0.0-2.0	---
Sparank	0-2	---	---	7.4 - 8.4	---	---	2.0-4.0	---
	2-60	---	---	7.4 - 8.4	---	---	2.0-4.0	---
San Mateo	0-2	---	---	7.4 - 8.4	---	---	0.0-2.0	---
	2-29	---	---	7.4 - 8.4	---	---	2.0-4.0	---
	29-60	---	---	7.4 - 9.0	---	---	2.0-4.0	---
Mespun	0-11	2.6-6.2	---	6.1 - 7.8	---	---	---	---
	11-60	---	---	6.1 - 7.8	---	---	---	---
Palma	0-7	4.8-9.1	---	6.6 - 8.4	---	---	---	---
	7-60	---	---	7.4 - 8.4	---	---	0.0-2.0	---
Rock outcrop	0-60	---	---	---	---	---	---	---
Mikim	0-9	8.9-21	---	6.6 - 8.4	---	---	---	---
	9-60	---	---	7.4 - 9.0	---	---	0.0-2.0	---
Venadito	0-3	20-35	---	7.9 - 8.4	5-10	0-2	0.0-2.0	0-5
	3-60	40-55	---	7.9 - 8.4	5-10	0-2	2.0-4.0	0-10
Mion	0-3	13-21	---	6.6 - 8.4	---	---	---	---
	3-13	---	---	7.4 - 8.4	---	---	0.0-2.0	---
	13-17	---	---	---	---	---	---	---

Chemical Soil Properties

United States

Map symbol and soil name	Depth	Cation-exchange capacity	Effective cation-exchange capacity	Soil reaction	Calcium carbon-ate	Gypsum	Salinity	Sodium adsorption ratio
	In	*meq/100 g*	*meq/100 g*	*pH*	*Pct*	*Pct*	*mmhos/cm*	
s5167:								
Raton	0-9	18-29	---	6.6 - 7.3	---	---	---	---
	9-15	---	---	6.6 - 7.3	---	---	---	---
	15-19	---	---	---	---	---	---	---
Charo	0-5	17-22	---	6.6 - 7.3	---	---	---	---
	5-28	---	---	6.6 - 7.8	---	---	---	---
	28-32	---	---	---	---	---	---	---
Lava flows	0-60	---	---	---	---	---	---	---
Rock outcrop	0-60	---	---	---	---	---	---	---
Bandera	0-9	10-18	---	6.6 - 8.4	0	0	0.0-2.0	0-4
	9-16	8.0-16	---	6.6 - 8.4	0-5	0	0.0-2.0	0-4
	16-60	1.0-5.0	---	6.6 - 8.4	0-5	0	0.0-2.0	0-4
Borrego	0-6	11-19	---	6.6 - 7.3	---	---	---	---
	6-13	---	---	5.6 - 7.3	---	---	---	---
	13-18	---	---	5.6 - 7.3	---	---	---	---
	18-22	---	---	---	---	---	---	---
s5168:								
Flugle	0-3	4.8-9.3	---	6.6 - 7.3	---	---	---	---
	3-25	---	---	6.6 - 8.4	---	---	---	---
	25-60	---	---	7.4 - 8.4	---	---	0.0-2.0	---
Rock outcrop	0-60	---	---	---	---	---	---	---
Catman	0-3	---	---	7.4 - 7.8	---	---	2.0-8.0	---
	3-43	---	---	7.4 - 8.4	---	---	2.0-8.0	---
	43-70	---	---	7.4 - 8.4	---	---	2.0-8.0	---
Celacy	0-8	13-16	---	7.4 - 7.8	---	---	---	---
	8-22	---	---	7.4 - 7.8	---	---	---	---
	22-28	---	---	7.4 - 8.4	---	---	0.0-2.0	---
	28-32	---	---	---	---	---	---	---
Quintana	0-11	8.6-17	---	7.4 - 7.8	---	---	---	---
	11-46	---	---	7.9 - 8.4	---	---	0.0-2.0	---
	46-60	---	---	7.9 - 8.4	---	---	0.0-2.0	---
Silkie	0-4	---	---	7.4 - 7.8	---	---	0.0-2.0	---
	4-60	---	---	6.6 - 7.8	---	---	0.0-2.0	---

Chemical Soil Properties

United States

Map symbol and soil name	Depth	Cation-exchange capacity	Effective cation-exchange capacity	Soil reaction	Calcium carbon-ate	Gypsum	Salinity	Sodium adsorption ratio
	In	*meq/100 g*	*meq/100 g*	*pH*	*Pct*	*Pct*	*mmhos/cm*	
s5168:								
Teco	0-6	8.9-17	---	6.6 - 7.3	---	---	---	---
	6-36	---	---	7.4 - 8.4	---	---	---	---
	36-60	---	---	7.9 - 8.4	---	---	0.0-2.0	---
Mion	0-4	17-23	---	7.4 - 8.4	---	---	---	---
	4-14	---	---	7.4 - 8.4	---	---	0.0-2.0	---
	14-18	---	---	---	---	---	---	---
Vessilla	0-2	5.4-11	---	6.6 - 8.4	5-10	---	---	---
	2-11	5.0-10	---	7.4 - 8.4	5-10	---	0.0-2.0	---
	11-15	---	---	---	---	---	---	---
Atarque	0-2	8.6-15	---	6.6 - 7.3	---	---	---	---
	2-16	---	---	6.6 - 7.8	---	---	---	---
	16-22	---	---	---	---	---	---	---
Goesling	0-4	4.8-9.3	---	6.6 - 7.8	---	---	---	---
	4-30	---	---	6.6 - 8.4	---	---	---	---
	30-64	---	---	7.4 - 8.4	---	---	0.0-2.0	---
Venadito	0-3	20-35	---	7.9 - 8.4	5-10	0-2	0.0-2.0	0-5
	3-60	40-55	---	7.9 - 8.4	5-10	0-2	2.0-4.0	0-10
Hickman	0-3	13-23	---	7.4 - 8.4	0-2	---	---	1-5
	3-60	13-27	---	7.4 - 9.0	1-10	---	0.0-2.0	1-12
s5169:								
Rock outcrop	0-60	---	---	---	---	---	---	---
Nogal	0-2	8.9-16	---	6.6 - 7.3	---	---	---	---
	2-30	---	---	7.4 - 8.4	---	---	0.0-2.0	---
	30-34	---	---	---	---	---	---	---
Galestina	0-2	8.6-16	---	6.6 - 7.3	---	---	---	---
	2-7	---	---	6.6 - 7.8	---	---	---	---
	7-46	---	---	6.6 - 7.8	---	---	---	---
	46-60	---	---	---	---	---	---	---
Mion	0-4	17-23	---	7.4 - 8.4	---	---	---	---
	4-14	---	---	7.4 - 8.4	---	---	0.0-2.0	---
	14-18	---	---	---	---	---	---	---
Pinitos	0-2	8.6-15	---	6.6 - 7.3	---	---	---	---
	2-24	14-27	---	6.6 - 7.8	---	---	---	---
	24-60	11-20	---	7.4 - 7.8	5-10	---	---	---

Chemical Soil Properties

United States

Map symbol and soil name	Depth	Cation-exchange capacity	Effective cation-exchange capacity	Soil reaction	Calcium carbon-ate	Gypsum	Salinity	Sodium adsorption ratio
	In	*meq/100 g*	*meq/100 g*	*pH*	*Pct*	*Pct*	*mmhos/cm*	
s5169:								
Vessilla	0-2	5.4-11	---	6.6 - 8.4	5-10	---	---	---
	2-11	5.0-10	---	7.4 - 8.4	5-10	---	0.0-2.0	---
	11-15	---	---	---	---	---	---	---
Ribera	0-9	10-15	---	6.6 - 7.8	---	---	---	---
	9-26	---	---	7.4 - 8.4	---	---	---	---
	26-31	---	---	7.9 - 8.4	---	---	0.0-2.0	---
	31-35	---	---	---	---	---	---	---
Flugle	0-3	4.8-9.3	---	6.6 - 7.3	---	---	---	---
	3-25	---	---	6.6 - 8.4	---	---	---	---
	25-60	---	---	7.4 - 8.4	---	---	0.0-2.0	---
Montecito	0-6	8.6-17	---	6.6 - 7.8	---	---	---	---
	6-19	---	---	7.4 - 8.4	---	---	0.0-2.0	---
	19-30	---	---	7.4 - 8.4	---	---	0.0-2.0	---
	30-45	---	---	7.4 - 8.4	---	---	0.0-2.0	---
	45-60	---	---	7.4 - 8.4	---	---	0.0-2.0	---
Teco	0-6	8.9-17	---	6.6 - 7.3	---	---	---	---
	6-36	---	---	7.4 - 8.4	---	---	---	---
	36-60	---	---	7.9 - 8.4	---	---	0.0-2.0	---
Catman	0-3	---	---	7.4 - 7.8	---	---	2.0-8.0	---
	3-43	---	---	7.4 - 8.4	---	---	2.0-8.0	---
	43-70	---	---	7.4 - 8.4	---	---	2.0-8.0	---
Hickman	0-3	13-23	---	7.4 - 8.4	0-2	---	---	1-5
	3-60	13-27	---	7.4 - 9.0	1-10	---	0.0-2.0	1-12
s5170:								
Teco	0-6	8.9-17	---	6.6 - 7.3	---	---	---	---
	6-36	---	---	7.4 - 8.4	---	---	---	---
	36-60	---	---	7.9 - 8.4	---	---	0.0-2.0	---
Cabezon	0-2	13-23	---	6.1 - 7.8	---	---	---	---
	2-18	---	---	6.1 - 7.8	---	---	---	---
	18-22	---	---	---	---	---	---	---
Atarque	0-2	8.6-15	---	6.6 - 7.3	---	---	---	---
	2-16	---	---	6.6 - 7.8	---	---	---	---
	16-22	---	---	---	---	---	---	---

Chemical Soil Properties

United States

Map symbol and soil name	Depth	Cation-exchange capacity	Effective cation-exchange capacity	Soil reaction	Calcium carbon-ate	Gypsum	Salinity	Sodium adsorption ratio
	In	*meq/100 g*	*meq/100 g*	*pH*	*Pct*	*Pct*	*mmhos/cm*	
s5170:								
Montecito	0-3	21-24	---	6.6 - 7.8	---	---	---	---
	3-24	---	---	7.4 - 8.4	---	---	0.0-2.0	---
	24-60	---	---	7.4 - 8.4	---	---	0.0-2.0	---
Rock outcrop	0-60	---	---	---	---	---	---	---
Torreon	0-2	11-25	---	6.6 - 7.3	---	---	---	---
	2-25	---	---	6.6 - 7.8	---	---	---	---
	25-60	---	---	7.4 - 8.4	---	---	0.0-2.0	---
s5171:								
Cinnadale	0-4	8.9-13	---	6.6 - 7.3	---	---	---	---
	4-12	---	---	6.6 - 7.3	---	---	---	---
	12-16	---	---	---	---	---	---	---
Valnor	0-6	17-29	---	6.6 - 7.3	---	---	---	---
	6-12	---	---	6.6 - 7.3	---	---	---	---
	12-31	---	---	6.6 - 7.8	---	---	---	---
	31-36	---	---	6.6 - 8.4	---	---	0.0-2.0	---
	36-40	---	---	---	---	---	---	---
Techado	0-3	23-30	---	6.6 - 7.3	---	---	---	---
	3-16	---	---	6.6 - 7.3	---	---	---	---
	16-20	---	---	---	---	---	---	---
Kenray	0-15	4.0-7.7	---	6.6 - 7.3	---	---	---	---
	15-60	---	---	6.6 - 7.3	---	---	---	---
Mirabal	0-3	8.9-16	---	6.1 - 6.5	---	---	---	---
	3-14	---	---	6.1 - 6.5	---	---	---	---
	14-21	---	---	6.1 - 6.5	---	---	---	---
	21-25	---	---	---	---	---	---	---
Rock outcrop	0-60	---	---	---	---	---	---	---
Abersito	0-3	15-25	---	6.1 - 6.5	0	0	0.0-2.0	0-4
	3-9	7.0-15	---	6.1 - 6.5	0	0	0.0-2.0	0-4
	9-24	25-45	---	6.1 - 6.5	0	0	0.0-2.0	0-4
	24-28	---	---	---	---	---	---	---
McGaffey	0-3	---	---	7.4 - 8.4	---	---	0.0-2.0	---
	3-60	---	---	7.9 - 8.4	---	---	0.0-2.0	---

Chemical Soil Properties

United States

Map symbol and soil name	Depth	Cation-exchange capacity	Effective cation-exchange capacity	Soil reaction	Calcium carbon-ate	Gypsum	Salinity	Sodium adsorption ratio
	In	*meq/100 g*	*meq/100 g*	*pH*	*Pct*	*Pct*	*mmhos/cm*	
s5171:								
Stout	0-3	8.6-15	---	6.6 - 7.3	---	---	---	---
	3-14	---	---	6.6 - 7.3	---	---	---	---
	14-18	---	---	---	---	---	---	---
Stout	0-3	8.6-15	---	6.6 - 7.3	---	---	---	---
	3-14	---	---	6.6 - 7.3	---	---	---	---
	14-18	---	---	---	---	---	---	---
s5172:								
Stout	0-3	8.6-15	---	6.6 - 7.3	---	---	---	---
	3-14	---	---	6.6 - 7.3	---	---	---	---
	14-18	---	---	---	---	---	---	---
Hesperus	0-11	7.5-16	---	6.1 - 7.8	---	---	---	---
	11-44	17-29	---	6.1 - 7.8	---	---	---	---
	44-60	11-27	---	6.1 - 7.8	---	---	---	---
Kiln	0-5	10-25	---	6.6 - 7.8	0-1	0	0.0-2.0	0-4
	5-10	15-25	---	6.6 - 7.8	0-1	0	0.0-2.0	0-4
	10-14	---	---	---	---	---	---	---
s5173:								
Royosa	0-8	0.0-5.3	---	6.6 - 7.8	0-3	---	---	---
	8-60	0.0-7.4	---	6.6 - 7.8	0-3	---	---	---
Royosa	0-8	2.7-8.2	---	6.6 - 7.8	0-3	---	---	---
	8-60	0.0-7.4	---	6.6 - 7.8	0-3	---	---	---
Telescope	0-3	2.6-9.4	---	6.6 - 7.8	---	---	---	---
	3-19	---	---	7.4 - 7.8	---	---	---	---
	19-45	---	---	7.9 - 8.4	---	---	0.0-2.0	---
	45-55	---	---	7.9 - 8.4	---	---	0.0-2.0	---
s5174:								
Kimbeto	0-3	2.0-5.0	---	7.4 - 8.4	0-1	---	0.0-2.0	---
	3-10	5.0-10	---	7.9 - 8.4	1-5	---	0.0-2.0	0-5
	10-18	10-15	---	7.9 - 9.6	5-10	---	0.0-2.0	0-5
	18-29	5.0-10	---	7.9 - 9.0	10-30	---	2.0-8.0	5-25
	29-42	2.0-10	---	7.9 - 9.0	5-15	0-5	4.0-16.0	13-30
	42-46	---	---	---	---	---	---	---
Denazar	0-11	1.0-5.0	---	6.6 - 7.8	0-3	---	0.0-2.0	---
	11-34	2.0-5.0	---	7.9 - 9.0	5-15	---	2.0-4.0	0-5
	34-62	2.0-5.0	---	7.9 - 9.0	15-50	---	2.0-4.0	0-5

Chemical Soil Properties

United States

Map symbol and soil name	Depth	Cation-exchange capacity	Effective cation-exchange capacity	Soil reaction	Calcium carbon-ate	Gypsum	Salinity	Sodium adsorption ratio
	In	*meq/100 g*	*meq/100 g*	*pH*	*Pct*	*Pct*	*mmhos/cm*	
s5174:								
Farb	0-3	13-17	---	7.4 - 8.4	---	---	---	---
	3-11	---	---	7.4 - 8.4	---	---	0.0-2.0	---
	11-15	---	---	---	---	---	---	---
Tocito	0-6	10-15	---	7.9 - 8.4	5-10	0-1	2.0-4.0	0-5
	6-12	10-15	---	7.9 - 8.4	5-10	0-1	2.0-4.0	0-5
	12-16	15-20	---	7.9 - 8.4	5-10	1-5	4.0-8.0	5-13
	16-28	10-15	---	7.9 - 8.4	10-15	1-5	4.0-8.0	0-5
	28-70	10-20	---	7.9 - 8.4	10-15	1-5	4.0-8.0	5-13
Jeddito	0-2	---	---	7.4 - 8.4	---	---	0.0-2.0	---
	2-9	---	---	7.4 - 8.4	---	---	0.0-2.0	---
	9-27	---	---	7.4 - 8.4	---	---	2.0-4.0	---
	27-60	---	---	7.4 - 8.4	---	---	2.0-4.0	---
Tewa	0-1	13-17	---	7.4 - 7.8	---	---	---	---
	1-25	---	---	7.4 - 8.4	---	---	0.0-2.0	---
	25-31	---	---	7.4 - 8.4	---	---	0.0-2.0	---
	31-60	---	---	7.4 - 8.4	---	---	0.0-2.0	---
Huerfano	0-1	5.0-10	---	7.4 - 8.4	1-3	---	0.0-2.0	0-5
	1-11	10-20	---	8.5 - 9.0	3-10	0-1	4.0-8.0	30-60
	11-18	10-20	---	7.9 - 8.4	2-5	1-5	8.0-16.0	13-30
	18-22	---	---	---	---	---	---	---
Shiprock	0-3	2.0-5.0	---	7.9 - 8.4	1-3	---	0.0-2.0	---
	3-36	5.0-10	---	7.9 - 9.0	3-5	---	2.0-4.0	0-5
	36-66	5.0-10	---	7.9 - 9.0	3-5	---	4.0-8.0	5-13
Benally	0-4	2.0-5.0	---	7.4 - 8.4	1-3	---	0.0-2.0	0-5
	4-15	5.0-10	---	7.9 - 9.0	1-3	---	0.0-2.0	5-13
	15-56	10-20	---	8.5 - 9.0	3-5	1-3	4.0-8.0	13-30
	56-64	2.0-5.0	---	7.9 - 8.4	1-3	0-1	4.0-8.0	5-13
Werito	0-3	10-15	---	7.9 - 8.4	3-5	---	0.0-2.0	0-5
	3-7	15-20	---	8.5 - 9.0	3-5	---	0.0-4.0	5-13
	7-17	15-20	---	7.9 - 9.0	3-10	---	2.0-4.0	13-30
	17-22	15-30	---	6.1 - 7.8	1-3	5-10	4.0-8.0	13-30
	22-34	---	15-30	3.6 - 6.0	0-1	0-1	4.0-8.0	13-30
	34-38	---	---	---	---	---	---	---
Badland	0-60	---	---	---	---	---	---	---

Chemical Soil Properties

United States

Map symbol and soil name	Depth	Cation-exchange capacity	Effective cation-exchange capacity	Soil reaction	Calcium carbon-ate	Gypsum	Salinity	Sodium adsorption ratio
	In	*meq/100 g*	*meq/100 g*	*pH*	*Pct*	*Pct*	*mmhos/cm*	
s5174:								
Brimhall	0-2	2.0-5.0	---	7.4 - 8.4	2-5	---	0.0-2.0	---
	2-21	5.0-10	---	7.9 - 8.4	5-20	0-1	0.0-2.0	0-5
	21-29	5.0-10	---	7.9 - 8.4	5-10	1-5	2.0-4.0	0-5
	29-49	5.0-10	---	7.9 - 8.4	1-5	15-30	4.0-16.0	5-35
	49-53	---	---	---	---	---	---	---
Genats	0-4	2.0-5.0	---	7.4 - 7.8	1-3	0-1	2.0-4.0	0-5
	4-13	15-30	---	7.4 - 9.0	0-1	1-5	4.0-8.0	13-30
	13-27	15-30	---	6.1 - 7.8	---	1-3	8.0-16.0	13-30
	27-31	---	---	---	---	---	---	---
Nakai	0-18	---	---	7.4 - 9.0	---	---	0.0-2.0	---
	18-34	---	---	7.9 - 9.0	---	---	0.0-2.0	---
	34-60	---	---	7.9 - 9.0	---	---	0.0-2.0	---
Rock outcrop	0-60	---	---	---	---	---	---	---
Benally	0-2	---	---	7.9 - 8.4	---	---	2.0-4.0	---
	2-18	---	---	8.5 - 9.0	---	---	4.0-16.0	---
	18-45	---	---	7.9 - 8.4	---	---	8.0-16.0	---
	45-49	---	---	---	---	---	---	---
Mack	0-3	---	---	7.4 - 8.4	---	---	0.0-2.0	---
	3-16	---	---	7.9 - 8.4	---	---	2.0-4.0	---
	16-60	---	---	7.9 - 9.0	---	---	0.0-2.0	---
Mesa	0-4	13-17	---	7.4 - 7.8	---	---	---	---
	4-14	---	---	7.4 - 8.4	---	---	---	---
	14-20	---	---	7.9 - 8.4	---	---	0.0-8.0	---
	20-60	---	---	7.9 - 8.4	---	---	4.0-16.0	---
Suwanee	0-7	---	---	7.4 - 8.4	---	---	0.0-4.0	---
	7-60	---	---	7.4 - 8.4	---	---	0.0-4.0	---
Notal	0-3	---	---	7.9 - 9.0	---	---	4.0-8.0	---
	3-60	---	---	7.9 - 9.0	---	---	4.0-8.0	---
Sheppard	0-6	---	---	7.9 - 8.4	---	---	0.0-2.0	---
	6-60	---	---	7.9 - 8.4	---	---	0.0-2.0	---
s5175:								
Fruitland	0-7	5.0-10	---	7.4 - 8.4	5-10	---	0.0-4.0	---
	7-60	5.0-10	---	7.4 - 8.4	5-10	---	0.0-4.0	---

Chemical Soil Properties

United States

Map symbol and soil name	Depth	Cation-exchange capacity	Effective cation-exchange capacity	Soil reaction	Calcium carbon-ate	Gypsum	Salinity	Sodium adsorption ratio
	In	*meq/100 g*	*meq/100 g*	*pH*	*Pct*	*Pct*	*mmhos/cm*	
s5175:								
Turley	0-3	---	---	7.4 - 9.0	---	---	2.0-4.0	---
	3-57	---	---	7.4 - 9.0	---	---	2.0-4.0	---
	57-80	---	---	7.4 - 9.0	---	---	2.0-4.0	---
Garland	0-4	10-15	---	7.4 - 8.4	---	---	2.0-4.0	---
	4-21	15-20	---	7.4 - 9.0	0-5	---	2.0-4.0	1-10
	21-30	10-15	---	7.9 - 9.0	5-10	0-5	2.0-4.0	5-10
	30-60	---	---	7.9 - 8.4	0-5	0-5	0.0-2.0	---
Walrees	0-6	10-20	---	7.9 - 9.0	0-5	0	2.0-8.0	0-5
	6-30	10-25	---	7.9 - 9.0	5-15	0	2.0-8.0	0-5
	30-81	1.0-10	---	7.9 - 9.0	0-5	0	0.0-2.0	0-5
Apishapa	0-8	---	---	7.4 - 8.4	---	---	2.0-16.0	---
	8-60	---	---	7.9 - 9.0	---	---	4.0-16.0	---
Werlog	0-6	12-17	---	7.4 - 9.0	---	---	2.0-4.0	---
	6-60	11-21	---	7.4 - 9.0	---	---	2.0-4.0	---
	60-81	1.0-6.0	---	7.4 - 9.0	---	---	2.0-4.0	---
Green River	0-6	---	---	7.9 - 8.4	---	---	2.0-8.0	---
	6-60	---	---	7.9 - 8.4	---	---	2.0-8.0	---
Youngston	0-10	---	---	7.9 - 8.4	---	---	2.0-4.0	---
	10-60	---	---	7.9 - 8.4	---	---	2.0-4.0	---
s5177:								
Rock outcrop	0-60	---	---	---	---	---	---	---
Travessilla	0-2	---	---	7.4 - 8.4	---	---	0.0-2.0	---
	2-12	---	---	7.4 - 8.4	---	---	0.0-2.0	---
	12-16	---	---	---	---	---	---	---
Weska	0-1	---	---	7.9 - 8.4	---	---	0.0-2.0	---
	1-7	---	---	7.9 - 8.4	---	---	0.0-2.0	---
	7-11	---	---	---	---	---	---	---
Oelop	0-3	12-22	---	7.9 - 8.4	---	---	0.0-2.0	---
	3-44	11-23	---	7.9 - 8.4	1-10	---	2.0-4.0	---
	44-60	6.0-12	---	7.9 - 9.0	5-15	---	2.0-4.0	---
Blancot	0-2	---	---	7.9 - 8.4	---	---	0.0-2.0	---
	2-15	---	---	7.9 - 8.4	---	---	0.0-2.0	---
	15-60	---	---	7.9 - 9.0	---	---	0.0-4.0	---

Chemical Soil Properties

United States

Map symbol and soil name	Depth	Cation-exchange capacity	Effective cation-exchange capacity	Soil reaction	Calcium carbon-ate	Gypsum	Salinity	Sodium adsorption ratio
	In	*meq/100 g*	*meq/100 g*	*pH*	*Pct*	*Pct*	*mmhos/cm*	
s5177:								
Notal	0-3	---	---	7.9 - 9.0	---	---	4.0-8.0	---
	3-60	---	---	7.9 - 9.0	---	---	4.0-8.0	---
Twick	0-4	---	---	7.4 - 8.4	---	---	2.0-4.0	---
	4-17	---	---	7.4 - 8.4	---	---	2.0-4.0	---
	17-21	---	---	---	---	---	---	---
Silver	0-4	---	---	7.4 - 8.4	---	---	0.0-2.0	---
	4-60	---	---	7.4 - 8.4	---	---	0.0-2.0	---
	60-70	---	---	7.4 - 8.4	---	---	0.0-2.0	---
s5179:								
Badland	0-60	---	---	---	---	---	---	---
Persayo	0-4	---	---	7.9 - 9.0	---	---	0.0-8.0	---
	4-14	---	---	7.4 - 9.0	---	---	0.0-8.0	---
	14-18	---	---	---	---	---	---	---
Farb	0-7	11-16	---	7.4 - 8.4	---	---	---	---
	7-10	---	---	7.4 - 8.4	---	---	0.0-2.0	---
	10-14	---	---	---	---	---	---	---
Blancot	0-2	---	---	7.9 - 8.4	---	---	0.0-2.0	---
	2-15	---	---	7.9 - 8.4	---	---	0.0-2.0	---
	15-60	---	---	7.9 - 9.0	---	---	0.0-4.0	---
Rock outcrop	0-60	---	---	---	---	---	---	---
Blackston	0-14	---	---	7.9 - 8.4	---	---	0.0-2.0	---
	14-28	---	---	7.9 - 8.4	---	---	4.0-8.0	---
	28-60	---	---	7.9 - 8.4	---	---	4.0-8.0	---
Fruitland	0-7	5.0-10	---	7.4 - 8.4	5-10	---	0.0-4.0	---
	7-60	5.0-10	---	7.4 - 8.4	5-10	---	0.0-4.0	---
Sheppard	0-6	---	---	7.9 - 8.4	---	---	0.0-2.0	---
	6-60	---	---	7.9 - 8.4	---	---	0.0-2.0	---
Stumble	0-5	---	---	7.9 - 8.4	---	---	0.0-2.0	---
	5-29	---	---	7.9 - 9.0	---	---	0.0-4.0	---
	29-49	---	---	7.9 - 9.0	---	---	0.0-4.0	---
	49-81	---	---	7.9 - 9.0	---	---	0.0-4.0	---
Notal	0-3	---	---	7.9 - 9.0	---	---	4.0-8.0	---
	3-60	---	---	7.9 - 9.0	---	---	4.0-8.0	---

Chemical Soil Properties

United States

Map symbol and soil name	Depth	Cation-exchange capacity	Effective cation-exchange capacity	Soil reaction	Calcium carbon-ate	Gypsum	Salinity	Sodium adsorption ratio
	In	*meq/100 g*	*meq/100 g*	*pH*	*Pct*	*Pct*	*mmhos/cm*	
s5179:								
Riverwash	0-3	---	---	---	---	---	---	---
	3-60	---	---	---	---	---	---	---
Shiprock	0-2	8.6-16	---	7.4 - 8.4	---	---	---	---
	2-60	---	---	7.4 - 9.0	---	---	0.0-4.0	---
s5180:								
Doak	0-5	5.0-15	---	7.4 - 8.4	0-5	---	0.0-2.0	---
	5-43	10-20	---	7.4 - 9.0	1-10	---	2.0-4.0	---
	43-69	10-20	---	7.9 - 9.0	5-12	---	2.0-4.0	---
Sheppard	0-6	---	---	7.9 - 8.4	---	---	0.0-2.0	---
	6-60	---	---	7.9 - 8.4	---	---	0.0-2.0	---
Shiprock	0-2	8.6-16	---	7.4 - 8.4	---	---	---	---
	2-60	---	---	7.4 - 9.0	---	---	0.0-4.0	---
Blancot	0-2	---	---	7.9 - 8.4	---	---	0.0-2.0	---
	2-15	---	---	7.9 - 8.4	---	---	0.0-2.0	---
	15-60	---	---	7.9 - 9.0	---	---	0.0-4.0	---
Fruitland	0-7	5.0-10	---	7.4 - 8.4	5-10	---	0.0-4.0	---
	7-60	5.0-10	---	7.4 - 8.4	5-10	---	0.0-4.0	---
Notal	0-3	---	---	7.9 - 9.0	---	---	4.0-8.0	---
	3-60	---	---	7.9 - 9.0	---	---	4.0-8.0	---
Persayo	0-4	---	---	7.9 - 9.0	---	---	0.0-8.0	---
	4-14	---	---	7.4 - 9.0	---	---	0.0-8.0	---
	14-18	---	---	---	---	---	---	---
Badland	0-60	---	---	---	---	---	---	---
Stumble	0-5	---	---	7.9 - 8.4	---	---	0.0-2.0	---
	5-29	---	---	7.9 - 9.0	---	---	0.0-4.0	---
	29-49	---	---	7.9 - 9.0	---	---	0.0-4.0	---
	49-81	---	---	7.9 - 9.0	---	---	0.0-4.0	---
s5181:								
Badland	0-60	---	---	---	---	---	---	---
Sheppard	0-6	---	---	7.9 - 8.4	---	---	0.0-2.0	---
	6-60	---	---	7.9 - 8.4	---	---	0.0-2.0	---

Chemical Soil Properties

United States

Map symbol and soil name	Depth	Cation-exchange capacity	Effective cation-exchange capacity	Soil reaction	Calcium carbon-ate	Gypsum	Salinity	Sodium adsorption ratio
	In	*meq/100 g*	*meq/100 g*	*pH*	*Pct*	*Pct*	*mmhos/cm*	
s5181:								
Monierco	0-5	8.8-17	---	7.4 - 8.4	---	---	---	---
	5-16	---	---	7.4 - 8.4	---	---	0.0-2.0	---
	16-20	---	---	---	---	---	---	---
Rock outcrop	0-60	---	---	---	---	---	---	---
Fruitland	0-7	5.0-10	---	7.4 - 8.4	5-10	---	0.0-4.0	---
	7-60	5.0-10	---	7.4 - 8.4	5-10	---	0.0-4.0	---
Huerfano	0-2	---	---	7.9 - 9.0	---	---	4.0-16.0	---
	2-15	---	---	7.9 - 9.0	---	---	0.0-4.0	---
	15-19	---	---	---	---	---	---	---
Notal	0-3	---	---	7.9 - 9.0	---	---	4.0-8.0	---
	3-60	---	---	7.9 - 9.0	---	---	4.0-8.0	---
Avalon	0-11	---	---	7.9 - 8.4	---	---	2.0-8.0	---
	11-42	---	---	7.9 - 8.4	---	---	2.0-8.0	---
	42-60	---	---	7.9 - 8.4	---	---	2.0-8.0	---
Doak	0-5	5.0-15	---	7.4 - 8.4	0-5	---	0.0-2.0	---
	5-43	10-20	---	7.4 - 9.0	1-10	---	2.0-4.0	---
	43-69	10-20	---	7.9 - 9.0	5-12	---	2.0-4.0	---
Persayo	0-4	---	---	7.9 - 9.0	---	---	0.0-8.0	---
	4-14	---	---	7.4 - 9.0	---	---	0.0-8.0	---
	14-18	---	---	---	---	---	---	---
Blancot	0-2	---	---	7.9 - 8.4	---	---	0.0-2.0	---
	2-15	---	---	7.9 - 8.4	---	---	0.0-2.0	---
	15-60	---	---	7.9 - 9.0	---	---	0.0-4.0	---
Shiprock	0-2	8.6-16	---	7.4 - 8.4	---	---	---	---
	2-60	---	---	7.4 - 9.0	---	---	0.0-4.0	---
Uffens	0-9	---	---	7.4 - 8.4	---	---	4.0-8.0	---
	9-20	---	---	8.4 - 9.6	---	---	16.0	---
	20-60	---	---	7.8 - 9.6	---	---	16.0	---
s5182:								
Sheppard	0-6	---	---	7.9 - 8.4	---	---	0.0-2.0	---
	6-60	---	---	7.9 - 8.4	---	---	0.0-2.0	---

Chemical Soil Properties

United States

Map symbol and soil name	Depth	Cation-exchange capacity	Effective cation-exchange capacity	Soil reaction	Calcium carbon-ate	Gypsum	Salinity	Sodium adsorption ratio
	In	*meq/100 g*	*meq/100 g*	*pH*	*Pct*	*Pct*	*mmhos/cm*	
s5182:								
Huerfano	0-2	---	---	7.9 - 9.0	---	---	4.0-16.0	---
	2-15	---	---	7.9 - 9.0	---	---	0.0-4.0	---
	15-19	---	---	---	---	---	---	---
Notal	0-3	---	---	7.9 - 9.0	---	---	4.0-8.0	---
	3-60	---	---	7.9 - 9.0	---	---	4.0-8.0	---
Shiprock	0-2	8.6-16	---	7.4 - 8.4	---	---	---	---
	2-60	---	---	7.4 - 9.0	---	---	0.0-4.0	---
Muff	0-5	5.0-15	---	7.4 - 8.4	0-5	0-4	2.0-4.0	0-5
	5-19	10-20	---	8.4 - 9.6	4-15	0-4	4.0-8.0	13-30
	19-30	10-15	---	8.4 - 9.6	4-15	0-4	4.0-8.0	5-20
	30-34	---	---	---	---	---	---	---
Blancot	0-2	---	---	7.9 - 8.4	---	---	0.0-2.0	---
	2-15	---	---	7.9 - 8.4	---	---	0.0-2.0	---
	15-60	---	---	7.9 - 9.0	---	---	0.0-4.0	---
Avalon	0-11	---	---	7.9 - 8.4	---	---	2.0-8.0	---
	11-42	---	---	7.9 - 8.4	---	---	2.0-8.0	---
	42-60	---	---	7.9 - 8.4	---	---	2.0-8.0	---
Badland	0-60	---	---	---	---	---	---	---
Doak	0-5	5.0-15	---	7.4 - 8.4	0-5	---	0.0-2.0	---
	5-43	10-20	---	7.4 - 9.0	1-10	---	2.0-4.0	---
	43-69	10-20	---	7.9 - 9.0	5-12	---	2.0-4.0	---
Uffens	0-9	---	---	7.4 - 8.4	---	---	4.0-8.0	---
	9-20	---	---	8.4 - 9.6	---	---	16.0	---
	20-60	---	---	7.8 - 9.6	---	---	16.0	---
Monierco	0-5	8.8-17	---	7.4 - 8.4	---	---	---	---
	5-16	---	---	7.4 - 8.4	---	---	0.0-2.0	---
	16-20	---	---	---	---	---	---	---
Rock outcrop	0-60	---	---	---	---	---	---	---
s5183:								
Badland	0-60	---	---	---	---	---	---	---
Rock outcrop	0-60	---	---	---	---	---	---	---

Chemical Soil Properties

United States

Map symbol and soil name	Depth	Cation-exchange capacity	Effective cation-exchange capacity	Soil reaction	Calcium carbon-ate	Gypsum	Salinity	Sodium adsorption ratio
	In	*meq/100 g*	*meq/100 g*	*pH*	*Pct*	*Pct*	*mmhos/cm*	
s5183:								
Riverwash	0-3	---	---	---	---	---	---	---
	3-60	---	---	---	---	---	---	---
Blancot	0-2	---	---	7.9 - 8.4	---	---	0.0-2.0	---
	2-15	---	---	7.9 - 8.4	---	---	0.0-2.0	---
	15-60	---	---	7.9 - 9.0	---	---	0.0-4.0	---
Notal	0-3	---	---	7.9 - 9.0	---	---	4.0-8.0	---
	3-60	---	---	7.9 - 9.0	---	---	4.0-8.0	---
s5184:								
Badland	0-60	---	---	---	---	---	---	---
Fruitland	0-7	5.0-10	---	7.4 - 8.4	5-10	---	0.0-4.0	---
	7-60	5.0-10	---	7.4 - 8.4	5-10	---	0.0-4.0	---
Blancot	0-2	---	---	7.9 - 8.4	---	---	0.0-2.0	---
	2-15	---	---	7.9 - 8.4	---	---	0.0-2.0	---
	15-60	---	---	7.9 - 9.0	---	---	0.0-4.0	---
Persayo	0-4	---	---	7.9 - 9.0	---	---	0.0-8.0	---
	4-14	---	---	7.4 - 9.0	---	---	0.0-8.0	---
	14-18	---	---	---	---	---	---	---
Sheppard	0-6	---	---	7.9 - 8.4	---	---	0.0-2.0	---
	6-60	---	---	7.9 - 8.4	---	---	0.0-2.0	---
Notal	0-3	---	---	7.9 - 9.0	---	---	4.0-8.0	---
	3-60	---	---	7.9 - 9.0	---	---	4.0-8.0	---
s5185:								
Shiprock	0-2	8.6-16	---	7.4 - 8.4	---	---	---	---
	2-60	---	---	7.4 - 9.0	---	---	0.0-4.0	---
Avalon	0-11	---	---	7.9 - 8.4	---	---	2.0-8.0	---
	11-42	---	---	7.9 - 8.4	---	---	2.0-8.0	---
	42-60	---	---	7.9 - 8.4	---	---	2.0-8.0	---
Sheppard	0-6	---	---	7.9 - 8.4	---	---	0.0-2.0	---
	6-60	---	---	7.9 - 8.4	---	---	0.0-2.0	---
Mayqueen	0-3	---	---	7.9 - 8.4	---	---	0.0-2.0	---
	3-12	---	---	7.9 - 8.4	---	---	0.0-2.0	---
	12-60	---	---	7.9 - 8.4	---	---	0.0-2.0	---

Chemical Soil Properties

United States

Map symbol and soil name	Depth	Cation-exchange capacity	Effective cation-exchange capacity	Soil reaction	Calcium carbon-ate	Gypsum	Salinity	Sodium adsorption ratio
	In	*meq/100 g*	*meq/100 g*	*pH*	*Pct*	*Pct*	*mmhos/cm*	
s5185:								
Doak	0-5	5.0-15	---	7.4 - 8.4	0-5	---	0.0-2.0	---
	5-43	10-20	---	7.4 - 9.0	1-10	---	2.0-4.0	---
	43-69	10-20	---	7.9 - 9.0	5-12	---	2.0-4.0	---
s5186:								
Doak	0-5	5.0-15	---	7.4 - 8.4	0-5	---	0.0-2.0	---
	5-43	10-20	---	7.4 - 9.0	1-10	---	2.0-4.0	---
	43-69	10-20	---	7.9 - 9.0	5-12	---	2.0-4.0	---
Uffens	0-9	---	---	7.4 - 8.4	---	---	4.0-8.0	---
	9-20	---	---	8.4 - 9.6	---	---	16.0	---
	20-60	---	---	7.8 - 9.6	---	---	16.0	---
Sheppard	0-6	---	---	7.9 - 8.4	---	---	0.0-2.0	---
	6-60	---	---	7.9 - 8.4	---	---	0.0-2.0	---
Shiprock	0-2	8.6-16	---	7.4 - 8.4	---	---	---	---
	2-60	---	---	7.4 - 9.0	---	---	0.0-4.0	---
Avalon	0-11	---	---	7.9 - 8.4	---	---	2.0-8.0	---
	11-42	---	---	7.9 - 8.4	---	---	2.0-8.0	---
	42-60	---	---	7.9 - 8.4	---	---	2.0-8.0	---
Mayqueen	0-3	---	---	7.9 - 8.4	---	---	0.0-2.0	---
	3-12	---	---	7.9 - 8.4	---	---	0.0-2.0	---
	12-60	---	---	7.9 - 8.4	---	---	0.0-2.0	---
Fruitland	0-7	5.0-10	---	7.4 - 8.4	5-10	---	0.0-4.0	---
	7-60	5.0-10	---	7.4 - 8.4	5-10	---	0.0-4.0	---
Huerfano	0-2	---	---	7.9 - 9.0	---	---	4.0-16.0	---
	2-15	---	---	7.9 - 9.0	---	---	0.0-4.0	---
	15-19	---	---	---	---	---	---	---
Monierco	0-5	8.8-17	---	7.4 - 8.4	---	---	---	---
	5-16	---	---	7.4 - 8.4	---	---	0.0-2.0	---
	16-20	---	---	---	---	---	---	---
s5187:								
Gobernador	0-2	22-29	---	7.8 - 9.6	1-5	---	2.0-4.0	13-45
	2-60	28-38	---	7.8 - 9.6	1-5	---	8.0-16.0	13-45
Orlie	0-2	13-17	---	6.6 - 7.3	---	---	---	---
	2-22	19-23	---	6.6 - 8.4	0-5	---	0.0-2.0	---
	22-60	18-22	---	7.4 - 8.4	5-10	---	0.0-4.0	---

Chemical Soil Properties

United States

Map symbol and soil name	Depth	Cation-exchange capacity	Effective cation-exchange capacity	Soil reaction	Calcium carbon-ate	Gypsum	Salinity	Sodium adsorption ratio
	In	*meq/100 g*	*meq/100 g*	*pH*	*Pct*	*Pct*	*mmhos/cm*	
s5187:								
Sparham	0-4	22-26	---	7.9 - 8.4	1-10	---	0.0-2.0	1-12
	4-41	25-31	---	7.9 - 8.4	1-10	---	4.0-8.0	5-12
	41-54	25-31	---	7.9 - 8.4	1-10	---	4.0-8.0	5-12
	54-60	7.0-12	---	7.4 - 8.4	5-15	---	0.0-2.0	5-12
s5188:								
Sparank	0-2	14-21	---	7.9 - 9.0	1-10	---	0.0-4.0	1-5
	2-60	21-31	---	7.9 - 9.0	5-15	---	4.0-8.0	13-30
Pinavetes	0-10	2.6-7.8	---	6.6 - 8.4	1-5	---	---	---
	10-60	4.2-11	---	6.6 - 8.4	1-5	---	---	---
San Mateo	0-2	---	---	7.4 - 8.4	---	---	0.0-2.0	---
	2-29	---	---	7.4 - 8.4	---	---	2.0-4.0	---
	29-60	---	---	7.4 - 9.0	---	---	2.0-4.0	---
Florita	0-4	13-17	---	7.4 - 7.8	---	---	---	---
	4-43	---	---	7.4 - 7.8	---	---	---	---
	43-60	---	---	7.4 - 7.8	---	---	---	---
Riverwash	0-3	---	---	---	---	---	---	---
	3-60	---	---	---	---	---	---	---
s5189:								
Penistaja	0-4	8.0-16	---	6.6 - 8.4	---	---	0.0-2.0	---
	4-28	13-19	---	6.6 - 8.4	5-10	---	0.0-2.0	---
	28-60	10-16	---	6.6 - 8.4	5-10	---	0.0-2.0	---
Sedale	0-2	---	---	6.6 - 7.8	---	---	---	---
	2-8	---	---	6.6 - 7.8	---	---	---	---
	8-15	---	---	---	---	---	---	---
	15-19	---	---	---	---	---	---	---
Menefee	0-2	---	---	7.4 - 8.4	---	---	0.0-2.0	---
	2-14	---	---	7.4 - 9.0	---	---	0.0-2.0	---
	14-18	---	---	---	---	---	---	---
Rock outcrop	0-60	---	---	---	---	---	---	---
Hosta	0-8	---	---	7.4 - 8.4	---	---	0.0-2.0	---
	8-46	---	---	7.4 - 8.4	---	---	0.0-2.0	---
	46-60	---	---	7.4 - 8.4	---	---	4.0-8.0	---

Chemical Soil Properties

United States

Map symbol and soil name	Depth	Cation-exchange capacity	Effective cation-exchange capacity	Soil reaction	Calcium carbon-ate	Gypsum	Salinity	Sodium adsorption ratio
	In	meq/100 g	meq/100 g	pH	Pct	Pct	mmhos/cm	
s5192:								
Pinitos	0-2	13-20	---	6.6 - 7.3	---	---	---	---
	2-24	14-27	---	6.6 - 7.8	---	---	---	---
	24-60	11-20	---	7.4 - 7.8	5-10	---	---	---
Royosa	0-8	0.0-5.3	---	6.6 - 7.8	0-3	---	---	---
	8-60	0.0-7.4	---	6.6 - 7.8	0-3	---	---	---
s5193:								
Lybrook	0-5	---	---	7.9 - 8.4	---	---	2.0-4.0	---
	5-30	---	---	7.9 - 8.4	---	---	2.0-4.0	---
	30-60	---	---	8.4 - 9.6	---	---	4.0-8.0	---
Tsosie	0-2	---	---	6.6 - 7.8	---	---	2.0-4.0	---
	2-26	---	---	8.5 - 9.0	---	---	4.0-8.0	---
	26-36	---	---	8.5 - 9.0	---	---	4.0-8.0	---
	36-60	---	---	8.5 - 9.0	---	---	4.0-8.0	---
s5194:								
Nalivag	0-3	10-20	---	6.6 - 7.3	---	---	0.0-2.0	---
	3-60	13-23	---	7.4 - 7.8	1-5	---	0.0-2.0	---
Ruson	0-2	17-22	---	7.4 - 8.4	---	---	---	---
	2-19	23-30	---	7.4 - 8.4	---	---	---	---
	19-60	25-31	---	7.4 - 8.4	0-5	---	0.0-4.0	---
s5197:								
Berryman	0-3	13-21	---	7.4 - 8.4	40-55	0-1	---	---
	3-60	4.7-19	---	7.4 - 8.4	40-55	0-1	---	---
Menefee	0-2	---	---	7.4 - 8.4	---	---	0.0-2.0	---
	2-14	---	---	7.4 - 9.0	---	---	0.0-2.0	---
	14-18	---	---	---	---	---	---	---
Calendar	0-2	17-22	---	7.4 - 8.4	5-10	---	---	---
	2-17	26-34	---	7.4 - 8.4	5-10	---	---	---
	17-35	20-25	---	7.4 - 8.4	10-15	---	0.0-4.0	---
	35-39	---	---	---	---	---	---	---
s5213:								
Armijo	0-11	---	---	8.4 - 9.6	---	---	4.0-16.0	---
	11-33	---	---	8.4 - 9.6	---	---	4.0-16.0	---
	33-60	---	---	8.4 - 9.6	---	---	4.0-16.0	---

Chemical Soil Properties

United States

Map symbol and soil name	Depth	Cation-exchange capacity	Effective cation-exchange capacity	Soil reaction	Calcium carbon-ate	Gypsum	Salinity	Sodium adsorption ratio
	In	*meq/100 g*	*meq/100 g*	*pH*	*Pct*	*Pct*	*mmhos/cm*	
s5213:								
Tome	0-5	---	---	8.4 - 9.6	---	---	16.0	---
	5-42	---	---	8.4 - 9.6	---	---	16.0	---
	42-60	---	---	8.4 - 9.6	---	---	16.0	---
Bluepoint	0-9	---	---	7.4 - 9.0	---	---	0.0-2.0	---
	9-24	---	---	7.9 - 9.0	---	---	0.0-4.0	---
	24-41	---	---	7.9 - 9.0	---	---	0.0-4.0	---
	41-60	---	---	7.9 - 9.0	---	---	0.0-4.0	---
Tome	0-5	---	---	8.4 - 9.6	---	---	16.0	---
	5-42	---	---	8.4 - 9.6	---	---	16.0	---
	42-60	---	---	8.4 - 9.6	---	---	16.0	---
Adelino	0-4	---	---	8.5 - 9.0	---	---	4.0-8.0	---
	4-38	---	---	8.5 - 9.0	---	---	4.0-8.0	---
	38-60	---	---	8.5 - 9.0	---	---	4.0-8.0	---
Adelino	0-4	---	---	7.9 - 8.4	---	---	0.0-2.0	---
	4-38	---	---	7.9 - 9.0	---	---	0.0-2.0	---
	38-60	---	---	7.9 - 9.0	---	---	0.0-2.0	---
s5224:								
Penistaja	0-4	8.0-16	---	6.6 - 8.4	---	---	0.0-2.0	---
	4-28	13-19	---	6.6 - 8.4	5-10	---	0.0-2.0	---
	28-60	10-16	---	6.6 - 8.4	5-10	---	0.0-2.0	---
Silver	0-3	13-21	---	7.4 - 7.8	---	---	---	---
	3-45	---	---	7.4 - 8.4	---	---	0.0-2.0	---
	45-60	---	---	7.4 - 8.4	---	---	0.0-2.0	---
	60-70	---	---	7.4 - 8.4	---	---	0.0-2.0	---
Otero	0-14	5.0-20	---	7.4 - 8.4	0-5	---	0.0-2.0	---
	14-60	2.0-10	---	7.4 - 8.4	1-5	---	0.0-4.0	---
Shingle	0-4	---	---	7.4 - 9.0	---	---	0.0-2.0	---
	4-15	---	---	7.4 - 9.0	---	---	0.0-2.0	---
	15-19	---	---	---	---	---	---	---
Travessilla	0-2	---	---	7.4 - 8.4	---	---	0.0-2.0	---
	2-12	---	---	7.4 - 8.4	---	---	0.0-2.0	---
	12-16	---	---	---	---	---	---	---
Badland	0-60	---	---	---	---	---	---	---

Chemical Soil Properties

United States

Map symbol and soil name	Depth	Cation-exchange capacity	Effective cation-exchange capacity	Soil reaction	Calcium carbon-ate	Gypsum	Salinity	Sodium adsorption ratio
	In	*meq/100 g*	*meq/100 g*	*pH*	*Pct*	*Pct*	*mmhos/cm*	
s5225:								
Kim	0-6	5.4-9.7	---	7.4 - 8.4	---	---	---	---
	6-60	---	---	7.9 - 8.4	---	---	---	---
Shingle	0-4	---	---	7.4 - 9.0	---	---	0.0-2.0	---
	4-15	---	---	7.4 - 9.0	---	---	0.0-2.0	---
	15-19	---	---	---	---	---	---	---
Badland	0-60	---	---	---	---	---	---	---
Gila	0-10	---	---	7.4 - 8.4	---	---	0.0-4.0	---
	10-60	---	---	7.4 - 8.4	---	---	0.0-4.0	---
Hantz	0-3	---	---	7.9 - 9.0	---	---	2.0-4.0	---
	3-60	---	---	7.9 - 9.0	---	---	2.0-4.0	---
	60-70	---	---	7.9 - 9.0	---	---	2.0-4.0	---
s5227:								
Kokan	0-4	---	---	7.4 - 9.0	---	---	0.0-2.0	---
	4-60	---	---	7.4 - 9.0	---	---	0.0-2.0	---
Vinton	0-12	---	---	7.4 - 8.4	---	---	0.0-2.0	---
	12-60	---	---	7.9 - 8.4	---	---	0.0-2.0	---
Badland	0-60	---	---	---	---	---	---	---
Kim	0-6	5.4-9.7	---	7.4 - 8.4	---	---	---	---
	6-60	---	---	7.9 - 8.4	---	---	---	---
Pajarito	0-5	5.0-12	---	7.4 - 8.4	0	0	0.0-2.0	0
	5-40	10-20	---	7.9 - 8.4	2-15	0	0.0-2.0	0
	40-60	10-20	---	7.9 - 8.4	10-15	0	0.0-2.0	0
	60-70	5.0-10	---	7.9 - 8.4	10-15	0	0.0-2.0	0
s5228:								
Badland	0-60	---	---	---	---	---	---	---
Cudei	0-4	---	---	7.9 - 9.0	---	---	0.0-2.0	---
	4-12	---	---	7.9 - 9.0	---	---	0.0-2.0	---
	12-42	---	---	7.9 - 9.0	---	---	0.0-4.0	---
	42-60	---	---	7.9 - 9.0	---	---	0.0-4.0	---

Chemical Soil Properties

United States

Map symbol and soil name	Depth	Cation-exchange capacity	Effective cation-exchange capacity	Soil reaction	Calcium carbon-ate	Gypsum	Salinity	Sodium adsorption ratio
	In	*meq/100 g*	*meq/100 g*	*pH*	*Pct*	*Pct*	*mmhos/cm*	
s5228:								
Tocito	0-6	10-15	---	7.9 - 8.4	5-10	0-1	2.0-4.0	0-5
	6-12	10-15	---	7.9 - 8.4	5-10	0-1	2.0-4.0	0-5
	12-16	15-20	---	7.9 - 8.4	5-10	1-5	4.0-8.0	5-13
	16-28	10-15	---	7.9 - 8.4	10-15	1-5	4.0-8.0	0-5
	28-70	10-20	---	7.9 - 8.4	10-15	1-5	4.0-8.0	5-13
Blackston	0-4	5.0-10	---	7.9 - 8.4	2-10	0	0.0	0
	4-25	5.0-15	---	7.9 - 9.0	15-25	0	0.0-2.0	0
	25-60	5.0-10	---	7.9 - 9.0	15-30	0	0.0-2.0	0
Kimbeto	0-2	5.0-10	---	7.4 - 7.8	3-5	---	0.0-2.0	---
	2-10	10-15	---	7.9 - 9.0	5-10	---	2.0-4.0	0-5
	10-54	10-15	---	7.9 - 9.0	10-30	0-2	4.0-16.0	5-30
	54-66	10-15	---	7.4 - 8.4	5-15	2-5	8.0-16.0	13-30
Mesa	0-4	21-28	---	7.4 - 8.4	---	---	---	---
	4-14	---	---	7.4 - 8.4	---	---	---	---
	14-20	---	---	7.9 - 8.4	---	---	0.0-8.0	---
	20-60	---	---	7.9 - 8.4	---	---	4.0-16.0	---
Fruitland	0-7	10-15	---	7.4 - 8.4	3-5	---	2.0-4.0	---
	7-42	5.0-10	---	7.4 - 8.4	3-5	---	2.0-4.0	---
	42-65	10-15	---	7.4 - 8.4	3-5	0-1	2.0-4.0	---
Water	---	---	---	---	---	---	---	---
Mesa	0-4	21-28	---	7.4 - 8.4	---	---	---	---
	4-14	---	---	7.4 - 8.4	---	---	---	---
	14-20	---	---	7.9 - 8.4	---	---	0.0-8.0	---
	20-60	---	---	7.9 - 8.4	---	---	4.0-16.0	---
Camac	0-3	5.0-10	---	7.9 - 8.4	5-10	---	0.0-4.0	0-5
	3-17	5.0-15	---	7.9 - 9.0	5-15	---	0.0-4.0	0-5
	17-31	10-20	---	7.9 - 9.0	10-15	0-1	4.0-8.0	5-13
	31-35	---	---	---	---	---	---	---
Turley	0-2	---	---	7.4 - 9.0	---	---	2.0-4.0	---
	2-23	---	---	7.4 - 9.0	---	---	2.0-4.0	---
	23-31	---	---	7.4 - 9.0	---	---	2.0-4.0	---
	31-57	---	---	7.4 - 9.0	---	---	2.0-4.0	---
	57-60	---	---	7.4 - 9.0	---	---	2.0-4.0	---
Rock outcrop	0-60	---	---	---	---	---	---	---

Chemical Soil Properties

United States

Map symbol and soil name	Depth	Cation-exchange capacity	Effective cation-exchange capacity	Soil reaction	Calcium carbon-ate	Gypsum	Salinity	Sodium adsorption ratio
	In	*meq/100 g*	*meq/100 g*	*pH*	*Pct*	*Pct*	*mmhos/cm*	
s5228:								
Riverwash	0-3	---	---	---	---	---	---	---
	3-60	---	---	---	---	---	---	---
Sheppard	0-6	---	---	7.9 - 8.4	---	---	0.0-2.0	---
	6-60	---	---	7.9 - 8.4	---	---	0.0-2.0	---
s5229:								
Littlehat	0-2	5.0-15	---	7.9 - 9.0	10-20	1-10	4.0-16.0	13-30
	2-31	5.0-15	---	7.9 - 9.0	10-20	1-5	8.0-35.0	30-100
	31-35	---	---	---	---	---	---	---
Persayo	0-5	---	---	8.5 - 9.0	---	---	0.0-8.0	---
	5-12	---	---	8.5 - 9.0	---	---	0.0-8.0	---
	12-16	---	---	---	---	---	---	---
Lawet	0-10	---	---	8.5 - 9.0	---	---	0.0-2.0	---
	10-29	---	---	8.5 - 9.0	---	---	2.0-4.0	---
	29-60	---	---	7.9 - 9.0	---	---	4.0-8.0	---
Nataani	0-3	5.0-10	---	7.4 - 8.4	5-10	0-1	2.0-4.0	0-5
	3-9	5.0-10	---	7.9 - 8.4	10-15	0-1	2.0-4.0	0-5
	9-21	5.0-10	---	7.4 - 8.4	5-15	15-45	2.0-16.0	0-13
	21-30	5.0-10	---	7.9 - 8.4	5-15	1-5	8.0-16.0	5-13
	30-34	---	---	---	---	---	---	---
Nakai	0-18	---	---	7.4 - 9.0	---	---	0.0-2.0	---
	18-34	---	---	7.9 - 9.0	---	---	0.0-2.0	---
	34-60	---	---	7.9 - 9.0	---	---	0.0-2.0	---
Badland	0-60	---	---	---	---	---	---	---
Gyptur	0-2	5.0-10	---	7.4 - 8.4	5-10	---	2.0-4.0	0-5
	2-5	10-20	---	7.9 - 9.0	5-15	0-2	2.0-4.0	5-13
	5-17	10-20	---	7.9 - 9.0	5-15	10-25	2.0-8.0	5-13
	17-46	10-20	---	7.9 - 9.0	5-15	5-10	8.0-25.0	13-50
	46-50	---	---	---	---	---	---	---
Tsebitai	0-5	5.0-10	---	7.4 - 8.4	5-10	0-1	0.0-2.0	---
	5-26	5.0-10	---	7.4 - 8.4	5-10	0-1	0.0-2.0	---
	26-64	5.0-10	---	7.4 - 8.4	5-10	2-5	2.0-8.0	0-5
Benally	0-2	---	---	7.9 - 8.4	---	---	2.0-4.0	---
	2-18	---	---	8.5 - 9.0	---	---	4.0-16.0	---
	18-45	---	---	7.9 - 8.4	---	---	8.0-16.0	---
	45-49	---	---	---	---	---	---	---

Chemical Soil Properties

United States

Map symbol and soil name	Depth	Cation-exchange capacity	Effective cation-exchange capacity	Soil reaction	Calcium carbon-ate	Gypsum	Salinity	Sodium adsorption ratio
	In	*meq/100 g*	*meq/100 g*	*pH*	*Pct*	*Pct*	*mmhos/cm*	
s5229:								
Rock outcrop	0-60	---	---	---	---	---	---	---
Gullied land	0-60	---	---	---	---	---	---	---
Tocito	0-6	10-15	---	7.9 - 8.4	5-10	0-1	2.0-4.0	0-5
	6-12	10-15	---	7.9 - 8.4	5-10	0-1	2.0-4.0	0-5
	12-16	15-20	---	7.9 - 8.4	5-10	1-5	4.0-8.0	5-13
	16-28	10-15	---	7.9 - 8.4	10-15	1-5	4.0-8.0	0-5
	28-70	10-20	---	7.9 - 8.4	10-15	1-5	4.0-8.0	5-13
s5233:								
Querencia	0-4	11-21	---	7.4 - 8.4	---	---	---	---
	4-24	---	---	7.4 - 8.4	---	---	---	---
	24-60	---	---	7.4 - 8.4	---	---	---	---
Sandoval	0-2	---	---	7.9 - 9.0	---	---	0.0-4.0	---
	2-15	---	---	7.9 - 9.0	---	---	0.0-4.0	---
	15-19	---	---	---	---	---	---	---
Sparank	0-2	---	---	7.4 - 8.4	---	---	2.0-4.0	---
	2-60	---	---	7.4 - 8.4	---	---	2.0-4.0	---
San Mateo	0-2	---	---	7.4 - 8.4	---	---	0.0-2.0	---
	2-29	---	---	7.4 - 8.4	---	---	2.0-4.0	---
	29-60	---	---	7.4 - 9.0	---	---	2.0-4.0	---
Skyvillage	0-2	8.9-13	---	7.4 - 8.4	---	---	---	---
	2-16	---	---	7.4 - 8.4	---	---	---	---
	16-20	---	---	---	---	---	---	---
Zia	0-5	---	---	7.4 - 8.4	---	---	0.0-2.0	---
	5-60	---	---	7.4 - 8.4	---	---	0.0-2.0	---
Rock outcrop	0-60	---	---	---	---	---	---	---
s5235:								
Rock outcrop	0-60	---	---	---	---	---	---	---
Zia	0-5	---	---	7.4 - 8.4	---	---	0.0-2.0	---
	5-60	---	---	7.4 - 8.4	---	---	0.0-2.0	---
Sandoval	0-2	---	---	7.9 - 9.0	---	---	0.0-4.0	---
	2-15	---	---	7.9 - 9.0	---	---	0.0-4.0	---
	15-19	---	---	---	---	---	---	---

Chemical Soil Properties

United States

Map symbol and soil name	Depth	Cation-exchange capacity	Effective cation-exchange capacity	Soil reaction	Calcium carbon-ate	Gypsum	Salinity	Sodium adsorption ratio
	In	*meq/100 g*	*meq/100 g*	*pH*	*Pct*	*Pct*	*mmhos/cm*	
s5235:								
San Mateo	0-2	---	---	7.4 - 8.4	---	---	0.0-2.0	---
	2-29	---	---	7.4 - 8.4	---	---	2.0-4.0	---
	29-60	---	---	7.4 - 9.0	---	---	2.0-4.0	---
Penistaja	0-4	8.0-16	---	6.6 - 8.4	---	---	0.0-2.0	---
	4-28	13-19	---	6.6 - 8.4	5-10	---	0.0-2.0	---
	28-60	10-16	---	6.6 - 8.4	5-10	---	0.0-2.0	---
Saido	0-5	2.0-15	---	7.4 - 8.4	1-10	2-10	2.0-8.0	0-4
	5-60	2.0-15	---	7.9 - 8.4	5-10	35-50	0.0-2.0	0-4
Skyvillage	0-2	8.9-13	---	7.4 - 8.4	---	---	---	---
	2-16	---	---	7.4 - 8.4	---	---	---	---
	16-20	---	---	---	---	---	---	---
Hagerman	0-3	8.8-17	---	6.6 - 7.8	---	---	---	---
	3-30	12-22	---	6.6 - 8.4	2-10	---	0.0-2.0	---
	30-34	---	---	---	---	---	---	---
Sparank	0-2	---	---	7.9 - 9.0	---	---	16.0	---
	2-60	---	---	7.9 - 9.0	---	---	16.0	---
Querencia	0-4	11-15	---	7.4 - 8.4	---	---	---	---
	4-24	---	---	7.4 - 8.4	---	---	---	---
	24-60	---	---	7.4 - 8.4	---	---	---	---
s5248:								
Sheppard	0-6	---	---	7.9 - 8.4	---	---	0.0-2.0	---
	6-60	---	---	7.9 - 8.4	---	---	0.0-2.0	---
Fajada	0-2	---	---	7.4 - 7.8	---	---	2.0-4.0	---
	2-6	---	---	9.0 - 9.6	---	---	4.0-16.0	---
	6-16	---	---	9.0 - 9.6	---	---	4.0-16.0	---
	16-28	---	---	7.9 - 8.4	---	---	4.0-16.0	---
	28-60	---	---	---	---	---	---	---
Sparank	0-2	---	---	7.4 - 8.4	---	---	2.0-4.0	---
	2-60	---	---	7.4 - 8.4	---	---	2.0-4.0	---
s5250:								
Mion	0-2	25-29	---	6.6 - 8.4	---	---	---	---
	2-16	---	---	7.4 - 8.4	---	---	0.0-2.0	---
	16-20	---	---	---	---	---	---	---
Rock outcrop	0-60	---	---	---	---	---	---	---

Chemical Soil Properties

United States

Map symbol and soil name	Depth	Cation-exchange capacity	Effective cation-exchange capacity	Soil reaction	Calcium carbon-ate	Gypsum	Salinity	Sodium adsorption ratio
	In	*meq/100 g*	*meq/100 g*	*pH*	*Pct*	*Pct*	*mmhos/cm*	
s5250:								
Atarque	0-2	8.6-15	---	6.6 - 7.3	---	---	---	---
	2-16	---	---	6.6 - 7.8	---	---	---	---
	16-22	---	---	---	---	---	---	---
s5251:								
Doak	0-5	5.0-10	---	7.4 - 8.4	0-5	---	0.0-2.0	---
	5-43	10-20	---	7.4 - 9.0	1-10	---	2.0-4.0	---
	43-69	10-20	---	7.9 - 9.0	5-12	---	2.0-4.0	---
Kiki	0-6	---	---	7.4 - 7.8	---	---	0.0-2.0	---
	6-14	---	---	7.4 - 7.8	---	---	0.0-2.0	---
	14-24	---	---	7.4 - 7.8	---	---	0.0-2.0	---
	24-28	---	---	---	---	---	---	---
s5252:								
Doakum	0-5	---	---	7.9 - 8.4	---	---	0.0-2.0	---
	5-17	---	---	7.9 - 8.4	---	---	2.0-4.0	---
	17-60	---	---	8.5 - 9.0	---	---	4.0-8.0	---
Betonnie	0-2	---	---	7.9 - 8.4	---	---	0.0-2.0	---
	2-60	---	---	7.9 - 8.4	---	---	0.0-2.0	---
s5253:								
Blancot	0-2	---	---	7.9 - 8.4	---	---	0.0-2.0	---
	2-23	---	---	7.9 - 8.4	---	---	0.0-2.0	---
	23-60	---	---	7.9 - 9.0	---	---	2.0-4.0	---
Councelor	0-2	3.0-10	---	7.9 - 8.4	0-5	0	0.0-2.0	0-4
	2-60	2.0-12	---	7.9 - 9.0	3-5	0	2.0-4.0	4-13
Tsosie	0-2	---	---	6.6 - 7.8	---	---	2.0-4.0	---
	2-26	---	---	8.5 - 9.0	---	---	4.0-8.0	---
	26-36	---	---	8.5 - 9.0	---	---	4.0-8.0	---
	36-60	---	---	8.5 - 9.0	---	---	4.0-8.0	---
s5331:								
Cabezon	0-4	24-36	---	6.1 - 7.3	---	---	---	---
	4-12	---	---	6.1 - 7.3	---	---	---	---
	12-16	---	---	---	---	---	---	---
Hubbell	0-4	---	---	7.9 - 8.4	---	---	2.0-4.0	---
	4-60	---	---	9.0 - 9.6	---	---	2.0-4.0	---

Chemical Soil Properties

United States

Map symbol and soil name	Depth	Cation-exchange capacity	Effective cation-exchange capacity	Soil reaction	Calcium carbon-ate	Gypsum	Salinity	Sodium adsorption ratio
	In	*meq/100 g*	*meq/100 g*	*pH*	*Pct*	*Pct*	*mmhos/cm*	
s5331:								
Thunderbird	0-5	14-23	---	6.6 - 7.8	---	---	---	---
	5-23	---	---	6.6 - 8.4	---	---	0.0-2.0	---
	23-27	---	---	---	---	---	---	---
Rudd	0-10	17-23	---	7.4 - 8.4	---	---	---	---
	10-13	---	---	7.9 - 8.4	---	---	0.0-2.0	---
	13-17	---	---	---	---	---	---	---
Veteado	0-6	13-17	---	6.6 - 7.3	---	---	---	---
	6-16	---	---	6.6 - 7.8	---	---	---	---
	16-28	---	---	7.4 - 8.4	---	---	---	---
	28-60	---	---	7.9 - 9.0	---	---	0.0-2.0	---
Modyon	0-3	17-21	---	7.9 - 8.4	---	---	---	---
	3-16	---	---	7.9 - 8.4	---	---	---	---
	16-28	---	---	7.9 - 8.4	---	---	0.0-2.0	---
	28-32	---	---	---	---	---	---	---
Penistaja	0-4	8.0-16	---	6.6 - 8.4	---	---	0.0-2.0	---
	4-28	13-19	---	6.6 - 8.4	5-10	---	0.0-2.0	---
	28-60	10-16	---	6.6 - 8.4	5-10	---	0.0-2.0	---
Celsosprings	0-3	17-23	---	6.1 - 6.5	---	---	---	---
	3-13	---	---	6.6 - 7.3	---	---	---	---
	13-26	---	---	6.6 - 7.3	---	---	---	---
	26-33	---	---	7.4 - 8.4	---	---	0.0-2.0	---
	33-60	---	---	7.4 - 8.4	---	---	0.0-2.0	---
Ceniza	0-6	11-17	---	7.4 - 7.8	---	---	---	---
	6-30	8.5-12	---	7.9 - 8.4	---	---	---	---
	30-42	0.0-3.8	---	7.9 - 8.4	---	---	---	---
	42-60	---	---	7.9 - 9.0	---	---	0.0-2.0	---
Abrazo	0-2	8.9-17	---	6.6 - 7.3	---	---	---	---
	2-20	---	---	7.4 - 8.4	---	---	0.0-2.0	---
	20-27	---	---	7.4 - 8.4	---	---	0.0-2.0	---
	27-31	---	---	---	---	---	---	---
Apache	0-3	---	---	7.4 - 8.4	---	---	0.0-2.0	---
	3-10	---	---	7.4 - 8.4	---	---	0.0-2.0	---
	10-14	---	---	7.4 - 8.4	---	---	0.0-2.0	---
	14-18	---	---	---	---	---	---	---

Chemical Soil Properties

United States

Map symbol and soil name	Depth	Cation-exchange capacity	Effective cation-exchange capacity	Soil reaction	Calcium carbon-ate	Gypsum	Salinity	Sodium adsorption ratio
	In	*meq/100 g*	*meq/100 g*	*pH*	*Pct*	*Pct*	*mmhos/cm*	
s5331:								
Flaco	0-2	---	---	7.9 - 8.4	---	---	0.0-2.0	---
	2-11	---	---	7.9 - 8.4	---	---	0.0-2.0	---
	11-29	---	---	7.9 - 8.4	---	---	0.0-2.0	---
	29-33	---	---	---	---	---	---	---
Gatlin	0-4	13-22	---	7.4 - 8.4	---	---	---	---
	4-10	---	---	7.4 - 9.0	---	---	0.0-2.0	---
	10-60	---	---	7.4 - 9.0	---	---	0.0-2.0	---
s5396:								
Datil	0-7	13-21	---	7.4 - 7.8	---	---	---	---
	7-22	---	---	7.4 - 7.8	---	---	---	---
	22-40	---	---	7.4 - 8.4	---	---	0.0-2.0	---
	40-60	---	---	7.4 - 7.8	---	---	0.0-2.0	---
Loarc	0-14	8.9-13	---	6.6 - 7.3	---	---	---	---
	14-23	---	---	6.6 - 8.4	---	---	---	---
	23-36	---	---	6.1 - 9.0	---	---	0.0-2.0	---
	36-60	---	---	6.1 - 9.0	---	---	0.0-2.0	---
Guy	0-3	5.0-10	---	7.4 - 8.4	1-5	0	0.0-1.0	0-2
	3-10	5.0-10	---	7.4 - 8.4	1-5	0	0.0-2.0	0-2
	10-60	3.0-10	---	7.4 - 8.4	10-30	0	0.0-2.0	0-5
Dioxice	0-3	15-19	---	7.4 - 7.8	---	---	---	---
	3-24	---	---	7.4 - 8.4	---	---	0.0-2.0	---
	24-60	---	---	7.4 - 7.8	---	---	0.0-2.0	---
Millpaw	0-4	16-21	---	7.4 - 7.8	---	---	---	---
	4-35	---	---	7.4 - 7.8	---	---	---	---
	35-60	---	---	7.4 - 8.4	---	---	0.0-2.0	---
Gustspring	0-2	13-17	---	6.6 - 7.3	---	---	---	---
	2-11	---	---	6.6 - 8.4	---	---	---	---
	11-22	---	---	7.9 - 9.0	---	---	0.0-2.0	---
	22-60	---	---	7.4 - 8.4	---	---	0.0-2.0	---
Hiarc	0-2	13-17	---	6.6 - 7.3	---	---	---	---
	2-7	---	---	6.6 - 7.3	---	---	---	---
	7-19	---	---	6.6 - 7.3	---	---	---	---
	19-27	---	---	6.6 - 7.3	---	---	---	---
	27-31	---	---	---	---	---	---	---

Chemical Soil Properties

United States

Map symbol and soil name	Depth	Cation-exchange capacity	Effective cation-exchange capacity	Soil reaction	Calcium carbon-ate	Gypsum	Salinity	Sodium adsorption ratio
	In	*meq/100 g*	*meq/100 g*	*pH*	*Pct*	*Pct*	*mmhos/cm*	
s5396:								
Amenson	0-3	17-23	---	7.4 - 7.8	---	---	---	---
	3-11	---	---	7.4 - 7.8	---	---	---	---
	11-15	---	---	8.5 - 9.0	---	---	0.0-2.0	---
	15-20	---	---	---	---	---	---	---
	20-24	---	---	---	---	---	---	---
Joachem	0-3	7.5-14	---	7.4 - 7.8	---	---	---	---
	3-8	---	---	7.4 - 8.4	---	---	---	---
	8-11	---	---	7.9 - 9.0	---	---	0.0-2.0	---
	11-15	---	---	---	---	---	---	---
Landavaso	0-10	13-17	---	6.6 - 7.3	---	---	---	---
	10-27	---	---	6.6 - 7.3	---	---	---	---
	27-60	---	---	6.6 - 7.3	---	---	---	---
Pena	0-8	---	---	7.4 - 8.4	---	---	0.0-2.0	---
	8-30	---	---	7.9 - 8.4	---	---	2.0-4.0	---
	30-60	---	---	7.9 - 8.4	---	---	2.0-4.0	---
	60-70	---	---	7.9 - 8.4	---	---	2.0-4.0	---
Ralphston	0-2	11-15	---	7.9 - 8.4	---	---	---	---
	2-13	---	---	7.9 - 8.4	---	---	---	---
	13-60	---	---	7.9 - 9.0	---	---	0.0-2.0	---
Rock outcrop	0-60	---	---	---	---	---	---	---
s5399:								
Rock outcrop	0-60	---	---	---	---	---	---	---
Motoqua	0-2	8.9-17	---	6.6 - 7.3	---	---	---	---
	2-16	---	---	6.6 - 7.3	---	---	---	---
	16-20	---	---	---	---	---	---	---
Mion	0-2	25-29	---	6.6 - 8.4	---	---	---	---
	2-16	---	---	7.4 - 8.4	---	---	0.0-2.0	---
	16-20	---	---	---	---	---	---	---
Abrazo	0-8	13-21	---	6.6 - 7.3	---	---	---	---
	8-26	---	---	6.6 - 8.4	---	---	0.0-2.0	---
	26-30	---	---	---	---	---	---	---
Gustspring	0-2	8.9-13	---	6.6 - 7.3	---	---	---	---
	2-11	---	---	6.6 - 8.4	---	---	---	---
	11-22	---	---	7.9 - 9.0	---	---	0.0-2.0	---
	22-60	---	---	7.4 - 8.4	---	---	0.0-2.0	---

Chemical Soil Properties

United States

Map symbol and soil name	Depth	Cation-exchange capacity	Effective cation-exchange capacity	Soil reaction	Calcium carbon-ate	Gypsum	Salinity	Sodium adsorption ratio
	In	*meq/100 g*	*meq/100 g*	*pH*	*Pct*	*Pct*	*mmhos/cm*	
s5399:								
Travessilla	0-3	8.9-16	---	6.6 - 8.4	---	---	---	---
	3-13	---	---	6.6 - 8.4	---	---	0.0-2.0	---
	13-17	---	---	---	---	---	---	---
Goldust	0-7	8.9-17	---	6.6 - 7.8	---	---	---	---
	7-27	---	---	6.6 - 7.8	---	---	---	---
	27-60	---	---	7.4 - 8.4	---	---	0.0-2.0	---
Parquat	0-2	11-17	---	7.4 - 7.8	---	---	---	---
	2-12	---	---	7.4 - 7.8	---	---	---	---
	12-19	---	---	7.4 - 7.8	---	---	---	---
	19-33	---	---	7.4 - 8.4	---	---	0.0-2.0	---
	33-60	---	---	7.4 - 8.4	---	---	0.0-2.0	---
s5400:								
Puertecito	0-2	5.0-15	---	6.6 - 7.3	8-15	0	0.0-2.0	0-4
	2-14	10-25	---	6.6 - 7.3	8-15	0	0.0-2.0	0
	14-18	---	---	---	---	---	---	---
Rock outcrop	0-60	---	---	---	---	---	---	---
Travessilla	0-3	8.9-16	---	6.6 - 8.4	---	---	---	---
	3-13	---	---	6.6 - 8.4	---	---	0.0-2.0	---
	13-17	---	---	---	---	---	---	---
Mion	0-2	13-17	---	6.6 - 8.4	---	---	---	---
	2-16	---	---	7.4 - 8.4	---	---	0.0-2.0	---
	16-20	---	---	---	---	---	---	---
La Fonda	0-3	8.7-13	---	7.4 - 8.4	---	---	---	---
	3-60	---	---	7.4 - 8.4	---	---	0.0-2.0	---
San Mateo	0-2	---	---	7.4 - 8.4	---	---	0.0-2.0	---
	2-29	---	---	7.4 - 8.4	---	---	2.0-4.0	---
	29-60	---	---	7.4 - 9.0	---	---	2.0-4.0	---
s5401:								
Datil	0-7	8.1-21	---	7.4 - 7.8	---	---	---	---
	7-22	---	---	7.4 - 7.8	---	---	---	---
	22-40	---	---	7.4 - 8.4	---	---	0.0-2.0	---
	40-60	---	---	7.4 - 7.8	---	---	0.0-2.0	---
Lapdun	0-9	---	---	7.9 - 9.0	---	---	0.0-2.0	---
	9-60	---	---	7.9 - 9.0	---	---	0.0-2.0	---

Chemical Soil Properties

United States

Map symbol and soil name	Depth	Cation-exchange capacity	Effective cation-exchange capacity	Soil reaction	Calcium carbon-ate	Gypsum	Salinity	Sodium adsorption ratio
	In	*meq/100 g*	*meq/100 g*	*pH*	*Pct*	*Pct*	*mmhos/cm*	
s5401:								
Cascajo	0-10	4.6-12	---	7.4 - 8.4	---	---	---	---
	10-21	---	---	7.4 - 8.4	---	---	---	---
	21-60	---	---	7.9 - 8.4	---	---	0.0-2.0	---
Celsosprings	0-3	17-23	---	6.1 - 6.5	---	---	---	---
	3-13	---	---	6.6 - 7.3	---	---	---	---
	13-26	---	---	6.6 - 7.3	---	---	---	---
	26-33	---	---	7.4 - 8.4	---	---	0.0-2.0	---
	33-60	---	---	7.4 - 8.4	---	---	0.0-2.0	---
Majada	0-7	8.9-17	---	6.6 - 7.8	---	---	---	---
	7-19	---	---	7.4 - 7.8	---	---	---	---
	19-40	---	---	7.9 - 9.0	---	---	---	---
	40-60	---	---	7.4 - 9.0	---	---	0.0-2.0	---
Millett	0-2	---	---	7.4 - 8.4	---	---	0.0-2.0	---
	2-8	---	---	7.9 - 8.4	---	---	0.0-2.0	---
	8-18	---	---	7.9 - 8.4	---	---	0.0-2.0	---
	18-60	---	---	7.9 - 8.4	---	---	0.0-2.0	---
Sedillo	0-3	8.6-17	---	7.4 - 8.4	---	---	---	---
	3-23	---	---	7.4 - 8.4	---	---	---	---
	23-60	---	---	7.9 - 9.0	---	---	0.0-2.0	---
Alegros	0-2	16-31	---	6.6 - 7.3	---	---	---	---
	2-21	---	---	6.6 - 7.8	---	---	---	---
	21-52	---	---	7.4 - 8.4	---	---	0.0-2.0	---
	52-60	---	---	7.4 - 8.4	---	---	0.0-2.0	---
Hickman	0-3	13-23	---	7.4 - 8.4	0-2	---	---	1-5
	3-60	13-27	---	7.4 - 9.0	1-10	---	0.0-2.0	1-12
Ladron	0-2	9.2-13	---	7.4 - 7.8	---	---	---	---
	2-31	---	---	7.4 - 8.4	---	---	0.0-2.0	---
	31-47	---	---	7.9 - 8.4	---	---	0.0-2.0	---
	47-60	---	---	8.5 - 9.0	---	---	0.0-2.0	---
Goldust	0-4	---	---	6.6 - 7.3	---	---	0.0-2.0	---
	4-22	---	---	6.6 - 7.8	---	---	0.0-2.0	---
	22-35	---	---	7.4 - 8.4	---	---	0.0-2.0	---
	35-60	---	---	7.9 - 8.4	---	---	0.0-2.0	---
Loarc	0-14	8.9-13	---	6.6 - 7.3	---	---	---	---
	14-23	---	---	6.6 - 8.4	---	---	---	---
	23-36	---	---	6.1 - 9.0	---	---	0.0-2.0	---
	36-60	---	---	6.1 - 9.0	---	---	0.0-2.0	---

Chemical Soil Properties

United States

Map symbol and soil name	Depth	Cation-exchange capacity	Effective cation-exchange capacity	Soil reaction	Calcium carbon-ate	Gypsum	Salinity	Sodium adsorption ratio
	In	*meq/100 g*	*meq/100 g*	*pH*	*Pct*	*Pct*	*mmhos/cm*	
s5401:								
Magdalena	0-2	8.6-13	---	6.1 - 7.3	---	---	---	---
	2-62	---	---	6.1 - 7.8	---	---	---	---
	62-74	---	---	7.4 - 8.4	---	---	2.0-4.0	---
s5404:								
Dulce	0-13	4.6-15	---	7.4 - 8.4	---	---	---	---
	13-17	---	---	---	---	---	---	---
Rock outcrop	0-60	---	---	---	---	---	---	---
Travessilla	0-4	4.8-13	---	6.6 - 8.4	---	---	---	---
	4-8	---	---	6.6 - 8.4	---	---	0.0-2.0	---
	8-12	---	---	---	---	---	---	---
Weska	0-1	---	---	7.9 - 8.4	---	---	0.0-2.0	---
	1-7	---	---	7.9 - 8.4	---	---	0.0-2.0	---
	7-11	---	---	---	---	---	---	---
Mikim	0-9	8.9-21	---	6.6 - 8.4	---	---	---	---
	9-60	---	---	7.4 - 9.0	---	---	0.0-2.0	---
Buckle	0-5	10-20	---	7.4 - 8.4	0-5	0	0.0-2.0	0-5
	5-44	10-20	---	7.9 - 9.0	5-14	0	0.0-2.0	5-10
	44-66	10-20	---	7.9 - 9.0	0-10	0	0.0-2.0	5-10
Florita	0-4	13-17	---	7.4 - 7.8	---	---	---	---
	4-43	---	---	7.4 - 7.8	---	---	---	---
	43-60	---	---	7.4 - 7.8	---	---	---	---
Yenlo	0-3	8.9-16	---	6.6 - 7.8	---	---	---	---
	3-13	---	---	7.4 - 7.8	---	---	---	---
	13-60	---	---	7.4 - 8.4	---	---	0.0-2.0	---
s5576:								
St. Thomas	0-2	---	---	7.9 - 9.0	---	---	0.0-2.0	---
	2-12	---	---	7.9 - 9.0	---	---	0.0-2.0	---
	12-16	---	---	---	---	---	---	---
St. Thomas	0-2	---	---	7.9 - 9.0	---	---	0.0-2.0	---
	2-12	---	---	7.9 - 9.0	---	---	0.0-2.0	---
	12-16	---	---	---	---	---	---	---
Rock outcrop	0-60	---	---	---	---	---	---	---

Chemical Soil Properties

United States

Map symbol and soil name	Depth	Cation-exchange capacity	Effective cation-exchange capacity	Soil reaction	Calcium carbon-ate	Gypsum	Salinity	Sodium adsorption ratio
	In	*meq/100 g*	*meq/100 g*	*pH*	*Pct*	*Pct*	*mmhos/cm*	
s5576:								
Kyler	0-3	---	---	7.9 - 9.0	30-40	---	0.0-2.0	---
	3-7	---	---	7.9 - 9.0	30-40	---	0.0-2.0	---
	7-11	---	---	---	---	---	---	---
Pookaloo	0-4	10-20	---	7.9 - 8.4	20-30	0	0.0	---
	4-19	10-20	---	7.9 - 8.4	30-50	0	0.0	---
	19-23	---	---	---	---	---	---	---
St. Thomas	0-2	---	---	7.9 - 9.0	---	---	0.0-2.0	---
	2-12	---	---	7.9 - 9.0	---	---	0.0-2.0	---
	12-16	---	---	---	---	---	---	---
Tonopah	0-6	---	---	7.9 - 9.0	---	---	0.0-2.0	---
	6-60	---	---	8.5 - 9.0	---	---	0.0-4.0	---
Weiser	0-6	---	---	7.9 - 9.0	---	---	0.0-2.0	---
	6-60	---	---	7.9 - 9.0	---	---	0.0-2.0	---
s7769:								
Rizno	0-2	5.0-10	---	7.4 - 8.4	5-15	---	0.0-2.0	---
	2-5	5.0-10	---	7.9 - 9.0	5-15	---	0.0-2.0	---
	5-7	5.0-10	---	7.9 - 9.0	5-15	---	0.0-2.0	---
	7-14	5.0-10	---	7.9 - 9.0	5-15	---	0.0-2.0	---
	14-18	---	---	---	---	---	---	---
Witt	0-7	7.1-17	---	6.6 - 8.4	---	---	---	---
	7-48	13-27	---	6.6 - 8.4	0-10	---	---	---
	48-60	10-20	---	7.9 - 9.0	5-30	---	0.0-2.0	---
Ruinpoint	0-2	13-17	---	7.4 - 8.4	---	---	---	---
	2-13	---	---	7.4 - 8.4	---	---	---	---
	13-60	---	---	7.9 - 9.0	---	---	0.0-2.0	---
Cahona	0-11	8.6-17	---	6.6 - 8.4	0-5	---	---	---
	11-24	5.0-25	---	6.6 - 8.4	1-15	---	0.0-2.0	---
	24-60	5.0-20	---	7.9 - 9.0	1-15	---	0.0-2.0	---
Sharps	0-9	8.6-17	---	6.6 - 7.8	0-3	---	---	---
	9-19	16-28	---	6.6 - 8.4	5-10	---	---	---
	19-30	10-20	---	7.9 - 9.0	10-20	---	0.0-2.0	---
	30-34	---	---	---	---	---	---	---

Chemical Soil Properties

United States

Map symbol and soil name	Depth	Cation-exchange capacity	Effective cation-exchange capacity	Soil reaction	Calcium carbon-ate	Gypsum	Salinity	Sodium adsorption ratio
	In	*meq/100 g*	*meq/100 g*	*pH*	*Pct*	*Pct*	*mmhos/cm*	
s7770:								
Mota	0-6	---	---	8.5 - 9.0	---	---	0.0-2.0	---
	6-23	---	---	8.5 - 9.0	---	---	0.0-2.0	---
	23-60	---	---	9.0 - 9.6	---	---	0.0-2.0	---
Neskahi	0-6	---	---	8.5 - 9.0	---	---	0.0-2.0	---
	6-60	---	---	8.5 - 9.0	---	---	0.0-2.0	---
Oljeto	0-20	---	---	7.9 - 8.4	---	---	0.0-2.0	---
	20-60	---	---	7.9 - 8.4	---	---	0.0-2.0	---
Rock outcrop	0-60	---	---	---	---	---	---	---
Sheppard	0-12	1.4-4.0	---	7.4 - 8.4	0-5	---	---	---
	12-60	0.0-10	---	7.4 - 9.0	0-10	---	0.0-2.0	---
s7771:								
Moenkopie	0-2	---	---	7.9 - 8.4	---	---	0.0-4.0	---
	2-9	---	---	7.4 - 8.4	---	---	0.0-4.0	---
	9-13	---	---	---	---	---	---	---
Hoskinnini	0-1	---	---	7.9 - 8.4	---	---	0.0-2.0	---
	1-8	---	---	7.9 - 9.0	---	---	0.0-2.0	---
	8-12	---	---	7.9 - 9.0	---	---	0.0-2.0	---
	12-16	---	---	---	---	---	---	---
Rock outcrop	0-60	---	---	---	---	---	---	---
Piute	0-9	---	---	7.4 - 8.4	---	---	0.0-2.0	---
	9-13	---	---	---	---	---	---	---
Deleco	0-3	---	---	8.5 - 9.0	---	---	0.0-2.0	---
	3-7	---	---	8.5 - 9.0	---	---	0.0-2.0	---
	7-10	---	---	8.5 - 9.0	---	---	0.0-2.0	---
	10-14	---	---	---	---	---	---	---
	14-45	---	---	9.0 - 9.6	---	---	0.0-2.0	---
s7772:								
Whit	0-4	---	---	8.5 - 9.0	---	---	0.0-2.0	---
	4-30	---	---	7.9 - 9.0	---	---	0.0-2.0	---
	30-66	---	---	7.8 - 9.6	---	---	0.0-2.0	---
Sogzie	0-5	---	---	8.5 - 9.0	---	---	0.0-2.0	---
	5-21	---	---	7.9 - 9.0	---	---	0.0-2.0	---
	21-80	---	---	7.9 - 8.4	---	---	0.0-2.0	---

Chemical Soil Properties

United States

Map symbol and soil name	Depth	Cation-exchange capacity	Effective cation-exchange capacity	Soil reaction	Calcium carbon-ate	Gypsum	Salinity	Sodium adsorption ratio
	In	*meq/100 g*	*meq/100 g*	*pH*	*Pct*	*Pct*	*mmhos/cm*	
s7772:								
Sheppard	0-12	1.4-4.0	---	7.4 - 8.4	0-5	---	---	---
	12-60	0.0-10	---	7.4 - 9.0	0-10	---	0.0-2.0	---
Rock outcrop	0-60	---	---	---	---	---	---	---
s7773:								
Piute	0-9	---	---	7.4 - 8.4	---	---	0.0-2.0	---
	9-13	---	---	---	---	---	---	---
Pickrell	0-5	---	---	8.5 - 9.0	---	---	0.0-2.0	---
	5-18	---	---	8.5 - 9.0	---	---	0.0-2.0	---
	18-22	---	---	---	---	---	---	---
Rock outcrop	0-60	---	---	---	---	---	---	---
Badland	0-60	---	---	---	---	---	---	---
Sheppard	0-12	1.4-4.0	---	7.4 - 8.4	0-5	---	---	---
	12-60	0.0-10	---	7.4 - 9.0	0-10	---	0.0-2.0	---
s7774:								
Rock outcrop	0-60	---	---	---	---	---	---	---
Lithic Torriorthents	0-3	---	---	7.4 - 9.0	---	---	0.0-2.0	---
	3-8	---	---	---	---	---	---	---
	8-12	---	---	---	---	---	---	---
Badland	0-60	---	---	---	---	---	---	---
s7938:								
Ruinpoint	0-2	13-17	---	7.4 - 8.4	---	---	---	---
	2-13	---	---	7.4 - 8.4	---	---	---	---
	13-60	---	---	7.9 - 9.0	---	---	0.0-2.0	---
Rizno	0-2	5.0-10	---	7.4 - 8.4	5-15	---	0.0-2.0	---
	2-5	5.0-10	---	7.9 - 9.0	5-15	---	0.0-2.0	---
	5-7	5.0-10	---	7.9 - 9.0	5-15	---	0.0-2.0	---
	7-14	5.0-10	---	7.9 - 9.0	5-15	---	0.0-2.0	---
	14-18	---	---	---	---	---	---	---
Cahona	0-11	13-21	---	6.6 - 8.4	0-5	---	---	---
	11-24	5.0-25	---	6.6 - 8.4	1-15	---	0.0-2.0	---
	24-60	5.0-20	---	7.9 - 9.0	1-15	---	0.0-2.0	---

Chemical Soil Properties

United States

Map symbol and soil name	Depth	Cation-exchange capacity	Effective cation-exchange capacity	Soil reaction	Calcium carbon-ate	Gypsum	Salinity	Sodium adsorption ratio
	In	*meq/100 g*	*meq/100 g*	*pH*	*Pct*	*Pct*	*mmhos/cm*	
s7939:								
Rizno	0-2	5.0-10	---	7.4 - 8.4	5-15	---	0.0-2.0	---
	2-5	5.0-10	---	7.9 - 9.0	5-15	---	0.0-2.0	---
	5-7	5.0-10	---	7.9 - 9.0	5-15	---	0.0-2.0	---
	7-14	5.0-10	---	7.9 - 9.0	5-15	---	0.0-2.0	---
	14-18	---	---	---	---	---	---	---
Littlenan	0-3	---	---	7.9 - 8.4	---	---	0.0-2.0	---
	3-29	---	---	7.9 - 9.0	---	---	2.0-4.0	---
	29-33	---	---	---	---	---	---	---
Bodot	0-6	---	---	7.9 - 8.4	---	---	0.0-2.0	---
	6-15	---	---	7.9 - 8.4	---	---	0.0-2.0	---
	15-36	---	---	7.9 - 8.4	---	---	0.0-2.0	---
	36-40	---	---	---	---	---	---	---
Mellenthin	0-4	5.0-10	---	7.9 - 8.4	---	---	0.0-2.0	---
	4-15	10-20	---	7.9 - 8.4	---	---	0.0-2.0	---
	15-18	5.0-10	---	7.9 - 8.4	---	---	0.0-2.0	---
	18-22	---	---	---	---	---	---	---
Rock outcrop	0-60	---	---	---	---	---	---	---
s7944:								
Moenkopie	0-3	2.0-12	---	7.4 - 9.0	1-10	---	0.0-2.0	---
	3-8	3.0-14	---	7.4 - 9.0	1-10	0-1	0.0-2.0	0-2
	8-12	---	---	---	---	---	---	---
Rock outcrop	0-60	---	---	---	---	---	---	---
Myton family	0-6	7.4-11	---	7.9 - 8.4	5-15	---	---	---
	6-60	4.0-12	---	7.9 - 9.0	15-30	0-1	0.0-2.0	---
s7945:								
Nakai	0-2	---	---	7.9 - 8.4	---	---	0.0-2.0	---
	2-28	---	---	7.9 - 9.0	---	---	0.0-2.0	---
	28-52	---	---	7.8 - 9.6	---	---	0.0-2.0	---
	52-56	---	---	---	---	---	---	---
Limeridge	0-1	---	---	7.9 - 8.4	---	---	0.0-2.0	---
	1-8	---	---	7.9 - 9.0	---	---	0.0-2.0	---
	8-16	---	---	8.5 - 9.0	---	---	0.0-2.0	---
	16-20	---	---	---	---	---	---	---

Chemical Soil Properties

United States

Map symbol and soil name	Depth	Cation-exchange capacity	Effective cation-exchange capacity	Soil reaction	Calcium carbon-ate	Gypsum	Salinity	Sodium adsorption ratio
	In	*meq/100 g*	*meq/100 g*	*pH*	*Pct*	*Pct*	*mmhos/cm*	
s7945:								
Bluechief	0-3	---	---	7.9 - 8.4	---	---	0.0-2.0	---
	3-25	---	---	7.9 - 9.0	---	---	0.0-2.0	---
	25-38	---	---	8.5 - 9.0	---	---	0.0-2.0	---
	38-42	---	---	---	---	---	---	---
s7947:								
Rock outcrop	0-60	---	---	---	---	---	---	---
Piute	0-9	---	---	7.4 - 8.4	---	---	0.0-2.0	---
	9-13	---	---	---	---	---	---	---
Sheppard	0-12	1.4-4.0	---	7.4 - 8.4	0-5	---	---	---
	12-60	0.0-10	---	7.4 - 9.0	0-10	---	0.0-2.0	---
s8104:								
Tosser	0-4	---	---	7.4 - 8.4	3-15	---	0.0-2.0	---
	4-10	---	---	7.9 - 9.0	3-15	---	0.0-2.0	---
	10-23	---	---	8.4 - 9.6	15-35	---	0.0-4.0	5-10
	23-37	---	---	8.4 - 9.6	1-3	---	0.0-4.0	5-10
	37-60	---	---	8.4 - 9.6	3-15	---	0.0-4.0	5-10
Hiko Peak	0-4	5.0-15	---	7.9 - 9.0	15-25	---	0.0-4.0	---
	4-13	5.0-10	---	7.9 - 9.0	25-35	---	0.0-4.0	---
	13-60	5.0-10	---	7.9 - 9.0	25-35	---	0.0-4.0	---
Sitar	0-8	---	---	8.5 - 9.0	---	---	0.0-2.0	---
	8-29	---	---	8.4 - 9.6	---	---	0.0-2.0	---
	29-60	---	---	8.4 - 9.6	---	---	0.0-2.0	---
s8189:								
Badland	0-60	---	---	---	---	---	---	---
Rock outcrop	0-60	---	---	---	---	---	---	---
Clapper	0-3	---	---	7.9 - 9.0	---	---	0.0-2.0	---
	3-10	---	---	7.9 - 9.0	---	---	0.0-2.0	---
	10-60	---	---	7.9 - 9.0	---	---	0.0-2.0	---
Bluechief	0-3	---	---	7.9 - 8.4	---	---	0.0-2.0	---
	3-25	---	---	7.9 - 9.0	---	---	0.0-2.0	---
	25-38	---	---	8.5 - 9.0	---	---	0.0-2.0	---
	38-42	---	---	---	---	---	---	---

Chemical Soil Properties

United States

Map symbol and soil name	Depth	Cation-exchange capacity	Effective cation-exchange capacity	Soil reaction	Calcium carbon-ate	Gypsum	Salinity	Sodium adsorption ratio
	In	*meq/100 g*	*meq/100 g*	*pH*	*Pct*	*Pct*	*mmhos/cm*	
s8189:								
Myton family	0-3	---	---	7.4 - 7.8	---	---	0.0-2.0	---
	3-9	---	---	7.4 - 7.8	---	---	0.0-2.0	---
	9-14	---	---	7.4 - 7.8	---	---	0.0-2.0	---
	14-26	---	---	7.4 - 7.8	---	---	0.0-2.0	---
	26-60	---	---	7.4 - 7.8	---	---	0.0-2.0	---
Rairdent family	0-8	---	---	7.9 - 8.4	---	---	0.0-4.0	---
	8-30	---	---	7.9 - 8.4	---	---	0.0-4.0	---
	30-60	---	---	7.9 - 8.4	---	---	0.0-4.0	---
Rizno	0-2	5.0-10	---	7.4 - 8.4	5-15	---	0.0-2.0	---
	2-8	5.0-10	---	7.9 - 9.0	5-15	---	0.0-2.0	---
	8-10	5.0-10	---	7.4 - 9.0	5-15	---	0.0-2.0	---
	10-14	---	---	---	---	---	---	---
Wayneco	0-3	5.6-9.1	---	7.9 - 8.4	1-5	---	---	0
	3-9	4.1-8.6	---	7.9 - 8.4	1-5	---	---	0
	9-19	4.0-12	---	7.9 - 9.0	15-30	---	0.0-2.0	0
	19-23	---	---	---	---	---	---	---
s8369:								
Water	---	---	---	---	---	---	---	---
s9583:								
Badland	0-1	---	---	---	1-15	0-90	2.0-16.0	1-30
	1-60	---	---	---	1-15	0-90	2.0-16.0	1-30
Torriorthents	0-10	---	---	---	---	---	4.0-16.0	0-13
	10-60	---	---	---	---	---	---	---
Burnswick	0-3	10-20	---	7.9 - 9.0	1-5	0	0.0-4.0	6-20
	3-16	10-20	---	7.9 - 9.0	1-15	0	0.0-8.0	6-20
	16-41	10-20	---	8.5 - 9.0	1-15	0	0.0-8.0	13-30
	41-53	2.0-10	---	8.5 - 9.0	1-15	0	0.0-8.0	13-30
	53-60	10-20	---	8.5 - 9.0	1-15	0	0.0-8.0	13-30
Claysprings	0-3	20-30	---	7.4 - 9.0	1-10	0	0.0-16.0	0-13
	3-18	15-35	---	7.4 - 9.0	1-10	0	0.0-16.0	0-13
	18-28	---	---	---	---	---	---	---
Marcou	0-6	1.0-5.0	---	7.9 - 8.4	1-10	0	0.0-8.0	2-13
	6-47	5.0-10	---	8.5 - 9.0	1-10	0	2.0-8.0	13-30
	47-54	10-25	---	8.5 - 9.0	1-10	0	2.0-8.0	13-30
	54-60	1.0-5.0	---	8.5 - 9.0	5-20	0	2.0-8.0	13-30

Chemical Soil Properties

United States

Map symbol and soil name	Depth	Cation-exchange capacity	Effective cation-exchange capacity	Soil reaction	Calcium carbon-ate	Gypsum	Salinity	Sodium adsorption ratio
	In	*meq/100 g*	*meq/100 g*	*pH*	*Pct*	*Pct*	*mmhos/cm*	
s9583:								
Rock outcrop	0-60	---	---	---	---	---	---	---
s9584:								
Strych	0-2	5.0-15	---	7.4 - 8.4	1-14	0	0.0-2.0	0
	2-9	5.0-15	---	7.9 - 8.4	5-14	0	0.0-2.0	0
	9-23	5.0-10	---	7.9 - 8.4	14-30	0	0.0-2.0	0
	23-60	5.0-10	---	7.9 - 9.0	15-30	0	0.0-2.0	0
Rock outcrop	0-60	---	---	---	---	---	---	---
Monue	0-1	5.0-10	---	7.4 - 8.4	0-2	0	0.0-2.0	0
	1-46	5.0-10	---	7.4 - 8.4	1-5	0	0.0-2.0	0
	46-84	0.0-5.0	---	7.4 - 8.4	1-5	0	0.0-2.0	0-10
Begay	0-4	4.0-15	---	7.4 - 8.4	0-2	0	0.0-2.0	0
	4-57	2.0-10	---	7.4 - 8.4	0-5	0	0.0-2.0	0
	57-84	2.0-10	---	7.4 - 8.4	1-5	0	0.0-2.0	0
Kinan	0-1	2.0-5.0	---	7.4 - 8.4	5-10	0	0.0-2.0	0
	1-12	5.0-10	---	7.4 - 8.4	5-15	0	0.0-2.0	0
	12-30	5.0-10	---	7.9 - 8.4	15-35	0	0.0-2.0	0
	30-84	2.0-5.0	---	7.9 - 8.4	10-35	0	0.0-2.0	0
Penistaja	0-2	5.0-15	---	6.6 - 8.4	0	0	0.0-2.0	0
	2-18	10-25	---	6.6 - 8.4	0-5	0	0.0-2.0	0
	18-58	5.0-15	---	6.6 - 8.4	3-10	0	0.0-2.0	0
	58-84	1.0-5.0	---	6.6 - 8.4	3-10	0	0.0-2.0	0-5
Mido	0-3	1.0-5.0	---	7.4 - 9.0	0-2	0	0.0-2.0	0
	3-84	1.0-5.0	---	7.9 - 9.0	1-5	0	0.0-2.0	0

Physical Soil Properties

United States

[Entries under "Erosion Factors--T" apply to the entire profile. Entries under "Wind Erodibility Group" and "Wind Erodibility Index" apply only to the surface layer. Absence of an entry indicates that data were not estimated]

Map symbol and soil name	Depth	Sand	Silt	Clay	Moist bulk density	Saturated hydraulic conductivity	Available water capacity	Linear extensi-bility	Organic matter	Erosion factors			Wind erodi-bility group	Wind erodi-bility index
										Kw	Kf	T		
	In	*Pct*	*Pct*	*Pct*	*g/cc*	*micro m/sec*	*In/In*	*Pct*	*Pct*					
s318:														
Rock outcrop	0-60	---	---	---	---	---	---	---	---	---	---	---	8	0
Torriorthents	0-60	---	---	---	---	---	---	---	---	---	---	---	---	---
s319:														
Deama	0-4	---	---	18-25	1.30-1.40	4.23-14.11	0.12-0.14	0.0-2.9	1.0-2.0	.20	.37	1	8	0
	4-12	---	---	18-25	1.40-1.50	4.23-14.11	0.05-0.08	0.0-2.9	---	.10	.49			
	12-16	---	---	---	---	---	---	---	---	---	---			
Toqui	0-3	---	---	8-20	1.35-1.50	14.11-42.34	0.13-0.15	0.0-2.9	1.0-2.0	.24	.24	1	3	---
	3-15	---	---	35-50	1.15-1.40	0.42-1.41	0.16-0.21	6.0-8.9	0.5-1.0	.15	.17			
	15-19	---	---	25-35	1.15-1.40	4.23-14.11	0.10-0.15	3.0-5.9	0.5-1.0	.05	.10			
	19-23	---	---	---	---	---	---	---	---	---	---			
Tovar	0-3	---	---	15-25	---	4.23-14.11	0.08-0.11	0.0-2.9	0.5-1.0	.05	.20	2	8	0
	3-8	---	---	28-40	---	1.41-4.23	0.11-0.15	3.0-5.9	---	.15	.28			
	8-35	---	---	35-55	---	0.42-1.41	0.11-0.15	6.0-8.9	---	.10	.20			
	35-39	---	---	---	---	---	---	---	---	---	---			
s337:														
Tours	0-6	---	---	30-40	1.20-1.30	1.40-4.00	0.05-0.07	3.0-5.9	0.2-0.5	.43	.43	5	4L	86
	6-47	---	---	25-40	1.20-1.30	1.40-4.00	0.05-0.07	3.0-5.9	0.0-0.5	.37	.37			
	47-60	---	---	5-20	1.20-1.55	4.00-14.00	0.03-0.04	0.0-2.9	0.0-0.5	.32	.32			
Burnswick	0-3	---	---	20-35	1.25-1.35	1.40-4.00	0.03-0.08	3.0-5.9	0.5-1.0	.24	.28	5	4L	86
	3-16	---	---	20-35	1.35-1.50	1.40-4.00	0.03-0.08	3.0-5.9	0.0-0.5	.28	.28			
	16-41	---	---	20-35	1.35-1.50	1.40-4.00	0.03-0.08	3.0-5.9	0.0-0.5	.28	.28			
	41-53	---	---	5-20	1.10-1.30	14.00-42.00	0.02-0.07	0.0-2.9	0.0-0.5	.20	.20			
	53-60	---	---	20-35	1.25-1.35	1.40-4.00	0.03-0.08	3.0-5.9	0.0-0.5	.28	.28			

Physical Soil Properties

United States

Map symbol and soil name	Depth	Sand	Silt	Clay	Moist bulk density	Saturated hydraulic conductivity	Available water capacity	Linear extensi-bility	Organic matter	Erosion factors			Wind erodi-bility group	Wind erodi-bility index
										Kw	Kf	T		
	In	Pct	Pct	Pct	g/cc	micro m/sec	In/In	Pct	Pct					
s337:														
Jocity	0-9	---	---	20-35	1.20-1.30	1.40-4.00	0.01-0.12	3.0-5.9	0.0-0.5	.28	.28	5	5	56
	9-41	---	---	20-35	1.20-1.30	1.40-4.00	0.01-0.12	3.0-5.9	0.0-0.5	.28	.28			
	41-60	---	---	5-20	1.40-1.55	14.00-42.00	0.01-0.11	0.0-2.9	0.0-0.5	.24	.24			
Ives	0-13	---	---	10-18	1.45-1.60	4.00-14.00	0.03-0.05	0.0-2.9	0.5-1.0	.55	.55	5	3	86
	13-55	---	---	5-18	1.40-1.55	4.00-14.00	0.01-0.03	0.0-2.9	0.0-0.5	.24	.24			
	55-62	---	---	2-10	1.50-1.60	14.00-42.00	0.01-0.02	0.0-2.9	0.0-0.5	.17	.17			
Riverwash	0-59	---	---	---	---	---	---	---	---	---	---	---	---	---
Trail	0-3	---	---	4-8	1.50-1.60	42.00-141.00	0.06-0.08	0.0-2.9	0.2-0.6	.15	.15	5	2	134
	3-60	---	---	4-8	1.40-1.50	14.00-42.00	0.06-0.09	0.0-2.9	0.2-0.6	.20	.20			
Typic Torrifluvents	0-60	---	---	---	---	---	---	---	---	---	---	3	---	---
Navajo	0-5	---	---	45-50	1.15-1.30	0.00-0.42	0.03-0.05	6.0-8.9	0.0-0.5	.28	.28	5	4	86
	5-60	---	---	40-60	1.15-1.30	0.00-0.42	0.03-0.05	6.0-8.9	0.0-0.5	.28	.28			
Rock outcrop	---	---	---	---	---	---	---	---	---	---	---	---	8	0
s338:														
Burnswick	0-3	---	---	20-35	1.25-1.35	1.40-4.00	0.03-0.08	3.0-5.9	0.5-1.0	.24	.28	5	4L	86
	3-16	---	---	20-35	1.35-1.50	1.40-4.00	0.03-0.08	3.0-5.9	0.0-0.5	.28	.28			
	16-41	---	---	20-35	1.35-1.50	1.40-4.00	0.03-0.08	3.0-5.9	0.0-0.5	.28	.28			
	41-53	---	---	5-20	1.10-1.30	14.00-42.00	0.02-0.07	0.0-2.9	0.0-0.5	.20	.20			
	53-60	---	---	20-35	1.25-1.35	1.40-4.00	0.03-0.08	3.0-5.9	0.0-0.5	.28	.28			
Marcou	0-6	---	---	3-5	1.45-1.60	14.00-42.00	0.05-0.08	0.0-2.9	0.5-1.0	.15	.15	5	2	134
	6-47	---	---	10-15	1.35-1.50	4.00-14.00	0.09-0.11	0.0-2.9	0.0-0.5	.20	.20			
	47-54	---	---	20-35	1.20-1.30	4.00-14.00	0.09-0.14	0.0-2.9	0.0-0.5	.28	.28			
	54-60	---	---	1-10	1.50-1.60	42.00-141.00	0.02-0.04	0.0-2.9	0.0-0.5	.15	.15			

Physical Soil Properties

United States

Map symbol and soil name	Depth	Sand	Silt	Clay	Moist bulk density	Saturated hydraulic conductivity	Available water capacity	Linear extensi-bility	Organic matter	Erosion factors			Wind erodi-bility group	Wind erodi-bility index
										Kw	Kf	T		
	In	*Pct*	*Pct*	*Pct*	*g/cc*	*micro m/sec*	*In/In*	*Pct*	*Pct*					
s338:														
Jocity	0-9	---	---	20-35	1.20-1.30	1.40-4.00	0.01-0.12	3.0-5.9	0.0-0.5	.28	.28	5	5	56
	9-41	---	---	20-35	1.20-1.30	1.40-4.00	0.01-0.12	3.0-5.9	0.0-0.5	.28	.28			
	41-60	---	---	5-20	1.40-1.55	14.00-42.00	0.01-0.11	0.0-2.9	0.0-0.5	.24	.24			
Clayspings	0-3	---	---	40-50	1.15-1.30	0.00-0.42	0.14-0.16	6.0-8.9	0.5-1.0	.28	.28	2	4	86
	3-18	---	---	40-55	1.15-1.30	0.00-0.42	0.14-0.16	6.0-8.9	0.0-0.5	.28	.28			
	18-28	---	---	---	---	---	---	---	---	---	---			
Rock outcrop	---	---	---	---	---	---	---	---	---	---	---	---	8	0
s339:														
Jocity	0-3	---	---	7-18	1.25-1.55	4.00-14.00	0.14-0.16	0.0-2.9	0.0-0.5	.28	.28	5	3	86
	3-84	---	---	20-35	1.55-1.75	0.42-1.40	0.14-0.18	3.0-5.9	0.0-0.5	.32	.32			
Polacca	0-3	---	---	28-35	1.25-1.55	1.40-4.00	0.16-0.19	3.0-5.9	1.0-2.0	.28	.32	5	4L	86
	3-33	---	---	22-30	1.35-1.55	0.42-1.40	0.15-0.18	3.0-5.9	0.5-1.0	.24	.24			
	33-84	---	---	3-8	1.45-1.65	42.00-141.00	0.05-0.08	0.0-2.9	0.0-0.5	.10	.15			
Wepo	0-3	---	---	35-40	1.20-1.30	0.42-1.40	0.18-0.20	6.0-8.9	0.5-1.0	.32	.32	5	4	86
	3-32	---	---	35-45	1.45-1.55	0.42-1.40	0.14-0.17	6.0-8.9	0.0-0.5	.32	.32			
	32-84	---	---	35-45	1.25-1.35	0.42-1.40	0.14-0.17	6.0-8.9	0.0-0.5	.28	.28			
Jeddito	0-2	---	---	5-10	1.45-1.65	42.00-141.00	0.08-0.11	0.0-2.9	0.0-0.5	.15	.15	5	2	134
	2-9	---	---	10-15	1.10-1.20	14.00-42.00	0.11-0.13	0.0-2.9	0.0-0.5	.24	.24			
	9-27	---	---	10-15	1.35-1.45	14.00-42.00	0.12-0.14	0.0-2.9	0.0-0.5	.20	.20			
	27-84	---	---	10-15	1.10-1.20	14.00-42.00	0.11-0.13	0.0-2.9	0.0-0.5	.24	.24			
Tewa	0-1	---	---	15-20	1.15-1.25	4.00-14.00	0.14-0.16	0.0-2.9	0.0-1.0	.37	.37	5	3	86
	1-25	---	---	25-35	1.35-1.45	1.40-4.00	0.15-0.19	0.0-2.9	0.0-0.5	.32	.32			
	25-31	---	---	10-20	1.25-1.35	4.00-14.00	0.13-0.15	0.0-2.9	0.0-0.5	.32	.32			
	31-84	---	---	25-35	1.20-1.30	1.40-4.00	0.15-0.19	0.0-2.9	0.0-0.5	.32	.32			

Physical Soil Properties

United States

Map symbol and soil name	Depth	Sand	Silt	Clay	Moist bulk density	Saturated hydraulic conductivity	Available water capacity	Linear extensi-bility	Organic matter	Erosion factors			Wind erodi-bility group	Wind erodi-bility index
										Kw	Kf	T		
	In	Pct	Pct	Pct	g/cc	micro m/sec	In/In	Pct	Pct					
s339:														
Sheppard	0-2	---	---	5-8	1.20-1.30	42.00-141.00	0.06-0.08	0.0-2.9	0.5-1.0	.15	.15	5	2	134
	2-84	---	---	1-10	1.20-1.40	42.00-141.00	0.05-0.08	0.0-2.9	0.0-0.5	.15	.15			
Monue	0-5	---	---	10-15	1.25-1.55	14.00-42.00	0.14-0.16	0.0-2.9	0.0-0.5	.28	.28	5	3	86
	5-84	---	---	10-20	1.25-1.35	14.00-42.00	0.12-0.16	0.0-2.9	0.0-0.5	.28	.32			
Rock outcrop	0-60	---	---	---	1.50-1.80	0.00-1.40	---	---	0.0	---	---	---	8	0
s340:														
Sheppard	0-2	---	---	5-8	1.20-1.30	42.00-141.00	0.06-0.08	0.0-2.9	0.5-1.0	.15	.15	5	2	134
	2-84	---	---	1-10	1.20-1.40	42.00-141.00	0.05-0.08	0.0-2.9	0.0-0.5	.15	.15			
Sheppard	0-1	---	---	3-5	1.20-1.35	42.00-141.00	0.05-0.07	0.0-2.9	0.0-0.5	.10	.10	5	2	134
	1-84	---	---	3-8	1.20-1.35	42.00-141.00	0.05-0.08	0.0-2.9	0.0-0.5	.15	.15			
Jocity	0-3	---	---	7-18	1.25-1.55	4.00-14.00	0.14-0.16	0.0-2.9	0.0-0.5	.28	.28	5	3	86
	3-84	---	---	20-35	1.55-1.75	0.42-1.40	0.14-0.18	3.0-5.9	0.0-0.5	.32	.32			
Joraibi	0-2	---	---	30-40	1.25-1.55	0.42-1.40	0.12-0.16	3.0-5.9	0.0-0.5	.28	.28	5	4L	86
	2-23	---	---	27-40	1.25-1.35	1.40-4.00	0.10-0.14	0.0-2.9	0.0-0.5	.37	.37			
	23-54	---	---	5-8	1.55-1.65	42.00-141.00	0.04-0.07	0.0-2.9	0.0-0.5	.15	.20			
	54-84	---	---	20-35	1.25-1.55	0.42-1.40	0.08-0.12	0.0-2.9	0.0-0.5	.37	.37			
Jocity	0-1	---	---	27-35	1.25-1.55	0.42-1.40	0.03-0.10	3.0-5.9	0.0-0.5	.24	.32	5	4L	86
	1-24	---	---	20-35	1.55-1.75	1.40-4.00	0.04-0.12	3.0-5.9	0.0-0.5	.24	.24			
	24-84	---	---	20-35	1.25-1.55	0.42-1.40	0.04-0.10	3.0-5.9	0.0-0.5	.37	.37			
Torriorthents	0-20	---	---	---	---	0.42-141.00	---	---	0.0-0.5	---	---	3	---	---
	20-60	---	---	---	---	0.00-1.40	---	---	0.0	---	---			

Physical Soil Properties

United States

Map symbol and soil name	Depth	Sand	Silt	Clay	Moist bulk density	Saturated hydraulic conductivity	Available water capacity	Linear extensi-bility	Organic matter	Erosion factors Kw	Kf	T	Wind erodi-bility group	Wind erodi-bility index
	In	Pct	Pct	Pct	g/cc	micro m/sec	In/In	Pct	Pct					
s341:														
Jeddito	0-2	---	---	5-10	1.45-1.65	42.00-141.00	0.08-0.11	0.0-2.9	0.0-0.5	.15	.15	5	2	134
	2-9	---	---	10-15	1.10-1.20	14.00-42.00	0.11-0.13	0.0-2.9	0.0-0.5	.24	.24			
	9-27	---	---	10-15	1.35-1.45	14.00-42.00	0.12-0.14	0.0-2.9	0.0-0.5	.20	.20			
	27-84	---	---	10-15	1.10-1.20	14.00-42.00	0.11-0.13	0.0-2.9	0.0-0.5	.24	.24			
Tewa	0-1	---	---	15-20	1.15-1.25	4.00-14.00	0.14-0.16	0.0-2.9	0.0-1.0	.37	.37	5	3	86
	1-25	---	---	25-35	1.35-1.45	1.40-4.00	0.15-0.19	0.0-2.9	0.0-0.5	.32	.32			
	25-31	---	---	10-20	1.25-1.35	4.00-14.00	0.13-0.15	0.0-2.9	0.0-0.5	.32	.32			
	31-84	---	---	25-35	1.20-1.30	1.40-4.00	0.15-0.19	0.0-2.9	0.0-0.5	.32	.32			
Sheppard	0-2	---	---	5-8	1.20-1.30	42.00-141.00	0.06-0.08	0.0-2.9	0.5-1.0	.15	.15	5	2	134
	2-84	---	---	1-10	1.20-1.40	42.00-141.00	0.05-0.08	0.0-2.9	0.0-0.5	.15	.15			
Torriorthents	0-20	---	---	---	---	0.42-141.00	---	---	0.0-0.5	---	---	3	---	---
	20-60	---	---	---	---	0.00-1.40	---	---	0.0	---	---			
Mido	0-3	---	---	1-5	1.55-1.65	42.00-141.00	0.05-0.07	0.0-2.9	0.5-1.0	.17	.17	5	1	220
	3-84	---	---	3-8	1.55-1.65	42.00-141.00	0.05-0.09	0.0-2.9	0.0-0.5	.32	.32			
Monue	0-5	---	---	10-15	1.25-1.55	14.00-42.00	0.14-0.16	0.0-2.9	0.0-0.5	.28	.28	5	3	86
	5-84	---	---	10-20	1.25-1.35	14.00-42.00	0.12-0.16	0.0-2.9	0.0-0.5	.28	.32			
Rock outcrop	0-60	---	---	---	1.50-1.80	0.00-1.40	---	---	0.0	---	---	---	8	0
s342:														
Rock outcrop	0-60	---	---	---	---	---	---	---	---	---	---	---	8	0
Moenkopie	0-3	---	---	12-18	1.35-1.45	4.23-14.11	0.10-0.14	0.0-2.9	0.5-1.0	.20	.20	1	3	---
	3-8	---	---	7-20	1.35-1.45	14.11-42.34	0.10-0.13	0.0-2.9	0.5-1.0	.28	.32			
	8-12	---	---	---	---	0.00-1.41	---	---	---	---	---			

Physical Soil Properties

United States

Map symbol and soil name	Depth	Sand	Silt	Clay	Moist bulk density	Saturated hydraulic conductivity	Available water capacity	Linear extensi-bility	Organic matter	Erosion factors			Wind erodi-bility group	Wind erodi-bility index
										Kw	Kf	T		
	In	*Pct*	*Pct*	*Pct*	*g/cc*	*micro m/sec*	*In/In*	*Pct*	*Pct*					
s342:														
Bluechief	0-3	---	---	5-10	1.40-1.50	14.11-42.34	0.11-0.13	0.0-2.9	0.5-1.0	.37	.37	2	3	---
	3-25	---	---	10-15	1.40-1.50	14.11-42.34	0.11-0.13	0.0-2.9	---	.43	.43			
	25-38	---	---	12-18	1.40-1.50	14.11-42.34	0.11-0.14	0.0-2.9	---	.43	.17			
	38-42	---	---	---	---	---	---	---	---	---	---			
Casmos family	0-2	---	---	15-20	1.25-1.40	14.11-42.34	0.09-0.11	0.0-2.9	0.5-1.0	.24	.24	1	3	---
	2-8	---	---	18-27	1.20-1.35	4.23-14.11	0.14-0.16	0.0-2.9	0.0-0.5	.32	.32			
	8-11	---	---	18-27	1.25-1.40	4.23-14.11	0.11-0.14	0.0-2.9	0.0-0.5	.24	.32			
	11-15	---	---	---	---	---	---	---	---	---	---			
Monue family	0-3	---	---	2-5	1.40-1.50	14.11-42.34	0.07-0.08	0.0-2.9	0.5-1.0	.24	.24	2	2	---
	3-31	---	---	10-17	1.40-1.50	14.11-42.34	0.10-0.12	0.0-2.9	0.5-1.0	.37	.37			
	31-35	---	---	---	---	---	---	---	---	---	---			
Nakai	0-3	---	---	5-10	1.30-1.45	14.11-42.34	0.08-0.11	0.0-2.9	0.5-1.0	.28	.28	3	2	---
	3-51	---	---	10-18	1.30-1.50	14.11-42.34	0.10-0.16	0.0-2.9	---	.28	.28			
	51-55	---	---	---	---	---	---	---	---	---	---			
Sheppard	0-12	---	---	2-5	1.50-1.60	42.34-141.14	0.06-0.08	0.0-2.9	0.0-0.5	.24	.24	5	2	---
	12-60	---	---	3-8	1.50-1.60	42.34-141.14	0.06-0.08	0.0-2.9	0.0-0.5	.20	.20			
s343:														
Monue	0-3	---	---	3-5	1.45-1.55	14.11-42.34	0.07-0.10	0.0-2.9	0.5-1.0	.20	.20	5	2	---
	3-60	---	---	8-17	1.35-1.45	14.11-42.34	0.10-0.15	0.0-2.9	0.0-0.5	.28	.28			
Nakai	0-18	---	---	3-10	1.45-1.55	42.34-141.14	0.07-0.09	0.0-2.9	0.5-1.0	.28	.28	5	2	---
	18-34	---	---	8-18	1.50-1.60	14.11-42.34	0.10-0.18	0.0-2.9	0.5-1.0	.43	.43			
	34-60	---	---	5-10	1.55-1.65	42.34-141.14	0.08-0.11	0.0-2.9	0.5-1.0	.28	.28			

Physical Soil Properties

United States

Map symbol and soil name	Depth	Sand	Silt	Clay	Moist bulk density	Saturated hydraulic conductivity	Available water capacity	Linear extensi-bility	Organic matter	Erosion factors			Wind erodi-bility group	Wind erodi-bility index
										Kw	Kf	T		
	In	Pct	Pct	Pct	g/cc	micro m/sec	In/In	Pct	Pct					
s343:														
Blackston	0-3	---	---	10-18	1.50-1.60	14.11-42.34	0.07-0.09	0.0-2.9	0.4-0.6	.15	.24	5	5	---
	3-9	---	---	10-18	1.50-1.60	14.11-42.34	0.11-0.13	0.0-2.9	0.3-0.5	.24	.24			
	9-15	---	---	20-35	1.50-1.60	4.23-14.11	0.10-0.12	3.0-5.9	0.3-0.5	.15	.32			
	15-35	---	---	10-18	1.45-1.55	42.34-141.14	0.03-0.06	0.0-2.9	0.2-0.4	.05	.20			
	35-70	---	---	0-8	1.45-1.55	141.14	0.01-0.03	0.0-2.9	0.2-0.4	.02	.15			
s344:														
Purgatory	0-1	---	---	10-15	1.40-1.55	4.00-14.00	0.10-0.15	0.0-2.9	0.5-1.0	.49	.49	3	3	86
	1-20	---	---	10-25	1.35-1.45	4.00-14.00	0.12-0.16	0.0-2.9	0.0-0.5	.37	.43			
	20-27	---	---	30-35	1.20-1.30	4.00-14.00	0.19-0.21	3.0-5.9	0.0-0.5	.37	.37			
	27-60	---	---	---	---	---	---	---	---	---	---			
Clayspring s	0-3	---	---	40-50	1.15-1.30	0.00-0.42	0.14-0.16	6.0-8.9	0.5-1.0	.28	.28	2	4	86
	3-18	---	---	40-55	1.15-1.30	0.00-0.42	0.14-0.16	6.0-8.9	0.0-0.5	.28	.28			
	18-28	---	---	---	---	---	---	---	---	---	---			
Badland	0-1	---	---	---	---	---	---	---	---	---	---	---	---	---
	1-60	---	---	---	---	---	---	6.0-8.9	---	---	---			
Epikom	0-1	---	---	5-18	1.45-1.65	14.00-42.00	0.07-0.11	0.0-2.9	0.0-0.5	.17	.20	1	3	86
	1-10	---	---	15-18	1.40-1.50	4.00-14.00	0.14-0.18	0.0-2.9	0.0-0.5	.32	.32			
	10-14	---	---	12-18	1.35-1.45	4.00-14.00	0.07-0.12	0.0-2.9	0.0-0.5	.10	.32			
	14-24	---	---	---	---	---	---	---	---	---	---			
Rock outcrop	---	---	---	---	---	---	---	---	---	---	---	---	8	0
s345:														
Sheppard	0-2	---	---	5-8	1.20-1.30	42.00-141.00	0.06-0.08	0.0-2.9	0.5-1.0	.15	.15	5	2	134
	2-84	---	---	1-10	1.20-1.40	42.00-141.00	0.05-0.08	0.0-2.9	0.0-0.5	.15	.15			

Physical Soil Properties

United States

Map symbol and soil name	Depth	Sand	Silt	Clay	Moist bulk density	Saturated hydraulic conductivity	Available water capacity	Linear extensi-bility	Organic matter	Erosion factors			Wind erodi-bility group	Wind erodi-bility index
										Kw	Kf	T		
	In	*Pct*	*Pct*	*Pct*	*g/cc*	*micro m/sec*	*In/In*	*Pct*	*Pct*					
s345:														
Monue	0-5	---	---	10-15	1.25-1.55	14.00-42.00	0.14-0.16	0.0-2.9	0.0-0.5	.28	.28	5	3	86
	5-84	---	---	10-20	1.25-1.35	14.00-42.00	0.12-0.16	0.0-2.9	0.0-0.5	.28	.32			
Nakai	0-3	---	---	8-18	1.25-1.35	14.00-42.00	0.15-0.17	0.0-2.9	0.5-1.0	.49	.49	5	3	86
	3-30	---	---	8-18	1.25-1.55	14.00-42.00	0.10-0.18	0.0-2.9	0.0-0.5	.43	.43			
	30-84	---	---	20-30	1.55-1.75	1.40-4.00	0.14-0.16	3.0-5.9	0.0-0.5	.28	.28			
Typic Torriorthents	0-20	---	---	---	---	0.42-141.00	---	---	0.0-0.5	---	---	3	---	---
	20-60	---	---	---	---	0.00-1.40	---	---	0.0	---	---			
Tewa	0-1	---	---	15-20	1.15-1.25	4.00-14.00	0.14-0.16	0.0-2.9	0.0-1.0	.37	.37	5	3	86
	1-25	---	---	25-35	1.35-1.45	1.40-4.00	0.15-0.19	0.0-2.9	0.0-0.5	.32	.32			
	25-31	---	---	10-20	1.25-1.35	4.00-14.00	0.13-0.15	0.0-2.9	0.0-0.5	.32	.32			
	31-84	---	---	25-35	1.20-1.30	1.40-4.00	0.15-0.19	0.0-2.9	0.0-0.5	.32	.32			
Rock outcrop	0-60	---	---	---	1.50-1.80	0.00-1.40	---	---	0.0	---	---	---	8	0
s348:														
Kinan	0-1	---	---	10-20	1.25-1.35	14.11-42.34	0.08-0.10	0.0-2.9	0.5-1.0	.17	.32	5	3	---
	1-13	---	---	5-20	1.25-1.35	14.11-42.34	0.11-0.14	0.0-2.9	0.5-1.0	.24	.24			
	13-27	---	---	5-20	1.35-1.50	14.11-42.34	0.05-0.08	0.0-2.9	0.0-0.5	.05	.17			
	27-60	---	---	5-20	1.25-1.35	14.11-42.34	0.11-0.14	0.0-2.9	0.0-0.5	.24	.24			
Pennell	0-4	---	---	10-20	1.30-1.35	4.23-14.11	0.12-0.15	0.0-2.9	0.0-0.5	.32	.37	1	5	---
	4-7	---	---	10-15	1.35-1.40	14.11-42.34	0.10-0.13	0.0-2.9	0.0-0.5	.20	.17			
	7-14	---	---	10-15	1.35-1.40	14.11-42.34	0.05-0.08	0.0-2.9	0.0-0.5	.15	.17			
	14-19	---	---	10-15	1.35-1.40	14.11-42.34	0.10-0.13	0.0-2.9	0.0-0.5	.20	.17			
	19-23	---	---	---	---	---	---	---	---	---	---			

Physical Soil Properties

United States

Map symbol and soil name	Depth	Sand	Silt	Clay	Moist bulk density	Saturated hydraulic conductivity	Available water capacity	Linear extensi-bility	Organic matter	Erosion factors			Wind erodi-bility group	Wind erodi-bility index
										Kw	Kf	T		
	In	*Pct*	*Pct*	*Pct*	*g/cc*	*micro m/sec*	*In/In*	*Pct*	*Pct*					
s348:														
Pagina	0-2	---	---	0-15	1.45-1.55	42.34-141.14	0.08-0.11	0.0-2.9	0.5-1.0	.15	.17	2	2	---
	2-22	---	---	0-15	1.45-1.55	42.34-141.14	0.08-0.11	0.0-2.9	0.0-0.5	.15	.17			
	22-39	---	---	5-20	1.35-1.50	14.11-42.34	0.09-0.13	0.0-2.9	0.0-0.5	.20	.24			
	39-43	---	---	---	---	---	---	---	---	---	---			
s351:														
Palma	0-4	---	---	8-12	1.20-1.45	14.11-42.34	0.12-0.14	0.0-2.9	0.5-1.0	.28	.28	5	3	---
	4-60	---	---	12-18	1.20-1.45	14.11-42.34	0.12-0.14	0.0-2.9	0.5-1.0	.28	.28			
Mespun	0-18	---	---	3-8	1.40-1.50	141.14	0.05-0.08	0.0-2.9	0.5-1.0	.24	.24	5	1	---
	18-60	---	---	3-8	1.40-1.50	42.34-141.14	0.05-0.09	0.0-2.9	0.0-0.5	.24	.24			
Sazi	0-4	---	---	8-14	1.35-1.50	14.11-42.34	0.12-0.16	0.0-2.9	1.0-3.0	.37	.37	2	3	---
	4-17	---	---	10-18	1.35-1.50	14.11-42.34	0.10-0.16	0.0-2.9	---	.43	.43			
	17-32	---	---	8-16	1.35-1.50	14.11-42.34	0.11-0.16	0.0-2.9	---	.37	.37			
	32-36	---	---	---	---	---	---	---	---	---	---			
Rizno	0-2	---	---	3-18	1.30-1.55	14.11-42.34	0.08-0.12	0.0-2.9	0.5-1.0	.32	.24	1	3	---
	2-8	---	---	5-18	1.30-1.55	14.11-42.34	0.08-0.12	0.0-2.9	0.5-1.0	.20	.32			
	8-10	---	---	5-18	1.30-1.55	14.11-42.34	0.08-0.12	0.0-2.9	0.5-1.0	.32	.17			
	10-14	---	---	---	---	0.00-1.41	---	---	---	---	---			
Rock outcrop	0-60	---	---	---	---	---	---	---	---	---	---	---	8	0
Wayneco	0-3	---	---	6-10	1.40-1.50	14.11-42.34	0.06-0.10	0.0-2.9	1.0-2.0	.17	.24	1	3	---
	3-9	---	---	5-10	1.45-1.50	14.11-42.34	0.04-0.08	0.0-2.9	0.0-0.5	.17	.15			
	9-19	---	---	10-18	1.35-1.40	4.23-14.11	0.08-0.13	0.0-2.9	0.0-0.5	.28	.32			
	19-23	---	---	---	---	0.00-1.41	---	---	---	---	---			

Physical Soil Properties

United States

Map symbol and soil name	Depth	Sand	Silt	Clay	Moist bulk density	Saturated hydraulic conductivity	Available water capacity	Linear extensi-bility	Organic matter	Erosion factors			Wind erodi-bility group	Wind erodi-bility index
										Kw	Kf	T		
	In	*Pct*	*Pct*	*Pct*	*g/cc*	*micro m/sec*	*In/In*	*Pct*	*Pct*					
s351:														
Mellenthin	0-4	---	---	10-15	1.25-1.35	4.23-14.11	0.07-0.09	0.0-2.9	0.8-2.0	.02	.24	1	5	---
	4-15	---	---	15-25	1.25-1.35	4.23-14.11	0.09-0.11	0.0-2.9	0.5-1.0	.05	.32			
	15-18	---	---	10-15	1.25-1.35	4.23-14.11	0.06-0.08	0.0-2.9	0.5-1.0	.02	.17			
	18-22	---	---	---	---	0.00-1.41	---	---	---	---	---			
s355:														
Winona	0-2	---	---	15-25	---	4.23-14.11	0.08-0.15	0.0-2.9	0.5-1.0	.15	.24	1	8	0
	2-15	---	---	15-25	---	4.23-14.11	0.05-0.10	0.0-2.9	---	.10	.64			
	15-19	---	---	---	---	---	---	---	---	---	---			
Tusayan	0-10	---	---	15-20	---	4.23-14.11	0.11-0.13	0.0-2.9	0.5-1.0	.20	.32	2	8	0
	10-29	---	---	10-28	---	4.23-14.11	0.05-0.07	0.0-2.9	---	.10	.37			
	29-33	---	---	---	---	---	---	---	---	---	---			
Boysag	0-3	---	---	10-20	---	4.23-14.11	0.11-0.13	0.0-2.9	1.0-2.0	.15	.24	1	8	0
	3-13	---	---	35-50	---	0.42-1.41	0.14-0.19	6.0-8.9	---	.17	.24			
	13-16	---	---	8-20	---	1.41-4.23	0.05-0.08	0.0-2.9	---	.05	.10			
	16-20	---	---	---	---	---	---	---	---	---	---			
s356:														
Epikom	0-1	---	---	5-18	1.45-1.65	14.00-42.00	0.07-0.11	0.0-2.9	0.0-0.5	.17	.20	1	3	86
	1-10	---	---	15-18	1.40-1.50	4.00-14.00	0.14-0.18	0.0-2.9	0.0-0.5	.32	.32			
	10-14	---	---	12-18	1.35-1.45	4.00-14.00	0.07-0.12	0.0-2.9	0.0-0.5	.10	.32			
	14-24	---	---	---	---	---	---	---	---	---	---			
Rock outcrop	0-60	---	---	---	1.50-1.80	---	---	---	---	---	---	---	8	0
Needle	0-7	---	---	0-10	1.35-1.45	141.00-705.00	0.05-0.07	0.0-2.9	0.5-1.0	.10	.10	1	1	310
	7-9	---	---	0-15	1.45-1.55	42.00-141.00	0.05-0.08	0.0-2.9	0.5-1.0	.10	.10			
	9-19	---	---	---	---	---	---	---	---	---	---			

Physical Soil Properties

United States

Map symbol and soil name	Depth	Sand	Silt	Clay	Moist bulk density	Saturated hydraulic conductivity	Available water capacity	Linear extensi-bility	Organic matter	Erosion factors Kw	Kf	T	Wind erodi-bility group	Wind erodi-bility index
	In	*Pct*	*Pct*	*Pct*	*g/cc*	*micro m/sec*	*In/In*	*Pct*	*Pct*					
s357:														
Clovis	0-5	---	---	10-17	1.45-1.55	4.23-14.11	0.13-0.15	0.0-2.9	0.7-0.9	.28	.28	5	3	---
	5-25	---	---	20-35	1.40-1.50	4.23-14.11	0.14-0.18	3.0-5.9	0.5-0.7	.32	.32			
	25-60	---	---	9-17	1.45-1.55	14.11-42.34	0.09-0.12	0.0-2.9	0.0-0.5	.43	.43			
Palma	0-7	---	---	10-20	1.70-1.75	14.11-42.34	0.13-0.15	0.0-2.9	1.0-2.0	.24	.24	5	3	---
	7-60	---	---	10-20	1.65-1.70	14.11-42.34	0.13-0.17	0.0-2.9	---	.28	.28			
Sheppard	0-2	---	---	5-8	1.20-1.30	42.34-141.14	0.06-0.08	0.0-2.9	0.5-1.0	.15	.15	5	2	---
	2-60	---	---	3-8	1.15-1.30	42.34-141.14	0.04-0.07	0.0-2.9	---	.15	.15			
	60-70	---	---	1-10	1.20-1.40	42.34-141.14	0.05-0.08	0.0-2.9	---	.15	.15			
Hubert	0-10	---	---	20-27	---	4.23-14.11	0.13-0.15	0.0-2.9	---	.17	.28	5	4L	---
	10-15	---	---	25-35	---	4.23-14.11	0.12-0.15	3.0-5.9	---	.15	.24			
	15-48	---	---	20-27	---	4.23-14.11	0.08-0.11	0.0-2.9	---	.10	.28			
	48-60	---	---	25-35	---	1.41-4.23	0.09-0.12	3.0-5.9	---	.10	.28			
s360:														
Tuweep	0-3	---	---	18-25	---	4.23-14.11	0.05-0.08	0.0-2.9	0.5-1.0	.10	.37	5	8	0
	3-34	---	---	28-34	---	1.41-4.23	0.17-0.19	3.0-5.9	---	.32	.43			
	34-60	---	---	15-20	---	4.23-14.11	0.04-0.06	0.0-2.9	---	.10	.64			
Wukoki	0-10	---	---	18-25	1.00-1.05	4.23-14.11	0.05-0.08	0.0-2.9	1.0-2.0	.10	.37	2	8	0
	10-18	---	---	18-25	1.05-1.10	4.23-14.11	0.05-0.08	0.0-2.9	0.5-1.0	.10	.37			
	18-65	---	---	0-1	---	141.14	0.03-0.05	0.0-2.9	0.0-0.5	.02	.02			
Wupatki	0-6	---	---	18-25	---	4.23-14.11	0.07-0.09	0.0-2.9	1.0-2.0	.10	.37	1	8	0
	6-16	---	---	18-25	---	4.23-14.11	0.07-0.09	0.0-2.9	---	.10	.37			
	16-20	---	---	---	---	---	---	---	---	---	---			
	20-60	---	---	0-1	---	141.14	0.03-0.05	0.0-2.9	---	.02	---			

Physical Soil Properties

United States

Map symbol and soil name	Depth	Sand	Silt	Clay	Moist bulk density	Saturated hydraulic conductivity	Available water capacity	Linear extensi-bility	Organic matter	Erosion factors			Wind erodi-bility group	Wind erodi-bility index
										Kw	Kf	T		
	In	*Pct*	*Pct*	*Pct*	*g/cc*	*micro m/sec*	*In/In*	*Pct*	*Pct*					
s362:														
Rock outcrop	0-60	---	---	---	---	---	---	---	---	---	---	---	8	0
Arches	0-4	---	---	3-8	1.40-1.50	42.34-141.14	0.08-0.10	0.0-2.9	0.5-1.0	.28	.28	1	2	---
	4-13	---	---	2-6	1.30-1.50	42.34-141.14	0.06-0.08	0.0-2.9	0.5-1.0	.28	.28			
	13-15	---	---	3-8	1.40-1.50	42.34-141.14	0.08-0.10	0.0-2.9	0.5-1.0	.28	.28			
	15-19	---	---	---	---	---	---	---	---	---	---			
Batterson	0-4	---	---	2-10	1.45-1.60	42.34-141.14	0.06-0.08	0.0-2.9	0.5-1.0	.20	.20	1	2	---
	4-15	---	---	2-10	1.45-1.60	42.34-141.14	0.06-0.08	0.0-2.9	0.0-0.5	.24	.24			
	15-19	---	---	---	---	0.07-1.41	---	---	---	---	---			
Bond family	0-2	---	---	10-20	1.30-1.40	14.11-42.34	0.10-0.12	0.0-2.9	1.0	.24	.24	1	3	---
	2-16	---	---	20-35	1.40-1.50	4.23-14.11	0.13-0.15	0.0-2.9	---	.15	.24			
	16-20	---	---	---	---	---	---	---	---	---	---			
Lava flows	0-60	---	---	---	---	---	---	---	---	---	---	---	8	0
Magotsu	0-5	---	---	12-25	1.25-1.40	4.23-14.11	0.07-0.09	0.0-2.9	1.0-2.0	.05	.32	1	8	0
	5-17	---	---	33-47	1.25-1.40	1.41-4.23	0.15-0.18	6.0-8.9	---	.24	.32			
	17-21	---	---	---	---	---	---	---	---	---	---			
	21-25	---	---	---	---	---	---	---	---	---	---			
Yaki	0-2	---	---	14-25	1.25-1.40	14.11-42.34	0.07-0.09	0.0-2.9	0.5-1.0	.02	.20	2	8	0
	2-19	---	---	20-27	1.30-1.45	14.11-42.34	0.09-0.12	0.0-2.9	---	.10	.32			
	19-23	---	---	---	---	---	---	---	---	---	---			
Cinder land	0-60	---	---	0-1	---	42.34-141.14	0.01-0.02	0.0-2.9	0.0-0.1	---	---	5	8	0

Physical Soil Properties

United States

Map symbol and soil name	Depth	Sand	Silt	Clay	Moist bulk density	Saturated hydraulic conductivity	Available water capacity	Linear extensi-bility	Organic matter	Erosion factors			Wind erodi-bility group	Wind erodi-bility index
										Kw	Kf	T		
	In	Pct	Pct	Pct	g/cc	micro m/sec	In/In	Pct	Pct					
s363:														
Grieta	0-3	---	---	10-20	1.45-1.55	14.00-42.00	0.11-0.13	0.0-2.9	0.1-0.5	.20	.20	5	3	86
	3-20	---	---	20-35	1.40-1.50	4.00-14.00	0.13-0.20	3.0-5.9	0.1-0.5	.28	.28			
	20-44	---	---	20-35	1.40-1.50	4.00-14.00	0.13-0.20	3.0-5.9	0.1-0.5	.28	.28			
	44-60	---	---	10-20	1.45-1.55	14.00-42.00	0.11-0.13	0.0-2.9	0.1-0.5	.20	.20			
Sheppard	0-60	---	---	2-5	1.50-1.60	42.00-141.00	0.06-0.08	0.0-2.9	0.0-0.5	.24	.24	5	2	134
s364:														
Begay	0-4	---	---	5-15	1.25-1.35	4.00-14.00	0.14-0.17	0.0-2.9	1.0-2.0	.32	.32	5	3	86
	4-57	---	---	5-15	1.25-1.55	14.00-42.00	0.12-0.15	0.0-2.9	0.5-1.0	.32	.32			
	57-84	---	---	5-10	1.45-1.65	42.00-141.00	0.07-0.10	0.0-2.9	0.0-0.5	.17	.24			
Penistaja	0-2	---	---	10-20	1.25-1.55	4.00-14.00	0.13-0.15	0.0-2.9	1.0-2.0	.28	.28	5	3	86
	2-18	---	---	20-30	1.55-1.75	4.00-14.00	0.15-0.18	0.0-2.9	0.5-1.0	.32	.32			
	18-58	---	---	15-25	1.25-1.55	14.00-42.00	0.12-0.15	0.0-2.9	0.0-0.5	.28	.28			
	58-84	---	---	5-10	1.45-1.65	42.00-141.00	0.04-0.07	0.0-2.9	0.0-0.5	.20	.20			
Mido	0-3	---	---	1-5	1.55-1.65	42.00-141.00	0.05-0.07	0.0-2.9	0.5-1.0	.17	.17	5	1	220
	3-84	---	---	3-8	1.55-1.65	42.00-141.00	0.05-0.09	0.0-2.9	0.0-0.5	.32	.32			
Ustic Torriorthents	0-31	---	---	---	---	0.42-141.00	---	---	0.0-1.0	---	---	3	---	---
	31-41	---	---	---	---	0.00-1.40	---	---	0.0	---	---			
Rock outcrop	0-60	---	---	---	1.50-1.80	0.00-1.40	---	---	0.0	---	---	---	8	0
s377:														
Thunderbird	0-2	---	---	30-45	0.95-1.20	1.41-4.23	0.11-0.12	6.0-8.9	1.0-2.0	.10	.20	2	8	0
	2-31	---	---	35-55	0.95-1.20	0.00-0.42	0.14-0.16	6.0-8.9	0.5-1.0	.24	.32			
	31-35	---	---	---	---	---	---	---	---	---	---			

Physical Soil Properties

United States

Map symbol and soil name	Depth	Sand	Silt	Clay	Moist bulk density	Saturated hydraulic conductivity	Available water capacity	Linear extensi-bility	Organic matter	Erosion factors			Wind erodi-bility group	Wind erodi-bility index
										Kw	Kf	T		
	In	Pct	Pct	Pct	g/cc	micro m/sec	In/In	Pct	Pct					
s377:														
Cabezon	0-4	---	---	30-40	1.40-1.50	0.42-1.41	0.05-0.10	3.0-5.9	1.0-2.0	.15	.28	1	8	0
	4-12	---	---	45-60	1.35-1.45	0.42-1.41	0.12-0.14	6.0-8.9	---	.17	.24			
	12-16	---	---	---	---	---	---	---	---	---	---			
Rudd	0-10	---	---	20-27	---	4.23-14.11	0.12-0.14	0.0-2.9	1.0-3.0	.20	.37	1	5	---
	10-13	---	---	20-32	---	4.23-14.11	0.09-0.11	0.0-2.9	---	.10	.37			
	13-17	---	---	---	---	---	---	---	---	---	---			
Springerville	0-4	---	---	40-60	1.75-1.80	0.42-1.41	0.09-0.12	6.0-8.9	1.0-2.0	.05	.10	3	8	0
	4-35	---	---	40-60	1.85-1.90	0.00-0.42	0.15-0.17	6.0-8.9	---	.28	.28			
	35-42	---	---	40-60	1.85-1.90	0.42-1.41	0.10-0.14	6.0-8.9	---	.17	.28			
	42-46	---	---	---	---	---	---	---	---	---	---			
s383:														
Kydestea	0-1	---	---	25-35	1.15-1.25	1.40-4.00	0.07-0.10	3.0-5.9	1.0-2.0	.15	.49	1	8	0
	1-5	---	---	25-35	1.15-1.25	1.40-4.00	0.08-0.12	3.0-5.9	1.0-2.0	.15	.49			
	5-15	---	---	25-35	1.15-1.25	1.40-4.00	0.06-0.10	3.0-5.9	1.0-2.0	.05	.24			
	15-19	---	---	---	---	0.00-1.40	---	---	0.0	---	---			
Zyme	0-1	---	---	35-40	1.25-1.55	1.40-4.00	0.16-0.20	6.0-8.9	1.0-2.0	.43	.43	1	4	86
	1-18	---	---	35-45	1.15-1.55	0.42-1.40	0.14-0.19	6.0-8.9	0.5-1.0	.43	.43			
	18-22	---	---	---	---	0.00-1.40	---	---	0.0	---	---			
Tonalea	0-3	---	---	5-10	1.25-1.35	42.00-141.00	0.09-0.11	0.0-2.9	0.2-0.5	.20	.20	2	2	134
	3-24	---	---	5-10	1.30-1.40	42.00-141.00	0.06-0.09	0.0-2.9	0.2-0.5	.20	.20			
	24-26	---	---	---	---	0.00-1.40	---	---	0.0	---	---			
	26-30	---	---	---	---	0.00-1.40	---	---	0.0	---	---			
Ustic Torriorthents	0-20	---	---	---	---	0.42-141.00	---	---	0.0-0.5	---	---	3	---	---
	20-60	---	---	---	---	0.00-1.40	---	---	0.0	---	---			

Physical Soil Properties

United States

Map symbol and soil name	Depth	Sand	Silt	Clay	Moist bulk density	Saturated hydraulic conductivity	Available water capacity	Linear extensi-bility	Organic matter	Erosion factors Kw	Kf	T	Wind erodi-bility group	Wind erodi-bility index
	In	*Pct*	*Pct*	*Pct*	*g/cc*	*micro m/sec*	*In/In*	*Pct*	*Pct*					
s383:														
Rock outcrop	0-60	---	---	---	1.50-1.80	0.00-1.40	---	---	0.0	---	---	---	8	0
Begay	0-4	---	---	5-15	1.25-1.35	4.00-14.00	0.14-0.17	0.0-2.9	1.0-2.0	.32	.32	5	3	86
	4-57	---	---	5-15	1.25-1.55	14.00-42.00	0.12-0.15	0.0-2.9	0.5-1.0	.32	.32			
	57-84	---	---	5-10	1.45-1.65	42.00-141.00	0.07-0.10	0.0-2.9	0.0-0.5	.17	.24			
Penistaja	0-2	---	---	10-20	1.25-1.55	4.00-14.00	0.13-0.15	0.0-2.9	1.0-2.0	.28	.28	5	3	86
	2-18	---	---	20-30	1.55-1.75	4.00-14.00	0.15-0.18	0.0-2.9	0.5-1.0	.32	.32			
	18-58	---	---	15-25	1.25-1.55	14.00-42.00	0.12-0.15	0.0-2.9	0.0-0.5	.28	.28			
	58-84	---	---	5-10	1.45-1.65	42.00-141.00	0.04-0.07	0.0-2.9	0.0-0.5	.20	.20			
s384:														
Torriorthents	0-31	---	---	---	---	0.42-141.00	---	---	0.0-1.0	---	---	3	---	---
	31-41	---	---	---	---	0.00-1.40	---	---	0.0	---	---			
Badland	0-60	---	---	---	---	0.00-1.40	---	---	0.0	---	---	---	---	---
Monue	0-5	---	---	10-15	1.25-1.55	14.00-42.00	0.14-0.16	0.0-2.9	0.0-0.5	.28	.28	5	3	86
	5-84	---	---	10-20	1.25-1.35	14.00-42.00	0.12-0.16	0.0-2.9	0.0-0.5	.28	.32			
Sheppard	0-2	---	---	5-8	1.20-1.30	42.00-141.00	0.06-0.08	0.0-2.9	0.5-1.0	.15	.15	5	2	134
	2-84	---	---	1-10	1.20-1.40	42.00-141.00	0.05-0.08	0.0-2.9	0.0-0.5	.15	.15			
Rock outcrop	0-60	---	---	---	1.50-1.80	0.00-1.40	---	---	0.0	---	---	---	8	0
s392:														
Aneth	0-2	---	---	3-10	1.55-1.65	42.34-141.14	0.08-0.10	0.0-2.9	0.0-0.5	.15	.15	5	2	---
	2-60	---	---	3-10	1.55-1.65	42.34-141.14	0.08-0.10	0.0-2.9	0.0-0.5	.15	.15			
Sheppard	0-12	---	---	2-5	1.50-1.60	42.34-141.14	0.05-0.07	0.0-2.9	0.0-0.5	.20	.20	5	1	---
	12-60	---	---	3-8	1.50-1.60	42.34-141.14	0.06-0.08	0.0-2.9	0.0-0.5	.20	.20			

Physical Soil Properties

United States

Map symbol and soil name	Depth	Sand	Silt	Clay	Moist bulk density	Saturated hydraulic conductivity	Available water capacity	Linear extensi-bility	Organic matter	Erosion factors			Wind erodi-bility group	Wind erodi-bility index
										Kw	Kf	T		
	In	Pct	Pct	Pct	g/cc	micro m/sec	In/In	Pct	Pct					
s392:														
Rock outcrop	0-60	---	---	---	---	---	---	---	---	---	---	---	8	0
Sogzie	0-5	---	---	10-18	1.35-1.45	4.23-14.11	0.15-0.17	0.0-2.9	0.5-1.0	.43	.43	5	3	---
	5-21	---	---	10-18	1.35-1.45	4.23-14.11	0.15-0.17	0.0-2.9	---	.43	.43			
	21-80	---	---	10-18	1.35-1.45	4.23-14.11	0.11-0.13	0.0-2.9	---	.32	.32			
s393:														
Begay	0-3	---	---	2-10	1.40-1.50	14.11-42.34	0.08-0.11	0.0-2.9	1.0-3.0	.49	.49	5	2	---
	3-42	---	---	12-18	1.40-1.50	14.11-42.34	0.13-0.18	0.0-2.9	0.5-1.0	.43	.43			
	42-60	---	---	5-12	1.40-1.50	14.11-42.34	0.10-0.15	0.0-2.9	0.0-0.5	.37	.37			
Shedado	0-7	---	---	5-10	1.45-1.55	14.11-42.34	0.09-0.11	0.0-2.9	2.0-3.0	.37	.37	2	2	---
	7-15	---	---	3-8	1.45-1.55	14.11-42.34	0.06-0.08	0.0-2.9	0.5-1.0	.43	.43			
	15-35	---	---	5-18	1.40-1.50	14.11-42.34	0.09-0.11	0.0-2.9	0.5-1.0	.28	.28			
	35-39	---	---	---	---	0.00-1.41	---	---	---	---	---			
Anasazi	0-4	---	---	12-18	1.40-1.50	14.11-42.34	0.11-0.13	0.0-2.9	1.0-2.0	.24	.37	2	8	0
	4-24	---	---	12-18	1.40-1.50	14.11-42.34	0.09-0.12	0.0-2.9	---	.43	.49			
	24-28	---	---	---	---	---	---	---	---	---	---			
Mespun	0-18	---	---	2-10	1.40-1.50	42.34-141.14	0.08-0.10	0.0-2.9	0.0-0.5	.32	.32	5	2	---
	18-60	---	---	3-8	1.40-1.50	42.34-141.14	0.05-0.09	0.0-2.9	0.0-0.5	.24	.24			
Rock outcrop	0-60	---	---	---	---	---	---	---	---	---	---	---	8	0
s394:														
Namon	0-5	---	---	8-15	1.40-1.50	14.11-42.34	0.05-0.08	0.0-2.9	3.0-5.0	.10	.49	1	8	0
	5-21	---	---	10-18	1.40-1.50	14.11-42.34	0.08-0.10	0.0-2.9	---	.24	.49			
	21-48	---	---	10-18	1.40-1.50	14.11-42.34	0.04-0.07	0.0-2.9	---	.10	.43			
	48-52	---	---	---	---	---	---	---	---	---	---			

Physical Soil Properties

United States

Map symbol and soil name	Depth	Sand	Silt	Clay	Moist bulk density	Saturated hydraulic conductivity	Available water capacity	Linear extensi-bility	Organic matter	Erosion factors			Wind erodi-bility group	Wind erodi-bility index
										Kw	Kf	T		
	In	*Pct*	*Pct*	*Pct*	*g/cc*	*micro m/sec*	*In/In*	*Pct*	*Pct*					
s394:														
Rock outcrop	0-60	---	---	---	---	---	---	---	---	---	---	---	8	0
Ustollic Haplargids	0-8	---	---	8-18	1.30-1.45	14.11-42.34	0.08-0.10	0.0-2.9	1.0-3.0	.17	.24	3	8	0
	8-24	---	---	20-40	1.15-1.35	1.41-14.11	0.13-0.16	3.0-5.9	---	.10	.24			
	24-60	---	---	28-35	1.10-1.30	0.42-14.11	0.12-0.15	3.0-5.9	---	.20	.24			
s398:														
Monue	0-13	---	---	5-18	1.30-1.45	14.11-42.34	0.08-0.11	0.0-2.9	0.5-1.0	.28	.28	3	2	---
	13-46	---	---	10-18	1.20-1.35	14.11-42.34	0.10-0.16	0.0-2.9	---	.28	.28			
	46-50	---	---	---	---	---	---	---	---	---	---			
Moepitz	0-10	---	---	3-5	1.50-1.60	14.11-42.34	0.09-0.12	0.0-2.9	0.5-1.0	.49	.49	3	1	---
	10-22	---	---	14-18	1.35-1.45	14.11-42.34	0.08-0.10	0.0-2.9	---	.20	.37			
	22-30	---	---	12-18	1.35-1.45	14.11-42.34	0.09-0.13	0.0-2.9	---	.49	.49			
	30-34	---	---	---	---	---	---	---	---	---	---			
Sheppard	0-12	---	---	2-5	1.50-1.60	42.34-141.14	0.05-0.07	0.0-2.9	0.0-0.5	.20	.20	5	1	---
	12-60	---	---	3-8	1.50-1.60	42.34-141.14	0.06-0.08	0.0-2.9	0.0-0.5	.20	.20			
Rock outcrop	0-60	---	---	---	---	---	---	---	---	---	---	---	8	0
Deleco	0-3	---	---	3-10	1.45-1.55	14.11-42.34	0.08-0.09	0.0-2.9	0.0-0.5	.37	.37	1	2	---
	3-7	---	---	5-10	1.40-1.45	14.11-42.34	0.07-0.09	0.0-2.9	---	.15	.17			
	7-10	---	---	5-10	1.40-1.45	14.11-42.34	0.05-0.06	0.0-2.9	---	.10	.17			
	10-14	---	---	---	---	---	---	---	---	---	---			
	14-45	---	---	0-10	1.35-1.45	0.00-0.42	0.08-0.09	0.0-2.9	---	.43	.43			

Physical Soil Properties

United States

Map symbol and soil name	Depth	Sand	Silt	Clay	Moist bulk density	Saturated hydraulic conductivity	Available water capacity	Linear extensi-bility	Organic matter	Erosion factors			Wind erodi-bility group	Wind erodi-bility index
										Kw	Kf	T		
	In	*Pct*	*Pct*	*Pct*	*g/cc*	*micro m/sec*	*In/In*	*Pct*	*Pct*					
s415:														
Eutric Glossoboralfs	0-2	---	---	18-26	1.20-1.30	14.11-42.34	0.11-0.15	0.0-2.9	0.5-0.9	.20	---	5	7	---
	2-16	---	---	15-25	1.45-1.55	14.11-42.34	0.07-0.13	0.0-2.9	---	.20	---			
	16-35	---	---	30-45	1.35-1.45	1.41-4.23	0.07-0.09	3.0-5.9	---	.10	---			
	35-67	---	---	35-50	1.30-1.40	1.41-4.23	0.05-0.08	3.0-5.9	---	.10	---			
Typic Haplustalfs	0-7	---	---	20-35	1.30-1.40	4.23-14.11	0.14-0.20	3.0-5.9	1.0-2.0	.37	---	4	6	---
	7-30	---	---	35-50	1.40-1.50	0.42-4.23	0.12-0.18	6.0-8.9	---	.28	---			
	30-41	---	---	35-50	1.40-1.50	1.41-4.23	0.07-0.10	3.0-5.9	---	.15	---			
	41-48	---	---	18-25	1.45-1.55	4.23-14.11	0.07-0.10	0.0-2.9	---	.15	---			
	48-60	---	---	5-15	1.40-1.50	42.34-141.14	0.03-0.05	0.0-2.9	---	.10	---			
Rock outcrop	0-60	---	---	---	---	---	---	---	---	---	---	---	8	0
s441:														
Piute	0-9	---	---	2-8	1.45-1.50	14.11-42.34	0.08-0.09	0.0-2.9	0.0-0.5	.43	.43	1	2	---
	9-13	---	---	---	---	---	---	---	---	---	---			
Bluechief	0-3	---	---	5-10	1.40-1.50	14.11-42.34	0.11-0.13	0.0-2.9	0.5-1.0	.37	.37	2	3	---
	3-25	---	---	10-15	1.40-1.50	14.11-42.34	0.11-0.13	0.0-2.9	---	.43	.43			
	25-38	---	---	12-18	1.40-1.50	14.11-42.34	0.11-0.14	0.0-2.9	---	.43	.17			
	38-42	---	---	---	---	---	---	---	---	---	---			
Rock outcrop	0-60	---	---	---	---	---	---	---	---	---	---	---	8	0
s442:														
Shumbegay	0-2	---	---	2-5	1.55-1.65	42.34-141.14	0.09-0.10	0.0-2.9	0.2-0.5	.20	.20	5	2	---
	2-6	---	---	5-8	1.55-1.65	14.11-42.34	0.09-0.10	0.0-2.9	0.2-0.5	.20	.20			
	6-10	---	---	2-5	1.55-1.65	42.34-141.14	0.07-0.09	0.0-2.9	0.2-0.5	.20	.20			
	10-80	---	---	3-8	1.55-1.65	14.11-42.34	0.09-0.11	0.0-2.9	0.2-0.5	.20	.20			

Physical Soil Properties

United States

Map symbol and soil name	Depth	Sand	Silt	Clay	Moist bulk density	Saturated hydraulic conductivity	Available water capacity	Linear extensi-bility	Organic matter	Erosion factors			Wind erodi-bility group	Wind erodi-bility index
										Kw	Kf	T		
	In	*Pct*	*Pct*	*Pct*	*g/cc*	*micro m/sec*	*In/In*	*Pct*	*Pct*					
s442:														
Uzona	0-1	---	---	20-27	1.35-1.55	4.23-14.11	0.04-0.07	3.0-5.9	0.5-1.0	.37	.37	5	4L	---
	1-45	---	---	35-55	1.30-1.45	0.00-0.42	0.03-0.06	6.0-8.9	---	.32	.32			
	45-58	---	---	20-30	1.35-1.50	1.41-4.23	0.03-0.05	3.0-5.9	---	.28	.28			
	58-60	---	---	5-10	1.50-1.60	42.34-141.14	0.01-0.02	0.0-2.9	---	.10	.10			
Escavada	0-2	---	---	5-15	1.40-1.50	4.23-14.11	0.15-0.17	0.0-2.9	0.2-0.6	.55	.55	5	3	---
	2-70	---	---	2-10	1.50-1.55	4.23-14.11	0.06-0.08	0.0-2.9	0.2-0.6	.17	.17			
s443:														
Farview	0-2	---	---	10-18	1.50-1.60	14.11-42.34	0.12-0.14	0.0-2.9	0.5-1.0	.28	.32	1	3	---
	2-6	---	---	10-18	1.50-1.60	14.11-42.34	0.10-0.14	0.0-2.9	0.5-1.0	.20	.28			
	6-10	---	---	---	---	---	---	---	---	---	---			
Millett	0-4	---	---	13-16	1.35-1.45	14.11-42.34	0.07-0.09	0.0-2.9	1.0-3.0	.15	.32	3	3	---
	4-12	---	---	18-35	1.40-1.50	4.23-14.11	0.12-0.16	3.0-5.9	---	.24	.43			
	12-50	---	---	8-22	1.40-1.55	4.23-42.34	0.08-0.12	3.0-5.9	---	.15	.28			
	50-60	---	---	5-12	1.40-1.55	14.11-141.14	0.05-0.09	0.0-2.9	---	.10	.37			
Doakum	0-5	---	---	10-20	1.40-1.50	14.11-42.34	0.13-0.15	0.0-2.9	0.5-0.6	.28	.28	5	3	---
	5-17	---	---	18-35	1.45-1.55	4.23-14.11	0.17-0.20	3.0-5.9	---	.32	.32			
	17-60	---	---	20-35	1.40-1.50	4.23-14.11	0.12-0.15	3.0-5.9	---	.32	.32			
s444:														
Arches	0-4	---	---	3-8	1.40-1.50	42.34-141.14	0.08-0.10	0.0-2.9	0.5-1.0	.28	.28	1	2	---
	4-13	---	---	2-6	1.30-1.50	42.34-141.14	0.06-0.08	0.0-2.9	0.5-1.0	.28	.28			
	13-15	---	---	3-8	1.40-1.50	42.34-141.14	0.08-0.10	0.0-2.9	0.5-1.0	.28	.28			
	15-19	---	---	---	---	---	---	---	---	---	---			
Blanding	0-4	---	---	10-18	1.35-1.40	4.23-14.11	0.16-0.18	0.0-2.9	0.8-0.9	.43	.43	5	3	---
	4-60	---	---	20-25	1.25-1.30	4.23-14.11	0.16-0.18	0.0-2.9	---	.49	.49			

Physical Soil Properties

United States

Map symbol and soil name	Depth	Sand	Silt	Clay	Moist bulk density	Saturated hydraulic conductivity	Available water capacity	Linear extensi-bility	Organic matter	Erosion factors			Wind erodi-bility group	Wind erodi-bility index
										Kw	Kf	T		
	In	Pct	Pct	Pct	g/cc	micro m/sec	In/In	Pct	Pct					
s444:														
Mido	0-2	---	---	8-18	1.40-1.50	14.11-42.34	0.09-0.12	0.0-2.9	0.0-0.5	.37	.37	5	3	---
	2-60	---	---	3-8	1.40-1.50	42.34-141.14	0.05-0.09	0.0-2.9	0.0-0.5	.32	.32			
s445:														
Akhoni	0-6	---	---	5-18	1.70-1.80	14.11-42.34	0.14-0.16	0.0-2.9	1.0-3.0	.24	---	1	3	---
	6-18	---	---	5-18	1.70-1.80	14.11-42.34	0.13-0.15	0.0-2.9	1.0-2.0	.24	---			
	18-22	---	---	---	---	---	---	---	---	---	---			
Tunitcha	0-5	---	---	10-18	1.25-1.35	14.11-42.34	0.05-0.08	0.0-2.9	1.0-4.0	.10	.24	3	6	---
	5-8	---	---	10-18	1.35-1.45	14.11-42.34	0.08-0.10	0.0-2.9	1.0-4.0	.15	.24			
	8-38	---	---	20-27	1.40-1.50	4.23-14.11	0.12-0.15	0.0-2.9	0.5-1.0	.32	.32			
	38-57	---	---	10-18	1.40-1.50	14.11-42.34	0.11-0.13	0.0-2.9	0.4-0.6	.24	.24			
	57-61	---	---	---	---	---	---	---	---	---	---			
Klizhin	0-2	---	---	3-12	1.25-1.35	14.11-42.34	0.09-0.10	0.0-2.9	2.0-4.0	.20	.20	5	2	---
	2-40	---	---	3-18	1.35-1.45	14.11-42.34	0.11-0.14	0.0-2.9	1.0-3.0	.28	.28			
	40-60	---	---	3-18	1.65-1.75	14.11-42.34	0.11-0.14	0.0-2.9	0.5-1.0	.28	.28			
s452:														
Augustine	0-3	---	---	8-17	1.35-1.45	14.11-42.34	0.12-0.14	0.0-2.9	1.0-2.0	.28	.37	5	3	---
	3-37	---	---	18-35	1.40-1.50	4.23-14.11	0.16-0.18	3.0-5.9	---	.37	.37			
	37-60	---	---	18-35	1.40-1.50	4.23-14.11	0.13-0.15	3.0-5.9	---	.37	.37			
Telescope	0-3	---	---	3-11	1.40-1.50	42.34-141.14	0.06-0.08	0.0-2.9	0.0-0.5	.20	.20	4	2	---
	3-19	---	---	5-15	1.45-1.55	14.11-42.34	0.12-0.14	0.0-2.9	---	.28	.28			
	19-45	---	---	5-15	1.45-1.55	14.11-42.34	0.11-0.13	0.0-2.9	---	.28	.28			
	45-55	---	---	3-11	1.45-1.55	42.34-141.14	0.09-0.11	0.0-2.9	---	.20	.28			

Physical Soil Properties

United States

Map symbol and soil name	Depth	Sand	Silt	Clay	Moist bulk density	Saturated hydraulic conductivity	Available water capacity	Linear extensi-bility	Organic matter	Erosion factors			Wind erodi-bility group	Wind erodi-bility index
										Kw	Kf	T		
	In	*Pct*	*Pct*	*Pct*	*g/cc*	*micro m/sec*	*In/In*	*Pct*	*Pct*					
s452:														
Royosa	0-4	---	---	2-6	1.35-1.45	141.14	0.05-0.07	0.0-2.9	1.0-2.0	.17	.17	3	1	---
	4-43	---	---	3-10	1.40-1.50	141.14	0.05-0.08	0.0-2.9	---	.17	.17			
	43-45	---	---	5-15	1.45-1.55	14.11-42.34	0.13-0.15	0.0-2.9	---	.28	.28			
	45-49	---	---	---	---	---	---	---	---	---	---			
s466:														
Kopie	0-2	---	---	8-15	---	14.11-42.34	0.11-0.13	0.0-2.9	1.0-2.0	.17	.17	1	3	---
	2-6	---	---	15-25	---	4.23-14.11	0.16-0.18	0.0-2.9	---	.28	.32			
	6-14	---	---	15-25	---	4.23-14.11	0.14-0.18	0.0-2.9	---	.15	.20			
	14-18	---	---	---	---	---	---	---	---	---	---			
Quintana	0-6	---	---	15-27	1.30-1.40	4.23-14.11	0.08-0.10	0.0-2.9	1.0-2.0	.20	.32	5	7	---
	6-33	---	---	20-30	1.45-1.55	4.23-14.11	0.16-0.19	3.0-5.9	---	.37	.37			
	33-41	---	---	10-16	1.40-1.50	14.11-42.34	0.10-0.12	0.0-2.9	---	.24	.24			
	41-60	---	---	10-16	1.40-1.50	14.11-42.34	0.07-0.15	0.0-2.9	---	.10	.32			
s490:														
Monue	0-3	---	---	3-5	1.45-1.55	14.11-42.34	0.07-0.10	0.0-2.9	0.5-1.0	.20	.20	5	2	---
	3-60	---	---	8-17	1.35-1.45	14.11-42.34	0.10-0.15	0.0-2.9	0.0-0.5	.28	.28			
Nakai	0-18	---	---	3-10	1.45-1.55	42.34-141.14	0.07-0.09	0.0-2.9	0.5-1.0	.28	.28	5	2	---
	18-34	---	---	8-18	1.50-1.60	14.11-42.34	0.10-0.18	0.0-2.9	0.5-1.0	.43	.43			
	34-60	---	---	5-10	1.55-1.65	42.34-141.14	0.08-0.11	0.0-2.9	0.5-1.0	.28	.28			
Blackston	0-3	---	---	10-18	1.50-1.60	14.11-42.34	0.07-0.09	0.0-2.9	0.4-0.6	.15	.24	5	5	---
	3-9	---	---	10-18	1.50-1.60	14.11-42.34	0.11-0.13	0.0-2.9	0.3-0.5	.24	.24			
	9-15	---	---	20-35	1.50-1.60	4.23-14.11	0.10-0.12	3.0-5.9	0.3-0.5	.15	.32			
	15-35	---	---	10-18	1.45-1.55	42.34-141.14	0.03-0.06	0.0-2.9	0.2-0.4	.05	.20			
	35-70	---	---	0-8	1.45-1.55	141.14	0.01-0.03	0.0-2.9	0.2-0.4	.02	.15			

Physical Soil Properties

United States

Map symbol and soil name	Depth	Sand	Silt	Clay	Moist bulk density	Saturated hydraulic conductivity	Available water capacity	Linear extensi-bility	Organic matter	Erosion factors			Wind erodi-bility group	Wind erodi-bility index
										Kw	Kf	T		
	In	*Pct*	*Pct*	*Pct*	*g/cc*	*micro m/sec*	*In/In*	*Pct*	*Pct*					
s495:														
Badland	0-60	---	---	---	---	---	---	---	---	---	---	---	8	0
Torriorthents	0-60	---	---	---	---	---	---	---	---	---	---	---	---	---
Calciorthids	0-5	---	---	20-27	---	4.23-14.11	0.08-0.10	0.0-2.9	0.5-2.0	.10	.28	3	6	---
	5-60	---	---	15-30	---	14.11-42.34	0.07-0.09	0.0-2.9	---	.10	.28			
s1417:														
Youngston	0-10	---	---	27-35	1.25-1.35	1.41-4.23	0.15-0.18	3.0-5.9	0.5-1.0	.32	.32	5	5	---
	10-43	---	---	18-35	1.25-1.40	1.41-4.23	0.15-0.18	3.0-5.9	0.5-1.0	.32	.32			
	43-60	---	---	18-35	1.25-1.40	1.41-4.23	0.15-0.18	3.0-5.9	0.5-1.0	.32	.32			
Torrifluvents	0-6	---	---	---	---	1.41-141.14	---	---	0.5-3.0	---	---	---	8	0
	6-60	---	---	0-10	1.45-1.60	42.34-141.14	0.03-0.06	0.0-2.9	0.5-1.0	.05	.20			
s1420:														
Farb	0-7	---	---	15-20	1.45-1.55	14.11-42.34	0.08-0.13	0.0-2.9	0.0-0.7	.28	.28	1	3	---
	7-10	---	---	10-20	1.45-1.55	14.11-42.34	0.06-0.13	0.0-2.9	0.0-0.5	.24	.24			
	10-14	---	---	---	---	---	---	---	---	---	---			
Mack	0-4	---	---	15-20	1.40-1.50	4.23-14.11	0.13-0.18	0.0-2.9	0.5-1.0	.20	.20	5	4	---
	4-18	---	---	18-35	1.30-1.40	1.41-4.23	0.16-0.18	0.0-2.9	0.0-0.5	.28	.28			
	18-36	---	---	15-25	1.30-1.40	4.23-14.11	0.12-0.14	0.0-2.9	0.0-0.5	.28	.49			
	36-60	---	---	15-25	1.30-1.40	4.23-14.11	0.10-0.12	0.0-2.9	0.0-0.5	.17	.32			
	60-70	---	---	10-25	1.30-1.40	4.23-14.11	0.13-0.16	0.0-2.9	0.0-0.5	.28	.28			
Redlands	0-7	---	---	15-20	1.30-1.40	14.11-42.34	0.10-0.12	0.0-2.9	0.5-1.0	.24	.24	5	3	---
	7-18	---	---	20-30	1.30-1.40	4.23-14.11	0.16-0.18	0.0-2.9	---	.28	.28			
	18-60	---	---	10-18	1.35-1.45	4.23-14.11	0.15-0.17	0.0-2.9	---	.32	.32			
Rock outcrop	0-60	---	---	---	---	---	---	---	---	---	---	---	8	0

Physical Soil Properties

United States

Map symbol and soil name	Depth	Sand	Silt	Clay	Moist bulk density	Saturated hydraulic conductivity	Available water capacity	Linear extensi-bility	Organic matter	Erosion factors			Wind erodi-bility group	Wind erodi-bility index
										Kw	Kf	T		
	In	*Pct*	*Pct*	*Pct*	*g/cc*	*micro m/sec*	*In/In*	*Pct*	*Pct*					
s1420:														
Badland	0-60	---	---	---	---	---	---	---	---	---	---	---	8	0
Moenkopie	0-3	---	---	5-17	1.30-1.40	14.11-42.34	0.06-0.10	0.0-2.9	0.5-1.0	.10	.37	1	6	---
	3-8	---	---	7-20	1.35-1.45	14.11-42.34	0.10-0.13	0.0-2.9	0.5-1.0	.28	.32			
	8-12	---	---	---	---	0.00-1.41	---	---	---	---	---			
Myton family	0-6	---	---	18-27	1.25-1.35	4.23-14.11	0.07-0.11	0.0-2.9	0.5-1.0	.15	.37	5	8	0
	6-60	---	---	10-18	1.35-1.45	14.11-42.34	0.05-0.08	0.0-2.9	0.5-1.0	.05	.17			
s1422:														
Clayspings	0-3	---	---	27-35	1.25-1.40	1.41-4.23	0.10-0.12	3.0-5.9	0.0-0.5	.15	.49	1	8	0
	3-18	---	---	35-60	1.20-1.35	0.42-1.41	0.16-0.18	6.0-8.9	0.0-0.5	.28	.37			
	18-22	---	---	---	---	---	---	---	---	---	---			
Myton family	0-6	---	---	18-27	1.25-1.35	4.23-14.11	0.07-0.11	0.0-2.9	0.5-1.0	.15	.37	5	8	0
	6-60	---	---	10-18	1.35-1.45	14.11-42.34	0.05-0.08	0.0-2.9	0.5-1.0	.05	.17			
Rock outcrop	0-60	---	---	---	---	---	---	---	---	---	---	---	8	0
Uzona	0-1	---	---	27-35	1.35-1.40	1.41-4.23	0.16-0.18	3.0-5.9	0.5-1.0	.24	.43	5	6	---
	1-45	---	---	35-60	1.35-1.45	0.00-0.42	0.15-0.17	6.0-8.9	0.5-1.0	.28	.32			
	45-60	---	---	27-40	1.40-1.45	1.41-4.23	0.17-0.19	3.0-5.9	0.0-0.5	.24	.28			
s1424:														
Cragola	0-2	---	---	20-35	1.45-1.55	4.23-14.11	0.06-0.09	0.0-2.9	0.5-1.0	.10	.37	1	8	0
	2-18	---	---	27-35	1.45-1.55	0.42-1.41	0.07-0.10	0.0-2.9	0.0-0.5	.17	---			
	18-22	---	---	---	---	---	---	---	---	---	---			

Physical Soil Properties

United States

Map symbol and soil name	Depth	Sand	Silt	Clay	Moist bulk density	Saturated hydraulic conductivity	Available water capacity	Linear extensi-bility	Organic matter	Erosion factors			Wind erodi-bility group	Wind erodi-bility index
										Kw	Kf	T		
	In	*Pct*	*Pct*	*Pct*	*g/cc*	*micro m/sec*	*In/In*	*Pct*	*Pct*					
s1424:														
Rizno	0-2	---	---	10-17	1.20-1.40	14.11-42.34	0.10-0.13	0.0-2.9	0.5-1.0	.28	.24	1	3	---
	2-5	---	---	20-30	1.10-1.30	4.23-14.11	0.12-0.15	0.0-2.9	0.5-1.0	.15	.24			
	5-7	---	---	10-18	1.20-1.40	14.11-42.34	0.10-0.13	0.0-2.9	0.5-1.0	.28	.17			
	7-14	---	---	6-10	1.40-1.50	42.34-141.14	0.05-0.06	0.0-2.9	---	.10	.15			
	14-18	---	---	---	---	---	---	---	---	---	---			
Romberg	0-2	---	---	15-27	---	4.23-14.11	0.12-0.14	0.0-2.9	1.0-2.0	.20	.37	5	8	0
	2-20	---	---	27-35	---	1.41-4.23	0.07-0.08	3.0-5.9	---	.10	.32			
	20-60	---	---	27-35	---	1.41-4.23	0.07-0.08	3.0-5.9	---	.10	.32			
Littlenan	0-3	---	---	20-40	1.20-1.35	0.42-4.23	0.14-0.16	3.0-5.9	0.5-1.0	.20	.37	3	4L	---
	3-29	---	---	35-45	1.15-1.30	0.42-1.41	0.16-0.18	6.0-8.9	---	.24	.32			
	29-33	---	---	---	---	---	---	---	---	---	---			
Rock outcrop	0-60	---	---	---	---	---	---	---	---	---	---	---	8	0
Bodot	0-6	---	---	20-27	1.15-1.35	1.41-14.11	0.08-0.12	3.0-5.9	1.0-2.0	.43	.64	2	8	0
	6-15	---	---	30-40	1.20-1.40	0.42-4.23	0.16-0.18	6.0-8.9	---	.43	.43			
	15-36	---	---	35-60	1.20-1.40	0.42-1.41	0.17-0.18	6.0-8.9	---	.37	.37			
	36-40	---	---	---	---	0.00-14.11	---	---	---	---	---			
s5091:														
Typic Ustochrepts	0-9	---	---	12-18	1.45-1.55	4.23-14.11	0.09-0.11	0.0-2.9	0.5-0.9	.10	---	5	7	---
	9-37	---	---	24-30	1.45-1.55	4.23-14.11	0.07-0.10	3.0-5.9	---	.10	---			
	37-60	---	---	5-15	1.45-1.55	14.11-42.34	0.05-0.08	0.0-2.9	---	.10	---			
s5092:														
Typic Ustochrepts	0-6	---	---	10-16	1.35-1.45	14.11-42.34	0.11-0.13	0.0-2.9	1.0-2.0	.24	---	5	3	---
	6-33	---	---	20-30	1.45-1.55	4.23-14.11	0.16-0.19	3.0-5.9	---	.37	---			
	33-41	---	---	10-16	1.40-1.50	14.11-42.34	0.10-0.12	0.0-2.9	---	.24	---			
	41-60	---	---	10-16	1.40-1.50	14.11-42.34	0.07-0.15	0.0-2.9	---	.10	---			

Physical Soil Properties

United States

Map symbol and soil name	Depth	Sand	Silt	Clay	Moist bulk density	Saturated hydraulic conductivity	Available water capacity	Linear extensi-bility	Organic matter	Erosion factors			Wind erodi-bility group	Wind erodi-bility index
										Kw	Kf	T		
	In	*Pct*	*Pct*	*Pct*	*g/cc*	*micro m/sec*	*In/In*	*Pct*	*Pct*					
s5092:														
Lithic Ustochrepts	0-3	---	---	15-20	1.45-1.55	4.23-14.11	0.11-0.14	0.0-2.9	0.5-0.9	.20	---	1	5	---
	3-11	---	---	10-20	1.45-1.55	4.23-14.11	0.07-0.09	0.0-2.9	---	.10	---			
	11-15	---	---	---	---	---	---	---	---	---	---			
s5112:														
Cumulic Haplustolls	0-14	---	---	10-25	1.20-1.30	4.23-14.11	0.16-0.18	0.0-2.9	2.0-3.0	.43	---	5	6	---
	14-60	---	---	18-34	1.40-1.50	1.41-4.23	0.16-0.21	3.0-5.9	---	.37	---			
	60-70	---	---	15-20	1.45-1.55	14.11-42.34	0.13-0.15	0.0-2.9	---	.28	---			
s5160:														
Viuda	0-3	---	---	10-20	1.35-1.40	14.11-42.34	0.05-0.07	0.0-2.9	0.5-0.9	.10	.24	1	6	---
	3-16	---	---	35-50	1.40-1.45	0.42-1.41	0.14-0.17	6.0-8.9	---	.20	.20			
	16-19	---	---	20-35	1.45-1.50	4.23-14.11	0.15-0.17	3.0-5.9	---	.15	.32			
	19-23	---	---	---	---	---	---	---	---	---	---			
Penistaja	0-4	---	---	10-20	1.35-1.45	4.23-14.11	0.13-0.15	0.0-2.9	0.8-2.0	.28	.28	5	3	---
	4-28	---	---	20-30	1.40-1.50	4.23-14.11	0.15-0.18	0.0-2.9	0.0-0.5	.32	.32			
	28-60	---	---	15-25	1.20-1.30	14.11-42.34	0.12-0.15	0.0-2.9	0.0-0.5	.28	.28			
Rock outcrop	0-60	---	---	---	---	---	---	---	---	---	---	---	8	0
Aparejo	0-2	---	---	18-25	1.20-1.30	4.23-14.11	0.19-0.21	0.0-2.9	0.5-0.9	.43	.43	5	4L	---
	2-18	---	---	18-35	1.20-1.30	1.41-4.23	0.19-0.21	3.0-5.9	---	.37	.37			
	18-60	---	---	18-30	1.20-1.30	4.23-14.11	0.14-0.21	0.0-2.9	---	.32	.32			
Venadito	0-3	---	---	30-39	1.40-1.50	1.41-4.23	0.19-0.21	3.0-5.9	0.5-1.0	.37	.37	5	4L	---
	3-60	---	---	60-80	1.15-1.25	0.07-0.42	0.14-0.16	6.0-8.9	0.5-1.0	.20	.20			

Physical Soil Properties

United States

Map symbol and soil name	Depth	Sand	Silt	Clay	Moist bulk density	Saturated hydraulic conductivity	Available water capacity	Linear extensi-bility	Organic matter	Erosion factors Kw	Kf	T	Wind erodi-bility group	Wind erodi-bility index
	In	*Pct*	*Pct*	*Pct*	*g/cc*	*micro m/sec*	*In/In*	*Pct*	*Pct*					
s5161:														
Cabezon	0-2	---	---	10-20	1.25-1.40	14.11-42.34	0.06-0.08	0.0-2.9	1.0-2.0	.10	.24	1	8	0
	2-18	---	---	35-60	1.35-1.45	0.42-1.41	0.14-0.17	6.0-8.9	---	.24	.28			
	18-22	---	---	---	---	---	---	---	---	---	---			
Cantina	0-2	---	---	15-20	1.45-1.55	14.11-42.34	0.11-0.13	0.0-2.9	1.0-2.0	.24	.24	3	3	---
	2-9	---	---	20-35	1.35-1.45	4.23-14.11	0.14-0.16	3.0-5.9	---	.32	.32			
	9-31	---	---	35-55	1.35-1.45	0.42-1.41	0.15-0.17	6.0-8.9	---	.28	.28			
	31-54	---	---	25-40	1.40-1.50	4.23-14.11	0.15-0.17	3.0-5.9	---	.32	.32			
	54-58	---	---	---	---	---	---	---	---	---	---			
Millpaw	0-4	---	---	18-25	1.15-1.25	4.23-14.11	0.16-0.18	0.0-2.9	2.0-3.0	.37	.37	5	6	---
	4-35	---	---	35-50	1.40-1.50	0.42-1.41	0.17-0.19	6.0-8.9	---	.32	.32			
	35-60	---	---	18-35	1.40-1.50	4.23-14.11	0.16-0.18	3.0-5.9	---	.37	.37			
Montecito	0-3	---	---	27-30	1.35-1.45	4.23-14.11	0.19-0.21	0.0-2.9	0.5-0.9	.32	.37	5	6	---
	3-24	---	---	35-40	1.45-1.55	1.41-4.23	0.19-0.21	3.0-5.9	---	.32	.37			
	24-60	---	---	35-40	1.45-1.55	1.41-4.23	0.15-0.17	3.0-5.9	---	.32	.32			
Rock outcrop	0-60	---	---	---	---	---	---	---	---	---	---	---	8	0
Bandera	0-9	---	---	10-15	1.10-1.20	4.23-14.11	0.06-0.12	0.0-2.9	2.0-3.0	.10	.32	1	7	---
	9-16	---	---	10-15	1.10-1.20	4.23-14.11	0.06-0.12	0.0-2.9	1.0-2.0	.10	.32			
	16-60	---	---	0-5	1.00-1.10	141.14	0.01-0.03	0.0-2.9	0.5-1.0	.02	---			
Ildefonso	0-3	---	---	8-18	1.45-1.55	14.11-42.34	0.04-0.08	0.0-2.9	0.5-2.0	.10	.24	5	6	---
	3-60	---	---	8-18	1.45-1.55	14.11-42.34	0.04-0.08	0.0-2.9	---	.10	.32			
Torreon	0-2	---	---	15-25	1.10-1.15	4.23-14.11	0.08-0.09	0.0-2.9	1.0-3.0	.10	.37	5	8	0
	2-25	---	---	35-50	1.25-1.30	0.42-1.41	0.14-0.16	6.0-8.9	---	.24	.28			
	25-60	---	---	30-40	1.25-1.30	1.41-4.23	0.19-0.21	3.0-5.9	---	.37	.43			

Physical Soil Properties

United States

Map symbol and soil name	Depth	Sand	Silt	Clay	Moist bulk density	Saturated hydraulic conductivity	Available water capacity	Linear extensi-bility	Organic matter	Erosion factors Kw	Kf	T	Wind erodi-bility group	Wind erodi-bility index
	In	*Pct*	*Pct*	*Pct*	*g/cc*	*micro m/sec*	*In/In*	*Pct*	*Pct*					
s5161:														
Loarc	0-14	---	---	10-15	1.35-1.45	14.11-42.34	0.13-0.15	0.0-2.9	1.0-3.0	.28	.28	5	3	---
	14-23	---	---	18-35	1.40-1.50	4.23-14.11	0.14-0.16	3.0-5.9	---	.32	.32			
	23-36	---	---	10-25	1.45-1.55	14.11-42.34	0.11-0.13	0.0-2.9	---	.24	.28			
	36-60	---	---	10-25	1.40-1.50	14.11-42.34	0.09-0.11	0.0-2.9	---	.15	.24			
s5164:														
Laporte	0-3	---	---	12-20	1.35-1.40	4.23-14.11	0.11-0.14	0.0-2.9	1.0-2.0	.20	.37	1	5	---
	3-11	---	---	15-27	1.35-1.40	4.23-14.11	0.11-0.14	0.0-2.9	---	.20	.37			
	11-15	---	---	---	---	0.00-1.41	---	---	---	---	---			
Rock outcrop	0-60	---	---	---	---	---	---	---	---	---	---	---	8	0
Vessilla	0-2	---	---	10-20	1.45-1.55	14.11-42.34	0.11-0.13	0.0-2.9	0.6-0.9	.24	.24	1	3	---
	2-11	---	---	8-18	1.50-1.60	14.11-42.34	0.13-0.15	0.0-2.9	0.0-0.5	.28	.28			
	11-15	---	---	---	---	---	---	---	---	---	---			
Atarque	0-2	---	---	10-18	1.40-1.50	14.11-42.34	0.13-0.15	0.0-2.9	0.5-0.9	.28	.28	1	3	---
	2-16	---	---	24-35	1.40-1.50	4.23-14.11	0.14-0.16	3.0-5.9	---	.32	.32			
	16-22	---	---	---	---	---	---	---	---	---	---			
Flugle	0-3	---	---	5-10	1.45-1.55	42.34-141.14	0.09-0.10	0.0-2.9	1.0-3.0	.20	.20	5	2	---
	3-25	---	---	20-35	1.45-1.55	4.23-14.11	0.16-0.18	3.0-5.9	---	.37	.37			
	25-60	---	---	10-20	1.45-1.55	4.23-14.11	0.11-0.13	0.0-2.9	---	.24	.24			
Mion	0-4	---	---	20-27	1.30-1.40	4.23-14.11	0.16-0.18	0.0-2.9	1.0-3.0	.37	.37	1	4L	---
	4-14	---	---	38-55	1.35-1.45	0.00-0.42	0.15-0.17	6.0-8.9	---	.32	.32			
	14-18	---	---	---	---	---	---	---	---	---	---			

Physical Soil Properties

United States

Map symbol and soil name	Depth	Sand	Silt	Clay	Moist bulk density	Saturated hydraulic conductivity	Available water capacity	Linear extensi-bility	Organic matter	Erosion factors			Wind erodi-bility group	Wind erodi-bility index
										Kw	Kf	T		
	In	*Pct*	*Pct*	*Pct*	*g/cc*	*micro m/sec*	*In/In*	*Pct*	*Pct*					
s5165:														
Penistaja	0-4	---	---	10-20	1.35-1.45	4.23-14.11	0.13-0.15	0.0-2.9	0.8-2.0	.28	.28	5	3	---
	4-28	---	---	20-30	1.40-1.50	4.23-14.11	0.15-0.18	0.0-2.9	0.0-0.5	.32	.32			
	28-60	---	---	15-25	1.20-1.30	14.11-42.34	0.12-0.15	0.0-2.9	0.0-0.5	.28	.28			
Sparank	0-2	---	---	30-40	1.35-1.45	1.41-4.23	0.19-0.21	3.0-5.9	1.0-2.0	.32	.32	5	4L	---
	2-60	---	---	35-50	1.50-1.60	0.00-0.42	0.16-0.18	6.0-8.9	---	.37	.37			
San Mateo	0-2	---	---	27-35	1.35-1.45	1.41-4.23	0.19-0.21	3.0-5.9	0.5-0.9	.24	.24	5	4L	---
	2-29	---	---	20-35	1.35-1.45	4.23-14.11	0.15-0.17	3.0-5.9	---	.32	.32			
	29-60	---	---	18-35	1.35-1.45	4.23-14.11	0.15-0.17	3.0-5.9	---	.32	.43			
Mespun	0-11	---	---	3-8	1.35-1.45	141.14	0.05-0.07	0.0-2.9	0.5-0.7	.17	.17	5	1	---
	11-60	---	---	3-10	1.35-1.45	42.34-141.14	0.05-0.09	0.0-2.9	---	.17	.17			
Palma	0-7	---	---	5-10	1.70-1.75	42.34-141.14	0.06-0.11	0.0-2.9	1.0-2.0	.20	.20	5	2	---
	7-60	---	---	10-20	1.65-1.70	14.11-42.34	0.13-0.17	0.0-2.9	---	.28	.28			
Rock outcrop	0-60	---	---	---	---	---	---	---	---	---	---	---	8	0
Mikim	0-9	---	---	10-25	1.40-1.45	4.23-14.11	0.16-0.18	0.0-2.9	1.0-3.0	.32	.32	5	5	---
	9-60	---	---	18-32	1.35-1.45	4.23-14.11	0.14-0.16	0.0-2.9	---	.32	.32			
Venadito	0-3	---	---	30-39	1.40-1.50	1.41-4.23	0.19-0.21	3.0-5.9	0.5-1.0	.32	.32	5	4L	---
	3-60	---	---	60-80	1.15-1.25	0.07-0.42	0.14-0.16	6.0-8.9	0.5-1.0	.20	.20			
Mion	0-3	---	---	15-25	1.20-1.30	4.23-14.11	0.10-0.15	0.0-2.9	2.0-4.0	.20	.37	1	8	0
	3-13	---	---	35-55	1.35-1.45	0.00-0.42	0.15-0.21	6.0-8.9	---	.17	.17			
	13-17	---	---	---	---	---	---	---	---	---	---			

Physical Soil Properties

United States

Map symbol and soil name	Depth	Sand	Silt	Clay	Moist bulk density	Saturated hydraulic conductivity	Available water capacity	Linear extensi-bility	Organic matter	Erosion factors			Wind erodi-bility group	Wind erodi-bility index
										Kw	Kf	T		
	In	*Pct*	*Pct*	*Pct*	*g/cc*	*micro m/sec*	*In/In*	*Pct*	*Pct*					
s5167:														
Raton	0-9	---	---	20-27	1.20-1.30	1.41-4.23	0.10-0.12	0.0-2.9	2.0-4.0	.20	.37	1	8	0
	9-15	---	---	35-55	1.35-1.45	0.42-1.41	0.08-0.09	6.0-8.9	---	.10	.32			
	15-19	---	---	---	---	---	---	---	---	---	---			
Charo	0-5	---	---	20-27	1.30-1.40	4.23-14.11	0.13-0.15	0.0-2.9	1.0-2.0	.20	.32	2	7	---
	5-28	---	---	35-60	1.35-1.45	0.42-1.41	0.15-0.18	3.0-5.9	---	.28	.28			
	28-32	---	---	---	---	---	---	---	---	---	---			
Lava flows	0-60	---	---	---	---	---	---	---	---	---	---	---	8	0
Rock outcrop	0-60	---	---	---	---	---	---	---	---	---	---	---	8	0
Bandera	0-9	---	---	10-15	1.10-1.20	4.23-14.11	0.10-0.15	0.0-2.9	2.0-3.0	.20	.43	1	6	---
	9-16	---	---	10-15	1.10-1.20	4.23-14.11	0.06-0.12	0.0-2.9	1.0-2.0	.10	.32			
	16-60	---	---	0-5	1.00-1.10	141.14	0.01-0.03	0.0-2.9	0.5-1.0	.02	---			
Borrego	0-6	---	---	20-35	1.20-1.30	1.41-4.23	0.13-0.15	3.0-5.9	2.0-4.0	.37	.37	1	6	---
	6-13	---	---	35-45	1.40-1.50	0.00-0.42	0.10-0.12	6.0-8.9	---	.20	.24			
	13-18	---	---	30-35	1.45-1.55	4.23-14.11	0.10-0.12	3.0-5.9	---	.15	.32			
	18-22	---	---	---	---	---	---	---	---	---	---			
s5168:														
Flugle	0-3	---	---	5-10	1.45-1.55	42.34-141.14	0.09-0.10	0.0-2.9	1.0-3.0	.20	.20	5	2	---
	3-25	---	---	20-35	1.45-1.55	4.23-14.11	0.16-0.18	3.0-5.9	---	.37	.37			
	25-60	---	---	10-20	1.45-1.55	4.23-14.11	0.11-0.13	0.0-2.9	---	.24	.24			
Rock outcrop	0-60	---	---	---	---	---	---	---	---	---	---	---	8	0
Catman	0-3	---	---	25-40	1.40-1.50	1.41-4.23	0.14-0.20	3.0-5.9	0.5-0.9	.32	.32	5	4L	---
	3-43	---	---	60-75	1.15-1.25	0.00-0.42	0.13-0.15	6.0-8.9	---	.20	.20			
	43-70	---	---	30-45	1.40-1.50	0.00-0.42	0.15-0.17	3.0-5.9	---	.28	.28			

Physical Soil Properties

United States

Map symbol and soil name	Depth	Sand	Silt	Clay	Moist bulk density	Saturated hydraulic conductivity	Available water capacity	Linear extensi-bility	Organic matter	Erosion factors Kw	Kf	T	Wind erodi-bility group	Wind erodi-bility index
	In	Pct	Pct	Pct	g/cc	micro m/sec	In/In	Pct	Pct					
s5168:														
Celacy	0-8	---	---	15-18	1.35-1.45	14.11-42.34	0.11-0.13	0.0-2.9	1.0-3.0	.24	.24	2	3	---
	8-22	---	---	18-35	1.45-1.55	4.23-14.11	0.16-0.18	3.0-5.9	---	.37	.37			
	22-28	---	---	18-30	1.40-1.50	4.23-14.11	0.15-0.17	0.0-2.9	---	.32	.37			
	28-32	---	---	---	---	---	---	---	---	---	---			
Quintana	0-11	---	---	10-20	1.40-1.45	14.11-42.34	0.13-0.15	0.0-2.9	0.5-0.9	.28	.28	5	3	---
	11-46	---	---	20-35	1.35-1.40	4.23-14.11	0.14-0.16	3.0-5.9	---	.32	.32			
	46-60	---	---	10-20	1.40-1.45	14.11-42.34	0.11-0.13	0.0-2.9	---	.24	.24			
Silkie	0-4	---	---	30-40	1.35-1.45	0.42-1.41	0.19-0.21	3.0-5.9	0.5-0.9	.32	.32	5	6	---
	4-60	---	---	35-55	1.35-1.45	0.00-0.42	0.16-0.18	6.0-8.9	---	.24	.24			
Teco	0-6	---	---	10-20	1.35-1.45	14.11-42.34	0.12-0.14	0.0-2.9	1.0-2.0	.24	.24	5	3	---
	6-36	---	---	35-45	1.45-1.55	1.41-4.23	0.15-0.18	6.0-8.9	---	.37	.37			
	36-60	---	---	15-30	1.45-1.55	14.11-42.34	0.15-0.17	0.0-2.9	---	.28	.43			
Mion	0-4	---	---	20-27	1.30-1.40	4.23-14.11	0.16-0.18	0.0-2.9	1.0-3.0	.37	.37	1	4L	---
	4-14	---	---	38-55	1.35-1.45	0.00-0.42	0.15-0.17	6.0-8.9	---	.32	.32			
	14-18	---	---	---	---	---	---	---	---	---	---			
Vessilla	0-2	---	---	10-20	1.45-1.55	14.11-42.34	0.11-0.13	0.0-2.9	0.6-0.9	.24	.24	1	3	---
	2-11	---	---	8-18	1.50-1.60	14.11-42.34	0.13-0.15	0.0-2.9	0.0-0.5	.28	.28			
	11-15	---	---	---	---	---	---	---	---	---	---			
Atarque	0-2	---	---	10-18	1.40-1.50	14.11-42.34	0.13-0.15	0.0-2.9	0.5-0.9	.28	.28	1	3	---
	2-16	---	---	24-35	1.40-1.50	4.23-14.11	0.14-0.16	3.0-5.9	---	.32	.32			
	16-22	---	---	---	---	---	---	---	---	---	---			
Goesling	0-4	---	---	5-10	1.45-1.55	42.34-141.14	0.09-0.10	0.0-2.9	1.0-3.0	.20	.20	5	2	---
	4-30	---	---	18-35	1.45-1.55	1.41-4.23	0.17-0.19	3.0-5.9	---	.32	.32			
	30-64	---	---	16-30	1.40-1.50	1.41-4.23	0.13-0.15	0.0-2.9	---	.28	.28			

Physical Soil Properties

United States

Map symbol and soil name	Depth	Sand	Silt	Clay	Moist bulk density	Saturated hydraulic conductivity	Available water capacity	Linear extensi-bility	Organic matter	Erosion factors Kw	Kf	T	Wind erodi-bility group	Wind erodi-bility index
	In	*Pct*	*Pct*	*Pct*	*g/cc*	*micro m/sec*	*In/In*	*Pct*	*Pct*					
s5168:														
Venadito	0-3	---	---	30-39	1.40-1.50	1.41-4.23	0.19-0.21	3.0-5.9	0.5-1.0	.32	.32	5	4L	---
	3-60	---	---	60-80	1.15-1.25	0.07-0.42	0.14-0.16	6.0-8.9	0.5-1.0	.20	.20			
Hickman	0-3	---	---	15-27	1.05-1.15	4.23-14.11	0.15-0.17	0.0-2.9	2.0-4.0	.37	.49	5	5	---
	3-60	---	---	18-35	1.20-1.30	1.41-4.23	0.14-0.16	3.0-5.9	0.0-0.8	.32	.37			
s5169:														
Rock outcrop	0-60	---	---	---	---	---	---	---	---	---	---	---	8	0
Nogal	0-2	---	---	10-18	1.45-1.55	14.11-42.34	0.11-0.13	0.0-2.9	1.0-2.0	.24	.24	2	3	---
	2-30	---	---	40-60	1.30-1.40	0.42-1.41	0.11-0.17	6.0-8.9	---	.24	.24			
	30-34	---	---	---	---	---	---	---	---	---	---			
Galestina	0-2	---	---	10-19	1.45-1.55	14.11-42.34	0.11-0.13	0.0-2.9	0.5-0.9	.24	.24	3	3	---
	2-7	---	---	15-30	1.25-1.35	4.23-14.11	0.16-0.18	3.0-5.9	---	.37	.37			
	7-46	---	---	35-60	1.35-1.50	0.42-1.41	0.16-0.18	6.0-8.9	---	.28	.28			
	46-60	---	---	---	---	---	---	---	---	---	---			
Mion	0-4	---	---	20-27	1.30-1.40	4.23-14.11	0.16-0.18	0.0-2.9	1.0-3.0	.37	.37	1	4L	---
	4-14	---	---	38-55	1.35-1.45	0.00-0.42	0.15-0.17	6.0-8.9	---	.32	.32			
	14-18	---	---	---	---	---	---	---	---	---	---			
Pinitos	0-2	---	---	10-18	1.45-1.55	14.11-42.34	0.11-0.13	0.0-2.9	0.5-0.9	.24	.24	5	3	---
	2-24	---	---	20-35	1.40-1.50	4.23-14.11	0.17-0.19	3.0-5.9	0.0-0.5	.32	.32			
	24-60	---	---	15-25	1.40-1.50	14.11-42.34	0.13-0.15	0.0-2.9	0.0-0.5	.28	.28			
Vessilla	0-2	---	---	10-20	1.45-1.55	14.11-42.34	0.11-0.13	0.0-2.9	0.6-0.9	.24	.24	1	3	---
	2-11	---	---	8-18	1.50-1.60	14.11-42.34	0.13-0.15	0.0-2.9	0.0-0.5	.28	.28			
	11-15	---	---	---	---	---	---	---	---	---	---			

Physical Soil Properties

United States

Map symbol and soil name	Depth	Sand	Silt	Clay	Moist bulk density	Saturated hydraulic conductivity	Available water capacity	Linear extensi-bility	Organic matter	Erosion factors			Wind erodi-bility group	Wind erodi-bility index
										Kw	Kf	T		
	In	Pct	Pct	Pct	g/cc	micro m/sec	In/In	Pct	Pct					
s5169:														
Ribera	0-9	---	---	12-18	1.30-1.40	4.23-14.11	0.13-0.16	0.0-2.9	0.5-1.0	.28	.28	2	3	---
	9-26	---	---	20-30	1.20-1.30	4.23-14.11	0.16-0.19	0.0-2.9	---	.32	.32			
	26-31	---	---	12-18	1.55-1.65	4.23-14.11	0.13-0.16	0.0-2.9	---	.32	.32			
	31-35	---	---	---	---	---	---	---	---	---	---			
Flugle	0-3	---	---	5-10	1.45-1.55	42.34-141.14	0.09-0.10	0.0-2.9	1.0-3.0	.20	.20	5	2	---
	3-25	---	---	20-35	1.45-1.55	4.23-14.11	0.16-0.18	3.0-5.9	---	.37	.37			
	25-60	---	---	10-20	1.45-1.55	4.23-14.11	0.11-0.13	0.0-2.9	---	.24	.24			
Montecito	0-6	---	---	10-20	1.40-1.50	14.11-42.34	0.11-0.13	0.0-2.9	0.5-0.9	.28	.28	5	3	---
	6-19	---	---	35-50	1.35-1.45	1.41-4.23	0.15-0.17	6.0-8.9	---	.32	.32			
	19-30	---	---	35-50	1.35-1.45	1.41-4.23	0.12-0.14	6.0-8.9	---	.15	.28			
	30-45	---	---	16-28	1.40-1.50	14.11-42.34	0.07-0.09	0.0-2.9	---	.10	.24			
	45-60	---	---	16-28	1.20-1.30	14.11-42.34	0.04-0.06	0.0-2.9	---	.05	.24			
Teco	0-6	---	---	10-20	1.35-1.45	14.11-42.34	0.12-0.14	0.0-2.9	1.0-2.0	.24	.24	5	3	---
	6-36	---	---	35-45	1.45-1.55	1.41-4.23	0.15-0.18	6.0-8.9	---	.37	.37			
	36-60	---	---	15-30	1.45-1.55	14.11-42.34	0.15-0.17	0.0-2.9	---	.28	.43			
Catman	0-3	---	---	30-40	1.40-1.50	1.41-4.23	0.19-0.21	3.0-5.9	0.5-0.9	.37	.37	5	4L	---
	3-43	---	---	60-75	1.15-1.25	0.00-0.42	0.13-0.15	6.0-8.9	---	.20	.20			
	43-70	---	---	30-45	1.40-1.50	0.00-0.42	0.15-0.17	3.0-5.9	---	.28	.28			
Hickman	0-3	---	---	15-27	1.05-1.15	4.23-14.11	0.15-0.17	0.0-2.9	2.0-4.0	.37	.49	5	5	---
	3-60	---	---	18-35	1.20-1.30	1.41-4.23	0.14-0.16	3.0-5.9	0.0-0.8	.32	.37			
s5170:														
Teco	0-6	---	---	10-20	1.35-1.45	14.11-42.34	0.12-0.14	0.0-2.9	1.0-2.0	.24	.24	5	3	---
	6-36	---	---	35-45	1.45-1.55	1.41-4.23	0.15-0.18	6.0-8.9	---	.37	.37			
	36-60	---	---	15-30	1.45-1.55	14.11-42.34	0.15-0.17	0.0-2.9	---	.28	.43			

Physical Soil Properties

United States

Map symbol and soil name	Depth	Sand	Silt	Clay	Moist bulk density	Saturated hydraulic conductivity	Available water capacity	Linear extensi-bility	Organic matter	Erosion factors			Wind erodi-bility group	Wind erodi-bility index
										Kw	Kf	T		
	In	Pct	Pct	Pct	g/cc	micro m/sec	In/In	Pct	Pct					
s5170:														
Cabezon	0-2	---	---	18-27	1.25-1.40	4.23-14.11	0.09-0.11	0.0-2.9	1.0-2.0	.10	.43	1	8	0
	2-18	---	---	35-60	1.35-1.45	0.42-1.41	0.14-0.17	6.0-8.9	---	.24	.28			
	18-22	---	---	---	---	---	---	---	---	---	---			
Atarque	0-2	---	---	10-18	1.40-1.50	14.11-42.34	0.13-0.15	0.0-2.9	0.5-0.9	.28	.28	1	3	---
	2-16	---	---	24-35	1.40-1.50	4.23-14.11	0.14-0.16	3.0-5.9	---	.32	.32			
	16-22	---	---	---	---	---	---	---	---	---	---			
Montecito	0-3	---	---	27-30	1.35-1.45	4.23-14.11	0.19-0.21	0.0-2.9	0.5-0.9	.32	.37	5	6	---
	3-24	---	---	35-40	1.45-1.55	1.41-4.23	0.19-0.21	3.0-5.9	---	.32	.37			
	24-60	---	---	35-40	1.45-1.55	1.41-4.23	0.15-0.17	3.0-5.9	---	.32	.32			
Rock outcrop	0-60	---	---	---	---	---	---	---	---	---	---	---	8	0
Torreon	0-2	---	---	15-25	1.10-1.15	4.23-14.11	0.08-0.09	0.0-2.9	1.0-3.0	.10	.37	5	8	0
	2-25	---	---	35-50	1.25-1.30	0.42-1.41	0.14-0.16	6.0-8.9	---	.24	.28			
	25-60	---	---	30-40	1.25-1.30	1.41-4.23	0.19-0.21	3.0-5.9	---	.37	.43			
s5171:														
Cinnadale	0-4	---	---	10-15	1.35-1.45	14.11-42.34	0.12-0.14	0.0-2.9	1.0-2.0	.28	.43	1	4	---
	4-12	---	---	10-15	1.40-1.50	14.11-42.34	0.08-0.10	0.0-2.9	---	.10	.43			
	12-16	---	---	---	---	---	---	---	---	---	---			
Valnor	0-6	---	---	20-35	1.35-1.45	1.41-4.23	0.19-0.21	3.0-5.9	2.0-4.0	.32	.37	2	6	---
	6-12	---	---	20-35	1.45-1.55	4.23-14.11	0.15-0.17	3.0-5.9	---	.32	.37			
	12-31	---	---	35-45	1.55-1.65	0.42-1.41	0.14-0.16	6.0-8.9	---	.32	.32			
	31-36	---	---	35-45	1.55-1.65	0.42-1.41	0.14-0.16	6.0-8.9	---	.32	.32			
	36-40	---	---	---	---	---	---	---	---	---	---			

Physical Soil Properties

United States

Map symbol and soil name	Depth	Sand	Silt	Clay	Moist bulk density	Saturated hydraulic conductivity	Available water capacity	Linear extensi-bility	Organic matter	Erosion factors			Wind erodi-bility group	Wind erodi-bility index
										Kw	Kf	T		
	In	*Pct*	*Pct*	*Pct*	*g/cc*	*micro m/sec*	*In/In*	*Pct*	*Pct*					
s5171:														
Techado	0-3	---	---	29-39	1.40-1.50	1.41-4.23	0.14-0.16	3.0-5.9	0.5-0.9	.15	.28	1	7	---
	3-16	---	---	40-55	1.40-1.50	0.42-1.41	0.13-0.15	6.0-8.9	---	.20	.24			
	16-20	---	---	---	---	---	---	---	---	---	---			
Kenray	0-15	---	---	5-10	1.40-1.50	42.34-141.14	0.05-0.07	0.0-2.9	0.5-0.9	.17	.17	5	1	---
	15-60	---	---	5-12	1.55-1.65	42.34-141.14	0.06-0.08	0.0-2.9	---	.17	.17			
Mirabal	0-3	---	---	10-18	1.40-1.50	4.23-14.11	0.09-0.10	0.0-2.9	1.0-2.0	.10	.37	2	7	---
	3-14	---	---	10-18	1.40-1.50	4.23-14.11	0.09-0.10	0.0-2.9	---	.10	.37			
	14-21	---	---	20-25	1.25-1.35	4.23-14.11	0.07-0.09	0.0-2.9	---	.10	.37			
	21-25	---	---	---	---	---	---	---	---	---	---			
Rock outcrop	0-60	---	---	---	---	---	---	---	---	---	---	---	8	0
Abersito	0-3	---	---	18-26	1.15-1.25	4.23-14.11	0.12-0.14	0.0-2.9	1.0-2.0	.20	.37	2	7	---
	3-9	---	---	10-19	1.40-1.50	14.11-42.34	0.07-0.08	0.0-2.9	0.5-1.0	.10	.37			
	9-24	---	---	40-55	1.40-1.50	0.42-1.41	0.07-0.08	6.0-8.9	0.5-1.0	.05	.20			
	24-28	---	---	---	---	---	---	---	---	---	---			
McGaffey	0-3	---	---	20-27	1.25-1.35	4.23-14.11	0.17-0.19	0.0-2.9	2.0-3.0	.43	.43	5	6	---
	3-60	---	---	20-30	1.40-1.50	4.23-14.11	0.17-0.19	0.0-2.9	---	.37	.37			
Stout	0-3	---	---	10-18	1.50-1.55	14.11-42.34	0.11-0.13	0.0-2.9	0.5-0.9	.24	.28	1	3	---
	3-14	---	---	10-18	1.50-1.55	14.11-42.34	0.11-0.13	0.0-2.9	---	.24	.28			
	14-18	---	---	---	---	---	---	---	---	---	---			
Stout	0-3	---	---	10-18	1.50-1.55	14.11-42.34	0.11-0.13	0.0-2.9	0.5-0.9	.24	.28	1	3	---
	3-14	---	---	10-18	1.50-1.55	14.11-42.34	0.11-0.13	0.0-2.9	---	.24	.28			
	14-18	---	---	---	---	---	---	---	---	---	---			

Physical Soil Properties

United States

Map symbol and soil name	Depth	Sand	Silt	Clay	Moist bulk density	Saturated hydraulic conductivity	Available water capacity	Linear extensi-bility	Organic matter	Erosion factors			Wind erodi-bility group	Wind erodi-bility index
										Kw	Kf	T		
	In	Pct	Pct	Pct	g/cc	micro m/sec	In/In	Pct	Pct					
s5172:														
Stout	0-3	---	---	10-18	1.50-1.55	14.11-42.34	0.11-0.13	0.0-2.9	0.5-0.9	.24	.28	1	3	---
	3-14	---	---	10-18	1.50-1.55	14.11-42.34	0.11-0.13	0.0-2.9	---	.24	.28			
	14-18	---	---	---	---	---	---	---	---	---	---			
Hesperus	0-11	---	---	8-18	1.35-1.40	14.11-42.34	0.12-0.14	0.0-2.9	2.0-4.0	.17	.17	5	3	---
	11-44	---	---	20-35	1.30-1.40	1.41-14.11	0.16-0.19	0.0-2.9	1.0-3.0	.32	.32			
	44-60	---	---	15-35	1.40-1.50	4.23-14.11	0.16-0.19	0.0-2.9	0.0-0.5	.28	.28			
Kiln	0-5	---	---	18-32	1.05-1.15	4.23-14.11	0.10-0.15	0.0-2.9	2.0-3.0	.24	.37	1	7	---
	5-10	---	---	28-35	1.40-1.50	4.23-14.11	0.10-0.15	3.0-5.9	2.0-3.0	.20	.37			
	10-14	---	---	---	---	0.00-0.42	---	---	---	---	---			
s5173:														
Royosa	0-8	---	---	0-6	1.35-1.45	141.14	0.05-0.06	0.0-2.9	1.0-2.0	.10	.10	5	1	---
	8-60	---	---	0-10	1.40-1.50	141.14	0.05-0.08	0.0-2.9	0.0-0.5	.17	.17			
Royosa	0-8	---	---	3-10	1.35-1.45	141.14	0.06-0.08	0.0-2.9	1.0-2.0	.17	.17	5	2	---
	8-60	---	---	0-10	1.40-1.50	141.14	0.05-0.08	0.0-2.9	0.0-0.5	.17	.17			
Telescope	0-3	---	---	3-11	1.40-1.50	42.34-141.14	0.06-0.08	0.0-2.9	0.0-0.5	.20	.20	4	2	---
	3-19	---	---	5-15	1.45-1.55	14.11-42.34	0.12-0.14	0.0-2.9	---	.28	.28			
	19-45	---	---	5-15	1.45-1.55	14.11-42.34	0.11-0.13	0.0-2.9	---	.28	.28			
	45-55	---	---	3-11	1.45-1.55	42.34-141.14	0.09-0.11	0.0-2.9	---	.20	.28			
s5174:														
Kimbeto	0-3	---	---	5-10	1.55-1.65	42.34-141.14	0.08-0.10	0.0-2.9	0.5-0.8	.20	.20	3	2	---
	3-10	---	---	10-18	1.45-1.55	14.11-42.34	0.12-0.15	0.0-2.9	0.5-0.8	.28	.28			
	10-18	---	---	18-27	1.50-1.60	4.23-14.11	0.13-0.15	0.0-2.9	0.5-0.8	.32	.32			
	18-29	---	---	15-20	1.50-1.60	14.11-42.34	0.10-0.12	0.0-2.9	0.3-0.8	.28	.28			
	29-42	---	---	5-18	1.55-1.65	14.11-42.34	0.05-0.10	0.0-2.9	0.2-0.4	.28	.28			
	42-46	---	---	---	---	---	---	---	---	---	---			

Physical Soil Properties

United States

Map symbol and soil name	Depth	Sand	Silt	Clay	Moist bulk density	Saturated hydraulic conductivity	Available water capacity	Linear extensi-bility	Organic matter	Erosion factors Kw	Erosion factors Kf	Erosion factors T	Wind erodi-bility group	Wind erodi-bility index
	In	*Pct*	*Pct*	*Pct*	*g/cc*	*micro m/sec*	*In/In*	*Pct*	*Pct*					
s5174:														
Denazar	0-11	---	---	1-5	1.50-1.60	42.34-141.14	0.05-0.07	0.0-2.9	0.3-0.5	.17	.17	5	1	---
	11-34	---	---	4-10	1.55-1.65	42.34-141.14	0.06-0.09	0.0-2.9	0.2-0.4	.17	.17			
	34-62	---	---	5-12	1.60-1.70	14.11-42.34	0.06-0.11	0.0-2.9	0.2-0.4	.20	.20			
Farb	0-3	---	---	15-20	1.35-1.45	14.11-42.34	0.10-0.12	0.0-2.9	0.5-1.0	.24	.24	1	3	---
	3-11	---	---	15-20	1.35-1.45	14.11-42.34	0.09-0.11	0.0-2.9	---	.15	.20			
	11-15	---	---	---	---	---	---	---	---	---	---			
Tocito	0-6	---	---	18-27	1.20-1.30	4.23-14.11	0.19-0.21	0.0-2.9	0.5-1.0	.43	.43	5	4L	---
	6-12	---	---	27-35	1.40-1.50	1.41-4.23	0.16-0.20	0.0-2.9	0.3-0.5	.32	.32			
	12-16	---	---	27-35	1.40-1.50	1.41-4.23	0.14-0.16	3.0-5.9	0.3-0.5	.37	.37			
	16-28	---	---	18-25	1.40-1.50	4.23-14.11	0.12-0.15	0.0-2.9	0.2-0.5	.43	.43			
	28-70	---	---	20-35	1.45-1.55	1.41-4.23	0.12-0.15	3.0-5.9	0.2-0.4	.43	.43			
Jeddito	0-2	---	---	5-10	1.20-1.30	42.34-141.14	0.08-0.11	0.0-2.9	0.0-0.5	.15	.15	5	2	---
	2-9	---	---	10-15	1.10-1.20	14.11-42.34	0.11-0.13	0.0-2.9	---	.24	.24			
	9-27	---	---	10-15	1.35-1.45	14.11-42.34	0.12-0.14	0.0-2.9	---	.20	.20			
	27-60	---	---	10-15	1.10-1.20	14.11-42.34	0.11-0.13	0.0-2.9	---	.24	.24			
Tewa	0-1	---	---	15-20	1.15-1.25	4.23-14.11	0.14-0.16	0.0-2.9	0.5-1.0	.37	.37	5	3	---
	1-25	---	---	25-35	1.35-1.45	1.41-4.23	0.15-0.19	0.0-2.9	---	.32	.32			
	25-31	---	---	10-20	1.25-1.35	4.23-14.11	0.13-0.15	0.0-2.9	---	.32	.32			
	31-60	---	---	25-35	1.20-1.30	1.41-4.23	0.15-0.19	0.0-2.9	---	.32	.32			
Huerfano	0-1	---	---	10-20	1.50-1.60	14.11-42.34	0.12-0.14	0.0-2.9	0.2-0.5	.28	.28	1	3	---
	1-11	---	---	27-35	1.50-1.60	1.41-4.23	0.09-0.11	3.0-5.9	0.2-0.4	.32	.32			
	11-18	---	---	27-35	1.35-1.45	1.41-4.23	0.09-0.11	3.0-5.9	0.2-0.4	.32	.32			
	18-22	---	---	---	---	---	---	---	---	---	---			

Physical Soil Properties

United States

Map symbol and soil name	Depth	Sand	Silt	Clay	Moist bulk density	Saturated hydraulic conductivity	Available water capacity	Linear extensi-bility	Organic matter	Erosion factors Kw	Kf	T	Wind erodi-bility group	Wind erodi-bility index
	In	*Pct*	*Pct*	*Pct*	*g/cc*	*micro m/sec*	*In/In*	*Pct*	*Pct*					
s5174:														
Shiprock	0-3	---	---	5-10	1.50-1.60	42.34-141.14	0.09-0.10	0.0-2.9	0.4-0.6	.20	.20	5	2	---
	3-36	---	---	15-18	1.55-1.65	14.11-42.34	0.13-0.15	0.0-2.9	0.3-0.5	.28	.28			
	36-66	---	---	10-15	1.50-1.60	14.11-42.34	0.10-0.11	0.0-2.9	0.2-0.4	.28	.28			
Benally	0-4	---	---	4-10	1.45-1.55	42.34-141.14	0.06-0.08	0.0-2.9	0.2-0.4	.17	.17	5	2	---
	4-15	---	---	10-18	1.45-1.55	14.11-42.34	0.12-0.14	0.0-2.9	0.3-0.5	.28	.28			
	15-56	---	---	20-35	1.40-1.50	1.41-4.23	0.11-0.14	3.0-5.9	0.3-0.5	.32	.32			
	56-64	---	---	4-10	1.45-1.55	42.34-141.14	0.03-0.05	0.0-2.9	0.2-0.4	.17	.17			
Werito	0-3	---	---	18-27	1.25-1.35	4.23-14.11	0.14-0.17	0.0-2.9	0.4-0.6	.37	.37	2	4L	---
	3-7	---	---	27-40	1.40-1.50	1.41-4.23	0.16-0.20	3.0-5.9	0.4-0.6	.32	.32			
	7-17	---	---	35-40	1.40-1.50	0.42-1.41	0.16-0.20	3.0-5.9	0.4-0.6	.32	.32			
	17-22	---	---	35-55	1.40-1.50	0.42-1.41	0.10-0.14	3.0-5.9	0.3-0.5	.24	.24			
	22-34	---	---	35-55	1.50-1.60	0.42-1.41	0.11-0.15	3.0-5.9	0.3-0.5	.24	.24			
	34-38	---	---	---	---	---	---	---	---	---	---			
Badland	0-60	---	---	---	---	---	---	---	---	---	---	---	8	0
Brimhall	0-2	---	---	4-8	1.50-1.60	42.34-141.14	0.08-0.09	0.0-2.9	0.2-0.6	.20	.20	3	2	---
	2-21	---	---	8-18	1.50-1.60	14.11-42.34	0.12-0.15	0.0-2.9	0.2-0.4	.28	.28			
	21-29	---	---	8-18	1.50-1.60	14.11-42.34	0.12-0.15	0.0-2.9	0.2-0.4	.28	.28			
	29-49	---	---	---	1.50-1.60	14.11-42.34	0.07-0.09	0.0-2.9	0.2-0.4	.15	.28			
	49-53	---	---	---	---	---	---	---	---	---	---			
Genats	0-4	---	---	5-10	1.45-1.55	42.34-141.14	0.07-0.08	0.0-2.9	0.2-0.6	.10	.17	2	2	---
	4-13	---	---	35-55	1.45-1.55	0.42-1.41	0.14-0.16	3.0-5.9	0.4-0.6	.24	.28			
	13-27	---	---	35-55	1.45-1.55	0.42-1.41	0.08-0.11	3.0-5.9	0.3-0.5	.24	.28			
	27-31	---	---	---	---	---	---	---	---	---	---			

Physical Soil Properties

United States

Map symbol and soil name	Depth	Sand	Silt	Clay	Moist bulk density	Saturated hydraulic conductivity	Available water capacity	Linear extensi-bility	Organic matter	Erosion factors			Wind erodi-bility group	Wind erodi-bility index
										Kw	Kf	T		
	In	*Pct*	*Pct*	*Pct*	*g/cc*	*micro m/sec*	*In/In*	*Pct*	*Pct*					
s5174:														
Nakai	0-18	---	---	3-10	1.45-1.55	42.34-141.14	0.07-0.09	0.0-2.9	0.5-1.0	.28	.28	5	2	---
	18-34	---	---	8-18	1.50-1.60	14.11-42.34	0.10-0.18	0.0-2.9	0.0-0.5	.43	.43			
	34-60	---	---	5-10	1.55-1.65	42.34-141.14	0.08-0.11	0.0-2.9	0.0-0.5	.28	.28			
Rock outcrop	0-60	---	---	---	---	---	---	---	---	---	---	---	8	0
Benally	0-2	---	---	20-25	1.30-1.40	4.23-14.11	0.12-0.14	0.0-2.9	0.2-0.6	.32	.32	3	5	---
	2-18	---	---	25-35	1.40-1.50	0.42-1.41	0.04-0.08	3.0-5.9	---	.32	.32			
	18-45	---	---	20-30	1.40-1.50	4.23-14.11	0.06-0.08	0.0-2.9	---	.32	.32			
	45-49	---	---	---	---	---	---	---	---	---	---			
Mack	0-3	---	---	5-17	1.30-1.50	4.23-42.34	0.12-0.17	0.0-2.9	1.0-3.0	.32	.32	5	4L	---
	3-16	---	---	18-33	1.20-1.40	1.41-14.11	0.16-0.19	3.0-5.9	---	.43	.43			
	16-60	---	---	5-19	1.20-1.30	4.23-42.34	0.13-0.17	0.0-2.9	---	.49	.49			
Mesa	0-4	---	---	15-20	1.35-1.45	4.23-14.11	0.14-0.17	0.0-2.9	0.5-1.0	.49	.49	5	3	---
	4-14	---	---	25-30	1.25-1.40	1.41-14.11	0.17-0.20	3.0-5.9	---	.28	.28			
	14-20	---	---	25-30	1.25-1.40	4.23-14.11	0.14-0.17	3.0-5.9	---	.28	.28			
	20-60	---	---	25-30	1.25-1.40	4.23-14.11	0.08-0.12	0.0-2.9	---	.10	.28			
Suwanee	0-7	---	---	18-27	1.20-1.30	4.23-14.11	0.15-0.18	0.0-2.9	1.0-2.0	.43	.43	5	4L	---
	7-60	---	---	18-35	1.25-1.35	1.41-4.23	0.12-0.18	3.0-5.9	---	.43	.43			
Notal	0-3	---	---	28-35	1.40-1.50	1.41-4.23	0.09-0.11	3.0-5.9	0.5-0.7	.37	.37	5	4L	---
	3-60	---	---	40-50	1.35-1.45	0.00-0.42	0.08-0.10	6.0-8.9	---	.24	.24			
Sheppard	0-6	---	---	5-10	1.45-1.60	42.34-141.14	0.06-0.08	0.0-2.9	0.0-0.5	.15	.15	5	2	---
	6-60	---	---	5-10	1.45-1.60	42.34-141.14	0.06-0.08	0.0-2.9	---	.15	.15			

Physical Soil Properties

United States

Map symbol and soil name	Depth	Sand	Silt	Clay	Moist bulk density	Saturated hydraulic conductivity	Available water capacity	Linear extensi-bility	Organic matter	Erosion factors			Wind erodi-bility group	Wind erodi-bility index
										Kw	Kf	T		
	In	*Pct*	*Pct*	*Pct*	*g/cc*	*micro m/sec*	*In/In*	*Pct*	*Pct*					
s5175:														
Fruitland	0-7	---	---	5-10	1.45-1.55	14.11-42.34	0.11-0.13	0.0-2.9	0.6-0.8	.28	.28	5	3	---
	7-60	---	---	5-18	1.45-1.55	14.11-42.34	0.11-0.13	0.0-2.9	0.0-0.5	.28	.28			
Turley	0-3	---	---	28-35	1.40-1.50	1.41-4.23	0.18-0.20	3.0-5.9	0.5-0.6	.32	.32	5	4L	---
	3-57	---	---	18-35	1.40-1.50	1.41-4.23	0.18-0.20	3.0-5.9	---	.37	.37			
	57-80	---	---	28-35	1.45	4.23-14.11	0.14-0.16	3.0-5.9	---	.32	.32			
Garland	0-4	---	---	20-27	1.15-1.25	4.23-14.11	0.16-0.18	0.0-2.9	0.5-1.0	.32	.32	2	6	---
	4-21	---	---	27-35	1.25-1.35	4.23-14.11	0.19-0.21	3.0-5.9	0.0-0.5	.37	.37			
	21-30	---	---	20-30	1.25-1.35	4.23-14.11	0.14-0.16	3.0-5.9	0.0-0.5	.32	.32			
	30-60	---	---	3-5	1.45-1.55	42.34-141.14	0.03-0.05	0.0-2.9	0.0-0.5	.02	.10			
Walrees	0-6	---	---	18-27	1.30-1.40	4.23-14.11	0.13-0.17	0.0-2.9	1.0-2.0	.37	.37	5	4L	---
	6-30	---	---	18-35	1.40-1.50	1.41-4.23	0.13-0.19	0.0-2.9	0.5-1.0	.49	.49			
	30-81	---	---	0-15	1.40-1.50	141.14	0.07-0.13	0.0-2.9	0.0-0.8	.10	---			
Apishapa	0-8	---	---	30-40	1.25-1.35	1.41-4.23	0.14-0.18	3.0-5.9	1.0-2.0	.20	.20	5	4	---
	8-60	---	---	35-60	1.30-1.35	0.42-1.41	0.10-0.14	6.0-8.9	---	.24	.24			
Werlog	0-6	---	---	18-27	1.40-1.50	4.23-14.11	0.13-0.17	0.0-2.9	0.9-1.0	.37	.37	5	6	---
	6-60	---	---	18-35	1.40-1.50	1.41-4.23	0.15-0.19	3.0-5.9	0.0-0.5	.32	.32			
	60-81	---	---	0-10	1.40-1.50	141.14	0.03-0.06	0.0-2.9	0.0-0.5	.10	.15			
Green River	0-6	---	---	10-18	1.30-1.40	14.11-42.34	0.08-0.12	0.0-2.9	1.0-2.0	.24	.24	5	3	---
	6-60	---	---	15-18	1.25-1.35	4.23-14.11	0.09-0.12	0.0-2.9	---	.28	.28			
Youngston	0-10	---	---	28-35	---	1.41-4.23	0.19-0.21	3.0-5.9	0.6-0.9	.32	.32	5	6	---
	10-60	---	---	18-35	---	1.41-4.23	0.16-0.19	3.0-5.9	---	.32	.32			
s5177:														
Rock outcrop	0-60	---	---	---	---	---	---	---	---	---	---	---	8	0

Physical Soil Properties

United States

Map symbol and soil name	Depth	Sand	Silt	Clay	Moist bulk density	Saturated hydraulic conductivity	Available water capacity	Linear extensi-bility	Organic matter	Erosion factors			Wind erodi-bility group	Wind erodi-bility index
										Kw	Kf	T		
	In	Pct	Pct	Pct	g/cc	micro m/sec	In/In	Pct	Pct					
s5177:														
Travessilla	0-2	---	---	15-20	1.45-1.55	14.11-42.34	0.08-0.13	0.0-2.9	0.4-0.6	.28	.28	1	3	---
	2-12	---	---	15-27	1.45-1.55	14.11-42.34	0.08-0.17	0.0-2.9	---	.37	.37			
	12-16	---	---	---	---	---	---	---	---	---	---			
Weska	0-1	---	---	28-35	1.40-1.50	1.41-4.23	0.19-0.21	3.0-5.9	0.5-0.7	.37	.37	1	6	---
	1-7	---	---	28-35	1.40-1.50	1.41-4.23	0.19-0.21	3.0-5.9	---	.37	.37			
	7-11	---	---	---	---	---	---	---	---	---	---			
Oelop	0-3	---	---	18-27	1.15-1.25	4.23-14.11	0.19-0.21	0.0-2.9	1.0-2.0	.43	.43	5	6	---
	3-44	---	---	18-35	1.45-1.55	1.41-4.23	0.17-0.20	3.0-5.9	0.0-0.5	.37	.37			
	44-60	---	---	10-17	1.40-1.50	14.11-42.34	0.11-0.13	0.0-2.9	0.0-0.5	.24	.24			
Blancot	0-2	---	---	15-26	1.20-1.30	4.23-14.11	0.13-0.19	0.0-2.9	0.0-0.7	.43	.43	5	6	---
	2-15	---	---	20-35	1.40-1.50	4.23-14.11	0.14-0.19	3.0-5.9	---	.37	.37			
	15-60	---	---	18-35	1.40-1.50	4.23-14.11	0.13-0.19	3.0-5.9	---	.32	.32			
Notal	0-3	---	---	28-35	1.40-1.50	1.41-4.23	0.09-0.11	3.0-5.9	0.5-0.7	.37	.37	5	4L	---
	3-60	---	---	40-50	1.35-1.45	0.00-0.42	0.08-0.10	6.0-8.9	---	.24	.24			
Twick	0-4	---	---	28-35	1.40-1.50	1.41-4.23	0.15-0.19	3.0-5.9	1.0-2.0	.20	.37	1	5	---
	4-17	---	---	35-60	1.30-1.40	0.42-1.41	0.13-0.17	6.0-8.9	---	.28	.28			
	17-21	---	---	---	---	---	---	---	---	---	---			
Silver	0-4	---	---	30-40	---	1.41-4.23	0.14-0.16	3.0-5.9	1.0-2.0	.20	.37	5	4	---
	4-60	---	---	35-50	---	0.42-1.41	0.15-0.17	6.0-8.9	---	.32	.32			
	60-70	---	---	30-40	---	1.41-4.23	0.14-0.16	3.0-5.9	---	.15	.28			
s5179:														
Badland	0-60	---	---	---	---	---	---	---	---	---	---	---	8	0

Physical Soil Properties

United States

Map symbol and soil name	Depth	Sand	Silt	Clay	Moist bulk density	Saturated hydraulic conductivity	Available water capacity	Linear extensi-bility	Organic matter	Erosion factors			Wind erodi-bility group	Wind erodi-bility index
										Kw	Kf	T		
	In	*Pct*	*Pct*	*Pct*	*g/cc*	*micro m/sec*	*In/In*	*Pct*	*Pct*					
s5179:														
Persayo	0-4	---	---	27-35	1.35-1.45	1.41-4.23	0.15-0.17	3.0-5.9	0.5-1.0	.37	.37	1	8	0
	4-14	---	---	20-35	1.25-1.35	1.41-4.23	0.17-0.19	3.0-5.9	---	.37	.37			
	14-18	---	---	---	---	0.00-1.41	---	---	---	---	---			
Farb	0-7	---	---	15-20	1.45-1.55	14.11-42.34	0.08-0.13	0.0-2.9	0.0-0.7	.28	.28	1	3	---
	7-10	---	---	10-20	1.45-1.55	14.11-42.34	0.06-0.13	0.0-2.9	0.0-0.5	.24	.24			
	10-14	---	---	---	---	---	---	---	---	---	---			
Blancot	0-2	---	---	15-26	1.20-1.30	4.23-14.11	0.13-0.19	0.0-2.9	0.0-0.7	.43	.43	5	6	---
	2-15	---	---	20-35	1.40-1.50	4.23-14.11	0.14-0.19	3.0-5.9	---	.37	.37			
	15-60	---	---	18-35	1.40-1.50	4.23-14.11	0.13-0.19	3.0-5.9	---	.32	.32			
Rock outcrop	0-60	---	---	---	---	---	---	---	---	---	---	---	8	0
Blackston	0-14	---	---	15-25	---	4.23-14.11	0.11-0.14	0.0-2.9	0.5-1.0	.10	.17	3	8	0
	14-28	---	---	15-25	---	4.23-14.11	0.07-0.10	0.0-2.9	---	.10	.28			
	28-60	---	---	0-5	---	42.34-141.14	0.03-0.06	0.0-2.9	---	.10	.28			
Fruitland	0-7	---	---	5-10	1.45-1.55	14.11-42.34	0.11-0.13	0.0-2.9	0.6-0.8	.28	.28	5	3	---
	7-60	---	---	5-18	1.45-1.55	14.11-42.34	0.11-0.13	0.0-2.9	0.0-0.5	.28	.28			
Sheppard	0-6	---	---	5-10	1.45-1.60	42.34-141.14	0.06-0.08	0.0-2.9	0.0-0.5	.15	.15	5	2	---
	6-60	---	---	5-10	1.45-1.60	42.34-141.14	0.06-0.08	0.0-2.9	---	.15	.15			
Stumble	0-5	---	---	0-10	---	42.34-141.14	0.06-0.08	0.0-2.9	---	.17	.17	5	2	---
	5-29	---	---	0-10	---	42.34-141.14	0.06-0.08	0.0-2.9	---	.15	.15			
	29-49	---	---	0-5	---	42.34-141.14	0.04-0.06	0.0-2.9	---	.10	.24			
	49-81	---	---	0-10	---	42.34-141.14	0.06	0.0-2.9	---	.15	.15			
Notal	0-3	---	---	28-35	1.40-1.50	1.41-4.23	0.09-0.11	3.0-5.9	0.5-0.7	.37	.37	5	4L	---
	3-60	---	---	40-50	1.35-1.45	0.00-0.42	0.08-0.10	6.0-8.9	---	.24	.24			

Physical Soil Properties

United States

Map symbol and soil name	Depth	Sand	Silt	Clay	Moist bulk density	Saturated hydraulic conductivity	Available water capacity	Linear extensi-bility	Organic matter	Erosion factors Kw	Erosion factors Kf	Erosion factors T	Wind erodi-bility group	Wind erodi-bility index
	In	*Pct*	*Pct*	*Pct*	*g/cc*	*micro m/sec*	*In/In*	*Pct*	*Pct*					
s5179:														
Riverwash	0-3	---	---	7-15	---	4.23-14.11	0.13-0.14	0.0-2.9	0.0-0.1	---	---	---	5	---
	3-60	---	---	3-10	---	14.11-42.34	0.07-0.09	0.0-2.9	---	---	---			
Shiprock	0-2	---	---	10-20	1.45-1.55	14.11-42.34	0.09-0.12	0.0-2.9	0.5-0.6	.28	.28	5	3	---
	2-60	---	---	10-18	1.45-1.55	14.11-42.34	0.09-0.12	0.0-2.9	---	.28	.28			
s5180:														
Doak	0-5	---	---	15-27	1.20-1.30	4.23-14.11	0.15-0.17	0.0-2.9	0.5-0.6	.37	.37	5	5	---
	5-43	---	---	25-35	1.45-1.55	1.41-4.23	0.15-0.18	3.0-5.9	0.0-0.5	.37	.37			
	43-69	---	---	25-35	1.40-1.50	1.41-4.23	0.15-0.18	3.0-5.9	0.0-0.5	.37	.37			
Sheppard	0-6	---	---	5-10	1.45-1.60	42.34-141.14	0.06-0.08	0.0-2.9	0.0-0.5	.15	.15	5	2	---
	6-60	---	---	5-10	1.45-1.60	42.34-141.14	0.06-0.08	0.0-2.9	---	.15	.15			
Shiprock	0-2	---	---	10-20	1.45-1.55	14.11-42.34	0.09-0.12	0.0-2.9	0.5-0.6	.28	.28	5	3	---
	2-60	---	---	10-18	1.45-1.55	14.11-42.34	0.09-0.12	0.0-2.9	---	.28	.28			
Blancot	0-2	---	---	15-26	1.20-1.30	4.23-14.11	0.13-0.19	0.0-2.9	0.0-0.7	.43	.43	5	6	---
	2-15	---	---	20-35	1.40-1.50	4.23-14.11	0.14-0.19	3.0-5.9	---	.37	.37			
	15-60	---	---	18-35	1.40-1.50	4.23-14.11	0.13-0.19	3.0-5.9	---	.32	.32			
Fruitland	0-7	---	---	5-10	1.45-1.55	14.11-42.34	0.11-0.13	0.0-2.9	0.6-0.8	.28	.28	5	3	---
	7-60	---	---	5-18	1.45-1.55	14.11-42.34	0.11-0.13	0.0-2.9	0.0-0.5	.28	.28			
Notal	0-3	---	---	28-35	1.40-1.50	1.41-4.23	0.09-0.11	3.0-5.9	0.5-0.7	.37	.37	5	4L	---
	3-60	---	---	40-50	1.35-1.45	0.00-0.42	0.08-0.10	6.0-8.9	---	.24	.24			
Persayo	0-4	---	---	27-35	1.35-1.45	1.41-4.23	0.15-0.17	3.0-5.9	0.5-1.0	.37	.37	1	8	0
	4-14	---	---	20-35	1.25-1.35	1.41-4.23	0.17-0.19	3.0-5.9	---	.37	.37			
	14-18	---	---	---	---	0.00-1.41	---	---	---	---	---			

Physical Soil Properties

United States

Map symbol and soil name	Depth	Sand	Silt	Clay	Moist bulk density	Saturated hydraulic conductivity	Available water capacity	Linear extensi-bility	Organic matter	Erosion factors Kw	Erosion factors Kf	Erosion factors T	Wind erodi-bility group	Wind erodi-bility index
	In	Pct	Pct	Pct	g/cc	micro m/sec	In/In	Pct	Pct					
s5180:														
Badland	0-60	---	---	---	---	---	---	---	---	---	---	---	8	0
Stumble	0-5	---	---	0-10	---	42.34-141.14	0.06-0.08	0.0-2.9	---	.17	.17	5	2	---
	5-29	---	---	0-10	---	42.34-141.14	0.06-0.08	0.0-2.9	---	.15	.15			
	29-49	---	---	0-5	---	42.34-141.14	0.04-0.06	0.0-2.9	---	.10	.24			
	49-81	---	---	0-10	---	42.34-141.14	0.06	0.0-2.9	---	.15	.15			
s5181:														
Badland	0-60	---	---	---	---	---	---	---	---	---	---	---	8	0
Sheppard	0-6	---	---	5-10	1.45-1.60	42.34-141.14	0.06-0.08	0.0-2.9	0.0-0.5	.15	.15	5	2	---
	6-60	---	---	5-10	1.45-1.60	42.34-141.14	0.06-0.08	0.0-2.9	---	.15	.15			
Monierco	0-5	---	---	10-20	1.45-1.55	14.11-42.34	0.08-0.13	0.0-2.9	0.7-0.9	.28	.28	1	3	---
	5-16	---	---	18-35	1.40-1.50	1.41-4.23	0.13-0.19	3.0-5.9	---	.37	.37			
	16-20	---	---	---	---	---	---	---	---	---	---			
Rock outcrop	0-60	---	---	---	---	---	---	---	---	---	---	---	8	0
Fruitland	0-7	---	---	5-10	1.45-1.55	14.11-42.34	0.11-0.13	0.0-2.9	0.6-0.8	.28	.28	5	3	---
	7-60	---	---	5-18	1.45-1.55	14.11-42.34	0.11-0.13	0.0-2.9	0.0-0.5	.28	.28			
Huerfano	0-2	---	---	15-25	1.55-1.65	4.23-14.11	0.15-0.17	3.0-5.9	0.5-8.0	.37	.37	1	5	---
	2-15	---	---	28-35	1.40-1.50	1.41-4.23	0.15-0.19	3.0-5.9	---	.32	.32			
	15-19	---	---	---	---	---	---	---	---	---	---			
Notal	0-3	---	---	28-35	1.40-1.50	1.41-4.23	0.09-0.11	3.0-5.9	0.5-0.7	.37	.37	5	4L	---
	3-60	---	---	40-50	1.35-1.45	0.00-0.42	0.08-0.10	6.0-8.9	---	.24	.24			

Physical Soil Properties

United States

Map symbol and soil name	Depth	Sand	Silt	Clay	Moist bulk density	Saturated hydraulic conductivity	Available water capacity	Linear extensi-bility	Organic matter	Erosion factors			Wind erodi-bility group	Wind erodi-bility index
										Kw	Kf	T		
	In	Pct	Pct	Pct	g/cc	micro m/sec	In/In	Pct	Pct					
s5181:														
Avalon	0-11	---	---	15-20	1.40-1.50	4.23-14.11	0.16-0.18	0.0-2.9	0.5-1.0	.43	.43	3	4L	---
	11-42	---	---	18-35	1.40-1.50	4.23-14.11	0.15-0.17	3.0-5.9	---	.43	---			
	42-60	---	---	5-15	1.50-1.65	14.11-42.34	0.10-0.12	0.0-2.9	---	.32	.37			
Doak	0-5	---	---	15-27	1.20-1.30	4.23-14.11	0.15-0.17	0.0-2.9	0.5-0.6	.37	.37	5	5	---
	5-43	---	---	25-35	1.45-1.55	1.41-4.23	0.15-0.18	3.0-5.9	0.0-0.5	.37	.37			
	43-69	---	---	25-35	1.40-1.50	1.41-4.23	0.15-0.18	3.0-5.9	0.0-0.5	.37	.37			
Persayo	0-4	---	---	27-35	1.35-1.45	1.41-4.23	0.15-0.17	3.0-5.9	0.5-1.0	.37	.37	1	8	0
	4-14	---	---	20-35	1.25-1.35	1.41-4.23	0.17-0.19	3.0-5.9	---	.37	.37			
	14-18	---	---	---	---	0.00-1.41	---	---	---	---	---			
Blancot	0-2	---	---	15-26	1.20-1.30	4.23-14.11	0.13-0.19	0.0-2.9	0.0-0.7	.43	.43	5	6	---
	2-15	---	---	20-35	1.40-1.50	4.23-14.11	0.14-0.19	3.0-5.9	---	.37	.37			
	15-60	---	---	18-35	1.40-1.50	4.23-14.11	0.13-0.19	3.0-5.9	---	.32	.32			
Shiprock	0-2	---	---	10-20	1.45-1.55	14.11-42.34	0.09-0.12	0.0-2.9	0.5-0.6	.28	.28	5	3	---
	2-60	---	---	10-18	1.45-1.55	14.11-42.34	0.09-0.12	0.0-2.9	---	.28	.28			
Uffens	0-9	---	---	10-20	1.30-1.40	14.11-42.34	0.08-0.14	0.0-2.9	0.5-1.0	.20	.20	1	3	---
	9-20	---	---	25-35	1.20-1.30	1.41-4.23	0.05-0.10	3.0-5.9	---	.32	.32			
	20-60	---	---	20-30	1.20-1.35	1.41-4.23	0.05-0.10	3.0-5.9	---	.28	.28			
s5182:														
Sheppard	0-6	---	---	5-10	1.45-1.60	42.34-141.14	0.06-0.08	0.0-2.9	0.0-0.5	.15	.15	5	2	---
	6-60	---	---	5-10	1.45-1.60	42.34-141.14	0.06-0.08	0.0-2.9	---	.15	.15			
Huerfano	0-2	---	---	15-25	1.55-1.65	4.23-14.11	0.15-0.17	3.0-5.9	0.5-8.0	.37	.37	1	5	---
	2-15	---	---	28-35	1.40-1.50	1.41-4.23	0.15-0.19	3.0-5.9	---	.32	.32			
	15-19	---	---	---	---	---	---	---	---	---	---			

Physical Soil Properties

United States

Map symbol and soil name	Depth	Sand	Silt	Clay	Moist bulk density	Saturated hydraulic conductivity	Available water capacity	Linear extensi-bility	Organic matter	Erosion factors			Wind erodi-bility group	Wind erodi-bility index
										Kw	Kf	T		
	In	*Pct*	*Pct*	*Pct*	*g/cc*	*micro m/sec*	*In/In*	*Pct*	*Pct*					
s5182:														
Notal	0-3	---	---	28-35	1.40-1.50	1.41-4.23	0.09-0.11	3.0-5.9	0.5-0.7	.37	.37	5	4L	---
	3-60	---	---	40-50	1.35-1.45	0.00-0.42	0.08-0.10	6.0-8.9	---	.24	.24			
Shiprock	0-2	---	---	10-20	1.45-1.55	14.11-42.34	0.09-0.12	0.0-2.9	0.5-0.6	.28	.28	5	3	---
	2-60	---	---	10-18	1.45-1.55	14.11-42.34	0.09-0.12	0.0-2.9	---	.28	.28			
Muff	0-5	---	---	5-15	1.25-1.35	4.23-14.11	0.13-0.15	0.0-2.9	0.5-1.0	.32	.32	2	3	---
	5-19	---	---	20-35	1.20-1.35	0.42-1.41	0.04-0.16	3.0-5.9	0.0-0.5	.37	.37			
	19-30	---	---	20-30	1.25-1.40	1.41-4.23	0.12-0.14	3.0-5.9	0.0-0.5	.32	.32			
	30-34	---	---	---	---	---	---	---	---	---	---			
Blancot	0-2	---	---	15-26	1.20-1.30	4.23-14.11	0.13-0.19	0.0-2.9	0.0-0.7	.43	.43	5	6	---
	2-15	---	---	20-35	1.40-1.50	4.23-14.11	0.14-0.19	3.0-5.9	---	.37	.37			
	15-60	---	---	18-35	1.40-1.50	4.23-14.11	0.13-0.19	3.0-5.9	---	.32	.32			
Avalon	0-11	---	---	5-15	1.50-1.60	14.11-42.34	0.11-0.13	0.0-2.9	0.5-1.0	.37	.37	3	3	---
	11-42	---	---	18-35	1.40-1.50	4.23-14.11	0.15-0.17	3.0-5.9	---	.43	---			
	42-60	---	---	5-15	1.50-1.65	14.11-42.34	0.10-0.12	0.0-2.9	---	.32	.37			
Badland	0-60	---	---	---	---	---	---	---	---	---	---	---	8	0
Doak	0-5	---	---	15-27	1.20-1.30	4.23-14.11	0.15-0.17	0.0-2.9	0.5-0.6	.37	.37	5	5	---
	5-43	---	---	25-35	1.45-1.55	1.41-4.23	0.15-0.18	3.0-5.9	0.0-0.5	.37	.37			
	43-69	---	---	25-35	1.40-1.50	1.41-4.23	0.15-0.18	3.0-5.9	0.0-0.5	.37	.37			
Uffens	0-9	---	---	10-20	1.30-1.40	14.11-42.34	0.08-0.14	0.0-2.9	0.5-1.0	.20	.20	1	3	---
	9-20	---	---	25-35	1.20-1.30	1.41-4.23	0.05-0.10	3.0-5.9	---	.32	.32			
	20-60	---	---	20-30	1.20-1.35	1.41-4.23	0.05-0.10	3.0-5.9	---	.28	.28			

Physical Soil Properties

United States

Map symbol and soil name	Depth	Sand	Silt	Clay	Moist bulk density	Saturated hydraulic conductivity	Available water capacity	Linear extensi-bility	Organic matter	Erosion factors			Wind erodi-bility group	Wind erodi-bility index
										Kw	Kf	T		
	In	Pct	Pct	Pct	g/cc	micro m/sec	In/In	Pct	Pct					
s5182:														
Monierco	0-5	---	---	10-20	1.45-1.55	14.11-42.34	0.08-0.13	0.0-2.9	0.7-0.9	.28	.28	1	3	---
	5-16	---	---	18-35	1.40-1.50	1.41-4.23	0.13-0.19	3.0-5.9	---	.37	.37			
	16-20	---	---	---	---	---	---	---	---	---	---			
Rock outcrop	0-60	---	---	---	---	---	---	---	---	---	---	---	8	0
s5183:														
Badland	0-60	---	---	---	---	---	---	---	---	---	---	---	8	0
Rock outcrop	0-60	---	---	---	---	---	---	---	---	---	---	---	8	0
Riverwash	0-3	---	---	7-15	---	4.23-14.11	0.13-0.14	0.0-2.9	0.0-0.1	---	---	---	5	---
	3-60	---	---	3-10	---	14.11-42.34	0.07-0.09	0.0-2.9	---	---	---			
Blancot	0-2	---	---	15-26	1.20-1.30	4.23-14.11	0.13-0.19	0.0-2.9	0.0-0.7	.43	.43	5	6	---
	2-15	---	---	20-35	1.40-1.50	4.23-14.11	0.14-0.19	3.0-5.9	---	.37	.37			
	15-60	---	---	18-35	1.40-1.50	4.23-14.11	0.13-0.19	3.0-5.9	---	.32	.32			
Notal	0-3	---	---	28-35	1.40-1.50	1.41-4.23	0.09-0.11	3.0-5.9	0.5-0.7	.37	.37	5	4L	---
	3-60	---	---	40-50	1.35-1.45	0.00-0.42	0.08-0.10	6.0-8.9	---	.24	.24			
s5184:														
Badland	0-60	---	---	---	---	---	---	---	---	---	---	---	8	0
Fruitland	0-7	---	---	5-10	1.45-1.55	14.11-42.34	0.11-0.13	0.0-2.9	0.6-0.8	.28	.28	5	3	---
	7-60	---	---	5-18	1.45-1.55	14.11-42.34	0.11-0.13	0.0-2.9	0.0-0.5	.28	.28			
Blancot	0-2	---	---	15-26	1.20-1.30	4.23-14.11	0.13-0.19	0.0-2.9	0.0-0.7	.43	.43	5	6	---
	2-15	---	---	20-35	1.40-1.50	4.23-14.11	0.14-0.19	3.0-5.9	---	.37	.37			
	15-60	---	---	18-35	1.40-1.50	4.23-14.11	0.13-0.19	3.0-5.9	---	.32	.32			

Physical Soil Properties

United States

Map symbol and soil name	Depth	Sand	Silt	Clay	Moist bulk density	Saturated hydraulic conductivity	Available water capacity	Linear extensi-bility	Organic matter	Erosion factors			Wind erodi-bility group	Wind erodi-bility index
										Kw	Kf	T		
	In	*Pct*	*Pct*	*Pct*	*g/cc*	*micro m/sec*	*In/In*	*Pct*	*Pct*					
s5184:														
Persayo	0-4	---	---	27-35	1.35-1.45	1.41-4.23	0.15-0.17	3.0-5.9	0.5-1.0	.37	.37	1	8	0
	4-14	---	---	20-35	1.25-1.35	1.41-4.23	0.17-0.19	3.0-5.9	---	.37	.37			
	14-18	---	---	---	---	0.00-1.41	---	---	---	---	---			
Sheppard	0-6	---	---	5-10	1.45-1.60	42.34-141.14	0.06-0.08	0.0-2.9	0.0-0.5	.15	.15	5	2	---
	6-60	---	---	5-10	1.45-1.60	42.34-141.14	0.06-0.08	0.0-2.9	---	.15	.15			
Notal	0-3	---	---	28-35	1.40-1.50	1.41-4.23	0.09-0.11	3.0-5.9	0.5-0.7	.37	.37	5	4L	---
	3-60	---	---	40-50	1.35-1.45	0.00-0.42	0.08-0.10	6.0-8.9	---	.24	.24			
s5185:														
Shiprock	0-2	---	---	10-20	1.45-1.55	14.11-42.34	0.09-0.12	0.0-2.9	0.5-0.6	.28	.28	5	3	---
	2-60	---	---	10-18	1.45-1.55	14.11-42.34	0.09-0.12	0.0-2.9	---	.28	.28			
Avalon	0-11	---	---	5-15	1.50-1.60	14.11-42.34	0.11-0.13	0.0-2.9	0.5-1.0	.37	.37	3	3	---
	11-42	---	---	18-35	1.40-1.50	4.23-14.11	0.15-0.17	3.0-5.9	---	.43	---			
	42-60	---	---	5-15	1.50-1.65	14.11-42.34	0.10-0.12	0.0-2.9	---	.32	.37			
Sheppard	0-6	---	---	5-10	1.45-1.60	42.34-141.14	0.06-0.08	0.0-2.9	0.0-0.5	.15	.15	5	2	---
	6-60	---	---	5-10	1.45-1.60	42.34-141.14	0.06-0.08	0.0-2.9	---	.15	.15			
Mayqueen	0-3	---	---	5-10	1.40-1.50	42.34-141.14	0.06-0.10	0.0-2.9	0.0-0.5	.20	.20	5	2	---
	3-12	---	---	8-18	1.45-1.55	14.11-42.34	0.10-0.14	0.0-2.9	---	.28	.28			
	12-60	---	---	5-10	1.40-1.50	42.34-141.14	0.07-0.10	0.0-2.9	---	.20	.20			
Doak	0-5	---	---	15-27	1.20-1.30	4.23-14.11	0.15-0.17	0.0-2.9	0.5-0.6	.37	.37	5	5	---
	5-43	---	---	25-35	1.45-1.55	1.41-4.23	0.15-0.18	3.0-5.9	0.0-0.5	.37	.37			
	43-69	---	---	25-35	1.40-1.50	1.41-4.23	0.15-0.18	3.0-5.9	0.0-0.5	.37	.37			

Physical Soil Properties

United States

Map symbol and soil name	Depth	Sand	Silt	Clay	Moist bulk density	Saturated hydraulic conductivity	Available water capacity	Linear extensi-bility	Organic matter	Erosion factors			Wind erodi-bility group	Wind erodi-bility index
										Kw	Kf	T		
	In	*Pct*	*Pct*	*Pct*	*g/cc*	*micro m/sec*	*In/In*	*Pct*	*Pct*					
s5186:														
Doak	0-5	---	---	15-27	1.20-1.30	4.23-14.11	0.15-0.17	0.0-2.9	0.5-0.6	.37	.37	5	5	---
	5-43	---	---	25-35	1.45-1.55	1.41-4.23	0.15-0.18	3.0-5.9	0.0-0.5	.37	.37			
	43-69	---	---	25-35	1.40-1.50	1.41-4.23	0.15-0.18	3.0-5.9	0.0-0.5	.37	.37			
Uffens	0-9	---	---	10-20	1.30-1.40	14.11-42.34	0.08-0.14	0.0-2.9	0.5-1.0	.20	.20	1	3	---
	9-20	---	---	25-35	1.20-1.30	1.41-4.23	0.05-0.10	3.0-5.9	---	.32	.32			
	20-60	---	---	20-30	1.20-1.35	1.41-4.23	0.05-0.10	3.0-5.9	---	.28	.28			
Sheppard	0-6	---	---	5-10	1.45-1.60	42.34-141.14	0.06-0.08	0.0-2.9	0.0-0.5	.15	.15	5	2	---
	6-60	---	---	5-10	1.45-1.60	42.34-141.14	0.06-0.08	0.0-2.9	---	.15	.15			
Shiprock	0-2	---	---	10-20	1.45-1.55	14.11-42.34	0.09-0.12	0.0-2.9	0.5-0.6	.28	.28	5	3	---
	2-60	---	---	10-18	1.45-1.55	14.11-42.34	0.09-0.12	0.0-2.9	---	.28	.28			
Avalon	0-11	---	---	5-15	1.50-1.60	14.11-42.34	0.11-0.13	0.0-2.9	0.5-1.0	.37	.37	3	3	---
	11-42	---	---	18-35	1.40-1.50	4.23-14.11	0.15-0.17	3.0-5.9	---	.43	---			
	42-60	---	---	5-15	1.50-1.65	14.11-42.34	0.10-0.12	0.0-2.9	---	.32	.37			
Mayqueen	0-3	---	---	5-10	1.40-1.50	42.34-141.14	0.06-0.10	0.0-2.9	0.0-0.5	.20	.20	5	2	---
	3-12	---	---	8-18	1.45-1.55	14.11-42.34	0.10-0.14	0.0-2.9	---	.28	.28			
	12-60	---	---	5-10	1.40-1.50	42.34-141.14	0.07-0.10	0.0-2.9	---	.20	.20			
Fruitland	0-7	---	---	5-10	1.45-1.55	14.11-42.34	0.11-0.13	0.0-2.9	0.6-0.8	.28	.28	5	3	---
	7-60	---	---	5-18	1.45-1.55	14.11-42.34	0.11-0.13	0.0-2.9	0.0-0.5	.28	.28			
Huerfano	0-2	---	---	15-25	1.55-1.65	4.23-14.11	0.15-0.17	3.0-5.9	0.5-8.0	.37	.37	1	5	---
	2-15	---	---	28-35	1.40-1.50	1.41-4.23	0.15-0.19	3.0-5.9	---	.32	.32			
	15-19	---	---	---	---	---	---	---	---	---	---			

Physical Soil Properties

United States

Map symbol and soil name	Depth	Sand	Silt	Clay	Moist bulk density	Saturated hydraulic conductivity	Available water capacity	Linear extensi-bility	Organic matter	Erosion factors Kw	Kf	T	Wind erodi-bility group	Wind erodi-bility index
	In	Pct	Pct	Pct	g/cc	micro m/sec	In/In	Pct	Pct					
s5186:														
Monierco	0-5	---	---	10-20	1.45-1.55	14.11-42.34	0.08-0.13	0.0-2.9	0.7-0.9	.28	.28	1	3	---
	5-16	---	---	18-35	1.40-1.50	1.41-4.23	0.13-0.19	3.0-5.9	---	.37	.37			
	16-20	---	---	---	---	---	---	---	---	---	---			
s5187:														
Gobernador	0-2	---	---	28-35	1.30-1.40	1.41-4.23	0.10-0.11	3.0-5.9	1.0-2.0	.37	.37	5	4L	---
	2-60	---	---	40-50	1.35-1.45	0.42-1.41	0.07-0.08	6.0-8.9	0.0-0.5	.24	.24			
Orlie	0-2	---	---	15-20	1.15-1.25	1.41-4.23	0.11-0.14	0.0-2.9	2.0-3.0	.28	.32	5	3	---
	2-22	---	---	28-35	1.40-1.50	1.41-4.23	0.19-0.21	3.0-5.9	0.7-0.9	.37	.37			
	22-60	---	---	28-35	1.40-1.50	1.41-4.23	0.16-0.20	3.0-5.9	0.0-0.5	.37	.37			
Sparham	0-4	---	---	35-39	1.30-1.45	1.41-4.23	0.19-0.21	3.0-5.9	0.7-0.9	.32	.32	5	4L	---
	4-41	---	---	40-50	1.35-1.50	0.00-0.42	0.14-0.16	6.0-8.9	0.0-0.5	.20	.20			
	41-54	---	---	40-50	1.30-1.40	0.42-1.41	0.15-0.17	6.0-8.9	0.0-0.5	.32	.32			
	54-60	---	---	10-20	1.50-1.60	14.11-42.34	0.11-0.13	0.0-2.9	---	.24	.24			
s5188:														
Sparank	0-2	---	---	20-27	1.10-1.20	4.23-14.11	0.10-0.12	0.0-2.9	1.0-2.0	.43	.43	5	4L	---
	2-60	---	---	35-50	1.35-1.45	0.00-0.42	0.10-0.12	6.0-8.9	0.0-0.5	.37	.37			
Pinavetes	0-10	---	---	3-10	1.40-1.50	42.34-141.14	0.06-0.08	0.0-2.9	0.5-1.0	.17	.17	5	2	---
	10-60	---	---	7-15	1.40-1.50	42.34-141.14	0.05-0.07	0.0-2.9	0.0-0.8	.20	.20			
San Mateo	0-2	---	---	30-40	1.35-1.45	1.41-4.23	0.19-0.21	3.0-5.9	0.5-0.9	.37	.37	5	4L	---
	2-29	---	---	20-35	1.35-1.45	4.23-14.11	0.15-0.17	3.0-5.9	---	.32	.32			
	29-60	---	---	18-35	1.35-1.45	4.23-14.11	0.15-0.17	3.0-5.9	---	.32	.43			
Florita	0-4	---	---	15-20	1.35-1.45	14.11-42.34	0.08-0.13	0.0-2.9	1.0-3.0	.24	.24	5	3	---
	4-43	---	---	5-20	1.45-1.55	14.11-42.34	0.10-0.13	0.0-2.9	---	.20	.20			
	43-60	---	---	0-5	1.40-1.50	42.34-141.14	0.03-0.05	0.0-2.9	---	.20	.20			

Physical Soil Properties

United States

Map symbol and soil name	Depth	Sand	Silt	Clay	Moist bulk density	Saturated hydraulic conductivity	Available water capacity	Linear extensi-bility	Organic matter	Erosion factors			Wind erodi-bility group	Wind erodi-bility index
										Kw	Kf	T		
	In	*Pct*	*Pct*	*Pct*	*g/cc*	*micro m/sec*	*In/In*	*Pct*	*Pct*					
s5188:														
Riverwash	0-3	---	---	7-15	---	4.23-14.11	0.13-0.14	0.0-2.9	0.0-0.1	---	---	---	5	---
	3-60	---	---	3-10	---	14.11-42.34	0.07-0.09	0.0-2.9	---	---	---			
s5189:														
Penistaja	0-4	---	---	10-20	1.35-1.45	4.23-14.11	0.13-0.15	0.0-2.9	0.8-2.0	.28	.28	5	3	---
	4-28	---	---	20-30	1.40-1.50	4.23-14.11	0.15-0.18	0.0-2.9	0.0-0.5	.32	.32			
	28-60	---	---	15-25	1.20-1.30	14.11-42.34	0.12-0.15	0.0-2.9	0.0-0.5	.28	.28			
Sedale	0-2	---	---	5-18	1.45-1.55	14.11-42.34	0.10-0.15	0.0-2.9	0.5-0.9	.28	.28	1	3	---
	2-8	---	---	5-18	1.45-1.55	14.11-42.34	0.10-0.15	0.0-2.9	---	.32	.32			
	8-15	---	---	---	---	---	---	---	---	---	---			
	15-19	---	---	---	---	---	---	---	---	---	---			
Menefee	0-2	---	---	30-35	1.15-1.25	1.41-4.23	0.17-0.19	3.0-5.9	2.0-3.0	.37	.37	1	4L	---
	2-14	---	---	20-35	1.15-1.25	0.42-1.41	0.16-0.19	3.0-5.9	---	.37	.37			
	14-18	---	---	---	---	---	---	---	---	---	---			
Rock outcrop	0-60	---	---	---	---	---	---	---	---	---	---	---	8	0
Hosta	0-8	---	---	30-40	1.20-1.35	1.41-4.23	0.18-0.20	3.0-5.9	1.0-3.0	.32	.32	5	6	---
	8-46	---	---	35-55	1.30-1.50	0.42-1.41	0.14-0.16	6.0-8.9	---	.20	.20			
	46-60	---	---	30-50	1.50-1.60	0.42-1.41	0.12-0.16	6.0-8.9	---	.37	.37			
s5192:														
Pinitos	0-2	---	---	15-25	1.45-1.55	4.23-14.11	0.16-0.18	0.0-2.9	0.5-0.9	.37	.37	5	4	---
	2-24	---	---	20-35	1.40-1.50	4.23-14.11	0.17-0.19	3.0-5.9	0.0-0.5	.32	.32			
	24-60	---	---	15-25	1.40-1.50	14.11-42.34	0.13-0.15	0.0-2.9	0.0-0.5	.28	.28			
Royosa	0-8	---	---	0-6	1.35-1.45	141.14	0.06-0.07	0.0-2.9	1.0-2.0	.17	.17	5	1	---
	8-60	---	---	0-10	1.40-1.50	141.14	0.05-0.08	0.0-2.9	0.0-0.5	.17	.17			

Physical Soil Properties

United States

Map symbol and soil name	Depth	Sand	Silt	Clay	Moist bulk density	Saturated hydraulic conductivity	Available water capacity	Linear extensi-bility	Organic matter	Erosion factors			Wind erodi-bility group	Wind erodi-bility index
										Kw	Kf	T		
	In	*Pct*	*Pct*	*Pct*	*g/cc*	*micro m/sec*	*In/In*	*Pct*	*Pct*					
s5193:														
Lybrook	0-5	---	---	28-35	1.40-1.50	1.41-4.23	0.14-0.18	3.0-5.9	0.2-0.5	.32	.32	5	4L	---
	5-30	---	---	35-45	1.55-1.65	0.42-1.41	0.14-0.18	3.0-5.9	---	.32	.32			
	30-60	---	---	35-45	1.40-1.50	0.42-1.41	0.10-0.12	3.0-5.9	---	.32	.32			
Tsosie	0-2	---	---	15-20	1.30-1.40	14.11-42.34	0.13-0.15	0.0-2.9	0.5-0.9	.28	.28	5	3	---
	2-26	---	---	18-35	1.45-1.55	1.41-4.23	0.14-0.17	3.0-5.9	---	.37	.37			
	26-36	---	---	20-35	1.45-1.55	4.23-14.11	0.11-0.14	3.0-5.9	---	.32	.32			
	36-60	---	---	18-35	1.30-1.45	4.23-14.11	0.10-0.15	3.0-5.9	---	.32	.43			
s5194:														
Nalivag	0-3	---	---	15-27	1.35-1.45	4.23-14.11	0.16-0.18	0.0-2.9	0.5-1.0	.37	.37	5	6	---
	3-60	---	---	20-35	1.45-1.55	1.41-4.23	0.17-0.20	3.0-5.9	0.5-1.0	.32	.32			
Ruson	0-2	---	---	20-26	1.00-1.15	4.23-14.11	0.19-0.21	0.0-2.9	1.0-2.0	.43	.49	5	4L	---
	2-19	---	---	35-40	1.40-1.50	1.41-4.23	0.17-0.19	3.0-5.9	0.0-0.5	.37	.37			
	19-60	---	---	40-50	1.40-1.50	0.42-1.41	0.13-0.15	6.0-8.9	0.0-0.5	.24	.28			
s5197:														
Berryman	0-3	---	---	18-26	1.15-1.25	4.23-14.11	0.19-0.21	0.0-2.9	1.0-2.0	.43	.43	5	4L	---
	3-60	---	---	18-35	1.45-1.55	0.42-1.41	0.18-0.20	3.0-5.9	0.0-0.5	.37	.37			
Menefee	0-2	---	---	30-35	1.15-1.25	1.41-4.23	0.17-0.19	3.0-5.9	2.0-3.0	.37	.37	1	4L	---
	2-14	---	---	20-35	1.15-1.25	0.42-1.41	0.16-0.19	3.0-5.9	---	.37	.37			
	14-18	---	---	---	---	---	---	---	---	---	---			
Calendar	0-2	---	---	20-26	1.15-1.25	4.23-14.11	0.11-0.13	0.0-2.9	1.0-2.0	.20	.43	2	5	---
	2-17	---	---	40-45	1.40-1.50	0.42-1.41	0.13-0.15	6.0-8.9	0.0-0.5	.20	.24			
	17-35	---	---	40-45	1.40-1.50	0.42-1.41	0.13-0.15	6.0-8.9	0.0-0.5	.20	.24			
	35-39	---	---	---	---	---	---	---	---	---	---			

Physical Soil Properties

United States

Map symbol and soil name	Depth	Sand	Silt	Clay	Moist bulk density	Saturated hydraulic conductivity	Available water capacity	Linear extensi-bility	Organic matter	Erosion factors Kw	Kf	T	Wind erodi-bility group	Wind erodi-bility index
	In	*Pct*	*Pct*	*Pct*	*g/cc*	*micro m/sec*	*In/In*	*Pct*	*Pct*					
s5213:														
Armijo	0-11	---	---	40-50	1.40-1.50	0.42-1.41	0.05-0.07	6.0-8.9	0.7-0.9	.20	.20	5	5	---
	11-33	---	---	40-50	1.40-1.50	0.00-0.42	0.05-0.08	6.0-8.9	---	.32	.32			
	33-60	---	---	30-45	1.40-1.50	0.42-1.41	0.05-0.09	6.0-8.9	---	.32	.32			
Tome	0-5	---	---	18-25	1.30-1.40	1.41-4.23	0.10-0.12	0.0-2.9	1.0-2.0	.37	.37	5	4L	---
	5-42	---	---	18-30	1.40-1.50	0.42-1.41	0.11-0.13	3.0-5.9	---	.37	.37			
	42-60	---	---	15-20	1.40-1.50	4.23-14.11	0.09-0.11	0.0-2.9	---	.55	.55			
Bluepoint	0-9	---	---	2-6	1.45-1.65	42.34-141.14	0.06-0.10	0.0-2.9	0.0-0.5	.17	.17	5	2	---
	9-24	---	---	2-6	1.50-1.65	42.34-141.14	0.05-0.08	0.0-2.9	---	.10	.28			
	24-41	---	---	2-6	1.50-1.65	42.34-141.14	0.05-0.09	0.0-2.9	---	.17	.17			
	41-60	---	---	2-10	1.50-1.65	14.11-42.34	0.05-0.14	0.0-2.9	---	.24	.24			
Tome	0-5	---	---	27-30	1.30-1.40	0.42-1.41	0.11-0.13	3.0-5.9	1.0-2.0	.37	.37	5	4L	---
	5-42	---	---	18-30	1.40-1.50	0.42-1.41	0.11-0.13	3.0-5.9	---	.37	.37			
	42-60	---	---	15-20	1.40-1.50	4.23-14.11	0.09-0.11	0.0-2.9	---	.55	.55			
Adelino	0-4	---	---	15-25	1.20-1.30	4.23-14.11	0.07-0.09	0.0-2.9	0.4-0.8	.37	.37	5	3	---
	4-38	---	---	20-35	1.40-1.50	4.23-14.11	0.09-0.11	3.0-5.9	---	.37	.37			
	38-60	---	---	15-25	1.20-1.30	14.11-42.34	0.07-0.09	0.0-2.9	---	.32	.32			
Adelino	0-4	---	---	5-10	1.40-1.50	14.11-42.34	0.07-0.09	0.0-2.9	0.3-0.6	.17	.17	5	2	---
	4-38	---	---	20-35	1.40-1.50	4.23-14.11	0.14-0.18	3.0-5.9	---	.37	.37			
	38-60	---	---	15-25	1.20-1.30	4.23-14.11	0.11-0.16	0.0-2.9	---	.32	.32			
s5224:														
Penistaja	0-4	---	---	10-20	1.35-1.45	4.23-14.11	0.13-0.15	0.0-2.9	0.8-2.0	.28	.28	5	3	---
	4-28	---	---	20-30	1.40-1.50	4.23-14.11	0.15-0.18	0.0-2.9	0.0-0.5	.32	.32			
	28-60	---	---	15-25	1.20-1.30	14.11-42.34	0.12-0.15	0.0-2.9	0.0-0.5	.28	.28			

Physical Soil Properties

United States

Map symbol and soil name	Depth	Sand	Silt	Clay	Moist bulk density	Saturated hydraulic conductivity	Available water capacity	Linear extensi-bility	Organic matter	Erosion factors Kw	Erosion factors Kf	Erosion factors T	Wind erodi-bility group	Wind erodi-bility index
	In	Pct	Pct	Pct	g/cc	micro m/sec	In/In	Pct	Pct					
s5224:														
Silver	0-3	---	---	15-25	1.15-1.25	4.23-14.11	0.14-0.16	0.0-2.9	1.0-2.0	.55	.43	5	5	---
	3-45	---	---	35-50	1.30-1.45	0.42-1.41	0.15-0.17	6.0-8.9	---	.37	.37			
	45-60	---	---	15-25	1.40-1.50	4.23-14.11	0.11-0.13	0.0-2.9	---	.28	.49			
	60-70	---	---	30-40	1.40-1.50	1.41-4.23	0.12-0.14	3.0-5.9	---	.15	.28			
Otero	0-14	---	---	10-20	1.40-1.45	14.11-42.34	0.11-0.13	0.0-2.9	0.5-2.0	.20	.20	5	3	---
	14-60	---	---	5-18	1.45-1.50	14.11-42.34	0.08-0.12	0.0-2.9	0.0-0.5	.17	.17			
Shingle	0-4	---	---	28-35	1.10-1.20	4.23-14.11	0.19-0.21	3.0-5.9	1.0-3.0	.32	.32	1	4L	---
	4-15	---	---	20-35	1.20-1.30	4.23-14.11	0.17-0.20	3.0-5.9	0.5-1.0	.49	.49			
	15-19	---	---	---	---	---	---	---	---	---	---			
Travessilla	0-2	---	---	15-20	1.45-1.55	14.11-42.34	0.08-0.13	0.0-2.9	0.4-0.6	.28	.28	1	3	---
	2-12	---	---	15-27	1.45-1.55	14.11-42.34	0.08-0.17	0.0-2.9	---	.37	.37			
	12-16	---	---	---	---	---	---	---	---	---	---			
Badland	0-60	---	---	---	---	---	---	---	---	---	---	---	8	0
s5225:														
Kim	0-6	---	---	10-18	1.30-1.40	4.23-14.11	0.15-0.17	0.0-2.9	0.5-1.0	.28	.28	5	3	---
	6-60	---	---	20-35	1.35-1.45	4.23-14.11	0.16-0.17	3.0-5.9	---	.32	.32			
Shingle	0-4	---	---	28-35	1.10-1.20	4.23-14.11	0.19-0.21	3.0-5.9	1.0-3.0	.32	.32	1	4L	---
	4-15	---	---	20-35	1.20-1.30	4.23-14.11	0.17-0.20	3.0-5.9	0.5-1.0	.49	.49			
	15-19	---	---	---	---	---	---	---	---	---	---			
Badland	0-60	---	---	---	---	---	---	---	---	---	---	---	8	0
Gila	0-10	---	---	27-30	1.40-1.50	1.41-4.23	0.19-0.21	0.0-2.9	0.5-1.0	.37	.37	5	4L	---
	10-60	---	---	10-20	1.30-1.60	1.41-4.23	0.18-0.20	0.0-2.9	---	.32	.37			

Physical Soil Properties

United States

Map symbol and soil name	Depth	Sand	Silt	Clay	Moist bulk density	Saturated hydraulic conductivity	Available water capacity	Linear extensi-bility	Organic matter	Erosion factors			Wind erodi-bility group	Wind erodi-bility index
										Kw	Kf	T		
	In	*Pct*	*Pct*	*Pct*	*g/cc*	*micro m/sec*	*In/In*	*Pct*	*Pct*					
s5225:														
Hantz	0-3	---	---	25-35	1.30-1.40	1.41-14.11	0.19-0.21	3.0-5.9	0.5-1.0	.37	.37	5	4L	---
	3-60	---	---	40-50	1.35-1.45	0.00-0.42	0.14-0.16	6.0-8.9	---	.24	.24			
	60-70	---	---	18-27	1.30-1.40	4.23-14.11	0.08-0.12	0.0-2.9	---	.20	.37			
s5227:														
Kokan	0-4	---	---	5-10	1.40-1.50	141.14	0.04-0.06	0.0-2.9	0.5-0.9	.02	.05	5	2	---
	4-60	---	---	2-10	1.40-1.50	141.14	0.03-0.05	0.0-2.9	---	.05	.24			
Vinton	0-12	---	---	5-15	---	14.11-42.34	0.08-0.12	0.0-2.9	0.5-1.0	.24	.24	5	3	---
	12-60	---	---	3-5	---	14.11-42.34	0.06-0.08	0.0-2.9	---	.10	.10			
Badland	0-60	---	---	---	---	---	---	---	---	---	---	---	8	0
Kim	0-6	---	---	10-18	1.30-1.40	4.23-14.11	0.15-0.17	0.0-2.9	0.5-1.0	.28	.28	5	3	---
	6-60	---	---	20-35	1.35-1.45	4.23-14.11	0.16-0.17	3.0-5.9	---	.32	.32			
Pajarito	0-5	---	---	15-20	1.45-1.55	14.11-42.34	0.13-0.15	0.0-2.9	0.5-0.8	.24	.24	5	3	---
	5-40	---	---	15-20	1.45-1.55	14.11-42.34	0.13-0.15	0.0-2.9	0.5-1.0	.24	.24			
	40-60	---	---	15-24	1.45-1.55	14.11-42.34	0.13-0.15	0.0-2.9	0.5-1.0	.24	.24			
	60-70	---	---	5-12	1.40-1.50	14.11-42.34	0.09-0.11	0.0-2.9	0.5-1.0	.17	.17			
s5228:														
Badland	0-60	---	---	---	---	---	---	---	---	---	---	---	8	0
Cudei	0-4	---	---	10-18	1.45-1.55	14.11-42.34	0.06-0.08	0.0-2.9	0.2-0.5	.10	.28	5	5	---
	4-12	---	---	15-25	1.50-1.55	4.23-14.11	0.07-0.09	0.0-2.9	---	.10	.37			
	12-42	---	---	20-35	1.60-1.70	1.41-4.23	0.09-0.11	3.0-5.9	---	.10	.37			
	42-60	---	---	20-35	1.60-1.70	4.23-14.11	0.07-0.09	3.0-5.9	---	.10	.32			

Physical Soil Properties

United States

Map symbol and soil name	Depth	Sand	Silt	Clay	Moist bulk density	Saturated hydraulic conductivity	Available water capacity	Linear extensi-bility	Organic matter	Erosion factors			Wind erodi-bility group	Wind erodi-bility index
										Kw	Kf	T		
	In	*Pct*	*Pct*	*Pct*	*g/cc*	*micro m/sec*	*In/In*	*Pct*	*Pct*					
s5228:														
Tocito	0-6	---	---	18-27	1.20-1.30	4.23-14.11	0.19-0.21	0.0-2.9	0.5-1.0	.43	.43	5	4L	---
	6-12	---	---	27-35	1.40-1.50	1.41-4.23	0.16-0.20	0.0-2.9	0.3-0.5	.32	.32			
	12-16	---	---	27-35	1.40-1.50	1.41-4.23	0.14-0.16	3.0-5.9	0.3-0.5	.37	.37			
	16-28	---	---	18-25	1.40-1.50	4.23-14.11	0.12-0.15	0.0-2.9	0.2-0.5	.43	.43			
	28-70	---	---	20-35	1.45-1.55	1.41-4.23	0.12-0.15	3.0-5.9	0.2-0.4	.43	.43			
Blackston	0-4	---	---	10-20	1.25-1.40	4.23-14.11	0.08-0.10	0.0-2.9	0.5-1.0	.17	.32	3	5	---
	4-25	---	---	23-35	1.20-1.35	4.23-14.11	0.10-0.14	0.0-2.9	0.5-1.0	.15	.43			
	25-60	---	---	5-10	1.35-1.45	42.34-141.14	0.02-0.05	0.0-2.9	0.5-1.0	.05	.37			
Kimbeto	0-2	---	---	15-20	1.40-1.50	14.11-42.34	0.12-0.14	0.0-2.9	0.5-0.8	.28	.28	5	3	---
	2-10	---	---	20-27	1.45-1.55	4.23-14.11	0.08-0.10	0.0-2.9	0.5-0.8	.37	.37			
	10-54	---	---	18-27	1.45-1.55	4.23-14.11	0.06-0.08	0.0-2.9	0.3-0.6	.28	.32			
	54-66	---	---	20-27	1.45-1.55	4.23-14.11	0.05-0.07	0.0-2.9	0.2-0.4	.15	.32			
Mesa	0-4	---	---	27-35	1.25-1.40	4.23-14.11	0.16-0.18	3.0-5.9	0.5-1.0	.28	.28	5	6	---
	4-14	---	---	25-30	1.25-1.40	1.41-14.11	0.17-0.20	3.0-5.9	---	.28	.28			
	14-20	---	---	25-30	1.25-1.40	4.23-14.11	0.14-0.17	3.0-5.9	---	.28	.28			
	20-60	---	---	25-30	1.25-1.40	4.23-14.11	0.08-0.12	0.0-2.9	---	.10	.28			
Fruitland	0-7	---	---	20-27	1.40-1.50	4.23-14.11	0.14-0.16	0.0-2.9	0.5-1.0	.32	.32	5	4L	---
	7-42	---	---	10-18	1.45-1.55	14.11-42.34	0.13-0.15	0.0-2.9	0.3-0.6	.28	.28			
	42-65	---	---	20-27	1.40-1.50	4.23-14.11	0.14-0.16	0.0-2.9	0.2-0.4	.32	.32			
Water	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Mesa	0-4	---	---	27-35	1.25-1.40	4.23-14.11	0.16-0.18	3.0-5.9	0.5-1.0	.28	.28	5	6	---
	4-14	---	---	25-30	1.25-1.40	1.41-14.11	0.17-0.20	3.0-5.9	---	.28	.28			
	14-20	---	---	25-30	1.25-1.40	4.23-14.11	0.14-0.17	3.0-5.9	---	.28	.28			
	20-60	---	---	25-30	1.25-1.40	4.23-14.11	0.08-0.12	0.0-2.9	---	.10	.28			

Physical Soil Properties

United States

Map symbol and soil name	Depth	Sand	Silt	Clay	Moist bulk density	Saturated hydraulic conductivity	Available water capacity	Linear extensi-bility	Organic matter	Erosion factors			Wind erodi-bility group	Wind erodi-bility index
										Kw	Kf	T		
	In	Pct	Pct	Pct	g/cc	micro m/sec	In/In	Pct	Pct					
s5228:														
Camac	0-3	---	---	10-18	1.40-1.50	14.11-42.34	0.06-0.08	0.0-2.9	0.4-0.6	.10	.28	2	6	---
	3-17	---	---	15-27	1.40-1.50	4.23-14.11	0.09-0.13	0.0-2.9	0.3-0.5	.15	.32			
	17-31	---	---	18-35	1.45-1.55	1.41-4.23	0.12-0.16	3.0-5.9	0.2-0.4	.32	.32			
	31-35	---	---	---	---	---	---	---	---	---	---			
Turley	0-2	---	---	10-20	1.45-1.55	14.11-42.34	0.11-0.13	0.0-2.9	0.2-0.3	.24	.24	5	3	---
	2-23	---	---	20-35	1.40-1.50	4.23-14.11	0.14-0.16	0.0-2.9	---	.32	.32			
	23-31	---	---	27-35	1.40-1.50	1.41-4.23	0.19-0.21	3.0-5.9	---	.32	.32			
	31-57	---	---	20-35	1.40-1.50	4.23-14.11	0.14-0.16	0.0-2.9	---	.32	.32			
	57-60	---	---	10-20	1.45-1.55	14.11-42.34	0.11-0.13	0.0-2.9	---	.24	.24			
Rock outcrop	0-60	---	---	---	---	---	---	---	---	---	---	---	8	0
Riverwash	0-3	---	---	7-15	---	4.23-14.11	0.13-0.14	0.0-2.9	0.0-0.1	---	---	---	5	---
	3-60	---	---	3-10	---	14.11-42.34	0.07-0.09	0.0-2.9	---	---	---			
Sheppard	0-6	---	---	5-10	1.45-1.60	42.34-141.14	0.06-0.08	0.0-2.9	0.0-0.5	.15	.15	5	2	---
	6-60	---	---	5-10	1.45-1.60	42.34-141.14	0.06-0.08	0.0-2.9	---	.15	.15			
s5229:														
Littlehat	0-2	---	---	18-27	1.20-1.30	4.23-14.11	0.10-0.16	0.0-2.9	0.3-0.5	.43	.43	2	4L	---
	2-31	---	---	18-35	1.30-1.50	4.23-14.11	0.04-0.10	3.0-5.9	0.2-0.4	.43	.43			
	31-35	---	---	---	---	---	---	---	---	---	---			
Persayo	0-5	---	---	18-27	1.20-1.30	4.23-14.11	0.15-0.17	3.0-5.9	0.5-1.0	.37	.37	1	4L	---
	5-12	---	---	20-35	1.10-1.20	1.41-4.23	0.16-0.18	3.0-5.9	---	.49	.49			
	12-16	---	---	---	---	0.00-14.11	---	---	---	---	---			
Lawet	0-10	---	---	10-18	1.40-1.50	4.23-14.11	0.15-0.17	0.0-2.9	0.2-0.4	.55	.55	5	3	---
	10-29	---	---	18-27	1.40-1.50	4.23-14.11	0.15-0.18	0.0-2.9	---	.55	.55			
	29-60	---	---	18-27	1.40-1.50	4.23-14.11	0.12-0.14	0.0-2.9	---	.37	.37			

Physical Soil Properties

United States

Map symbol and soil name	Depth	Sand	Silt	Clay	Moist bulk density	Saturated hydraulic conductivity	Available water capacity	Linear extensi-bility	Organic matter	Erosion factors Kw	Kf	T	Wind erodi-bility group	Wind erodi-bility index
	In	Pct	Pct	Pct	g/cc	micro m/sec	In/In	Pct	Pct					
s5229:														
Nataani	0-3	---	---	10-18	1.40-1.50	4.23-14.11	0.15-0.17	0.0-2.9	0.4-0.8	.55	.55	2	3	---
	3-9	---	---	15-20	1.35-1.45	4.23-14.11	0.15-0.18	0.0-2.9	0.4-0.6	.49	.49			
	9-21	---	---	---	1.15-1.35	4.23-14.11	0.10-0.15	0.0-2.9	0.4-0.6	.49	.49			
	21-30	---	---	10-18	1.50-1.60	4.23-14.11	0.08-0.10	0.0-2.9	0.3-0.5	.49	.49			
	30-34	---	---	---	---	---	---	---	---	---	---			
Nakai	0-18	---	---	3-10	1.45-1.55	42.34-141.14	0.07-0.09	0.0-2.9	0.5-1.0	.28	.28	5	2	---
	18-34	---	---	8-18	1.50-1.60	14.11-42.34	0.10-0.18	0.0-2.9	0.0-0.5	.43	.43			
	34-60	---	---	5-10	1.55-1.65	42.34-141.14	0.08-0.11	0.0-2.9	0.0-0.5	.28	.28			
Badland	0-60	---	---	---	---	---	---	---	---	---	---	---	8	0
Gyptur	0-2	---	---	15-18	1.35-1.45	4.23-14.11	0.15-0.17	0.0-2.9	0.4-0.6	.55	.55	3	3	---
	2-5	---	---	27-35	1.20-1.30	1.41-4.23	0.19-0.21	3.0-5.9	0.2-0.5	.37	.37			
	5-17	---	---	---	1.20-1.30	1.41-4.23	0.09-0.17	0.0-2.9	0.2-0.5	.43	.43			
	17-46	---	---	18-35	1.20-1.30	1.41-4.23	0.04-0.05	3.0-5.9	0.2-0.5	.37	.37			
	46-50	---	---	---	---	---	---	---	---	---	---			
Tsebitai	0-5	---	---	10-18	1.40-1.50	4.23-14.11	0.15-0.17	0.0-2.9	0.4-0.6	.55	.55	5	3	---
	5-26	---	---	10-18	1.40-1.50	4.23-14.11	0.15-0.17	0.0-2.9	0.4-0.6	.43	.43			
	26-64	---	---	8-18	1.40-1.50	4.23-14.11	0.11-0.17	0.0-2.9	0.3-0.5	.43	.43			
Benally	0-2	---	---	20-25	1.30-1.40	4.23-14.11	0.12-0.14	0.0-2.9	0.2-0.6	.32	.32	3	5	---
	2-18	---	---	25-35	1.40-1.50	0.42-1.41	0.04-0.08	3.0-5.9	---	.32	.32			
	18-45	---	---	20-30	1.40-1.50	4.23-14.11	0.06-0.08	0.0-2.9	---	.32	.32			
	45-49	---	---	---	---	---	---	---	---	---	---			
Rock outcrop	0-60	---	---	---	---	---	---	---	---	---	---	---	8	0
Gullied land	0-60	---	---	---	---	---	---	---	---	---	---	---	8	0

Physical Soil Properties

United States

Map symbol and soil name	Depth	Sand	Silt	Clay	Moist bulk density	Saturated hydraulic conductivity	Available water capacity	Linear extensi-bility	Organic matter	Erosion factors			Wind erodi-bility group	Wind erodi-bility index
										Kw	Kf	T		
	In	*Pct*	*Pct*	*Pct*	*g/cc*	*micro m/sec*	*In/In*	*Pct*	*Pct*					
s5229:														
Tocito	0-6	---	---	18-27	1.20-1.30	4.23-14.11	0.19-0.21	0.0-2.9	0.5-1.0	.43	.43	5	4L	---
	6-12	---	---	27-35	1.40-1.50	1.41-4.23	0.16-0.20	0.0-2.9	0.3-0.5	.32	.32			
	12-16	---	---	27-35	1.40-1.50	1.41-4.23	0.14-0.16	3.0-5.9	0.3-0.5	.37	.37			
	16-28	---	---	18-25	1.40-1.50	4.23-14.11	0.12-0.15	0.0-2.9	0.2-0.5	.43	.43			
	28-70	---	---	20-35	1.45-1.55	1.41-4.23	0.12-0.15	3.0-5.9	0.2-0.4	.43	.43			
s5233:														
Querencia	0-4	---	---	12-25	1.30-1.40	4.23-14.11	0.15-0.17	0.0-2.9	1.0-2.0	.37	.37	5	4L	---
	4-24	---	---	18-30	1.35-1.45	4.23-14.11	0.15-0.17	0.0-2.9	---	.37	.37			
	24-60	---	---	15-25	1.40-1.50	4.23-14.11	0.14-0.16	0.0-2.9	---	.37	.37			
Sandoval	0-2	---	---	10-18	1.35-1.45	4.23-14.11	0.12-0.14	0.0-2.9	1.0-2.0	.28	.32	1	3	---
	2-15	---	---	18-35	1.45-1.55	1.41-4.23	0.17-0.19	3.0-5.9	---	.37	.37			
	15-19	---	---	---	---	---	---	---	---	---	---			
Sparank	0-2	---	---	30-40	1.35-1.45	1.41-4.23	0.19-0.21	3.0-5.9	1.0-2.0	.37	.37	5	4L	---
	2-60	---	---	35-50	1.50-1.60	0.00-0.42	0.16-0.18	6.0-8.9	---	.37	.37			
San Mateo	0-2	---	---	10-18	1.40-1.50	14.11-42.34	0.11-0.13	0.0-2.9	0.5-0.9	.24	.24	5	3	---
	2-29	---	---	20-35	1.35-1.45	4.23-14.11	0.15-0.17	3.0-5.9	---	.32	.32			
	29-60	---	---	18-35	1.35-1.45	4.23-14.11	0.15-0.17	3.0-5.9	---	.32	.43			
Skyvillage	0-2	---	---	10-15	1.35-1.45	14.11-42.34	0.11-0.13	0.0-2.9	1.0-2.0	.28	.28	1	3	---
	2-16	---	---	10-18	1.45-1.55	14.11-42.34	0.14-0.16	0.0-2.9	---	.32	.32			
	16-20	---	---	---	---	---	---	---	---	---	---			
Zia	0-5	---	---	8-20	1.45-1.55	14.11-42.34	0.11-0.13	0.0-2.9	0.5-0.9	.24	.28	5	3	---
	5-60	---	---	8-20	1.50-1.60	14.11-42.34	0.11-0.14	0.0-2.9	---	.28	.28			
Rock outcrop	0-60	---	---	---	---	---	---	---	---	---	---	---	8	0

Physical Soil Properties

United States

Map symbol and soil name	Depth	Sand	Silt	Clay	Moist bulk density	Saturated hydraulic conductivity	Available water capacity	Linear extensi-bility	Organic matter	Erosion factors			Wind erodi-bility group	Wind erodi-bility index
										Kw	Kf	T		
	In	Pct	Pct	Pct	g/cc	micro m/sec	In/In	Pct	Pct					
s5235:														
Rock outcrop	0-60	---	---	---	---	---	---	---	---	---	---	---	8	0
Zia	0-5	---	---	8-20	1.45-1.55	14.11-42.34	0.11-0.13	0.0-2.9	0.5-0.9	.24	.28	5	3	---
	5-60	---	---	8-20	1.50-1.60	14.11-42.34	0.11-0.14	0.0-2.9	---	.28	.28			
Sandoval	0-2	---	---	10-18	1.35-1.45	4.23-14.11	0.12-0.14	0.0-2.9	1.0-2.0	.28	.32	1	3	---
	2-15	---	---	18-35	1.45-1.55	1.41-4.23	0.17-0.19	3.0-5.9	---	.37	.37			
	15-19	---	---	---	---	---	---	---	---	---	---			
San Mateo	0-2	---	---	15-25	1.35-1.45	4.23-14.11	0.16-0.18	0.0-2.9	0.5-0.9	.37	.37	5	4L	---
	2-29	---	---	20-35	1.35-1.45	4.23-14.11	0.15-0.17	3.0-5.9	---	.32	.32			
	29-60	---	---	18-35	1.35-1.45	4.23-14.11	0.15-0.17	3.0-5.9	---	.32	.43			
Penistaja	0-4	---	---	10-20	1.35-1.45	4.23-14.11	0.13-0.15	0.0-2.9	0.8-2.0	.28	.28	5	3	---
	4-28	---	---	20-30	1.40-1.50	4.23-14.11	0.15-0.18	0.0-2.9	0.0-0.5	.32	.32			
	28-60	---	---	15-25	1.20-1.30	14.11-42.34	0.12-0.15	0.0-2.9	0.0-0.5	.28	.28			
Saido	0-5	---	---	10-15	1.35-1.45	4.23-14.11	0.17-0.19	0.0-2.9	0.2-0.6	.43	.43	5	4L	---
	5-60	---	---	10-18	1.05-1.15	4.23-14.11	0.19-0.21	0.0-2.9	0.2-0.6	.37	.37			
Skyvillage	0-2	---	---	10-15	1.35-1.45	14.11-42.34	0.11-0.13	0.0-2.9	1.0-2.0	.28	.28	1	3	---
	2-16	---	---	10-18	1.45-1.55	14.11-42.34	0.14-0.16	0.0-2.9	---	.32	.32			
	16-20	---	---	---	---	---	---	---	---	---	---			
Hagerman	0-3	---	---	10-20	1.45-1.55	14.11-42.34	0.13-0.15	0.0-2.9	0.8-0.9	.28	.28	2	3	---
	3-30	---	---	18-35	1.40-1.50	4.23-14.11	0.15-0.17	3.0-5.9	0.0-0.5	.32	.32			
	30-34	---	---	---	---	---	---	---	---	---	---			
Sparank	0-2	---	---	30-40	1.25-1.35	1.41-4.23	0.05-0.06	3.0-5.9	1.0-2.0	.37	.37	5	4L	---
	2-60	---	---	35-50	1.35-1.45	0.00-0.42	0.04-0.06	6.0-8.9	---	.37	.37			

Physical Soil Properties

United States

Map symbol and soil name	Depth	Sand	Silt	Clay	Moist bulk density	Saturated hydraulic conductivity	Available water capacity	Linear extensi-bility	Organic matter	Erosion factors			Wind erodi-bility group	Wind erodi-bility index
										Kw	Kf	T		
	In	*Pct*	*Pct*	*Pct*	*g/cc*	*micro m/sec*	*In/In*	*Pct*	*Pct*					
s5235:														
Querencia	0-4	---	---	12-17	1.35-1.45	14.11-42.34	0.12-0.14	0.0-2.9	1.0-2.0	.28	.32	5	3	---
	4-24	---	---	18-30	1.35-1.45	4.23-14.11	0.15-0.17	0.0-2.9	---	.37	.37			
	24-60	---	---	15-25	1.40-1.50	4.23-14.11	0.14-0.16	0.0-2.9	---	.37	.37			
s5248:														
Sheppard	0-6	---	---	5-10	1.45-1.60	42.34-141.14	0.06-0.08	0.0-2.9	0.0-0.5	.15	.15	5	2	---
	6-60	---	---	5-10	1.45-1.60	42.34-141.14	0.06-0.08	0.0-2.9	---	.15	.15			
Fajada	0-2	---	---	18-26	1.50-1.55	4.23-14.11	0.13-0.15	0.0-2.9	0.2-0.6	.37	.37	3	4L	---
	2-6	---	---	27-34	1.50-1.60	0.42-1.41	0.07-0.10	3.0-5.9	---	.32	.32			
	6-16	---	---	24-34	1.40-1.45	1.41-4.23	0.06-0.08	3.0-5.9	---	.32	.32			
	16-28	---	---	27-34	1.50-1.60	1.41-4.23	0.06-0.10	3.0-5.9	---	.32	.32			
	28-60	---	---	---	---	---	---	---	---	---	---			
Sparank	0-2	---	---	30-40	1.35-1.45	1.41-4.23	0.19-0.21	3.0-5.9	1.0-2.0	.37	.37	5	4L	---
	2-60	---	---	35-50	1.50-1.60	0.00-0.42	0.16-0.18	6.0-8.9	---	.37	.37			
s5250:														
Mion	0-2	---	---	30-35	1.30-1.40	1.41-4.23	0.14-0.16	3.0-5.9	2.0-4.0	.15	.28	1	5	---
	2-16	---	---	38-55	1.35-1.45	0.00-0.42	0.15-0.17	6.0-8.9	---	.24	.24			
	16-20	---	---	---	---	---	---	---	---	---	---			
Rock outcrop	0-60	---	---	---	---	---	---	---	---	---	---	---	8	0
Atarque	0-2	---	---	10-18	1.40-1.50	14.11-42.34	0.11-0.13	0.0-2.9	0.5-0.9	.24	.24	1	3	---
	2-16	---	---	24-35	1.40-1.50	4.23-14.11	0.14-0.16	3.0-5.9	---	.32	.32			
	16-22	---	---	---	---	---	---	---	---	---	---			

Physical Soil Properties

United States

Map symbol and soil name	Depth	Sand	Silt	Clay	Moist bulk density	Saturated hydraulic conductivity	Available water capacity	Linear extensi-bility	Organic matter	Erosion factors Kw	Kf	T	Wind erodi-bility group	Wind erodi-bility index
	In	Pct	Pct	Pct	g/cc	micro m/sec	In/In	Pct	Pct					
s5251:														
Doak	0-5	---	---	10-20	1.40-1.50	14.11-42.34	0.11-0.14	0.0-2.9	0.5-0.6	.28	.28	5	3	---
	5-43	---	---	25-35	1.45-1.55	1.41-4.23	0.15-0.18	3.0-5.9	0.0-0.5	.37	.37			
	43-69	---	---	25-35	1.40-1.50	1.41-4.23	0.15-0.18	3.0-5.9	0.0-0.5	.37	.37			
Kiki	0-6	---	---	13-19	1.45-1.55	14.11-42.34	0.11-0.13	0.0-2.9	0.3-0.6	.24	.28	2	3	---
	6-14	---	---	28-35	1.45-1.55	4.23-14.11	0.17-0.19	3.0-5.9	---	.32	.32			
	14-24	---	---	21-32	1.45-1.55	4.23-14.11	0.14-0.16	3.0-5.9	---	.32	.32			
	24-28	---	---	---	---	---	---	---	---	---	---			
s5252:														
Doakum	0-5	---	---	10-20	1.40-1.50	14.11-42.34	0.13-0.15	0.0-2.9	0.5-0.6	.28	.28	5	3	---
	5-17	---	---	18-35	1.45-1.55	4.23-14.11	0.17-0.20	3.0-5.9	---	.32	.32			
	17-60	---	---	20-35	1.40-1.50	4.23-14.11	0.12-0.15	3.0-5.9	---	.32	.32			
Betonnie	0-2	---	---	5-15	1.45-1.55	14.11-42.34	0.09-0.15	0.0-2.9	0.4-0.5	.28	.28	5	3	---
	2-60	---	---	8-18	1.45-1.55	14.11-42.34	0.09-0.15	0.0-2.9	---	.28	.32			
s5253:														
Blancot	0-2	---	---	10-20	1.40-1.50	14.11-42.34	0.13-0.15	0.0-2.9	0.5-0.7	.28	.28	5	3	---
	2-23	---	---	20-35	1.45-1.55	1.41-4.23	0.15-0.19	3.0-5.9	---	.32	.32			
	23-60	---	---	8-18	1.40-1.50	14.11-42.34	0.11-0.14	0.0-2.9	---	.24	.24			
Councelor	0-2	---	---	5-15	1.50-1.60	14.11-42.34	0.13-0.15	0.0-2.9	0.3-0.5	.28	.28	5	3	---
	2-60	---	---	5-18	1.50-1.60	14.11-42.34	0.11-0.18	0.0-2.9	0.0-0.5	.37	.37			
Tsosie	0-2	---	---	15-20	1.30-1.40	14.11-42.34	0.13-0.15	0.0-2.9	0.5-0.9	.28	.28	5	3	---
	2-26	---	---	18-35	1.45-1.55	1.41-4.23	0.14-0.17	3.0-5.9	---	.37	.37			
	26-36	---	---	20-35	1.45-1.55	4.23-14.11	0.11-0.14	3.0-5.9	---	.32	.32			
	36-60	---	---	18-35	1.30-1.45	4.23-14.11	0.10-0.15	3.0-5.9	---	.32	.43			

Physical Soil Properties

United States

Map symbol and soil name	Depth	Sand	Silt	Clay	Moist bulk density	Saturated hydraulic conductivity	Available water capacity	Linear extensi-bility	Organic matter	Erosion factors			Wind erodi-bility group	Wind erodi-bility index
										Kw	Kf	T		
	In	*Pct*	*Pct*	*Pct*	*g/cc*	*micro m/sec*	*In/In*	*Pct*	*Pct*					
s5331:														
Cabezon	0-4	---	---	28-35	1.20-1.30	1.41-4.23	0.16-0.18	3.0-5.9	2.0-4.0	.15	.24	1	7	---
	4-12	---	---	35-50	1.35-1.45	0.42-1.41	0.12-0.14	6.0-8.9	---	.24	.28			
	12-16	---	---	---	---	---	---	---	---	---	---			
Hubbell	0-4	---	---	5-12	1.50-1.60	14.11-42.34	0.06-0.08	0.0-2.9	1.0-2.0	.17	.17	5	2	---
	4-60	---	---	5-18	1.30-1.40	14.11-42.34	0.08-0.10	0.0-2.9	---	.20	.20			
Thunderbird	0-5	---	---	20-27	1.45-1.55	4.23-14.11	0.15-0.17	0.0-2.9	1.0-2.0	.37	.43	2	6	---
	5-23	---	---	35-55	1.40-1.55	0.00-0.42	0.14-0.16	6.0-8.9	---	.28	.43			
	23-27	---	---	---	---	---	---	---	---	---	---			
Rudd	0-10	---	---	20-27	---	4.23-14.11	0.12-0.14	0.0-2.9	1.0-3.0	.20	.37	1	5	---
	10-13	---	---	20-32	---	4.23-14.11	0.09-0.11	0.0-2.9	---	.10	.37			
	13-17	---	---	---	---	---	---	---	---	---	---			
Veteado	0-6	---	---	15-20	1.35-1.45	14.11-42.34	0.11-0.13	0.0-2.9	0.9-1.0	.24	.28	5	3	---
	6-16	---	---	35-60	1.30-1.40	0.42-1.41	0.14-0.16	6.0-8.9	---	.24	.24			
	16-28	---	---	25-35	1.40-1.50	1.41-4.23	0.15-0.17	3.0-5.9	---	.32	.32			
	28-60	---	---	18-35	1.40-1.50	4.23-14.11	0.13-0.15	0.0-2.9	---	.32	.32			
Modyon	0-3	---	---	20-25	1.15-1.25	4.23-14.11	0.12-0.14	0.0-2.9	1.0-3.0	.20	.37	2	5	---
	3-16	---	---	18-35	1.40-1.50	4.23-14.11	0.08-0.10	0.0-2.9	---	.10	.32			
	16-28	---	---	18-35	1.40-1.50	4.23-14.11	0.07-0.09	0.0-2.9	---	.10	.32			
	28-32	---	---	---	---	---	---	---	---	---	---			
Penistaja	0-4	---	---	10-20	1.35-1.45	4.23-14.11	0.13-0.15	0.0-2.9	0.8-2.0	.28	.28	5	3	---
	4-28	---	---	20-30	1.40-1.50	4.23-14.11	0.15-0.18	0.0-2.9	0.0-0.5	.32	.32			
	28-60	---	---	15-25	1.20-1.30	14.11-42.34	0.12-0.15	0.0-2.9	0.0-0.5	.28	.28			

Physical Soil Properties

United States

Map symbol and soil name	Depth	Sand	Silt	Clay	Moist bulk density	Saturated hydraulic conductivity	Available water capacity	Linear extensi- bility	Organic matter	Erosion factors			Wind erodi- bility group	Wind erodi- bility index
										Kw	Kf	T		
	In	Pct	Pct	Pct	g/cc	micro m/sec	In/In	Pct	Pct					
s5331:														
Celsosprings	0-3	---	---	20-27	1.15-1.25	4.23-14.11	0.17-0.20	0.0-2.9	1.0-3.0	.43	.49	5	6	---
	3-13	---	---	35-45	1.35-1.45	0.42-1.41	0.16-0.18	6.0-8.9	---	.32	.32			
	13-26	---	---	35-45	1.35-1.45	0.42-1.41	0.13-0.15	6.0-8.9	---	.15	.28			
	26-33	---	---	35-45	1.35-1.45	0.42-1.41	0.13-0.15	6.0-8.9	---	.15	.24			
	33-60	---	---	20-35	1.40-1.50	4.23-14.11	0.16-0.18	3.0-5.9	---	.24	.37			
Ceniza	0-6	---	---	12-18	1.05-1.15	42.34-141.14	0.05-0.07	0.0-2.9	1.0-3.0	.05	.32	5	8	0
	6-30	---	---	12-18	0.80-0.95	14.11-42.34	0.06-0.08	0.0-2.9	---	.10	.32			
	30-42	---	---	0-5	0.70-0.90	141.14	0.03-0.05	0.0-2.9	---	.02	---			
	42-60	---	---	20-30	1.20-1.30	4.23-14.11	0.14-0.16	0.0-2.9	---	.32	.32			
Abrazo	0-2	---	---	10-20	1.35-1.45	4.23-14.11	0.16-0.18	0.0-2.9	1.0-2.0	.37	.43	2	5	---
	2-20	---	---	35-55	1.35-1.45	0.42-1.41	0.14-0.16	6.0-8.9	---	.20	.24			
	20-27	---	---	40-55	1.35-1.45	0.42-1.41	0.14-0.16	6.0-8.9	---	.20	.24			
	27-31	---	---	---	---	---	---	---	---	---	---			
Apache	0-3	---	---	10-17	1.35-1.45	14.11-42.34	0.09-0.11	0.0-2.9	1.0-2.0	.15	.28	1	4	---
	3-10	---	---	15-25	1.40-1.50	4.23-14.11	0.15-0.17	0.0-2.9	---	.37	.37			
	10-14	---	---	10-18	1.45-1.55	14.11-42.34	0.09-0.11	0.0-2.9	---	.15	.28			
	14-18	---	---	---	---	---	---	---	---	---	---			
Flaco	0-2	---	---	13-26	1.15-1.25	4.23-14.11	0.12-0.14	0.0-2.9	1.0-2.0	.20	.37	2	5	---
	2-11	---	---	18-35	1.20-1.30	1.41-4.23	0.17-0.19	3.0-5.9	---	.37	.37			
	11-29	---	---	18-30	1.40-1.50	4.23-14.11	0.15-0.17	0.0-2.9	---	.32	.32			
	29-33	---	---	---	---	---	---	---	---	---	---			
Gatlin	0-4	---	---	15-25	1.30-1.40	4.23-14.11	0.08-0.10	0.0-2.9	1.0-3.0	.10	.32	5	6	---
	4-10	---	---	20-30	1.20-1.30	4.23-14.11	0.09-0.11	0.0-2.9	---	.10	.28			
	10-60	---	---	5-10	1.40-1.50	141.14	0.03-0.05	0.0-2.9	---	.02	.10			

Physical Soil Properties

United States

Map symbol and soil name	Depth	Sand	Silt	Clay	Moist bulk density	Saturated hydraulic conductivity	Available water capacity	Linear extensi-bility	Organic matter	Erosion factors			Wind erodi-bility group	Wind erodi-bility index
										Kw	Kf	T		
	In	*Pct*	*Pct*	*Pct*	*g/cc*	*micro m/sec*	*In/In*	*Pct*	*Pct*					
s5396:														
Datil	0-7	---	---	15-25	1.15-1.25	4.23-14.11	0.15-0.17	0.0-2.9	1.0-3.0	.37	.49	5	5	---
	7-22	---	---	18-35	1.45-1.55	4.23-14.11	0.15-0.18	3.0-5.9	---	.32	.32			
	22-40	---	---	15-25	1.40-1.50	4.23-14.11	0.12-0.15	0.0-2.9	---	.32	.32			
	40-60	---	---	15-25	1.40-1.50	4.23-14.11	0.09-0.11	0.0-2.9	---	.20	.32			
Loarc	0-14	---	---	10-15	1.35-1.45	14.11-42.34	0.11-0.13	0.0-2.9	1.0-3.0	.24	.24	5	3	---
	14-23	---	---	18-35	1.40-1.50	4.23-14.11	0.14-0.16	3.0-5.9	---	.32	.32			
	23-36	---	---	10-25	1.45-1.55	14.11-42.34	0.11-0.13	0.0-2.9	---	.24	.28			
	36-60	---	---	10-25	1.40-1.50	14.11-42.34	0.09-0.11	0.0-2.9	---	.15	.24			
Guy	0-3	---	---	5-17	1.30-1.40	14.11-42.34	0.08-0.10	0.0-2.9	1.0-2.0	.15	.28	5	5	---
	3-10	---	---	5-17	1.45-1.55	14.11-42.34	0.08-0.10	0.0-2.9	1.0-2.0	.15	.28			
	10-60	---	---	5-17	1.45-1.55	14.11-42.34	0.10-0.12	0.0-2.9	0.5-1.0	.20	.32			
Dioxice	0-3	---	---	18-23	1.45-1.55	4.23-14.11	0.15-0.17	0.0-2.9	1.0-2.0	.37	.43	5	5	---
	3-24	---	---	20-35	1.55-1.70	4.23-14.11	0.13-0.15	3.0-5.9	---	.32	.37			
	24-60	---	---	20-27	1.50-1.60	4.23-14.11	0.13-0.15	0.0-2.9	---	.32	.49			
Millpaw	0-4	---	---	18-25	1.15-1.25	4.23-14.11	0.16-0.18	0.0-2.9	2.0-3.0	.37	.37	5	6	---
	4-35	---	---	35-50	1.40-1.50	0.42-1.41	0.17-0.19	6.0-8.9	---	.32	.32			
	35-60	---	---	18-35	1.40-1.50	4.23-14.11	0.16-0.18	3.0-5.9	---	.37	.37			
Gustspring	0-2	---	---	15-20	1.35-1.45	4.23-14.11	0.15-0.17	0.0-2.9	1.0-3.0	.37	.43	2	5	---
	2-11	---	---	18-35	1.40-1.50	4.23-14.11	0.08-0.10	3.0-5.9	---	.20	.37			
	11-22	---	---	5-10	1.45-1.55	14.11-42.34	0.05-0.07	0.0-2.9	---	.10	.24			
	22-60	---	---	5-10	1.40-1.50	42.34-141.14	0.02-0.04	0.0-2.9	---	.05	.10			

Physical Soil Properties

United States

Map symbol and soil name	Depth	Sand	Silt	Clay	Moist bulk density	Saturated hydraulic conductivity	Available water capacity	Linear extensi-bility	Organic matter	Erosion factors Kw	Erosion factors Kf	Erosion factors T	Wind erodi-bility group	Wind erodi-bility index
	In	Pct	Pct	Pct	g/cc	micro m/sec	In/In	Pct	Pct					
s5396:														
Hiarc	0-2	---	---	15-20	1.35-1.45	14.11-42.34	0.12-0.14	0.0-2.9	1.0-2.0	.28	.28	2	3	---
	2-7	---	---	15-20	1.45-1.55	14.11-42.34	0.11-0.13	0.0-2.9	---	.24	.24			
	7-19	---	---	20-25	1.45-1.55	4.23-14.11	0.15-0.17	0.0-2.9	---	.37	.37			
	19-27	---	---	18-25	1.45-1.55	4.23-14.11	0.11-0.13	0.0-2.9	---	.24	.24			
	27-31	---	---	---	---	---	---	---	---	---	---			
Amenson	0-3	---	---	20-27	1.30-1.40	4.23-14.11	0.16-0.18	0.0-2.9	1.0-3.0	.37	.37	1	4L	---
	3-11	---	---	27-35	1.40-1.50	1.41-4.23	0.16-0.18	3.0-5.9	---	.32	.32			
	11-15	---	---	15-27	1.40-1.50	4.23-14.11	0.12-0.14	0.0-2.9	---	.28	.28			
	15-20	---	---	---	---	---	---	---	---	---	---			
	20-24	---	---	---	---	---	---	---	---	---	---			
Joachem	0-3	---	---	8-15	1.25-1.35	14.11-42.34	0.08-0.10	0.0-2.9	2.0-4.0	.15	.28	1	5	---
	3-8	---	---	9-18	1.45-1.55	4.23-14.11	0.10-0.12	0.0-2.9	---	.20	.28			
	8-11	---	---	5-10	1.45-1.55	4.23-14.11	0.07-0.10	0.0-2.9	---	.15	.32			
	11-15	---	---	---	---	---	---	---	---	---	---			
Landavaso	0-10	---	---	15-20	1.30-1.40	14.11-42.34	0.10-0.12	0.0-2.9	1.0-2.0	.24	.24	3	3	---
	10-27	---	---	20-35	1.45-1.55	4.23-14.11	0.11-0.13	0.0-2.9	---	.15	.28			
	27-60	---	---	0-8	1.40-1.50	42.34-141.14	0.03-0.05	0.0-2.9	---	.05	.10			
Pena	0-8	---	---	7-15	1.30-1.40	14.11-42.34	0.11-0.13	0.0-2.9	1.0-2.0	.24	.28	5	3	---
	8-30	---	---	10-30	1.30-1.45	4.23-14.11	0.07-0.09	0.0-2.9	---	.10	.32			
	30-60	---	---	7-27	1.30-1.40	4.23-14.11	0.03-0.08	0.0-2.9	---	.05	.43			
	60-70	---	---	20-30	1.30-1.40	4.23-14.11	0.03-0.08	0.0-2.9	---	.05	.32			
Ralphston	0-2	---	---	12-17	1.15-1.25	4.23-14.11	0.15-0.17	0.0-2.9	2.0-4.0	.37	.43	5	4L	---
	2-13	---	---	18-25	1.35-1.45	4.23-14.11	0.14-0.16	0.0-2.9	---	.37	.37			
	13-60	---	---	18-35	1.45-1.55	4.23-14.11	0.16-0.18	3.0-5.9	---	.37	.32			
Rock outcrop	0-60	---	---	---	---	---	---	---	---	---	---	---	8	0

Physical Soil Properties

United States

Map symbol and soil name	Depth	Sand	Silt	Clay	Moist bulk density	Saturated hydraulic conductivity	Available water capacity	Linear extensi-bility	Organic matter	Erosion factors			Wind erodi-bility group	Wind erodi-bility index
										Kw	Kf	T		
	In	*Pct*	*Pct*	*Pct*	*g/cc*	*micro m/sec*	*In/In*	*Pct*	*Pct*					
s5399:														
Rock outcrop	0-60	---	---	---	---	---	---	---	---	---	---	---	8	0
Motoqua	0-2	---	---	10-20	---	4.23-14.11	0.12-0.14	0.0-2.9	1.0-2.0	.20	.37	1	7	---
	2-16	---	---	20-32	---	4.23-14.11	0.09-0.11	0.0-2.9	---	.10	.32			
	16-20	---	---	---	---	---	---	---	---	---	---			
Mion	0-2	---	---	30-35	1.30-1.40	1.41-4.23	0.14-0.16	3.0-5.9	2.0-4.0	.15	.28	1	5	---
	2-16	---	---	38-55	1.35-1.45	0.00-0.42	0.15-0.17	6.0-8.9	---	.24	.24			
	16-20	---	---	---	---	---	---	---	---	---	---			
Abrazo	0-8	---	---	15-25	1.20-1.30	4.23-14.11	0.08-0.10	0.0-2.9	1.0-3.0	.20	.37	2	6	---
	8-26	---	---	35-45	1.45-1.55	0.42-1.41	0.12-0.14	3.0-5.9	---	.15	.24			
	26-30	---	---	---	---	---	---	---	---	---	---			
Gustspring	0-2	---	---	10-15	1.35-1.45	14.11-42.34	0.06-0.08	0.0-2.9	1.0-2.0	.10	.24	2	6	---
	2-11	---	---	18-35	1.40-1.50	4.23-14.11	0.08-0.10	3.0-5.9	---	.20	.37			
	11-22	---	---	5-10	1.45-1.55	14.11-42.34	0.05-0.07	0.0-2.9	---	.10	.24			
	22-60	---	---	5-10	1.40-1.50	42.34-141.14	0.02-0.04	0.0-2.9	---	.05	.10			
Travessilla	0-3	---	---	10-18	1.35-1.45	14.11-42.34	0.05-0.07	0.0-2.9	1.0-2.0	.10	.24	1	4	---
	3-13	---	---	10-18	1.40-1.50	14.11-42.34	0.08-0.10	0.0-2.9	---	.15	.28			
	13-17	---	---	---	---	---	---	---	---	---	---			
Goldust	0-7	---	---	10-20	1.35-1.45	14.11-42.34	0.08-0.10	0.0-2.9	1.0-2.0	.15	.28	5	5	---
	7-27	---	---	35-55	1.35-1.45	0.42-1.41	0.09-0.11	3.0-5.9	---	.10	.32			
	27-60	---	---	18-20	1.40-1.50	14.11-42.34	0.04-0.06	0.0-2.9	---	.10	.24			

Physical Soil Properties

United States

Map symbol and soil name	Depth	Sand	Silt	Clay	Moist bulk density	Saturated hydraulic conductivity	Available water capacity	Linear extensi-bility	Organic matter	Erosion factors Kw	Kf	T	Wind erodi-bility group	Wind erodi-bility index
	In	*Pct*	*Pct*	*Pct*	*g/cc*	*micro m/sec*	*In/In*	*Pct*	*Pct*					
s5399:														
Parquat	0-2	---	---	12-20	1.40-1.50	14.11-42.34	0.05-0.07	0.0-2.9	1.0-2.0	.10	.24	3	4L	---
	2-12	---	---	35-40	1.35-1.45	1.41-4.23	0.09-0.11	3.0-5.9	---	.10	.32			
	12-19	---	---	35-45	1.35-1.45	1.41-4.23	0.08-0.10	3.0-5.9	---	.10	.32			
	19-33	---	---	10-20	1.30-1.40	14.11-42.34	0.09-0.11	0.0-2.9	---	.15	.24			
	33-60	---	---	5-15	1.40-1.50	42.34-141.14	0.04-0.06	0.0-2.9	---	.10	.24			
s5400:														
Puertecito	0-2	---	---	12-18	1.45-1.55	4.23-14.11	0.08-0.10	0.0-2.9	1.0-2.0	.10	.32	1	7	---
	2-14	---	---	23-35	1.60-1.70	1.41-4.23	0.09-0.11	3.0-5.9	0.5-1.0	.10	.37			
	14-18	---	---	---	---	---	---	---	---	---	---			
Rock outcrop	0-60	---	---	---	---	---	---	---	---	---	---	---	8	0
Travessilla	0-3	---	---	10-18	1.35-1.45	14.11-42.34	0.10-0.12	0.0-2.9	1.0-2.0	.15	.28	1	4	---
	3-13	---	---	10-18	1.40-1.50	14.11-42.34	0.08-0.10	0.0-2.9	---	.15	.28			
	13-17	---	---	---	---	---	---	---	---	---	---			
Mion	0-2	---	---	15-20	1.35-1.45	14.11-42.34	0.09-0.11	0.0-2.9	1.0-2.0	.15	.24	1	5	---
	2-16	---	---	38-55	1.35-1.45	0.00-0.42	0.15-0.17	6.0-8.9	---	.24	.24			
	16-20	---	---	---	---	---	---	---	---	---	---			
La Fonda	0-3	---	---	10-15	1.40-1.50	14.11-42.34	0.11-0.13	0.0-2.9	0.6-0.8	.24	.24	5	3	---
	3-60	---	---	18-35	1.40-1.50	4.23-14.11	0.16-0.19	3.0-5.9	---	.32	.32			
San Mateo	0-2	---	---	10-18	1.40-1.50	14.11-42.34	0.11-0.13	0.0-2.9	0.5-0.9	.24	.24	5	3	---
	2-29	---	---	20-35	1.35-1.45	4.23-14.11	0.15-0.17	3.0-5.9	---	.32	.32			
	29-60	---	---	18-35	1.35-1.45	4.23-14.11	0.15-0.17	3.0-5.9	---	.32	.43			

Physical Soil Properties

United States

Map symbol and soil name	Depth	Sand	Silt	Clay	Moist bulk density	Saturated hydraulic conductivity	Available water capacity	Linear extensi-bility	Organic matter	Erosion factors Kw	Kf	T	Wind erodi-bility group	Wind erodi-bility index
	In	Pct	Pct	Pct	g/cc	micro m/sec	In/In	Pct	Pct					
s5401:														
Datil	0-7	---	---	9-25	1.15-1.25	4.23-14.11	0.09-0.11	0.0-2.9	1.0-3.0	.28	.32	5	4	---
	7-22	---	---	18-35	1.45-1.55	4.23-14.11	0.15-0.18	3.0-5.9	---	.32	.32			
	22-40	---	---	15-25	1.40-1.50	4.23-14.11	0.12-0.15	0.0-2.9	---	.32	.32			
	40-60	---	---	15-25	1.40-1.50	4.23-14.11	0.09-0.11	0.0-2.9	---	.20	.32			
Lapdun	0-9	---	---	15-20	1.35-1.45	4.23-14.11	0.10-0.12	0.0-2.9	1.0-3.0	.20	.43	5	6	---
	9-60	---	---	20-30	1.40-1.50	4.23-14.11	0.08-0.10	3.0-5.9	---	.10	.37			
Cascajo	0-10	---	---	5-15	1.40-1.55	14.11-42.34	0.07-0.09	0.0-2.9	0.5-1.0	.10	.28	5	8	0
	10-21	---	---	0-15	1.55-1.70	42.34-141.14	0.05-0.08	0.0-2.9	---	.10	.28			
	21-60	---	---	0-5	1.65-1.80	42.34-141.14	0.05-0.06	0.0-2.9	---	.10	.28			
Celsosprings	0-3	---	---	20-27	1.15-1.25	4.23-14.11	0.17-0.20	0.0-2.9	1.0-3.0	.43	.49	5	6	---
	3-13	---	---	35-45	1.35-1.45	0.42-1.41	0.16-0.18	6.0-8.9	---	.32	.32			
	13-26	---	---	35-45	1.35-1.45	0.42-1.41	0.13-0.15	6.0-8.9	---	.15	.28			
	26-33	---	---	35-45	1.35-1.45	0.42-1.41	0.13-0.15	6.0-8.9	---	.15	.24			
	33-60	---	---	20-35	1.40-1.50	4.23-14.11	0.16-0.18	3.0-5.9	---	.24	.37			
Majada	0-7	---	---	10-20	1.30-1.40	14.11-42.34	0.06-0.08	0.0-2.9	1.0-2.0	.10	.24	5	6	---
	7-19	---	---	20-35	1.45-1.55	1.41-4.23	0.08-0.10	3.0-5.9	---	.10	.37			
	19-40	---	---	20-30	1.50-1.60	4.23-14.11	0.08-0.10	0.0-2.9	---	.10	.32			
	40-60	---	---	20-30	1.45-1.55	4.23-14.11	0.09-0.10	0.0-2.9	---	.10	.37			
Millett	0-2	---	---	15-20	---	14.11-42.34	0.09-0.11	0.0-2.9	1.0-2.0	.15	.24	5	3	---
	2-8	---	---	25-35	---	4.23-14.11	0.12-0.16	3.0-5.9	---	.15	.24			
	8-18	---	---	15-25	---	4.23-14.11	0.13-0.15	0.0-2.9	---	.28	.49			
	18-60	---	---	15-25	---	4.23-14.11	0.06-0.09	0.0-2.9	---	.10	.32			
Sedillo	0-3	---	---	10-20	1.35-1.45	14.11-42.34	0.05-0.07	0.0-2.9	0.5-1.0	.10	.24	5	6	---
	3-23	---	---	22-34	1.40-1.50	1.41-4.23	0.05-0.07	3.0-5.9	---	.10	.37			
	23-60	---	---	15-25	1.40-1.50	4.23-14.11	0.07-0.09	0.0-2.9	---	.10	.32			

Physical Soil Properties

United States

Map symbol and soil name	Depth	Sand	Silt	Clay	Moist bulk density	Saturated hydraulic conductivity	Available water capacity	Linear extensi-bility	Organic matter	Erosion factors			Wind erodi-bility group	Wind erodi-bility index
										Kw	Kf	T		
	In	Pct	Pct	Pct	g/cc	micro m/sec	In/In	Pct	Pct					
s5401:														
Alegros	0-2	---	---	15-25	1.00-1.10	4.23-14.11	0.12-0.14	0.0-2.9	3.0-6.0	.20	.37	3	6	---
	2-21	---	---	35-60	1.25-1.35	0.42-1.41	0.12-0.14	6.0-8.9	---	.15	.24			
	21-52	---	---	5-15	1.55-1.65	14.11-42.34	0.04-0.06	0.0-2.9	---	.02	.15			
	52-60	---	---	0-10	1.60-1.70	42.34-141.14	0.02-0.04	0.0-2.9	---	.02	.20			
Hickman	0-3	---	---	15-27	1.05-1.15	4.23-14.11	0.15-0.17	0.0-2.9	2.0-4.0	.37	.49	5	5	---
	3-60	---	---	18-35	1.20-1.30	1.41-4.23	0.14-0.16	3.0-5.9	0.0-0.8	.32	.37			
Ladron	0-2	---	---	12-18	1.35-1.45	14.11-42.34	0.06-0.07	0.0-2.9	0.9-1.0	.10	.24	5	6	---
	2-31	---	---	18-26	1.45-1.55	4.23-14.11	0.08-0.09	0.0-2.9	---	.10	.37			
	31-47	---	---	8-15	1.55-1.65	14.11-42.34	0.06-0.07	0.0-2.9	---	.10	.32			
	47-60	---	---	18-24	1.55-1.65	4.23-14.11	0.08-0.09	0.0-2.9	---	.10	.32			
Goldust	0-4	---	---	15-20	---	14.11-42.34	0.09-0.10	0.0-2.9	1.0-2.0	.15	.28	5	5	---
	4-22	---	---	15-26	---	4.23-14.11	0.10-0.12	0.0-2.9	---	.10	.37			
	22-35	---	---	40-60	---	0.42-1.41	0.09-0.11	6.0-8.9	---	.05	.15			
	35-60	---	---	40-55	---	0.42-1.41	0.10-0.12	6.0-8.9	---	.10	.24			
Loarc	0-14	---	---	10-15	1.35-1.45	14.11-42.34	0.11-0.13	0.0-2.9	1.0-3.0	.24	.24	5	3	---
	14-23	---	---	18-35	1.40-1.50	4.23-14.11	0.14-0.16	3.0-5.9	---	.32	.32			
	23-36	---	---	10-25	1.45-1.55	14.11-42.34	0.11-0.13	0.0-2.9	---	.24	.28			
	36-60	---	---	10-25	1.40-1.50	14.11-42.34	0.09-0.11	0.0-2.9	---	.15	.24			
Magdalena	0-2	---	---	10-15	1.45-1.55	4.23-14.11	0.11-0.13	0.0-2.9	0.4-0.8	.20	.37	5	6	---
	2-62	---	---	35-50	1.50-1.60	0.00-0.42	0.08-0.10	6.0-8.9	---	.10	.32			
	62-74	---	---	25-35	1.55-1.65	4.23-14.11	0.08-0.10	3.0-5.9	---	.10	.32			
s5404:														
Dulce	0-13	---	---	5-18	1.45-1.55	14.11-42.34	0.11-0.13	0.0-2.9	0.5-1.0	.24	.24	1	3	---
	13-17	---	---	---	---	0.00-14.11	---	---	---	---	---			

Physical Soil Properties

United States

Map symbol and soil name	Depth	Sand	Silt	Clay	Moist bulk density	Saturated hydraulic conductivity	Available water capacity	Linear extensi-bility	Organic matter	Erosion factors			Wind erodi-bility group	Wind erodi-bility index
										Kw	Kf	T		
	In	*Pct*	*Pct*	*Pct*	*g/cc*	*micro m/sec*	*In/In*	*Pct*	*Pct*					
s5404:														
Rock outcrop	0-60	---	---	---	---	---	---	---	---	---	---	---	8	0
Travessilla	0-4	---	---	5-15	1.35-1.45	14.11-42.34	0.11-0.13	0.0-2.9	1.0-2.0	.24	.28	1	3	---
	4-8	---	---	10-18	1.35-1.45	4.23-14.11	0.13-0.15	0.0-2.9	---	.20	.37			
	8-12	---	---	---	---	---	---	---	---	---	---			
Weska	0-1	---	---	28-35	1.40-1.50	1.41-4.23	0.19-0.21	3.0-5.9	0.5-0.7	.37	.37	1	6	---
	1-7	---	---	28-35	1.40-1.50	1.41-4.23	0.19-0.21	3.0-5.9	---	.37	.37			
	7-11	---	---	---	---	---	---	---	---	---	---			
Mikim	0-9	---	---	10-25	1.40-1.45	4.23-14.11	0.16-0.18	0.0-2.9	1.0-3.0	.32	.32	5	5	---
	9-60	---	---	18-32	1.35-1.45	4.23-14.11	0.14-0.16	0.0-2.9	---	.32	.32			
Buckle	0-5	---	---	18-27	1.40-1.50	4.23-14.11	0.13-0.19	0.0-2.9	1.0-2.0	.43	.43	5	6	---
	5-44	---	---	28-35	1.40-1.50	1.41-4.23	0.15-0.19	3.0-5.9	0.0-1.0	.37	.37			
	44-66	---	---	20-35	1.40-1.50	4.23-14.11	0.13-0.19	3.0-5.9	0.0-0.5	.37	.37			
Florita	0-4	---	---	15-20	1.35-1.45	14.11-42.34	0.08-0.13	0.0-2.9	1.0-3.0	.24	.24	5	3	---
	4-43	---	---	5-20	1.45-1.55	14.11-42.34	0.10-0.13	0.0-2.9	---	.20	.20			
	43-60	---	---	0-5	1.40-1.50	42.34-141.14	0.03-0.05	0.0-2.9	---	.20	.20			
Yenlo	0-3	---	---	10-18	1.40-1.45	14.11-42.34	0.10-0.13	0.0-2.9	1.0-2.0	.20	.20	5	3	---
	3-13	---	---	20-30	1.35-1.45	4.23-14.11	0.14-0.18	3.0-5.9	---	.24	.24			
	13-60	---	---	10-30	1.35-1.45	4.23-14.11	0.10-0.18	0.0-2.9	---	.24	.24			
s5576:														
St. Thomas	0-2	---	---	4-10	1.15-1.35	14.11-42.34	0.06-0.08	0.0-2.9	0.0-0.5	.17	.32	1	8	0
	2-12	---	---	8-18	1.15-1.35	14.11-42.34	0.04-0.07	0.0-2.9	---	.10	.37			
	12-16	---	---	---	---	0.00-0.07	---	---	---	---	---			

Physical Soil Properties

United States

Map symbol and soil name	Depth	Sand	Silt	Clay	Moist bulk density	Saturated hydraulic conductivity	Available water capacity	Linear extensi-bility	Organic matter	Erosion factors			Wind erodi-bility group	Wind erodi-bility index
										Kw	Kf	T		
	In	Pct	Pct	Pct	g/cc	micro m/sec	In/In	Pct	Pct					
s5576:														
St. Thomas	0-2	---	---	4-10	1.15-1.35	14.11-42.34	0.06-0.08	0.0-2.9	0.0-0.5	.17	.32	1	8	0
	2-12	---	---	8-18	1.15-1.35	14.11-42.34	0.04-0.07	0.0-2.9	---	.10	.37			
	12-16	---	---	---	---	0.00-0.07	---	---	---	---	---			
Rock outcrop	0-60	---	---	---	---	---	---	---	---	---	---	---	8	0
Kyler	0-3	---	---	7-18	1.30-1.45	4.23-14.11	0.05-0.07	0.0-2.9	0.5-1.0	.15	.55	1	5	---
	3-7	---	---	7-18	1.25-1.45	4.23-14.11	0.08-0.11	0.0-2.9	0.0-0.5	.15	.55			
	7-11	---	---	---	---	0.00-0.07	---	---	---	---	---			
Pookaloo	0-4	---	---	10-18	1.20-1.35	4.23-14.11	0.06-0.09	0.0-2.9	1.0-2.0	.20	.43	1	6	---
	4-19	---	---	10-18	1.35-1.50	4.23-14.11	0.11-0.13	0.0-2.9	0.0-0.5	.20	.55			
	19-23	---	---	---	---	0.00-0.07	---	---	---	---	---			
St. Thomas	0-2	---	---	4-10	1.15-1.35	14.11-42.34	0.06-0.08	0.0-2.9	0.0-0.5	.17	.32	1	8	0
	2-12	---	---	8-18	1.15-1.35	14.11-42.34	0.04-0.07	0.0-2.9	---	.10	.37			
	12-16	---	---	---	---	0.00-0.07	---	---	---	---	---			
Tonopah	0-6	---	---	5-15	1.55-1.70	42.34-141.14	0.06-0.08	0.0-2.9	0.0-0.5	.20	.37	5	4	---
	6-60	---	---	2-10	1.55-1.75	141.14	0.03-0.05	0.0-2.9	0.0-0.5	.10	.20			
Weiser	0-6	---	---	5-18	1.25-1.45	14.11-42.34	0.04-0.06	0.0-2.9	0.0-0.5	.10	.32	5	6	---
	6-60	---	---	5-18	1.25-1.45	14.11-42.34	0.07-0.09	0.0-2.9	---	.15	.32			
s7769:														
Rizno	0-2	---	---	10-17	1.20-1.40	14.11-42.34	0.10-0.13	0.0-2.9	0.5-1.0	.28	.24	1	3	---
	2-5	---	---	20-30	1.10-1.30	4.23-14.11	0.12-0.15	0.0-2.9	0.5-1.0	.15	.24			
	5-7	---	---	10-18	1.20-1.40	14.11-42.34	0.10-0.13	0.0-2.9	0.5-1.0	.28	.17			
	7-14	---	---	6-10	1.40-1.50	42.34-141.14	0.05-0.06	0.0-2.9	---	.10	.15			
	14-18	---	---	---	---	---	---	---	---	---	---			

Physical Soil Properties

United States

Map symbol and soil name	Depth	Sand	Silt	Clay	Moist bulk density	Saturated hydraulic conductivity	Available water capacity	Linear extensi-bility	Organic matter	Erosion factors			Wind erodi-bility group	Wind erodi-bility index
										Kw	Kf	T		
	In	*Pct*	*Pct*	*Pct*	*g/cc*	*micro m/sec*	*In/In*	*Pct*	*Pct*					
s7769:														
Witt	0-7	---	---	8-20	1.30-1.40	4.23-14.11	0.15-0.18	0.0-2.9	0.5-1.0	.37	.37	5	5	---
	7-48	---	---	18-35	1.25-1.40	1.41-4.23	0.18-0.21	3.0-5.9	0.0-0.5	.37	.37			
	48-60	---	---	18-27	1.30-1.40	4.23-14.11	0.16-0.19	0.0-2.9	0.0-0.5	.37	.37			
Ruinpoint	0-2	---	---	15-20	1.15-1.25	14.11-42.34	0.12-0.18	0.0-2.9	1.0-2.0	.43	.43	5	3	---
	2-13	---	---	20-30	1.05-1.20	4.23-14.11	0.15-0.18	3.0-5.9	---	.43	.43			
	13-60	---	---	20-30	1.10-1.25	4.23-14.11	0.15-0.18	3.0-5.9	---	.43	.43			
Cahona	0-11	---	---	10-20	1.40-1.50	4.23-14.11	0.14-0.16	0.0-2.9	0.5-2.0	.37	.37	5	3	---
	11-24	---	---	20-35	1.30-1.40	1.41-4.23	0.15-0.17	3.0-5.9	0.5-1.0	.37	.37			
	24-60	---	---	10-27	1.40-1.50	4.23-14.11	0.13-0.16	0.0-2.9	0.0-0.5	.37	.37			
Sharps	0-9	---	---	10-20	1.30-1.40	4.23-14.11	0.16-0.18	0.0-2.9	0.5-2.0	.37	.37	3	5	---
	9-19	---	---	20-35	1.25-1.35	1.41-4.23	0.15-0.17	3.0-5.9	0.5-1.0	.37	.37			
	19-30	---	---	20-30	1.25-1.35	4.23-14.11	0.13-0.15	3.0-5.9	0.0-0.5	.37	.37			
	30-34	---	---	---	---	0.00-14.11	---	---	---	---	---			
s7770:														
Mota	0-6	---	---	5-10	1.50-1.55	14.11-42.34	0.09-0.11	0.0-2.9	0.0-0.5	.43	.43	5	2	---
	6-23	---	---	8-18	1.40-1.45	14.11-42.34	0.14-0.16	0.0-2.9	---	.43	.43			
	23-60	---	---	5-10	1.50-1.55	14.11-42.34	0.09-0.11	0.0-2.9	---	.49	.49			
Neskahi	0-6	---	---	---	---	14.11-42.34	0.06-0.11	0.0-2.9	---	.43	.17	5	2	---
	6-60	---	---	---	---	14.11-42.34	0.12-0.17	0.0-2.9	---	.43	.43			
Oljeto	0-20	---	---	---	---	14.11-42.34	0.08-0.10	0.0-2.9	---	.43	---	3	2	---
	20-60	---	---	---	---	42.34-141.14	0.02-0.04	0.0-2.9	---	.10	.17			
Rock outcrop	0-60	---	---	---	---	---	---	---	---	---	---	---	8	0

Physical Soil Properties

United States

Map symbol and soil name	Depth	Sand	Silt	Clay	Moist bulk density	Saturated hydraulic conductivity	Available water capacity	Linear extensi-bility	Organic matter	Erosion factors			Wind erodi-bility group	Wind erodi-bility index
										Kw	Kf	T		
	In	*Pct*	*Pct*	*Pct*	*g/cc*	*micro m/sec*	*In/In*	*Pct*	*Pct*					
s7770:														
Sheppard	0-12	---	---	2-5	1.50-1.60	42.34-141.14	0.06-0.08	0.0-2.9	0.0-0.5	.24	.24	5	2	---
	12-60	---	---	3-8	1.50-1.60	42.34-141.14	0.06-0.08	0.0-2.9	0.0-0.5	.20	.20			
s7771:														
Moenkopie	0-2	---	---	10-20	1.45-1.55	14.11-42.34	0.11-0.13	0.0-2.9	0.5-1.0	.24	.24	1	3	---
	2-9	---	---	15-20	1.45-1.55	14.11-42.34	0.11-0.13	0.0-2.9	---	.24	.43			
	9-13	---	---	---	---	---	---	---	---	---	---			
Hoskinnini	0-1	---	---	13-17	1.35-1.45	14.11-42.34	0.08-0.11	0.0-2.9	0.5-1.0	.28	.24	1	3	---
	1-8	---	---	16-20	1.35-1.45	14.11-42.34	0.08-0.11	0.0-2.9	---	.20	.24			
	8-12	---	---	18-25	1.30-1.45	4.23-14.11	0.11-0.17	3.0-5.9	---	.24	.24			
	12-16	---	---	---	---	---	---	---	---	---	---			
Rock outcrop	0-60	---	---	---	---	---	---	---	---	---	---	---	8	0
Piute	0-9	---	---	2-8	1.45-1.50	14.11-42.34	0.08-0.09	0.0-2.9	0.0-0.5	.43	.43	1	2	---
	9-13	---	---	---	---	---	---	---	---	---	---			
Deleco	0-3	---	---	3-10	1.45-1.55	14.11-42.34	0.08-0.09	0.0-2.9	0.0-0.5	.37	.37	1	2	---
	3-7	---	---	5-10	1.40-1.45	14.11-42.34	0.07-0.09	0.0-2.9	---	.15	.17			
	7-10	---	---	5-10	1.40-1.45	14.11-42.34	0.05-0.06	0.0-2.9	---	.10	.17			
	10-14	---	---	---	---	---	---	---	---	---	---			
	14-45	---	---	0-10	1.35-1.45	0.00-0.42	0.08-0.09	0.0-2.9	---	.43	.43			
s7772:														
Whit	0-4	---	---	18-20	1.35-1.45	4.23-14.11	0.14-0.16	0.0-2.9	0.5-1.0	.43	.43	3	3	---
	4-30	---	---	18-25	1.35-1.45	4.23-14.11	0.14-0.16	0.0-2.9	---	.43	.43			
	30-66	---	---	18-25	1.35-1.45	4.23-14.11	0.14-0.16	0.0-2.9	---	.43	.43			

Physical Soil Properties

United States

Map symbol and soil name	Depth	Sand	Silt	Clay	Moist bulk density	Saturated hydraulic conductivity	Available water capacity	Linear extensi-bility	Organic matter	Erosion factors			Wind erodi-bility group	Wind erodi-bility index
										Kw	Kf	T		
	In	*Pct*	*Pct*	*Pct*	*g/cc*	*micro m/sec*	*In/In*	*Pct*	*Pct*					
s7772:														
Sogzie	0-5	---	---	10-18	1.35-1.45	4.23-14.11	0.15-0.17	0.0-2.9	0.5-1.0	.43	.43	5	3	---
	5-21	---	---	10-18	1.35-1.45	4.23-14.11	0.15-0.17	0.0-2.9	---	.43	.43			
	21-80	---	---	10-18	1.35-1.45	4.23-14.11	0.11-0.13	0.0-2.9	---	.32	.32			
Sheppard	0-12	---	---	2-5	1.50-1.60	42.34-141.14	0.05-0.07	0.0-2.9	0.0-0.5	.20	.20	5	1	---
	12-60	---	---	3-8	1.50-1.60	42.34-141.14	0.06-0.08	0.0-2.9	0.0-0.5	.20	.20			
Rock outcrop	0-60	---	---	---	---	---	---	---	---	---	---	---	8	0
s7773:														
Piute	0-9	---	---	2-8	1.45-1.50	14.11-42.34	0.08-0.09	0.0-2.9	0.0-0.5	.43	.43	1	2	---
	9-13	---	---	---	---	---	---	---	---	---	---			
Pickrell	0-5	---	---	---	---	14.11-42.34	0.07-0.09	0.0-2.9	---	.43	.24	1	2	---
	5-18	---	---	---	---	14.11-42.34	0.06-0.08	0.0-2.9	---	.43	.24			
	18-22	---	---	---	---	---	---	---	---	---	---			
Rock outcrop	0-60	---	---	---	---	---	---	---	---	---	---	---	8	0
Badland	0-60	---	---	---	---	---	---	---	---	---	---	---	8	0
Sheppard	0-12	---	---	2-5	1.50-1.60	42.34-141.14	0.06-0.08	0.0-2.9	0.0-0.5	.24	.24	5	2	---
	12-60	---	---	3-8	1.50-1.60	42.34-141.14	0.06-0.08	0.0-2.9	0.0-0.5	.20	.20			
s7774:														
Rock outcrop	0-60	---	---	---	---	---	---	---	---	---	---	---	8	0
Lithic Torriorthents	0-3	---	---	10-30	1.25-1.40	4.23-14.11	0.15-0.18	0.0-2.9	0.0-0.5	.32	.37	1	3	---
	3-8	---	---	---	---	---	---	---	---	---	---			
	8-12	---	---	---	---	---	---	---	---	---	---			

Physical Soil Properties

United States

Map symbol and soil name	Depth	Sand	Silt	Clay	Moist bulk density	Saturated hydraulic conductivity	Available water capacity	Linear extensi-bility	Organic matter	Erosion factors Kw	Kf	T	Wind erodi-bility group	Wind erodi-bility index
	In	*Pct*	*Pct*	*Pct*	*g/cc*	*micro m/sec*	*In/In*	*Pct*	*Pct*					
s7774:														
Badland	0-60	---	---	---	---	---	---	---	---	---	---	---	8	0
s7938:														
Ruinpoint	0-2	---	---	15-20	1.15-1.25	14.11-42.34	0.12-0.18	0.0-2.9	1.0-2.0	.43	.43	5	3	---
	2-13	---	---	20-30	1.05-1.20	4.23-14.11	0.15-0.18	3.0-5.9	---	.43	.43			
	13-60	---	---	20-30	1.10-1.25	4.23-14.11	0.15-0.18	3.0-5.9	---	.43	.43			
Rizno	0-2	---	---	10-17	1.20-1.40	14.11-42.34	0.10-0.13	0.0-2.9	0.5-1.0	.28	.24	1	3	---
	2-5	---	---	20-30	1.10-1.30	4.23-14.11	0.12-0.15	0.0-2.9	0.5-1.0	.15	.24			
	5-7	---	---	10-18	1.20-1.40	14.11-42.34	0.10-0.13	0.0-2.9	0.5-1.0	.28	.17			
	7-14	---	---	6-10	1.40-1.50	42.34-141.14	0.05-0.06	0.0-2.9	---	.10	.15			
	14-18	---	---	---	---	---	---	---	---	---	---			
Cahona	0-11	---	---	15-25	1.40-1.50	4.23-14.11	0.15-0.17	0.0-2.9	0.5-2.0	.37	.37	5	4	---
	11-24	---	---	20-35	1.30-1.40	1.41-4.23	0.15-0.17	3.0-5.9	0.5-1.0	.37	.37			
	24-60	---	---	10-27	1.40-1.50	4.23-14.11	0.13-0.16	0.0-2.9	0.0-0.5	.37	.37			
s7939:														
Rizno	0-2	---	---	10-17	1.20-1.40	14.11-42.34	0.10-0.13	0.0-2.9	0.5-1.0	.28	.24	1	3	---
	2-5	---	---	20-30	1.10-1.30	4.23-14.11	0.12-0.15	0.0-2.9	0.5-1.0	.15	.24			
	5-7	---	---	10-18	1.20-1.40	14.11-42.34	0.10-0.13	0.0-2.9	0.5-1.0	.28	.17			
	7-14	---	---	6-10	1.40-1.50	42.34-141.14	0.05-0.06	0.0-2.9	---	.10	.15			
	14-18	---	---	---	---	---	---	---	---	---	---			
Littlenan	0-3	---	---	20-40	1.20-1.35	0.42-4.23	0.14-0.16	3.0-5.9	0.5-1.0	.20	.37	3	4L	---
	3-29	---	---	35-45	1.15-1.30	0.42-1.41	0.16-0.18	6.0-8.9	---	.24	.32			
	29-33	---	---	---	---	---	---	---	---	---	---			

Physical Soil Properties

United States

Map symbol and soil name	Depth	Sand	Silt	Clay	Moist bulk density	Saturated hydraulic conductivity	Available water capacity	Linear extensi-bility	Organic matter	Erosion factors Kw	Kf	T	Wind erodi-bility group	Wind erodi-bility index
	In	*Pct*	*Pct*	*Pct*	*g/cc*	*micro m/sec*	*In/In*	*Pct*	*Pct*					
s7939:														
Bodot	0-6	---	---	20-27	1.15-1.35	1.41-14.11	0.08-0.12	3.0-5.9	1.0-2.0	.43	.64	2	8	0
	6-15	---	---	30-40	1.20-1.40	0.42-4.23	0.16-0.18	6.0-8.9	---	.43	.43			
	15-36	---	---	35-60	1.20-1.40	0.42-1.41	0.17-0.18	6.0-8.9	---	.37	.37			
	36-40	---	---	---	---	0.00-14.11	---	---	---	---	---			
Mellenthin	0-4	---	---	10-15	1.25-1.35	4.23-14.11	0.07-0.09	0.0-2.9	0.8-2.0	.02	.24	1	5	---
	4-15	---	---	15-25	1.25-1.35	4.23-14.11	0.09-0.11	0.0-2.9	0.5-1.0	.05	.32			
	15-18	---	---	10-15	1.25-1.35	4.23-14.11	0.06-0.08	0.0-2.9	0.5-1.0	.02	.17			
	18-22	---	---	---	---	0.00-1.41	---	---	---	---	---			
Rock outcrop	0-60	---	---	---	---	---	---	---	---	---	---	---	8	0
s7944:														
Moenkopie	0-3	---	---	5-17	1.30-1.40	14.11-42.34	0.06-0.10	0.0-2.9	0.5-1.0	.10	.37	1	6	---
	3-8	---	---	7-20	1.35-1.45	14.11-42.34	0.10-0.13	0.0-2.9	0.5-1.0	.28	.32			
	8-12	---	---	---	---	0.00-1.41	---	---	---	---	---			
Rock outcrop	0-60	---	---	---	---	---	---	---	---	---	---	---	8	0
Myton family	0-6	---	---	10-15	1.35-1.45	14.11-42.34	0.05-0.08	0.0-2.9	0.5-1.0	.10	.24	5	6	---
	6-60	---	---	10-18	1.35-1.45	14.11-42.34	0.05-0.08	0.0-2.9	0.5-1.0	.05	.17			
s7945:														
Nakai	0-2	---	---	6-14	1.30-1.40	14.11-42.34	0.10-0.13	0.0-2.9	0.5-1.0	.32	.32	3	3	---
	2-28	---	---	10-18	1.25-1.40	14.11-42.34	0.10-0.14	0.0-2.9	---	.43	.49			
	28-52	---	---	10-18	1.25-1.40	14.11-42.34	0.08-0.13	0.0-2.9	---	.24	.17			
	52-56	---	---	---	---	---	---	---	---	---	---			

Physical Soil Properties

United States

Map symbol and soil name	Depth	Sand	Silt	Clay	Moist bulk density	Saturated hydraulic conductivity	Available water capacity	Linear extensi-bility	Organic matter	Erosion factors			Wind erodi-bility group	Wind erodi-bility index
										Kw	Kf	T		
	In	*Pct*	*Pct*	*Pct*	*g/cc*	*micro m/sec*	*In/In*	*Pct*	*Pct*					
s7945:														
Limeridge	0-1	---	---	8-18	1.25-1.35	14.11-42.34	0.10-0.12	0.0-2.9	0.5-1.0	.32	.24	2	3	---
	1-8	---	---	12-20	1.40-1.50	14.11-42.34	0.09-0.13	0.0-2.9	---	.24	.17			
	8-16	---	---	18-30	1.40-1.50	4.23-14.11	0.11-0.15	0.0-2.9	---	.15	.24			
	16-20	---	---	---	---	---	---	---	---	---	---			
Bluechief	0-3	---	---	5-10	1.40-1.50	14.11-42.34	0.11-0.13	0.0-2.9	0.5-1.0	.37	.37	2	3	---
	3-25	---	---	10-15	1.40-1.50	14.11-42.34	0.11-0.13	0.0-2.9	---	.43	.43			
	25-38	---	---	12-18	1.40-1.50	14.11-42.34	0.11-0.14	0.0-2.9	---	.43	.17			
	38-42	---	---	---	---	---	---	---	---	---	---			
s7947:														
Rock outcrop	0-60	---	---	---	---	---	---	---	---	---	---	---	8	0
Piute	0-9	---	---	2-8	1.45-1.50	14.11-42.34	0.08-0.09	0.0-2.9	0.0-0.5	.43	.43	1	2	---
	9-13	---	---	---	---	---	---	---	---	---	---			
Sheppard	0-12	---	---	2-5	1.50-1.60	42.34-141.14	0.06-0.08	0.0-2.9	0.0-0.5	.24	.24	5	2	---
	12-60	---	---	3-8	1.50-1.60	42.34-141.14	0.06-0.08	0.0-2.9	0.0-0.5	.20	.20			
s8104:														
Tosser	0-4	---	---	5-15	1.30-1.40	14.11-42.34	0.04-0.08	0.0-2.9	1.0-2.0	.10	.24	2	6	---
	4-10	---	---	10-17	1.30-1.45	14.11-42.34	0.08-0.10	0.0-2.9	0.5-1.0	.24	.17			
	10-23	---	---	2-8	1.30-1.50	42.34-141.14	0.03-0.06	0.0-2.9	0.5-1.0	.05	.15			
	23-37	---	---	2-8	1.50-1.80	42.34-141.14	0.02-0.04	0.0-2.9	0.5-1.0	.02	.15			
	37-60	---	---	2-8	1.50-1.80	14.11-42.34	0.04-0.07	0.0-2.9	0.5-1.0	.10	.15			
Hiko Peak	0-4	---	---	10-18	1.40-1.50	4.23-14.11	0.11-0.14	0.0-2.9	1.0-2.0	.24	.37	2	5	---
	4-13	---	---	10-18	1.40-1.50	14.11-42.34	0.09-0.14	0.0-2.9	0.5-1.0	.17	.32			
	13-60	---	---	10-18	1.40-1.60	14.11-42.34	0.06-0.11	0.0-2.9	0.0-0.5	.10	.32			

Physical Soil Properties

United States

Map symbol and soil name	Depth	Sand	Silt	Clay	Moist bulk density	Saturated hydraulic conductivity	Available water capacity	Linear extensi-bility	Organic matter	Erosion factors			Wind erodi-bility group	Wind erodi-bility index
										Kw	Kf	T		
	In	*Pct*	*Pct*	*Pct*	*g/cc*	*micro m/sec*	*In/In*	*Pct*	*Pct*					
s8104:														
Sitar	0-8	---	---	18-27	1.15-1.25	1.41-4.23	0.16-0.20	0.0-2.9	0.5-2.0	.37	.43	2	4L	---
	8-29	---	---	12-18	1.15-1.25	4.23-14.11	0.10-0.16	0.0-2.9	---	.20	.37			
	29-60	---	---	8-18	1.15-1.25	14.11-42.34	0.08-0.12	0.0-2.9	---	.17	.49			
s8189:														
Badland	0-60	---	---	---	---	---	---	---	---	---	---	---	8	0
Rock outcrop	0-60	---	---	---	---	---	---	---	---	---	---	---	8	0
Clapper	0-3	---	---	18-27	1.25-1.30	4.23-14.11	0.10-0.13	0.0-2.9	0.5-1.0	.15	.37	1	8	0
	3-10	---	---	18-27	1.25-1.30	4.23-14.11	0.10-0.13	0.0-2.9	---	.20	.32			
	10-60	---	---	18-27	1.25-1.30	4.23-14.11	0.08-0.10	0.0-2.9	---	.10	.32			
Bluechief	0-3	---	---	5-10	1.40-1.50	14.11-42.34	0.11-0.13	0.0-2.9	0.5-1.0	.37	.37	2	3	---
	3-25	---	---	10-15	1.40-1.50	14.11-42.34	0.11-0.13	0.0-2.9	---	.43	.43			
	25-38	---	---	12-18	1.40-1.50	14.11-42.34	0.11-0.14	0.0-2.9	---	.43	.17			
	38-42	---	---	---	---	---	---	---	---	---	---			
Myton family	0-3	---	---	27-35	1.15-1.30	0.42-1.41	0.12-0.16	3.0-5.9	0.5-1.0	.20	.37	3	5	---
	3-9	---	---	27-35	1.20-1.30	1.41-4.23	0.16-0.18	3.0-5.9	0.5-1.0	.28	.24			
	9-14	---	---	18-27	1.25-1.40	4.23-14.11	0.11-0.14	0.0-2.9	0.5-1.0	.32	.32			
	14-26	---	---	18-27	1.30-1.50	4.23-14.11	0.06-0.11	0.0-2.9	0.5-1.0	.15	.32			
	26-60	---	---	20-35	1.25-1.40	4.23-14.11	0.09-0.12	0.0-2.9	0.5-1.0	.10	.24			
Rairdent family	0-8	---	---	18-23	1.25-1.30	4.23-14.11	0.16-0.18	0.0-2.9	0.5-1.0	.32	.32	3	4L	---
	8-30	---	---	20-28	1.25-1.30	4.23-14.11	0.16-0.18	3.0-5.9	---	.43	.43			
	30-60	---	---	16-22	1.30-1.45	4.23-14.11	0.13-0.17	0.0-2.9	---	.32	.32			

Physical Soil Properties

United States

Map symbol and soil name	Depth	Sand	Silt	Clay	Moist bulk density	Saturated hydraulic conductivity	Available water capacity	Linear extensi-bility	Organic matter	Erosion factors Kw	Kf	T	Wind erodi-bility group	Wind erodi-bility index
	In	Pct	Pct	Pct	g/cc	micro m/sec	In/In	Pct	Pct					
s8189:														
Rizno	0-2	---	---	3-18	1.30-1.55	14.11-42.34	0.08-0.12	0.0-2.9	0.5-1.0	.32	.24	1	3	---
	2-8	---	---	5-18	1.30-1.55	14.11-42.34	0.08-0.12	0.0-2.9	0.5-1.0	.20	.32			
	8-10	---	---	5-18	1.30-1.55	14.11-42.34	0.08-0.12	0.0-2.9	0.5-1.0	.32	.17			
	10-14	---	---	---	---	0.00-1.41	---	---	---	---	---			
Wayneco	0-3	---	---	6-10	1.40-1.50	14.11-42.34	0.06-0.10	0.0-2.9	1.0-2.0	.17	.24	1	3	---
	3-9	---	---	5-10	1.45-1.50	14.11-42.34	0.04-0.08	0.0-2.9	0.0-0.5	.17	.15			
	9-19	---	---	10-18	1.35-1.40	4.23-14.11	0.08-0.13	0.0-2.9	0.0-0.5	.28	.32			
	19-23	---	---	---	---	0.00-1.41	---	---	---	---	---			
s8369:														
Water	---	---	---	---	---	---	---	---	---	---	---	---	---	---
s9583:														
Badland	0-1	---	---	---	---	---	---	---	---	---	---	---	---	---
	1-60	---	---	---	---	---	---	6.0-8.9	---	---	---			
Torriorthents	0-10	---	---	---	---	---	---	---	---	---	---	2	---	---
	10-60	---	---	---	---	---	---	6.0-8.9	---	---	---			
Burnswick	0-3	---	---	20-35	1.25-1.35	1.40-4.00	0.03-0.08	3.0-5.9	0.5-1.0	.24	.28	5	4L	86
	3-16	---	---	20-35	1.35-1.50	1.40-4.00	0.03-0.08	3.0-5.9	0.0-0.5	.28	.28			
	16-41	---	---	20-35	1.35-1.50	1.40-4.00	0.03-0.08	3.0-5.9	0.0-0.5	.28	.28			
	41-53	---	---	5-20	1.10-1.30	14.00-42.00	0.02-0.07	0.0-2.9	0.0-0.5	.20	.20			
	53-60	---	---	20-35	1.25-1.35	1.40-4.00	0.03-0.08	3.0-5.9	0.0-0.5	.28	.28			
Claysprings	0-3	---	---	40-50	1.15-1.30	0.00-0.42	0.14-0.16	6.0-8.9	0.5-1.0	.28	.28	2	4	86
	3-18	---	---	40-55	1.15-1.30	0.00-0.42	0.14-0.16	6.0-8.9	0.0-0.5	.28	.28			
	18-28	---	---	---	---	---	---	---	---	---	---			

Physical Soil Properties

United States

Map symbol and soil name	Depth	Sand	Silt	Clay	Moist bulk density	Saturated hydraulic conductivity	Available water capacity	Linear extensi-bility	Organic matter	Erosion factors Kw	Erosion factors Kf	Erosion factors T	Wind erodi-bility group	Wind erodi-bility index
	In	*Pct*	*Pct*	*Pct*	*g/cc*	*micro m/sec*	*In/In*	*Pct*	*Pct*					
s9583:														
Marcou	0-6	---	---	3-5	1.45-1.60	14.00-42.00	0.05-0.08	0.0-2.9	0.5-1.0	.15	.15	5	2	134
	6-47	---	---	10-15	1.35-1.50	4.00-14.00	0.09-0.11	0.0-2.9	0.0-0.5	.20	.20			
	47-54	---	---	20-35	1.20-1.30	4.00-14.00	0.09-0.14	0.0-2.9	0.0-0.5	.28	.28			
	54-60	---	---	1-10	1.50-1.60	42.00-141.00	0.02-0.04	0.0-2.9	0.0-0.5	.15	.15			
Rock outcrop	0-60	---	---	---	1.50-1.80	---	---	---	---	---	---	---	8	0
s9584:														
Strych	0-2	---	---	10-20	1.35-1.45	14.00-42.00	0.03-0.05	0.0-2.9	1.0-2.0	.05	.24	5	8	0
	2-9	---	---	7-20	1.35-1.45	14.00-42.00	0.07-0.09	0.0-2.9	1.0-2.0	.10	.32			
	9-23	---	---	10-20	1.35-1.45	14.00-42.00	0.06-0.10	0.0-2.9	0.5-1.0	.10	.17			
	23-60	---	---	10-20	1.35-1.45	14.00-42.00	0.03-0.05	0.0-2.9	0.0-0.5	.05	.17			
Rock outcrop	0-60	---	---	---	1.50-1.80	0.00-1.40	---	---	0.0	---	---	---	8	0
Monue	0-1	---	---	5-15	1.25-1.35	4.00-14.00	0.13-0.17	0.0-2.9	0.0-0.5	.37	.37	5	3	86
	1-46	---	---	10-18	1.25-1.55	14.00-42.00	0.13-0.15	0.0-2.9	0.0-0.5	.24	.28			
	46-84	---	---	0-5	1.45-1.65	42.00-141.00	0.06-0.08	0.0-2.9	0.0-0.5	.24	.24			
Begay	0-4	---	---	5-15	1.25-1.35	4.00-14.00	0.14-0.17	0.0-2.9	1.0-2.0	.32	.32	5	3	86
	4-57	---	---	5-15	1.25-1.55	14.00-42.00	0.12-0.15	0.0-2.9	0.5-1.0	.32	.32			
	57-84	---	---	5-10	1.45-1.65	42.00-141.00	0.07-0.10	0.0-2.9	0.0-0.5	.17	.24			
Kinan	0-1	---	---	3-10	1.20-1.30	42.00-141.00	0.05-0.06	0.0-2.9	0.5-1.0	.10	.32	5	3	86
	1-12	---	---	10-20	1.10-1.20	14.00-42.00	0.11-0.14	0.0-2.9	0.0-0.5	.24	.28			
	12-30	---	---	10-18	1.25-1.35	14.00-42.00	0.10-0.15	0.0-2.9	0.0-0.5	.24	.32			
	30-84	---	---	3-8	1.45-1.55	42.00-141.00	0.04-0.07	0.0-2.9	0.0-0.5	.15	.20			

Physical Soil Properties

United States

Map symbol and soil name	Depth	Sand	Silt	Clay	Moist bulk density	Saturated hydraulic conductivity	Available water capacity	Linear extensi-bility	Organic matter	Erosion factors			Wind erodi-bility group	Wind erodi-bility index
										Kw	Kf	T		
	In	*Pct*	*Pct*	*Pct*	*g/cc*	*micro m/sec*	*In/In*	*Pct*	*Pct*					
s9584:														
Penistaja	0-2	---	---	10-20	1.25-1.55	4.00-14.00	0.13-0.15	0.0-2.9	1.0-2.0	.28	.28	5	3	86
	2-18	---	---	20-30	1.55-1.75	4.00-14.00	0.15-0.18	0.0-2.9	0.5-1.0	.32	.32			
	18-58	---	---	15-25	1.25-1.55	14.00-42.00	0.12-0.15	0.0-2.9	0.0-0.5	.28	.28			
	58-84	---	---	5-10	1.45-1.65	42.00-141.00	0.04-0.07	0.0-2.9	0.0-0.5	.20	.20			
Mido	0-3	---	---	2-10	1.45-1.65	42.00-141.00	0.08-0.10	0.0-2.9	0.5-1.0	.37	.37	5	2	134
	3-84	---	---	3-8	1.55-1.65	42.00-141.00	0.05-0.09	0.0-2.9	0.0-0.5	.32	.32			

Appendix K. Analysis of Herbicides Unique to the Navajo Nation IWMP

Navajo Nation Integrated Weed Management Plan

BIOLOGICAL ASSESSMENT

August 2022

UNITED STATE DEPARTMENT OF THE INTERIOR
BUREAU OF INDIAN AFFAIRS NAVAJO REGION
NAVAJO NATION
ARIZONA DEPARTMENT OF TRANSPORTATION
NAVAJO NATION SOIL AND WATER CONSERVATION DISTRICTS
ANIMAL AND PLANT HEALTH INSPECTION SERVICE

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NAVAJO NATION INTEGRATED WEED MANAGEMENT PLAN

BIOLOGICAL ASSESSMENT

Bureau of Indian Affairs, Navajo Region

LOCATION:

The project covers lands administered by the BIA Navajo Regional Office (16.3 million acres), including all Navajo Indian Allotments and Indian trust land.

Contact:
Leonard Notah, Supervisory Environmental Protection Specialist
Branch of Environmental Quality Act Compliance Review
Bureau of Indian Affair-Navajo Region

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1. Introduction

This Biological Assessment is being prepared by the Bureau of Indian Affairs (BIA) Navajo Regional Office to assess the effects from the Navajo Nation Integrated Weed Management Plan (NNIWMP) and Programmatic Environmental Impact Statement (PEIS) on Navajo Nation Department of Fish and Wildlife's Navajo Natural Heritage Program (NNHP) and US Fish and Wildlife Service (USFWS) threatened, endangered, proposed, or sensitive species listed below. The biological assessment is prepared in compliance with legal requirements set forth under Section 7 of the Endangered Species Act (ESA) (16 U.S.C. 1536 (c)), and follows the standards established in the Bureau of Indian Affairs (BIA) and Navajo Nation Heritage Program (NNHP) guidance.

The species considered in this document are outline in **Tables 1 - 3**. Tribal designations are developed by the Navajo Nation Division of Natural Resources, Department of Fish and Wildlife, approved by the Navajo Nation Resources Committee Resolution (No. RDCJA-01-20) (NNHP 2020), and include the following.

Group 1 (G1): Those species or subspecies that no longer occur on the Navajo Nation.

Group 2 (G2): & Group 3 (G3): "Endangered" – Any species or subspecies whose prospects of survival or recruitment within the Navajo Nation are in jeopardy or are likely within the foreseeable future to become so.

> **G2:** A species or subspecies whose prospects of survival or recruitment are in jeopardy.
>
> **G3:** A species or subspecies whose prospects of survival or recruitment are likely to be in jeopardy in the foreseeable future.

Group 4 (G4): Any species or subspecies for which the Navajo Nation Department of Fish and Wildlife's Navajo Natural Heritage Program (NNHP) does not currently have sufficient information to support their being listed in G2 or G3 but has reason to consider them.

1.1 Threatened, Endangered, Proposed Threatened and Proposed Endangered

Table 1. Threatened (T) and Endangered (E) Species with Federal Endangered Species Act status that may occur in treatment areas within the project area. Tribal status of each species, as defined by NNHP and based on populations that occur on the Navajo Nation, is also indicated. Exp. Pop. = nonessential experimental population.

Common Name (*Scientific Name*)	Federal Status	Tribal Status
Birds		
California condor (*Gymnogyps californianus)*	E; Exp. Pop.	G4
Southwestern willow flycatcher (*Empidonax traillii extimus)*	E	G2
Mexican spotted owl *(Strix occidentalis lucida)*	T	G3
Western yellow-billed Cuckoo (*Coccyzus americanus)*	T	G2
Fish		
Colorado Pikeminnow (*Ptychocheilus lucius*)	E	G2

Common Name (*Scientific Name*)	**Federal Status**	**Tribal Status**
Humpback Chub (*Gila cypha*)	E	G2
Razorback Sucker (*Xyrauchen texanus*)	E	G2
Zuni Bluehead Sucker (*Catostomus discobolus*)	E	G2
Plants		
Brady Pincushion Cactus (*Pediocactus bradyi*)	E	G2
Fickeisen Plains Cactus (*Pediocactus pebblesianus ssp. fickeiseniae*)	E	G3
Mancos Milk-vetch (*Astragalus humillimus*)	E	G2
Mesa Verde Cactus (*Schlerocactus mesae-verdae*)	T	G2
Navajo Sedge (*Carex specuicola*)	T	G3
Welsh's Milkweed (*Asclepias welshii*)	T	G3
Zuni/Rhizome Fleabane (*Erigeron rhizomatus*)	T	G2

1.2 Sensitive Species and Species of Concern – Navajo Listed Species

Table 2. Species with Navajo Natural Heritage Program under the Navajo Nation Department of Fish and Wildlife tribal status that may occur in treatment areas within the project area.

Common Name (*Scientific Name*)	**Tribal Status**
Mammals	
Pronghorn (*Antilocapra americana*)	G3
Townsend's big-eared bat (*Corynorhius townsendii*)	G4
Chisel-toothed kangaroo rat (*Dipodomys microps*)	G4
Banner-tailed kangaroo rat (*Dipodomys spectabilis*)	G4
Navajo Mountain vole (*Microtus mogollonensis*)	G4
Arizona (Wupatki) pocket mouse (*Perognathus amplus cineis*)	G4
Kit Fox (*Vulpes macrotis*)	G4
Birds	
Bald Eagle (*Haliaeetus leucocephalus*)	G2
Golden Eagle (*Aquila chrysaetos*)	G3
Ferruginous Hawk (*Buteo regalis*)	G3
American dipper (*Cinclus mexicanus*)	G3
Northern goshawk (*Accipter gentilis*)	G4
Clark's grebe (*Aechmophorus clarkia*)	G4
Northern saw-whet owl (*Aegolius acadicus*)	G4
Burrowing owl (*Athene cunicularia*)	G4
Belted kingfisher (*Ceryle alcyon*)	G4
Mountain plover (*Charadrius montanus*)	G4
Dusky grouse (*Dendragapus obscurus)*	G4
Yellow warbler (*Dendroica petechia*)	G4
Hammond's flycatcher (*Empidonax hammondii*)	G4
Northern Pygmy owl (*Glaucidium gnoma*)	G4
Flammulated owl (*Otus flammeolus*)	G4
Band-tailed pigeon (*Patagioenas fasciata*)	G4
American three-toed woodpecker (*Picoides dorsalis*)	G4
Sora (*Porzana Carolina*)	G4
Tree swallow (*Tachycineta bicolor)*	G4
Gray vireo (*Vireo vicinior*)	G4
Invertebrates	
Great Basin silverspot (*Speyeris nokomis*)	G3
Rocky mountainsnail (*Oreohelix strigose*)	G4
Yavapai mountainsnail (*Oreohelis yavapai*)	G4
Kanab ambersnail (*Oxyloma kanabense*)	G4
Fish	
Roundtail Chub (*Gila robusta*)	G2

Common Name (*Scientific Name*)	**Tribal Status**
Bluehead sucker (*Catostomus discobolus*)	G4
Amphibians and Reptiles	
Northern Leopard frog (*Lithobates pipiens*)	G2
Milk snake (*Lampropeltis triangulum*)	G4
Chuckwalla (*Sauromalus ater*)	G4
Plants	
Cutler's milkvetch (*Astragalus cutleri*)	G2
Gooding's onion (*Allium gooddingii*)	G3
Marble Canyon milk-vetch (*Astragalus cremnophylax* var. *hevronii*)	G3
Cronquist's milk-vetch (*Astragalus cronquistii*)	G3
Naturita milk-vetch (*Astragalus naturitensis*)	G3
Acoma fleabane (*Erigeron acomanus*)	G3
Round dunebroom (*Errazurizia rotundata*)	G3
Navajo bladderpod (*Physaria navajoensis*)	G3
Navajo Mountain penstemon (*Penstemon navajoa*)	G3
Alcove rock daisy (*Perityle specuicola*)	G3
Alcove bog-orchid (*Platanthera zothecina*)	G3
Alcove death camas (*Anticlea vaginatus*)	G3
Aztec gilia (*Aliciella formosa*)	G4
San Juan milkweed (*Asclepias sanjuanensis*)	G4
Heil's milkvetch (*Astragalus heilii*)	G4
Navajo saltbush (*Atriplex garrettii var. navajoensis*)	G4
Atwood's Camissonia (*Camissonia atwoodii*)	G4
Rydberg's thistle (*Cirsium rydbergii*)	G4
Utah bladder-fern (*Cytsopteris utahensis*)	G4
Sivinski's fleabane (*Erigeron sivinskii*)	G4
Sarah's buckwheat (*Eriogonum lachnogynum var. sarahiae*)	G4
Bluff phacelia (*Phacelia indecora*)	G4
Cave primrose (*Primula specuicola*)	G4
Marble Canyon dalea (*Psorothamnus arborescens var. pubescens*)	G4
Parish's alkali grass (*Puccinellla parishii*)	G4
Arizona rose sage (*Salvia pachyphylla ssp. eremopictus*)	G4
Brack hardwall cactus (*Sclerocactus cloverae brackii*)	G4
Welsh' American-aster (*Symphyotrichum welshii*)	G4

1.4 Critical Habitat

The action addressed by this biological assessment falls within Critical Habitat for Colorado pikeminnow, humpback chub, razorback sucker, and Navajo sedge. Final rulings on Critical Habitat for the species listed above and the date established by USFWS are listed below.

Table 3. Species with Federally designated critical habitat as per the Endangered Species Act within the project area and the date of the critical habitat determination.

Common Name	Date of Critical Habitat Determination
Colorado Pikeminnow (*Ptychocheilus lucius*	1994
Humpback Chub (*Gila cypha*)	1994
Razorback Sucker (*Xyrauchen texanus*)	1994
Navajo Sedge (Carex specuicola)	1985

2. Consultation to Date

Informal Section 7 consultation for the NNIWMP began with a National Environmental Policy Act (NEPA) scoping request dated December 19, 2012. The U.S. Fish and Wildlife Service (USFWS which will be addressed as the Service), Arizona Ecological Services Field Office responded to this request with a letter and species list dated June 28, 2012. On November 2, 2020, the Service reviewed and provided comments on the species conservation measures developed in 2014.

The Navajo Nation responded to this request with a letter dated October 19, 2012, and appointed Navajo Nation Department of Fish and Wildlife as the lead agency for the consultation. BIA submitted a data request for the project to NNHP on February 11, 2014 to initiate involvement of NNHP. The data request provided the list of Navajo Nation listed species, including the federally listed species, and their potential habitat. Extensive surveys for all listed species have not been conducted across the Navajo Nation; therefore, there is a dearth of information on species' status and distribution. The existing information on listed species was obtained by the NNHP. On August 20, 2020, NNHP sent a letter to BIA to accept the continued participation in the Navajo Nation IWMP and PEIS project. An additional meeting between BIA and NNHP occurred on January 12, 2021 to clarify the coverage of the Biological Evaluation (BE) being prepared for the PEIS and the mitigation measures.

BIA informally met with the USFWS and NNHP over seven meetings from February 15, 2013 through February 27, 2014 to discuss the species conservation measures for Federal and Navajo Nation listed species and the potential effects of the methodology proposed. Both the "Recommended Protection Measures for Pesticide Applications in the Southwest Region of the U.S. Fish and Wildlife Service (RPR)" (White 2007) and the "Navajo Nation Endangered Species List Species Accounts (Version 4.20)" (NNHP 2020) were used to select the species conservation measures. In general, the most conservative species conservation measures of the two documents were selected to include in the BA with some revisions discussed during the meetings with USFWS and NNHP. On October 23, 2020, BIA met informally with NNHP and USFWS to discuss the updated Federal and Navajo Nation listed species and revised mitigation measures based on the "Navajo Nation Endangered Species List Species Accounts (Version 4.20)" (NNHP 2020). Finally, on April 5, 2022 and June 17, 2022 BIA met informally with

NNHP and USFWS to discuss the addition of the herbicide indaziflam and recommended species conservation measures.

3. Description of the Proposed Action

The BIA Navajo Regional Office proposes to authorize new weed treatments of up to 50,000 acres annually, for a total of up to 500,000 acres with repeat visits over 10 years to manage 45 noxious weed species (**Table 5**). Because the NNIWMP will be implemented across the Navajo Nation, a programmatic approach was developed to provide the BIA NRO with a strategic approach to prioritize projects, species, and treatment methods for project planning and management. Individual weed treatment projects will tier off the PEIS and will require individual environmental assessments with detailed impact analyses and information related to the site and each project's proposed methods. However, it was determined by USFWS that if the species avoidance and minimization measures were implemented (as listed below) for each weed treatment project under this plan, it would be covered by this biological assessment determination. Further Section 7 consultation for federally listed species would not be required provided adherence to these measures and that there was no change in the proposed action.

Project specific actions tiering off this document would require further biological evaluation by submitting a Data Request Form for the project to NNHP. The Data Request Form requires the specific weed treatment methods proposed and maps of the project area. The project sponsor is required to obtain a Biological Resource Compliance Form (BRCF) to initiate the project. The BRCF will determine if potential habitat for Federal or Navajo Listed Endangered, Threatened, Sensitive, or Proposed species or migratory birds exists at the site. If potential habitat occurs at the site, the project sponsor will have to complete species or habitat assessments by a qualified and permitted biologist, implement species conservation measures, and/or have a qualified biologist on site during project implementation. If federally listed species occur or have the potential to occur at a project site the Service will be copied on any correspondence to the NNHP.

The various methods analyzed under an integrated weed treatment approach (see Appendix A for more detailed descriptions) include:

- Manual: pulling, grubbing, or digging using hand tools;
- Mechanical: grubbing, tillage, mowing, prescribed burning, and heavy machinery;
- Cultural: grazing by livestock, use of weed and weed seed-free hay, crop rotation, mulching native plants, active and passive restoration of native plants
- Chemical: use of herbicide (cut stump, hand spraying, boom sprayer, aerial spraying); and
- Biological: use of U.S. Department of Agriculture Animal and Plant Health Inspection Service (APHIS) approved insects and pathogens.

The combination of methods used for each project will vary depending on site conditions and the species identified for treatment. Treatments will be applied across the Navajo Nation with priority areas including Navajo Nation, BIA, State, and County roads; riparian areas; Navajo Agricultural Products Industry (NAPI) lands; utility rights-of-way; designated farmlands, designated rangeland, and Navajo Nation Designated Community Development Areas. For a more detailed description of the priority areas see (Appendix A). This plan will cover a 10-year period, with a review after five years. After that time, the plan would remain in place until the BIA prepares an updated or replacement plan.

Prevention, education, annual weed mapping, and early detection and rapid response will be implemented under the plan.

Table 4. Estimated annual acreage of each noxious weed treatment under the Proposed Action on the Navajo Nation. Acreages for cut stump treatments are counted in both mechanical and chemical treatment acres since both methods are utilized under this technique.

Treatment Type	Estimated Acreage of Treatment per Year
Manual	2,000
Mechanical	8,000
Cultural	5,000
Biological	5,000
Chemical	30,000
TOTAL	**50,000**

The use of biological controls will be discussed with NNHP and the Service on a project-by-project basis. Under the NNIWMP, only biological control agents approved by APHIS will be used. For the list of proposed biological control agents see Appendix A. The total number of acres affected by biological control agents would be based on the total acres of the host plant available to the agent within a reasonable distance from the original released population. This would vary depending on the biocontrol agent used and the target weed species. Biological control agents would be used in combination with other weed treatment methods. The introduction of tamarisk leaf beetle (*Diorhabda* sp.) will not be considered as a biological agent for tamarisk (*Tamarix* sp.). APHIS terminated the program in 2010 due to its negative effects on nesting habitat for the endangered southwestern willow flycatcher (*Empidonax traillii extimus*). Due to the migration of the tamarisk leaf beetle from the introduction site, near Moab, Utah, to the Navajo Nation, this species now exists across the Navajo Nation in tamarisk inhabited locations.

While targeted grazing, where trained livestock graze areas with heavy weed coverage (more than 50% cover), is recommended for treating weed populations in Community Development areas and agricultural areas, its use in other areas should be done in close consultation with NNHP and Navajo Nation EPA. It will also be prohibited in areas where federally or tribally listed species occur.

This BA covers the activities outlined in the NNIWMP for the BIA Navajo Regional Office and Cooperating Agencies including Arizona Department of Transportation (ADOT), Utah

Department of Transportation (UDOT), Navajo Nation (NN), Navajo Nation Soil and Water Conservation Districts (NNSWCD), San Juan Soil and Water Conservation District (SJSWCD), USDA AZ Natural Resources Conservation Services (NRCS), and U.S. Department of Agriculture Animal and Plant Health Inspection Service (APHIS).

3.1 Project Goals

The project goals developed for the Integrated Weed Management Plan include:

- Develop the best control techniques for the target weed species in a planned, coordinated, and economically feasible program to limit the impact and spread of noxious weeds.
- Use adaptive management to incorporate project successes and lessons learned from completed weed projects when developing new initiatives.
- Identify and prevent the expansion of existing target weed species, and quickly prevent the spread of new high priority weed species through utilization of spatial technology.
- Coordinate weed removal efforts with adjacent landowners, land managers, and/or federal agencies to prevent the further spread of weeds.
- Provide and promote economic opportunities to the Navajo people to improve rangeland and farmland productivity and to remove noxious weeds.
- Develop a public education program focused on weed identification, prevention, and removal techniques for local communities and non-profit organizations.

3.2 Project Location

The Navajo Nation is in northeastern Arizona, southeastern Utah, and northwestern New Mexico and encompasses approximately 16.3 million acres (**Figure 1**). The BIA Navajo Region is divided into five BIA agencies including:

- Western Navajo Agency (Tuba City, AZ, 5.2 million acres),
- Eastern Navajo Agency (Crownpoint, NM, 2.3 million acres),
- Fort Defiance Agency (3.3 million acres),
- Shiprock / Northern Navajo Agency (2.7 million acres), and
- Chinle / Central Navajo Agency (1.4 million acres).

The Navajo Partitioned Lands (Pinon, AZ, 910,000 acres) and the New Lands Area (310,000 acres) contain an additional 1.2 million acres. At the date of this writing, New Lands is managed by the Office of Hopi and Navajo Indian Relocation but may come under the BIA in the foreseeable future. Thus, the New Lands Area is included in the project area. Additionally, there are approximately a million acres of land that may be in transition to allotment or trust lands on the Navajo Nation as part of land buy backs. For this document, the project area refers to the entire Navajo Nation as described above, and project sites refer to individual weed removal project locations.

A map of the Navajo Nation with the different management agency boundaries in different colors. Shiprock, or Northern Agency is beige, Eastern Agency is blue, Fort Defiance Agency is red, Chinle or Central Agency is yellow, Western Agency is gray, Navajo Partitioned Lands are green, and New Lands is bright pink.

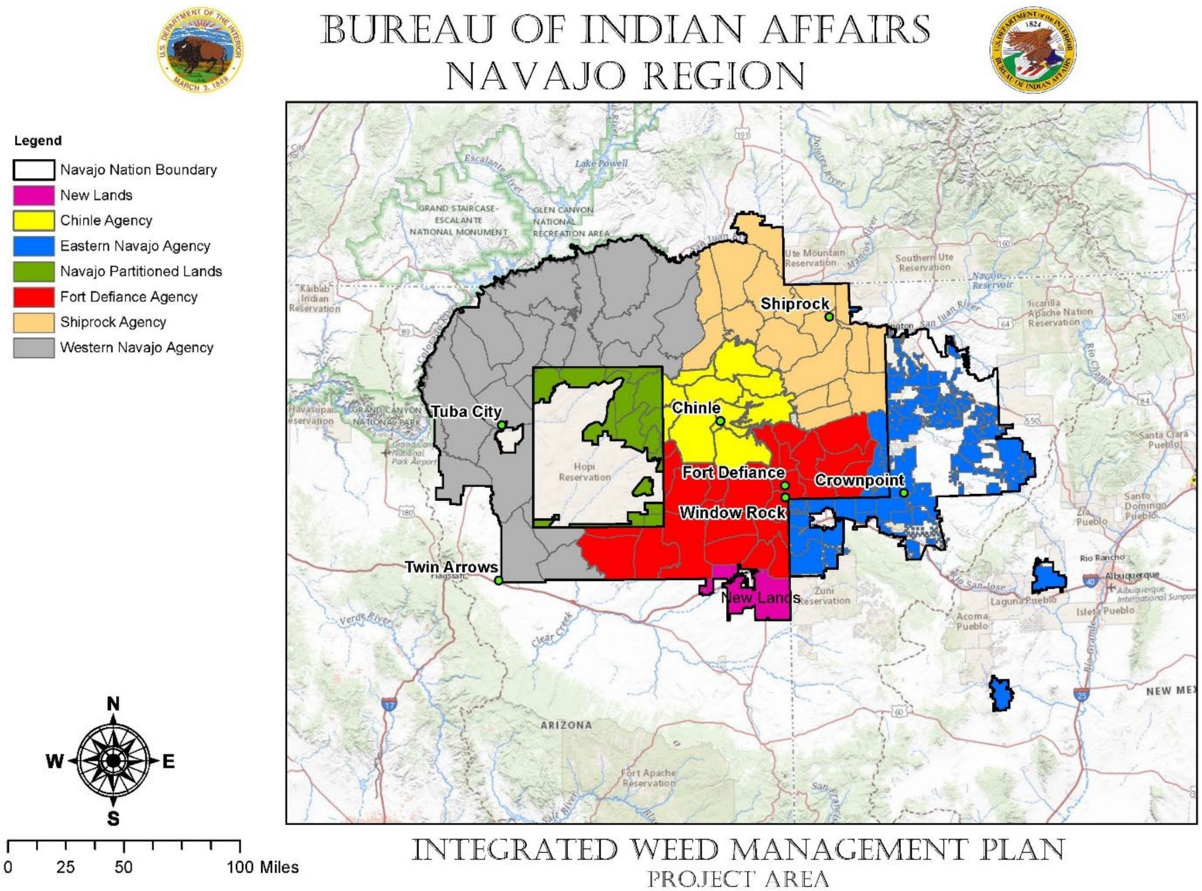

Figure 1. Project area of the Navajo Nation divided by BIA Navajo Regional Agencies.

3.3 Species Conservation Measures

The species conservation measures below are intended for the proposed action and serve as a guide for mitigating impacts to Navajo Endangered species (NESL) and Federally Threatened and Endangered species when conducting weed treatments on Navajo Nation. However, the Navajo Natural Heritage Program (NNHP) encourages treatment of noxious weeds within sensitive species populations as a tool to improve habitat for NESL species, with proper consultation with NNHP and USFWS, as applicable. Therefore, if the goal of the weed treatment project is to improve habitat for threatened and sensitive species, the conservation measures below can be modified for individual species through consultation with NNHP and USFWS on a project-specific basis. Buffers for mechanical, cultural, manual (low impact), and non-aerial herbicide use can be modified on a project-by-project basis with approval from NNHP but will require the presence of a qualified Biologist on-site during all stages of project implementation. Flagging and fencing around listed plant species will also be required.

Species Conservation Measures (Project Design Features)

The Recommended Protection Measures for Pesticide Applications (RPR) in USFWS Region 2 (White 2007) and the Avoidance Measures listed in the Navajo Nation Endangered Species List, Species Accounts (NNHP 2020) were used as a starting point for the conservation measures. If any treatment was not covered under these documents, similar conservation measures based on similar treatment impact parameters were developed. For example, herbicide conservation measures for indaziflam were developed based on similar species toxicity rates as reported in the literature and by U.S. EPA (USFS 2020). The BIA requires the most conservative avoidance measures of the two wildlife agency documents be implemented for NNIWMP projects. BIA conducted nine informal discussions with the USFWS and the NNHP to refine the conservation measures.

3.3.1 Federally Listed Species

General Project BMPs

1. Submit a Biological Consultant Data Request Form to the NNHP to initiate the Biological Resource Compliance Form (BRCF) process prior to project implementation for background information on species habitat and occupancy (the form and instructions can be accessed here: https://www.NNHP.org/nnhp/drs.htm). A brief report should be submitted with the BRCF request that includes the following:
    a. Description and map of the project location and treatment activities proposed
    b. Consideration of the intersection of the project site with potential habitat of potential and known species listed in the Data Response.
    c. Description of survey timing and methodology (including buffers) and species-specific surveys performed.
    d. Conservation measures that will be applied for the project, if applicable.
2. If preliminary analysis based on maps, aerial photos, and other knowledge of the project site indicates that potential habitat for listed species is present, a qualified biologist will conduct a habitat assessment and may be required on site during all stages of project implementation as determined by the BRCF process.
3. If suitable habitat is present, the project may apply the conservation measures (see below and **Appendix B**), including buffers established for that species to the habitat boundaries or a qualified biologist will conduct additional surveys for species' presence.
4. Qualified biologists should obtain federally listed species permits from USFWS and be on the permitted consultants list for NNHP prior to conducting species surveys on Navajo Nation land.

5. If the species is present at the site, the species-based protection measures will be employed as described. If protocol surveys do not detect the species, there will be no buffers.

6. Where specified, species breeding season timing restrictions and buffers apply to all treatment methods.

7. Where two or more species' habitats overlap, the more restrictive measures will take priority.

8. Consult **Appendix B** for the required protection measures for herbicide application in federally and NNHP listed species habitat.

3.3.2 Navajo Nation Endangered Species List

General Project Best Management Practices (BMPs)

1. Submit a Biological Consultant Data Request Form to the NNHP to initiate the Biological Resource Compliance Form (BRCF) process prior to project implementation for background information on species habitat and occupancy (the form and instructions can be accessed here: https://www.nndfw.org/nnhp/drs.htm). A brief report should be submitted with the BRCF request that includes the following:
    a. Description and map of the project location and treatment activities proposed
    b. Consideration of the intersection of the project site with potential habitat of potential and known species listed in the Data Response.
    c. Description of survey timing and methodology (including buffers) and species-specific surveys performed.
    d. Conservation measures that will be applied for the project, if applicable.

2. Include General Project BMPs species conservation measures listed above.

3. If preliminary analysis based on maps, aerial photos, and other knowledge of the project site indicates that potential for habitat for Group 2 and 3 species is present, a qualified biologist will conduct species surveys.

4. Species surveys are preferred for Group 4 species but not required. A qualified biologist will conduct Group 4 species surveys concurrently with Group 2 and 3 species surveys.

5. Qualified biologists should be on the annual permitted consultants list from NNHP prior to conducting species surveys.

Table 5. Required species conservation measures for federally listed endangered and threatened and Group 2 and 3 Navajo Nation listed plant species.

Plants (Federally listed and NNHP G3) – Species Conservation Measures																					
USFWS Status	**E**			**T**				**T**	**Group 3**												
NNHP Group	**G2**	**G3**	**G2**	**G2**	**G3**	**G3**	**G2**	**G2**													
Conservation Measure	**Brady pincushion cactus** *(Pediocactus bradyi)*	**Fickeisen plains cactus** *(Pediocactus peeblesianus ssp. fickeiseniae)*	**Mancos milk-vetch** *(Astragalus humillimus)*	**Zuni (Rhizome) fleabane** *(Erigeron rhizomatus)*	**Welsh's milkweed** *(Asclepias welshii)*	**Navajo sedge** *(Carex specuicola)*	**Cutler's milk-vetch** *(Astragalus cutleri)*	**Mesa Verde cactus** *(Sclerocactus mesae-verdae)*	**Aztec gilia** *(Aliciella formosa)*	**Gooding's onion** *(Allium goodingii)*	**Alcove death camas** *(Anticlea vaginatus)*	**Marble Canyon milk-vetch** *(Astragalus cremnophytax var. hevronii)*	**Cronquist's milk-vetch** *(Astragalus cronquistii)*	**Naturita milk-vetch** *(Astragalus naturitensis)*	**Acoma fleabane** *(Erigeron acomanus)*	**Round dunebroom** *(Errazurizia rotundata)*	**Navajo Mountain Penstemon** *(Penstemon navajoa)*	**Alcove rock daisy** *(Perityle specuicola)*	**Navajo bladderpod** *(Physaria navajoensis)*	**Alcove bog-orchid** *(Platanthera zothecina)*	**Brack's hardwall cactus** *(Sclerocactus cloverae ssp. brackii)*
Low and high aerial spraying of herbicides requires a 1-mile (1.6-km) buffer from identified listed species locations.	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Mechanical, cultural, chemical, and prescribed burn treatments require a 200-ft (60-m) buffer from identified listed plant species locations. A burn plan must be developed for each project using prescribed fire, which will include specific treatment buffers.	X	X	X	X	X	X	X	X	X		X	X	X	X	X	X		X	X	X	X
Manual treatments (low impact treatments) require a 20-ft (6-m) buffer from identified listed species locations.	X	X	X	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X	X	X
Known plant locations will be flagged, and/or fenced during treatments.	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
The NNHP botanist will be notified of rare plant survey results and if weed treatments will be conducted near listed or sensitive plants. If treatments occur buffers and other avoidance measures will be implemented in consultation with the NNHP botanist.	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X

Conservation Measure	**Brady pincushion cactus** *(Pediocactus bradyi)*	**Fickeisen plains cactus** *(Pediocactus peeblesianus* ssp. *fickeiseniae)*	**Mancos milk-vetch** *(Astragalus humillimus)*	**Zuni (Rhizome) fleabane** *(Erigeron rhizomatus)*	**Welsh’s milkweed** *(Asclepias welshii)*	**Navajo sedge** *(Carex specuicola)*	**Cutler’s milk-vetch** *(Astragalus cutleri)*	**Mesa Verde cactus** *(Sclerocactus mesae-verdae)*	**Aztec gilia** *(Aliciella formosa)*	**Gooding’s onion** *(Allium goodingii)*	**Alcove death camas** *(Anticlea vaginatus)*	**Marble Canyon milk-vetch** *(Astragalus cremnophytax var. hevronii)*	**Cronquist’s milk-vetch** *(Astragalus cronquistii)*	**Naturita milk-vetch** *(Astragalus naturitensis)*	**Acoma fleabane** *(Erigeron acomanus)*	**Round dunebroom** *(Errazurizia rotundata)*	**Navajo Mountain Penstemon** *(Penstemon navajoa)*	**Alcove rock daisy** *(Perityle specuicola)*	**Navajo bladderpod** *(Physaria navajoensis)*	**Alcove bog-orchid** *(Platanthera zothecina)*	**Brack’s hardwall cactus** *(Sclerocactus cloverae ssp. brackii)*
Vehicles will use only established roads for accessing project sites.	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Vehicles will be parked at previously disturbed parking areas located at least 20-ft (6-m) from known populations when treating. Parking areas will be near established Navajo-BIA, tribal, State, or County roads that receive moderate to heavy use.	X	X	X	X	X	X	X	X													
Treatments occurring in the Mesa Verde Biological Preserves require additional consultation with USFWS and the NNHP botanist. A qualified biological is required on-site to monitor all phases of implementation.								X													
Manual treatments (low impact treatments) require a 50-ft (15-m) buffer from identified listed species locations.								X													
No pre-emergent herbicide applications will be used							X														
Mechanical, cultural, chemical, and prescribed burn treatments require a 1-mile (1.6-km) buffer from identified listed plant species locations. A burn plan must be developed for each project using prescribed fire, which will include specific treatment buffers.										X							X				

Table 6. Recommended species conservation measures for NNHP Group 4 plants.

NNHP Group 4 Plants – Recommended Species Conservation Measures														
Conservation Measure	**San Juan milkweed** *(Asclepias sanjuanensis)*	**Heils milk-vetch** *(Astragalus heilii)*	**Navajo saltbush** *(Atriplex garrettii var. navajoensis)*	**Atwoods camissonia** *(Camissonia atwoodii)*	**Welchs American-aster** *(Symphyotrichum welshii)*	**Arizona rose sage** *(Salvia pachyphylla ssp. eremopictus)*	**Rydberg's thistle** *(Cirsium rydbergii)*	**Utah bladder-fern** *(Cystopteris utahensis)*	**Sivinski's fleabane** *(Erigeron sivinskii)*	**Sarah's buckwheat** *(Eriogonum lachnogynum var. sarahiae)*	**Bluff phacelia** *(Phacelia indecora)*	**Cave primrose** *(Primula specuicola)*	**Marble Canyon dalea** *(Psorothamnus arborescens var. pubescens)*	**Parish's alkali grass** *(Puccinella parishii)*
Low and high aerial spraying of herbicides require a 1-mile (1.6 km) buffer from identified listed species locations.	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Mechanical, cultural, chemical, and prescribed fire treatments require a 200-ft (60-m) buffer from identified listed plant species locations. A burn plan must be developed for each project using this technique, which will include specific treatment buffers.	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Manual treatments (low impact treatments) require a 20-ft (6-m) buffer from identified listed species locations.	X	X	X	X	X	X	X	X	X	X	X	X	X	X
When doing treatments, workers will place flagging, and/or fencing around listed or sensitive plant populations.	X	X	X	X	X	X	X	X	X	X	X	X	X	X

Table 7. Required species conservation measures for Federally listed endangered, threated, and experimental population and NNHP Group 2 and 3 bird species.

Birds (NNHP G2, G3, and G4 Exp. Pop) – Species Conservation Measures								
USFWS Status	**T**	**E, Exp. Pop.***	**E**	**T**				
NNHP Group	**G3**	**G4**	**G2**	**G2**	**G2**	**G3**	**G3**	**G3**
Conservation Measure	**Mexican spotted owl** *(Strix occidentalis lucida)*	**California condor** *(Gymnogyps californianus)*	**Southwestern willow flycatcher** (SWFL)** *(Empidonax traillii extimus)*	**Western yellow-billed cuckoo (YBCU)** *(Coccyzus americanus)*	**Bald Eagle** *(Haliaeetus leucocephalus)*	**Golden Eagle** *(Aquila chrysaetos)*	**Ferruginous hawk** *(Buteo regalis)*	**American dipper** *(Cinclus mexicanus)*
Breeding season is March 1 through August 31.	X							
All treatments require a ¼-mile (0.4-km) buffer from protected activity centers (PACs) and suitable nesting habitat during the breeding season. A PAC is approximately 600 acres (240 ha) around an owl activity center (nest, roost, or best roost habitat).	X							
Specified herbicides may be applied along road and utility rights-of-way in MSO PACS during the breeding season, but applicators should make sure that pesticide spray drift does not occur beyond rights-of-way.	X							
Contact NNHP for background information on known nesting sites, suitable nesting sites, or known communal roosting sites in species habitat.		X						
Mechanical, prescribed fire, and ground application of herbicide treatments require a 1-mile (1.6-km) buffer from known nesting sites, suitable nesting sites, or known communal roosting sites in species habitat of canyon lands and mountain ridges.		X						
Aerial applications of herbicides require a 1.5-mile (2.4-km) buffer from release sites, suitable nesting sites, or known communal roosting sites in species habitat of canyon lands and mountain ridges.		X						
If a condor is present all weed treatment activities will cease and NNHP will be contacted. Field crews will avoid interacting with condors if present on site.		X						
All trash and debris will be disposed of properly off site.		X						
No new populations biological control for saltcedar on the Navajo Nation.			X					
A permitted biologist will confirm occupancy during the breeding season (May 15 through July 17, "SWFL Recovery Plan") within a year prior to conducting treatments to determine suitable habitat, breeding habitat, important migration corridors, or potential territory for occupied habitat.			X					
A qualified SWFL biologist in coordination with NNHP will determine breeding patch size for nesting areas per the "SWFL Recovery Plan" and identify sites on the ground prior to treatments.			X					

USFWS Status	**T**	**E, Exp. Pop.***	**E**	**T**				
NNHP Group	**G3**	**G4**	**G2**	**G2**	**G2**	**G3**	**G3**	**G3**
Conservation Measure	**Mexican spotted owl** *(Strix occidentalis lucida)*	**California condor** *(Gymnogyps californianus)*	**Southwestern willow flycatcher** (SWFL)** *(Empidonax traillii extimus)*	**Western yellow-billed cuckoo (YBCU)** *(Coccyzus americanus)*	**Bald Eagle** *(Haliaeetus leucocephalus)*	**Golden Eagle** *(Aquila chrysaetos)*	**Ferruginous hawk** *(Buteo regalis)*	**American dipper** *(Cinclus mexicanus)*
In occupied breeding areas, mechanical and mechanized and low and high aerial chemical treatments require a ¼-mile (0.4-km) buffer from the breeding patch boundary or suitable habitat.			X	X				
Prescribed fires outside of a breeding patch will be conducted outside of the migrating and breeding season. Small pile burns will be conducted outside of the floodplain or 300-ft (90-m) buffer from edge of waterway.			X	X				
Manual treatments will be used up to the breeding patch boundary or suitable habitat.			X	X				
Important migratory corridors for SWFL will be buffered as listed above from May 15 to July 17.			X					
All projects within the riparian zone near occupied habitat will require restoration with native riparian/wetland vegetation following noxious weed removal.			X	X				
A permitted biologist will confirm occupancy during the breeding season (June 15 through August 15) within a year prior to conducting treatments. No activity will occur within ¼-mi (0.4-km) of potential habitat no survey information exists.				X				
A qualified, yellow-billed cuckoo (YBCU) biologist, in coordination with NNHP, will determine breeding patch size for nesting areas and identify sites on the ground prior to treatments.				X				
The breeding season for bald and golden eagles is January 15 – July 15 ('Navajo Nation Golden and Bald Eagle Nest Protection Regulations').					X	X		
Brief activities that occur for up to one hour per day and involve only personnel and passenger or maintenance vehicles (one hour of spot spraying, mechanical, or manual treatments) require a 0.4 mi (600 m) buffer from an active nest.					X	X		
Breeding season occurs March 1 – July 31 (Navajo Nation Endangered Species List: species accounts).							X	
Light activities that occur for up to one day in the same general area and involve up to five vehicles and up to ten personnel (mechanical treatments and mechanized ground chemical treatments) require a 0.5-mi (800-m) buffer from an active nest.					X	X	X	
Heavy activities that exceed at least one of the criteria for Light Activities that involve human activity of up to one visit per week (prescribed fire, low and high aerial chemical treatments) will be conducted outside of the breeding season and ¾-mi (1-km) from a nesting site.					X	X	X	

USFWS Status	T	E, Exp. Pop.*	E	T				
NNHP Group	**G3**	**G4**	**G2**	**G2**	**G2**	**G3**	**G3**	**G3**
Conservation Measure	**Mexican spotted owl** *(Strix occidentalis lucida)*	**California condor** *(Gymnogyps californianus)*	**Southwestern willow flycatcher** (SWFL)** *(Empidonax traillii extimus)*	**Western yellow-billed cuckoo (YBCU)** *(Coccyzus americanus)*	**Bald Eagle** *(Haliaeetus leucocephalus)*	**Golden Eagle** *(Aquila chrysaetos)*	**Ferruginous hawk** *(Buteo regalis)*	**American dipper** *(Cinclus mexicanus)*
Brief activities that occur for up to one hour per day and involve only personnel and passenger or maintenance vehicles (one hour of spot spraying, mechanical, or manual treatments) require a ½-mile (0.8-km) buffer from an occupied nest.							X	
Mechanical treatments require a 50–200-ft (15-60-m) buffer from occupied nesting habitat outside of breeding season.								X
No mechanical, mechanized ground, low or high aerial chemical treatments within 1/8 mile (0.2 km) from the active nest during March 15- August 15.								X
Spot chemical spraying or manual treatments require a buffer of 330-ft (0.1-km) from the active nest during March 15- August 15.								X
Small migratory birds- Class 2 or Class 3 herbicides require 30-ft (9-m) buffer for spot and mechanized ground application of herbicide, 150-ft (50-m) with low aerial chemical treatments, and 1/8-mi (200-m) for high aerial chemical treatments near the species habitat.								X

***Exp. Pop = Experimental Population**

****Southwestern willow flycatcher** (*Empidonax traillii extimus)*

Definitions (from "Southwestern Willow Flycatcher Recover Plan ("SWFL Recovery Plan)

Currently suitable habitat is defined as a riparian area with all the components needed to provide conditions suitable for breeding flycatchers. These conditions are generally dense, mesic riparian shrub and tree communities 0.25 acre (0.1 ha) or greater in size within floodplains large enough to accommodate riparian patches at least 33 ft (10 m) wide. Suitable habitat may be occupied or unoccupied.

Potentially suitable habitat is defined as a riparian system that does not currently have all the components needed to provide conditions suitable for nesting flycatchers, but which could – if managed appropriately – develop these components over time. Potential habitat occurs where the flood plain conditions, sediment characteristics, and hydrological setting provide potential for development of dense riparian vegetation.

Breeding Patch is the area used by breeding flycatchers. Breeding patches include all flycatcher territories, and most flycatcher breeding patches are larger than the sum total of the flycatcher territory sizes at that site.

Table 8. Recommended species conservation measures for NNHP Group 4 bird species and bird species protected under the Migratory Bird Treaty Act.

NNHP Group 4 Birds – Species Conservation Measures Protected under Migratory Bird Treaty Act																
Conservation Measure	**Northern goshawk** *(Accipiter gentilis)*	**Clarks grebe** *(Aechmophorus clarkia)*	**Northern saw-whet owl** *(Aegolius acadicus)*	**Burrowing owl** *(Athene cunicularia)*	**Belted kingfisher** *(Ceryle alcyon)*	**Mountain plover** *(Charadrius montanus)*	**Dusky grouse** *(Dendragapus obscurus)*	**Yellow warbler** *(Dendroica petechial)*	**Hammond’ s flycatcher** *(Empidonax hammondii)*	**Northern pygmy-owl** *(Glaucidium gnoma)*	**Flammulated owl** *(Otus flammeolus)*	**Band-tailed pigeon** *(Patagioenas fasciata)*	**American three-toed woodpecker** *(Picoides dorsalis)*	**Tree swallow** *(Tachycineta bicolor)*	**Sora** *(Porzana Carolina)*	**Gray vireo** *(Vireo vicinior)*
All treatments require a ¼-mi (0.4-km) buffer from nest site during March 1- August 15 and within 0.20-mi (0.2-km) of nest site year-round.	X			X												
Mechanical treatments require 200-ft (60-m) buffer from lake-side vegetation or within the 100-yr floodplain, whichever is greater.		X														
Prescribed fire, target livestock grazing, and mechanized ground, low and high aerial chemical spraying require a 1/8-mile (0.2km) buffer from the active nest.		X*			X*	X*	X∞								X ‡	
Chemical spot and manual treatments require a 330-ft (0.1-km) buffer from active nest.		X*			X*	X*	X∞		X ϕ			X ‡	X ‡	X ‡	X ‡	X***
All treatments require a 1/8-mile (0.2-km) buffer from the nest site year-round or during nesting.			X					X**								
Pesticides that rate as Class 2 or Class 3 in the Predatory Avian, Small Mammal, or Terrestrial Arthropod toxicity groups should have a ½-mile (0.8-km) buffer from occupied nests.			X	X						X	X					
No treatments within nesting habitats year-round.					X	X										
Mechanical treatments require 1/8-mile (0.2-km) buffer from nest site year-round.							X				X					
Mechanical, mechanized ground and low and high aerial chemical treatments require a 1/8-mile (0.2 km) buffer from habitat patches used for breeding or potential habitat year-round.								X	X	X		X	X	X		X
Chemical spot and manual treatments require a 1/8-mile (0.2 km) buffer from the nest site.										X∞	X #					

Conservation Measure	**Northern goshawk** *(Accipiter gentilis)*	**Clarks grebe** *(Aechmophorus clarkia)*	**Northern saw-whet owl** *(Aegolius acadicus)*	**Burrowing owl** *(Athene cunicularia)*	**Belted kingfisher** *(Ceryle alcyon)*	**Mountain plover** *(Charadrius montanus)*	**Dusky grouse** *(Dendragapus obscurus)*	**Yellow warbler** *(Dendroica petechial)*	**Hammond' s flycatcher** *(Empidonax hammondii)*	**Northern pygmy-owl** *(Glaucidium gnoma)*	**Flammulated owl** *(Otus flammeolus)*	**Band-tailed pigeon** *(Patagioenas fasciata)*	**American three-toed woodpecker** *(Picoides dorsalis)*	**Tree swallow** *(Tachycineta bicolor)*	**Sora** *(Porzana Carolina)*	**Gray vireo** *(Vireo vicinior)*
Mechanical treatments require 200-ft (60-m) buffer from lakes and Category I wetlands and 150-ft (45-m) of Category II wetlands, per Navajo Natural Heritage Program 1994.															X	

* - nesting period May 1- July 31, ** - nesting period April 15 – July 31	*** - nesting period May 1 – August 31 ∞- nesting period April 1- July 15	ɸ - nesting period May 15 – August 15 ‡ - nesting period May 1 – August 1	# - nesting period May 1 – August 15

Migratory Birds – Species Conservation Measures
Mechanical treatments within the buffer zone will be conducted outside of the breeding season (March through August).
Non-endangered raptors - All treatments require a 490 ft (0.15 km) buffer from the active nest from March-August or until juveniles have left the nest.
Predatory birds - Spot and mechanized ground herbicide treatments with Class 2 or Class 3 liquid formulation herbicides require a 300 ft (90 m) buffer from the active nest from March- August or until juveniles have left the nest. Low and high aerial treatments require a 1/8 mi (200 m) buffer from the active nest.
Small migratory birds - Class 2 or Class 3 herbicides require 30 ft (9 m) buffer for spot and mechanized ground application of herbicide, 150 ft (50 m) with low aerial chemical treatments, and 1/8 mi (200 m) for high aerial chemical treatments near the species habitat.
Waterfowl - avoid using Class 2 or 3 herbicides in areas where waterfowl are concentrated and wait until birds have migrated for the season. Applications of liquid formulations of Class 2 and 3 herbicides require a 30 ft (9m) buffer for spot applications, 60 ft (20 m) for mechanized ground, 200 ft (60 m) for low aerial spraying, and 1/8 mi (200 m) for high aerial spraying.
Prescribed fires outside of a breeding patch will be conducted outside of the migrating and breeding season.

Table 9. Required species conservation measures for federally listed candidate and endangered and NNHP Group 2 fish species and recommended species conservation measures for NNHP Group 4 fish species.

Fish – Species Conservation Measures						
USFWS Status	**E**	**E**	**C**	**E**	**E**	
NNHP Group	**G2**	**G2**	**G2**	**G2**	**G2**	**G4**
Conservation Measure	**Colorado pikeminnow** *(Ptychocheilus Lucius)*	**Razorback sucker** *(Xyrauchen texanus)*	**Roundtail chub** *(Gila robusta)*	**Humpback chub** *(Gila cypha)*	**Zuni bluehead sucker** *(Catostomus discobolus yarrowii)*	**Bluehead sucker** *(Catostomus discobolus)*
Weed removal projects will require restoration of native vegetation to prevent erosion. Weed removal activities in the riparian zone will be conducted in patches to prevent erosion. Patch size will be determined in consultation with NNHP.	X	X	X	X	X	X
Best Management Practices (see Appendix A) will be used to reduce sedimentation and chemical run-off from mechanical and chemical weed treatments along bank lines within the 100-year floodplain.	X	X	X	X	X	X
Pile burning and prescribed burning will be conducted 300-ft (90-m) outside of the floodplain.	X	X	X	X	X	X
Approved herbicides (aquatic formulations only): 2,4-D, glyphosate, triclopyr and imazapyr will exclusively be used within 25-ft (7.6-m) of the daily high-water mark.	X	X	X	X	X	X
Herbicides with relatively low aquatic toxicity to fish require a 25-ft (7.6-m) buffer from the daily high-water mark in the riparian zone, including: aminopyralid, chlorsulfuron methyl, clopyralid, imazapic, and thifensulfuron-methyl.	X	X	X	X	X	X
Non-aquatic approved and moderate to high aquatic toxicity herbicides require a 30-ft (90-m) buffer from the daily high-water mark (see Appendix A).		X	X	X	X	
No surface disturbance year-round within 98 – 200 ft (30 – 60 m) from the top of the stream bank. NNHP fish biologist will determine exact distance on a case-by-case basis.					X	X
Only the cut-stump method will be used to remove large trees or shrubs in the floodplain. Debris will be piled outside of the floodplain.					X	
Heavy machinery (bulldozers/root plows) mechanical treatments require a 300-ft (90-m) buffer from edge of the waterway.					X	X

Table 10. Required species conservation measures for federally listed endangered and NNHP Group 3 invertebrate species and recommended species conservation measures for NNHP Group 4 invertebrate species.

Invertebrates – Species Conservation Measures				
NNHP Group	**G4**	**G3**	**G4**	**G4**
Conservation Measure	**Kanab ambersnail** (*Oxyloma kanabense*)	**Great Basin silverspot** (*Speyeria nokomis*)	**Rocky mountainsnail** (*Oreohelix strigosa*)	**Yavapai mountainsnail** (*Oreohelix yavapai*)
Mechanized, manual and chemical spot treatments require a 200-ft (60-m) buffer from suitable habitat.				
Low aerial spraying requires a 150-ft (50-m) buffer and high aerial spraying requires a 1/8-mile (200 m) buffer from suitable habitat.				
Surveys will be conducted from August 1 - September 1.		X		
Avoidance measures will be applied to the host plant, violet.		X		
No chemical or mechanical treatments permitted within 200-ft (60-m) of occupied habitat year-round.		X		
No target livestock grazing in wet areas containing host plants during the mating season.		X		
No broadcast or aerial herbicide applications will be permitted within Great Basin silverspot habitat or in areas containing host plants.		X		
Mechanical and manual treatments require a 200-ft (60-m) buffer from occupied habitat year-round.	X		X	X

Table 11. Required species conservation measures for NNHP Group 2 amphibian and reptile species and recommended species conservation measures for NNHP Group 4 amphibian and reptile species.

Amphibians and Reptiles – Species Conservation Measures			
NNHP Group	**G2**	**G4**	**G4**
Conservation Measure	**Northern leopard frog** *(Lithobates pipiens)*	**Milk snake** *(Lampropeltis triangulum)*	**Chuckwalla** *(Sauromalus ater)*
Mechanized and manual treatments require a 200-ft (60-m) buffer from open water habitats.	X		
Prescribed fire requires a 200-ft (60-m) buffer zone from the edge of the wetland vegetation.	X		
No applications of herbicides will be used inside occupied or potentially occupied aquatic habitat.	X		
Mitigation measures will be applied in dispersal and migration corridors after rain events.	X		
All projects in riparian/wetland habitats near occupied habitat will require native riparian/wetland vegetation restoration following invasive species removal.	X		
Only herbicides labeled for aquatic use and the cut-stump method on tree species will be used in potential habitat.	X		
No target grazing will be used in the habitat.	X		
All equipment and boots will be cleaned with bleach before and after treatments within 200-ft (60-m) of occupied habitat to prevent the spread of chytrid fungus.	X		
No mechanical treatments (surface disturbance) within occupied habitats.		X	X

Table 12. Required species conservation measures for NNHP Group 3 mammal species and recommended species conservation measures for NNHP Group 4 mammal species.

Mammals – Species Conservation Measures							
NNHP Group	**G3**	**G4**	**G4**	**G4**	**G4**	**G4**	**G4**
Conservation Measure	**Pronghorn** *(Antilocapra americana)*	**Townsend's big-eared bat** *(Corynorhinus townsendii)*	**Chisel-toothed kangaroo rat** *(Dipodomys microps)*	**Banner-tailed kangaroo rat** *(Dipodomys spectabilis)*	**Navajo Mountain vole** *(Microtus mogollonensis)*	**Arizona (Wupatki) pocket mouse** *(Perognathus amplus cineris)*	**Kit fox** *(Vulpes macrotis)*
All treatments require a 1-mile (1.6-km) buffer from potential lambing areas from May 1 through June 15.	X						
All treatments require a 200-ft (60-m) buffer from occupied roost site during April 15- August 31.		X					
Mechanical and target grazing treatments require a 200-ft (60-m) buffer from occupied habitats year-round.			X	X	X	X	X
All treatments require a 1/8-mi (0.2-km) buffer from active den during December 1- August 31							X

Black-footed ferret (*Mustela nigripes)* and Northern river otter were extirpated from the Navajo Nation. Both species have been reintroduced in areas adjacent to the Navajo Nation. For black-footed ferret, reintroduction efforts have occurred at Babbitt Ranches, adjacent to the Navajo Nation, and may be considered for other areas within or around the Navajo Nation. Northern river otters were detected in southern Colorado, but no sightings have occurred on the Navajo Nation. If black-footed ferrets and Northern river otters are reintroduced or expand into the Navajo Nation the conservation measures, listed below, for this species would be initiated in addition to the regulations outlined in the reintroduction guidelines.

Table 13. Recommended species conservation measures for NNHP Group 1 mammal species.

Mammals (G1 Extirpated) – Species Conservation Measures		
Conservation Measure	**Northern river otter** *(Lontra canadensis)*	**Black-footed ferret** *(Mustela nigripes)*
No activity year-round within 300-ft (100-m) of occupied habitat that could result in destruction of burrows/runways and take of individuals or prevent changes to water chemistry.	X	
Breeding season for black-footed ferret is from mid-March to August, with most sensitive period from mid-March to June. Only occur in medium to large active prairie dog towns (>198 acres (80 hectare (ha), and ≥20 burrows/ha).		X
Notify USFWS and NNHP of any project that will impact prairie dog towns greater than 200 acres (80 ha).		X
Weed treatments will be scheduled outside of breeding season.		X
No disking, plowing or prescribed burns around habitat during the breeding season (March to September).		X
No herbicide limitations for this project per the RPR, pg. 109.		X

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4. Species Considered and Evaluated

All terrestrial and aquatic Threatened, Endangered, and Candidate species with the potential to occur on the Navajo Nation were considered in this evaluation. This Biological Assessment (BA) determines the effects of the NNIWMP, including all aspects of treatments outlined in the proposed alternative, on 16 plants and animals federally listed or proposed under the Endangered Species Act of 1973, as amended (**Table 1** and **Table 2**. Additionally, this BA considers 63 Navajo Natural Heritage Program Department of Fish and Wildlife listed plant and animal species (Resource Committee Resolution No. RDCJA-01-20) (**Table 3**). Tribally listed species are categorized into groups that are designated as extirpated from the Navajo Nation (G1); critically endangered (G2); endangered (G3); and sensitive (G4). This program of noxious and invasive weed treatments with its proposed conservation measures has no effect or is not likely to adversely affect the following Federal or Navajo Nation endangered, threatened, or candidate species or any designated critical habitat.

Black-footed ferret (*Mustela nigripes*) and Northern river otter (*Lontra canadensis*) are extirpated from the Navajo Nation. Reintroduction efforts are proposed to occur on and are occurring adjacent to the Navajo Nation, but no individuals have currently been detected on the Navajo Nation. If reintroduction efforts are initiated on and species are detected on the Navajo Nation mitigation measures will be implemented and the species effects will be evaluated on an individual project basis.

5. Species Accounts and Effects Findings

5.1 Federally Listed Species

5.1.1 Birds

California condor (Gymnogyps californianus)

Endangered Species Act Status: Endangered, 1967; Non-essential Experimental Population, 1996
Navajo Nation Endangered Species List: Group 4
Recovery Plan: Final, 1996
Critical Habitat: Final, 1976

Species Account

The California condor is the largest North American vulture. It is a strict scavenger and historically fed on the carcasses of deer, elk, and antelope. Condors spend much of their time roosting on cliffs or tall conifers. They nest on rock crevices, overhung ledges, or rarely in cavities in sequoia trees. They roost in snags or tall open branched trees near important foraging grounds. There is no critical habitat for California condors on the Navajo Nation.

Habitat Status

The historic distribution of the California condor was along the Pacific coast from British Columbia, Canada, to Baja California Norte, Mexico. By 1987, the range of the condor had been reduced to six counties north of Los Angeles, California. At that time, all existing condors were removed from the wild for captive breeding.

Currently there are four California condor release areas in the United States, three in California and one in Arizona. Condors were released at the Vermillion Cliffs site in Arizona in 1996. These released birds are part of a non-essential experimental population. As of April 2019, the total number of free-flying California condors in Arizona was 88 birds (AZGF 2020).

Existing Environment

Vermillion Cliffs, the release site for the non-essential experimental population in Arizona, is adjacent to the Navajo Nation. Condors use Marble and Grand Canyons for foraging and roosting, and to a smaller extent in the Western Navajo Nation. Condors are now breeding in the wild in northern Arizona, and one nesting attempt was detected on the Navajo Nation (NNHP 2020).

Effects Analysis

California condors are uncommon visitors to the Navajo Nation and, if detected, mitigation measures would be implemented. Therefore, there will be no direct effects of noxious weed treatments on California condors. The bioaccumulation of pesticide residues in body tissue was formerly a major threat to California condors. However, none of the herbicides used for this weed management program will bioaccumulate in body tissue. It is unlikely that California condors will encounter herbicides from road-killed animals because they would have a low likelihood of exposure.

There would be a small likelihood for indirect effects. If some herbicides were consumed, there is a low risk from small amounts of ingestion. The potential for direct disturbance to roosting or nesting condors would be eliminated by prohibiting ground disturbing treatments, including mechanical, prescribed fire, and ground application of herbicide, within one mile (2.6 km) or aerial application of herbicides within 1.5 mile (2.4 km) of nest and roost sites. The natural curiosity of California condors to humans and brightly colored materials may draw the attention of the condors to a treatment site. If a condor is present on a treatment site, all treatment activities would cease and the NNHP and Peregrine Fund will be contacted. Finally, all materials including waste will be cleaned up daily from a treatment site to prevent condors from removing and ingesting it. The combination of low herbicide toxicity, low potential for herbicide exposure, and protection from disturbance makes the possibility of insignificant effects to the California condor. No synergistic or cumulative effects are anticipated to occur.

Determination of Effects

Based on the effects analysis and implementation of the species conservation measures, the Integrated Weed Management Plan may affect, not likely to adversely affect California condors.

Southwestern Willow Flycatcher (Empidonax traillii extimus)

Endangered Species Act Status: Endangered, 1995
Navajo Nation Endangered Species List: Group 2
Recovery Plan: Final, 2002
Critical Habitat: Final, 2013

Species Account

The southwestern willow flycatcher (SWFL) is one of five subspecies of the willow flycatcher. It is a neotropical migrant that breeds in the southwestern United States and winters in Mexico, Central America, and extreme northern South America. SWFL arrive on breeding grounds in Arizona and New Mexico in late April and early May. Nesting begins in late May and early June.

SWFL nest in lowland riparian communities typically where there are dense patches of willow, buttonbush, boxelder, and *Baccharis* spp., sometimes with a scattered overstory of cottonwood. Nesting habitat greatly varies in size and shape and may be as small at 0.8 ha but does not include linear riparian zones <10 m wide. Migrant flycatchers may use unsuitable breeding riparian and non-riparian areas in early spring. Nests are typically placed in trees where the plant growth is most dense, where trees and shrubs have vegetation near ground level, and where there is a low-density canopy. Some of the more common tree and shrub species currently known to comprise nesting habitat on the Navajo Nation include Goodding's willow (*Salix gooddingii*), coyote willow (*S. exigua*), arroyo willow (*S. lasiolepis*), red willow (*S. laevigata*), tamarisk (*Tamarix ramosissima*), and Russian olive (*Elaeagnus angustifolia*). In almost all cases, water that is still or slowly moving or saturated soils are present at or near the breeding site (USFWS 2002). SWFL feed on small to medium-sized insects. They use "sit-and-wait" foraging with long periods of perching interspersed with foraging bouts (USFWS 2002).

Habitat Status

The southwestern willow flycatcher (SWFL) was listed as endangered by the USFWS in 1995. Reasons for the decline of the SWFL have been attributed to fragmentation and modification of riparian breeding habitat, including loss of wintering habitat (Sogge et al. 1997, 2010 and USFWS 2002). Habitat modification has primarily occurred due to water management and land use practices such as dams and reservoirs, diversions and groundwater pumping, channelization and bank stabilization, phreatophyte control, livestock grazing, recreation, fire, agricultural development, urbanization. Fire is an increasing threat to willow flycatcher habitat, especially in monotypic saltcedar vegetation and where water diversions or groundwater pumping desiccates riparian vegetation. Feeding sites for cowbirds are enhanced by the presence of livestock and range improvements (such as water tanks and corrals), agriculture, urban areas, and trash areas.

Coupled with habitat fragmentation, proximity of cowbird feeding areas to flycatcher breeding habitat may lead to an increase in cowbird parasitism of flycatcher nests. Additionally, SWFL is threatened by habitat loss due to tamarisk defoliation caused by tamarisk beetle (McLeod and Pellegrini 2013).

The Navajo Nation is located within the Upper Colorado River and Lower Colorado River Recovery Unit for the SWFL (USFWS 2002). The management units include San Juan and Powell in the Upper Colorado River Recovery Unit and the Little Colorado River in the Lower Colorado River Recovery Unit. Breeding may occur at any elevation (except possibly above 2600 m) throughout the Navajo Nation where appropriate habitat exists. Migrant flycatchers have been found in less dense or abundant riparian habitat across the Navajo Nation (NNHP 2020).

Due to extensive tamarisk defoliation from the tamarisk leaf beetle across the Navajo Nation, NNHP designated priority areas for noxious weed treatments. The Little Colorado and San Juan Rivers (500 m buffer) are “high” priority for noxious weed treatments and areas around perennial and intermittent streams (200 m buffer) lower than 2,600 m are a “moderate” priority (NNHP 2020a). After treatment in these areas, NNHP recommends native species replanting based on an evaluation of the site conditions to determine appropriate species based on hydrologic conditions. No critical habitat exists in the Navajo Nation.

Existing Environment

Breeding is known to occur along the San Juan and Colorado Rivers in the Upper Colorado River Management Unit (**Table 14**). In 2008, there were a total of 19 territories in both the Little and Lower Colorado River Recovery Units (Durst et al. 2008), however these do not necessarily occur on the Navajo Nation. Since 1985, 39 individuals have been detected on the Navajo Nation however territory data was not collected, and it is unknown if they were migrating or breeding (Brent Powers, Zoologist Navajo Nation Natural Heritage Program, personal communication). Recent surveys have not been conducted.

Table 14. Known number of SWFL breeding sites and territories in the Upper Colorado River and Lower Colorado River Recovery Units during 2007 (Durst et al. 2008). Number of territories does not indicate presence on the Navajo Nation.

Upper Colorado River Recovery Unit		
Management Unit	**Number of Sites**	**Number of Territories**
San Juan	5	10
Powell	0	0
Lower Colorado River Recovery Unit		
Little Colorado River	5	9

Effects Analysis

The project area contains suitable or potentially suitable habitat for migrating and nesting SWFL. Native vegetation in these areas will be retained during treatments. Saltcedar and Russian olive, which provides SWFL habitat, are priority noxious weeds in the NNIWMP. Implementing the conservation measures will minimize any effects from treatments that might disturb SWFL or damage their habitat. These measures include timing restrictions during the migrating and breeding seasons; ¼ mile (0.4 km) buffers from breeding patch boundary or suitable habitat for mechanical and mechanized and low and high aerial chemical treatments; 300 ft (91 m) buffers for small pile burns from edge of the waterway; use of selective herbicides; and native species planting after noxious weed removal. Also, transferring tamarisk leaf beetle to novel areas is not permitted.

SWFL typically forage within the breeding patch, and no treatments will occur within the breeding patch. If an individual leaves the breeding patch to forage, the ¼ mile (0.4 km) buffer will prevent SWFL from contacting herbicides or other mechanical disturbances. Manual treatments will be allowed up to the breeding patch boundary or suitable habitat, which may cause disturbance to the foraging flycatcher from the administering personnel. However, manual treatments have low weed treatment success without the use of herbicides or mechanical tools. It is unlikely that SWFL would ingest herbicide contaminated insects, or come into direct contact with herbicides, because the buffers will prevent the likelihood of this contact. SWFL will benefit from treatments by removing lower-quality beetle defoliated saltcedar habitat to planted native riparian species.

Cumulative effects may occur in foraging habitats when weed control measures are implemented in tamarisk stands impacted by the tamarisk leaf beetle. The conservation measures will be implemented, and no treatments will occur in nesting areas as discussed above. While weed treatments will provide cumulative effects to the habitat, there will be greater benefits from removing defoliated saltcedar and replacing riparian vegetation with native riparian vegetation. There are no anticipated synergistic effects.

Determination of Effects

Based on the effects analysis and implementation of the species conservation measures, the Integrated Weed Management Plan may affect, but is not likely to adversely affect the southwestern willow flycatcher.

Mexican spotted owl (*Strix occidentalis lucida*)

Endangered Species Act Status: Threatened, 1993
Navajo Nation Endangered Species List: Group 3
Recovery Plan: Final, 1995; First Revision, 2012
Critical Habitat: Final, 2004

Species Account

Mexican spotted owls are territorial, where a pair will defend a breeding territory (activity center) within a larger home range. A core area is a specific type of activity center that usually includes a minimum area for protecting special resources like trees and groves used for roosting, nesting, or rearing of young (USFWS 2012). They have high territory fidelity, and they will remain in these territories year after year (USFWS 2012). Mexican spotted owls are nocturnal predators that feed primarily on small mammals. Spotted owls in mountain ranges with forest-meadow interfaces take relatively more small mammals than in other areas (USFWS 2012).

Habitat Status

The Mexican spotted owl was federally listed as threatened due to habitat alteration from timber-management practices, habitat loss, degradation, and fragmentation. The Revised Recovery Plan (2012) identified that the primary threats to the Mexican spotted owl population in the U.S. have transitioned from timber harvest to an increased risk of stand-replacing wildland fire. Climate variability combined with current forest conditions may synergistically result in increased loss of habitat from fire. The intensification of natural drought cycles and the stress placed on forested habitats could result in even larger and more severe wildland fires in owl habitat (USFWS 2012). Spotted owls have low fecundity due to small clutch size, variability in nesting success, and delayed onset of breeding which contributes to decline of this species. No critical habitat was designated for Mexican spotted owl on the Navajo Nation.

Existing Environment

The Navajo Nation is located in the Colorado Plateau Ecological Management Unit (CP EMU), in which tribal lands (Navajo Nation being the largest tribe) account for 27% of the total land ownership. The CP EMU accounts for approximately 15% of the known Mexican spotted owls in the U.S with the majority detected on USDI National Park Service Land (N=132) (USFWS 2012). This percentage is not specific to owl numbers on the Navajo Nation. In 2018, NNHP completed a Mexican spotted owl occupancy survey to map the PACs across the Navajo Nation from Navajo Mountain and Black Mesa east to the Chuska Mountains.

Mexican spotted owls use three distinct habitat types on the Navajo Nation: 1) mid-aged to mature mixed-conifer stands dominated by Douglas fir, typically on mountain slopes with moderate to dense canopies and multiple canopy layers; 2) steep-walled narrow canyons, or side and hanging canyons in wide canyons, often with riparian vegetation and cool microclimates; and 3) moderately sloped drainages with Douglas fir in pinyon-juniper woodland (*e.g*. Black Mesa) (NNHP 2020). The species is not known to nest in ponderosa pine-oak forests on the Navajo Nation, but will use a variety of habitats, including pinyon-juniper and clearings when foraging. On the Navajo Nation, Mexican Spotted Owls are known to occur within, or adjacent to, the Chuska Mountain Range, Defiance Plateau, Canyon de Chelly, Black Mesa, and the extensive canyonlands to the north (NNHP 2020).

Effects Analysis

Rights-of-way and riparian areas are priority areas for weed treatments under this project which may pass through occupied Mexican spotted owl habitats. Linear corridors, such as roads, trails and easements are vectors for noxious weed infestations into PAC habitat from vehicles, boots, livestock, or wild animals. Many riparian areas are in canyons, which may include owl habitat. It is unlikely that Mexican spotted owls would come in contact with herbicides from direct application or from brushing against freshly sprayed vegetation because owls are nocturnal, and spraying would be completed during the day.

Owl prey, primarily rodents, tend to be nocturnal so they are also unlikely to be directly sprayed. Therefore, it is unlikely that owls would ingest herbicides when capturing prey where treatments have occurred. Mechanical treatments may provide some temporary noise disturbances; however, this would also be conducted during the day and would not affect the nocturnal owls. Owls near travel corridors are likely accustomed to noise effects from vehicles and livestock and would not be disturbed by treatment noise. Also, mechanical, prescribed fire, and low and high aerial and mechanized chemical spraying require a ¼-mile (0.4 km) buffer from the protected activity center (PAC) during the breeding season, and manual or spot chemical treatments require an 80-ft (24-m) buffer from PAC. A PAC is approximately 600 acres (243 ha) around an owl activity center (nest, roost, or best roost habitat) (USFWS 2012). Along road and utility rights-of-way applicators will make sure that pesticide drift does not occur beyond the right-of-way. The herbicides that are chosen for use within Mexican spotted owl PACs are those with low ecotoxicity rating and with no eye irritation to predatory birds.

One of the concerns in the Mexican spotted owl Recovery Plan is the risk of wildfire to owl habitat. Noxious weed treated under the NNIWMP include species, such as tamarisk, that increase the risk of wildfire that could spread into owl habitat. Treating these noxious weed species would comply with the goals in the Recovery Plan and improve owl habitat. Also, treating weed species would allow native plants to recolonize, creating more favorable habitat for owl prey species.

There are no anticipated cumulative or synergistic effects that would occur with this project.

Determination of Effects

Based on the effects analysis and implementation of the species conservation measures, the Integrated Weed Management Plan may affect, but is not likely to adversely affect the Mexican spotted owl.

Western yellow-billed Cuckoo *(Coccyzus americanus)*

Endangered Species Act Status: Threatened, 2014
Navajo Nation Endangered Species List: Group 2
Recovery Plan: No
Critical Habitat: Proposed Rule, 2020

Species Account

Western yellow-billed cuckoo nests occur in thick undergrowth or in trees, typically 4 to 8 feet above ground. Cuckoos rarely nest at sites less than 50 acres (20 ha) in size, and sites less than 37 acres (15 ha) are considered unsuitable habitat (Laymon and Halterman 1989). The optimal size of habitat patches for the species are generally greater than 200 acres (81 ha) in extent and have dense canopy closure and high foliage volume of willows (*Salix* sp.) and cottonwoods

(*Populus* sp.) (Laymon and Halterman 1989) and thus provide adequate space for foraging and nesting.

Tamarisk (*Tamarix* sp.) is a component of cuckoo habitat in Arizona and New Mexico. As the proportion of tamarisk increases, the suitability of the habitat for the cuckoo decreases. Sites with a monoculture of tamarisk are unsuitable habitat for the species. Sites with strips of habitat less than 325-ft (100-m) in width are rarely occupied, which indicates that edge effects in addition to overall patch size influence cuckoo habitat selection for nesting. During movements between nesting attempts cuckoos are found at riparian sites with small groves or strips of trees, sometimes less than 10 acres (4 ha) in extent (Laymon and Halterman 1989).

Cuckoos usually gleans prey items from foliage or branches, sometimes while hovering, or sallying from a perch to capture prey on the wing (Ehrlich et al. 1992). Food items primarily consist of cicadas, katydids, caterpillars, tree frogs and lizards.

Habitat Status

The USFWS (2014) considers the yellow billed cuckoos in the western United States as a distinct population segment (DPS). Western yellow-billed cuckoo is a late neo-tropical migrant and summer resident in the Western United States and winters in South America. Habitat condition and food resources are variable within years which cause cuckoos to move between areas to take advantage of these resources. Cuckoos breed from June to August, with the peak of breeding occurring in mid-July to early August. They require large tracts of willow-cottonwood or mesquite forest or woodland for nesting season habitat. They prefer dense vegetation, which creates a humid environment. The moist conditions support riparian plant communities that provide cuckoo habitat typically and exist in lower elevation, broad floodplains, where rivers and streams enter impoundments. The species does not use narrow, steep walled canyons. No critical habitat exists on the Navajo Nation.

Existing Environment

In Arizona cuckoos were historically widespread and locally common (Phillips et al. 1964 and Groschupf 1987). However, the cuckoo populations in Arizona have declined by 70 to 80 percent over the past 30 years (Halterman et al. 2016). On the Navajo Nation, Western yellow-billed cuckoos are known only to breed from several sections on the San Juan River (NNHP 2020). Potential for breeding may also occur along the Little Colorado and Colorado rivers, within Canyon de Chelly, Chinle Valley, and other canyons or streams with appropriate habitat (NNHP 2020).

Effects Analysis

There is little potential for yellow-billed cuckoo to be directly impacted by noxious weed removal. While weed treatments are proposed for the San Juan River, this area does not occur in critical habitat. Implementation of the species conservation measures, including buffer distances from known nesting sites discussed above would reduce potential impacts on the population. If project activities are planned in potential habitat, impacts are expected to be short-term and minor, because follow up native vegetation planting will replace lower-quality noxious weed infested habitat with native riparian vegetation. Furthermore, noxious weed removal activities would be completed entirely outside the breeding season, reducing the potential impacts for this species.

Yellow-billed cuckoos typically have a large home range that they use for foraging and nesting. No treatments will occur within the breeding patch. If an individual leaves the breeding patch to forage, the ¼-mile (0.4 km) buffer will prevent yellow-billed cuckoos from coming into contact with herbicides or other mechanical disturbances. Manual treatments will be allowed up to the breeding patch boundary or suitable habitat, which may cause disturbance to the foraging cuckoos from the administering personnel. However, manual treatments are low-impact and will not use herbicides or mechanical tools. It is unlikely that yellow-billed cuckoos will ingest herbicide contaminated insects, or come into direct contact with herbicides, because the buffers will prevent the likelihood of this contact.

The conversion of native habitat into noxious weed dominated habitat is a major threat to yellow-billed cuckoos. Tamarisk, the dominant noxious weed in southwestern riparian corridors, is wide-spread in yellow-billed cuckoo habitat. Tamarisk dominated habitat does not provide essential food resources and adequate thermal cover for the yellow-billed cuckoo. Focusing on tamarisk removal efforts, and re-planting with native species, such as cottonwood and willow, would ultimately result in long-term beneficial impacts for yellow-billed cuckoo by potentially increasing the likelihood of residency and/or nesting in the project area. There are no synergistic or cumulative impacts anticipated.

Determination of Effects

Based on the effects analysis and implementation of the species conservation measures, the Integrated Weed Management Plan may affect, but is not likely to adversely affect the Western yellow-billed cuckoo.

5.1.2 Fish

Colorado Pikeminnow *(Ptychocheilus lucius)*

Endangered Species Act Status: Endangered, 1973 and Experimental Population, Non-Essential, 1985
Navajo Nation Endangered Species List: Group 2
Recovery Plan: Final, 1978, Recovery Goals 2002
Critical Habitat: Final, 1994

Species Account

Colorado pikeminnow spawn over clean cobbles and rubble in relatively swift waters. Preferred temperatures for embryo development, juvenile growth, and adult spawning are from 20.0-26.0°C (68.0-78.8°F) (Berry 1988). Juveniles utilize slackwater, backwater, and side channel areas with low or no current velocity and silt/sand substrates. Larger individuals, greater than 200 mm (7.9 in.) occur in turbid, deep, and strongly flowing waters (Sublette et al. 1990). Adults use backwaters and flooded riparian areas during spring runoff and migrate large distances (15-64 km) in the San Juan River to spawn in riffle-run areas with cobble/gravel substrates.

Young pikeminnow eat crustaceans and aquatic fly (Diptera) larvae. Aquatic and terrestrial insects make up most of the diet as fish exceed 50 mm (1.97 in.). Fishes predominate in the diets of squawfish larger than 100 mm (3.9 in.) (Minckley 1973). Condition of young fish entering winter periods may have a role in determining their overwinter survival. Low fat stores and poor condition may result in low overwinter survival of age-0 squawfish (Thompson et al. 1991).

Habitat Status

The Colorado pikeminnow was first listed as endangered following a period of dam construction throughout the Colorado River Basin. Total Colorado pikeminnow habitat lost to reservoir inundation in the upper basin is about 435 miles, including Flaming Gorge on the Green River (99 miles), Lake Powell (199 miles on the Colorado River and 75 miles on the San Juan River), and Navajo Reservoir on the San Juan River (62 miles) (USFWS 2011a). Cold-water releases have eliminated most native fishes from river reaches immediately downstream of dams. This species has been extirpated from the lower basin states, including Arizona, California, Nevada and New Mexico.

Streamflow regulation and associated habitat modification are identified as the primary threats to Colorado pikeminnow populations. Dams have blocked migration routes (Tyus 1991) and cold-water temperatures affect embryonic development and survival. Recommended flow on the upper basin reaches has been implemented to promote adequate spawning habitat and appropriate spawning ques, adequate nursery habitat, and adequate juvenile and adult habitat. Other factors that may affect the continued survival and success of reintroduced populations of pikeminnow include interactions with non-native fishes, including channel catfish, smallmouth bass, and flathead catfish (AGFD 2002).

Critical Habitat

Critical habitat for Colorado pikeminnow includes six reaches of the Colorado River System. These reaches total 1,848 km (1,148 mi) as measured along the center line of each reach to the 100-year floodplain. This represents about 29 percent of the historical habitat of this species. Critical habitat is designated in portions of the Colorado, Green, Yampa, White, and San Juan Rivers in the Upper Basin. In the San Juan River Subbasin critical habitat includes 290 km (180 mi) from State Route 371 Bridge at Farmington to Neshahai Canyon in the San Juan arm of Lake Powell (59 FR 13374).

The critical habitat listed above is based on the primary constituent elements for the recovery of the Colorado pikeminnow (59 FR 13378) and include:

1. A quantity of water of sufficient quality that is delivered to a specific location in accordance with a hydrologic regime that is required for the particular life stage for each species. For the Colorado pikeminnow, reproduction is associated with declining flows in June, July, or August and average water temperatures ranging from 22 to 25'C depending on annual hydrology.
2. The physical habitat that is inhabited or potentially habitable by fish for use in spawning, nursery, feeding, and rearing or corridors in between these areas. Colorado pikeminnow use a variety of riverine habitats for spawning and after including eddies, backwaters, shorelines. During winter they use backwaters, runs, pools, eddies, and in shallow, ice-covered shoreline areas. In the spring and early summer, they use shorelines and lowlands inundated during typical spring flooding.
3. The biological environment includes food supply, predation, and competition.

Existing Environment

The Navajo Nation is located in the San Juan sub-basin where the Colorado pikeminnow is known to occur as a wild population. It has been documented throughout the San Juan River, from Shiprock to Lake Powell; the mouth of the Mancos River is used during the spring runoff period. Only 17 wild adults were captured in the San Juan River between 1991 and 1995 and estimated at fewer than 20 individuals by 2001. Colorado pikeminnow are stocked in the San Juan to meet the delisting requirements in the San Juan River. During 2004-2008, about 983 stocked pikeminnow were recaptured from the San Juan River (Ryden 2009). In 2014, 496 individuals were captured, however 98% were stocked without pit tags (typically at age 0) (Durst 2015). In 2018, approximately 180 adults were estimated in the San Juan River subbasin (USFWS 2020).

On the Navajo Nation, many adults use the stretch from 11 km downstream of Shiprock (RM142) to just downstream of Four Corners (RM117), and spawn in 'The Mixer Area' (RM131-132); young-of-year have primarily been found within the lower 26 km of the San Juan River, just upstream from Lake Powell (NNHP 2008).

Effects Analysis

Colorado pikeminnow and its critical habitat will not be directly affected since the NNIWMP treats only terrestrial weed species. Indirect effects to pikeminnow and critical habitat include increased turbidity during mechanical treatments using heavy machinery and prescribed burning within the riparian areas adjacent to their habitat. These effects would be reduced when implementing erosion control mitigation measures, including erosion control measures to stabilize and limit erosion along bank lines in riparian areas. Also, the San Juan River has naturally high turbidity of 10 Nephelometric Turbidity Unit (NTU) due to high sediment loads from tributaries in Arizona and New Mexico during thunderstorms in April – June and the highly erodible geology (USBR 2002). Additional impacts from turbidity caused by mechanical impacts would be minimal and temporary. Pile burning and prescribed fire would require a site-specific burn plan and would be conducted 300ft outside of the floodplain. Also, long term measures include planting native vegetation to stabilize soils and prevent noxious weed re-growth after weed treatments, which would improve critical habitat.

An indirect effect from herbicide overspray would be discountable with the following herbicide buffers. Only herbicides that are practically non-toxic to fish species will be used within the riparian zone. Only aquatic formulations of 2,4-D, glyphosate, triclopyr and imazapyr will be used exclusively within 25 feet of the daily high-water mark. Herbicides that are practically non-toxic to fish and mollusks (White 2007) require a 25 feet (8 m) buffer from the daily high-water mark, including: aminopyralid, chlorsulfuron methyl, clopyralid, imazapic, and thifensulfuron-methyl. These herbicides have shown no risk to fish even if there is an accidental direct spray or spill to the aquatic habitat (BLM 2007). Non-aquatic and moderate to high aquatic toxicity herbicides (White 2007) require a 300 feet (90 m) buffer from the daily high-water mark. Only aquatic approved herbicides will be used for aerial applications by either fixed wing or rotary aircraft in riparian areas. All herbicide applications will follow required protection measures. Implementing these features will minimize herbicide exposure to such small levels that the effect would be immeasurable to the species or critical habitat. The long-term benefits to habitat and critical habitat floodplain areas and its riparian vegetation include improved function, reduced erosion, and an improved invertebrate foodbase due to the return of the native riparian vegetation.

Aquatic treatments are not proposed under this plan, and, therefore, no synergistic effects or cumulative impacts are anticipated by the proposed treatments.

Effects Determination

Based on the effects analysis and implementation of the species conservation measures, the Integrated Weed Management Plan may affect, but is not likely to adversely affect Colorado pikeminnow or the critical habitat.

Humpback Chub *(Gila cypha)*

Endangered Species Act Status: Threatened, 2001
Navajo Nation Endangered Species List: Group 2
Recovery Plan: Final, 1978, Recovery Goals 2002
Critical Habitat: Final, 1994

Species Account

In 2001 the Service reclassified the humpback chub from endangered to threatened due to substantial improvements to the species' overall listing since it was listed in 1974 (86 FR 57588). Populations of humpback chub are restricted to deep, swift, canyon-bound regions of the mainstem and large tributaries of the Colorado River Basin. Adults require eddies and sheltered shoreline habitats maintained by high spring flows. These high spring flows maintain channel and habitat diversity, flush sediments from spawning areas, rejuvenate food production, and form gravel and cobble deposits used for spawning. Spawning occurs on the descending limb of the spring hydrograph at water temperatures typically between 16 and 22°C (USFWS 2002b). Young require low-velocity shoreline habitats, including eddies and backwaters, that are more prevalent under base-flow conditions.

Habitat Status

This species originally declined due to habitat changes caused by dam impoundments and the competition with and predation by introduced fish. Dams created population fragmentation, which restricted gene flow between isolated populations. Dams also altered flows and created clear and cold-water conditions (USFWS 1990). Other threats to this species include parasitism, hybridization with other *Gila* spp., and pesticides and pollutants (USFWS 2002b).

Critical Habitat

The USFWS designated seven reaches of the Colorado River system as critical habitat for humpback chub. These reaches total 610 km (380 mi) as measured along the centerline of the subject reaches. This represents approximately 28 percent of the historic habitat of the species. Critical habitat for the humpback chub is designated for portions of the Colorado, Green, and Yampa Rivers in the Upper Basin and the Colorado and Little Colorado Rivers in the Lower Basin. Critical habitat occurring on or adjacent to the Navajo Nation includes the Colorado River and Little Colorado River in Grand Canyon National Park.

The critical habitat listed above is based on the primary constituent elements for the recovery of the Humpback chub (59 FR 13378) and include:

4. A quantity of water of sufficient quality that is delivered to a specific location in accordance with a hydrologic regime that is required for the particular life stage for each species. For the humpback chub, spawning occurs after high spring flows when water temperatures approach 20ºC.
5. The physical habitat that is inhabited or potentially habitable by fish for use in spawning, nursery, feeding, and rearing or corridors in between these areas. Humpback chub use a diversity of habitats including pools, riffles, and eddies associated with boulder-strewn canyons, travertine dams, pools, and shoreline eddies.
6. The biological environment includes food supply, predation, and competition. Competition and predation from nonnative fish are a limiting factor for humpback chub.

Existing Environment

The Grand Canyon population has had a stable core of 11,500-12,000 adults in the Little Colorado River since 2008 (USFWS 2018). In addition to this core population, there are approximately 250 adults, several hundred juveniles and sub-adults distributed throughout the mainstem Colorado River, indicating reproduction (USFWS 2018). Finally, translocation efforts in the Little Colorado River and Havasu Creek expanded the range of the species to new habitats. In the lower basin, Humpback chub have high quality habitat, connectivity to mainstem habitats, and high genetic diversity. The key factors controlling this population are river flow, water temperature, food supply, and predation/competition. The Little Colorado River, on the Navajo Nation and in Grand Canyon National Park, supports the largest and only known naturally spawning population of Humpback chub.

Effects Analysis

The NNIWMP will not result in direct impacts to humpback chub or critical habitat since it does not propose any treatments for aquatic weed species. Indirect impacts to chub and critical habitat include increased turbidity during mechanical treatments and prescribed fire in the riparian areas upstream of their habitat on the Little Colorado River. Additional impacts from turbidity caused by mechanical impacts will be minimal and temporary. Pile burning and prescribed fire will require a site-specific burn plan and will be conducted 300 ft outside of the floodplain. The mitigation measures within riparian areas require erosion control measures to stabilize and limit erosion along bank lines. The Colorado and Little Colorado Rivers receive high sediment inputs following precipitation events, which is much greater than the estimated inputs from mechanical treatments. Also, this species evolved in high turbidity waters and will not likely be impacted by an increase in turbidity. Finally, long-term measures include planting native vegetation to stabilize soils and prevent noxious weed re-growth after weed treatments occur.

An indirect effect on humpback chub and critical habitat from herbicide overspray would be discountable with the following herbicide buffers. Only herbicides that are practically non-toxic to fish will be used within the riparian zone. Many of these herbicides will degrade as they moved downstream. Only aquatic formulations of 2,4-D, glyphosate, triclopyr and imazapyr will exclusively be used within 25 feet of the daily high-water mark. Herbicides that are practically non-toxic to fish and mollusks (White 2007) require a 25 feet (8 m) buffer from the daily high-water mark, including: aminopyralid, chlorsulfuron methyl, clopyralid, imazapic, and thifensulfuron-methyl. Chlorsulfuron, imazapic, imazapyr, and herbicides have shown no risk to fish even if there is an accidental direct spray or spill to the aquatic habitat (BLM 2007). Non-aquatic approved and moderate to high aquatic toxicity herbicides (White 2007) require a 300 feet (90 m) buffer from the daily high-water mark. Only aquatic approved herbicides will be used for aerial applications by either fixed wing or rotary aircraft in riparian areas. All herbicide applications will follow required protection measures. Implementing these features will minimize herbicide exposure to such small levels that the effects would be immeasurable to the species or its critical habitat. The long-term benefits to habitat and critical habitat floodplain areas and its riparian vegetation include improved function, reduced erosion, and an improved invertebrate foodbase due to the return of the native riparian vegetation.

Treatment of aquatic weeds are not proposed under this plan, and, therefore, no synergistic effects or cumulative impacts are anticipated by the proposed treatments. No cumulative impacts will occur to water quality from indirect impacts of mechanical and chemical treatments.

Effects Determination

Based on the effects analysis and implementation of the species conservation measures, the Integrated Weed Management Plan may affect, but is not likely to adversely affect humpback chub or the critical habitat.

Razorback Sucker *(Xyrauchen texanus)*

Endangered Species Act Status: Endangered, 1991
Navajo Nation Endangered Species List: Group 2
Recovery Plan: Final, 1998, Recovery Goals 2002
Critical Habitat: Final, 1994

Species Account

The Service is proposing to downlist the razorback sucker from an endangered species to a threatened species due to improved species status from conservation actions and partnerships since the time of listing in 1991 (86 FR 35708). Razorback suckers are most common in low-velocity habitats such as backwaters, floodplains, flatwater river reaches, and reservoirs. Spring migrations of adult razorback sucker were associated with spawning in historic accounts, and a variety of local and long-distance movements and habitat-use patterns have been documented. The species is tolerant of wide-ranging temperatures, high turbidity and salinity, low dissolved oxygen, and flow conditions. Cobble or rocky substrate is preferred for spawning, but they have successfully spawned over clay beds at a wide range of water temperatures (typically greater than 14°C) (USFWS 2002c, 2018). Spawning also occurs in reservoirs over rocky shoals and shorelines. Young require nursery environments with quiet, warm, shallow water such as tributary mouths, backwaters, or inundated floodplain habitats in rivers, and coves or shorelines in reservoirs. Irrigation canals and ponds connected to the San Juan River may be potential habitat.

Habitat Status

The species is endemic to the Colorado River Basin of the southwestern United States. Decline of this species coincided with dam construction and non-native fish introductions that left only small, fragmented populations. These and other threats continue to impact the species, including water diversions, degraded water quality, and habitat modification (USFWS 2002c). Although razorback sucker are long-lived species (40+ years), persistent recruitment failure has depleted and extirpated numerous populations (USFWS 2002c). Current risks to this species include climate change, hybridization, reductions in diversity, habitat changes, and predation and competition from nonnative and invasive fish species. Overutilization, parasites, diseases, and pollutants were considered but considered least impactful risks.

Critical Habitat

The USFWS designated 15 reaches of the Colorado River system as critical habitat for the razorback sucker. These reaches total 2,776 km (1,724 mi) as measured along the centerline of the river within the subject reaches. This represents approximately 49 percent of the historical habitat for the species. In the Upper Basin, critical habitat is designated for portions of the Green, Yampa, Duchesne, Colorado, White, Gunnison, and San Juan Rivers. Portions of the Colorado, Gila, Salt, and Verde Rivers are designated in the Lower Basin. Critical habitat occurring on or adjacent to the Navajo Nation includes the San Juan River.

The critical habitat listed above is based on the primary constituent elements for the recovery of the razorback sucker (59 FR 13378) and include:

7. A quantity of water of sufficient quality that is delivered to a specific location in accordance with a hydrologic regime that is required for the particular life stage for each species. Razorback suckers depend on variable temperatures and flows, and lotic populations depend on high spring flows that carry larvae into the floodplain wetlands to provide food and protection (86 FR 35713).
8. The physical habitat that is inhabited or potentially habitable by fish for use in spawning, nursery, feeding, and rearing or corridors in between these areas. Razorback suckers are most common in low-velocity habitats such as backwaters, floodplains, flatwater river reaches, and reservoirs with rocky substrate, warms shallow water, and deeper water. Rocky substrates are required for spawning and egg development, larvae and juveniles require persistent, shallow, warm, and sheltered shorelines of backwaters floodplains or similar habitat with cover, and adults need deeper water of reservoirs, pools, or eddies with slow velocities (86 FR 35713).
9. The biological environment includes food supply, predation, and competition. Competition and predation from nonnative fish and reduced flows are a limiting factor for razorback suckers. They are omnivorous and feed on plants and animals.

Existing Environment

Historically, razorback suckers were widely distributed in warm water reaches of larger rivers of the Colorado River Basin from Mexico to Wyoming. Currently, razorback suckers are found in the Green River, Upper Colorado River, and San Juan subbasins (Upper Colorado River Basin Recovery Unit) (USFWS 2002c). The Navajo Nation is included in the Upper Colorado River Basin Recovery Unit within the San Juan subbasin. Wild razorback suckers were extirpated from the San Juan River; however, the San Juan River Basin Recovery Implementation Basin stocks 11,400 razorback sucker annually (Bestgen et al. 2009, USFWS 2018a). Since stocking has occurred, a small percentage of razorback sucker spawning has been documented throughout the San Juan River. Additionally, juvenile recruitment has rarely been documented, and without stocking, this population would eventually become extinct. There is an abundant wild population of razorback sucker in Lake Powell, but a waterfall provides a barrier for the fish moving upstream into the San Juan River.

The Navajo Nation operates the NAPI (Navajo Agricultural Products Industry) rearing ponds to rear razorback suckers for augmentation and recovery efforts in the San Juan River basin (Cheek 2014). The fish reared in the NAPI ponds accounted for 40.6% of the 15,362 razorback suckers stocked by the San Juan River Basin Recovery Implementation Program in 2013. NAPI pond raised fish were introduced to the San Juan River at Bloomfield, Hatch Trading Post, PNM Fish Passage, Montezuma Creek, UT, Berg Park, and Animas River Park.

Effects Analysis

The NNIWMP will not result in direct impacts to razorback sucker or critical habitat since it does not include treatment for aquatic weed species. Indirect impacts to razorback suckers and critical habitat include increased turbidity during mechanical treatments using heavy machinery and prescribed fire in the riparian areas adjacent to their habitat. Razorback suckers show to have a high tolerance for a variety of turbidity levels; however, this may impact spawning habitat as sediment settles on the cobble substrate. Razorback suckers have shown to clean sediment off cobbles to spawn (USFWS 2018a). Turbidity impacts from mechanical treatments will be minimal, temporary, and almost eliminated from implementing erosion control mitigation measures. The species protection measures within riparian areas require erosion control measures to stabilize and limit erosion along bank lines. Also, long-term measures include planting native vegetation to stabilize soils and prevent noxious weed re-growth after weed treatments occur along the San Juan which would improve critical habitat. Pile burning and prescribed burns will require a site-specific burn plan and will be conducted 300ft outside of the floodplain.

An indirect effect on razorback sucker and critical habitat from herbicide overspray would be discountable with the following herbicide buffers. Only herbicides that have been determined to be practically non-toxic to fish species will be used within the riparian zone. Aquatic formulations of 2,4-D, glyphosate, triclopyr and imazapyr will exclusively be used within 25 feet of the daily high-water mark. Only aquatic approved herbicides will be used for aerial applications by either fixed wing or rotary aircraft within riparian areas. All herbicide applications will follow required protection measures. Implementing these features will minimize herbicide exposure to such small levels that the effect would be minimal to the species or its critical habitat. The long-term benefits to habitat and critical habitat floodplain areas and its riparian vegetation include improved function, reduced erosion, and an improved invertebrate foodbase due to the return of the native riparian vegetation.

Treatment of aquatic weeds is not proposed under this plan, and, therefore, no synergistic effects or cumulative impacts are anticipated by the proposed treatments. Cumulative impacts may occur if there is an indirect effect of herbicide overspray by adding additional chemicals to the San Juan River. The Species Status Report prepared by USFWS (2018a) determined that pollutants were considered a least impactful risk. Spot treatments of Dichlobenil were used in the NAPI rearing ponds to control vegetation and to prevent disease outbreak in razorback suckers (Cheek 2014). This exposure to chemical from the rearing ponds may cumulatively impact razorback if they experience herbicide over spray when introduced into the San Juan River. However, this is a minor impact, since only aquatic approved herbicides will be used within 25 ft of the daily high-water mark. Organochlorine pesticides are found in low concentrations from agriculture along the San Juan River; however, are not significant enough to affect fish and wildlife (USGS 1998).

Effects Determination

Based on the effects analysis and implementation of the species conservation measures, the Integrated Weed Management Plan may affect, but is not likely to adversely affect razorback sucker or critical habitat.

Zuni Bluehead Sucker *(Catostomus discobolus yarrowi)*

Endangered Species Act Status: Endangered, 2014
Navajo Nation Endangered Species List: Group 2
Recovery Plan: None
Critical Habitat: Final Rule, 2016

Species Account

The Zuni bluehead sucker typically inhabit small desert stream systems including isolated headwater springs with clean, hard substrate, hard substrate, flowing water, and abundant riparian vegetation (Carman 2008, Gilbert and Carman 2011). Zuni bluehead suckers occupy habitat with abundant shade in pools, runs and riffles with water velocities ranging from 0-0.35 m/sec (1.15 ft/sec) or less and ranging in depth from 0.2 – 2.0 m (8-79 in) (Hanson 1980, Propst and Hobbes 1996, Gilbert and Carmon 2011). Water temperatures in sucker habitat vary from -2-23°C (Gilbert and Carmen 2011). The Zuni bluehead sucker is a benthic forager (eating food from the stream bottom) that scrapes algae, insects, and other organic and inorganic material from the surface of rocks (USFWS 2014b). Zuni bluehead sucker spawn from early April to early June when water temperatures are 6 to 15°C (43 to 59°F) peaking around 10°C (50°F) (Propst 1999, Propst et al. 2001). They require clean gravel substrate with minimal silt for spawning because silt covers eggs and leads to suffocation and decreased prey (Maddux and Kepner 1988).

Habitat Status

Zuni bluehead suckers were greatly reduced in the Zuni River watershed due to 27 chemical treatments during the 1960’s to remove green sunfish and fathead minnow from the Rio to establish a rainbow trout sport fishery in reservoirs on the Zuni pueblo (Winter 1979). This eliminated the sucker from most of the Zuni River watershed. The current threats to the Zuni bluehead sucker include water withdrawal, sedimentation, impoundments, development, non-native species, wildfire, and climate change (USFWS 2014). Overgrazing has created unstable bank line conditions and has increased sedimentation into the streams on the Navajo Nation (Selby and Kitcheyan 2020). Saltcedar and Russian olive were identified as a threat to this species because of the tendency to invade riparian habitats and dry out perennially flowing streams and their removal is a priority management action (NNHP 2020). Genetic information determined that the bluehead suckers detected in the lower San Juan River were bluehead suckers and not Zuni bluehead suckers (USFWS 2014b) and were removed from the final listing rule.

Navajo Nation Fisheries Management Plan

Navajo Nation manages Zuni bluehead sucker populations on their lands, with management criteria outlined in the Navajo Nation Fisheries Management Plan (2020a) which was developed as a joint effort between the NNHP and BIA. One objective outlined in the plan is to identify and protect existing Zuni bluehead sucker populations and their habitats. This objective includes the specific tasks of monitoring populations, re-establish Zuni bluehead suckers in reclaimed streams, reduce or eliminate nonnative fishes or crayfish, cattle exclosures, restore habitat conditions, construction of nonnative fish barriers, identify facilities or refugium sites to maintain isolated populations, develop and implement fire and drought contingency plans, and participate in the Zuni bluehead sucker Recovery Team (Selby and Kitcheyan 2020). The Kinlichee Creek Watershed within Navajo Nation is designated as a Highly Sensitive Area, which are the most protected habitats, but still allow minimal development.

Existing Environment

It is estimated that the present range of the Zuni bluehead sucker is 5% or less of its historic range (USFWS 2014). On the Navajo Nation, Zuni bluehead suckers are found in Kinlichee Creek, Black Soil Wash, and Scattered Willow Wash in the Defiance Plateau. In 2012, collections occurred in Black Soil Wash and Kinlichee Creek, with 664 and 92 Zuni bluehead suckers detected, respectively (Kitcheyan and Mata 2013). It is unlikely that the entirety of the Kinlichee Creek watershed is occupied because the streams are susceptible to drying during drought.

Effects Analysis

No direct impacts would affect Zuni bluehead sucker because no aquatic weed treatments are proposed under this plan. Zuni bluehead suckers are sensitive to increased sedimentation in their habitat and could receive indirect impacts from mechanical or prescribed burning treatments. Conservation measures and best management practices are required to minimize ground disturbance during noxious weed treatments. These impacts would be minimal and temporary. Pile burning and prescribed fire will require a site-specific burn plan and will be conducted 300 ft outside of the floodplain. Mitigation measures in riparian areas require erosion control measures to stabilize and limit erosion along bank lines. Also, long term measures include planting native vegetation to stabilize soils and prevent noxious weed re-growth after weed treatments occur. Target grazing is not proposed for areas where Zuni bluehead suckers occur, as overgrazing could destabilize banks and increase erosion.

Another indirect effect may occur from herbicide overspray. Only herbicides that have been determined to be practically non-toxic to fish species will be used within the riparian zone. Aquatic formulations of 2,4-D, glyphosate, triclopyr and imazapyr will exclusively be used within 25 feet of the daily high-water mark. Herbicides that are practically non-toxic to fish and mollusks (White 2007) require a 25 feet (8 m) buffer from the daily high-water mark, including: aminopyralid, chlorsulfuron methyl, clopyralid, imazapic, and thifensulfuron-methyl. Chlorsulfuron, imazapic, imazapyr, and herbicides have shown no risk to fish even if there is an accidental direct spray or spill to the aquatic habitat (BLM 2007). No aerial spraying will occur in habitats with Zuni bluehead sucker. All herbicide applications will follow required protection measures. Implementing these features will minimize herbicide exposure to such small levels that the effect will be minimal to the species or its habitat. The long-term benefits to habitat and critical habitat floodplain areas and its riparian vegetation include improved function, reduced erosion, and an improved invertebrate foodbase due to the return of the native riparian vegetation.

There are no proposed aquatic treatments under this plan, and, therefore, no synergistic effects or cumulative impacts are anticipated by the proposed treatments. Cumulative impacts may occur if there is an indirect effect of increased sedimentation from mechanical treatments in areas where overgrazing has already destabilized bank lines. Destabilized bank lines provide increased erosion particularly during high water events. Conservation measures will be implemented to prevent increased erosion during treatments and will be maintained until native vegetation re-growth occurs. Noxious weed treatments will temporarily decrease vegetation at a site but will stabilize bank lines in the long-term from planting activities.

Effects Determination

Based on the effects analysis and implementation of the species conservation measures, the Integrated Weed Management Plan may affect, but is not likely to adversely affect the Zuni bluehead sucker.

5.1.3 Plants

Brady Pincushion Cactus *(Pediocactus bradyi)*

Endangered Species Act Status: Proposed Endangered, 1979
Navajo Nation Endangered Species List: Group 2
Recovery Plan: Final 1985
Critical Habitat: None

Species Account

This cactus is restricted to habitat composed of Kaibab limestone chips overlaying soils derived from Moenkopi shale and sandstone. It is typically found on gently sloping benches and terraces with sparse vegetation from mid-March to late April. Populations are known from 1,170-1,368 m (3,861 – 4,488 ft.) in elevation (USFWS 1985b).

In the summer and winter months, Brady pincushion cactus spends most of its time below ground level covered by loose limestone fragments along the Marble Canyon plateaus of the Colorado River. The cacti typically respond to summer rainfall events by expanding above the soil (Heil et al. 1981). If the conditions are favorable the cacti will flower typically between

March and April (Spence 2008). By May the cactus responds to drought conditions and rising temperatures by retracting into the soil.

Species reproduction is cross-pollinated and self-incompatible, meaning the pollen transferred between flowers on the same plant will not self-fertilize (Spence 1992 and Tepedino 2000). The cactus is insect-pollinated with sweat bees (*Dialictus spp.)* being the primary pollinators (Tepedino 2000).

Habitat Status

Brady pincushion cactus (*Pediocactus bradyi*) is a narrow endemic, occupying distinctive restricted habitats on the Colorado Plateau. It is known from a geographical area of about 70 km^2 (17,000 acres) in Coconino County, Arizona (USFWS 1985b). The species was first discovered in 1958, and since then, there has been a marked reduction in the number of plants due to collecting, off-road vehicles (OHV), uranium mining, and livestock grazing (USFWS 1985b). The current threats to Brady pincushion cactus, particularly on the Navajo Nation, include OHVs, livestock trampling and grazing, development of roads along with traffic associated with tourism, and herbivory (Roth 2004). Collection and uranium mining are a minor threat. An extensive evaluation of the extant population of this cactus has not occurred (USFWS 2011c). Additionally, two nonnative, annual grasses (*Bromus rubens* and *Schismus barbatus*) are abundant at Brady pincushion monitoring sites and along the Marble Canyon rim, but it is unknown if these species impact the cactus (Nora Talkington, Botanist, Navajo Natural Heritage Program, personal communication on March 10, 2021). Climate change may have a significant impact on this species in the future.

Existing Environment

The distribution of the species comprises an area approximately 23 km (15 mi) in length, north to south, and varies in width from 1.6 km (1 mi) to 4.58 km (3 mi). The range of Brady Pincushion cactus is limited to plateaus on both sides of the Colorado River along both rims of Marble Canyon. As of April 2022, 19 Element Occurrences (populations separated by more than 1km) of Brady's pincushion cactus have been observed on the Navajo Nation (Nora Talkington, Botanist, Navajo Natural Heritage Program, personal communication on July 21, 2022).

The Navajo Nation Heritage Program (NNHP) has two demography monitoring plots for this species on the Navajo Nation (Jackass Canyon and Cave). In 2018, there were approximately 87 individuals detected at the Jackass site and 115 individuals at the Cave site. In a summary study of Brady pincushion cactus from 2009-2014, two sites at the Jackass Canyon site were monitored (campsite and ridgetop sites). This study showed that the campsite population was stable with 23 individuals detected in 2009 and 24 individuals detected in 2014. The ridgetop site showed significant declines in the population from 121 individuals recorded in 2009 to 84 individuals in 2014 (Hazelton 2015). Reproductive success of these species was highest during 2012 and 2013 (Hazelton 2015), and the ridgetop population had a high proportion of small size classes (<2 cm diameter) which indicated recent recruitment. There is almost no recruitment of cacti in the campsite plots, with only two individuals smaller than 2 cm detected throughout the 5 years of monitoring (Hazelton 2015).

Effects Analysis

Prior to weed treatments, surveys by a trained biologist will be conducted to identify the locations of Brady pincushion cactus within potential habitat in the project area. The 200 ft buffer from Brady pincushion cactus populations identified in the species conservation measures will be marked with flagging to prevent weed treatment field crews from entering the buffer zone.

There will be no direct effects to Brady pincushion cactus since weed treatments are not proposed to occur within 200 ft of the population. Indirect effects include herbicide drift from chemical treatments. The likelihood of herbicide drift is reduced by implementing the 200 ft buffer for chemical treatments. Also, herbicides will not be applied when wind speeds exceed 10 miles per hour, temperatures are greater than 80° F (26.7° C), and humidity is high. Other methods such as mechanical (including prescribed fire) and cultural treatments require a 200 ft buffer from Brady pincushion cactus populations. All vehicles used to access sites will follow established roadways and will be parked in previously disturbed sites.

Livestock can be a threat to Brady pincushion cactus from grazing and trampling effects. Livestock impacts are primarily a result of unmanaged grazing. Cultural treatments, which include targeted grazing with specific planning parameters and mitigations, are proposed for Community Development Areas and agricultural fields. If Brady pincushion cactus is present in these locations, a fence would be established around the site to ensure the 200 ft buffer is enforced.

Cactus borer beetles can have negative impacts on Brady pincushion cactus (Roth 2008). No biological control agents are proposed to control cactus, and none of the proposed agents are in the same genus as the cactus borer beetle (*Moneilma)*. Therefore, the proposed biological controls will not have any impacts on this species.

Herbicide overspray and trampling during treatments may provide a cumulative impact combined with the known threats, including livestock grazing and trampling, and herbivory in Brady pincushion cactus habitat. Trampling and herbicide overspray will exacerbate the effects from the current threats to cactus populations due to the small size of the population. Management actions have been implemented in some areas where the cactus occurs to minimize the impacts of these threats, however some still occur. Herbicide overspray and trampling will be minimized by implementing the conservation measures and best management practices. These impacts are expected to synergistically affect the cactus population as the climate changes. Herbicide overspray and trampling combined with climate change will provide a synergistic effect and increase mortality and decrease plant vigor. Again, synergistic effects will be avoided or minimized by implementing the conservation measures and best management practices.

Even though noxious weeds have not been identified as a threat to this species, the removal of noxious weeds around Brady pincushion cactus habitat may benefit its population. This biological assessment does not cover treatments within 200 ft of Brady pincushion cactus. Removing dense root structures of some noxious weed species, especially grasses, will promote seed establishment and reduce the risk of catastrophic wildfire. Since the cactus is small, the removal of noxious weeds will enhance pollination by making the plant more visible to insect pollinators.

Effects Determination

Based on the effects analysis and implementation of the species conservation measures, the Integrated Weed Management Plan may affect, but is not likely to adversely affect the Brady pincushion cactus.

Fickeisen Plains Cactus *(Pediocactus peeblesianus ssp. fickeiseniae)*

Endangered Species Act Status: Endangered, 2013
Navajo Nation Endangered Species List: Group 3
Recovery Plan: None
Critical Habitat: 2016

Species Account

The Fickeisen plains cactus is a narrow endemic restricted to exposed layers of Kaibab limestone on the Colorado Plateau in Coconino and Mohave Counties of northern Arizona. Most populations occur on the margins of canyon rims, flat terraces, limestone benches, or on the toe of well-drained hills, typically with limestone chips scattered across the surface (NNHP 2008). Plants are found primarily on slopes of 0 to 5 percent but some also occur on slopes up to 20 percent at elevations between 1,280 to 1,814 m (4,200 to 5,950 ft) (ARPC 2001; USFS 2013b).

At maturity, the Fickeisen plains cactus are the size of a quarter making them difficult to locate even when their location is known. The lifespan of the Fickeisen plains cactus is estimated to be between 10 to 15 years (Phillips et al. 1982). It is a cold-adapted plant with contractile roots that enables the plant to retract into the soil during the winter (cold) and summer (dry) seasons, and during periods of drought (Phillips et al. 1982). When ambient air temperatures rise in the spring and adequate rainfall occurs, plants emerge from beneath the soil surface to flower in mid-April. Solitary bees from the genus *Agapostemon* pollinate Fickeisen plains cactus; however, a pollinator study showed that pollinator visitation rates are low indicating there may be a specialized pollinator with low density and diversity (USFWS 2020a).

Habitat Status

Fickeisen plains cactus is threatened by the current and ongoing modification and destruction of its habitat and range from livestock grazing, on-going drought, and warmer winters (USFWS 2013b). Small mammal predation is also an important threat to the species. Small population size likely exacerbates the effects of these threats on the Fickeisen plains cactus.

On the Navajo Nation, livestock impacts have been observed in the three largest populations, including Hellhole Bend, Salt Trail Canyon, and Blue Spring (Hazelton 2011a). Noxious weeds are a potential threat to this species by increasing fire frequency and intensity and competition. Off-road vehicle use may become a threat to the cactus. Dirt roads lead to most of the known populations on the Navajo Nation. While traffic is light, NNHP have documented damage to the cactus from trampling from car tires and foot traffic. (NNHP 1994). Commercial development and tourist activities are a threat to the cactus and may become a greater threat if commercial development is proposed to occur in one of the larger populations.

Existing Environment

The plant's known range covered 200 linear km (125 mi) of land, extending from Mainstreet Valley of the Arizona Strip to House Rock Valley; along the canyon rims of the Colorado River and Little Colorado River; the area of Gray Mountain; and along the canyon rims of Cataract Canyon on the Coconino Plateau (USFWS 2013b).

The current population on the Navajo Nation includes 1,572 individuals within 22 populations from surveys completed in 2019 (USFWS 2020a). This shows an increase in abundance from 2013, which may be due to different monitoring methodologies (USFWS 2020a). Some of the sites showed population declines. The Salt Trail Canyon showed a 58% reduction in individuals from 2006 to 2018, with between 0-6 seedlings per year indicating low recruitment (USFWS 2020a). The suspected cause of the decline was likely due to below average precipitation (Hazelton 2011a). At the Hellhole Bend site live plant populations increased by 20% from 2013 to 2018, but few individuals were comprised of seedlings indicating low and variable recruitment (USFWS 2020b).

Effects Analysis

There are significant population declines due to poor reproduction and little recruitment. Threats include habitat disturbance from livestock grazing, small mammal predation, and its small population size compounded by long-term drought. Noxious weeds were evaluated as a threat by the U.S. Fish and Wildlife Service in their final listing but were determined that while they are stressors on the landscape, they do not have enough evidence that noxious weeds negatively affect Fickeisen plains cactus (USFWS 2013b). If weed treatments do occur near Fickeisen plains cactus suitable habitat, the species conservation measures will require a 200 ft buffer from cactus and will be marked with flagging to prevent field crews from entering the buffer zone. Much of the suitable habitat on the Navajo Nation has not been surveyed for the cactus, therefore prior to weed treatments, surveys by a trained biologist will be conducted to determine if the species is present. The NNHP will be notified immediately if the species is detected. There will be no direct effects to Fickeisen plains cactus because the conservation measures will be implemented.

Indirect effects include herbicide drift from chemical treatments. The likelihood of herbicide drift is reduced by implementing the 200 ft buffer for chemical treatments. Also, herbicides will not be applied when wind speeds exceed 10 miles per hour, temperatures are greater than 80° F (26.7° C), and humidity is high. Other methods such as mechanical (including prescribed fire) and cultural treatments require a 200 ft buffer from Fickeisen plains cactus populations. All vehicles used to access sites will follow established roadways and will park in previously disturbed sites.

Livestock can be a threat to Fickeisen plains cactus from grazing and trampling. Livestock threats are primarily a result of unmanaged grazing, which will not be considered cultural control under this action. Cultural treatments are proposed for Community Development Areas and agricultural fields. If Fickeisen plains cactus is present in these locations, a fence will be established around the site to ensure the 200 ft buffer is enforced.

Cactus borer beetles in the genus *Moneilma* have only been observed to affect one individual of Fickeisen plains cactus in 1991 (USFWS 2013b). No biological control agents are proposed to control cactus, and none of the proposed agents are in the same genus as the cactus borer beetle. Therefore, the proposed biological controls will not have any impacts on this species.

The reproductive capacity for the Fickeisen plains cactus is considered naturally low (e.g., seed dormancy, low seed production, poor dispersal mechanisms, and slow growth) (USFWS 2013b). Therefore, introduced external factors that may place additional stress on the life history characteristics of these populations may further inhibit population growth. Herbicide overspray and trampling during treatments may provide a cumulative impact on the species when combined with current stressors of feral livestock trampling, tourism, small mammal consumption and OHV use due to low reproductive capacity and small population size. Herbicide overspray and trampling will be minimized by implementing the conservation measures and best management practices. These impacts would synergistically affect the cactus population as the climate changes. Climate change and drought may have indirect effect to this species by impacting reproductive frequency and timing, which may impact recruitment (Nora Talkington, Botanist, Navajo Natural Heritage Program, personal communication on July 21, 2022). Herbicide overspray and trampling combined with climate change will provide a synergistic effect and increase mortality and inhibit population growth. Again, synergistic effects will be avoided or minimized by implementing the conservation measures and best management practices.

Even though noxious weeds were not identified as a threat to this species, the removal of noxious weeds around Fickeisen plains cactus habitat may benefit its population. The proposed action does not cover treatments within 200 ft of Fickeisen plains cactus. However, by removing dense root structures of some noxious weed species in areas adjacent to Fickeisen plains cactus habitat, especially grasses, would promote seed establishment and reduce the risk of catastrophic wildfire. Since the cactus is small, the removal of noxious weeds would enhance pollination by making the plant more visible to insect pollinators.

Effects Determination

Based on the effects analysis and implementation of the species conservation measures, the Integrated Weed Management Plan may affect, but is not likely to adversely affect the Fickeisen plains cactus.

Mancos Milk-vetch (*Astragalus humillimus*)

Endangered Species Act Status: Endangered, 1985
Navajo Nation Endangered Species List: Group 2
Recovery Plan: Final 1989
Critical Habitat: None

Species Account

Mancos milk-vetch flowers in late April and early May (USFWS 1989). Larger plants may produce over 100 flowers in a growing season and fruits mature by mid-June (USFWS 1989). In New Mexico, monitoring results revealed that it takes two growing seasons for seedlings to mature with flowering into the third or fourth year as compared to other species of *Astragalus*, which typically take one growing season to bloom (NMSFD 2008). Mancos milk-vetch plants produce viable fruit by outcrossing and self-pollination (Tepedino 2002). This species often requires native bee pollination to produce seeds. Mancos milk-vetch germination and initial seeding survival are positively related to the death of older plants, which may be due to moisture and shade availability (NMSFD 2008). Mancos milk-vetch forms highly localized populations; occupied habitat ranges from 1.5 to 7.6 hectares in size, where plants can be concentrated in densities as high as 40 plants per square meter (Sivinski 2008).

Mancos milk-vetch typically occur on sandstone substrate ledges and mesa tops in cracks or shallow bowl-like depressions (tinajas) that accumulate sandy soils and rainfall (USFWS 1989; NMSFD 2008). Potential habitat corresponds to rimrock outcrops of the Point Lookout and Cliffhouse members of the Mesa Verde sandstone series with flat or gently sloping surfaces at an average elevation of 1,854 m (5,650 ft) (USFWS 1989). Overall cover is very low (<5%), and resource competition for these species is minimal (USFWS 1989).

Habitat Status

Mancos milk-vetch was listed as a federally endangered species due to narrow distribution and low tolerance for disturbance (USFWS 1985a). Mancos milk-vetch populations and their habitat have been negatively impacted by crushing from vehicles and equipment, direct removal and destruction from energy-related activities, and indirect effects from climate change and unauthorized traffic on roads constructed by oil and gas companies and transmission lines, OHVs. Current threats recorded in 2017 included livestock grazing, trampling, powerlines, invasive weeds, wood cutting, and oil and gas development (NNHP 2019).

Existing Environment

Mancos milk-vetch is a narrow endemic known only from the Four Corners region of New Mexico, San Juan County, and adjacent Montezuma County, Colorado. Species distribution closely follows a narrow band of Mesozoic (Point Lookout and Cliff House) sandstone along a 10-mile section of the Hogback geologic formation (USFWS 1989). Most populations are located on Navajo Nation lands in San Juan County, New Mexico on Palmer Mesa east to the Hogback area and south of the San Juan River, to a hogback east of Little Water (Roth 2008a, USFWS 2011d). Monitoring data indicate that population trends for Mancos milk-vetch are highly variable between years; however, Navajo Nation range-wide numbers have declined approximately 67-71 percent since the late 1980's /1990's tallies (NNHP 2019).

The Navajo Natural Heritage Program monitors 13 Mancos milk-vetch populations. Surveys conducted during 2007 and 2008 in the Hogback and Palmer Mesa areas found 12 of the original populations including one new population and one extirpated population (USFWS 2011d). Historic records indicate that during the 1980s, the total known population size was approximately 7,600 individual plants on Navajo Nation lands. By 2008, less than 400 plants were found in 12 populations and only 2 of the 12 populations (17 percent) had more than 50 live plants (NNHP 2008a; NNHP 2009). In 2017, 11 populations were relocated and three were shown to have increasing populations (NNHP 2019). Below is a table of the survey results from known locations of Mancos milk-vetch in 2017 as compared to historic data (**Table 15**).

Table 15. Historic and current population estimates for 12 populations of Mancos milk-vetch occurring at least partially on the Navajo Nation during 2013 and 2017 surveys by NNHP staff (NNHP 2019). Counts with asterisks are estimated populations.

Site Name	Approximate Population Extent (acres)	Year of First Survey	Number of Plants	Year of Last Survey	Number of Plants
Burnt Squash Draw	16.8	1997	Few plants*	2017	78
Coal Mine Creek	16.6	1986	4200*	2017	100
Hogan	11.2	1985	200*	2017	188
Hogback	16.8	1997	30	2017	66
Little Water Hogback	41.4	1997	Hundreds*	2017	40
Long Point	35	1986	200*	2017	57
North Long Point	19.8	1986	500*	2017	205
Oil Tanks	14	1997	17	2017	5
SE Palmer Mesa	0.5	2008	1	2017	5
West Palmer Mesa	286.7	1989	1700*	2017	1414
West Rim	42.5	1986	500*	2017	120
Little Water South	15.12	2013	130	NA	NA

During the 2017 monitoring season, seedlings comprised 57% of the plants observed in the NNHP plots (NNHP 2019). Also, only 37% of the Mancos milk-vetch had seed pods indicating poor reproduction (NNHP 2019).

Effects Analysis

Mancos milk-vetch is threatened by noxious weeds, particularly from cheatgrass (NNHP 2019). If weed treatments occur near Mancos milk-vetch suitable habitat, the species conservation measures will require a 200 ft buffer from the species and will be marked with flagging to prevent field crews from entering the buffer zone. Prior to weed treatments in suitable habitat for the species, surveys by a trained biologist will determine if the species is present. The NNHP will be notified immediately if the species is detected. There will be no direct effects to Mancos milk-vetch because the conservation measures will be implemented.

Indirect effects include herbicide drift from chemical treatments and trampling. The likelihood of herbicide drift is reduced by implementing the 200 ft buffer for chemical treatments. Also, herbicides will not be applied when wind speeds exceed 10 miles per hour, temperatures are greater than 80° F (26.7° C), and humidity is high. Chemical treatments may affect pollinators required for Mancos milk-vetch reproduction or their host plants. Weed treatments are anticipated to occur on a relatively small scale, except for agricultural fields. NAPI agricultural fields are within miles of some Mancos milk-vetch populations, and aerial spraying may occur in these areas. Implementing the mitigation measures will reduce the potential for chemical drift. Other methods such as mechanical, including control burn, and cultural treatments require a 200 ft buffer from Mancos milk-vetch populations. All vehicles used to access sites will follow established roadways and will be parked in previously disturbed sites.

Spider mite (*Tetranychus* genus), seed weevils (*Acanthoscelides* sp., *Apion* sp., *and Tychius* sp.), and Lepidoptera larvae herbivory have been reported to occur at insignificant levels during years with favorable rainfall years and can cause mortality during drought periods when the plant is already stressed (NMSFD 2008). These events are rare but may increase during drought. No biological control agents are proposed to control *Astragalus* sp., and none of the proposed agents occur within the genus of the spider mite, seed weevil and Lepidoptera. Therefore, the proposed biological controls will not have any impacts on this species.

This species has a small population size, which is likely due to low fecundity and reduced genetic variability (Allphin et al. 2005). Therefore, introducing external factors that may place additional stress on the life history characteristics of these populations may further inhibit population growth. Herbicide overspray and potential human or car tire trampling during treatments may provide a cumulative impact on the species when combined with current stressors of trampling from oil and gas, transmission line and OHV traffic due to low fecundity and small population size. Herbicide overspray and trampling will be minimized by implementing the conservation measures and best management practices. Water is critical for Mancos milk-vetch germination and development. Therefore, continued drought, as anticipated with climate change, threatens this species' continued existence (USFWS 2011d). Herbicide overspray and trampling combined with climate change would provide a synergistic effect and increase mortality and inhibit population growth. Again, synergistic effects would be avoided or minimized by implementing the conservation measures and best management practices.

Effects Determination

Based on the effects analysis and implementation of the species conservation measures, the Integrated Weed Management Plan may affect, but is not likely to adversely affect the Mancos milk-vetch.

Mesa Verde Cactus *(Sclerocactus mesae-verdae)*

Endangered Species Act Status: Threatened, 1979
Navajo Nation Endangered Species List: Group 2
Recovery Plan: Final, 1984
Critical Habitat: None

Species Account

Mesa Verde cactus is a perennial desert plant that grows slowly and has a lifespan of approximately 20 years (CNAP 2005). Mesa Verde cactus can self-fertilize; however, pollination occurs more frequently and more successfully by insect pollinators. Recruitment and mortality events occur at infrequent (greater than 10 year) intervals (CNAP 2005) and are associated with rainfall. Since 2003, germination and recruitment have been documented in some populations, but they have occurred at relatively low levels (USFWS 2011e). During severe dry periods, individual plants shrink and retract back into soils to minimize desiccation or dehydration (Heil and Porter 1994). Vegetation cover in Mesa Verde cactus habitat is sparse and has the appearance of a nearly barren badland.

Habitat Status

The primary threats identified by the U.S. Fish and Wildlife Service (USFWS) include poaching; highway and transmission line construction; and off-highway vehicle activity (USFWS 1979). The Mesa Verde Cactus Recovery Plan identifies additional threats, all related to the "destruction or modification of its habitat:" coal mining; oil and gas exploration and development; commercial and residential development; livestock grazing and trampling; pesticide use; and natural causes such as erosion and interspecific competition (USFWS 1984). The most recent 5-year review of the species' status also discusses climate change and insect predation as threats (USFWS 2011e). Finally, *Halogeton* sp. is present at Mesa Verde cactus monitoring sites but its effect on the cactus is uncertain (Nora Talkington, Botanist, Navajo Natural Heritage Program, Personal Communication on March 10, 2021).

The total range of this species is an area of approximately 75 x 30 miles (120 x 48 km), stretching from near Naschitti in southern San Juan County, New Mexico to about 10 miles north of the New Mexico border in Montezuma County, Colorado (USFWS 1984). Distribution within this range is sporadic and widely scattered. The topography consists of eroded badlands from numerous small, dry drainages between low hills and ridges at elevations between 4,800 and 6,560 ft. Density varies greatly within populations with as many as 20 cacti in 50 m^2 (538 ft^2) or as few as a single cactus located several hundred meters from any others (Sivinski 2000). The highest known concentration is a 40 km (25 mi) swath around Shiprock, New Mexico, which may be an artifact of numerous botanical surveys conducted due to increased development pressures (Sivinski 2000). Of the known populations of Mesa Verde cactus, at least 80 percent occur on Navajo Nation lands, 15 percent on Ute Mountain Ute lands, and 5 percent on small blocks of BLM and New Mexico State lands (Sivinski 2000).

Navajo Nation Conservation Areas

On Navajo Nation lands, Conservation Areas (CAs) were officially designated to protect Mesa Verde cactus and potential habitat, including El Malpais, Many Devils Wash, Rattlesnake, and Monument Rocks Conservation Areas (Hazelton 2013). El Malpais Conservation Area (7,416 ac) was established in 2008 as a mitigation bank for the Western Administrative Power Authority (WAPA). Since its creation, the site has been monitored annually expect for 2010. At this site, total Mesa Verde cacti numbers slightly declined over five years from 2014 – 2019 (**Table 16**). High recruitment occurred during 2017, 2018, and 2019. In 2015 the mortality was from an unknown cause, whereas in 2017 seven were due to feral horses, three to erosion, and the others to an unknown cause. In 2018, the death of four stems was due to rodents and the rest from unknown causes and all deaths occurring in 2019 were due to unknown causes.

Table 16. Total number of cacti, new cacti (new stems from new recruits and overlooked adults), and dead cacti censused at El Malpais Conservation Area on the Navajo Nation from 2014 – 2019. No data was recorded during 2016 (Talkington 2021).

Year	Total # of Cactus	# New Cactus	# Dead Cactus
2014	91	17	0
2015	100	9	1
2017	95	42	43
2018	114	34	15
2019	170	58	8

Existing Environment

In 2004, 56 known natural population sites of Mesa Verde cactus were found and resurveyed over approximately 1,911 ha (4,723 ac) on Navajo Nation lands (NNHP 2004). Most plants were found within a 12 km (20 mi) radius around the town of Shiprock. Surveys were expanded to cover larger areas around the town of Shiprock, including Malpais Arroyo, the Fairgrounds, Many Devils Wash, and an area southwest of the town of Cudie. Navajo Natural Heritage Program found approximate population totals of 6,700 cacti on 37 of the 45 sites prior to 2002 with many sites with only one cactus and a few others as high as 1,500 individuals (NNHP 2004). Following the significant mortality caused by a severe drought and insect predation during the 2002-2003 growing season, only a few sites supported 20 or more cacti (NNHP 2004). In 2004, the total number of plants in 56 surveyed sites was 948 live cacti, 428 dead cacti, and 20 damaged cacti (NNHP 2004). This total included 7 newly surveyed sites, which totaled 175 cacti (125 live, 50 dead). At one site, Mesa Verde cactus experienced a 99% decrease from 1,500 or more individuals reported in 1989 to 4 plants in 2004. Surveys were conducted at Sheep Springs in 1986 where 50 cacti were found and in 1990 an estimated 122 cacti were detected (USFWS 2011e). After the severe drought in 2002-2003, no Mesa Verde cactus were detected at the site by 2004. In 2019, NNHP surveyed the WAPA site and detected 170 individuals which was up from 114 individuals in 2018.

Other surveys conducted but not monitored by the Navajo Nation have detected populations of Mesa Verde cactus. Along the Navajo Transmission Project right-of-way and through the

Malpais Conservation Area, a total of 1,377 live and 475 dead cacti were found along 25.7 km (16 mi) of suitable habitat (Ecosphere Environmental Services 2007). For the existing Lost Canyon and Kayenta – Shiprock Transmission Line, 45 km (28 mi) of suitable habitat was surveyed; 436 live and 148 dead cacti were found (Ecosphere Environmental Services 2007). From 2009 to 2011, Bureau of Reclamation (BOR) contracted Ecosphere Environmental Services to inventory for Mesa Verde cactus on Navajo Nation lands in potential cacti habitat along Navajo Route N-36 and U.S. Highway 491 for the Navajo-Gallup Water Supply Project. Results from 2009 and 2010, which covered the same survey area each year, indicate an increase in mature and juvenile cacti as well as increased mortality with a slight reduction in offshoots.

In 1986, USFWS transplanted 35 Mesa Verde cactus within a 24 km (15 mi) radius of the urban community of Shiprock, New Mexico with little success (USFWS 2011e). In 1989, fewer than 10 cacti were found at the site, which may have been contributed to lack of mapping and documentation (Hazelton 2011a). Twenty-nine cacti were transplanted in 1995, however after the drought of 2002 and infestation of cutworms in 2003 only four cacti remained in 2004 (Roth 2004a). In 2001, an additional 54 cacti were transplanted within non-development zones on the Northern Navajo Fairgrounds near Shiprock. In 2019, 31 cacti were detected at this site with only 8 of the transplanted cacti remaining in the plots (Nora Talkington, Botanist, Navajo Natural Heritage Program, Personal Communication on March 10, 2021).

Effects Analysis

Noxious weeds were not identified as a threat to Mesa Verde cactus; however, they have been detected during recent surveys (USFWS 2011e, Hazelton 2011a). NNHP has noted that noxious weed treatments within Mesa Verde cactus Conservation Areas could be beneficial to the species. If weed treatments occur within the Conservation Areas, additional consultation with NNHP staff would be required on a project-by-project basis. If weed treatments are conducted near Conservation Areas or near Mesa Verde cactus suitable habitat the species conservation measures will eliminate direct impacts on the species. A 200 ft buffer from cactus will be required and each individual will be marked with flagging to prevent weed treatment field crews from entering the buffer zone. The NNHP will be notified immediately if the species is detected.

Indirect effects include herbicide drift from chemical treatments and trampling. The likelihood of herbicide drift is reduced by implementing the 200 ft buffer for chemical treatments. Also, herbicides would not be applied when wind speeds exceed 10 miles per hour, temperatures are greater than 80° F (26.7° C), and humidity is high. Chemical treatments may affect pollinators required for Mesa Verde cactus reproduction or their host plants. Weed treatments are anticipated to occur on a relatively small scale, however implementing the mitigation measures and best management practices will reduce the potential for chemical drift. Other methods such as mechanical, including prescribed fire, and cultural treatments require a 200 ft buffer from cactus populations. All vehicles used to access sites would follow established roadways and will be parked in previously disturbed sites.

Livestock grazing is considered a threat to Mesa Verde cactus from grazing and trampling. Cultural treatments are proposed for Community Development Areas and agricultural fields. If Mesa Verde cactus is present in these locations, a fence will be established around the site to ensure the 200 ft buffer is enforced.

The native longhorn cactus beetle (*Moneilema semipunctatum*) and nonnative army cutworms (*Euxoa spp*.) consume Mesa Verde cactus often causing mortality. Mortality from invertebrate consumption is more significant during drought conditions (USFWS 2014b). No biological control agents are proposed to control cactus, and none of the proposed agents occur within the longhorn cactus beetle and army cutworm genus, which eliminates the possibility of a species attacking a native species. Therefore, the proposed biological controls would not have any impacts on this species.

The reproductive capacity for the Mesa Verde cactus is considered naturally low (germination and recruitment) (USFWS 2011e). Therefore, introducing external factors may place additional stress on the life history characteristics of these populations and further inhibit population growth. Herbicide overspray and potential human or car tire trampling during treatments may provide a cumulative impact on the species when combined with its current stressors of livestock trampling and consumption, oil and gas development, transmission line easements, insect consumption and OHV use due to low reproductive capacity and small population size. Herbicide overspray and trampling will be minimized by implementing the conservation measures and best management practices. These impacts would synergistically affect the cactus population with warmer and drier climates. It is predicted that this species would be highly impacted by climate change as observed in the monitored populations after the drought of 2002, where some populations experienced a 99% reduction in population size. Rodent herbivory of cacti has increased with drought. The combination of climate change, insect consumption, herbicide overspray and trampling combined would provide synergistic effects that could increase mortality and inhibit population growth. Synergistic effects would be avoided or minimized by implementing the conservation measures and best management practices.

Even though noxious weeds were not identified as a threat to this species, the removal of noxious weeds around Mesa Verde cactus habitat may benefit its population. The proposed action does not cover treatments within 200 ft of the cactus. However, removing dense root structures of some noxious weed species near Mesa Verde cactus habitat, especially grasses, would help promote seed establishment and reduce the risk of wildfire.

Effects Determination

Based on the effects analysis and implementation of the species conservation measures, the Integrated Weed Management Plan may affect, but is not likely to adversely affect the Mesa Verde cactus.

Navajo Sedge *(Carex specuicola)*

Endangered Species Act Status: Threatened, 1985
Navajo Nation Endangered Species List: Group 3
Recovery Plan: Final, 1987
Critical Habitat: Final, 1985

Species Account

Navajo sedge is a wetland obligate of springs or hanging gardens, typically in alcoves associated with Navajo sandstone, Cedar Mesa, DeChelly, Kayenta, and Wingate formations on cliffs of varying height and slope (often vertical) at 1,280 to 2,300 m (4,200-7,600 ft) elevation in piñon-juniper woodland (USFWS 2014a, USFWS 2019). This species rarely occurs on level terrain; however, three sites were located on the canyon floor in Sheik Canyon, Utah (USFWS 2014a). Water supporting Navajo sedge is generally low in mineral content.

The nature of Navajo sedge habitat (springs on cliffs in arid environments) indicates its distribution pattern as uncommon, scattered, and isolated (USFWS 2014a). Monitoring results for 10 Navajo sedge populations (15 hanging gardens) on the Navajo Nation found that average plant vigor increased at six and decreased at two of the gardens from 2003 to 2011 (NNHP 2012). Of the six gardens with increased plant vigor, one had a decrease in grazing pressure, two experienced both a decrease in grazing pressure and an increase in water availability, and three experienced no change in either stressor. Additionally, NNHP ranked 16 of 32 population in good or excellent viability, and the rest were ranked poor (NNHP 2012).

Navajo sedge reproduction is mostly vegetative, but no species-specific reproduction studies have been completed. Pollination is likely by wind, as is common among sedges (Linder and Rudall 2005). Flowering and fruit set occur from late June through September (NNHP 2008), which is the only time Navajo sedge can be positively identified. Suitable habitat can be identified year-round. Preliminary results from a small sample of nine sites indicates cover of Navajo sedge within occupied hanging gardens is not correlated with site aspect or soil moisture level (Rink and Hazelton 2014).

Habitat Status

The largest threats to Navajo sedge populations include grazing, trampling by livestock, and water development. Climate change may be a potential threat in the future due to drying of springs. Noxious weeds have been recorded in hanging gardens on the Navajo Nation where Navajo sedge occurs, including cheatgrass, red brome, saltcedar, and Russian olive (NN). There is concern these noxious weeds could outcompete native species for resources. From 2000 to 2003, 23% of known populations on the Navajo Nation had medium or heavy impacts from grazing. Additionally, 37% showed signs of drought stress such as high mortality rates, no water discharge/dry soils, and sloughing vegetation mats (NNHP 2004a). In 2010 and 2011, grazing pressure did not appear to increase at any gardens, and decreased at three, indicating that the amount, distribution, and suitability of Navajo sedge habitat is not changing significantly due to impacts from livestock, water development, and changes in water availability (NNHP 2012).

Critical Habitat

Critical habitat for Navajo sedge was designated at three sites where which the plant was known to occur at the time of its listing on May 8, 1985. The locations are all in Coconino County, Arizona. Each location is approximately 40 x 5 meter (about 200 square meters) rectangular areas with long axes in the direction of seep spring flow. The total area designated comprises about 809 square meters (about 0.15 acres) and contains all known occupied habitat from 1985. Primary constituent elements are moist sandy to silty soils at shady seep-springs within the Navajo Sandstone Formation (Phillips et al. 1981a). Navajo sedge is also known to occur in association with Cedar Mesa, De Chelly, Kayenta, and Wingate geologic formations (USFWS 2019a). Since the time of listing additional Navajo sedge populations have been detected, however; critical habitat has not been updated.

Existing Environment

At the time of listing in 1985, this species was only known from three springs along the trail from Inscription House Trading Post to Inscription House Ruin on the Navajo Nation in Coconino County, Arizona (Howell 1949). These three sites are considered one population or "element occurrence record" (ERO) (NNHP 2004a). An ERO refers to Navajo sedge occupying one or more hanging gardens within a single canyon and within one kilometer of each other. Currently, there are 160 sites, in 64 EROs, across Arizona and Utah, spanning an area about 120mi (190km) by 110mi (175km) (USFWS 2019). There are 43 populations on the Navajo Nation documented from the Navajo Creek drainage in Coconino County; east to the Tsegi Canyon Watershed in Navajo County; south to Rock Point, Mexican Water, and Canyon de Chelly National Monument in Apache County, Arizona. Despite the survey effort to document these populations, much of this species' potential habitat has not been surveyed due to the difficult terrain that limits access to sites (USFWS 2014).

Effects Analysis

Prior to weed treatments, surveys by a trained biologist would be conducted to identify the locations of Navajo sedge within potential habitat in the project area. The 200 ft buffer from Navajo sedge populations identified in the special conservation measures would be marked with flagging to prevent weed treatment field crews from entering the buffer zone.

There will be no direct effects to Navajo sedge and critical habitat since weed treatments are not proposed in hanging garden sites. Indirect effects include herbicide drift from chemical treatments. The likelihood of herbicide drift is reduced by implementing the 200 ft buffer for chemical treatments. Also, herbicides would not be applied when wind speeds exceed 10 miles per hour, temperatures are greater than 80° F (26.7° C), and humidity is high. Finally, many hanging gardens with Navajo sedge and critical habitat exist in remote and inaccessible areas where it is unlikely weed treatments will occur, and, if they do occur, wind drift herbicide would not reach the populations. Other methods such as mechanical, including prescribed fire, and cultural treatments require a 200 ft buffer from Navajo sedge populations. Due to the remote nature of hanging gardens and critical habitat, it is unlikely that heavy machinery would be used to treat weeds in these areas. Chainsaws may be used for cutting stump treatments but would focus on woody trees.

Livestock have shown to be a threat to Navajo sedge from grazing and trampling effects. Cultural treatments are proposed for Community Development Areas and agricultural fields. If Navajo sedge is present in these locations, a fence would be established around the hanging garden and critical habitat to ensure the 200 ft buffer is enforced.

Herbicide overspray to Navajo sedge critical habitat may provide a cumulative impact with the known threats to Navajo sedge habitat, including livestock grazing and trampling and water development for livestock. If Navajo sedge populations are compromised due to these outside pressures, herbicide overspray may further impact these susceptible populations. The effect of grazing, trampling, climate change, and water development at hanging gardens with Navajo sedge fluctuates from year to year. Surveys conducted in 2010-2011 note that grazing pressure had not increased at 15 hanging gardens, and that it decreased at three of them (NNHP 2012). Of 32 populations with enough information to assess populations improvements over 20-30-year periods, 16 were assigned a rank of good or excellent viability. The rest were of fair viability, indicating some reason for concern.

Removing noxious weeds species from areas adjacent to Navajo sedge populations would help protect these populations from the identified threat of noxious weed invasion.

Effects Determination

The implementation of mitigation measures, including buffers identified for each treatment, and best management practices would eliminate the risk to Navajo sedge and critical habitat and make weed treatments not likely to adversely affect the species.

Welsh's Milkweed (*Asclepias welshii*)

Endangered Species Act Status: Threatened, 1987
Navajo Nation Endangered Species List: Group 3
Recovery Plan: Final, 1992
Critical Habitat: Final, 1987

Species Account

Welch’s milkweed only grows in active dunes and thrives in disturbed conditions with no competing vegetation (USFWS 2015). This species flowers from June to July with seed development and dispersal from July to early September (NNHP 2020). To produce fruit and seeds this species requires pollinators for germination. Juvenile plants have long, linear leaves, different from the ovate or rounded leaves of the adult so they are often misidentified. Welch’s milkweed populations are widely dispersed suggesting that while the species spreads clonally, seeds may be dispersed by wind (USFWS 2016). Populations are hard to monitor due to shifting winds making population viability determinations challenging. Also, since this species is rhizomatous, it is hard to discern the number of individuals. It grows from an extensive underground root system comprised of a taproot and horizontal runners connecting stem clusters.

Habitat Status

Suitable habitat consists of active sand dunes derived from Navajo sandstone in sagebrush, juniper, and ponderosa pine communities (NNHP 2020). Known populations occur from 5,000 to 6,230 ft elevation. Populations on the Navajo Nation are distributed across large dune fields with multiple, highly spaced stands of stems (USFWS 2015).

Due to the limited range and specialized habitat of this species, it is threatened by off-road vehicle use, and the potential for oil and gas development in its critical habitat. On the Navajo Nation, this plant is threatened by grazing, trampling and drought.

Existing Environment

Welsh's milkweed currently occurs in eight populations, with two (Tuba City and Comb Ridge) on the Navajo Nation, Arizona (USFWS 2015). The Comb Ridge population, consisting of the Kayenta and Capitan Valley populations, is approximately 3,200 acres with a stem count of 837 stems scattered widely across the dunes in 2019 (Nora Talkington, Botanist, Navajo Natural Heritage Program, Personal Communication on July 21, 2022). There is an estimate of 1,000 stems within this population including plants east of the end of the survey. The Tuba City population, consisting of the Kaibeto Plateau and Tonalea populations, is 960 acres with 212 live stems counted in 2019 (Nora Talkington, Botanist, Navajo Natural Heritage Program, Personal Communication on July 21, 2022). In 2016, a new population was detected at Standing Rock, approximately 5km southwest of Tuba City, with 162 stems counted in 2019 and 2020 (Nora Talkington, Botanist, Navajo Natural Heritage Program, Personal Communication on July 21, 2022).

Effects Analysis

This species is a rare endemic that occurs on a very dynamic and specialized habitat: sand dunes. The dynamic nature of sand dunes prevents other native or noxious plant species from establishing. Therefore, it is unlikely that weed treatments will occur in Welsh's milkweed habitat and there would be no direct impacts to the species. This species may be impacted by indirect effects from trampling, mechanical equipment impacts, and herbicide overspray from adjacent habitats. These effects would be reduced or eliminated by implementing the species conservation measures and best management practices. Flagging or fencing the species in the treatment area will prevent mechanical or human foot traffic from trampling the species. Herbicides will not be sprayed during high wind or humid conditions to prevent the potential for overspray.

Implementing the conservation measures would also eliminate synergistic effects. The largest threat to this species is human impact from off- road recreational vehicles and livestock grazing. Trampling from off-road vehicle use and livestock in combination with herbicide overspray may cause a synergistic effect to the species. OHV and livestock trampling may reduce the population through trampling and weed treatments may further those impacts. However, the known populations occurring on the Navajo Nation are located in remote areas that are not heavily impacted by off-road vehicles. Also, due to the sparse vegetation occurring on active sand dunes, it is unlikely that cattle would graze in these areas. The implementation of the conservation measures would reduce the potential of herbicide overspray, mechanical and trampling impacts.

Climate change may be another threat to Welsh's milkweed populations. As the climate warms and drought continues, this species will be impacted by reduced water availability in its habitat. The driest areas, such as in Welsh's milkweed habitat, are anticipated to have the largest impacts from climate change. Climate change, with the combination of herbicide overspray, mechanical impacts or trampling, may cause cumulative impacts to the population. Implementing the conservation measures would reduce the potential of herbicide overspray, mechanical and trampling impacts.

Effects Determination

Based on the effects analysis and implementation of the species conservation measures, the Integrated Weed Management Plan may affect, but is not likely to adversely affect the Welsh's milkweed.

Zuni/Rhizome Fleabane (*Erigeron rhizomatus*)

Endangered Species Act Status: Threatened, 1984
Navajo Nation Endangered Species List: Group 2
Recovery Plan: Final, 1988
Critical Habitat: None

Species Account

Zuni fleabane habitats are outcrops of coarse-textured shales on the Baca Formation in west-central New Mexico and the Chinle Formation in northwestern New Mexico and northeastern Arizona (USFWS 2007). These soils often have a strong odor of selenium and sometimes support species of seleniphytic plants. Occupied habitats range in elevation from 7,500 to 8,400 feet and in size from less than 1 acre to 260 acres (USFWS 2007). Shaley outcrops of suitable habitat are often nearly barren but occur within and contain scattered vegetation from piñon-juniper woodland to lower transitional forest of ponderosa pine and Douglas fir.

Habitat Status

Zuni fleabane is a rare regional endemic with three known, widely scattered population centers in Arizona and New Mexico (USFWS 2020b). On the Navajo Nation, Zuni fleabane is known in the Chuska Mountains on nearly barren slopes and scree. This species is geologically associated with the Chinle and Baca formations, which are known uranium deposits and mining claims. Therefore, mineral exploration and development and climate change are the two most significant threats to this species. The Dine Natural Resources Protection Act of 2005 eliminated uranium mining activities on Navajo Nation land, particularly in Zuni fleabane habitat (USFWS 2020b). Climate change, through drought and increased temperatures, may exacerbate already limited moisture availability and impact this species. Additional threats to this species on the Navajo Nation are residential housing development, off-road vehicle use, and recreational impacts (USFWS 2020b). Noxious weeds are not recognized as a threat to this species on the Navajo Nation (Nora Talkington, Botanist, Navajo Natural Heritage Program, personal communication, March 10, 2021).

No critical habitat was listed for this species.

Existing Environment

In 2022, 20 Element Occurrences of Zuni fleabane were detected on the slopes of the Chuska Mountains from Lukachukai and west of Red Valley in Apache County, Arizona south to Navajo in McKinley County, New Mexico (Nora Talkington, Botanist, Navajo Natural Heritage Program, Personal Communication on July 21, 2022). There is potential for the species to occur on the Navajo Nation in the Chuska Mountains and in suitable habitat in the pinyon-juniper associations between Lupton in Apache County, Arizona and Prewitt in McKinley County, New Mexico (NNHP 2020). In 2004, surveys in the Chuska Mountains estimated a Zuni fleabane population size of approximately 5,725 individuals in 15 subpopulations (Christie 2004). Surveys completed in 2019 documented a 14% increase in Zuni fleabane population size from 2004 (Christie and McBride 2020). The population trend was stable to increasing and populations were generally healthy.

Effects Analysis

Zuni fleabane is a rare, regional endemic that occurs on specialized soil type, including coarse-textured shales on the Baca Formation and the Chinle Formation. Noxious weeds are not recognized as a threat in Zuni fleabane habitat on the Navajo Nation. Therefore, it is unlikely this species will receive direct impacts from weed treatments. This along with implementing conservation measures would prevent direct impacts to the species from weed control activities. This species may be impacted by indirect effects from trampling during treatments and herbicide overspray. These effects would be reduced by implementing the species conservation measures and best management practices. Flagging or fencing the species in the treatment area would prevent mechanical or human foot traffic from trampling the species. Herbicides would not be sprayed during high wind or humid conditions to prevent the potential for overspray. Other methods such as mechanical, including prescribed fire, and cultural treatments require a 200 ft. buffer from fleabane populations. All vehicles used to access sites will follow established roadways and would be parked in previously disturbed sites. There are no documented predators or pathogens that affect Zuni fleabane (USFWS 2007). Also, no proposed biological controls target fleabane species. Therefore, there are no anticipated effects that will occur from the proposed biological controls.

While cattle do not eat fleabane, it may be trampled when it occurs in a grazing allotment. However, this is not identified as a major threat. Herbicide overspray and trampling from weed treatments may cause synergistic effects when combined with cattle trampling. However, the known populations occurring on the Navajo Nation are located in remote areas that are sparsely vegetated. The implementation of the conservation measures would reduce the potential of herbicide overspray, mechanical and trampling impacts.

Effects Determination

Based on the effects analysis and implementation of the species conservation measures, the Integrated Weed Management Plan may affect, but not likely to adversely affect Zuni/Rhizome fleabane.

5.3 Sensitive Species and Species of Concern – Navajo Listed Species

5.3.1 Mammals

Pronghorns *(Antilocapra americana)*

Species Account

Pronghorns are found in grasslands or desert scrub areas with rolling or dissected hills or small mesas, and usually with scattered shrubs and trees (typically juniper and sagebrush). Once common throughout the grasslands of the United States, unregulated markets, subsistence hunting, and overgrazing by livestock dramatically decimated populations.

Navajo Department of Fish and Wildlife permits special hunts of pronghorn in NNHP Big Game Management Unit 16 in New Lands, south of Sanders, AZ. Pronghorn population numbers have been declining in the Southwest due to various threats that decrease and fragment habitat. Habitat loss due to human population growth has affected their overall range. Habitat fragmentation from urban sprawl and highway construction have dramatically impacted dispersal and migration of pronghorn herds (AGFD 2013). Loss of habitat from the expansion of juniper of other shrub species due to a lack of fire suppression have affected range quality and habitat suitability. Grazing and historic fencing practices have reduced habitat quality and created barriers that prevent pronghorn crossings. Finally, drought and predation have also affected pronghorn populations. The introduction and spread of many noxious weed species within rangelands and pastures on the Navajo Nation may also affect forage quality, replacing native forbs and herbaceous species with less palatable species. Pronghorn antelope are browsers that prefer shorter plants, with grass being a minor food source (AGFD 2013).

Existing Habitat

Pronghorn range on the Navajo Nation includes the New Lands area, Kaibeto, Shiprock, the southwestern portion north of Flagstaff, and checkerboard lands in New Mexico. It is likely this species occurs in other areas across the Navajo Nation; however, due to limited survey information occupancy is unknown.

Effects Analysis

It is likely that weed management treatments would occur within suitable habitat for pronghorn. Implementation of best management practices and the species conservation measures would minimize or eliminate many direct impacts from weed treatments. Mechanical, manual, and biological control techniques would have the least impacts for pronghorn. Such techniques would require a 1-mile buffer around known lambing areas and would be done in a manner to minimize disturbance to individuals.

Cultural control methods, such as planting native species, mulching, or conservation of native plants are not expected to impact pronghorn. Targeted grazing, however, would require the installation of fencing around treated areas. Fencing may affect pronghorn by preventing herds from moving across their range. Installation of wildlife friendly fencing, where smooth wires are used on the bottom, would reduce impacts from fencing and reduce how fencing may prevent pronghorn movements.

The use of herbicides does pose the risk of some direct impacts to pronghorn. Pronghorn may graze on herbicide-treated plants, and while most of the proposed pesticides are not considered toxic to large mammals, a few do pose some concern. Fluazifop-P-butyl and 2,4-D are known to impact large mammals' reproductive issues in wildlife species. There is also evidence that atrazine can affect the androgen receptors in mammalian species. Such risks are most concerning for pregnant or nursing females, or offspring. Enforcement of the 1-mile buffer zone around pronghorn lambing areas would minimize the risk of pronghorn eating contaminated vegetation. Restrictions on the use of all herbicides during high temperatures, humid conditions, and within 24 hours of a precipitation event would also reduce the risk of herbicide contamination in adjacent non-treatment areas. Thus, use of herbicides is not likely to adversely affect pronghorn populations on the Navajo Nation.

Cumulative impacts may occur for pronghorn populations already stressed by habitat fragmentation, low population densities, poaching, and predation. Such impacts may increase the susceptibility of populations to negative effects from weed treatments, such as herbicide exposure. Implementation of conservation measures and best management practices would reduce the risk of synergistic effects on populations by avoiding treatments where herds are present and around lambing areas. However, the removal of noxious weeds from forage habitats would also improve the availability of native forage species and reduce the risks of injury from many noxious weed species. Such improvements would allow these habitats to better support wild and domesticated ungulates.

Townsend's Big-eared Bat *(Corynorhinus townsendii)*

Species Account

The Townsend's big-eared bat roosts, raises young, and hibernates primarily in sandstone or limestone caves, lava tubes, mine tunnels, and other man-made structures. These bats prefer open ceilings and do not use cracks or crevices (AGFD 2003a). The bats use a variety of habitats for foraging, including coniferous forests and pinyon-juniper woodlands, deciduous riparian woodlands, and desert lands. During spring and summer, females form maternity colonies of < 100 adults in warm parts of mines and caves (AGFD 2003a); males are solitary. During winter, they hibernate alone or in small groups in colder parts of mines and caves, near entrances and in well-ventilated areas. This species primarily feed on moths (Lepidoptera), with some evidence that they may show a preference for food found along edge habitats (riparian and forested areas) (AGFD 2003a, NMDGF 2014).

The Townsend's big-eared bat is most sensitive to human disturbance and alterations to suitable habitat, most notably in mines. Vandalism, recreation, and reclamation of mines in the western United States are the biggest threats. Grazing is thought to affect bat populations due to the alterations to foraging habitat and conversions from mesic to xeric landscapes (BLM 2003, NMDGF 2014). Pesticides may also impact bats due to bioaccumulation and loss of prey habitat (BLM 2003).

Existing Habitat

Two known bat caves occur on the western and northern portions of the Navajo Nation. Distribution is likely limited to areas with suitable roost sites. The species is reportedly common in coniferous forests but has not yet been documented from the Chuska Mountains or the Defiance Plateau (NNHP 2019).

Effects Analysis

While weed treatment are not proposed in caves or mines, treatments may impact habitat used by Townsend's big-eared bat for food. Weed treatments where field crews would be present (i.e. mechanical, manual, and revegetation of native species) would be performed during the day, avoiding potential encounters with bats in foraging habitat. The use of biological control agents would likely not affect bat populations.

While the use of pesticides to treat and control weeds may present some concerns for indirect impacts to the bat, only 2,4-D has shown evidence of bioaccumulation. Because of the close association between Townsend's big-eared bat and riparian areas, only the use of aquatic-approved 2,4-D would be permitted in known foraging habitat. This formulation of 2,4-D has less persistence in the environment and is less likely to result in bioaccumulation in insectivores like the bat. Preference for other herbicides proposed in the weed management plan would also further reduce the risk of bioaccumulation. However, bats are not likely to use recently disturbed areas, which would decrease the risk of consuming insects affected by herbicides. Further, implementing avoidance buffers around roosting sites, restrictions on herbicide use during periods of high humidity, precipitation events, and high temperatures would also reduce the risk of herbicide overspray and drift to non-target vegetation and treatment areas.

Grazing is considered a potential threat to the Townsend's big-eared bat. However, targeted grazing is only proposed in recognized Community Development Areas and designated rangelands and farmlands, which currently do not serve as forage habitat. Thus, the implementation of the integrated weed management plan is not likely to adversely affect the Townsend big-eared bat directly or indirectly.

There may be cumulative impacts to populations of Townsend's big-eared bats already impacted by mine reclamation, vandalism, or destruction. While weed treatments would not be permitted within roosting habitat, some populations may be more sensitive to potential impacts in forage areas. The implementation of species conservation measures and best management practices would avoid and reduce the potential for impacts to the bat in light of the additional stressors. Additionally, the treatment and control of many target weed species would improve plant diversity and support a broader array of insects and moths in forage habitats. This would be a long-term benefit to the bat by increasing prey availability.

Chisel-toothed Kangaroo Rat *(Dipodomys microps)*

Species Account

The chisel-toothed kangaroo rat is a small to medium-sized kangaroo rat native to the Great Basin area of the western United States. It is a general granivore, which is also known to feed extensively on saltbush leaves. It stores seeds and leaves in burrows for use during dry periods (AGFD 2001). Mating season occurs May to September and is thought to be related to the availability of certain nutrients in perennial shrub leaves or winter annuals (Johnson 1988). Common predators include rattlesnakes, gopher snakes, owls, and less commonly coyotes, bobcats, house cats, and raptors.

The species constructs burrow systems with multiple entrances on a discrete raised mound (2-4 m in diameter) in desert scrub habitat with open sandy areas and vegetation dominated by sparse grasses, shadscale, four-wing saltbush, or blackbrush. Preferred habitat has surface soils with a rock or gravel component and is relatively undisturbed by cattle grazing.

Major threats to the chisel-toothed kangaroo rat include grazing, agricultural land use, and predation by feral cats. Agricultural land use and grazing require the removal of shrubs from the landscapes, eliminating an important component of the kangaroo rat's diet. Unmanaged grazing in the region is believed to further exacerbate the availability of these shrubs, especially near water sources (AGFD 2001).

Existing Habitat

Chisel-toothed kangaroo rat is limited to Marble Canyon and House Rock Valley of Coconino County, Arizona, and is only known on the Navajo Nation near the Navajo Bridge of Marble Canyon; potential range is likely restricted to the upper Marble Canyon area (NNHP 2020).

Effects Analysis

Since the chisel-toothed kangaroo rat is only known to occur in a small portion of the Navajo Nation, it is unlikely that weed treatments would have an impact on the species. This species will not be directly impacted by treatments since it is most active the first few hours after sunset when weed treatments would not occur. Indirect effects may occur from contaminated food sources and smoke impacts during prescribed fire; however, buffer zones would reduce these impacts. Best management practices to reduce herbicide overspray would also prevent non-target plant species from impacts; therefore, herbicide use will not adversely affect kangaroo rats. Targeted grazing is not anticipated to affect the chisel-toothed kangaroo rat as it is recommended to Community Development Areas and agricultural areas, which do not currently occur in the rat's habitat. Application of targeted grazing to other areas will require close consultation with NNHP, which will restrict its use in kangaroo rat habitat. There will be no cumulative impacts or synergistic effects.

Banner-tailed Kangaroo Rat *(Dipodomys spectabilis)*

Species Account

The banner-tailed kangaroo rat is listed as a candidate species (Group 4) by the Navajo Nation. However, its designation as G4 only applies to populations in Arizona and Utah (NNHP 2020). Populations in the Chuska Mountains are not listed or protected as these populations are stable. Threats to this species, particularly in Arizona and Utah, include habitat loss and degradation. Damage to habitat burrows can occur in the event of heavy rainstorm events, which can impact seed stores and lead to major population declines. The expansion of dense woody vegetation in southwest grasslands is also thought to impact important food sources for banner-tails (NatureServe 2016h).

The banner-tailed kangaroo rat constructs elaborate and distinctive burrow systems, usually with 3-12 burrow openings on a discrete and raised (≤1.2 m tall) mound (1.5-4.5 m diameter), in Great Basin Desert grassland or desertscrub, preferring areas with heavier soils than other *Dipodomys* (NNHP 2020). Presence of grasses is necessary, but habitats at the extremes of vegetation density and height are avoided.

While they are nocturnal, this species does not hibernate and is sometimes known to forage during daylight hours in times of drought. Predators include snakes, badgers, foxes, bobcats, and great horned and barn owls (AGFD 2014a). The species consumes seeds of grass and other plants, and at times, green and succulent plants. Seeds are stored in burrows to carry them over periods of scarcity (AGFD 2014a).

Existing Habitat

Its occupied range on the Navajo Nation includes small remnant populations just west of Chinle and possibly near Navajo Mountain, with patches of desert lands in New Mexico. Potential range includes all desert lands east of the Chuska Mountains, northeast of Black Mesa in Apache Co., Arizona, and San Juan Co., Utah (NNHP 2020).

Effects Analysis

The banner-tailed kangaroo rat is only known to occur in a small portion of the Navajo Nation, making it unlikely that weed treatments would have a significant impact on the species. However, surveys conducted in potential habitat by a qualified biologist would determine if any populations were present in proposed treatment sites. Any populations found would have avoidance buffers placed at least 200 ft away from their habitat to prevent direct effects while implementing weed treatments. Indirect effects may come from herbicide overspray and smoke impacts during prescribed burning. Some of the proposed herbicides may negatively impact important food sources for the kangaroo rat, but buffer zones and preference for selective application methods near kangaroo rat habitat would reduce the risk of rats ingesting herbicide. Best management practices to reduce herbicide overspray would protect non-target plant species from impacts; therefore, herbicide use would not adversely affect kangaroo rats. Implementing the conservation measures would eliminate the indirect effects from smoke from prescribed fire. Targeted grazing is not anticipated to affect the chisel-toothed kangaroo rat as it is recommended to Community Development Areas and agricultural areas, which do not currently occur in the rat's habitat. Application of targeted grazing to other areas will require close consultation with NNHP, which will restrict its use in kangaroo rat habitat. There will be no cumulative impacts or synergistic effects.

Cumulative impacts may occur if weed treatments are proposed in areas where woody plant invasions have led to significant reductions in important food sources for the banner-tailed kangaroo rat. Such populations may be sensitive to potential impacts from weed treatments due to stress from these additional factors. If conservation measures are implemented, treatments would not occur in areas inhabited by the kangaroo rat. There would be no synergistic effects.

Navajo Mountain Vole *(Microtus mogollonensis)*

Species Account

The Navajo Mountain vole is active both day and night, year-round. Their runways are 1.5 to 2 inches wide, extending from one burrow entrance to another and to feeding sites (Kime 1994). Breeding occurs primarily in May – October. Their nest is constructed of dried grass and forbs and is placed in a dense clump of vegetation, under a log or rock, in a depression in the ground, or in a chamber in its burrow (AGFD 2003). Fresh green vegetation may stimulate breeding, and poor quality of vegetation may reduce successful reproduction.

The greatest threat to Navajo Mountain voles is loss or degradation to suitable habitat. Livestock grazing on Navajo Mountain is a continuing threat to vole habitat (Spicer 1987). Periodic droughts and heavy grazing have prevented grass or forb establishment. The population trends of this species are unknown; however, the data available suggests that the population is declining (AGFD 2003).

Existing Habitat

Navajo Mountain voles typically occupies dry, grassy vegetation in conifer forests, with variations including dense prostrate shrub patches in ponderosa pine forests (Navajo Mountain); monotypic sagebrush stands, thick grasses in greasewood/desert-olive stands and juniper stands, shrubby tamarisk thickets and chained pinyon and juniper woodlands (Black Mesa); and clear-cut pine flats with regenerating grasses and scattered oak (Chuska Mountains) (NNHP 2020). Ground cover vegetation is necessary.

The vole's range extends from Williams, Arizona to Mesa Verde, Colorado, including four locations on the Navajo Nation: Navajo Mountain, Black Mesa, Defiance Plateau, and the Chuska Mountains (NNHP 2020). Population numbers are unknown because Navajo Nation-wide sampling efforts have not been conducted.

Effects Analysis

Direct effects to the Navajo Mountain voles include destruction of potential habitat from mechanical treatments. Since this is a G4 species, species conservation measures are recommended but if the 200 ft buffer is implemented around occupied habitat these direct impacts would not occur. Indirect effects to voles include herbicide overspray. Most of the proposed herbicides are slightly to moderately toxic to small mammals, and paraquat is highly toxic to small mammals. Heavy machinery during mechanical control and trampling during manual control may compact potential habitat and destroy burrows; however, these effects would be temporary. Noxious weed removal would improve overall habitat for the voles in the long-term by promoting the growth of native grasses and forbs. Revegetating the habitat with native grass and forb seeds would help further encourage the growth of native species.

Livestock grazing is a threat to the vole due to trampling and consumption of preferred native grass and forbs. In vole habitats where grazing occurs cumulative impacts may occur when mechanical, manual, or chemical treatments would impact food resources and burrows. Disturbance may also introduce secondary noxious weeds, which would further impact native grass and forbs and potentially spread to vole habitat. This is unlikely to occur when implementing mitigation measures, including the seeding or planting of native species to replace noxious weeds. No anticipated synergistic effects are expected.

Arizona (Wupatki) Pocket Mouse *(Perognathus amplus cineris)*

Species Account

Pocket mice are typically solitary and are most active at night but may occasionally forage during the day. When temperatures cool in autumn, this species retreats to its burrows, remaining inactive until temperatures warm again in the spring. Population sizes of the species tend to fluctuate from year to year, depending on the amount of precipitation from the previous winter and the availability of seeds. This correlation with precipitations suggests that food limits the population of the Wupatki pocket mouse (AGFD 2014b).

The mouse is threatened by habitat degradation and loss from land use and development (Rieck et al. 2015). The majority of the Wupatki pocket mouse range, outside of Wupatki National Monument, is exposed to differing levels of land use, including livestock grazing. Studies suggest heavy grazing can limit the distribution of Wupatki pocket mouse as the abundance and diversity of shrubs and forbs are altered in favor of grasses (Rieck et al. 2015).

Existing Habitat

Wupatki pocket mouse occupies a small disjunct range including a narrow swath of the western Navajo Nation from the northern Echo Cliffs south to Wupatki National Monument near Flagstaff, AZ. The Arizona pocket mouse occupies Great Basin Desert scrub habitat, usually with sparse ground cover of greasewood, snakeweed, rabbitbrush, ephedra, shortgrass, and possibly, short junipers. The species' range includes the southwestern half of Arizona and extreme northwestern Mexico.

Potential range on the Navajo Nation likely extends from the Colorado River (Marble Canyon) east to Kaibito Plateau and south through Cameron to the Leupp area (NNHP 2020). The Wupatki pocket mouse currently only has range along Echo Cliffs from the Colorado River to the Little Colorado River and south of Wupatki National Monument (AGFD 2014b).

Effects Analysis

The Wupatki pocket mouse is found on only a small portion of the Navajo Nation, while the suitable and occupied habitat for the Arizona pocket mouse is more widespread. Because of the limited size of habitat for the Wupatki pocket mouse, it is unlikely that weed treatments would have a direct impact. Prior to the start of any projects in potential pocket mouse habitat, surveys are required by a qualified biologist to determine if mice are present. If mice are present, a 200 ft buffer would be placed around the occupied habitat for all weed treatment techniques. This avoidance buffer would eliminate or reduce the potential for direct impacts associated with mechanical, manual, cultural, and biological techniques. Additionally, the use of targeted grazing, which has the most potential to impact mice populations, would require consultation with NNHP to avoid mouse habitat, with its use recommended for community development areas and designated agricultural areas (farmland and rangeland). Because such areas have been altered by human use and disturbance, they do not currently serve as suitable habitat for the pocket mouse, making it unlikely that targeted grazing would adversely impact the species.

Herbicide use has the potential to impact the pocket mouse and its food sources. Herbicides can negatively impact non-target plant species and present an acute risk to small mammals. The herbicides that pose the greatest risk are clopyralid, fluazifop-P-butyl, and metribuzin, which show a high risk for acute toxicity in small mammals from broadcast applications (USEPA 1998, SERA 2014, BLM 2007). These risks are the result of directly spraying products onto the animals and from consuming herbicide on non-target plants. However, under the proposed action, broadcast applications would not be permitted within occupied habitat for the pocket mouse, reducing the potential for directly spraying animals. Additionally, since the avoidance measures apply to occupied habitat for the pocket mouse, it also reduces the potential for herbicide spray on non-target plants that may be used as food for existing populations. The implementation of mitigation measures and best management practices for herbicides would further reduce the risk of direct impacts from herbicides. These measures include the preference for more selective application techniques, restrictions on herbicide applications during periods of high humidity, within 24 hours of a precipitation event, and during periods of high temperatures.

These restrictions would reduce the risk of herbicide drift and over spray. Thus, it is not likely that herbicide treatments would adversely affect the Arizona (Wupatki) pocket mouse.

Cumulative impacts may occur for populations already impacted by habitat loss and destruction, especially those impacted by grazing. The implementation of weed treatments in these areas may further stress populations, resulting in synergistic effects. Such land use should be taken into consideration when developing a plan of action these areas by selecting control methods that reduce the potential for negative impacts. The implementation of the species conservation measures, and the best management practices would further reduce the potential for adverse effects for already impacted populations. It is not anticipated that climate change would pose a significant impact on the pocket mouse. Current modeling suggests climate change would increase the amount of suitable habitat for the mouse at higher elevation (Rieck et al. 2015).

Overall, the control and management of noxious weeds in Arizona pocket mouse habitat would benefit the species. Noxious weed removal would improve plant diversity and abundance of many native shrub and forb species in the Arizona pocket mouse's habitat. Such impacts would result in improved forage potential in the pocket mouse's habitat, increasing habitat quantity and quality.

Kit Fox (*Vulpes macrotis*)

Species Account

The kit fox inhabits dens excavated in desert scrub or desert grasslands with soft, alluvial or siltly-clay soils, and often with sparse saltbush, shadscale, greasewood, sagebrush, and grasses (NNHP 2020). There is little information on the kit fox throughout its range to estimate its population size or population trends for this species. This species is threatened throughout its range by development, particularly the conversion of desert habitats to agriculture or large-scale solar projects.

Existing Habitat

The kit fox is known from the Navajo Nation east of the Chuska Mountains and Chinle Valley in Arizona and Utah; however, potential exists within all desert lands on the Navajo Nation (NNHP 2020). It occurs in elevations ranging from 400 m to 1900 m.

Effects Analysis

No direct effects would occur to kit foxes because the conservation measures would be implemented, and all treatments would require a 200 ft buffer from occupied habitats year-round. Also, kit foxes and their prey are nocturnal so herbicide overspray would not directly impact the species, because treatments would occur during the day.

Mechanical clearing using heavy machinery or trampling from manual techniques could indirectly impact kit fox potential habitat. The species conservation measures including buffers to occupied habitats year-round would prevent the effect of mechanical and manual clearing on this species' dens and habitat. Weed treatment effects would be short term and temporary and, in the long-term, would improve habitat for the kit fox and its prey. There are no synergistic effects or cumulative impacts anticipated to occur.

5.3.2 Birds

Bald Eagle *(Haliaeetus leucocephalus)*

Species Account

The bald eagle typically nests within trees in forested areas, especially mature and old-growth stands, adjacent (usually <2 km) to large bodies of water with suitable forage for waterfowl and fish; bald eagles rarely use cliff faces adjacent to large bodies of water. Eagles winter roost in large trees in forests, river bottoms, or near canyon rims, usually within a few miles of ponds, lakes, and rivers with adequate prey. Ponds and lakes are used until completely iced over and prey availability is reduced.

Bald eagles tend to stay near their nesting locations throughout the year as long as food is available, and the weather is bearable. If they do vacate an area, they tend to travel the distance necessary to find adequate food and shelter. Younger birds tend to travel extensive southern migration routes from northern regions. As birds get older, northern populations will migrate south later and return earlier (AGFD 2010). Because of these migratory patterns, there is potential for some individuals to remain present on the Navajo Nation year-round, depending on age, nesting status, and resource needs.

Threats to bald eagle populations include habitat loss, reduction in prey, and reproductive impairment from pesticides and heavy metals. Losses have also been attributed to illegal shooting, trapping, poisoning, electrocution from powerlines, collision, and various accidents (AGFD 2010)

Existing Habitat

There are few nesting records on the Navajo Nation, and migrants use various lakes, including (but not limited to): Wheatfields, Tsaile, Many Farms, Morgan, Red, Black Lakes, and various lakes in the Chuska Mountains. Wintering eagles occur along the San Juan and Colorado Rivers (NNHP 2020).

Effects Analysis

There is little potential for bald eagles to be directly impacted by noxious weed treatments. The species conservation measures, including buffer distances outlined in NNHP 2020, would eliminate potential impacts on nesting eagles. The steep cliff habitats occupied by eagles also eliminates the risk of direct impacts of the treatments on non-nesting eagles. Mechanical, including prescribed fire, and mechanized chemical treatments may impact non-nesting eagles due to noise impacts. However, these impacts would be temporary, and eagles would likely disperse from a site with disturbance. Prescribed fire and aerial herbicide spraying would not occur during the breeding season and would require a ¾ mile (1.2 km) buffer from a nesting site during non-breeding season.

Eagles may encounter indirect effects from herbicide by consuming a prey that either consumed sprayed vegetation or was directly sprayed. This is unlikely since the primary prey eagles consume are nocturnal. Weed treatments would not occur at night. Herbicide drift may indirectly impact non-nesting eagles, however non-nesting eagles are more likely to disperse from a site with disturbance. Also, best management practices minimize herbicide drift. Biological control will have no effect on eagles. No synergistic or cumulative impacts are anticipated.

Weed treatments in eagle foraging habitat would enhance the plant community and provide beneficial habitat for prey species. This would be a long-term beneficial impact to golden eagles by increasing prey availability.

Golden Eagles *(Aquila chrysaetos)*

Species Account

Golden eagles nest on steep cliffs, typically ≥ 30 m in height, although shorter cliffs (≥ 10 m) are infrequently used. Nests are located in a variety of different habitats, including low elevation deserts and rugged mesas, and high elevation woodlands and forests (Stahlecker et al. 2009). Nesting cliffs are usually adjacent to foraging habitat consisting of desert grasslands or desert scrub, ponderosa pine and pinyon pine and juniper. These areas provide habitat for their primary prey, cottontail and jackrabbits, and to a lesser extent prairie dogs. Nests are usually constructed in the middle to upper parts of cliffs on sheltered ledges, potholes, or small caves, which provide protection from the elements.

Existing Habitat

On the Navajo Nation, golden eagles are widespread year-round residents. Nesting occurs at nearly all elevations across the Navajo Nation, and on nearly all types of cliff substrates including sandstone, limestone, and those of volcanic origin (NNHP 2020).

Effects Analysis

There is little risk for golden eagles to be directly impacted by noxious weed removal. The species conservation measures, including buffer distances outlined in NNHP 2020, would eliminate the potential impacts on nesting eagles. The steep cliff habitats occupied by eagles also eliminates the risk of direct impacts of the treatments on non-nesting eagles. Mechanical, including prescribed fire, and mechanized chemical treatments may impact non-nesting eagles due to noise impacts. However, these impacts would be temporary, and eagles would likely disperse from a site with disturbance. Prescribed fire and aerial herbicide spraying would not occur during the breeding season and would require a ¾ mile (1.2 km) buffer from a nesting site during non-breeding season.

Eagles may encounter indirect effects from herbicide by consuming prey that either consumed sprayed vegetation or was directly sprayed. This is unlikely since the primary prey species eagles consume are nocturnal. Weed treatments would not occur at night. Herbicide drift may indirectly impact non-nesting eagles, however non-nesting eagles are more likely to disperse from a site with disturbance. Also, best management practices minimize herbicide drift. Biological control will have no effect on eagles. No synergistic or cumulative impacts are anticipated.

Weed treatments in eagle foraging habitat would enhance the plant community and provide beneficial habitat for prey species. This would be a long-term beneficial impact to golden eagles by increasing prey availability.

Ferruginous Hawk *(Buteo regalis)*

Species Account

On the Navajo Nation, most nests are located on clay or rock pinnacles, small buttes, or short cliffs (< 30 m high); fewer are placed on top of juniper trees or on the ground (NNHP 2020). Habitat surrounding nest sites must support populations of their preferred prey: cottontails, jackrabbits, prairie dogs, ground squirrels, and gophers. They typically hunt early in the morning or late in the afternoon. The ferruginous hawk is threatened by long-term population decline, human disturbance, overgrazing and past and present habitat destruction and modification. Their population is directly linked to the presence of prey items.

Existing Habitat

The Navajo Nation is used by ferruginous hawks year-round; most hawks (>90%) breed and winter in northwestern New Mexico, but also occur in Chinle Valley and Dilkon area (NNHP 2020). They occur in open areas of desert grasslands with scattered trees, rocky mounds or outcrops, and shallow canyons that overlook open valleys. They may occur along streams and agricultural areas during migration.

Effects Analysis

Ferruginous hawks would not experience direct effects from any treatments during the breeding season, because the conservation measures would be implemented around nest sites. However, ferruginous hawks may be directly impacted by weed removal activities outside of the breeding season. Weed control activities may occur in foraging habitat using chemical, mechanical, and manual methods. The herbicides proposed, including metsulfuron, chlorosulfuron, clopyralid, 2,4-D, glyphosate, isobaxen, and thifensulfuron-methyl are slightly to moderately toxic eye irritants to predatory birds. Dichlobenil, metribuzin, paraquat, and pendimethalin are slightly to moderately toxic to predatory birds, which may affect ferruginous hawks if directly sprayed. Hawks may experience indirect effects if ingesting prey sprayed by herbicides. Implementing the species conservation measures would reduce the risk of contamination and disturbance to this species during the nesting season.

Mechanical and manual treatments may provide some habitat disturbances. Nests would be protected from the disturbances by the buffer distances outlined in the species conservation measures. Ferruginous hawk prey may be affected by manual and mechanical noxious weed treatments through trampling or crushing of burrows from heavy machinery. However, the removal of noxious weeds and replanting of native grass species would provide more beneficial habitat for small mammal prey species, which would benefit ferruginous hawks. There are no synergistic or cumulative impacts anticipated for this species.

American Dipper *(Cinclus mexicanus)*

Species Account

American dippers nest near clear, unpolluted water in mountain, coastal and desert streams of the West. Rivers and streams are typically comprised of a variety of riffles, pools, and waterfalls with substrates of rocks, sand, and rubble. Nests are placed on ledges, or in crevices, on stream bank structures of small cliffs, large rocks, fallen logs and tree roots. Dippers feed on aquatic insects and their larvae by dipping their head in the water.

Dippers may be impacted by road construction in nest locations. Also, dam construction threatens to flood dipper habitat, and logging, mining, and agriculture can affect water quality and reduce the availability of their aquatic insect prey (Kingery 1996).

Existing Habitat

Dippers are present on the Navajo Nation on the east and west faces of the Chuska Mountains, upper Canyon de Chelly, the Little Colorado River, and upper Piute Canyon near Navajo Mountain (NNHP 2020). This species may occur anywhere on the Navajo Nation where perennial streams have the appropriate habitat parameters.

Effects Analysis

Nesting American dippers would not receive direct impacts from noxious weed treatments due to the implementation of buffers listed in the conservation measures. American dippers may be impacted by chemical, mechanical and manual noxious weed removal outside of the breeding season. Only herbicides registered for aquatic use would be used in riparian areas and all are practically non-toxic to small birds and their aquatic invertebrate prey (White 2007). No herbicide treatments of aquatic weeds would be conducted; therefore, water quality will not be affected. Dippers rely on clear streams to harvest prey. Trampling or habitat disturbance may occur to dipper habitat during mechanical or manual treatments. These actions may impact water quality but would be short in duration and minimal. Dippers would be displaced temporarily during treatments outside of the nesting season. They would benefit from the long-term effects of noxious weed removal and native species planting by creating more habitat for dippers and improving water quality. It is anticipated that there would be no cumulative impacts or synergistic effects.

Northern Goshawk *(Accipiter gentilis)*

Species Account

The goshawk is a forest habitat generalist that uses a wide variety of forest seral stages. A variety of forest types, ages, and successional stages often surround nest sites and are used extensively by recently fledged young. It preys on small to medium size birds and mammals, which it captures on the ground, in trees, or in the air (Reynolds et al. 1992).

Existing Habitat

On the Navajo Nation, goshawks occupy the Chuska Mountain Range, Defiance Plateau, and Black Mesa (NNHP 2020). This species occupies ponderosa pine, mixed species, and spruce-fir forest types in the Southwest, usually above 6000 ft. In Arizona, goshawks primarily nest in mature conifers and cottonwoods located in drainages, canyon bottoms, or north-facing forested slopes with ponderosa pine stands composed of large mature trees and high (60-90%) canopy closure (NNHP 2020). They also inhabit mixed-species, spruce-fir, and aspen stands.

Effects Analysis

There is little risk for goshawks to be directly impacted from noxious weed removal treatments. The species conservation measures, including buffer distances, would eliminate potential impacts on nesting goshawks. Goshawks may be indirectly impacted by herbicide drift from chemical treatments; however, the proposed chemicals are practically non-toxic to predatory birds (White 2007). Also, best management practices would minimize herbicide drift. Mechanical treatments, including prescribed fire and mechanized chemical treatments, may impact goshawks due to noise impacts. These impacts would require a buffer to nest sites year-round. This impact would be temporary, and foraging goshawks would likely disperse from a site with noise disturbance.

Goshawks may encounter indirect effects from herbicide by consuming a prey that either consumed sprayed vegetation or was directly sprayed. This would be limited by the treatment buffers required around nest sites year-round. No synergistic or cumulative impacts are anticipated to occur.

Weed treatments within goshawk habitat would enhance the plant community and provide beneficial habitat for prey species. This would be a long-term beneficial impact to goshawks by increasing prey availability.

Clark's Grebe *(Aechmophorus clarkia)*

Species Account

Clark's grebe construct their nests in the water, typically anchored to a submerged snag or built from a collection of plant material from the bottom to the water surface. Occasionally, mating couples will build their nests on land, but will be close to the water to transport young to the water (AGFD 2013a).

Clark's grebe has been threatened by alterations in water availability and by habitat degradation from recreational use, which can impact the backwaters and coves used for breeding (USFS 2007, AGFD 2013a). Recreational use can make nesting pairs vulnerable, as those who approach nests too closely can cause adults to flush, leaving nests open to gulls and other predators. Impaired water quality is also a potential threat, which is linked to pesticide use and oil spills in habitats (LaPorte et al. 2013).

Existing Habitat

Clark's grebe nest on fresh-water lakes and marshes with extensive areas of open water bordered by emergent vegetation. They use lakes and occasionally small ponds during migration.

Its breeding range includes most of the western U.S. and Canada and east to the Great Lakes. The grebe winters along the Pacific Coast of the U.S., northern Mexico, and inland on open waters from California east to southern Texas.

On the Navajo Nation, this species has only been documented at Morgan Lake, but there is potential for the species on open waters throughout the Navajo Nation (NNHP 2020).

Effects Analysis

The Clark's grebe has only been identified in one location on the Navajo Nation at Morgan Lake, however many of the wetlands and lakes found on the Navajo Nation could be used during migration. While treatments are not proposed for any aquatic noxious weeds, treatments proposed for noxious weeds adjacent to open waters pose the most risk of impacting the grebe. Of greatest concern, would be nesting pairs that may build their nests on land next to open water bodies. Prior to the start of any weed treatments, surveys by a qualified biologist are required near potential habitat to determine if the species occurs in the proposed treatment site. If it is determined that the grebe occurs within the proposed project site, the species conservation measures proposed above would be implemented to avoid and minimize direct impacts to the species related to noxious weed management.

Because the grebe is an aquatic bird species, one of the largest concerns regarding weed treatment are techniques that could impact water quality in suitable habitat. Herbicide use, as proposed under the plan, would require mixing of all herbicides at designated staging areas at least 300 ft away from open water. Fueling of equipment and vehicles would also take place in these areas to minimize the risk of fuel spills. A spill contingency plan is required for any projects using herbicides. Aerial herbicide applications would require additional measures to avoid potential impacts to the grebe, such as considerations for formulation and wider buffer distances away from occupied habitat and nesting areas. As part of this plan, all aerial applications that occur in areas with rivers or lakes require the use of only aquatic-approved herbicides. Such formulations are safer to use in aquatic environments and have limited persistence in water, reducing the potential for long-term impacts. These measures would likely allow weed treatments to not adversely impact the Clark's grebe.

Since Morgan Lake, the one location where the Clark's grebe is known to occur on the Navajo Nation, is also a popular recreation site for fishing, there is potential for cumulative impacts. These populations may be under additional stress from recreational use of the lake, which may make them more susceptible to impacts from weed treatments. However, the species conservation measures, and best management practices would minimize the risk for direct and indirect impacts on the grebe. Overall, management of noxious weeds are not likely to adversely impact the Clark's grebe.

Northern Saw-whet Owl (*Aegolius acadicus*)

Species Account

Northern saw-whet owls roost during the day in thick vegetation; next to tree trunks of small trees in dense scrubby thickets or near a lower branch of larger trees, especially overhung by another branch. Their prey consists primarily of small mammals, such as deer mice, shrews, and voles, but will eat squirrels, moles, bats, birds, and some insects. They hunt almost entirely at night from perches on low branches, shrubs or fence posts in forest openings and other habitat edges. The greatest threat to northern saw-whet owls is destruction of habitat, particularly nesting snags. Logging has reduced suitable breeding habitat.

Existing Habitat

Northern saw-whet owls prefer coniferous forests but can be found in deciduous woodlands and riparian zones. They nest in tree cavities in relatively open ponderosa pine, Douglas-fir, or mixed conifer forests; they may also nest in old-growth riparian woodlands (NNHP 2020). Foraging habitat includes in sagebrush habitats. The owls' wintering habitat is variable, but dense vegetation is critical.

The northern saw-whet owl's breeding range includes most of the northern and western U.S., Canada, and central Mexico. There is no documented breeding on the Navajo Nation, but potential exists in forests and wooded canyons of the Chuska Mountains, Defiance Plateau, Black Mesa, and Navajo Mountain (NNHP 2020).

Effects Analysis

There is little potential for Northern saw-whet owls to be directly impacted by noxious weed treatments. Owls are active at night and treatments would occur during the day. Prior to completing weed treatments in owl habitat, surveys would be conducted to determine the presence of the species. If present, mitigation measures would be implemented. The best management practices would also eliminate overspray to roosting owls during the day. The proposed herbicides are slightly to moderately toxic to predatory birds (White 2007). The species conservation measures, including buffer distances, would eliminate potentials impact on nesting owls. Northern saw-whet owls may encounter indirect effects from herbicides by consuming prey that either consumed sprayed vegetation or was directly sprayed.

Mechanical treatments may impact owls due to noise impacts. However, these impacts would be temporary and minimal, particularly in native habitats. Mechanical impacts for grassland habitats would be minimal on the owls since they would not use these habitats during treatments. Owls disturbed by noise would likely disperse from a site with disturbance. No cumulative impacts or synergistic effects are anticipated to occur.

Weed treatments in owl foraging habitats would enhance the plant community and provide beneficial habitat for prey species. This would be a long-term beneficial impact to owls by increasing prey availability.

Burrowing Owl *(Athene cunicularia)*

Species Account

Burrowing owls are small, ground-dwelling owls. They nest in ground burrows (often deserted prairie-dog burrows), typically in dry, open grasslands or desert scrub. However, grasslands with sparse junipers may be used on the Navajo Nation; presence of a suitable nest burrow is critical. They hunt in flight, from perches, and on the ground, with the ability to take prey midair, or by hovering above their prey and then dropping rapidly to capture the intended victim. While most populations in Arizona are non-migratory, it is believed that populations in northern Arizona are migratory. They are sensitive to high temperatures, which limits their daytime activities (AGFD 2001a).

Burrowing owls have significant declined in the western United States due to habitat degradation, loss, and fragmentation from human land development for agriculture and residential construction (NMDGF 2015). Declines have also been connected to the loss of many burrowing mammal populations. While the burrowing owl does responds positively to grazing, nest loss has been associated with human efforts to control squirrels and prairie dogs by poisoning (AGFD 2001a).

Existing Habitat

Potential range on Navajo Nation includes all low-elevation desert lands to elevations where juniper habitat is found (NNHP 2008).

Effects Analysis

The wide range of potential habitat for the burrowing owl indicates the potential for weed treatments to occur in areas occupied by the owl. However, populations on the Navajo Nation occur irregularly, with most in the San Juan Valley (NMDGF 2015). Due to their limited populations, it is unlikely that weed treatments will have much impact on the species. Direct effects would be eliminated when conservation measures are implemented, particularly during breeding season. Indirect effects may come from herbicide overspray and smoke impacts during prescribed fires. None of the proposed herbicides cause secondary poisoning on predatory mammals (White 2007); therefore, herbicide overspray will not adversely affect burrowing owls.

Implementing the conservation measures would eliminate the indirect effects from smoke from prescribed fire during breeding season.

Cumulative impacts may occur if abandoned mammalian burrows, that are potential habitat for burrowing owls, are proposed for agricultural or infrastructure development and mechanical clearing is proposed at the same site. If conservation measures are implemented, mechanical clearing would not occur during the breeding season. Outside of the breeding season, clearing would provide greater habitat for burrowing mammals by removing dense weeds. Many burrowing mammals, such as prairie dogs, ground squirrels, or foxes, would be temporarily displaced, but would likely recolonize areas after clearing ends. While development is irreversible, unless agricultural land becomes fallow, mechanical clearing would provide more habitat if adjacent to developed land. There would be no synergistic effects.

Belted Kingfisher *(Ceryle alcyon)*

Species Account

The belted kingfisher nests in burrows in earthen banks, usually near major water sources (streams, rivers, ponds, and lakes), with adequate prey of small fish and other aquatic animals. Important components of aquatic habitat for the species include clear water, riffles, and lack of overgrown vegetation. Small lakes, ponds, coves, and shallow bays of larger lakes are preferred lentic habitats. The kingfisher is generally solitary and prefers branches, stumps, snags, and powerlines near waterways for perches. Common predators include snakes, mammals, the peregrine falcon, and the sharp-skinned hawk. They can avoid raptors by diving below the water's surface.

The reasons for belted kingfisher population decline in the southwest are not well understood, though habitat loss and deterioration may be a factor. While kingfishers live near humans, they require relatively undisturbed areas near water for suitable hunting and nesting sites. Breeding habitat may be lost or compromised by river management activities, channelization, erosion, development, livestock grazing, and recreational land use. Kingfishers may avoid or vacate habitats that are frequented by human, especially when breeding (Hamas 1994, NMACP 2016).

Existing Habitat

On the Navajo Nation, the species is known from the Chuska Mountains (Tsaile and Asaayi Creeks), Morgan Lake, and the Little Colorado River. There is potential for the species to occur throughout the Navajo Nation where appropriate habitat exists (NNHP 2020).

Effects Analysis

The belted kingfisher would not receive direct impacts from noxious weed treatments due to the implementation of buffers listed in the conservation measures. Kingfishers may be impacted by chemical, mechanical and manual noxious weed treatments outside of the breeding season. Prescribed fire, mechanized ground and low and high aerial chemical spraying require a 1/8-mile

(0.2 km) buffer from the active nest site from April 15- August 15. Chemical spot and manual treatments require 330 ft (0.1 km) buffer from the active nest.

Only herbicides registered for aquatic use are proposed for use in the riparian areas and all are practically non-toxic to small birds and their aquatic invertebrate prey (White 2007). No aquatic herbicide treatment would be conducted; therefore, water quality will not be affected. Kingfishers rely on clear streams to harvest prey. Trampling or habitat disturbance may occur to kingfisher habitat during mechanical or manual treatments. These actions may impact water quality; however, these impacts would be short in duration and minimal. Kingfishers would be displaced temporarily during treatments outside of the nesting season. Kingfishers would benefit from the long-term effects of noxious weed removal and native species planting as they create more habitat for dippers and improve water quality. No cumulative impacts or synergistic effects are anticipated.

Mountain Plover (*Charadrius montanus*)

Species Account

Mountain plover prefers dry shrublands, badlands, short grass prairie, and abandoned agricultural fields, including land disturbed by burrowing rodents such as prairie dogs (*Cynomys* spp.), native herbivores, or domestic livestock for foraging and nesting. Nests are usually located in flat (≤ 2-degree slope) to slightly rolling. Nests consist of a scrape in dirt, often next to a grass clump or old cow manure pile. Migration habitat is similar to breeding habitat. Suitable habitat ranges in elevation from 135 feet below sea level to 7,000 ft.

Existing Habitat

Known breeding areas on the Navajo Nation occur only in New Mexico (NNHP 2020). However, grasslands between the Chuska Mountains, Black Mesa, and southwest of Black Mesa to Little Colorado River are potential habitat (NNHP 2020).

Effects Analysis

Mountain plovers prefer dry shrublands, short grass prairie, and abandoned agricultural fields for foraging and nesting. They are rare migrating visitors to the Navajo Nation and only occur during breeding season. Therefore, no direct effects would occur for this species since conservation measures would be implemented. Indirect effects may occur from consuming herbicide contaminated prey. Most of the herbicides are a slightly to moderately toxic eye irritants, and dichlobenil, metribuzin, paraquat, pendimethalin being slightly to moderately toxic. These chemicals require acute or chronic ingestion rates higher than would be used in the field to have observable effects on birds. The buffers established in the conservation measures would reduce the risk of plovers encountering contaminated prey. Treated sites would be revegetated with native grass and forb species. This replacement vegetation would provide additional habitat for mountain plover.

Cumulative impacts may occur if the land is heavily grazed by livestock and treated for noxious weeds. Plovers prefer more open and disturbed habitat, so grazing provides habitat for the species; however heavy grazing poses a risk of nest trampling since the species nests on the ground. If a nest is trampled and plovers are seeking other areas for nesting, noxious weed treatments could impact these peripheral areas. Noxious weed treatments would provide more beneficial habitat to plovers in the short term by removing vegetation and long-term positive impacts from the recolonization of native grass and forb species. There are no synergistic effects anticipated for this action.

Dusky (or Blue) Grouse *(Dendragapus obscures)*

Species Account

The dusky grouse nests primarily in mixed-conifer stands with relatively open tree canopies, but possibly in nearly all montane forest habitats, especially those dominated by Douglas-fir with varying amounts of aspen, and possibly ponderosa pine. Winter habitat is nearly exclusively montane conifer forests composed of fir or spruce, and occasionally pinyon pine.

The grouse is primarily an herbivore, feeding on conifer needles and cones during the winter and preferring a variety of berries in the summer months. They also feed on insects, especially grasshoppers (James 2014). Common predators include mountain lions, bobcats, bears, badgers, and large raptors. Since the grouse can only fly in short bursts, camouflage is their best defense against predators (James 2014).

Forest management practices are known to affect dusky grouse populations. The species does poorly in even-aged silvicultural systems compared to old-growth forests. Overall, populations at the southern end of their range have been declining more than populations towards the northern end (Kaufman 2005). Declining populations are most impacted by deforestation and the loss of old growth forest habitat (Pekins et al. 1991) and the use of heavy grazing or overgrazing of habitats (Miyasaki 2003). Both actions remove important conifers that provide shelter and food for the grouse.

Existing Habitat

On the Navajo Nation, they are known only from the Chuska Mountains, with potential habitat occurring at all elevations, but the greatest potential is in high-elevation pine and fir forests, especially during winter (NNHP 2020).

Effects Analysis

The dusky grouse occur only in a very small area on the Navajo Nation, preferring forest habitats. The avoidance buffers in the conservation measures would avoid direct impacts to the dusky grouse. The grouse may be impacted by chemical and manual treatments when performed outside of the breeding season. Trampling or habitat disturbance may occur in grouse habitat during manual treatments. Cultural treatments are not likely to impact dusky grouse as the most impactful treatment method, targeted grazing, would only be employed in community development areas and in existing and fenced agricultural fields and designated rangeland; areas that do not provide suitable habitat for the grouse. While prescribed burning may temporarily impact grouse populations, over time burning operations would improve habitat and encourage more multi-aged and old growth forest habitat structures. The chemical treatment best management practices would be implemented to prevent overspray to native habitats. Also, the proposed herbicides are slightly to moderately toxic to small birds (White 2007). Dusky grouse may encounter indirect effects from herbicide by consuming sprayed vegetation. The implementation of avoidance measures would minimize that risk and reduce the potential for grouse populations to encounter treated vegetation. Thus, weed treatments would not adversely affect dusky grouse populations.

Weed treatments within grouse foraging habitat would enhance the plant community and provide beneficial habitat valuable forage plants. This would be a long-term beneficial impact to grouse by improving forage availability and diversity.

Yellow Warbler *(Dendroica petechia)*

Species Account

The yellow warbler nests primarily in wet deciduous thickets, especially those dominated by willows, and in disturbed and early successional habitats. Migration habitats are mainly semi-open scrub or shrublands and second-growth forests, often associated with wetlands.

During breeding season, yellow warblers are extremely territorial, choosing to stay in nesting pairs, but will rejoin small flocks after breeding (Kadlec 2003). The species feeds primarily on insects but can supplement their diet with berries. Small insect larvae and caterpillars are preferred, and they are known to glean and hunt for adult insects and spiders. Major predators of the yellow warbler include small birds of prey, such as American kestrels and hawks and small predators, such as parasitic cowbirds or snakes. Some yellow warblers are known to not be fooled when cowbirds lay eggs in their nests, choosing instead to cover the cowbird eggs in another layer of nest material, sometimes burying their own (Kadlec 2003).

The species has been most impacted by the loss of riparian habitat in the southwest and by the expansion of the parasitic cowbird. Some populations may experience declines from the use of certain insecticides, which can affect available food sources for the species. Climate change is anticipated to further reduce suitable habitat for the species in the southwest (NMDGF 2014b).

Existing Habitat

There are no current yellow warbler breeding records for the Navajo Nation, but may occur where suitable habitat is present, especially areas of the San Juan River and its tributaries (NNHP 2020).

Effects Analysis

The project area contains suitable or potentially suitable habitat for migrating and nesting yellow warbler. The natural vegetation in these areas would be retained during treatments. The conservation measures would minimize any impacts from treatments that might disturb yellow warbler or damage their habitat. These measures include timing restrictions during the migrating and breeding seasons; 1/8-mile (0.2 km) buffers from active nests or habitat patches for mechanical and mechanized and low and high aerial chemical treatments. Manual treatments would be allowed up to the habitat patch boundary or suitable habitat, which may cause disturbance to the foraging warblers. However, manual treatments are low impact and short-lived. It is unlikely that yellow warblers would ingest herbicide contaminated insects, or come into direct contact with herbicides, because the buffers would prevent the likelihood of such contact. Yellow warblers will benefit from the treatments by the removal of lower-quality riparian habitat to the planting of native riparian species.

Cumulative impacts may occur in foraging habitats when weed control measures are implemented in fragmented or low-quality riparian habitat. The conservation measures would be implemented, and no treatments would occur in nesting areas as discussed above. While weed treatments would provide cumulative impacts to the habitat, there would be greater benefits from removing noxious weed species and replacing with native riparian vegetation. There are no anticipated synergistic effects.

Hammond's Flycatcher (*Empidonax hammondii*)

Species Account

Hammond's flycatcher breeds in nearly all high-elevation (2,000-3,000 m) forest types, including monotypic Douglas-fir, ponderosa pine, aspen, as well as mixed-conifer and aspen/conifer types; stands are typically dense old-growth with cool micro-climates. Migration habitat is less restrictive, but preferentially includes mid-elevation forests and riparian habitats. They primarily eat insects, varying their diets depending on seasonal and regional availability. They are primarily aerial foragers that may occasionally forage from nest surfaces and the ground (AGFD 2003b).

Hammond's flycatcher populations have been most impacted in the southwest by loss and fragmentation of mature old-growth coniferous woodlands. Logging and stand replacing fires that remove dense stands have negatively impacted the species. Aerial insecticide applications, stream dewatering, and deforestation are also known threats to the species (AGFD 2003b).

Existing Habitat

On the Navajo Nation, its only known nesting site occurs in the Chuska Mountains; however, there is potential on Black Mesa and Navajo Mountain (NNHP 2020).

Effects Analysis

Hammond's flycatcher is known to occur in a very small area on the Navajo Nation, preferring forest habitats. The conservation measures would minimize any impacts from treatments that might disturb Hammond's flycatcher or damage their habitat. These measures include timing restrictions during the migrating and breeding seasons; 1/8-mile (0.2 km) buffers from active nests or habitat patches for mechanical and mechanized and low and high aerial chemical treatments. Manual treatments would be allowed up to the habitat patch boundary or suitable habitat, which may disturb foraging flycatchers. However, manual treatments are low-impact and short-lived.

It is unlikely that the flycatcher would be directly impacted by chemical treatments because buffers and best management practices would be implemented to protect nests and foraging habitat and prevent overspray to native habitats. Hammond's flycatcher may encounter indirect effects from herbicides by consuming insects that either consumed sprayed vegetation or were directly sprayed. However, the proposed chemicals are slightly to moderately toxic to passerine birds through direct consumption (White 2007). While prescribed fires may temporarily impact flycatcher populations, over time burning operations would improve habitat and encourage more multi-aged and old growth forest habitat structures. The implementation of avoidance measures would minimize risks and reduce the potential for flycatcher populations to encounter treated vegetation. Thus, weed treatments would not adversely affect Hammond's flycatcher populations.

Weed treatments within flycatcher foraging habitat would enhance the plant community and provide beneficial habitat valuable forage plants. This would be a long-term beneficial impact to Hammond's flycatcher by improving forage availability and diversity.

Northern Pygmy Owl (*Glaucidium gnoma*)

Species Account

Northern pygmy owls hunt songbirds during the day by sitting quietly and surprising their prey. They nest in tree cavities, often near openings (e.g. meadows, lakes, and ponds), in a variety of montane forest habitats and possibly wooded canyons (NNHP 2020). Montane habitats include coniferous (spruce, fir, and ponderosa pine), mixed conifer-hardwood forests with oak and aspen, hardwood bottomlands, and occasionally aspen stands. Owls may migrate to lower elevations and use woodlands or prairie foothills as wintering habitat.

Existing Habitat

On the Navajo Nation, they occur in the Chuska Mountain Range and Tsegi Canyon; however, there is potential throughout forested areas and canyon lands on the Navajo Nation (NNHP 2020).

Effects Analysis

Direct impacts to Northern pygmy owls may occur from herbicide spraying in riparian and shrubland foraging habitats. If the species forages in these habitats during herbicide applications, there is a slight chance this species could be directly sprayed by herbicide since it is a diurnal predator. Treatment sites should be surveyed for this species prior to implementation so applicators know if the species uses the area for foraging and conservation measures can be applied. This would reduce the risk of direct impacts from herbicide spraying. It is also likely that noise disturbance from noxious weed treatments would deter the owls from temporarily using the site for foraging. Species conservation measures would be implemented to eliminate direct impacts from noxious weed treatments to nesting sites.

Indirect impacts from herbicide may occur to owls that consume prey directly sprayed or that have consumed sprayed vegetation. Best management practices would be implemented during noxious weed treatments to minimize herbicide drift. The herbicides proposed for use in riparian and shrubland habitats are practically non-toxic to small and predatory birds (White 2007). Mechanical and manual treatments may affect owls due to noise impacts. However, these impacts would be temporary, and owls would likely disperse from a site with disturbance. No mechanical treatments would be used in Northern pygmy owl nesting habitat.

Weed treatments within Northern pygmy owl winter habitat would enhance the plant community and provide beneficial habitat for prey species. This would be a long-term benefit to owls by increasing prey availability.

Flammulated Owl (*Otus flammeolus*)

Species Account

The flammulated owl nests in tree cavities in open conifer (usually ponderosa pine) or aspen forests, often with a brushy understory of dense saplings or oak shrubs; areas with old growth are preferred. They are neotropical migratory birds that winter in Central and South America and breed in forests in North America. Owls roost within dense stands with large-diameter trees or regeneration. Nest and roost habitats need a high abundance and diversity of nocturnal arthropods for prey. The species winters in lower elevation habitats, especially riparian areas.

Flammulated owls mainly eat nocturnal arthropods, especially owlet and geometrid moths, crickets, grasshoppers, and beetles. They locate their prey visually from a perch, judging distance by bobbing their heads vertically and horizontally, and deliver only one prey item at a time to their nests (Environment Canada 2013).

The most prominent threat to the species is from habitat loss and fragmentation related to timber harvesting and deforestation in its historic range. This is mostly due to the loss of snags and tree cavities used for nesting. Additionally, the use of some insecticides to control spruce budworm can lower the abundance of non-target insect species that serve as an important food source for the owls (NatureServe 2015b, Strawder 2003).

Existing Habitat

On the Navajo Nation, flammulated owls occur in the Chuska Mountain Range, Defiance Plateau, and Black Mesa. Potential exists throughout forested areas of the Navajo Nation (NNHP 2020).

Effects Analysis

There are only a few locations on the Navajo Nation where weed treatments may occur in areas used by flammulated owls. If owls do occur in proposed treatment areas, the species conservation measures should be employed to reduce direct impacts to the species, especially from chemical and mechanical methods. Manual and biological control methods are not anticipated to impact the flammulated owl directly or indirectly. There is potential for herbicide treatments to indirectly impact owls through overspray or drift into non-treatment areas. However, the conservation measures and best management practices would reduce the potential for impacts. These include restrictions on applying herbicide during windy or humid conditions or during periods with high temperatures. Additionally, the proposed herbicides are all listed as Class 1 or 0, which range in slightly toxic to non-toxic for small and predatory birds (White 2007). Thus, it is anticipated that management and control of noxious weed species will not adversely affect the flammulated owl.

Cumulative impacts may occur for populations impacted by timber harvesting or insecticide use to control forest insects. Such populations may be more sensitive to weed treatments. However, the species conservation measures, and best management practices would minimize such risks and the potential for synergistic effects. Overall, control of weed treatments, such as through mechanical removal or prescribed fire, can help restore forest habitat structure for the flammulated owl.

Band-tailed Pigeon (*Patagioenas fasciata*)

Species Account

The band-tailed pigeon nests primarily in montane conifer or mixed-species forests dominated by pines and oaks between 1,600-2,700 m in elevation (5,250-8,850 ft). The species prefers pine-Douglas-fir forests and spruce-fir with abundant berry-producing shrubs in Colorado, northern Arizona, and New Mexico. Migratory habitat is generally the same as that used for nesting. The species winters in central and southern California, and throughout its breeding range south of the U.S.-Mexico border.

Acorns serve as the staple food source year-round in the pigeon’s range. Field grains, trees buds, cherries, blackberries, raspberries, and elderberries are the principal foods in the spring and summer months, while leaves and acorns are consumed during the late summer and fall (Ulev 2006). Mineral springs are also important to supplement mineral needs of their diet. The breeding season is prolonged, taking place from the beginning of March through fall in some areas and is largely a factor of food availability. Nests are built from a loose platform of twigs in trees or shrubs under dense foliage but near openings or above a slope or precipice. Band-tailed pigeons have shown high fidelity to nesting sites and mineral springs (NatureServe 2015c).

Populations in North America have experienced significant declines since the early 1900s, with populations in the southwestern United States showing large declines between the 1960s through the 1990s (NatureServe 2015c). The causes for decline have not been adequately verified, but are suspected to be due to habitat loss, degradation, and/or fragmentation, inadequate recruitment, overharvesting from hunting, and/or disease (Ulev 2006). Hunting is still largely permitted in many parts of Arizona, Colorado, New Mexico, and Utah, as it remains unclear how hunting pressure may affect long-term populations.

Existing Habitat

Band-tailed pigeon occurs in the Chuska Mountains on the Navajo Nation; however, there is potential for the species on the Defiance Plateau and possibly Black Mesa and Navajo Mountain (NNHP 2020).

Effects Analysis

While the band-tailed pigeon may occur in areas identified for weed treatments, it is not likely that treatments will directly impact the species. Effects from noise, habitat alternation from the removal of noxious weed species, and smoke or disturbance from prescribed fire may result in some pigeons temporarily leaving treated sites, but such impacts are not likely to result in permanent abandonment of these locations. The species conservation measures would allow work crews to avoid more sensitive nesting sites while implementing treatments. Herbicide treatment may indirectly impact some populations by exposing them to overspray or drift or by consuming contaminated food. The best management practices and above-mentioned species conservation measures would reduce the potential for such impacts by creating wide buffers around sensitive nest sites and restricting the use of herbicides during certain weather conditions. Such measures would reduce or eliminate the potential for pigeons to encounter or consume herbicides. Additionally, all proposed herbicides are not considered to be highly toxic to small or foraging bird species, such as the band-tailed pigeon (White 2007). These factors indicate that the integrated weed management plan would not likely adversely affect the band-tailed pigeon.

Cumulative impacts may be present for populations stressed from low birth rates, hunting, and/or habitat degradation. Such populations may be more sensitive to impacts from weed treatments. However, the species conservation measures and best management practices would reduce the potential for such impacts and the risk of synergistic effects. Overall, the removal of noxious weed species would improve foraging habitat and incorporate many of the forest management strategies suggested for conserving the band-tailed pigeon. As such, treatment and management of noxious weed species within band-tailed pigeon habitat would benefit the long-term survival of the species on the Navajo Nation.

American Three-toed Woodpecker (*Picoides dorsalis*)

Species Account

The American three-toed woodpecker is a resident bird to western North America. They feed on beetles found in decaying and dead trees within their range, often occurring in low densities. Populations may increase significantly in areas where fires have recently burned, or where other natural disturbances cause widespread die-off in conifer stands, leading to bark beetle. Such occurrences often lead woodpeckers to remain in affected areas for up to three years (Wiggins 2004). Breeding season for the species is estimated from March through late July, with birds preferring the use of snags or stubs found in a mature, unlogged, conifer forests that have undergone some form of disturbance (Wiggins 2004).

The American three-toed woodpecker nests and winters primarily in spruce, fir, aspen, or mixed-conifer forests (and possibly adjacent ponderosa pine habitats) above 2,400 m (8,000 feet) in elevation; ideal conditions have mature or old-growth stands, fire-killed trees, 42-52 snags per 40 ha (100 acres), and/or large numbers of bark-boring beetles. Nests are placed 1½-15 m high in a stump or dead/dying conifer or aspen.

Declines in the species have been largely attributed to forest management practices that affect old-growth forest habitat structure and natural disturbance regimes. Even-aged stand structures, short logging rotations, invasive species, and suppression of forest fires have largely contributed to the decline of the American three-toed woodpecker (Wiggins 2004).

Existing Habitat

On the Navajo Nation, the species is only known from the Chuska Mountains and has low potential to exist within habitats on Black Mesa and Navajo Mountain (NNHP 2020).

Effects Analysis

The American three-toed woodpecker is found in some areas on the Navajo Nation where noxious weed treatments may occur. Some treatments, such as mechanical removal, prescribed fire, and chemical applications may impact or disturb populations in treatment sites. The species conservation measures would require work crews to avoid or minimize disturbance to sensitive nesting birds and minimize encounters with birds while applying treatments. Herbicide applications have the potential to indirectly impact birds from overspray or drift, which may result in herbicides coming directly into contact with birds or their prey. Such impacts are most likely from broadcast aerial applications in treatment areas. However, the recommended buffers for these application methods, along with restrictions on herbicide use during weather conditions that can facilitate herbicide drift or volatilization, would reduce the potential for broadcast herbicide treatments to adversely impact woodpecker populations.

Cumulative impacts may occur for populations near timber harvesting operations in the Chuska Mountains. These populations may be more sensitive to weed treatments, which may be implemented as part of a forest management prescription. However, use of buffer zones and the best management practices outlined for each weed treatment method would minimize or avoid potential impacts to woodpecker populations. Noxious weeds, such as cheatgrass and Russian thistle, can increase the frequency and severity of fires within forests. While the woodpecker relies on such disturbance events for increased beetle activity, such fires increase the risk of severe fires that leave few live remaining trees, instead of the mixed severity fires the woodpeckers prefer (Kotliar et al 2008). While the continued spread of noxious weed species may provide a short-term benefit to the woodpecker by facilitating disturbance in its native habitat, increased fire severity would reduce the occurrence of preferred moderately burned forest patches and could negatively impact old-growth forest habitats that the woodpeckers rely on. Thus, the management of noxious weeds would contribute to creating more pre-historic disturbance regimes that would benefit the woodpecker over the long-term.

Sora (*Porzana carolina*)

Species Account

The sora nests in wetlands with shallow to intermediate-depth water and fine-leaved emergent vegetation (typically cattails, sedges, bur-reeds, and bulrushes); floating and submerged vegetation increases habitat quality. Wetlands with heavy snow, ice, or high water until early May are unusable for nesting. Migration habitat is typically wetlands with tall dense vegetation and shorter seed-producing plants, but occasionally may include upland habitats (e.g. fields and pastures).

Their diet consists mostly of seeds, insects, and snails. Seeds are primarily from common wetlands species and snails and insects are foraged from the ground surface. During mating season, which occurs from April to July, sora weave shallow basket nests from dead emergent wetland vegetation either directly over or adjacent to the water.

Many populations within the central United States have showed significant declines with losses attributed to wetland loss from drought or habitat loss (Stavne 2002). Heavy grazing has also negatively impacted sora habitat (Meyer 2006). However, the species is still widely abundant throughout much of its historic range.

Existing Habitat

The species winters in the extreme southern US, Mexico, and Central America. It is known from various ponds and lakes on the Navajo Nation, including several in the Chuska Mountains, Morgan Lake, and near Tuba City. The species may also exist in suitable wetlands throughout the Navajo Nation (NNHP 2020).

Effects Analysis

Because the sora occurs within wetland habitats, which are closely associated with riparian habitats, there is the potential for weed treatments to occur where sora are present. Biological control methods are not likely to impact the sora, beyond temporarily flushing the species while placing species. Targeted livestock grazing is not likely to occur within sora habitat as these treatments are recommended for Community Development Areas and agricultural or grazing areas, which will be fenced. While the sora may occasionally forage in these areas, they are considered of little value for the species. Application of targeted grazing to other areas will require close consultation with NNHP, which will restrict its use in sora habitat. Other cultural treatments, such as restoration of native vegetation, would benefit the sora, by creating more diverse plant communities and improving wetland habitat. The species conservation measures, described above, would reduce or eliminate the risk of mechanical, manual, and chemical treatments directly impacting the sora at treatment sites. Such measures would reduce impacts around more sensitive nesting areas and wetlands habitats by creating avoidance buffers. While the temporary loss of vegetation from treated sites may prevent the sora from utilizing treated habitats, birds are known to return to degraded sites once native wetland plants re-establish.

Herbicides may pose concern for the sora. Because sora are found in wetland habitats, only aquatic-approved herbicides would be used to treat potential habitat for the sora outside of the breeding season. Additionally, chemical treatments would not be permitted within 330 ft of an active nest. However, glyphosate does present a concern as it does have an aquatic formulation that may be applied near wetland habitats. In one study, sora abundance was less in wetland areas treated with glyphosate (Zimmerman et al. 2002). However, the abundance may have also been from a lack of living vegetation in the treated areas than from direct impacts from the herbicide. The species conservation measures and the best management practices for chemical treatments would minimize the risk of herbicide impacts to the sora. These include avoidance of nesting habitats and restrictions on herbicide applications near open water. Herbicides would also not be applied during high humidity, high winds, and high temperatures to reduce the risk of herbicide drift in non-treatment areas and to allow herbicides to work more effectively. The weed management plan, based on these measures, would not likely adversely affecting the sora.

Cumulative impacts may exist for sora populations impacted by changes in water availability, grazing, or loss of native plant communities. These populations may be more sensitive to impacts from the removal or control of noxious weed populations. The best management practices and species conservation measures would prevent or minimize potential synergistic impacts from noxious weed management. Additionally, the noxious weed removal from sora habitat would benefit the species, by replacing noxious weeds (which do not provide suitable habitat for the species), with preferred native plant communities and species. Thus, the integrated weed management plan would benefit the sora over the long-term.

Tree Swallow (*Tachycineta bicolor*)

Species Account

Tree swallows are small neotropical migratory birds that live in open areas near open water sources. They primarily eat flying insects along with some plant material. They forage while in flight and sometimes in flocks when insects are abundant, gleaning insects from the water or vertical surfaces from dusk until dawn. When weather conditions are bad, their diets become more herbivorous, feeding on bulrushes, bayberries, and other plant seeds (Roof and Harris 2001). When breeding, males and females engage in a complex courtship flight coinciding with more abundant food availability. Males select tree cavities for nesting prior to female arrival, and the females then select a nest site with an occupying male. Once paired, the females will construct a nest of grass to lay 4-7 eggs and incubate for about two weeks (Kaufman 2001).

Tree swallows breed in the existing cavities of a variety of tree species (coniferous and deciduous), and often use snags in open fields near water, especially marshes and wooded ponds. The Tree Swallows' breeding range includes most of central and northern North America but is a local breeder in Arizona and New Mexico.

Climate change models indicate that trees swallow wintering habitat will shift further north and inland, with a 56% loss of current winter range in the next 70-80 years (Langham et al. 2015). The movement of tree swallows north would require an increase in nest sites either through standing dead trees or human-supplied bird boxes. Herbicides, such as PCBs (polychlorinated biphenyl) and DDE (dichlorodipheynldicholorethylene, a biproduct of DDT), may affect some populations as studies have found high levels in adults, eggs, and nestlings, which may affect long-term recruitment of the species (Roof and Harris 2001). The use of some insecticides, such as imidacloprid, may also affect the health of insectivorous birds, such as the tree swallow (NMDGF 2013c). Lastly, the loss of dead standing trees could impact breeding success as the tree swallow uses the tree cavities for nesting habitat (Roof and Harris 2001).

Existing Habitat

On the Navajo Nation, the tree swallow occurs in the Chuska Mountains; but may be found throughout forested areas of Navajo Nation (NNHP 2020).

Effects Analysis

Tree swallow habitat on the Navajo Nation may occur in areas requiring noxious weed treatments. The conservation measures would avoid direct impacts to the tree swallow. The swallow may be impacted by chemical and manual treatments when performed outside of the breeding season. Cultural treatments, such as native plant restoration and mulching, are not likely to impact tree swallow. Targeted grazing would not occur in tree swallow habitat, as it would only be permitted in Community Development Areas and in fenced-in designated agriculture and rangeland areas. While prescribed fire may temporarily impact swallow populations, over time burning operations would improve habitat and encourage more multi-aged and old growth forest habitat structure. Many of the proposed chemicals are slightly to moderately toxic or non-toxic to small birds (White 2007). Potential negative effects from chemical treatments would be minimized or reduced by implementing the species conservation measures and following the best management practices. Such measures include restrictions on herbicide applications during periods of high humidity, high temperatures, or windy conditions to prevent overspray and drift. Tree swallows may encounter indirect herbicide impacts by consuming insects that either consumed sprayed vegetation or were sprayed during operations. The conservation measures would minimize such risks and reduce the potential for the consuming sprayed plants and insects, also reducing the risk of adverse impacts. Thus, weed treatments would not adversely affect swallow populations.

Cumulative impacts may exist for populations impacted by climate change. The shift in suitable habitat may affect species migration, tree cavity availability for nesting, and food resources. These populations may be more sensitive to impacts from weed treatments. The species conservation measures and best management practices for weed treatments would reduce or avoid the risk of synergistic impacts on more sensitive tree swallow populations.

Gray Vireo (*Vireo vicinior*)

Species Account

During the breeding season, the Gray Vireo is insectivorous, feeding on a wide variety of flying insects. During the winter, the species is frugivorous, instead preferring fruits from many desert plants. The Gray Vireo will stalk their prey after a short flight, preferring to forage in thickets (NMDGF 2007). During breeding season, males arrive first to the breeding grounds and begin calling for females. Once paired, they will search for a suitable nest site, which are built from woven grasses, bark, plant fiber, spider webs, and cocoons and are located primarily in juniper trees. Eggs are laid one per day until the clutch is complete and then the male and female take turns incubating them for 12 to 14 days (NMDGF 2007).

The gray vireo prefers habitat with mixed pinyon-juniper, juniper-sagebrush associations, and possibly in dry brushland and oak scrub woodlands. Continuous shrub cover, 0.5 – 2 m in height, is an important component of breeding habitat in California and Texas, and possibly on the Navajo Nation. Nests studied in Colorado were typically 2 m above the ground in 3 m tall junipers. The species is known to nest in pinyon pine, sagebrush, sumac, mountain mahogany, and oak species. The species' breeding range includes mostly montane regions and adjacent scrubland in the southwestern U.S.

The primary threat to the Gray Vireo is habitat alteration from juniper control, firewood collection, and energy production. These changes make sites unsuitable for the species, who will not use areas lacking trees. Brood parasites, such as the cowbird, have also impacted the species. It may also be impacted from increased soil erosion in some juniper woodlands, where a loss of native grasses may result in a lack of prey for the vireo (NMDGF 2007).

Existing Habitat

The species winters mostly in south-central Arizona; Sonora, Mexico; the Baja Peninsula; and southwestern Texas. The species distribution on the Navajo Nation is relatively unknown; however, it may occur throughout the pinyon-juniper woodlands on the Navajo Nation (NNHP 2020).

Effects Analysis

It is unknown whether the gray vireo currently occurs on the Navajo Nation, but potential habitat may exist in areas requiring noxious weed treatment. The species conservation measures would minimize and avoid direct impacts to the species from chemical, manual, and mechanical treatment methods. Biological control methods are not likely to impact the species. Herbicide treatments may indirectly impact the species by spraying prey or plant food used by the gray vireo. The buffer distances described in the species conservation measures and the best management practices for chemical methods would minimize the potential for overspray, reducing the risk of exposure for the gray vireo. There are also restrictions on the herbicide applications when there is high humidity, high windspeed, and high temperatures, which would minimize drift and overspray when applied. The integrated weed management plan, based on these mitigation measures, would likely not adversely affect gray vireos that may occur on the Navajo Nation.

There is the potential for cumulative impacts for populations affected by the removal of juniper trees or the loss of native grasses. These populations may be more sensitive to impacts from weed treatments. Removal of some noxious weeds, especially large trees or shrubs, from invaded areas, may reduce the suitability of certain habitats for the gray vireo. However, such impacts would likely be short-lived, as the regeneration of native plant communities may provide better forage habitat for prey. Overall, the treatment of noxious weeds may improve habitat for the gray vireo over the long-term, by improving soil retention and providing more diverse plant communities for valuable prey species.

5.3.3 Invertebrates

Great Basin silverspot *(Speyeria nokomis)*

Species Account

The Great Basin silverspot inhabits perennially wet meadows associated with seeps, springs, and streams, which vary in size from 0.1 ha to >1.2 ha. Habitat must be relatively open, dominated by grasses, and with few shrubs. Violets (*Viola nephrophylla*), found in wet soils in shady areas beneath shrubs or in stream banks, are a necessary habitat component and serve as the host plant for larvae. There is potential for the silverspot to occur on rangeland and farmland where violets, thistles, and other nectar producing plants grow, which are an important food source for adults and can include both native and introduced thistle species (NatureServe 2016). For populations to persist, continuous riparian habitat is needed for dispersal for reproduction and development (Wild Earth Guardians 2013).

The Great Basin silverspot is threatened by habitat loss and fragmentation, altered hydrology, overgrazing, climate change, and the use of pesticides. Expansion of noxious weeds are also a great concern, as the spread of rangeland species like Canadian thistle and leafy spurge, can replace diverse plant communities preferred by the silverspot with dense monocultures (Selby 2007). Noxious weeds can also contribute to habitat loss and fragmentation in riparian corridors.

Overgrazing can negatively impact the silverspot as heavy grazing can reduce nectar availability, alter vegetation cover, and spread noxious grass species (Wild Earth Guardians 2013). However, light to moderate grazing can provide a competitive advantage to violet plants (NatureServe 2016). On the Navajo Nation, heavy grazing and unmanaged grazing have largely reduced ground cover and led to reduced native plant diversity in many areas where the silverspot occurs. The pesticide use can also negatively impact the silverspot. Broadcast spraying can indiscriminately eliminate valuable food sources for larval and adult butterflies. However, the use of selective pesticide applications and non-persistent herbicides (i.e., glyphosate) can reduce negative impacts on non-target vegetation. Such applications, though, can be difficult to apply safely in areas with high water tables, which are also preferred by the Great Basin silverspot (Selby 2007).

Existing Habitat

On the Navajo Nation, the silverspot is known from <10 populations in the Chuska Mountains and Defiance Plateau: Tsaile, Wheatfields, Whiskey Creeks, and two springs near Washington Pass. However, potential exists throughout the Chuska Mountains and the Defiance Plateau where appropriate habitat is present (NNHP 2020). There are 12-13 breeding populations on the Navajo Nation, with each colony requiring 1-2 acres of habitat. These populations are considered stable but may be impacted by grazing and altered hydrology from water use and drought (Wild Earth Guardians 2013).

Effects Analysis

The occurrence of the Great Basin silverspot in riparian areas and rangelands means there is the possibility of weed treatments occurring in their known habitat and range. The greatest concern would be impacts that may harm violets and thistles that are important food sources for the silverspot. Surveys for species occurrence and the host plant would allow field crews to establish appropriate avoidance buffers to prevent and reduce the potential for weed treatments to negatively affect the species. Additionally, the use of targeted grazing would not be permitted in areas where host plants occur and during mating season. This would prevent grazing of required host plants and nectar sources within silverspot habitat.

For the control of many thistle species, the use of biological control agents is proposed. There is concern that some of the proposed biological agents may impact some native thistle species. However, none of the APHIS-approved biological agents proposed would treat thistle commonly used as food sources by the silverspot, including *Cirsium, Carduus, or Onopordum* species. Additionally, while thistles are a nectar source for the Great Basin silverspot, they also use a variety of other species, including horsemint (*Monarda* sp.), and joe pye weed (*Eutrochium* sp.). The silverspot needs diverse nectar sources throughout its adult flight to increase fecundity (Selby 2007). Control of individual weed species in the western seep fritillary may not result in negative impacts as long as other diverse native nectar sources are available. Introducing biological control agents in this species' habitat would eliminate potential deleterious effects from using other treatment methods, including erosion from mechanical methods and herbicide overspray that could impact its host plant and other native nectar sources. Native flowering plants could be planted on site to provide nectar sources for this species.

Herbicide use may impact silverspot populations, especially for broadcast applications herbicides. Because Great Basin silverspot populations are found in riparian areas near water sources, the use of non-aquatic herbicides would be prohibited per the plan mitigation measures. The use of aquatic approved herbicides in these areas, which are less persistent, would reduce their impacts on preferred food sources. Selective applications of pesticides in silverspot habitat would further reduce the risk of negative impacts on non-target plant species. The implementation of buffer zones and restrictions on herbicide applications during high humidity, precipitation events, and high temperatures would also reduce potential drift or overspray and potential risks to non-target plants.

There is potential for cumulative impacts on Great Basin silverspot populations already impacted by grazing, habitat fragmentation and loss, and altered hydrology. The conservation measures would reduce the risk of synergistic effects from weed treatments in areas where the Great Basin silverspot and its food sources occur. By setting up buffers around known populations identified by a qualified biologist and educating field crews, there is a better chance of reducing adverse impacts to the silverspot. Climate change is also considered a threat to the Great Basin silverspot, as changes in temperature and water availability may alter habitat suitability for the silverspot's host plant and a variety of food sources. The species conservation measures would reduce potential synergistic impacts related to climate change on the species.

Further, the treatment and control of noxious weed species in the silverspot's habitat would benefit the species. Noxious weed monoculture reduction would increase plant diversity and nectar sources. Avoidance of host plants would reduce negative impacts on populations while providing a competitive advantage for native vegetation. Overall, the mitigation measures, including buffers for each treatment method, and best management practices would reduce potential risks to the Great Basin silverspot and allow weed treatments to not adversely affect the species.

Rocky Mountainsnail (*Oreohelix strigosa*)

Species Account

The Rocky Mountainsnail occurs in leaf-litter or within/near rocks and rock outcrops within steep-sloped, northern-aspect coniferous forests. Steep-walled canyons and areas that maintain moist soils are also potential habitat (NatureServe 2015j). Within most of the species' U.S. range, it is restricted to limestone outcrops or under vegetation on limestone slopes where the presence of limestone is critical; sandstone seems to provide adequate substrate, especially on the Navajo Nation (NNHP 2020). Plant community composition is of little importance in determining potential habitat; however, a cool, moist microclimate and leaf mold are critical. This species may be threatened by timber harvesting and high intensity fires that could disturb soil habitat, increase soil temperature, and decrease humidity.

Existing Habitat

On the Navajo Nation, the Rocky Mountainsnail occurs in the southern half of its U.S. range. There is one historic record from the south slope of Navajo Mountain, but presently the species is known from only a few locations in the Chuska Mountains (NNHP 2020). The species may occur throughout forested areas and possibly canyon lands on the Navajo Nation (NNHP 2020).

Effects Analysis

The Rocky Mountainsnail has a limited distribution on the Navajo Nation. None of the herbicides proposed for this project have required buffers for land snails. Also, these snails are typically under leaf litter during the day when herbicide applications would occur so it is unlikely this species would be affected by herbicide overspray. This species may be directly affected by trampling from mechanical or manual treatments in their habitat. Rocky Mountainsnails may be threatened by high intensity fires, which would differ in intensity and severity from prescribed fire. Prescribed fires would be implemented to control surface noxious weeds and material and would not burn hot enough to affect soils. Also, the species conservation measures would reduce this effect on the snails by limiting more impactful treatments in areas where snails occur. Indirect effects may occur from foot traffic trampling when applying treatments. Indirect effects would be reduced by the species conservation measures. Biological controls and cultural treatments would not affect this species.

Cumulative impacts may occur as climate change reduces soil moisture causing additional stress to snails already stressed by weed treatments. Also, development of roads or infrastructure may make snails more susceptible to impacts from weed treatments. The species conservation measures can reduce or eliminate the overall impact of any cumulative effects by establishing buffers that would further protect the species.

Yavapai Mountainsnail (*Oreohelix yavapai*)

Species Account

The Yavapai mountainsnail's only known extant populations on the Navajo Nation occur on steep-sloped, northern-aspect coniferous forest with dense mossy groundcover over an exposed rock/boulder substrate (NNHP 2020). Cool and moist microclimate and dense moss are likely key habitat components. Potential habitats include steep forested slopes with leaf-litter and/or exposed rocks and rock outcrops, steep-walled canyons, and other areas with a cool microclimate and moist soils. Snails take shelter under plants. These snails will not breed in dry conditions, because they are subject to desiccation. This can hurt the population during dry winters (AZGFD 2003c). The snails are active in March – April and October – November, but inactive for the rest of the year (AZGFD 2003c). This species is threatened by habitat degradation from grazing pressure. It cannot traverse grazed areas, so it becomes restricted to suitable habitat (AZGFD 2003c).

Existing Habitat

Historic records indicate the presence of two subspecies on the Navajo Nation (*O.y.clutei* and *O.y.cummingsi*) from Navajo Mountain, but presently the species is only known from one location in Canyon de Chelly National Monument (subspecies unknown) (NNHP 2020). There is potential for the species to exist in forested areas and possibly canyon lands on the Navajo Nation (NNHP 2020).

Effects Analysis

Yavapai Mountainsnail has a limited distribution on the Navajo Nation. None of the herbicides proposed for this project have required buffers for land snails. These snails are active primarily during short periods of the year, in March – April and October – November, so they could be exposed to direct impacts from herbicide spray during this time. Their habitat includes dense moss and rock outcrops so it is unlikely that weeds would be a problem in these areas. This species' habitat is threatened by grazing, and it will not use heavily grazed areas. Cultural control techniques such as target grazing are not proposed in their habitat. These snails may be directly affected by trampling from mechanical or manual treatments in their habitat. The species conservation measure would reduce these effects on the snails. Indirect effects may occur from foot traffic trampling when applying treatments. Indirect effects would be reduced by the species conservation measures. Biological controls would not affect this species.

Cumulative impacts may occur if climate change reduces moisture levels, reducing reproduction and population growth, which could further stress populations impacted by weed treatments. Also, populations stressed by heavily grazing would be further stressed by weed treatments. The species conservation measures can reduce or eliminate the overall impact of these cumulative effects by establishing buffers that would further protect the species.

Kanab ambersnail (*Oxyloma haydeni kanabense)*

Species Account

The Kanab ambersnail, *Oxvloma haydeni kanabensis*, was removed from the USFWS List of Endangered Species on June 24, 2021, because genetic analysis indicated that it was not a valid subspecies (50 CFR Part 17). Given the decision of the USFWS to delist the Kanab ambersnail NNHP will remove this species from the Navajo Nation Endangered Species list (Brent Powers, Zoologist, Navajo Natural Heritage Program, Personal Communication on June 17, 2022). The species conservation measures will remain in this document until this species is removed from the list. Three populations of Kanab ambersnails were originally identified based on anatomy, including at Three Lakes, Utah and Vasey's Paradise and Upper Elves Chasm, Arizona. However, recent genetic evidence indicates that the population at Vasey's Paradise shared more genetic markers with nearby populations of non-listed *Oxyloma* snails than with those found in the other two identified sites. One study found that gene flow occurred among 12 populations of *Oxyloma* snails, indicating that the Kanab ambersnail is not a valid subspecies (Culver et al. 2013). The status of the larger population of *Oxyloma* sp. is currently unknown.

The Kanab ambersnail is restricted to permanently wet areas within small wetlands of the Colorado Plateau. The existing habitat of the Kanab ambersnail consists of spring-fed ponds and wet meadows, at the base of sandstone cliffs in the Kanab Creek drainage (USFWS 1995). Dominant vegetation in these sites include cattail (*Typha domingensis*), rushes, and sedge (*Juncus* spp.). Vasey's Paradise consists of a cool dolomitic spring that flows directly from Redwall limestone (USFWS 1995; Stevens et al. 1997). Large patches of mixed vegetation composed primarily of native crimson monkeyflower (*Mimulus cardinalis*), nonnative watercress (*Nasturtium officinale*), and native water sedge (*Carex aquatilus*) characterize Vasey's Paradise habitat (Stevens et al. 1997). Within this habitat, ambersnails often inhabit the dead and decaying monkeyflower litter and live watercress stems and leaves.

Kanab ambersnails live up to 15 months (Stevens et al. 1997). Peak reproduction occurs in mid-summer (Stevens et al. 1997; Nelson 2001). Kanab ambersnails lay eggs on the undersides of host plant stems and leaves, or in moist soil (Nelson 2001). They begin winter dormancy in October and emerge from dormancy in March (Stevens et al. 1997). During winter dormancy, the snails attach the aperture of their shells to a firm substrate such as host plant stems and leaves, rocks, sticks, or bark. Kanab ambersnail mortality rates are 25-80% during dormancy (Stevens et al. 1997; IKAMT 1998).

Existing Habitat

Kanab ambersnails have not been detected on the Navajo Nation. Potential for the species is likely restricted to the western Navajo Nation, including tributaries of the Colorado and Little Colorado Rivers, springs on Echo Cliffs, and creeks north and west of Navajo Mountain (NNHP 2008).

Effects Analysis

No known populations of Kanab ambersnail occur on the Navajo Nation. If Kanab ambersnails are detected on the Navajo Nation, no aquatic weed treatments are proposed under the NNIWMP; therefore, there will be no direct effect on the population. If surveys detect this species, the species conservation measures outlined above for potential habitat of the species will remove the potential for indirect effects. Also, the appropriate buffers and weather-related restrictions on terrestrial applications, will remove all potential for impacts from the project design. No synergistic or cumulative impacts are anticipated to occur. Based on the effects analysis and implementation of the species conservation measures, the Integrated Weed Management Plan will not affect the Kanab ambersnail.

5.3.4 Fish

Roundtail Chub *(Gila robusta)*

Species Account

Roundtail chub is a Group 2 listed species on NNHP Threatened and Endangered species list (NNHP 2020). On April 5, 2022, the Service found that the Colorado River basin distinct population segment of roundtail chub as an endangered or threatened species was not warranted (87 FR 19657).

Roundtail chub are found in cool to warm waters of rivers and streams, and often occupy the deepest pools and eddies present in streams (Minckley 1973; Brouder et al. 2000). Adult roundtail chub favor slow moving, deep pools. They use large rocks, undercut banks, and woody debris for cover (Bezzerides and Bestgen 2002). Young-of-the-year (fish species younger than one year) roundtail chub occupy shallow (less than 50 cm (20 in) depth) and low-velocity waters with vegetated shorelines (Brouder et al. 2000, Lanigan and Berry 1981). Juveniles use habitat similar to young-of-the-year but with depths less than 100 cm (40 in). Water temperatures for habitats occupied by roundtail chub vary seasonally between 0–32 °C (32–90 °F) (Bezzerides and Bestgen 2002, Bonar et al. 2011).

Roundtail chub spawning occurs from February to June in pool, run, and riffle habitats with slow to moderate water velocities (USFWS 2013a). Roundtail chubs are omnivores, consuming foods proportional to their availability, including aquatic and terrestrial invertebrates, aquatic plants, detritus, and fish and other vertebrates.

Populations have declined due to habitat loss and degradation related to dams, diversions, groundwater pumping, mining, development, recreation, improper livestock grazing, and competition and predation from non-native fishes (Miller 1961, Bezzerides and Bestgen 2002, and Voeltz 2002). Areas where roundtail chub still occur have been significantly altered by these and other factors, including mining, improper livestock grazing, wood cutting, recreation, urban and suburban development, groundwater pumping, dewatering, dams and dam operation, contaminants, and other human actions (USFWS 2013a).

Existing Habitat

On the Navajo Nation, the roundtail chub is extirpated from the Colorado River in the Grand Canyon but occurs in the San Juan and Mancos Rivers (NNHP 2020). Roundtail chubs have rarely been encountered in recent surveys; however, they have been found from Shiprock to near Lake Powell, with most occurrences located between Shiprock and Aneth (RM 107- 140) (NNHP 2020).

Effects Analysis

Few roundtail chub occur in the San Juan River or other rivers adjacent to the Navajo Nation. Re-introduction efforts in the upper Colorado River basin may facilitate occupation in the San Juan River or tributaries in the future. If the San Juan and tributaries become occupied, there will be no direct impacts to roundtail chub because no aquatic treatments are proposed under this plan. Indirect impacts may occur if habitats are occupied, include increased turbidity during mechanical treatments using heavy machinery and prescribed fire in the riparian areas adjacent to their habitat. These impacts would be minimal and temporary. Also, the implementation of the mitigation measures would require erosion control measures to stabilize and limit erosion along bank lines. Also, long term measures include planting native vegetation to stabilize soils and prevent noxious weed re-growth after treatments occur along the San Juan.

Indirect effects from herbicides would be minimal since only herbicides determined to be practically non-toxic to fish species will be used within the riparian zone and would follow protection measures. Implementing these features would minimize herbicide exposure to such small levels that the effects would be immeasurable to the species or its habitat. The long-term benefits to habitat, critical habitat floodplain areas, and riparian vegetation include improved habitat function, reduced erosion, and an improved invertebrate food base due to the return of the native riparian vegetation. There are no proposed aquatic treatments under this plan, and, therefore, no synergistic effects or cumulative impacts are anticipated by the proposed treatments. Based on the effects analysis and implementation of the species conservation measures, the Integrated Weed Management Plan will not affect the roundtail chub.

Bluehead Sucker (*Catostomus discobolus*)

Species Account

This species was determined as a genetically separate species from the federally listed Zuni bluehead sucker (*C. d. yarrowi*) found in Kinlichee Creek watershed of the Defiance Plateau. Bluehead suckers can occupy a range of water temperatures (16-26°C) and stream volumes (<1 to several hundred m^3/second) (NNHP 2020). They feed primarily on algae scraped off cobbles, boulders, or bedrock (Selby 2020). Adults tend to stay in deep pools and eddies during the day and move to shallow water to feed during the night. Small juveniles occupy shallow, slower stream edges and backwaters. Spawning occurs during spring and summer. One or two males accompany a female into flowing water over gravel substrates and fertilize the eggs as they are expressed by the female (AZGFD 2017).

Threats to bluehead suckers are dams, water diversions, land use practices, drought, climate change, habitat loss, and competition with non-native species. On the Navajo Nation, the bluehead sucker is also threatened by soil erosion, lack of plant cover, and high nutrient loads from domestic livestock grazing (Selby 2020). Logging and fire increase soil erosion and pollution. Finally, building and road construction increase sediment deposition into streams, decreased water quality, and pollution that can impact spawning areas for native fish (Selby 2020).

Existing Habitat

Bluehead suckers occur on the San Juan River and its major tributaries, Little Colorado River and confluence with Colorado River and Crystal, Tsaile, Wheatfield Creek, and Whiskey Creeks in the Chuska Mountains.

Effects Analysis

No direct impacts would occur to bluehead sucker because no aquatic weed treatments are proposed under this plan. Bluehead suckers are sensitive to increased sedimentation in their habitat and could receive indirect impacts from mechanical or prescribed fire treatments. Conservation measures and best management practices are required to minimize ground disturbance during noxious weed treatments. These impacts would be minimal and temporary. Pile burning and prescribed fire would require a site-specific burn plan and would be conducted 300 ft outside of the floodplain. Heavy machinery mechanical treatments require a 300 ft buffer from the edge of the waterway. The mitigation measures in riparian areas require erosion control measures to stabilize and limit erosion along bank lines. Also, long term measures include planting native vegetation to stabilize soils and prevent noxious weed re-growth after weed treatments. Target grazing is not proposed for areas where bluehead suckers occur, as overgrazing has shown to destabilize bank lines and increase erosion.

Another indirect effect may occur from herbicide overspray. Only herbicides determined to be practically non-toxic to fish species would be used within the riparian zone. Aquatic formulations of 2,4-D, glyphosate, triclopyr and imazapyr would be used exclusively within 25 ft of the daily high-water mark. Herbicides that are practically non-toxic to fish and mollusks (White 2007) require a 25 ft (8 m) buffer from the daily high-water mark, including: aminopyralid, chlorsulfuron methyl, clopyralid, imazapic, and thifensulfuron-methyl. Chlorsulfuron, imazapic, imazapyr, and herbicides have shown no risk to fish even if there is an accidental direct spray or spill to aquatic habitats (BLM 2007). No aerial spraying will occur in habitats with bluehead sucker. All herbicide applications would follow required protection measures. These measures would minimize herbicide exposure to such small levels that the effects would be immeasurable to the species or its habitat. The long-term benefits to habitat and critical habitat floodplain areas and its riparian vegetation include improved function, reduced erosion, and an improved invertebrate foodbase due to the return of the native riparian vegetation.

There are no proposed aquatic weed treatments under this plan, and, therefore, no synergistic effects or cumulative impacts are anticipated by the proposed treatments. Cumulative impacts may occur if there is an indirect effect from increased sedimentation from mechanical treatments in areas where overgrazing has destabilized bank lines. Destabilized bank lines increase erosion particularly during high water events. Conservation measures would be implemented to prevent increased erosion during treatments and would be maintained until native vegetation re-grows. Noxious weed treatments would temporarily decrease vegetation at a site but would stabilize bank lines in the long-term from planting activities.

5.3.5 Amphibians and Reptiles

Northern Leopard Frog (*Lithobates pipiens*)

Species Account

The northern leopard frog requires a mosaic of habitats to meet its life stage requirements. It breeds in a variety of aquatic habitats that include slow-moving or still water along streams and rivers, wetlands, permanent or temporary pools, beaver ponds, and human-constructed habitats such as earthen stock tanks and borrow pits (USFWS 2011f).

The northern leopard frog is threatened by habitat loss, disease, non-native species, pollution, and climate change that individually and cumulatively result in population declines, local extinctions, and disappearance from vast areas of its historical range in the western U.S. and Canada.

Existing Habitat

On the Navajo Nation, historic records include the Chuska Mountains; Little Colorado, Colorado, and San Juan Rivers; Navajo and Chinle Creeks; Canyon de Chelly; and near Tuba City, Cameron, Thoreau, and Newcomb (NNHP 2020). This species may occur where habitat occurs across the Navajo Nation.

Effects Analysis

No aquatic weed treatment will be conducted; therefore, no direct impacts are anticipated. Northern leopard frogs may be indirectly impacted by herbicide overspray, trampling during noxious weed treatments, and mechanical clearing. The conservation measures would eliminate the indirect effects of these treatments. Riparian noxious weeds would be treated with aquatic approved herbicides, which are practically non-toxic for aquatic amphibians (White 2007). Trampling of northern leopard frog habitat may occur if treatments take place in these areas. Also, weed treatments would be temporary and short term, and northern leopard frogs would benefit over the long-term from the removal of noxious weeds that encroach their habitat.

In the unlikely event of herbicide over-spray, cumulative impacts may occur. While adult and larval amphibians are not necessarily more sensitive to chemicals than other terrestrial or aquatic vertebrates, they may experience sublethal effects including increased susceptibility to disease, increased predation, altered growth rates, or disrupted development (Carey and Bryant 1995). Endocrine-disrupting toxicants can affect tissues well below detectable levels. Atrazine and the surfactant polyethoxylated tallow amine (POEA) used with glyphosate-based herbicides can have endocrine disrupting effects on amphibians. The use of POEA is not proposed under this action and atrazine would require a 300 ft (90 m) buffer from potential habitat.

Milk Snake (*Lampropeltis triangulum*)

Species Account

The milk snake is a secretive species that uses rocks, logs, stumps, boards, and other surface objects as cover in a variety of habitats including river valleys, desert scrub, grasslands, pinyon-juniper, and coniferous forests (NNHP 2020). They are shy and mostly nocturnal, especially during the summer, spending most of their time underground. Breeding occurs in spring and early summer (April through June). The snakes feed primarily on lizards, small snakes, and rodents, but will feed on eggs and insects. They may constrict their prey, but usually only hold them long enough to swallow them whole (AGFD 2012a). Common predators include raccoons, foxes, skunks, and coyotes.

While the milk snake is widespread and abundant in most of its range, many are killed by humans who mistake them for venomous snakes (Isberg 2002). Collecting snakes as pets may also affect local populations, especially populations near roads. Milk snakes may also be threatened by intense agricultural development and urbanization, which can alter habitat and result in local declines (NatureServe 2015k).

Existing Habitat

Currently no records exist on the Navajo Nation, but the species has been found in bordering areas (Farmington, Cameron, Bluff, Wupatki National Monument, and Petrified Forest National Park), and could occur at all elevations and habitats on the Navajo Nation (NNHP 2020).

Effects Analysis

If milksnakes do occur in weed treatment areas, there is potential for some treatment methods to directly impact the milksnake. Chemical, biological, manual, and cultural treatment methods are unlikely to impact existing snakes directly or indirectly since this species is nocturnal. However, some mechanical treatments, such as those that remove plant parts below the surface or those that cause soil compaction may impact milksnake dens, especially when hibernating. The species conservation measures would restrict the use of mechanical treatments in occupied habitats, avoiding the risk of indirect or direct impacts to the snake. Thus, the integrated weed management plan is not likely to adversely affect the milksnake.

No known cumulative impacts have been identified that would contribute toward synergistic effects on the milksnake.

Chuckwalla (*Sauromalus ater)*

Species Account

Chuckwalla habitat consists of low desert lands (especially with volcanic alluvia and lava flows or desert hardpan) and rocky canyons (especially with large boulders). Chuckwallas also use the margins of grass-oak woodlands in southern Utah. They are primarily herbivores, browsing on leaves, buds, flowers, and fruit, and may occasionally eat insects. They bask on rocks during the day and remain inactive during cold weather and extreme heat. Chuckwallas use rock crevices for their homes. When frightened, a chuckwalla will retreat into a crevice and wedge itself in sideways while inflating its body (AGFD 2009). Males are territorial, tolerating females and juveniles, but fighting off other adult males (AGFD 2009).

Local populations are most threatened by collectors and habitat degradation. Collectors often damage habitat to extract the animals by using tools to move or break rock and exfoliants to expose reptiles (NMDGF 1997). Populations in Arizona have been exploited based on unique color patterns that are highly desired by pet traders. Historic populations in the Glen Canyon portion of Utah have also been reduced or eliminated by the damming of the Colorado River (AGFD 2009).

Existing Habitat

Chuckwalla's known range on the Navajo Nation is not well understood, but likely includes deep canyons and adjacent desert lands of the Little Colorado River, the Marble Canyon area (including Echo Cliffs) of the Colorado River, and the San Juan River in Utah (NNHP 2020).

Effects Analysis

Because chuckwallas may occur near riparian areas and canyons on the Navajo Nation, this species may live in areas planned for weed treatments. Biological, cultural, or manual treatments would not likely impact the chuckwalla. The treatment method that poses the most risk of impacting the chuckwalla are mechanical treatments, specifically those that move or dig up large quantities of earth while removing vegetation. Because the chuckwalla is sensitive to habitat degradation, especially near the rock crevices it uses as its home, the species conservation measures would avoid potential negative effects to the species.

Use of herbicides may pose some risk to the chuckwalla, as it uses a wide variety of vegetation for its main diet. The proposed herbicides are all rated as being either slightly to moderately toxic to reptile species or non-toxic (White 2007). The best management practices for chemical treatment methods would reduce the risk of the chuckwalla unintentionally consuming enough contaminated vegetation to result in adverse effects. These measures include use of only aquatic approved herbicide near open water, restrictions on the application of herbicides during adverse weather conditions, restrictions on where herbicides can be mixed and stored, and adherence to the herbicide label, which includes restrictions on how much herbicide used for each application method. These restrictions would limit the amount of herbicide an animal would be exposed to and limit the risk of drift in non-target areas. Thus, the integrated weed management plan would likely not adversely affect the chuckwalla on the Navajo Nation.

No cumulative impacts have been identified that would contribute to synergistic impacts to the species. Overall, removal and treatment of noxious weeds in occupied habitats would benefit the chuckwalla by providing more diverse native plant communities for forage and browsing.

5.3.6 Plants

Cutler's Milk-vetch (*Astragalus cutleri*)

Species Account

Cutler's milk-vetch is endemic to San Juan County, Utah and isolated to the San Juan section of Lake Powell. Its habitat consists of warm desert shrub communities on sandy, seleniferous soils with level to moderate slopes on the Shinarump and Chinle Formations at 3800 ft. in elevation. This species grows in very remote areas of the Navajo Nation and annual germination and population size is primarily influenced by precipitation (Hazelton 2011b). Grazing pressure may influence seed set rates. Non-native annual species such as common Mediterranean grass (*Schismus barbatus)*, red brome (*Bromus rubens*), and red stork's bill (*Erodium cicutarium*) occur within Cutler's milkvetch habitat and compete with this rare species.

Existing Environment

There are three known populations of Cutler's milk-vetch: at Copper Canyon, Nokai Canyon, and Castle Creek, all of which occur at Lake Powell. Populations at Copper and Nokai Canyons are on the Navajo Nation. The Copper Canyon and Nokai Canyon populations are the largest known populations, likely containing close to 90% of the extant population (Roth 2009).

In 2005, the Utah and the Navajo Nation set up two monitoring plots at known population sites to better understand population dynamics of Cutler's milk-vetch. After a wet 2004-2005 winter, surveys conducted in May found a total of 501 plants spread between the Copper Canyon, Nokai Canyon, and Castle Creek sites. In 2018, a total of 48 plants were detected at the same site and by 2019 no plants were detected. Early surveys found that Culter's milk-vetch seeds could survive for extended periods of time in the seed bank until ideal conditions are present for germination and flowering (Roth 2009). This can lead to years where no plants are visible or present in an area, followed by thousands flowering in a single year, which may account for the varying populations numbers observed over sampling years.

Effects Analysis

As a G2 tribally listed species, the Navajo Nation requires surveys for Cutler's milk-vetch in areas with potential habitat. All identified populations would be flagged, and designated buffers would be established. Therefore, it is unlikely that weed treatments will have direct impacts on Cutler's milk-vetch individuals and habitat. This species may be indirectly impacted from trampling, mechanical equipment, and herbicide overspray from adjacent habitats. These effects would be reduced or eliminated by the species conservation measures and best management practices. Flagging or fencing the species in the treatment area would prevent mechanical or human foot traffic from trampling the species. No pre-emergent herbicide treatments would be applied in suitable habitat for this species. Herbicides would not be sprayed during high wind or humid conditions to prevent overspray.

The conservation measures would also eliminate synergistic effects. The largest threats to this species are drought/climate change and rodent and insect herbivory in their known habitat. Trampling from burros in combination with herbicide overspray may cause a synergistic effect to the species. However, the introduction and spread of noxious weeds such as red brome and common Mediterranean grass may more seriously impact the milk-vetch as these species compete for nutrients, water, and sunlight in the shallow soils where these plants grow. The conservation measures would reduce the risk of impacts from herbicide overspray, mechanical equipment, and trampling.

It is unknown how climate change may impact the milkvetch, but changes to other plant species in the area may have indirect impacts on Cutler's milkvetch. Shifts in species composition and the continued spread of many non-native noxious plant species could affect conditions needed for the milkvetch to germinate and grow. As the climate warms and drought continues, this species will be impacted by reduced water availability in its habitat and the frequency between wet and dry periods. Climate change with the combination of herbicide overspray, mechanical impacts, or trampling may cause cumulative impacts to the population. The conservation measures would reduce the risk of impacts from herbicide overspray, mechanical equipment, and trampling.

Goodding's Onion (*Allium gooddingii*)

Species Account

Gooding's onion habitat consists of spruce-fir forests and mixed conifer forests in the Chuska Mountains and under Gambel oak thickets interspersed with aspen, dogwood, and Douglas fir (NNHP 2020). It is often found in moist, shady canyon bottoms and north-facing slopes, often along streams, from 6,400 – 9,400 ft (2,286 to 3,429 m) in elevation (NNHP 2020). Soils that support this species are comprised of loamy alluvium with high organic content (USFWS 2001). This species reproduces from seed and vegetatively from bulbils from the division of its rhizomes. Seeds germinate readily, but a stem may not grow from every bulb every year. It may be locally abundant at certain sites and dominate the herbaceous understory. It usually does not occur where other perennial herbaceous species exceed 50% ground cover (AGFD 1999). Known pollinators include hymenopterans, dipterans, and lepidopterans (AGFD 1999).

Threats include livestock grazing, timber harvesting, habitat destruction, and wildfire. This species is unable to maintain its populations after high intensity fires that result in canopy removal but may survive direct impacts from localized fires (NMRPTC 1999a).

Existing Environment

On the Navajo Nation, Goodding's onion is found in Canyon de Chelly, the Chuska Mountains in Apache County, Arizona and McKinley County and San Juan Counties in New Mexico (USFS and USFWS 1997a). The species may occur throughout the Chuska Mountains and the Defiance Plateau (NNHP 2020). This species was extirpated from Canyon del Muerto on the Navajo Nation. It is locally abundant when it occurs, and its current population appears to be stable (NatureServe 2015f).

Effects Analysis

Goodding's onion is associated with native mixed conifer stands, Gambel oak thickets, and other native tree species at high elevation. Noxious weeds are not known as a threat to this species. As a G3 tribally listed species, the Navajo Nation requires surveys for Goodding's onion in areas with potential habitat. All identified populations would be flagged, and designated buffers would be established. Therefore, it is unlikely that weed treatments will have direct impacts on Goodding's onion individuals and habitat. The conservation measures would prevent direct impacts to the species from weed control activities. If treatments occur near this species' habitat, indirect effects may occur from trampling during treatments and herbicide overspray. These effects would be reduced or eliminated by the species conservation measures and best management practices. Mechanical, cultural, chemical, and prescribed burn treatments require a 1-mile buffer from Goodding's onion populations. A burn plan must be developed for each project using prescribed fire, which will include specific treatment buffers. All vehicles used to access sites will follow established roadways and would be parked in previously disturbed sites. There are no anticipated effects from the proposed biological controls as none of the control agents target onion species. Cultural controls are not proposed within its habitat.

The largest threats to Goodding's onion include logging, grazing, road construction, wildfire, and recreation. The Navajo Nation is considered open range, and livestock may use the habitat occupied by this species. This species appears to be less vigorous after several years of consistent grazing, which may eliminate sexual reproduction within an impacted population (AGFD 1999). Grazing and other threats combined with herbicide overspray or trampling may cause cumulative impacts on the population. If Goodding's onion populations are compromised by these outside pressures, herbicide overspray may further impact susceptible populations. The mitigation measures would reduce the potential impacts from herbicide overspray, mechanical treatments, and trampling.

Marble Canyon Milk-vetch (*Astragalus cremnophylax* var. *hevronii*)

Species Account

Marble Canyon milk-vetch habitat consists of crevices and depressions with shallow soils on Kaibab Limestone and on rimrock benches at the edge of Marble Canyon. The plants are associated with Great Basin Desert scrub communities found at 5000 ft. in elevation. It grows in clusters where cracks form in the limestone with a few centimeters of soil have formed. This species of milkvetch prefers areas with dry, exposed white rock with full sun and brisk dry winds.

Surveys of Marble Canyon milk-vetch indicate the species has a high rate of establishment, which has helped some populations recover quickly following extended periods of drought (Hazelton 2011c, Roth 2007). This is also evidenced by its higher seed to ovule seed ratio for survey populations in relation to other closely related milk-vetch species (Allphin et al. 2005, Roth 2007).

It is considered endemic to the rim of Marble Canyon and is threatened on the Navajo Nation by the rarity of its occurrence and the rarity of suitable habitat for the species (Hazelton 2011c). While the species has some level of protection due to the remoteness of known populations, its proximity to the Grand Canyon still presents a threat to its long-term survival. Major threats for the species include trampling and damage from visitors and livestock, illegal collection, long-term drought from climate change, and natural erosional processes (Roth 2007).

Existing Environment

Marble Canyon milk-vetch is known from 8 populations found along the rim of Marble Canyon; seven of which are located on the Navajo Nation. These populations are found along the east rim of Marble Canyon between Sheep Springs Wash and Shimuno Wash. Potential habitat for the species has been identified between Little Colorado River Gorge and Navajo Bridge along the Little Colorado River (NNHP 2020). Monitoring and survey efforts by the Navajo Natural Heritage Program have determined that the total range for Marble Canyon milk-vetch extends less than 10 miles along the eastern rim of Marble Canyon. Most populations are small with few plants. Surveys in 2007 estimated less than 1,000 plants total (Roth 2007).

In 1997, the Navajo Natural Heritage Program installed four permanent transects to monitor the Redwall population to assess changes in reproductive output, age class distribution, and survivorship (Hazelton 2011c, **Table 17**). The monitoring program determined that this population has remained relatively stable, even demonstrating population recovery during a prolonged regional drought between 2001 and 2002 (Roth 2007).

Table 17. Demographic data collected for the Redwall population of Marble Canyon milk-vetch during four monitoring years (Hazelton 2011 and Nora Talkington, Botanist, Navajo Natural Heritage Program, personal communication on July 21, 2021).

Monitoring Year	No. of Individual Plants
1997	169
2007	164
2008	171
2011	166
2018	172

It is currently unknown how existing populations respond to drought, while closely related species in the area experienced significant population declines. However, the limited range and number of plants on the Navajo Nation, the Marble Canyon milk-vetch is listed as threatened by the Navajo Nation Department of Fish and Wildlife.

Effects Analysis

The biggest threat to the Marble Canyon milk-vetch is trampling from humans and livestock and potential habitat destruction from development along Marble Canyon. Known populations of the milk-vetch occur in remote areas often infrequently visited by people. These factors make it unlikely that weed treatments will directly affect the Marble Canyon milk-vetch. However, indirect impacts from trampling, mechanical equipment use on site, and herbicide overspray from adjacent habitat may affect some populations. These effects, however, would be reduced or eliminated by the species conservation measures and best management practices for weed treatments. As a G3 species, the Navajo Nation requires surveys for Marble Canyon milk-vetch in areas with potential habitat. These measures include flagging or installing fencing at buffer zones around existing populations to avoid impacts from trampling or crushing of plants by workers or equipment. Also, herbicides would not be sprayed during periods of high winds or precipitation events to prevent overspray or drift into untreated areas.

Recent monitoring of known populations suggests the milk-vetch has a higher reproductive rate than other closely related milk-vetches in the area, allowing it to recover more quickly following drought events (Hazelton 2011). This suggests that the Marble Canyon milk-vetch may be better adapted to climate variability, but additional evidence on seed reproduction and plant establishment is still needed. However, how the plants respond to multiple stressors and how that may affect its ability to reproduce is unknown. The species conservation measures would minimize and eliminate known impacts (i.e., trampling and herbicide overspray) and would reduce the risk of cumulative impacts related to climate change.

Cronquist Milk-vetch (*Astragalus cronquistii*)

Species Account

Suitable habitat for the Cronquist milk-vetch consists of salt desert shrub and blackbrush communities on sandy or gravelly soils derived from the Cutler and Morrison Formations or Mancos Shale, ranging in elevation from 4750 to 5800 ft. in elevation (NNHP 2020). It is considered endemic to the Colorado Plateau in San Juan County, Utah, and Montezuma County, Colorado.

The Cronquist milk-vetch is threatened by habitat loss and trampling from oil and gas exploration and road construction (CNPS 1997).

Existing Environment

On the Navajo Nation, it is reported from south of Bluff, Aneth, and near the Utah border with Colorado, with known populations in the Comb Wash region near the San Juan River (CNPS 1997). Potential habitat is located throughout southeastern Utah (NNHP 2020). Estimates for the Cronquist milk-vetch put the total population at around 1500 individual plants distributed between 6-20 populations (NatureServe 2015b).

Effects Analysis

The Cronquist milk-vetch is considered rare in its suitable habitat. It has been heavily impacted by oil and gas exploration, and road construction in southern Utah. Trampling from humans and livestock may also affect populations. Its rarity in this portion of the Navajo Nation makes it unlikely that weed treatments directly impact existing populations. This species may be indirectly impacted by trampling, mechanical equipment, and herbicide overspray from adjacent habitats. This is a G3 tribally listed species and surveys are required by the Navajo Nation in areas with potential habitat. All identified populations would be flagged, and designated buffers would be established. Therefore, it is unlikely that weed treatments will have direct impacts on Cutler's milk-vetch individuals and habitat. These effects would be reduced or eliminated by the species conservation measures and best management practices. Flagging or fencing the species in the treatment area would prevent mechanical or human foot traffic from trampling the species. Herbicides would not be sprayed during high wind or humid conditions to prevent the potential for overspray.

The conservation measures would also eliminate synergistic effects. The largest threat to this species is from oil and gas development. Trampling from off-road vehicle use and livestock in combination with herbicide overspray may cause synergistic effects. OHV and livestock trampling may reduce the population and weed treatments may further stress and reduce existing populations. The conservation measures would reduce the risk of impacts from herbicide overspray, mechanical treatments, and trampling.

It is unknown how climate change will impact Cronquist milk-vetch. As the climate warms and drought continues, this species may be impacted by reduced water availability in its habitat. However, the Cronquist milk-vetch is adapted to persist underground and avoid flowering except during periods with adequate rainfall (CNPS 1997). Such adaptations can reduce stress on the plants during periods of extended drought. However, if weed treatments are conducted during periods of drought, it may make it harder to identify potential populations in treatment sites, resulting in unintended impacts during weed treatments. The conservation measures would reduce the risk of impacts from herbicide overspray, mechanical equipment, and trampling.

Brack's Hardwall Cactus (*Sclerocactus cloveriae* ssp. *brackii*)

Species Account

The Brack's hardwall cactus is found in northwest portion of New Mexico, in San Juan, Sandoval, and Rio Arriba Counties (NMRPTC 1999). Suitable habitat consists of desert scrub and scattered juniper communities growing on sandy, clay hills of the Nacimiento Formation. This cactus prefers eroding sandy-loam to sandy-clay substrates within valleys. The total range of this species is about 150 miles north to south and about 60 miles wide (Muldavin et al. 2016). Populations occur between 5,000 and 6,000 ft. in elevation. This species was determined to have no genetic differences with Clover's cactus (*Sclerocactus cloverae* spp. *cloverae*) and will be referred to as *Sclerocactus cloverae* in subsequent publications (NNHP 2020). Despite the lumping of these species, the species range is still limited.

The Brack's hardwall cactus is threatened by intense energy development and off-road vehicle use in its habitat. Its small size can make it difficult to see plants in its habitat (NMRPTC 1999).

Existing Environment

On the Navajo Nation, potential habitat exists in San Juan County south of the San Juan River (NNHP 2008). Surveys conducted on the Nacimiento formation in 2015 found 2,571 live cactus plants (including both sub-species) with the highest densities in sparse grama-galleta grasslands and open sagebrush shrublands with scattered grass understories along valleys and dry washes (Muldavin et al. 2016).

Effects Analysis

Due to its small size and limited population size, Brack's hardwall cactus is susceptible to impacts in its known habitat. Any projects that occur in its potential habitat are recommended to conduct surveys by a qualified biologist to identify and flag cacti. The recommended treatment-based buffers would prevent workers from accidently crushing or damaging plants in the treatment area. Buffers and restrictions on the use of herbicides during periods of high humidity, high temperatures, and within 24 hours of a precipitation event would reduce or eliminate direct impacts to the cactus.

However, indirect impacts from trampling, mechanical equipment use on site, and overspray of herbicide in adjacent habitat may potentially affect some populations. These effects, however, would be reduced or eliminated by the species conservation measures and best management practices for weed treatments.

Populations of Brack's hardwall cacti that occur in areas where energy development or off-road use is common may experience stress from these land uses, making them more susceptible to damage from weed treatments. The avoidance measures would prevent damage and impacts to such populations and minimize the risk of synergistic impacts. Further, management and control of noxious weed species in the range of the cactus would be beneficial as it would reduce competition and habitat alteration from many target weed species. Overall, the proposed noxious weed treatment management plan, with the proposed species conservation measures, would not adversely affect this species.

Naturita Milk-vetch (*Astragalus naturitensis*)

Species Account

Habitat consists of sand filled pockets on sandstone slickrock and rimrock pavement along canyons in the pinyon-juniper zone. Known populations occur between 5000—7000 ft. in elevation. The Naturita milk-vetch is a low-growing perennial with seed pods from late April through May. Plants growing in shady areas tend to have smaller overall diameters and are sparsely leaved and can be larger in sunny areas, especially after wet winters (Schneider 2015).

While the Naturita milk-vetch occurs in areas with active energy and housing development without much effect, land conversions in the area have restricted its current habitat (NatureServe 2015c).

Existing Environment

On the Navajo Nation, the species has been reported from the Hogback in San Juan County to the Pinetree Canyon area in McKinley County in New Mexico. Suitable habitat for the species occurs north of I-40 in McKinley County to the Hogback in San Juan County (NNHP 2020). Known populations occur in McKinley and San Juan Counties in New Mexico and in southwestern Colorado to San Juan County in Utah.

Effects Analysis

The Naturita milk-vetch is not likely to be directly impacted by noxious weed treatments as it is not highly impacted by disturbance and impacts related to trampling or construction. The Naturita milk-vetch is not heavily impacted by trampling in its native habitat, and thus impacts from mechanical equipment and manual removal are not likely to affect known plants. The milk-vetch may be indirectly impacted by herbicide overspray from adjacent habitat and vegetation removal from areas where it occurs. However, the species conservation measures and best management practices would reduce or eliminate these impacts on the species. As a G3 species, treatment areas would be surveyed for existing populations, which would be flagged or fenced to help field workers avoid plants. Herbicide would also not be applied during periods of high winds or high humidity to prevent overspray into adjacent areas.

Little is known about how climate change may affect the Naturita milk-vetch, which is not impacted by disturbance and climatic variability. Thus, it is unlikely that the Naturita milk-vetch would be impacted by cumulative impacts associated with weed treatments and current land use in the area. Species conservation measures and best management practices would reduce the impacts of unknown synergistic impacts on the Naturita milk-vetch.

Acoma Fleabane (*Erigeron acomanus*)

Species Account

The perennial plant sprouts in mat-forming clones from a rhizomatous taproot. The species produces white ray flowers (light pink when budding) and a yellow disk corolla, which flower between late May and July (Roth 2012). While the species is rare and endemic in its suitable habitat, it does have relatively high genetic diversity, which is attributed to its ability to spread through clonal asexual reproduction, obligatory outcrossing, and its ability to spread through wind dispersal and generalist pollinators (Roth 2012).

Suitable habitat consists of sandy slopes beneath sandstone cliffs of the Entrada Sandstone Formation in pinyon-juniper woodland communities, with some populations in areas overlain with Todilto Limestone (NNHP 2020, Roth 2012). Populations occur around 7000 ft. in elevation.

The rarity and the isolation of known populations make it susceptible to extinction events related to human and naturally caused disturbance. One population declined from trampling and equipment use at a nearby mining site. Other populations occur in areas where grazing occurs, but no evidence of damage from trampling or herbivory have been observed (Roth 2012).

Existing Environment

The species is currently known from four populations which have been divided between two distinct sub-populations in McKinley and Cibola counties in New Mexico, with one of the McKinley populations located on the Navajo Nation (Roth 2012). On the Navajo Reservation it is documented north of Thoreau and north of Prewitt; however, the species may exist north of I-40 in McKinley County (NNHP 2020). Surveys of the species estimates between 2,000 to 3,000 individual plants divided between the four known populations. In 2017, this population on the Navajo Nation was 117 plants (Nora Talkington, Botanist, Navajo Natural Heritage Program, personal communication on July 21, 2022).

Effects Analysis

The Acoma fleabane is a rare and endemic plant on the Navajo Nation, just north of the town of Thoreau. The rarity and isolation of the species makes it highly susceptible to extinction. Surveys and observations suggest its most direct threats could be related to trampling and disturbance (Roth 2012). Due to the rarity of the species in the project area, it is unlikely that weed treatments would directly affect the Acoma fleabane. However, weed treatments may take place near some populations and have the potential to indirectly affect individual plants through trampling, the use of mechanical equipment, and herbicide overspray. As a G3 tribally listed species, the Navajo Nation requires surveys for this species in areas with potential habitat. The species conservation measures would reduce or eliminate these impacts by identifying known plants so field crews could avoid them during treatments. Measures such as installing flagging and fencing at buffer perimeters around identified plants during mechanical and manual treatments to avoid disturbing the plants. Herbicides would also not be administered during high wind and humid conditions to prevent overspray to areas adjacent to treatment sites.

In terms of cumulative impacts, additional trampling from grazing, land use, and recreational activities near populations may have synergistic effects when coupled with weed treatments. The additional stress on the plants when activities happen within relatively short periods of time may contribute to the decline of the species at its known locations. Additionally, impacts from climate change, specifically extended periods of drought, may also contribute to the species' decline by stressing existing populations, making plants more susceptible to impacts from weed treatments. The species conservation measures can reduce or eliminate the overall impact of these cumulative effects by helping field crews avoid known populations and utilizing treatment methods that protect the species.

Round Dunebroom (*Errazurizia rotundata*)

Species Account

Round dunebroom grows as a low, woody shrub, reaching up to 30 cm in height, which spreads clonally. The plant also has several spikes emanating from the main branches with short flowers and an axis not over 2 cm long in fruit (NNHP 2020). This species can occur on several types of outcrops, ranging from sandy soils in sandstone, gravelly soils in calcareous outcrops, to deep, alluvial cinders in sandstone breaks. Generally, this plant is found in exposed habitats in semi-arid environments of the Great Basin Desert scrub.

The species is well adapted to wind erosion and has been used to reduce erosion in sandy areas and to protect annuals by the microclimate created by its branches (Phillips et al. 1981). While the species is naturally rare, it is most impacted by habitat loss, heavy grazing, and off-road vehicle use.

Existing Environment

On the Navajo Nation, populations are known from sandy pockets between outcroppings of Moenave Sandstone, between 4600 and 5200 ft. in elevation. This species has been found between Moenave and Willow Springs; however, suitable habitat exists between Gap, Arizona and Petrified Forest National Monument (NNHP 2020). It is considered endemic to the Little Colorado River drainage, particularly the Painted Desert, Echo Cliffs, Wupatki Basin, middle Little Colorado River drainage, and northwest of Winslow, Arizona (AGFD 2005a)

Effects Analysis

Round dunebroom is found in sandy areas along the Little Colorado River drainage and has been noted in several grazing areas, which are near areas some areas prioritized for weed treatment. However, the rarity of its occurrence and its suitable habitat make it unlikely that weed treatments would directly impact the species. These isolated populations may be indirectly impacted by trampling, mechanical equipment use, or from herbicide overspray in adjacent areas. As a G3 tribally listed species, the Navajo Nation requires surveys for round dunebroom in areas with potential habitat. The species conservation measures, however, would likely reduce or eliminate the negative impacts related to such activities. These measures include identification of populations in and near the treatment site, flagging or fencing of populations to establish avoidance buffers, and training crews to identify and avoid known populations. These measures would minimize trampling or crushing plants while field crews work in areas with round dunebroom. Herbicides would also not be sprayed during windy or humid conditions to prevent overspray or drift to areas adjacent to treatment sites.

Livestock are considered a threat to round dunebroome from grazing and trampling. Livestock threats are primarily the result of unmanaged grazing. While targeted grazing may be a cultural treatment method used in some range management areas, if round dunebroom is present, flagging and fencing would be placed around populations to ensure a 200 ft avoidance buffer.

Herbicide overspray may provide a cumulative impact with the known threats in round dunebroom habitat, including livestock grazing and trampling and water development for livestock. If round dunebroom populations are compromised by these outside pressures, herbicide overspray may further impact susceptible populations. The effect of grazing and trampling on round dunebroom may fluctuate from year to year, depending on how livestock are managed, which may also result in varying impacts to different populations. Such variations could be due to project location, the treatments used, the frequency of retreatments, and the size and intensity of grazing that occurs at the site.

By removing noxious weeds from areas adjacent to round dunebroom populations, these measures would protect these populations from the habitat loss from noxious species. The mitigation measures, including buffers for each treatment method, and best management practices would eliminate the risk to round dunebroom and allow weed treatments to not likely adversely affect the species.

Navajo Bladderpod (*Physaria navajoensis*)

Species Account

Suitable habitat primarily consists of windward, windswept mesa rims and nearby habitat with little vegetative cover and high insolation. It is also found at the base and slopes of small hills of the Chinle Formation. Typically, this plant is only found in a combination of Todilto Limestone overlaying Entrada Sandstone or Chinle outcrops in pinyon-juniper communities. Todilto limestone outcrops are heavily mined in this region for road material. Many populations also occur near areas near roads or are slated for road construction. These two land uses have largely restricted suitable habitat and led to population loss through trampling and crushing of plants (AGFD 2005b).

Existing Environment

On the Navajo Nation, Navajo bladderpod is found in New Mexico on mesa rims northwest of Thoreau and the Continental Divide and in the Chuska Mountains at Todilto Park; in Arizona it occurs from the Red Valley area to Wheatfields Lake. There is potential for the species to occur anywhere there are Todilto and Chinle outcroppings northeast and northwest of Thoreau and in the Chuska Mountains within McKinley and San Juan Counties in New Mexico. It is possible the species occurs in the Chuska and Carrizo Mountains in Apache County, Arizona as well (NNHP 2020). Currently, the species is known from about 20 populations, 10 of which occur on the Navajo Nation (NatureServe 2015d).

Effects Analysis

Trampling and crushing of plants are the biggest threats to the long-term survival of the plant, most of which is associated with mining in its habitat. Since the bladderpod occurs in areas with Todilto limestone, these areas are limited to a few small sites on the Navajo Nation, making it unlikely that noxious weed treatments will directly impact the species. However, indirect impacts from trampling, mechanical equipment use on site, and herbicide overspray from adjacent habitats may potentially affect some populations. As a G3 tribally listed species, the Navajo Nation requires surveys for this species in areas with potential habitat. These effects, however, would be reduced or eliminated by the species conservation measures and best management practices for weed treatments. These measures include flagging or installing fencing at buffer zones around existing populations to avoid impacts from trampling or crushing of plants by workers or equipment. Herbicides would also not be sprayed during periods of high winds or precipitation events to prevent overspray or drift into untreated areas.

Little is known about how climate change may affect the Navajo bladderpod. The species is currently threatened more by land use changes than by shifts in habitat suitability. However, the species conservation measures and best management practices would reduce the impacts of unknown synergistic impacts on the Navajo bladderpod.

Navajo Mountain Penstemon (*Penstemon navajoa*)

Species Account

Habitat consists of rocky, open places in ponderosa pine, aspen, and Douglas-fir communities ranging from 7,000 to 10,300 ft. in elevation. Plants are best identified during the flowering period between July and August.

Fire and fire-fighting activities are one of the largest threats to known populations. Other threats include road improvements and grazing in the region (NatureServe 2016).

Existing Environment

This plant is known from roughly 5 populations which occur on the upper slopes of Navajo Mountain and upper Dark Canyon in San Juan County, Utah (NatureServe 2016). The species may occur on the upper slopes of Navajo Mountain and, potentially, at upper elevations of Skeleton Mesa (NNHP 2020).

Effects Analysis

The Navajo Mountain penstemon is restricted to the mountains and plateaus in the Utah portion of the Navajo Nation. Additionally, its rarity makes it unlikely that weed treatments would occur in areas where the penstemon is found. As a G3 tribally listed species, the Navajo Nation requires surveys for this species in areas with potential habitat. All identified populations would be flagged, and designated buffers would be established. The conservation measures would further minimize or eliminate the risk of weed treatments directly or indirectly impacting the penstemon in its known habitat. Mechanical, cultural, chemical, and prescribed burn treatments require a 1-mile buffer from penstemon populations. A burn plan must be developed for each project using prescribed fire, which will include specific treatment buffers. This mitigation measures would reduce indirect impacts from trampling, damage from prescribed burning, and herbicide overspray into non-treated areas, which could cause damage to plants. Surveys for populations in potential habitat areas would identify known populations in and around the proposed treatment site. Such identification would allow field crews to implement buffer zones and avoidance measures to prevent and/or reduce the impacts of weed treatment on plants. Herbicides would also not be utilized when windy conditions or precipitation are forecast for the area, which can prevent and reduce herbicide drift to non-treatment sites.

In terms of cumulative impacts, many climate models indicate that the southwest could experience an increase in the frequency and severity of wildfires in the southwest, which is a significant threat to the Navajo Mountain penstemon. These changes in wildfires would result in additional stress to existing plants, which may further exacerbate impacts related to trampling or herbicide drift. Grazing and road improvements in the area may also present a cumulative impact, as these impacts can create pressure on existing populations, making them more susceptible to impacts from trampling by field crews or mechanical equipment use and contact with some herbicides.

Alcove Rock Daisy (*Perityle specuicola*)

Species Account

The alcove rock daisy is a perennial herb which is endemic to hanging gardens found on the Colorado Plateau between 3690 and 4000 ft. in elevation. Habitat consists of dry sites in alcoves, cliff bases, and narrow, protected canyons in Navajo Sandstone, Wingate, and Cedar Mesa sandstone formations, and in Permian limestone. However, it is not considered substrate specific (BLM 2008). They are often associated with pinyon-juniper, desert shrub and hanging garden plant communities (Welsh 2008). The alcove rocky daisy blooms between July and September. Due to the isolated and limited range of the plant, the alcove rock daisy is mostly threatened by water development and trampling from recreation in the area (NatureServe 2016).

Existing Environment

There are only 10 known populations composed of approximately 660 individual plants found along canyons on the Colorado and San Juan Rivers in Utah (NatureServe 2016a). On the Navajo Nation, it is only known from one site on the San Juan River downstream from Goosenecks State Park; however, there is potential for the species to occur anywhere there are hanging gardens in the San Juan River drainages (NNHP 2020).

Effects Analysis

There will be no direct effects to alcove rock daisy since weed treatments are not proposed in hanging garden sites. Since this is a G3 species, surveys for the rock daisy are required to identify species in the project area and install 200 ft buffers around populations found within treatment sites. Indirect effects include herbicide drift from chemical treatments. The likelihood of herbicide drift would be reduced by implementing a 200 ft buffer around existing plants during chemical treatments. Also, herbicides would not be applied when wind speeds exceed 10 miles per hour, temperatures are greater than 80° F (26.7° C), and humidity is high. Finally, many hanging gardens with alcove rock daisy are located in remote and inaccessible areas where it is unlikely weed treatments will occur, and, if they do occur, wind drift herbicide would likely not reach these populations. Other methods such as mechanical, including prescribed fire, and cultural treatments require a 200 ft buffer from alcove rock daisy populations. Due to the remote nature of hanging gardens, it is unlikely heavy machinery would impact such areas. Chainsaws may be used for cut-stump treatments, but would focus on woody trees, which could easily avoid damage to herbaceous plants in nearby areas.

Herbicide overspray on the alcove rock daisy may provide a cumulative impact with other known threats to alcove rock daisy habitat, including trampling and water development for livestock. If rock daisy populations are compromised due to these outside pressures, herbicide overspray may further impact susceptible populations. The effects of trampling, climate change, and water development on hanging gardens with alcove rock daisies annually, which may also result in variations in the severity of impacts on known populations. The mitigation measures, including buffers identified for each treatment, and best management practices would eliminate risks to alcove rock daisy and make weed treatments not likely to adversely affect the species.

Alcove Bog-orchid (*Platanthera zothecina*)

Species Account

Suitable habitat consists of seeps, hanging gardens, and moist stream areas in desert shrub, pinyon-juniper, and ponderosa pine/mixed conifer communities (NNHP 2020). Pollination is required for seed production and seed establishment is required for recruitment of new individuals (Hudson 2001). Herbivory of spikes and flowers from small mammals can be detrimental to the species, which may cause the plant to revert back to a vegetative state or even cause mortality (Hudson 2001). Alcove bog orchid populations are widely scattered with low numbers; however, colonies appear stable with plants still present in areas where they were reported over 60 years ago (AZGFD 2004).

Existing Environment

Known populations of this species are confined to the upper Colorado River watershed in southeastern Utah, northeastern Arizona, and extreme western Colorado between 4000 and 7200 ft. (1300 – 2700 m) in elevation (Hudson 2001). On the Navajo Nation, it occurs at the headwaters of Oljeto Wash, Tsegi Canyon Watershed, and hanging gardens surrounding Navajo Mountain, Chinle Wash drainages, and drainages within and around Carrizo Mountains (NNHP 2020). There are fewer than 30 sites known, and these are small, scattered, and with few individuals (AZGFD 2004a).

Effects Analysis

Prior to weed treatments, surveys by a trained biologist would be conducted to identify the locations of alcove bog orchid within potential habitat in the project area. A 200 ft buffer from identified orchid populations would be marked with flagging to prevent field crews from entering the buffer zone.

There would be no direct effects to alcove bog orchids due to the species conservation measures. Indirect effects include herbicide drift from chemical treatments. The likelihood of herbicide drift would be reduced by the 200 ft buffer required for chemical treatments. Also, herbicides would not be applied when wind speeds exceed 10 miles per hour, temperatures are greater than 80° F (26.7° C), and humidity is high. Finally, many hanging gardens and seeps with alcove bog orchid habitat are in remote and inaccessible areas where it is unlikely weed treatments will occur, and, if they do occur, wind drift herbicide would likely snot reach these populations. Other methods such as mechanical, including prescribed fire, and cultural treatments require a 200 ft buffer from alcove bog orchid populations.

Livestock grazing and trampling may be a threat to alcove bog orchid, which would decrease plant vigor. Livestock threats are primarily the result of unmanaged grazing, and differs from targeted grazing, which is proposed as a cultural treatment. Targeted grazing is restricted is proposed for Community Development Areas and agricultural fields. If alcove bog orchid is present in these locations, a fence would be established around the species to ensure that the 200 ft buffer is enforced.

Herbicide overspray to alcove bog orchid habitat may provide a cumulative impact with the known threats to its habitat, including livestock grazing and trampling and water development for livestock. If alcove bog orchid populations are compromised due to these outside pressures, herbicide overspray may further impact these susceptible populations. Climate change is a concern for species dependent on small seeps, including hanging gardens. Many of the species occurring in these rare habitats, including the alcove bog-orchid, rely on moisture for their existence. As the climate changes, this species may be synergistically impacted by herbicide overspray and trampling.

Removing noxious weeds species from areas adjacent to alcove bog-orchid populations would protect these populations from the potential threat of noxious weed invasion. The species conservation measures, including buffers identified for each treatment, and best management practices would eliminate the risk to alcove bog-orchid and allow weed treatments to not likely adversely affect the species.

Alcove Death Camas (*Anticlea vaginatus*)

Species Account

Alcove death camas is a stout perennial that sprouts from rhizomes. This species flowers from mid-July through August. Its habitat consists of hanging gardens, seeps, and alcoves, primarily on Navajo Sandstone, between 3,700 and 6,200 ft (1100 – 1900 m) in elevation. It is found in the backwall habitat and colluvial-detritus habitat in hanging gardens (Palmquist 2011). Populations are sporadic in distribution. The primary threat to this species is the potential impact of climate change and grazing and trampling by livestock.

Existing Environment

It is endemic to the Colorado Plateau in southern Utah and northern Arizona. On the Navajo Nation, it occurs hanging gardens in sandstone canyons surrounding Navajo Mountain in Coconino County, Arizona and San Juan County, Utah. There is a disjunct population in Canyon de Chelly National Monument (NNHP 2020). Potential habitat exists in the surrounding drainages into Lake Powell and Chinle Wash south of Canyon de Chelly (NNHP 2020).

Effects Analysis

Alcove death camas may have positive direct effects from a change in grazing management. A 5-year deferment period followed by adjustments to herd size based on carrying capacity, seasonal deferment, and rotational grazing would reduce the impacts of livestock on the alcove death camas habitat. This would lessen the impacts of trampling and grazing. Fencing springs where alcove death camas occurs would further protect the species over the long-term from trampling.

As a G3 tribally listed species, the Navajo Nation requires surveys for this species in areas with potential habitat. All identified populations would be flagged and designated buffers would be established. Therefore, it is unlikely that weed treatments will have direct impacts on alcove death camas individuals and habitat. Additionally, weed treatments are not proposed in hanging garden sites. Indirect effects include herbicide drift from chemical treatments. The species conservation measures and best management practices would reduce the indirect effect of herbicide drift from chemical treatments. Also, much of the habitat where alcove death camas may occur, including hanging gardens and seeps, are in remote and inaccessible areas where it is unlikely weed treatments would occur, and, if they do occur, wind drift herbicide would not reach the populations. It is unlikely these species would be impacted by mechanical treatments or trampling during manual treatments. However, the buffers outlined in the species conservation measures would be implemented and eliminate the effects of these treatments on this species.

The construction of stream stabilization structures would likely have no negative effect on alcove death camas. These structures are proposed for areas with severe streambank erosion issues and do not to occur in this species habitat. These structures would slow water and retain sediment on site, which may increase potential habitat for this species.

Climate change is a concern for species dependent on small seeps, including hanging gardens. Many of the species in these rare habitats, including the alcove death camas, rely on moisture for their existence. The proposed action for this project may mitigate some of the cumulative impacts that may occur from the current grazing management system, the threat of noxious weed invasion, and climate change. Addressing overgrazing, restoring riparian habitats, and fencing sensitive spring habitats would protect the alcove death camas and all hanging garden species from noxious weed competition and grazing and trampling.

By removing noxious weeds species from areas adjacent to alcove death camas populations would protect these populations from the potential threat of noxious weed invasion. The implementation of species conservation measures, including buffers identified for each treatment, and best management practices would eliminate the risks to alcove death camas and allow weed treatments to not likely adversely affect the species.

Aztec Gilia (*Aliciella formosa*)

Species Account

Aztec gilia is endemic to clay/sand soils of the Nacimiento Formation in salt-desert scrub communities ranging from 5,000 6,400 ft. in elevation. Vegetation cover in the badland habitats is sparse, but may consist of pinyon, Utah juniper, bitterbrush, Utah serviceberry, mountain mahogany, rabbitbrush, Mormon tea, Bailey's yucca, brown spine prickly pear, and Clover's hardwall cactus (Roth and Sivinski 2018). Due to its limited habitat range, it is found almost exclusively in San Juan County in New Mexico, although some have reported populations as far south as Sonora, Mexico (NatureServe 2016).

The Aztec gilia is most threatened by oil and gas development in the area, which occurs on the Nacimiento Formation, on the San Juan Basin. Such development has resulted in habitat loss and trampling or crushing of plants within the development areas. Plants have also been threatened by damage from recreational activities, such as off-road vehicles use (Heil and Herring 1999).

Existing Environment

On the Navajo Nation, it has been recorded in Kutz Canyon south of Bloomfield, New Mexico. The species may also exist south of Farmington and Bloomfield where the Nacimiento Formation occurs (NNHP 2020). In 2017, 107 out of 140 previously documented Aztec gilia populations were detected with a total of 13,674 plants documented on BLM lands (Roth and Sivinski 2018). This recent survey indicates that Aztec gilia populations are declining from original counts in 1992. The reason for these population declines is uncertain; however, oil and gas development, OHV use, and cattle grazing were uses detected in this species range.

Effects Analysis

Due to the limited range of the Aztec gilia on the Navajo Nation, it is likely that very few weed treatment projects would encounter or impact the plant. Additionally, any treatment sites in potential habitat for the Aztec gilia would require surveys conducted by a qualified biologist. Any identified populations would be flagged so field crews could follow the necessary buffers. These buffers and avoidance measures would minimize or eliminate any direct impacts on known gilia populations. In terms of indirect impacts, some plants may be impacted by trampling, mechanical equipment use, or herbicide drift from neighboring treatment areas. Damage or crushing of plants would be reduced or eliminated through the treatment buffers. Herbicides would also not be sprayed during high wind or humid conditions to prevent the risk of overspray.

In terms of cumulative impacts, continued development for oil and gas extraction and recreation in the area would continue to pose a threat to populations. If Aztec gilia populations are compromised from such activities, herbicide drift may further harm or impact these susceptible populations. Further stress on populations related to climate change, such as limited water availability and significant changes in seasonal temperatures, could also further exacerbate the effects of weed treatments to plant populations located in treatment sites.

The treatment of noxious weeds, however, would benefit the Aztec gilia, as treatments remove and control weed species that may outcompete the gilia in its known habitat. The species conservation measures, including buffers identified for each treatment, and best management practices would eliminate the risk to Aztec gilia and allow weed treatments to not likely adversely affect the species.

San Juan Milkweed (*Asclepias sanjuanensis*)

Species Account

Habitat for the San Juan milkweed consists of primarily sandy or sandy loam soils in pinyon-juniper woodlands and Great Basin grassland communities. Known populations occur from 5,000 to 6,200 ft. in elevation, often in disturbed sites. During dry years this species may not bloom.

Listed threats to the San Juan milkweed include land development and conversion of land to irrigated agriculture. While grazing occurs in its known habitat, no direct effects have been indicated (NMRTPC 1999).

Existing Environment

It primarily occurs in San Juan County in New Mexico, with potential for it to occur in southeastern Utah and northeastern Arizona. On the Navajo Reservation it is recorded from east of Highway 491 south of the San Juan River, and just south of the San Juan County line (NNHP 2020). The species may occur on the Navajo Nation within suitable habitat throughout San Juan and McKinley Counties in New Mexico.

Effects Analysis

The San Juan milkweed occurs in areas identified for treatment under the proposed action. The area indicated where known populations of the milkweed are present on the Navajo Nation is also area where the Navajo Agricultural Products Industry (NAPI) is located and where several Range Management Units (RMUs) and designated farmlands are managed by local land users. These areas have been prioritized for weed management under this action. As a G4 species, it is recommended that prior to weed treatment projects, biological surveys be conducted in proposed treatment areas to help identify, flag, and install buffers around populations so work crews can avoid damaging plants. The buffers in the species conservation measures would reduce and eliminate any direct impacts to milkweed populations found in treatment sites. Plants located outside of treatment sites may also be susceptible to indirect impacts, such as trampling from crews performing weed treatments, mechanical equipment use, and herbicide overspray to areas adjacent to the main treatment site. Educating field crew members to identify the San Juan milkweed, along with the proposed conservation measures would minimize and avoid damage to plants located directly outside of the treatment site.

While grazing does occur in the known habitat for the San Juan milkweed, it has not been shown to directly impact the species. Such grazing is largely due to unmanaged grazing of livestock and not from the use of targeted grazing as a cultural control method as described under this action. The use of cultural control (i.e. targeted grazing) would be restricted to Community Development Areas and agricultural fields, as long as fields are fenced. If the San Juan milkweed occurs in agricultural fields proposed for treatment, plants would be flagged and a fence would be installed around the plants to ensure a 200 ft buffer is enforced.

The San Juan milkweed is most impacted by agricultural land use and community development in its known habitat. Populations impacted by these factors may be more susceptible to impacts related to weed treatments, such as herbicide overspray or trampling. The avoidance measures previously described would help crews avoid plants and reduce or eliminate impacts associated with such treatments. By removing noxious weed species from areas adjacent to San Juan milkweed populations, these populations would be further protected from the potential threat that noxious weeds could have on the long-term conservation of this species. The proposed mitigation measures, including the buffers identified for each treatment method, and the best management practices would eliminate the risks to San Juan milkweed and allow weed treatments to not likely adversely affect the species.

Heil's Milk-vetch (*Astragalus heilii*)

Species Account

Heil's milk-vetch habitat consists of rocky ledges of the Mesa Verde Group in pinyon-juniper communities around 7,200 ft (NNHP 2020). It is currently only found in McKinley County in New Mexico (NMRPTC 1999b).

Existing Environment

On the Navajo Nation, it is only documented from its habitat near Borrego Pass, which currently is its only known location (NNHP 2020). More surveys are needed to understand this species abundance and distribution.

Effects Analysis

Heil's milk-vetch is currently only known from one population found on rocky ledges of the Mesa Verde geological formation near Borrego Pass on the Navajo Nation. Little is known about the factors that affect the species, making it hard to determine what impacts could potentially adversely affect the species. Currently the Heil's milk-vetch does not occur in any of the priority treatment areas. However, if noxious weed treatments are proposed in potential habitat for the Heil's milk-vetch, biological surveys of the area are recommended to identify any potential populations. These populations would be flagged, and buffers would be installed based on the proposed treatment methods. These measures would prevent trampling or damage to plants while treatments are implemented. Best management practices proposed for the use of herbicides, and avoidance buffers include restrictions during windy conditions, periods of high humidity, or when temperatures are greater than 80° F (26.7° C). Such measures would minimize or avoid adverse effects on the Heil's milk-vetch during chemical treatments.

Populations of Heil's milk-vetch may be located outside of the main weed treatment sites, and may be impacted indirectly through trampling, mechanical equipment use or transportation, or herbicide overspray. Educating field crews to identify and avoid plants found outside of the main treatment area would reduce these impacts. Avoidance measures, best management practices, and treatment buffers would also minimize damage to or avoid plants that could be indirectly impacted. Herbicides would also not be sprayed during periods of high winds or precipitation events to prevent overspray or drift into untreated areas.

Because little is known about the current threats that affect Heil's milk-vetch, it is hard to determine what impacts would contribute cumulatively to weed treatment and management. It is advised that the proposed species conservation measures and best management practices for the proposed weed treatment methods would reduce the potential for cumulative impacts to populations potentially impacted by additional environmental or land use stressors.

Treatment of noxious weed populations may likely benefit the milk-vetch. Noxious weed populations can impact native plant species by outcompeting plants for resources or by altering habitat conditions. By removing noxious weed species from areas adjacent to Heil's milk-vetch populations, these populations would be protected from the potential threat noxious weeds could have on the long-term conservation of this species. The proposed mitigation measures, including the buffers identified for each treatment method, and the best management practices would reduce or eliminate the risks to Heil's milk-vetch and allow weed treatments to not likely adversely affect the species.

Navajo Saltbush (*Atriplex garrettii* var. *navajoensis*)

Species Account

Navajo saltbush is a deciduous shrub growing up to 1.5 m in height. The species is found west of Marble Canyon near Navajo Bridge in Coconino County, Arizona. The species' habitat consists of salt desert shrub communities between 3000 – 4000ft. in elevation (NNHP 2020). It grows on Moenkopi Shale, often overlain with a Kaibab Limestone.

Navajo saltbush is considered narrowly endemic to the Navajo Bridge section of the Colorado River (Stutz 1978). The species is known to hybridize with the similar *A. occidentalis*, which affects its reproductive success (Sanderson and Stutz 2001). Recreation is also a potential impact in the area, as its habitat is near Grand Canyon National Park, Lee's Ferry, and Navajo Bridge. Because of its limited range, little is known about other potential threats affecting this species.

Existing Environment

On the Navajo Nation it is located on the east side of Marble Canyon from Lee's Backbone to Jackass Canyon; however, the species may exist on the east side of Marble Canyon and Glen Canyon from Glen Canyon Dam south and west to the Echo Cliffs and along tributary canyons of the Colorado River, south to Shinumo Wash (NNHP 2020).

Effects Analysis

Navajo saltbush is currently only known from a few populations found near Navajo Bridge and Marble Canyon on the Navajo Nation. Little is known about the factors that affect the species, making it hard to determine what impacts could adversely affect it. If noxious weed treatments are proposed in potential habitat for the Navajo saltbush, biological surveys of the area are recommended to identify any populations. If surveys are completed, identified populations would be flagged, and buffers would be installed based on the proposed treatment methods. These measures would prevent trampling or damage to plants while treatments are implemented. Best management practices proposed for herbicides, along with avoidance buffers, include restrictions during windy conditions, periods of high humidity, or when temperatures are greater than 80° F (26.7° C). Such measures would minimize or avoid adverse effects on the Navajo saltbush during any of the proposed noxious weed treatment methods.

Populations of Navajo saltbush located outside the main weed treatment sites, may be impacted indirectly through trampling, mechanical equipment use or transport, or herbicide overspray. The avoidance measures, best management practices, and treatment buffers would be implemented to avoid and minimize damage to plants as described above.

Because little is known about the current threats or factors that impact Navajo saltbush, determining cumulative impacts from weed treatment and management is difficult. It is advised that the proposed species conservation measures and best management practices for the proposed weed treatment methods would reduce the risk of cumulative impacts to populations already impacted by additional environmental or land use stressors.

Noxious weed treatment may benefit this species of saltbush. Noxious weed populations can impact native plant species by outcompeting other plants for resources or by altering habitats. By removing noxious weed species, Navajo saltbush populations would be protected from the potential threat noxious weeds may have on the long-term conservation of this species. The proposed mitigation measures would allow weed treatments to not likely adversely affect the species.

Atwood's Camissonia (*Camissonia atwoodii*)

Species Account

Atwood's camissonia is a winter annual herb that sprouts from a taproot. The plants proliferate following wet periods, making them hard to find during periods of drought. The species is endemic to a narrow portion of eastern Kane County, Utah near Last Chance Drainage. The species' habitat consists of salt desert shrub communities growing on clay soils of the Tropic Shale and Carmel Formations. Known populations occur between 4,060 and 5,000 ft. in elevation (NNHP 2020).

Threats to the camissonia include mining development and road construction in its known habitat (UNPS 2009). Because plants only tend to appear following years with sufficient rainfall, the overall trend of the population is unknown. Surveys conducted in the 1990s identified at least four distinct populations within the species' known habitat. While additional populations have been noted during subsequent surveys, no data on the size of these populations is known (NatureServe 2016d).

Existing Environment

Atwood's camissonia has not been reported on the Navajo Nation; however, there is potential habitat along shores and drainages of Lake Powell (NNHP 2020).

Effects Analysis

The Atwood's camissonia does not occur on the Navajo Nation, however, potential habitat does exist along the Navajo Nation side of Lake Powell. The species conservation measures would reduce or eliminate direct effects to populations that may occur in the main treatment areas. Some populations may be indirectly impacted by herbicide overspray or damage to plants from trampling or mechanical equipment transport and use in neighboring areas. As a G4 species it is recommended that surveys for plants and installation of fencing and flagging to mark treatment-specific avoidance buffers be implemented. Restrictions on the use of herbicides during periods of precipitation, high humidity, and high temperatures would reduce or eliminate indirect impacts to plants found within treatment sites. The removal of noxious weeds from camissonia habitat would benefit the species, by reducing competition and improving habitat quality. Therefore, it is determined that the proposed action would not result in adverse impacts to the Atwood's camissonia.

Cumulative impacts may occur to plants that are located near roads or mining sites. Road construction and mine development have been identified as major threats to this species of camissonia. Such impacts may make plants more susceptible to damage from herbicides or trampling. The conservation measures would help crews avoid additional impacts that may further stress or harm existing plants. Avoidance buffers would prevent treatments from damaging existing plants. Herbicide mitigation measures would reduce the risks of overspray and drift. These measures would reduce the potential for synergistic effects on the Atwood's camissonia.

Rydberg's Thistle (*Cirsium rydbergii*)

Species Account

Rydberg's thistle is considered an endemic to the hanging gardens of the Colorado Plateau, occurring in southeastern Utah and northern Arizona. Suitable habitat consists of hanging gardens, seeps, and sometimes stream banks below hanging gardens, between 3,300-6,500 ft. The species' restricted habitat makes it vulnerable to changes in groundwater availability that may be due to water diversion projects, groundwater pumping, and drought. Grazing and recreation near hanging garden habitats may also impact the species (May et al 2013).

Existing Environment

On the Navajo Nation, the species occurs in southern San Juan County, Utah and in Coconino and Apache Counties in Arizona (NNHP 2020).

Effects Analysis

Rydberg's thistle is an important indicator species for many hanging gardens in the Colorado Plateau. As a G4 tribally listed species, the Navajo Nation recommends surveys for this species in areas with potential habitat and identified populations flagged and designated buffers established. Therefore, it is unlikely that weed treatments will have direct impacts on Cutler's milk-vetch individuals and habitat. Buffers would be marked with flagging around identified populations to prevent weed treatment field crews from entering the buffer zone. There will be no direct effects to Rydberg's thistle since weed treatments are not proposed in hanging garden sites. Indirect effects include herbicide drift from chemical treatments. The likelihood of herbicide drift would be reduced by a 200 ft buffer for chemical treatments. Also, herbicides would not be applied when wind speeds exceed 10 miles per hour, temperatures are greater than 80° (26.7°), and humidity is high. Finally, many hanging gardens with Rydberg's thistles are in remote and inaccessible areas where it is unlikely weed treatments would occur, and, if they do occur, wind drift herbicide would not reach the populations. Other methods, such as mechanical, including prescribed fire, and cultural treatments, require a 200 ft buffer around identified populations. Due to the remote nature of hanging gardens, it is unlikely that heavy machinery would be used to treat weeds. Chainsaws may be used for cut stump treatments, but this technique is focused on trees and woody plants.

Livestock can also be a threat to Rydberg's thistle habitat due to grazing and trampling damage. Such impacts are primarily a result of unmanaged grazing, which differs from targeted grazing used as a cultural control method under this action. Targeted grazing is also restricted to Community Development Areas and agricultural fields, which require fencing around the treatment site.

No biological control agents for musk thistle, Canada thistle, and bull thistle are permitted under the plan due to their close relation to Rydberg's thistle. Three other thistles (spotted knapweed, yellow starthistle, and diffuse knapweed) also have biological control agents to control their populations. These agents are specific to the *Centaurea* family and have not been indicated for control of species outside of this family of thistles. Specificity testing is required of all biological control agents to further rule out the risk of these species negatively impacting other plant species in related genera. Many of the species proposed have already been released in the continental United States, some in states in or near the Navajo Nation (**Table 18**). As a result, the proposed agents have been permitted for by APHIS for some time and have not shown impacts on any of the native thistle populations. Because of these factors, it is not likely that biological control agents would adversely affect the Rydberg thistle under the proposed action.

Table 18. Biological control agents proposed for the management of thistles as proposed by the BIA Navajo Region Integrated Weed Management Plan. Date of release is based on information from the APHIS Technical Advisory Group for Biological Control Agents for Weeds (2013).

Proposed Agent	Type	Target Weed Species	Year released in the U.S.	States Released
Bangasternus fausti	Seed head feeding weevil	Spotted knapweed Diffuse knapweed	1990	CA, CO, ID, MO, MT, NE, OR, SD, UT, WA, WY[1]
Bangasternus orientalis	Seed head feeding weevil	Spotted knapweed Diffuse knapweed Yellow starthistle	1985	CA, ID, OR, UT, WA[2]
Chaetorellia australis	Starthistle peacock fly	Yellow starthistle	1988	CA, ID, OR, WA[2]
Cyphocleonus achates	Root feeding weevil	Spotted knapweed Diffuse knapweed	1988	CO, MT, NE, OR, UT, WA, WY[1]
Eustenopus villosus	Starthistle hairy weevil	Yellow starthistle	1990	AZ, CA, ID, OR, UT, WA[2]
Jaapiella ivannikovi	Diptera: Cecidomyiidae	Russian knapweed	2009	CO, MT, WY, OR[2]
Larinus minutus	Seed head feeding weevil	Spotted knapweed Diffuse knapweed	1991	CA, CO, MN, MT, NE, NV, OR, SD, UT, WA, WY[1]
Larinus obtusus	Seed head feeding weevil	Spotted knapweed	1993	CO, ID, MN, MT, NE, OR, SD, WA, WY[1]

[1] Cornell University, College of Agriculture and Life Sciences. 2009. Biological Control: A Guide to natural enemies of North America. Available online at: http://www.biocontrol.entomology.cornell.edu/weedfeedTOC.php. Last visited on Jan 21, 2016.

[2] Whitehall High School and Montana Weed Control Association. Montana War on Weeds: Biological Control Agents Website. Available online at: http://mtwow.org/Bio-Control-main.htm. Last visited Jan 21, 2016.

Herbicide overspray to populations of Rydberg's thistle may provide a cumulative impact with the known threats to its habitat, including livestock grazing, trampling, and water development. If Rydberg's thistle populations are comprised by these outside pressures, herbicide overspray may further affect these susceptible populations. The effect of grazing, trampling, climate change, and water development on hanging gardens fluctuates from year to year, meaning that the risk of synergistic impacts would vary as well.

Removal of noxious weed species from areas adjacent to Rydberg's thistle populations would protect the species from impacts related to noxious weed invasions. It is essential that the personnel conducting the treatments can distinguish Ryberg's thistle from noxious thistles targeted for removal. The mitigation measures, including buffers identified for each treatment method, and best management practices would eliminate the risk to Rydberg's thistle and allow weed treatments to not adversely affect the species.

Utah Bladder-fern (*Cystopteris utahensis*)

Species Account

The Utah bladderfern is found in hanging gardens in the southwest. Habitat consists of seeps, cracks, and ledges on cliffs formed from calcareous substrates including sandstone, limestone, and dacite, commonly those of the Weber formation (AGFD 2005d). Populations are known from 4,200 to 8,800 ft. in elevation. The bladderfern is listed as a sensitive species due to its limited range and its association with hanging gardens in the southwestern United States.

Existing Environment

It was formally thought to only occur on the Navajo Nation at Canyon de Chelly, but additional populations have been found in Coconino and Yavapai Counties in Arizona and in southern Utah (AGFD 2005d, NNHP 2020).

Effects Analysis

Prior to weed treatments, surveys by trained biologists are recommended to identify populations of Utah bladderfern in potential habitat identified at treatment sites. As a G4 tribally listed species it is recommended that buffers be marked with flagging based on the proposed treatment methods around identified populations to prevent field crews from entering the buffer zone.

There will be no direct effects to Utah bladder since weed treatments are not proposed in hanging garden sites. Indirect effects include herbicide drift from chemical treatments. The likelihood of herbicide drift would be reduced by a 200 ft buffer for chemical treatments. Also, herbicides would not be applied when wind speeds exceed 10 miles per hour, temperatures are greater than 80°F (26.7°C), and humidity is high. Finally, many hanging gardens with Utah bladderferns are in remote and inaccessible areas where it is unlikely weed treatments would occur, and, if they do occur, wind drift herbicide would not reach the populations. Other methods, such as mechanical, including prescribed fire, and cultural treatments, require a 200 ft buffer from identified populations. Due to the remote nature of hanging gardens, it is unlikely that heavy machinery would be used to treat weeds. Chainsaws may be used for cut stump treatments, but this technique is focused on trees and woody plants, which may occur in hanging gardens.

Livestock can be a threat to Utah bladderfern habitat due to grazing and trampling damage. Such impacts are primarily a result of unmanaged grazing, which differs from targeted grazing used as a cultural control method under this action. If Utah bladderfern populations are present where targeted grazing is implemented, a fence would be established around the hanging garden to ensure a 200 ft buffer is enforced.

Herbicide overspray to populations of Utah bladderfern may provide a cumulative impact with known threats to its habitat, including livestock grazing, trampling, and water development. If Utah bladderfern populations are compromised due to these outside pressures, herbicide overspray may further impact susceptible populations. The effect of grazing, trampling, climate change, and water development on hanging gardens fluctuates from year to year, meaning that the risk of synergistic impacts would vary as well.

Removal of noxious weed species from areas adjacent to Utah bladderfern populations would protect the species from impacts related to noxious weed invasions. The mitigation measures, including buffers identified for each treatment method, and best management practices would eliminate the risk to Utah bladderfern and allow weed treatments to not adversely affect the species.

Sivinski's Fleabane (*Erigeron sivinskii*)

Species Account

Sivinski's fleabane habitat consists of steep, barren, shale slopes of the Chinle Formation where it can be locally abundant, in pinyon-juniper woodland and Great Basin Desert scrub communities. Known populations from 6,100 to 7,400 ft (NNHP 2020) in elevation. The species occurs in McKinley County in New Mexico and Apache County in Arizona (AGFD 2005). This species is a sensitive due to its narrowly endemic status in its range, although it can withstand some disturbance (NatureServe 2016e).

Existing Environment

On the Navajo Nation, the plant is found on east and west facing slopes of the Carrizo and Chuska Mountains, the Cove area, the Round Rock area, and north of Navajo in San Juan County, New Mexico and Apache County, Arizona. Elsewhere on the Navajo Nation, the species may exist north of I-40 in New Mexico and in the Chuska Mountains (NNHP 2020).

Effects Analysis

Due to the rarity of the species in the project area and barren slope habitat, it is unlikely that weed treatments would directly affect Sivinski's fleabane. However, weed treatments may take place near populations and have the potential to indirectly affect individual plants through trampling, mechanical equipment, and herbicide overspray. As a G4 tribally listed species, the Navajo Nation recommends surveys and conservation measures for Sivinski's fleabane in areas with potential habitat. The recommended species conservation measures would likely reduce or eliminate such impacts by identifying known plants so field crews can avoid them during weed treatments. Measures such as installing flagging and fencing at buffer perimeters around identified plants would reduce or eliminate disturbance from mechanical and manual treatments. Herbicides would also not be administered during high wind and humid conditions to prevent overspray to areas adjacent to treatment sites.

In terms of cumulative impacts, additional trampling from grazing, land use, and recreational activities near populations may have synergistic effects when coupled with weed treatments. The additional stress on the plants from such activities happening within relatively short periods of time from each other may contribute to the decline of the species from its known locations. Additionally, impacts from climate change, specifically extended periods of drought, may also contribute to the species' decline by stressing existing populations, making plants more susceptible to impacts from weed treatments. The species conservation measures can reduce or eliminate the overall impact of such cumulative effects by helping field crews avoid known populations and utilize treatment methods that would further protect the species.

Sarah's Buckwheat (*Eriogonum lachnogynum var. sarahiae*)

Species Account

Sarah's Buckwheat suitable habitat consists of windswept mesa tops in pinyon – juniper communities between 5,900- 7,500 ft. in elevation (NNHP 2020). This species is endemic to the Owl Rock Member of the Chinle Formation, topped by Todilto limestone. The species occurs in very small, widely scatter populations that may be impacted by mining operations and road building projects in its habitat. Because it is considered unpalatable by livestock, grazing does not pose much of a threat to its conservation (NMRPTC 1999).

Existing Environment

Sarah's Buckwheat occurs in McKinley County in New Mexico, the Chuska Mountains, and Apache and Navajo Counties in Arizona (NMRPTC 1999). Only a few plants have been recorded on the Navajo Nation in the vicinity of Red Valley, north of Red Lake. The species may exist in the Chuska Mountains between Lupton, Arizona and Prewitt, New Mexico (NNHP 2020).

Effects Analysis

Sarah's buckwheat is most threatened by activities that alter habitat suitability or that directly damage existing plant populations. Surveys are for Sarah's buckwheat plants are recommended in the treatment area to identify, flag, and install the appropriate treatment buffers to avoid and minimize direct impacts to plants during noxious weed treatments, either through trampling, mechanical equipment use, or herbicide spraying. Some populations may occur outside the treatment area and may be at risk for indirect impacts from workers traveling to and from treatment areas, moving equipment, or from herbicide overspray or drift. Herbicides would not be applied when windy or humid conditions are anticipated, or if outside temperatures rise above 80°F (26.7°C) to avoid overspray and drift. These measures would prevent noxious weed treatments from adversely impacting Sarah's buckwheat.

Populations of Sarah's buckwheat impacted by mining operations, development, or road construction, may experience additional stress that would result in a cumulative impact in areas also treated for noxious weeds. These additional stressors may make populations more susceptible to damage from weed treatments. The removal of noxious weed species, however, would also benefit Sarah's buckwheat by reducing competition and habitat alteration caused by many of the target weed species. The mitigation measures, such as enforcement of avoidance buffers and limitations on herbicide use, would reduce the impacts associated with noxious weed management to limit such synergistic impacts.

Bluff Phacelia (*Phacelia indecora*)

Species Account

The bluff phacelia is a localized endemic, occurring in hanging gardens of salt desert communities between 3,600 ft. and 4,500 ft. in elevation in San Juan County in Utah (NNHP

2020). This species' range consists of<40-100 square miles (<100-250 square km) (NatureServe 2021).

Because bluff phacelia's habitat is composed of hanging gardens, which are endemic in this portion of the southwest, threats such as water development, grazing, and damage from recreation are believed to also impact this species.

Existing Environment

This species has not been documented on the Navajo Nation; however, it may occur in the San Juan River drainage on the Navajo Nation (NNHP 2020).

Effects Analysis

The bluff phacelia is endemic to hanging gardens on the Colorado Plateau. If this species occurs at the project site, buffers marked with flagging are recommended based on the proposed treatment methods around identified populations to prevent field crews from entering the buffer zone. This is a G4 tribally listed species and surveys and conservation measures are recommended.

There will be no direct effects to bluff phacelia since weed treatments are not proposed in hanging garden sites. Indirect effects include herbicide drift from chemical treatments. The likelihood of herbicide drift would be reduced by a 200 ft buffer for chemical treatments. Also, herbicides would not be applied when wind speeds exceed 10 miles per hour, temperatures are greater than 80°F (26.7°C), and humidity is high. Finally, many hanging gardens with bluff phacelia are in remote and inaccessible areas where it is unlikely weed treatments would occur, and, if they do occur, wind drift herbicide would not reach the populations. Other methods, such as mechanical, including prescribed fire, and cultural treatments, require a 200 ft buffer from identified populations. Due to the remote nature of hanging gardens, it is unlikely that heavy machinery would be used to treat weeds. Chainsaws may be used for cut stump treatments, but this technique is focused on trees and woody plants.

Livestock can also be a threat to bluff phacelia habitat due to grazing and trampling damage. Such impacts are the result of unmanaged grazing, which differs from targeted grazing used as a cultural control method under this action. Targeted grazing is also restricted to Community Development areas and agricultural use areas. If bluff phacelia is present in these locations, a fence would be established around the hanging garden to ensure a 200 ft buffer is enforced.

Herbicide overspray to populations of bluff phacelia may provide a cumulative impact with the known threats to its habitat, including livestock grazing, trampling, and water development. If bluff phacelia populations are comprised due to these outside pressures, herbicide overspray may further impact these susceptible populations. The effect of grazing, trampling, climate change, and water development on hanging gardens fluctuates from year to year, meaning that the risk of synergistic impacts would vary as well.

Removal of noxious weed species from areas adjacent to bluff phacelia populations would protect the species from impacts related to noxious weed invasions. The mitigation measures, including buffers for each treatment method, and best management practices would eliminate the risk to bluff phacelia and allow weed treatments to not adversely affect the species.

Cave Primrose (*Primula specuicola*)

Species Account

Cave primrose is endemic to the canyons found along the Colorado River in northern Arizona and southern Utah (AGFD 2004a). Suitable habitat consists of hanging gardens and occasionally stream sides in Entrada and Navajo Sandstone Formations between 3,500 and 7,200 ft. in elevation (NNHP 2020). In the Grand Canyon it occurs in seeps in Kaibab and Redwall limestone. Threats to the species are unknown due to the remoteness of its habitat, but recreation may impact the species (AGFD 2004a).

Existing Environment

On the Navajo Nation, it occurs in the Chinle Wash area and in canyons surrounding Navajo Mountain. The species may occur in any of the hanging gardens in the Chinle Wash drainage and in canyons north and south of Navajo Mountain (NNHP 2020).

Effects Analysis

The cave primrose is endemic to hanging gardens on the Colorado Plateau. If this species occurs at a project site, buffers marked with flagging around identified populations are recommended based on the treatment methods to prevent field crews from entering the buffer zone.

There will be no direct effects to cave primrose since weed treatments are not proposed in hanging garden sites. Indirect effects include herbicide drift from chemical treatments. The likelihood of herbicide drift is reduced by a 200 ft buffer for chemical treatments. Also, herbicides would not be applied when wind speeds exceed 10 miles per hour, temperatures are greater than 80°F (26.7°C), and humidity is high. Finally, many hanging gardens with cave primrose are in remote and inaccessible areas where it is unlikely weed treatments would occur, and, if they do occur, wind drift herbicide would not reach the populations. Other methods, such as mechanical, including prescribed fire, and cultural treatments, require a 200 ft buffer from identified populations. Due to the remote nature of hanging gardens, it is unlikely that heavy machinery would be used to treat weeds. Chainsaws may be used for cut stump treatments, but this technique is focused on trees and woody plants.

Herbicide overspray on populations of cave primrose may provide a cumulative impact with the known threats to its habitat, such as trampling from recreational users. If cave primrose populations are comprised by these outside pressures, herbicide overspray may further impact these susceptible populations. Removal of noxious weed species from areas adjacent to cave primrose populations would protect the species from noxious weed impacts. The mitigation measures, including buffers for each treatment method, and best management practices would eliminate the risk to cave primrose and allow weed treatments to not adversely affect the species.

Marble Canyon Dalea (*Psorothamnus arborescens var. pubescens*)

Species Account

The Marble Canyon dalea is found in drainages of the Colorado River in Marble Canyon and the Grand Canyon in southern Utah and northern Arizona (NatureServe 2016f). Suitable habitat consists of mixed desert shrub communities growing on soils derived from the Moenkopi Formation between 3,400 and 4,900 ft. (NNHP 2020). While grazing is common in the dalea's native habitat, little is known about any specific threats or impacts on the species.

Existing Environment

On the Navajo Nation, the dalea has been recorded in the Navajo Springs area south of Navajo Bridge. The species may occur from Lee's Backbone to Bitter Springs (NNHP 2020).

Effects Analysis

The Marble Canyon dalea is considered narrowly endemic to the sandstone cliffs found at Marble Canyon and the Grand Canyon. Little is currently known about factors that threaten the Marble Canyon dalea, although populations are limited with relative few individuals (NatureServe 2016). The recommended conservation measures would minimize or eliminate the risk of weed treatments to directly or indirectly impact the dalea in its known habitat. Indirect impacts may include those related to trampling, mechanical equipment use nearby, damage from prescribed burning, and herbicide overspray into non-treated areas. Herbicides would not be used when windy conditions, high temperatures, high humidity, or precipitation are forecast for the area, which can prevent and reduce herbicide drift to non-treatment sites.

Grazing in the area may present a cumulative impact, as unmanaged grazing can create pressure on existing populations, making them more susceptible to impacts from trampling from field crews or mechanical equipment use and contact with some herbicides. However, the species conservation measures, would minimize, or avoid impacts from weed treatments, reducing potential synergistic impacts. Removal of noxious weed species from areas adjacent to Marble Canyon dalea populations would protect the species from noxious weed impacts. The mitigation measures, including buffers identified for each treatment method, and best management practices would eliminate the risk to Marble Canyon dalea and allow weed treatments to not adversely affect the species.

Parish's Alkaligrass (*Puccinella parishii*)

Species Account

Parish's alkaligrass suitable habitat includes alkali seeps, springs, and seasonally wet areas such as washes where soils are wet or moist throughout the year. It occurs in alkaline clay soils. It does not occur in dense vegetation or where water is not present at the surface for part of the year (Greene and Sanders 2006). Populations occur between 800 to 2,200 m (2,600 to 7200 ft.)

(NNHP 2020). This species is threatened by reduction of water, trampling from livestock, and noxious weed invasion.

Existing Environment

On the Navajo Nation, this species occurs in Utah in San Juan County northeast of Beclabito and in the vicinity of Two Grey Hills (NNHP 2020). The species may exist anywhere on the Navajo Nation in alkali seeps, springs, or seasonally wet areas (NNHP 2020). This species does occur within Coconino Co, AZ, near Tuba City; in Navajo Co, AZ, near Shonto; Apache Co, AZ, near Tees Nos Pos, Monument Valley and south of Red Valley, and San Juan Co, NM, east of Beclabito and in the vicinity of Two Grey Hills.

Effects Analysis

Since Parish's alkali grass does not grow in dense vegetation but may be impacted by tamarisk and Russian olive treatments in riparian areas. The species conservation measures would eliminate direct effects to this species from noxious weed treatments. Noxious weed invasion is a threat to this species, so weed treatments in adjacent habitats would prevent the spread of noxious weeds. There may be indirect effects to this species from herbicide drift from chemical treatments or trampling and destruction of habitat from manual or mechanical treatments during site access. As a G4 tribally listed species, it is recommended that surveys are conducted, and species conservation measures are implemented. The best management practices would reduce the indirect effects of herbicide drift from chemical treatments and unintentional trampling.

Climate change is a concern for Parish's alkali grass since it depends on moist soils. Cumulative impacts may occur as the climate changes and this species' habitat is reduced. Herbicide overspray and trampling may further impact the vigor and density of this species. However, implementing noxious weed removal would reduce competition of noxious weeds and may increase moisture levels.

Arizona Rose Sage (*Salvia pachyphylla ssp. eremopictus*)

Species Account

Arizona rose sage habitat consists of barren desert shrub lands and pinyon-juniper communities on basalt or soils derived from the Chinle Formation, between 5,500 and 6,500 ft. (Taylor and Ayers 2006, NNHP 2020). While this subspecies is rare, its population appears stable (AZGFD 2014c).

Existing Environment

This species is found in California, Nevada, and Arizona, but the subspecies is endemic to northeast Arizona (AZGFD 2014c). This subspecies occurs from Meteor Crater to Petrified Forest National Park and north to Hopi Buttes area (AZGFD 2014c). On the Navajo Nation, it is often found along the base of volcanic plugs, mesa tops, and slopes (NNHP 2020). It has been found north of Dilkon in Navajo County. The species may occur along the southern boundary of the Navajo-Hopi Reservation to the southern boundary of the Navajo Nation, between just north of Winslow and Petrified Forest National Park (NNHP 2020).

Effects Analysis

Arizona rose sage has a limited range; however, it can be abundant where it occurs. Also, this species occurs on barren slopes, where noxious weeds are unlikely. Therefore, it is unlikely that noxious weed treatments would occur in this species' habitat and no direct impacts are anticipated. Weed treatments may indirectly affect individual plants through trampling, the use of mechanical equipment, and herbicide overspray. The species conservation measures are recommended and would likely reduce or eliminate such impacts by identifying known plants so field crews can avoid them during weed treatments. Measures, such as installing flagging and fencing at buffer perimeters around identified plants, will reduce or eliminate disturbance from mechanical and manual treatments. Herbicides would also not be administered during high wind and humid conditions to prevent overspray to areas adjacent to treatment sites.

Cumulative impacts may occur from the additive, indirect effects of weed treatments on the current disturbances from trampling due to grazing, land use, and recreational activities. The additional stress on the plants from these activities in relatively short periods of time may contribute to the decline of the species from its known locations. Additionally, impacts from climate change, specifically extended periods of drought, can also contribute to the species' decline by stressing existing populations, making plants more susceptible to impacts from weed treatments. The species conservation measures can reduce or eliminate the overall impact of such cumulative effects by helping field crews avoid known populations and utilize treatment methods that would protect the species.

Welsh's American-aster (*Symphyotrichum welshii*)

Species Account

Welsh's American-aster suitable habitat consists of wet meadows, seeps, springs, and hanging gardens between 4,300 and 8,000 ft. where they are locally abundant (NNHP 2020). They occur primarily on wet sandstone and limestone habitats (NatureServe 2021).

On the Navajo Nation, known populations occur within grazing habitat, although no direct impacts have been observed. Other threats include drying up of hanging gardens due to climate change (NatureServe 2021a). The species is considered protected by the remote nature of the hanging gardens where they occur (NatureServe 2016g).

Existing Environment

On the Navajo Nation, it is only known from one population in the Tsegi watershed in northern Navajo County. However, it may occur in northern Coconino and Navajo Counties (NNHP 2020). This species is currently known from 3 occurrences on the Navajo Nation in Arizona, however more occurrences may be present where hanging gardens occur (NatureServe 2021a).

Effects Analysis

To prevent field crews from trampling the aster in treatment sites, buffers marked with flagging are recommended based on the proposed treatment methods. There will be no direct effects to Welsh's American-aster since weed treatments are not proposed to hanging garden sites, although populations in other wetland habitats may require weed treatments. Indirect effects include herbicide drift from chemical treatments. The likelihood of herbicide drift would be reduced by a 200 ft buffer for chemical treatments. Also, herbicides would not be applied when wind speeds exceed 10 miles per hour, temperatures are greater than 80°F (26.7°C), and humidity is high. Finally, many hanging gardens with Welsh's American-aster are located in remote and inaccessible areas where it is unlikely weed treatments will occur, and, if they do occur, wind drift herbicide would not reach these populations. Other methods, such as mechanical, including prescribed fire, and cultural treatments, require a 200 ft buffer from identified populations. Due to the remote nature of hanging gardens, it is unlikely that heavy machinery would be used to treat weeds. Chainsaws may be used for cut stump treatments, but this technique is focused on trees and woody plants.

Livestock can also be a threat to Welsh's American-aster habitat due to grazing and trampling damage. Such impacts are primarily a result of unmanaged grazing, which differs from targeted grazing used as a cultural control method under this action. Targeted grazing is restricted to Community Development areas and agricultural areas. If Welsh's American-aster populations are present in targeted grazed locations, a fence would be established around the hanging garden to ensure a 200 ft buffer is enforced.

Herbicide overspray to populations of Welsh's American-aster may provide a cumulative impact with the known threats to its habitat, including livestock grazing, trampling, and water development. If Welsh's American-aster populations are compromised due to these outside pressures, herbicide overspray may further impact these susceptible populations. The effect of grazing, trampling, climate change, and water development on hanging gardens fluctuates from year to year, meaning that the risk of synergistic impacts would vary as well.

Removal of noxious weed species from areas adjacent to Welsh's American-aster populations would protect the species from impacts related to noxious weed. The mitigation measures, including buffers identified for each treatment method, and best management practices would eliminate the risk to Welsh's American-aster and allow weed treatments to not adversely affect the species.

6. Determination

The species listed above do occur in the action area for this project. Project-specific actions tiering off this document would require further biological evaluation by submitting a Data Request Form for the project to NNHP. The Data Request Form requires the specific weed treatment methods proposed and maps of the project area. The project sponsor is required to obtain a Biological Resource Compliance Form (BRCF) to initiate the project. The BRCF will determine if potential habitat for Federal or Navajo Listed Endangered, Threatened, Sensitive, or Proposed species or migratory birds exists at the site. If potential habitat occurs at the site, the project sponsor will have to complete species or habitat assessments by a qualified and permitted biologist, implement species conservation measures, and/or have a qualified biologist on site during project implementation. If federally listed species occur or have the potential to occur the Service will be copied on any correspondeºnce to the NNHP.

To conduct species surveys, a Native Endangered Species Recovery Permit will be obtained from the USFWS (if it is a species listed on the federal Endangered Species Act). Permitted consultants conducting surveys should be obtained from the NNHP permitted consultants list. Surveys will be conducted according to protocols approved by the USFWS and NNHP. If a listed species is found, the appropriate species-based protection measures would be implemented, or the species will be avoided. If the species is not present after species surveys are conducted, no buffers need to be employed. It is anticipated there will be long-term beneficial effects to the listed species above by the removal of noxious weeds. Based on the species conservation measures described above, the Integrated Weed Management Plan **may affect, but is not likely to adversely affect** the species or critical habitat discussed above.

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APPENDIX K. ANALYSIS OF HERBICIDES UNIQUE TO THE NAVAJO NATION IWMP

Introduction

This appendix compiles information on six herbicides unique to the Navajo Nation Integrated Weed Management Plan (NNIWMP). While most of the herbicides proposed for use in the NNIWMP are analyzed for their potential environmental impacts in other NEPA documents incorporated by reference, six of the herbicides have not been previously assessed. The NEPA documents incorporated by reference for this PEIS include:

- Final Environmental Impact Statement for Integrated Treatment of Noxious or Invasive Weeds for the Coconino, Kaibab, and Prescott National Forests within Coconino, Gila, Mojave, and Yavapai Counties, Arizona (2005)
- Final Programmatic Environmental Impact Statement: Vegetation Treatments Using Herbicides on Bureau of Land Management Lands in 17 Western States (2007)
- Final Programmatic Environmental Impact Statement for Vegetation Treatments Using Aminopyralid, Fluroxypyr, and Rimsulfuron on Bureau of Land Management Lands in 17 Western States (2016)

In addition to these NEPA documents, the U.S. Forest Service prepared risk assessments for several of the herbicides proposed in the NNIWMP. These risk assessments provide in-depth and technical information on the environmental fate, human health risks, exposure risk assessments, and ecological risk assessments. Environmental fate assessments provide an evaluation of how herbicides may persist and or move around in treated areas. This information is valuable for evaluating potential risks to soils and water resources. Human health risks review studies and information on how the herbicides may affect human health based on toxicology information. These assessments also include an analysis of whether the public, applicators, and other workers are at risk of encountering harmful concentrations of herbicides based on the herbicide’s label instructions, and approved application rates. This information is used to assess potential risks to public health.

Finally, ecological risk assessments examine each herbicide’s toxicity on terrestrial and aquatic organisms, including birds, reptiles, amphibians, mammals, and plants. While the EPA does require herbicide manufacturers to conduct toxicology studies as part of its registration process, it does not require companies to complete studies for each class of animals or plant forms. As a result, some toxicology information is not well known for some animals or may not be comparable between herbicides. To address this issue, many of the wildlife and plant studies may require that only the tested species be listed to allow for applicable comparisons and denote areas where information may be lacking. Overall, the ecological risk assessments prepared by the USFS are used in the PEIS in evaluating potential risks and impacts for wildlife and vegetation.

Herbicides Evaluated in Detail

While the BIA has utilized this information and incorporated into the PEIS for the NNIWMP, seven herbicides proposed under the action were not evaluated in any of these documents. These herbicides are listed below with the brand name products that may include them in parentheses. Because brand name herbicides may contain one or more active ingredients or may change formulations over time, the analysis refers to the herbicides by active ingredients only. The active ingredients are what the U.S. EPA requires manufacturers to develop their ecological, environmental, and human health analyses on. Thus, familiarity with the active ingredients is essential when selecting herbicides for a project and for any related environmental analyses.

- Dichlobenil (Redeem, Casoron)
- Metribuzin (Sencor)
- Paraquat (Gramoxone)
- Pendimethalin (Pendulum)
- Prodiamine (Evade)
- Thifensulfuron methyl (Volta)

For this PEIS, information was compiled from existing peer-review studies and U.S. EPA product registration reports to evaluate the potential risks they may pose to human health and the environment. This technical information has been compiled here for reference.

Herbicide analysis requires detailed, technical studies that look at potential side effects, model potential mobility of chemical agents, and an understanding of chemical toxicology. This analysis evaluates a variety of studies with laboratory animals or plants exposed to a wide array of herbicide concentrations. Such studies serve as proxies for how the herbicide may interact with humans or other animals and plants with similar biology. While they can provide valuable information on how herbicides may affect living organisms, they cannot be taken as full evaluations of the potential risks herbicides pose when use. Many of these studies have time constraints that make it hard to fully evaluate the potential risks of long-term exposure. Others may not evaluate some animal classes in their toxicology studies, and thus have incomplete information.

This appendix will provide the detailed analysis for these seven herbicides in for the resources analyzed in the Draft PEIS.

Soils and Water

The environmental fate of an herbicide determines its risk of remaining at treated sites, where it may expose the public, or travel to other areas and affect resources there. The risks depend on how much herbicides is applied, how long it takes to degrade, and how it dissolves in water. These factors are important in evaluating whether herbicide applications can be transported from sites at high enough concentrations to affect vegetation, wildlife, or the public. The U.S. EPA considers these factors when setting herbicide application limits for concentrations used, how frequently they are applied, and where they can be applied.

The fate of herbicides in the environment often depends on the interactions between soil and water. Risks to air quality are less of a concern as most herbicides do not remain airborne long after they are applied. They are also often mixed with other ingredients to increase their droplet size and weight to prevent airborne contamination. However, for herbicide applications under this plan, after sites are sprayed with herbicide, there is a risk that the herbicide may soak, or leach, into the ground and travel to groundwater reservoirs or to nearby open water through surface runoff or wind erosion. If sites are treated with high enough concentrations at frequent enough intervals, these risks could result in water contamination or indirect impacts to nearby vegetation or wildlife.

Soils

Herbicides vary in how they interact with soils and whether they can remain at sites for extended periods after they are applied. The most important factors in determining the impacts of an herbicide on soil are its mobility, persistence, and how it breaks down or degrades. These factors are determined by each herbicide's chemical properties, such as adsorption or affinity to soil particles, solubility, chemical half-life, and volatilization. Soil properties that influence the fate of herbicides in soils include organic matter content, pH, temperature, moisture content, soil texture and composition, climate, and microbial activity. Most herbicides degrade over time due to physical and chemical processes in soil and water. Herbicide degradation generally decreases with soil depth, as light, water, and microorganisms become less available. Persistence and mobility of herbicides may also be influenced by the formulation of the active ingredient. The overall impacts of herbicides on soil resources would depend on which herbicides are selected for a given project, the proposed application rates, and the frequency of retreatments.

Below are the environmental fates for the herbicides based on soil adsorption, water solubility, overall persistence in the environment, and degradation mechanisms to determine how long each herbicide may remain in the soils at a particular site.

Dichlobenil is considered moderately persistent in soils with an average half-life of 60 days. Its primary means of degradation is through microbial decomposition, which metabolizes the herbicide into 2,6-dichlorobenzamide (BAM) (BPA 2008). It also has moderate mobility in soils, with a soil adsorption rate (K_{oc}) of 400 (BPA 2008)

Metribuzin is considered moderately persistent in soils with a half-life that varies between to 1 to 2 months depending on climatic conditions and soil texture. It has a higher soil adsorption rate in soils with high clay or organic content but can leach through soils with high sand content. Its main mechanism for degradation is through microbial composition, which is fastest under aerobic conditions and at high temperatures (U.S. EPA 1985).

Paraquat has a low risk of soil mobility due to its high soil adsorption rate but can remain on sites for long periods of time due to its prolonged half-life, which can vary from 60 day to years depending on conditions. While it is soluble in water, it binds so quickly and strongly to soils that it does not stay in solution. Its soil binding strength also limits the ability of it to breakdown through photodegradation and microbial degradation (U.S. EPA 2019a)

Pendimethalin has a low risk of soil mobility due to its strong affinity for soil particles and can remain on sites for prolonged periods of time, which can decrease with increased temperature, moisture, and soil carbon. Its main method of decomposition is through microbial metabolism and volatilization (U.S. EPA 1997a)

Prodiamine is considered relatively immobile in soils due to its strong affinity for soils and it does not persist for long at sites. It can degrade rapidly through photodegradation and is also metabolized through microbial activity, which is higher under anerobic conditions with an average half-life of approximately 2 months (U.S. EPA 1992)

Thifensulfuron methyl is mobile in soils with a soil adsorption rate (K_{foc}) of 28. However, it does not persist long at sites due to its ability to degrade through microbial metabolism and photodegradation (U.S. EPA 2015).

Water

While only three of the herbicides proposed in the Navajo Nation IWMP have Navajo Nation EPA water quality standards associated with them, all herbicides may have the potential to persist accumulate in water depending on how they behave in the environment. Herbicides may be transported to open water if through surface runoff or wind erosion. If they have a higher affinity for water, they may transfer from soils to water, where they may pose a risk to nearby vegetation, wildlife, or humans. Below is a summary of the six herbicides potential risks to water quality based on their environmental fates.

Dichlobenil has moderate potential to leach through soils and contaminate ground water. It does have a high risk of contaminating surface water due to its moderate affinity for soils and moderate water solubility. However, microbial metabolism of dichlobenil may limits its long term persistence in water (BPA 2008)

Metribuzin has a higher potential to contaminate groundwater in areas with sandier soils, due to its limit affinity for sand particles. Its variable soil adsorption rate and moderate water solubility also increases its potential to contaminate surface water. There have been reported cases of surface water contamination in Ohio rivers and Iowa wells (U.S. EPA 1985).

Paraquat's strong soil affinity reduces its potential to contaminate water as it is less likely to dissolve in water or leach through soils. Thus it presents a low risk for groundwater or surface water contamination (U.S. EPA 2019a)

Pendimethalin has a low risk for ground water contamination due to its strong affinity for soil particles. It could contaminate surface water through spray drive or runoff events but its affinity for soils would likely reduces its risks of contaminating open water for long (U.S. EPA 1997).

Prodiamine has a low risk of contaminating groundwater due to its high affinity for soils. Its soil adsorption rate and its ability to degrade in sunlight also limits its ability to contaminate surface water (U.S. EPA 1992).

Thifensulfuron methyl could contaminate ground water due to its mobility in soils and high water solubility. However, its ability to degrade through microbial decomposition in aerobic and anaerobic conditions would limits its persistence for long. It does carry a moderate risk for surface water contamination, but it would be less likely than groundwater due its ability to degrade fast when exposed to sunlight (U.S. EPA 2015)

Vegetation

The assessments conducted by the BLM, USFS, and U.S. EPA Registration Eligibility Decision documents use modeling to estimate the probability of herbicides to move via off-site drift, surface runoff, and wind erosion based on different application methods, chemical composition, environmental properties, and toxicology information. The analyses look at the toxicity of the herbicides on a variety of plant species, such as common crops, grasses, and surrogate species for federally listed species. This information is then used to assess the impacts of herbicides on non-target weed species. Non-target weed species are separated into sensitive species and tolerant species. Sensitive species are often species that share common characteristics with the target species, such as form (grass, herbaceous, woody) and duration (annual vs. perennial). Sensitive species can also include federally or tribally listed threatened, endangered, or sensitive species. Tolerant plant species are those that are not expected to be harmed by the herbicide based on its selectivity or its mode of action on the target plant. For example, grasses would be a tolerant plant species for herbicides that are selective to broadleaf weeds or dicots.

The BLM and USFS use a series of landscape modeling tools for their analyses to look at potential exposure related to off-site drift, wind erosion, surface runoff, and ground water modeling. The USEPA uses models to examine runoff and generic environmental presence over time along with studies and incident reports to examine the ecological impacts of herbicides to decide labeling and use. The USEPA analyses, however, often do not model impacts of specific application methods and do not associate risks of exposure with distance to treatment site or environmental conditions. It is important to note that all modeling and analyses are general in nature and are not able to account for impacts to all native species or crops found on the Navajo Nation. Such risk assessments only provide a general idea of impacts associated with each of the herbicides covered under this plan.

Dichlobenil

Dichlobenil is a broad-spectrum herbicide that is selective for annual and perennial grasses, broadleaf weeds, and woody plants. It is classified as a cellulose inhibitor and works by disrupting the production of cellulose need to build cell walls. The herbicide works most strongly on growing points and root tips of plants, allowing it to be used as both a pre-emergent and post-emergent herbicidal treatment. It is known to reduce the growth of mycorrhizal fungi for some tree species (Hamel et al. 1994), which could impact growth and establishment of some tree species. Additionally, its major metabolite, 2,6-dichlorobenzamide (BAM) has similar impacts within treated areas and can persist within treated areas for longer periods than the parent chemical (U.S. EPA 1998). Dichlobenil is approved for use under Alternative 2 for broadcast ground applications and spot treatments.

Surface runoff does pose a significant risk to sensitive plants as dichlobenil is moderately mobile in coarser soils and can be persistent within water (Stavola and Turner 2003). This increases the potential for the herbicide to be transported off-site during major storm events. U.S. EPA modeling suggests that sensitive non-target plants may be at risk of damage if concentrations of dichlobenil exceed 0.23 lb/ac in associated runoff (U.S. EPA 1998). The U.S. EPA estimates assumes that approximately 2% of applied dichlobenil can potentially be transported from the treatment site through surface runoff. The degree of damage risk increases with increasing application rates which can range from 2-20lbs/ac. Some impacts may also be associated with off-site drift from broadcast treatments. However, these have not been adequately modeled or investigated based on method or application rate.

Metribuzin

Metribuzin is a selective herbicide used for the treatment of broadleaf weeds and grasses. It is classified as a Photosystem II inhibitor, which blocks the transfer of electrons during photosynthesis causing damage to chlorophyll and several lipids and proteins and resulting in abnormal growth and death. It can be used as both a pre-emergent and post-emergent herbicide for the control of weeds such as thistles, Dalmatian toadflax, kochia, field bindweed, and johnsongrass. Under Alternative 2, metribuzin can be used in aerial broadcast, ground broadcast, and spot treatments.

Off-site drift has the potential to cause significant risks to sensitive plant species within 15 feet of the treated area. Metribuzin, as well as at least one of its metabolites, is considered highly mobile in soil, and therefore surface runoff could also pose serious risks to sensitive plant species. Additionally, wind erosion could potentially cause damage to sensitive species, as the compound shows low to moderate persistence in the soil, with a half-life of up to approximately 3 weeks depending on soil type (EFSA 2006).

Paraquat

Paraquat is a selective herbicide used to control annual broadleaf weeds and grasses. It is classified as a Photosystem I inhibitor, meaning it interrupts the exchange of electrons during photosynthesis, initiating a chain of oxidation and reduction reactions that eventually weaken the integrity of cell membranes causing leaf wilt and desiccation. Paraquat is used as both a pre-emergent and post-emergent herbicide and has shown to be effective in the control of musk thistle, cheatgrass, and Russian thistles. Under Alternative 2, paraquat would be approved for aerial broadcast, ground broadcast, and spot application treatments.

Off-site drift from aerial applications is expected to result in the most impact to non-target plant species outside of the treatment area. U.S. EPA analysis determined that damage could happen to sensitive plant species at higher application rates (max rate 1lb a.i./ac) but that damage from drift or runoff was less likely at lower application rates (0.07 lb a.i./ac) (U.S. EPA 1997). Their analysis also indicated that aerial applications at the higher rate would likely pose a risk to non-target plants but would likely not cause harm during ground applications.

Because paraquat binds strongly to soil particles, wind erosion and surface run off are not likely to impact non-target plant species outside of the treatment area (EPA 1997).

Pendimethalin

Pendimethalin is a selective herbicide used to control broadleaf weeds and grasses and is approved for pre-emergent use. It is classified as a mitosis inhibitor, where it disrupts the formation of microtubules in dividing cells, preventing cell growth, seeding development and roots. It is most effective on roots of developing weeds. Under Alternative 2, pendimethalin can be used for aerial broadcast, ground broadcast, and spot applications. It is effective for the treatment of kochia and rescuegrass.

Off-site spray drift of broadcast applications of pendimethalin could potentially impact sensitive plant species. The U.S. EPA Spray Drift Task Force did find during its studies that ground broadcast applications could lead to 1% volume of the herbicide traveling 100ft from the treatment site and 5% of aerial applications (U.S. EPA 1996).

Because pendimethalin is persistent within soils and strongly binds to clay particles, it does have the potential to damage sensitive plant species during surface runoff events. The U.S. EPA analysis of pendimethalin characteristics indicate that such damage would occur during heavy rainfall events immediately after applications. However, pendimethalin's strong affinity for soil particles would reduce the longevity of such impacts (U.S. EPA 1996).

Damage from wind erosion is not seen as a likely risk due to how strongly adsorbed pendimethalin is to soil particles. While events such as dust storms are likely to move soils contaminated with the herbicide outside of the application area, much of the herbicide would be unavailable to plants.

Prodiamine

Prodiamine is a selective herbicide used for the control of annual broadleaf weeds and grasses. It is also classified as a mitosis inhibitor and is most effective as a pre-emergent herbicide. The herbicide kills and prevents seedling growth by interfering with the formation of microtubules in dividing cells. Under Alternative 2, prodiamine can be used in ground broadcast and spot applications.

Prodiamine is highly persistent in soils (soil half-life of up to 120 days) and binds strongly to soil particles (University of Hertfordshire 2013), thus there is the potential off-site transport through surface runoff or wind erosion as sediment is transported away from treated areas. Damage to non-target species from these routes, however, would likely be limited due to its low solubility in water and strong affinity for soil particles.

Overall, aerial and ground broadcast spraying of herbicides have the most potential to impact native plant populations as they are used to treat large areas with little specificity for native plants within the area. Use of broadcast and aerial spraying could impact non-target plants as pesticide drift would also increase. Plants could experience no effect, reduced vigor, or death depending on the sensitivity of the plant species to the specific pesticide and the dose the plant was subjected to. The use of such methods, however, would be limited to areas where noxious weeds have effectively crowded out native vegetation and where plant species of concern are not present. Broadcast spraying would also not be permitted under certain weather conditions, such as windy events or periods where precipitation is anticipated. The mitigation measures specified below would effectively reduce the overall impacts treatments on desired native vegetation within project areas.

Thifensulfuron methyl

Thifensulfuron methyl is a post-emergent herbicide used to control broadleaf weeds. Under Alternative 2, it can be applied through aerial broadcast, ground broadcast, and spot application treatments. Thifensulfuron methyl is classified as an acetolactate synthase (ALS) inhibitor which interferes with a key enzyme in plants used to synthesize necessary amino acids and proteins, eventually resulting in the death of the plant. Thifensulfuron methyl is often used for the control of spreading wallflower and is highly potent even at low application rates. It is often used in combination with tribenuron methyl.

Off-site drift could pose significant damage to sensitive plant species, especially valuable crops. Lee et al. (2005) listed thifensulfuron methyl as one of 28 “high potential risk” herbicides with regard to off-site drift, based on peer-reviewed studies showing damage to non-target species at sublethal levels, and frequency of drift complaints lodged with state and county agriculture agencies.

Surface runoff could also pose significant damage to sensitive vegetation as thifensulfuron is weakly adsorbed to soil particle (particularly in soils with low organic content, as in many areas across the Navajo Nation, fragile or highly erodible soil), increasing the chances of off-site transport (PSD 1991). Risk of damage is most significant in areas with high runoff potential (clay soils and heavy annual rainfall). On the Navajo Nation, the risk of damage from surface runoff would be most pronounced in washes neighboring treatment areas during heavy rainfall events.

Wind erosion also has the potential to cause unintended impacts on nontarget sensitive plant species. With a relatively long half-life in soil (up to approximately 3 weeks), significant quantities of herbicide may be transported off-site by erosion from wind events occurring days or weeks after application (PSD 1991).

Wildlife

Determining potential impacts to wildlife is based on their toxicity to organisms. **Table K-1** below shows the ecotoxicity categories for terrestrial organisms as defined by the U.S. EPA. The terrestrial animal endpoints for acute avian and mammalian assessment includes the lowest tested LD_{50} (medium lethal dose of pesticide that causes 50% lethality of the test population) or LC_{50} (concentration of dietary pesticide that causes lethality in 50% of the test population). For non-target insects the endpoints include an acute, single dose of pesticide that causes 50% mortality in a test population of bees (LD_{50}).

Table K-1. Ecotoxicity Categories for Terrestrial Organisms. (From 40 CFR 156.64: Toxicity Category).

Terrestrial Organism	Very Highly Toxic	Highly Toxic	Moderately Toxic	Slightly Toxic	Practically Non-Toxic
Avian: Acute Oral Concentration (mg/kg-bw)	<10	10-50	51-500	501-2000	>2000
Avian: Dietary Concentration (mg/kg-diet)	<50	50-500	501-1000	1001-5000	>5000
Wild Mammals: Acute oral concentration (mg/kg-bw)	<10	10-50	51-500	501-2000	>2000
Non-target insects: Acute concentration (μg/bee)		<2	2-11		>11

These toxicity standards were used in evaluating the U.S. EPA Eligibility Registration/Reregistration Decision Documents for the six herbicides proposed for use by the BIA that have not been previously evaluated for risk by the BLM or USFS. They are presented below.

Dichlobenil –Dichlobenil is slightly to moderately toxic to mammals with an acute oral LD_{50} ranging from greater than 3,160 mg/kg for rats to 270 mg/kg for rabbits. Oral doses of 200 to 400 mg/kg of dichlobenil to rabbits caused an increase in SDH (serum sorbitol dehydrogenase) activity and death in some animals (U.S. EPA 1998). The same study showed that rats receiving lethal doses of dichlobenil suffered liver and kidney damage, while rabbits suffered centrilobular necrosis of the liver. The dermal "no observable effect level" (NOEL) for rabbits has been reported as 100 mg/kg/day, and the acute dermal LD_{50} has been reported as 1,350 mg/kg/day (U.S. EPA 1998). No significant local skin reactions were noted at any test concentration. Dietary NOELs of 50 ppm have been reported for mice, rats, rabbits, and pigs (U.S. EPA 1998). Neurotoxic effects of dichlobenil have been observed in mammals, including depression in rabbits (U.S. EPA 1998) and muscle hypotomus in rats exposed to the dichlobenil degradate 2,6-dichlorobenzamide (U.S. EPA 1998).

Toxicity to birds is slight to very slight, with LD_{50} ranging from greater than 1,189 mg/kg/day for pheasants to greater than 5,000 mg/kg/day for Japanese quail. The dichlobenil LD_{50} for honeybees was reported to be greater than 120.86 mg/bee (U.S. EPA 1998).

Metribuzin- Metribuzin is slightly toxic to mammals on an acute oral basis with toxicity values for laboratory rats at 2,200 mg/kg for females and 2,300 mg/kg for males and for laboratory mice 711 mg/kg for females and 698 mg/kg for males (U.S. EPA 1998a). Small herbivorous/insectivorous mammals are at acute high risk for broadcast application of nongranular metribuzin at application rates greater than or equal to 4.0 lbs a.i./acre. The levels of concern for endangered herbivorous/insectivorous mammals are exceeded for application rates greater than single applications of 1.0 lb a.i./acre or multiple applications of 0.5 lbs a.i./acre or greater. Chronic levels of concern for small mammals is exceeded at registered application rates equal to or above 0.5 lbs a.i./acre for broadcast applications of nongranular products.

Metribuzin is moderately toxic to birds on an acute oral basis and practically non-toxic to birds on a subacute basis. The LD_{50} for acute oral toxicity is 169.2 mg/kg (U.S. EPA 1998a) and for subacute dietary toxicity is >4,000 ppm for small birds and >5,000 ppm for large birds (U.S. EPA 1998a). Chronic effects in avian reproduction include a reduction in body weight at 14-days post hatch at all levels tested for Northern bobwhite quail, but not for mallard ducks (Hancock 1996). The NOEL and LOEC for Northern bobwhite quail is <62 ppm and for Mallard ducks is >368 ppm (Hancock 1996). Technical grade metribuzin is practically non-toxic to honeybees in acute contact scenarios. The LD_{50} for honeybees is 60.4 µg/bee (U.S. EPA 1998a).

Paraquat– There is a high risk for herbivores, small insectivorous mammals, and endangered large herbivorous and small insectivorous mammals from consumption of grass with herbicide residues. Applications with moderate concentrations of paraquat (1.0 lbs cation/acre) may produce residues on grass that result in high risk for small and medium herbivorous and small insectivorous mammals, restricted use medium insectivorous mammals, and endangered large herbivorous and small insectivorous mammals. At the highest application rate (1.6 lbs cation/acre) produces residues in grass that result in high risk for small and medium herbivorous and insectivorous mammals, restricted use levels of concern for large herbivorous mammals and endangered species levels of concern for large insectivorous mammals. Medium and high application rates of paraquat (1.0 and 1.6 lbs cation/acre) are high chronic risk for mammals (U.S. EPA 1997). The level of concern is exceeded for birds and presents high acute risk at application rates at or above 1.49, 0.60, and 0.3 lbs cation/acre. At application rates of 0.5 and 5 lbs cation/acre, paraquat can cause reduction of hatchability, significant mortality and reduced growth to mallard duck eggs (U.S. EPA 1997). Environmental fate data indicate that paraquat once applied and dried is not expected to pose a risk, and if washed off plant surfaces is very strongly adsorbed to clay particles. Therefore, the registered uses of paraquat are expected to reduce acute risks and are not expected to pose a chronic risk to mammals or birds.

Paraquat is relatively non-toxic to bees in dry crystalline and liquid formulations of technical and technical end-product paraquat dichloride, where contact LD50 ranged from 6.04->144 µg/bee (U.S. EPA 1997). There is a risk for honeybees when directly sprayed with high concentrations of paraquat dichloride CL.

Pendimethalin- Pendimethalin is slightly toxic to birds on an acute oral and subacute dietary basis, where LC_{50} values are 4,187 – 4,640 ppm (U.S. EPA 2003). No chronic bird reproduction studies have been completed for this chemical. Pendimethalin is slightly toxic to small mammals on an acute oral basis, which is based on a study that showed female rats had a LD_{50} of 1,050 mg/kg and male rats had a LD_{50} of 1,250 mg/kg (U.S. EPA 2003). Pendimethalin is practically non-toxic to honeybees on an acute contact basis, where the LD_{50} >49.7 µg/bee (U.S. EPA 2003).

Thifensulfuron methyl- Thifensulfuron methyl is practically nontoxic to mammals on an acute oral basis, where the LD_{50} is >5,000 mg/kg (U.S. EPA 2015). However, exposure through drinking water alone is a potential concern for acute toxicity in mammals and birds and chronic exposure in birds. Thifensulfuron methyl is slightly toxic for acute oral scenarios (LD50 >2,510 ppm for Mallard duck) and practically nontoxic for acute dietary scenarios in birds (LC_{50}>5,620 for both Bobwhite quail and Mallard duck. A slight reduction in the production of eggs and hatchlings was observed at a concentration of 1,250 ppm (U.S. EPA 2015). The NOEL is 250 ppm for Bobwhite quail. Upon acute direct contact with honeybees thifensulfuron methyl is practically nontoxic (LD_{50}>12.5 µg/bee) (U.S. EPA 2015).

Aquatic Species

Per the mitigation measures of the Navajo Nation Integrated Weed Management Plan, only aquatic formulations of herbicides are permitted within 25 feet of the daily high-water mark of any open water body. All herbicides have to be approved through the U.S. EPA registration process to evaluate human health and ecological risks. Product registration through the U.S. EPA requires only data that supports the FIFRA. The USFS and BLM have done independent risk assessments on the pesticides used on USFS and BLM lands to further evaluate the human health and ecologic risks associated with the herbicide. These risk assessments use published scientific literature, modeling and data collected for product registration to evaluate the potential for impacts on terrestrial wildlife from exposure to herbicides. There are difficulties in assessing possible risks because toxicity testing is often performed on laboratory animals, which may not be representative of free ranging wild animals or only a few wildlife species are tested.

Therefore, the risk assessments typically employ exposure estimates that yield conservative assessments of possible risks (Kendall et al. 2001).

Many of the herbicides proposed for use by the BIA on the Navajo Nation have been evaluated by the USFS or BLM and their toxicology data are included below. However, there are six herbicides proposed for use by the BIA that have only been evaluated for risk from toxicology data required by the USEPA's pesticide registration process. These herbicides include: dichlobenil, metribuzin, paraquat dichloride, pendimethalin, prodiamine, and thifensulfuron methyl.

Table K-2 shows the ecotoxicity categories for aquatic organisms as defined by the U.S. EPA. The aquatic animal toxicity endpoint for acute assessment includes the lowest tested EC_{50} (concentration of pesticide in water that causes immobilization in 50% of the test population) or LC_{50} (concentration of pesticide in water that causes lethality in 50% of the test population) for freshwater fish and invertebrates from acute toxicity tests.

Table K-2. Ecotoxicity Categories for Aquatic Organisms (from the U.S. EPA at http://www.epa.gov/oppefed1/ecorisk_ders/toera_analysis_eco.htm).

Hazard Indicators	Very Highly Toxic	Highly Toxic	Moderately Toxic	Slightly Toxic	Practically Non-Toxic
Acute concentration (mg/L)	<0.1	0.1-1	>1-10	>10-100	>100

This information is used to evaluate the potential risk of the six additional herbicides proposed for use under the Navajo Nation IWMP. The information provided below discusses their potential impacts to aquatic species. It is important to note that all are only approved for terrestrial use and would not be used within the 25 ft buffer surrounding open water sources.

Dichlobenil – Direct contact and ingestion data indicates that technical grade dichlobenil is moderately toxic to freshwater fish and slightly to moderately toxic to freshwater invertebrates. Its primary degradate 2,6 dichlorobenzamide (BAM) is practically nontoxic to freshwater fish and invertebrates. Tests of aquatic invertebrates conducted with a 50% formulation indicated that it is moderately toxic, with long term effects on reproduction for freshwater fish and invertebrates (Stavola and Turner 2003). BAM is only slightly toxic compared to its parent chemical, with long-term effects on fish but not invertebrates.

Metribuzin - Metribuzin and its degradates have the potential to contaminate ground water and surface water. However, the persistence of metribuzin in surface water may be reduced as it degrades when exposed to light (U.S. EPA 1998a). Laboratory studies indicate that technical grade metribuzin is slightly toxic or practically non-toxic to freshwater fish when directly exposed (Mayer and Ellerzieck 1986, U.S. EPA 1998a). There are no direct contact or ingestion levels of concern for freshwater fish and aquatic invertebrates at any registered application rate. Metribuzin is moderately toxic to slightly toxic to aquatic invertebrates at all exposure concentrations of active ingredient from direct contact (U.S. EPA 1998a). Reproduction was affected at all exposure levels.

Paraquat – Paraquat is very immobile in the soil as it strongly adsorbs to clay crystalline lattices. Therefore, it may be found in surface water associated with soil particles carried by erosion but is not likely to contaminate groundwater. It does not hydrolyze or photodegrade in water. Paraquat dichloride is slightly toxic to fish from direct contact (U.S. EPA 1997). Paraquat is moderately toxic to aquatic invertebrates.

Pendimethalin- Pendimethalin is moderately to highly toxic to fish based on toxicity studies evaluated by the U.S. EPA using maximum application rates (U.S. EPA 1997a). Long-term exposure to pendimethalin in fathead minnow resulted in reduced egg production (U.S. EPA 1997a). Technical grade pendimethalin was found to be highly toxic to freshwater invertebrates when directly ingested or contacted (U.S. EPA 1997a).

Prodiamine- Prodiamine is not water soluable and does not easily break down in water. Therefore, it would have high toxicity when directly ingested or contacted by freshwater fish and aquatic invertebrates (U.S. EPA 1991).

Thifensulfuron methyl- Thifensulfuron methyl is soluble in water, therefore there may be extensive movement into the soil column. Thifensulfuron methyl is practically nontoxic when directly ingested or contacted by fish and aquatic invertebrates (U.S. EPA 2015). This herbicide requires a 25 ft buffer.

Public Health

Health risks associated with herbicides depend on the toxicity of the herbicide being used, how a person is exposed to the herbicide, and the duration of their exposure. The public may be exposed to herbicide by contacting treated vegetation, consuming contaminated vegetation or water, or through herbicide drift. All alternatives would use herbicides and have the potential to expose workers or the public to herbicides. However, most exposures are not expected to exceed the daily exposure level determined as safe by the U.S. EPA for a 70-year lifetime of daily exposure.

Risk assessments quantify the potential risks for an herbicide based on label use and safety standards accepted by scientific experts. They evaluate potential hazards associated with the use of the herbicide based on their toxicity and the risk of exposure to hazardous doses for workers and the general public. These assessments assume workers and agencies comply with the product label during treatments. In addition to label instructions, the BIA plans to implement additional environmental protection measures for Alternatives 2 and 3 which further reduce potential risks to human health and the environment for herbicide treatments. These measures are detailed in the Mitigation Measures (Appendix F). It should be noted that federally and tribally certified pesticide applicators are required to supervise all herbicide applications for all proposed alternatives.

Risks for Proposed Herbicides

The risks of using herbicide depend on three main factors:

Method of Application – Herbicide applicators have a higher risk than the public of being exposed to harmful concentrations of herbicides. In comparing the risks to workers for all application methods, including aerial, backpack, ground mechanical, and hand applications, ground mechanical application (using a vehicle to apply herbicide) had the lowest risks compared to other methods, even though the total amount of herbicide applied is higher. Backpack and hand application have the highest risk, as workers are closer to the spray nozzle and carry containers of herbicides on their body. Backpack and hand applications also increase the likelihood of workers being repeatedly exposed to herbicides that may remain on their skin for an extended period.

Length of Exposure – Determining if a dose is harmful to an individual depends on whether a single dose is given all at once (acute), multiple doses are given over longer periods (chronic), or regularly repeated doses occur over an isolated period of time, which can range from several days to months (subchronic). The U.S. EPA requires manufacturers to evaluate chemicals based on these doses to determine potential risks for acute, chronic, and subchronic exposures. These doses are set below the amount that would cause toxic effects in humans, accounting for potential reactions from hypersensitive individuals while evaluating doses that workers or the public may be exposed to in real life. Many of these studies assume that the maximum duration of exposure for commercial applicators ranges from 10 to 40 days annually.

Route of Exposure – There are three main routes of chemical exposure: by ingestion (oral), through the skin (dermal), or by breathing it in (inhalation). The U.S. EPA requires toxicity testing for all substances for these mechanisms which is done through animal testing. Skin acts as a protective barrier that limits and slows down movement of a chemical into the body. In general, about 10% or less of a chemical can pass through the skin into the bloodstream. In contrast, absorption of a chemical from the small intestine is quicker and more complete than from the skin (Ross et al. 2000). For this reason, harmful dermal doses are usually much higher than oral doses. However, harmful effects can occur more quickly through inhalation than by oral or dermal contact, as the substance can rapidly enter the bloodstream. However, studies on pesticide applicators indicate they have a higher risk of dermal exposure as they occur more often than through inhalation or oral exposure (Ross et al. 2000).

Except for accidental exposures, workers and the public would not be exposed to herbicides at concentrations that would adversely affect public health. This conclusion is based on workers wearing appropriate PPE and applying herbicides according to label instructions. By doing so, the risk of harmful exposure would be low based on each herbicide’s toxicity. It also assumes that a person can be exposed to certain amount of a contaminant and not have an adverse effect (i.e. the dose determines the effect).

The following discussion examines the herbicides proposed under Alternative 2 that do not have associated risks assessments. Each of the herbicides is described based on their toxicity (LD_{50}), which is the concentration needed to kill over 50% of test animals when applied orally, dermally, or through inhalation (**Table K-3**). These ratings provide a relative measure of how harmful these chemicals are to humans.

Table K-3. Toxicity categories as defined by the USEPA. Pesticides are classified based on the dose needed to kill 50% of test animals. For humans, lethal doses (LD_{50}) are based on toxicity tests on rats.

Category	Equivalent Dose	Oral LD_{50} (mg/kg)	Dermal LD_{50} (mg/kg)	Inhalation LD_{50} (mg/L)
IV - Not toxic	>1 pint	>5,000	>5,000	>2
III – Slightly Toxic	1 ounce to 1 pint	500-5,000	2,000-5,000	0.5-2
II – Moderately Toxic	1 teaspoon to 1 ounce	50-500	200-2,000	0.05-0.5
I – Highly Toxic	<1 teaspoon	<50	<200	<0.05

Dichlobenil –Dichlobenil can remain in the soil or on vegetation for two weeks to 6 months. The USEPA does classify it as a possible human carcinogen and it can cause liver and kidney damage at higher concentrations (U.S. EPA 2008). The herbicide can cause hormonal changes with prolonged exposure, which has led to further testing by the USEPA to examine its potential as an endocrine disrupter (U.S. EPA 1998, U.S. EPA 2009). Dichlobenil is classified as slightly toxic for oral and dermal exposures and not toxic for inhalation.

Metribuzin – Ecological risk assessments (EFSA 2006, U.S. EPA 1998a) indicate that metribuzin has a high risk of contaminating groundwater due to its weak adsorption to soil and its moderate half-life (ranging from 40 to 128 days). Based on animal studies (U.S. EPA 1998a), metribuzin can have adverse effects on liver function and reproduction at high doses. It can act as an endocrine disruptor and is not indicated as a carcinogen or a mutagen. Metribuzin has been classified as slightly toxic for oral and inhalation exposures and not toxic for dermal exposure.

Paraquat – Paraquat has the potential to contaminate surface water if contaminated soil is moved during erosion (U.S. EPA 1997). Animal studies indicate that paraquat can be toxic when ingested or inhaled (U.S. EPA 1997), resulting in adverse effects to the liver, kidneys, and lungs which can lead to death. Contact exposure to the eyes can cause moderate to severe irritation, while dermal exposure results in mild to moderate skin irritation. It is not indicated as a carcinogen but is a weak mutagen. Paraquat is classified as moderately toxic when taken orally, highly toxic when inhaled, and slightly toxic for dermal exposures.

Pendimethalin –It can bind strongly to soils, reducing its risk of contaminating groundwater or surface water through percolation or erosion. Pendimethalin is classified as a possible human carcinogen, which affects the thyroid (U.S. EPA 1997a). It can irritate the eyes and skin with direct contact. Pendimethalin is classified as slightly toxic for oral and dermal exposures and not toxic when inhaled.

Prodiamine –Prodiamine has a low risk of contaminating water sources as it has a short persistence in the environment and binds well to soils. Based on animal studies, prodiamine has adverse effects on the liver and thyroid (BPA 2000, U.S. EPA 1992). It is a carcinogen which has been tied to the development of thyroid tumors (Hurley 1998, COM 2001) and the liver (U.S. EPA 1992). It is shows fetal toxicity at high doses and developmental and maternal toxicity at low doses. It is slightly toxic when inhaled or applied to the skin. It is classified as not toxic for oral exposures.

Thifensulfuron methyl –Thifensulfuron carries a moderate risk of ground water and surface water contamination due to its weak affinity for soil particles. The risk is highest if rain or snowmelt creates runoff that impacts treated areas. Health risk evaluations (FAO 2011) indicate that thifensulfuron methyl is a mild eye irritant. It does not cause cancer, genetic damage, or birth defects and has little to no effect on fertility or reproduction. Thifensulfuron methyl is classified as not toxic for oral and inhaled exposures and slightly toxic for dermal exposures.

Metribuzin – Metribuzin impacts the thyroid at high doses. In rat studies, metribuzin decreased weight for the uterus and mammary glands in females and increased thyroid weight in males at high doses. Low doses resulted in changes to thyroid hormones that control growth, development, and metabolism. Studies indicate that metribuzin can reduce fetal body weight and interfere with bone development (U.S. EPA 1998a). EDSP Tier 1 screening indicated increased thyroid sizes with exposure to metribuzin and potential interactions with the thyroid (USEPA 2015b)

Impurities

Some of the herbicides proposed under the Navajo Nation IWMP can contain byproducts or impurities that are considered hazardous, making it important to limit the concentrations used to avoid potentially toxic exposures. Below various impurities associated with the proposed herbicides unique to the Navajo Nation IWMP discussed in detail, of which dichlobenil is the only with potentially hazardous metabolites.

Dichlobenil – A major metabolite of dichlobenil is 2,6-dichlorobenzamide (BAM), which leaves a residue on treated plants and poses a health risk to humans and animals. BAM has slightly greater toxicity than its parent compound and is classified as a possible human carcinogen with many of the same effects as dichlobenil (U.S. EPA 1998). However, the risk of adverse effects from exposure is considered low due to the low amounts measured in the environment after treatments (Björklund et al. 2011).

Inert Ingredients

The proprietary nature of herbicide formulations limits understanding the risks from inert ingredients (inerts) and adjuvants in herbicide formulations. Unless the compound is classified as hazardous by the USEPA, the manufacturer is not required to disclose its identity. It could be inferred that inert ingredients are not toxic, or their toxicity would be reported to the USEPA. While the USEPA has increased testing requirements for inerts, those currently in use have not been tested rigorously and their toxicity is not well characterized. Nonetheless, studies on the toxicity of technical grade formulations, which often contain inerts, accounts for their toxicity. These studies do not report human health concerns at the same level as herbicides. Analysis of inert ingredients is incorporated by reference (USFS 2005, BLM 2007, BLM 2016).

Surfactants

Surfactants are added to herbicides to improve mixing and absorption of the herbicide by the plant. Like dyes, there is limited information on surfactants and their toxicity, especially since the industry considers the surfactant to play a key role in the effectiveness of the herbicide. Most knowledge of surfactants is proprietary and not disclosed. The glyphosate risk assessment (SERA 2011), which provides some assessment of surfactants, reported that toxicity of glyphosate alone was the same as the toxicity of glyphosate + surfactant and greater than the toxicity of surfactants alone. Whether this same pattern would hold true of other herbicides with the same or different surfactants is unknown. If so, toxicological studies performed on herbicide formulations (which contain inerts and surfactants) may accurately portray the toxicity and risks posed to humans by the surfactant.

Endocrine Disruption

Recent studies raise concerns about the potential for some herbicides to interfere with hormone interactions. However, there is little evidence that herbicides considered for application would pose risks to the public at the recommended application rates based on the herbicide label instructions and the size of the area treated for any proposed alternative. The endocrine system regulates the production and release of hormones to manage a variety of bodily functions including growth, development, metabolism, and maturation. Endocrine glands (including pituitary, thyroid, adrenal, thymus, pancreas, ovaries, and testes) release measured amounts of hormones into the bloodstream that act as chemical messengers throughout the body to control many vital functions.

The U.S. EPA is required to develop tests to screen for chemicals with the potential to mimic hormones. Chemicals that mimic or antagonize hormones are called endocrine disrupting chemicals (Damstra et al. 2002) or hormonally active agents (HAAs). One concern over HAAs is due to how closely the endocrine system is linked to the brain and the immune system. All three systems communicate with one another to influence development and overall organ function. Adverse effects to this network can have a range of effects from cancer to infertility to behavioral problems (Felsot 2001).

Due to these concerns, the USEPA formed the Endocrine Disruptor Screening Program (EDSP). In 2009, the EDSP published screening protocols for 52 chemicals with the potential for endocrine disruption. Of the 52 chemicals, two herbicides proposed for approval under this action were found to have potential as endocrine disruptors (U.S. EPA 2015a, 2015b): dichlobenil, and metribuzin.

Dichlobenil – During a reregistration review of dichlobenil, the USEPA noted that new studies indicated that the herbicide could affect reproductive development (1998). The review looked at several animal studies and noted lower birth weights, increased maternal and fetal toxicity, and delayed maturation of the uterus. These effects were observed at both high and low doses. During the Tier 1 EDSP screening, dichlobenil showed evidence of androgen binding and decreased testosterone production (U.S. EPA 2015a).

Metribuzin – Metribuzin is known to impact the thyroid at high doses. In rat studies, metribuzin resulted in decreased weight for the uterus and mammary glands in females and increased thyroid weight in males at high doses. Low doses also resulted in changes to thyroxine and triiodothyronine, which help control growth, development, and metabolism. Developmental studies also indicate that metribuzin exposure can reduce fetal body weight and interfere with bone calcification (U.S. EPA 1998a). EDSP Tier 1 screening resulted in increased thyroid sizes for animals exposed to metribuzin, indicating interactions of the chemical with the thyroid pathway (U.S. EPA 2015b)

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Appendix L. Vegetation Analysis Supplement

APPENDIX L. VEGETATION ANALYSIS

Introduction

The analysis of vegetation on the Navajo Nation was performed by examining broad and detailed land cover classification, vegetation community dynamics, and how these communities may shift and change over time. Such shifts may be from land use, climate change, and natural ecological succession. This appendix was compiled to gather the technical information used in the National Environmental Policy Act (NEPA) or Programmatic Environmental Impact Statement (PEIS) analysis for the Navajo Nation Integrated Weed Management Plan (NNIWMP) and will serve as a supplement to the document. This appendix provides detailed descriptions of the land cover classes used, detailed maps of the described vegetation communities and land cover classes, a spatial analysis on how vegetation may have changed from pre-European settlement, and native species to monitor for that have close botanical relationships to those treated with biological control agents.

Land Cover Classes

Land cover for the Navajo Nation was analyzed using the National Land Cover Dataset (NLCD) developed by USGS. This classification system provides a broad classification for major forms of landcover for the entire United States. This classification system was further broken down to evaluate specific vegetation communities using the Southwest Regional GAP (SWReGAP or GAP) analysis, also developed by the USGS (Lowry et al. 2005). The GAP analysis provides detailed vegetation community descriptions for Arizona, Colorado, Nevada, New Mexico, and Utah. Below are listed the major landcover classes from the NLCD dataset. Acreage estimates and associated GAP landcover classes are outlined in **Table L-1**. Table of NLCD landcover and Southwest Regional Gap land cover for the Navajo Nation. Maps are provided for the NLCD land cover dataset and the GAP dataset (**Figure L-1** and **Figure L-2**).

Water
<u>Open Water</u> – Open water areas are classified based on presence of water year-round with less than 25% cover of vegetation or soils. Open water comprises 0.16% of land cover on the Navajo Nation.

Developed Land
<u>Developed, Open Space</u> – These are areas with a mixture of constructed materials, but mostly vegetation in the form of short grasses. Impervious surfaces account for less than 20% of total cover. These areas most commonly include large-lot single family housing units, parks, golf courses, and vegetation planted in developed settings for recreation, erosion control, or aesthetic purposes. Developed, Open Space land cover comprises approximately 0.45% of land cover on the Navajo Nation. This land cover classification also includes roads.

Developed, Low Intensity – These include areas with a mixture of constructed materials and vegetation. Impervious surfaces account for 20% to 49% of the total cover. These areas most commonly include single family housing units. Developed, Low Intensity land cover comprises 0.13% of the land cover of the Navajo Nation. Low Intensity areas are commonly homesite lease sites and rural housing areas.

Developed, Medium Intensity – These include areas with a mixture of constructed materials and vegetation. Impervious surfaces account for 50-79% of the total cover. On the Navajo Nation, Developed, Low Intensity areas comprise less than 0.03% of the region. Areas classified as Medium Intensity are often low-density residential areas.

Developed, High Intensity – Highly developed areas where people reside or work in high numbers. Examples include apartment complexes, row houses and commercial/industrials areas. Impervious surfaces account for 80% to 100% of the total cover. Developed, High Intensity areas comprise less than 0.01% of the Navajo Nation and are commonly associated with Community Development Areas.

Barren Land

Barren Land (Rock/Clay/Sand) – Barren land on the Navajo Nation is characterized by barren and sparsely vegetated landscapes, with generally less than 10% plant cover. Barren land composes 0.99% of the Navajo Nation. Canyons and tablelands are included in this classification, which are characterized by steep cliff faces, narrow canyons, and open tablelands of predominantly sedimentary rocks, such as sandstone, shale, and limestone. Sand dunes are also included and are characterized by shifting sandy substrates which form patchy or open grasslands, shrublands, or steppes. Vegetation, if present, is usually very open with scattered trees and shrubs and a sparse herbaceous layer. GAP land cover classes found within the Barren Lands on the Navajo Nation include:

- Barren Lands, Non-specific
- Colorado Plateau Mixed Bedrock Canyon and Tableland
- Inter-Mountain Basins Active and Stabilized Dune
- Inter-Mountain Basins Playa
- Inter-Mountain Basins Shale Badland
- Inter-Mountain Basins Volcanic Rock and Cinder Land
- Inter-Mountain Basins Wash
- North American Warm Desert Bedrock Cliff and Outcrop
- Rocky Mountain Cliff and Canyon

Forests

Deciduous Forest – These are areas dominated by trees greater than 5 meters tall and covering more than 20% of total vegetation cover. More than 75% of the tree species shed foliage simultaneously in response to season change. Due to the arid nature of the Colorado Plateau, deciduous forests only compose around 0.03% of land cover of the Navajo Nation. Deciduous forests in this region are characterized by upland forests dominated by aspen trees (*Populus* *tremuloides*), with complex shrub and herbaceous understories. Distribution of these forests is limited by water availability, length of growing season, and low temperature. The only GAP land cover classes found within the Deciduous Forests on the Navajo Nation is Rocky Mountain Aspen Forest and Woodland.

Evergreen Forest – Evergreen forests are dominated by trees greater than 5 meters tall and covering more than 20% of total vegetation cover. More than 75% of the trees maintain their leaves all year. Canopy is never without green foliage. On the Navajo Nation, Evergreen forests compose 11.9% of the land cover. Evergreen forests include ponderosa pine (*Pinus ponderosa*) forests and woodlands, alpine and subalpine mixed conifer forests, and pinyon-juniper woodlands. GAP land cover classes found within the Evergreen Forests on the Navajo Nation include:

- Colorado Plateau Pinyon-Juniper Woodland
- Madrean Pine-Oak Forest and Woodland
- Madrean Pinyon-Juniper Woodland
- Rocky Mountain Ponderosa Pine Woodland
- Rocky Mountain Montane Dry Mesic Mixed Conifer Forest and Woodland
- Rocky Mountain Montane Mesic Mixed Conifer Forest and Woodland
- Rocky Mountain Subalpine Dry-Mesic Spruce-Fir Forest and Woodland
- Rocky Mountain Subalpine Mesic Spruce-Fir Forest and Woodland
- Rocky Mountain Subalpine-Montane Limber-Bristlecone Pine Woodland
- Southern Rocky Mountain Pinyon-Juniper Woodland

Mixed Forest – These areas dominated by trees greater than 5 meters tall that cover more than 20% of total vegetation cover. Neither deciduous nor evergreen species are greater than 75% of total tree cover. This forest type is very uncommon on the Navajo Nation as it only composes around 270 estimated acres of the region. None of the GAP land cover classes on the Navajo Nation are associated with this vegetation type.

Shrubland

Shrub/Scrub – Areas dominated by shrubs; less than 5 meters tall with shrub canopy covering more than 20% of total vegetation. This class includes true shrubs, young trees in an early successional stage or trees stunted from environmental conditions. Shrub/Scrub comprises 75.8% of the Navajo Nation, making it the largest land cover class that is increasing on the landscape due to the expansion of sagebrush and juniper cover. On the Navajo Nation, Shrub/Scrub typically occurs along plains and foothills between mountain ranges in association with grasslands. GAP land cover classes in the Shrub/Scrublands on the Navajo Nation include:

- Apacherian-Chihuahuan Mesquite Upland Scrub
- Chihuahuan Creosotebush, Mixed Desert, and Thorn Scrub
- Colorado Plateau Blackbrush-Mormon-tea Shrubland
- Colorado Plateau Mixed Low Sagebrush Shrubland
- Colorado Plateau Pinyon-Juniper Shrubland
- Inter-Mountain Basins Big Sagebrush Shrubland

- Inter-Mountain Basins Mat Saltbush Shrubland
- Inter-Mountain Basins Mixed Salt Desert Scrub
- Mogollon Chaparral
- Rocky Mountain Gambel Oak-Mixed Montane Shrubland
- Southern Colorado Plateau Sand Shrubland

Herbaceous

Grassland/Herbaceous - Grasslands are dominated by graminoid or herbaceous vegetation, composed of more than 80% of total vegetation. These areas are not subject to intensive management such as tilling. Grasslands make up 9.7% of land cover on the Navajo Nation. Most grasslands on the Navajo Nation are found in arid areas with well-drained soils and are dominated by perennial bunchgrasses and can be found in associated with open shrub layers. GAP grassland cover classes on the Navajo Nation include:

- Apacherian-Chihuahuan Piedmont Semi-Desert Grassland and Steppe
- Chihuahuan Sandy Plains Semi-Desert Grassland
- Inter-Mountain Basins Juniper Savanna
- Inter-Mountain Basins Montane Sagebrush Steppe
- Inter-Mountain Basins Semi-Desert Grassland
- Inter-Mountain Basins Semi-Desert Shrub Steppe
- Madrean Juniper Savanna
- Rocky Mountain Subalpine Mesic Meadow
- Southern Rocky Mountain Juniper Woodland and Savanna
- Southern Rocky Mountain Montane-Subalpine Grassland

Planted/Cultivated

Pasture/Hay – These are areas of grasses, legumes, or grass-legume mixtures planted for livestock grazing or the production of seed or hay crops, typically on a perennial cycle. Pasture/hay vegetation accounts for greater than 20% of total vegetation. Pasture/Hay comprises approximately 0.5% of the Navajo Nation and includes many range management units near and along river ways and portions of the NAPI-NIIP agricultural fields.

Cultivated Crops – These are areas used to produce annual crops, such as corn, soybeans, vegetables, tobacco, cotton, and perennial woody crops such as orchards and vineyards. Crop vegetation accounts for greater than 20% of total vegetation. This class also includes all land being actively tilled. On the Navajo Nation, Cultivated Crops comprise 0.4% of land cover and primarily describe NAPI/NIIP agricultural lands.

Wetlands

Woody Wetlands – The are areas where forest or shrubland vegetation accounts for more than 20% of vegetative cover and the soil or substrate is periodically saturated with or covered with water. Woody Wetlands comprise close to 0.26% of the Navajo Nation and are commonly found near drainages and stream terraces within the floodplain. Trees and shrubs dominate such areas, which are subject to annual or episodic flooding, such as cottonwood, willow, and ash trees, are common. Tamarisk and Russian olive are common as well. GAP land cover classes found within Woody Wetlands on the Navajo Nation include:

- Inter-Mountain Basins Greasewood Flat
- Rocky Mountain Lower Montane Riparian Woodland and Shrubland
- Rocky Mountain Subalpine -Montane Riparian Shrubland
- North American Warm Desert Wash
- North American Warm Desert Riparian Woodland and Shrubland

Emergent Herbaceous Wetlands – Herbaceous Wetlands are areas where perennial herbaceous vegetation accounts for greater than 80% of vegetative cover and the soil or substrate is periodically saturated with or covered with water. Typically, tall grasses and sparse shrubs are found in these areas. Emergent Herbaceous Wetlands comprise close to 0.11% of land cover on the Navajo Nation. GAP land cover classes found in Emergent Herbaceous Wetlands on the Navajo Nation include:

- North American Arid West Emergent Marsh
- Rocky Mountain Alpine-Montane Wet Meadow

Disturbed

The NLCD land cover classification does not include a separate category for disturbed lands as they are often documented in any and all land cover classes. However, the GAP data does include a category for its land classes for disturbed areas. This includes areas that may be disturbed from some form of development, such as mining or oil development, or from environmental disturbances, such as fire or invasive weeds.

- Disturbed, Oil Well
- Invasive Annual and Biennial Forbland
- Invasive Annual Grassland
- Invasive Perennial Grassland
- Invasive Southwest Riparian Woodland and Shrubland
- Recently Burned
- Recently Mined or Quarried

Table L-1. Table of NLCD landcover and Southwest Regional Gap land cover for the Navajo Nation

NLCD Class	SWReGAP Land Cover	CODE	Acres
Barren	Colorado Plateau Mixed Bedrock Canyon and Tableland	S010	1,798,300.90
Barren	Inter-Mountain Basins Shale Badland	S011	206,549.32
Barren	Inter-Mountain Basins Active and Stabilized Dune	S012	124,485.04
Barren	Barren Lands, Non-specific	N31	60,481.49
Barren	North American Warm Desert Bedrock Cliff and Outcrop	S016	40,923.61
Barren	Rocky Mountain Cliff and Canyon	S006	22,986.99
Barren	Inter-Mountain Basins Volcanic Rock and Cinder Land	S013	8,999.22
Barren	Inter-Mountain Basins Wash	S014	1,772.49
Barren	Inter-Mountain Basins Playa	S015	296.45
Forest	Colorado Plateau Pinyon-Juniper Woodland	S039	3,980,360.06
Forest	Rocky Mountain Ponderosa Pine Woodland	S036	459,760.93
Forest	Rocky Mountain Aspen Forest and Woodland	S023	30,049.37
Forest	Madrean Pinyon-Juniper Woodland	S112	13,824.97
Forest	Rocky Mountain Montane Dry-Mesic Mixed Conifer Forest and Woodland	S032	13,222.95
Forest	Rocky Mountain Subalpine Dry-Mesic Spruce-Fir Forest and Woodland	S028	6,947.63

NLCD Class	SWReGAP Land Cover	CODE	Acres
Forest	Rocky Mountain Subalpine Mesic Spruce-Fir Forest and Woodland	S030	3,828.53
Forest	Rocky Mountain Montane Mesic Mixed Conifer Forest and Woodland	S034	2,357.17
Forest	Southern Rocky Mountain Pinyon-Juniper Woodland	S038	2,195.71
Forest	Madrean Pine-Oak Forest and Woodland	S035	46.04
Forest	Rocky Mountain Subalpine-Montane Limber-Bristlecone Pine Woodland	S025	19.13
Shrubland	Inter-Mountain Basins Mixed Salt Desert Scrub	S065	1,192,584.90
Shrubland	Colorado Plateau Blackbrush-Mormon-tea Shrubland	S059	1,108,049.82
Shrubland	Southern Colorado Plateau Sand Shrubland	S136	1,047,355.72
Shrubland	Inter-Mountain Basins Big Sagebrush Shrubland	S054	612,987.66
Shrubland	Colorado Plateau Pinyon-Juniper Shrubland	S052	45,630.16
Shrubland	Colorado Plateau Mixed Low Sagebrush Shrubland	S056	21,637.72
Shrubland	Rocky Mountain Gambel Oak-Mixed Montane Shrubland	S046	16,788.39
Shrubland	Inter-Mountain Basins Mat Saltbush Shrubland	S045	3,023.69
Shrubland	Mogollon Chaparral	S057	7.78
Shrubland	Apacherian-Chihuahuan Mesquite Upland Scrub	S058	1.33
Shrubland	Chihuahuan Creosotebush, Mixed Desert and Thorn Scrub	S062	1.78
Grassland	Inter-Mountain Basins Semi-Desert Shrub Steppe	S079	2,639,369.73
Grassland	Inter-Mountain Basins Semi-Desert Grassland	S090	2,365,320.36
Grassland	Inter-Mountain Basins Juniper Savanna	S075	300,619.59
Grassland	Apacherian-Chihuahuan Piedmont Semi-Desert Grassland and Steppe	S077	2,374.29
Grassland	Madrean Juniper Savanna	S115	756.81
Grassland	Chihuahuan Sandy Plains Semi-Desert Grassland	S113	593.35
Grassland	Southern Rocky Mountain Montane-Subalpine Grassland	S085	325.14
Grassland	Inter-Mountain Basins Montane Sagebrush Steppe	S071	156.34
Grassland	Rocky Mountain Subalpine Mesic Meadow	S083	72.50
Grassland	Southern Rocky Mountain Juniper Woodland and Savanna	S074	3.34
Wetland	Inter-Mountain Basins Greasewood Flat	S096	589,018.35
Wetland	Rocky Mountain Lower Montane Riparian Woodland and Shrubland	S093	22,741.91
Wetland	Rocky Mountain Subalpine-Montane Riparian Shrubland	S091	1,755.81
Wetland	Rocky Mountain Alpine-Montane Wet Meadow	S102	3,309.46
Wetland	North American Warm Desert Wash	S020	342.04
Wetland	North American Arid West Emergent Marsh	S100	269.32
Wetland	North American Warm Desert Riparian Woodland and Shrubland	S097	83.62
Open Water	Open Water	N11	22,932.06
Developed	Developed, Medium - High Intensity	N22	9,801.18
Developed	Developed, Open Space - Low Intensity	N21	8,957.19
Planted	Agriculture	N80	83,591.24
Disturbed	Invasive Southwest Riparian Woodland and Shrubland	D04	44,698.32
Disturbed	Recently Mined or Quarried	D03	37,085.29
Disturbed	Invasive Perennial Grassland	D06	9,244.75
Disturbed	Invasive Annual and Biennial Forbland	D09	4,885.13
Disturbed	Invasive Annual Grassland	D08	1,911.93
Disturbed	Recently Burned	D02	720.34
Disturbed	Disturbed, Oil well	D14	53.37

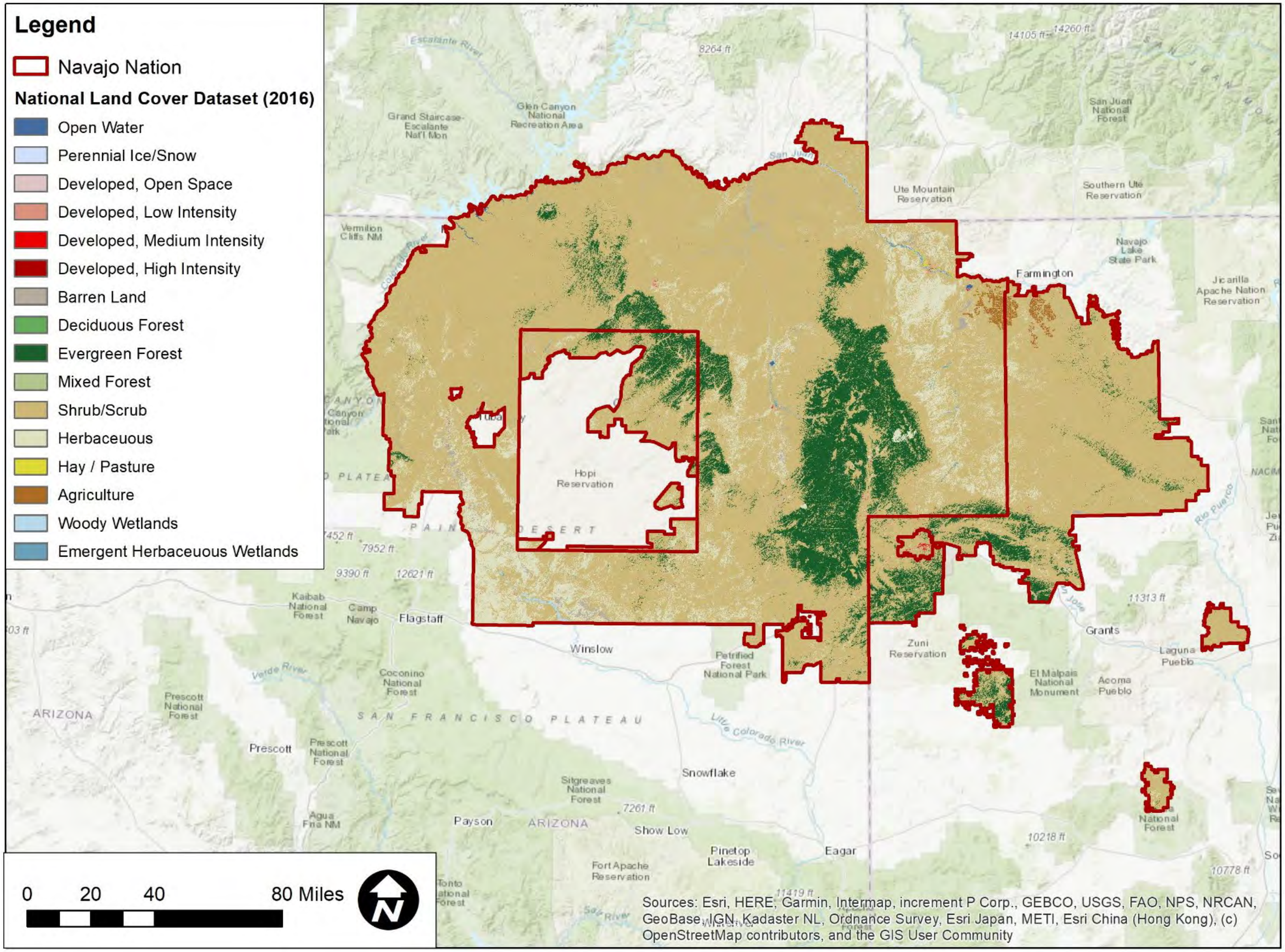


Figure L-1. Land cover classes for the Navajo Nation as determined by the USGS National Land Cover Dataset (Wickham et al. 2014)

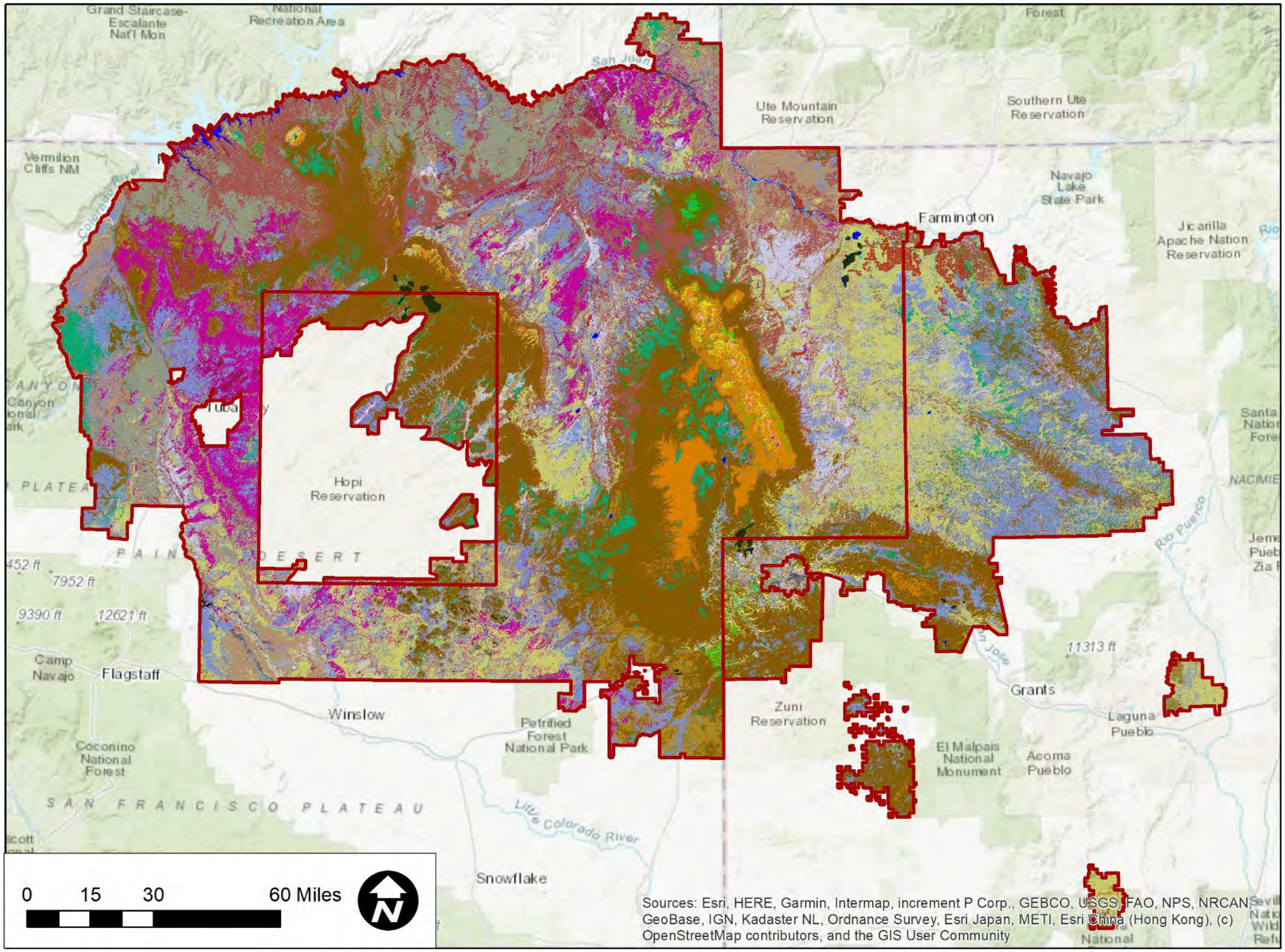


Figure L-2. Land cover classes for the Navajo Nation based on the Southwest Regional GAP Analysis from the USGS (Lowry et al. 2005).

Legend

- Navajo Nation

Southwestern Regional GAP

- 0
- Rocky Mountain Cliff and Canyon
- Colorado Plateau Mixed Bedrock Canyon and Tableland
- Inter-Mountain Basins Shale Badland
- Inter-Mountain Basins Active and Stabilized Dune
- Inter-Mountain Basins Volcanic Rock and Cinder Land
- Inter-Mountain Basins Wash
- Inter-Mountain Basins Playa
- North American Warm Desert Bedrock Cliff and Outcrop
- North American Warm Desert
- Rocky Mountain Aspen Forest and
- Rocky Mountain Subalpine Dry-Mesic Spruce-Fir Forest and Woodland
- Rocky Mountain Subalpine Mesic Spruce-Fir Forest and Woodland
- Rocky Mountain Montane Dry-Mesic Mixed Conifer Forest and Woodland
- Rocky Mountain Montane Mesic Mixed Conifer Forest and Woodland
- Rocky Mountain Ponderosa Pine Woodland
- Southern Rocky Mountain Pinyon-Juniper Woodland
- Colorado Plateau Pinyon-Juniper Woodland
- Inter-Mountain Basins Mat Saltbush Shrubland
- Rocky Mountain Gambel Oak-Mixed Montane Shrubland
- Colorado Plateau Pinyon-Juniper Shrubland
- Inter-Mountain Basins Big Sagebrush Shrubland
- Colorado Plateau Mixed Low Sagebrush Shrubland
- Colorado Plateau Blackbrush-Mormon-tea Shrubland
- Inter-Mountain Basins Mixed Salt Desert Scrub
- Inter-Mountain Basins Juniper Savanna
- Apacherian-Chihuahuan Piedmont Semi-Desert Grassland and Steppe
- Inter-Mountain Basins Semi-Desert Shrub Steppe
- Southern Rocky Mountain Montane-Subalpine Grassland
- Inter-Mountain Basins Semi-Desert Grassland
- Rocky Mountain Subalpine-Montane Riparian Shrubland
- Rocky Mountain Lower Montane Riparian Woodland and Shrubland
- Inter-Mountain Basins Greasewood Flat
- North American Warm Desert Riparian Woodland and Shrubland
- Rocky Mountain Alpine-Montane Wet Meadow
- Madrean Pinyon-Juniper Woodland
- Chihuahuan Sandy Plains Semi-Desert Grassland
- Madrean Juniper Savanna
- Southern Colorado Plateau Sand Shrubland
- Open Water
- Developed, Open Space - Low Intensity
- Developed, Medium - High Intensity
- Barren Lands, Non-specific
- Agriculture
- Recently Burned
- Recently Mined or Quarried
- Invasive Southwest Riparian Woodland and Shrubland
- Invasive Perennial Grassland
- Invasive Annual
- Invasive Annual and Biennial
- Disturbed, Oil well

Comparison of Land Cover

To determine the potential shift in vegetation from pre-European settlement to current day, a comparison of land cover classes was performed. This technique compares Landsat imagery from the LANDFIRE Program. Specifically, it compares the BioPhysical, or historic data (**Figure L-3**) to current existing land cover data (**Figure L-4**). Both datasets are based on the NatureServe ecological systems classification for the terrestrial United States. Historic data includes native vegetation types while the 2016 data includes cover types related to human activity, such as developed, agricultural, and exotic types. The methodology used is based on the riparian vegetation departure analysis developed by Utah State University (MacFarlane et al. 2016). Using this method, land cover classes assigned numeric values based on how similar the current land cover classes is to historic classes with higher values given to native plant cover and lower values given to cover types related to human-based activities (**Table L-2** and **Table L-3**). For this analysis, while overall composition may change or shift based on a variety of factors, the physiognomic groups are generally more consistent across time. Using physiognomy allows for significant differences between land cover groups to be analyzed, which is appropriate for a regional analysis.

Table L-2. Vegetation scores based on vegetation physiognomy group for historic land cover data.

Vegetation Group	Land Cover Score
Sparse	40
Shrubland	100
Riparian	100
Open Water	500
Hardwood-Conifer	100
Hardwood	100
Grassland	50
Conifer	100
Barren Rock/Sand/Clay	40

Table L-3. Vegetation scores based on vegetation physiognomy groups for 2016 land cover data.

Physical Group	Land Cover Score
Agricultural	1
Developed	2
Developed – High Intensity	2
Developed – Low Intensity	2
Developed – Medium Intensity	2
Developed – Roads	2
Exotic Herbaceous	3
Exotic Tree-Shrub	3
Quarries – Strip Mines – Gravel Pits – Well and Wind Pads	2
Sparsely Vegetated	40
Shrubland	100
Riparian	100
Open Water	500
Conifer-Hardwood	100
Hardwood	100
Grassland	50
Conifer	100

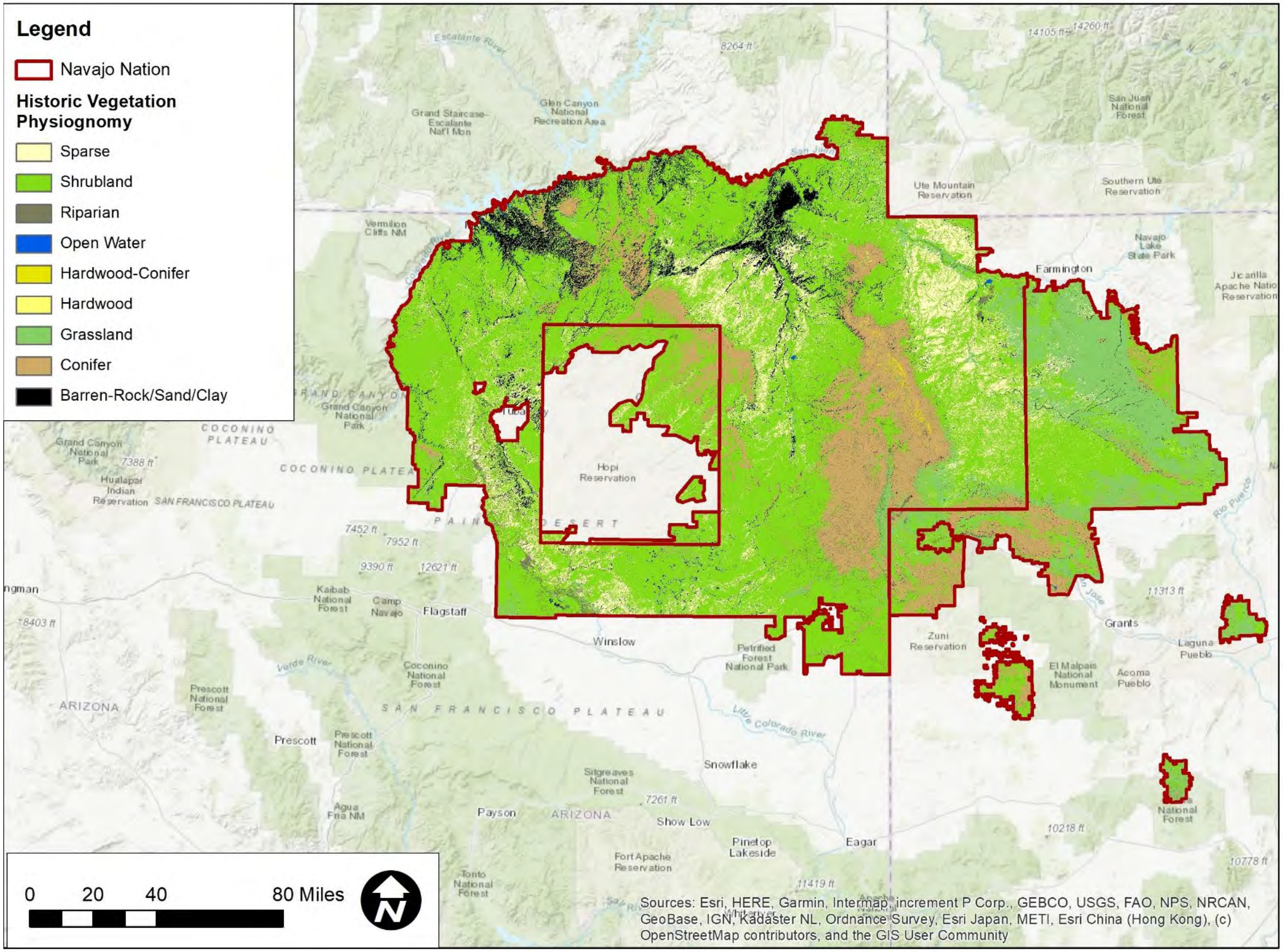


Figure L-3. Historic land cover from pre-European settlement based on LANDFIRE biophysical data analysis.

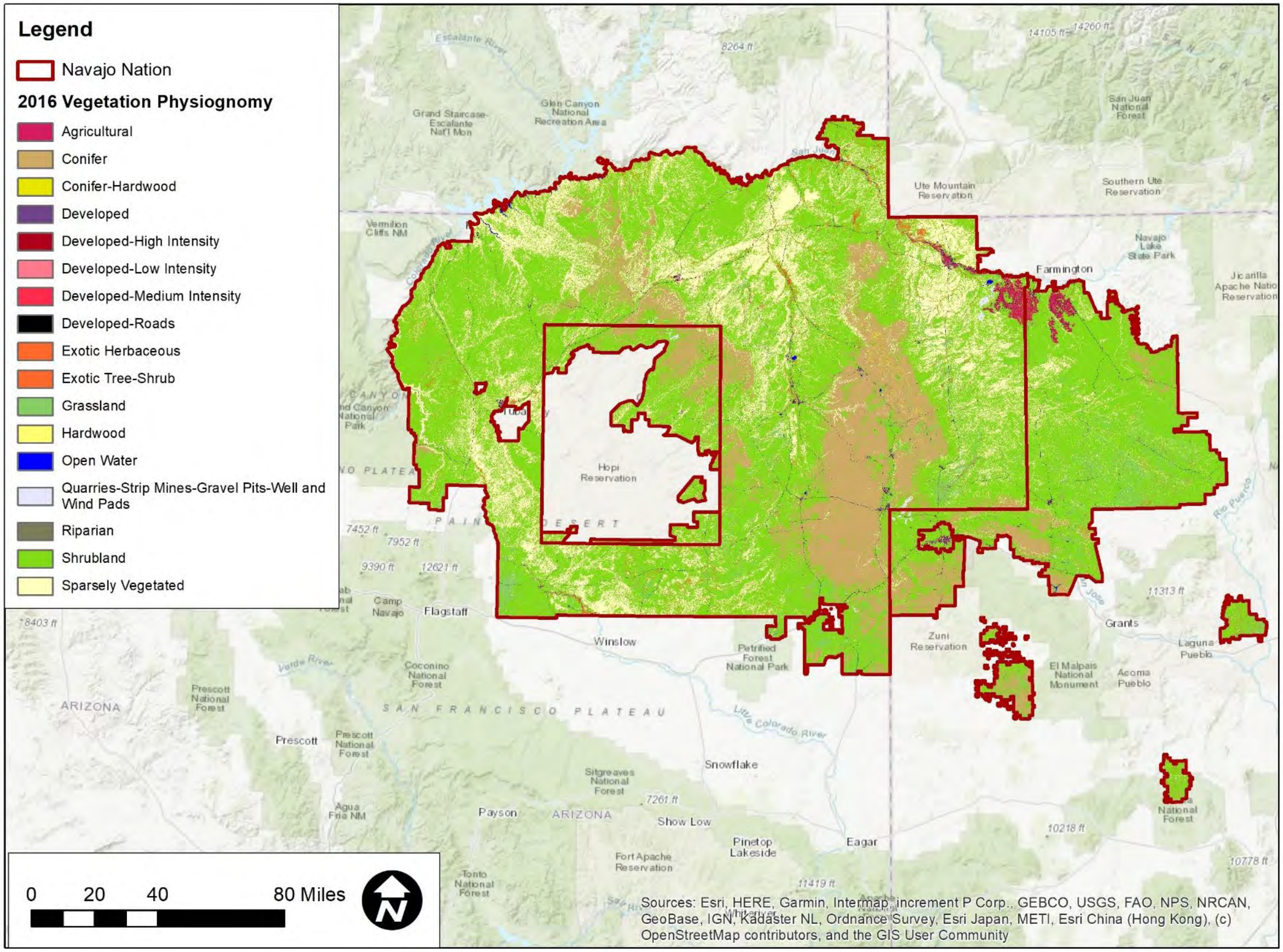


Figure L-4. 2016 land cover data from LANDFIRE based on the National Vegetation Classification for the Navajo Nation.

The scored raster datasets are then subtracted from each other to determine the level of change. The resulting changes in the scores indicate how different vegetation groups shifted on the Navajo Nation. Higher scores indicate more significant land cover shifts.

From this analysis, vegetation shifts affected 18.57% of the Navajo Nation (**Table L-4**). Much of this change was the result of grassland conversions either to woodlands (i.e. shrubland, conifers, or hardwoods) or to sparsely vegetated areas. While this analysis is generalized and does not indicate the specific reasons for such shifts, it does indicate that vegetation shifts may not be from direct human alterations on the landscape but from other causes. Such changes could be due to woody plant encroachment, changes in grazing management, desertification, or other causes which may be indirectly related to land use, climate change, or other factors.

Table L-4. Results from the vegetation departure analysis based on differences in physiognomic group.

Vegetation Shift	% Change
No Change	81.43
Woodland to Exotics	2.01
Woodland to Developed	0.95
Woodland to Agriculture	0.38
Woodland to Grassland	4.40
Woodland to Sparsely Vegetated	2.93
Grassland to Exotics	1.60
Grassland to Developed	1.45
Grassland to Agriculture	2.79
Grassland to Woodland	73.82
Grassland to Sparsely Vegetated	11.96
Sparsely Vegetated to Exotics	0.01
Sparsely Vegetated to Developed	0.33
Sparsely Vegetated to Agriculture	0.01
Sparsely Vegetated to Woodland	0.04
Sparsely Vegetated to Grassland	0.00

While this analysis does not indicate significant changes from to exotic species, exotic species account for 1.65% of these conversions. Given the size of the Navajo Nation, this represents close to 724 square miles or just over 463,475 acres of weeds that have significantly changed or altered the main vegetation physiognomy of an area (**Figure L-5**). This does not account for smaller populations that have intermixed with native vegetation. But does align with the scale of the weed problem on the Navajo Nation and could provide a general estimate of the size of noxious weed populations in the Region. While shifts occur through out the region, areas with a high concentration of exotic vegetation shifts include along the San Juan River, Chinle Valley, and the lower portion of the Little Colorado River on the Navajo Nation.

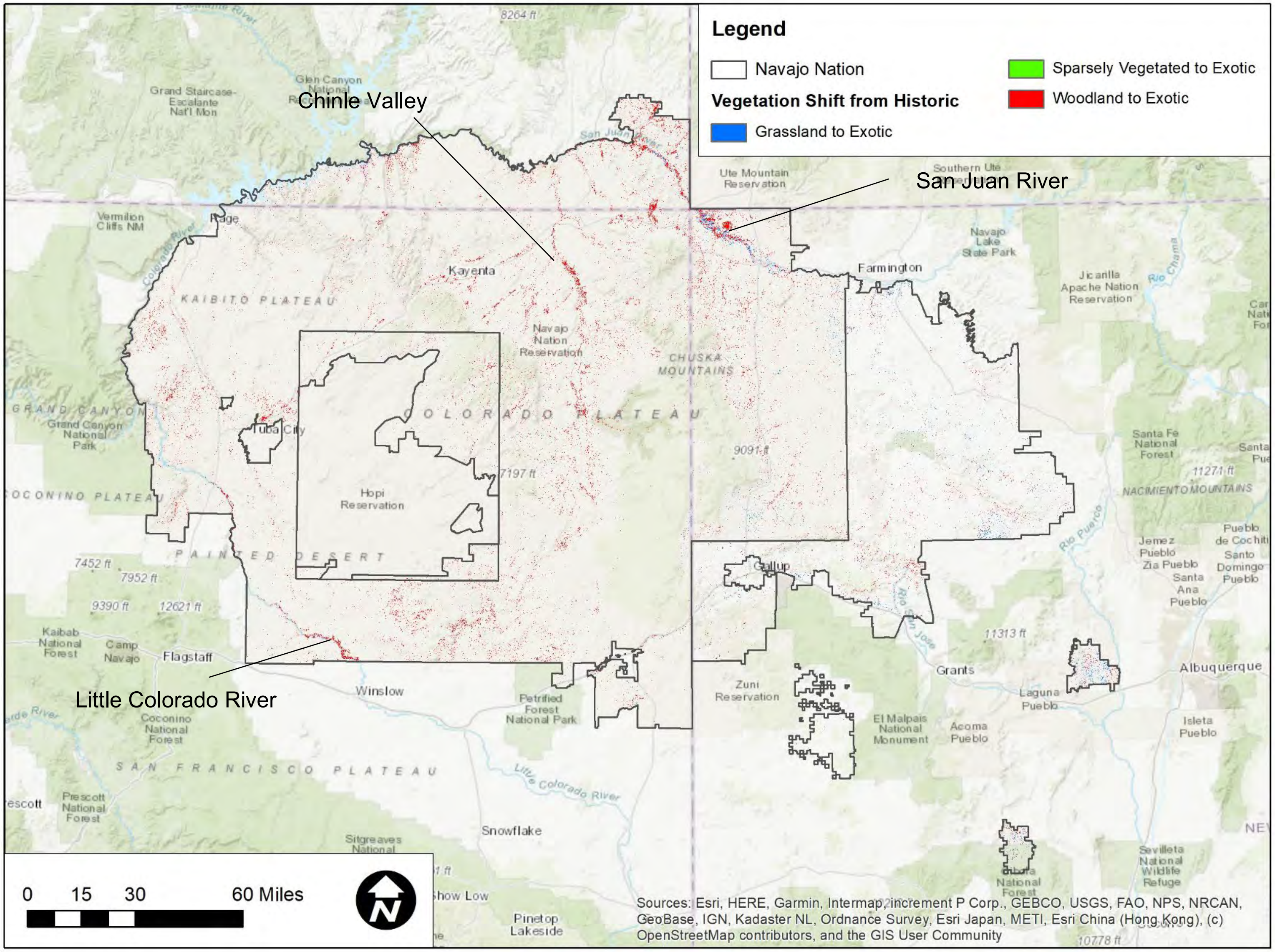


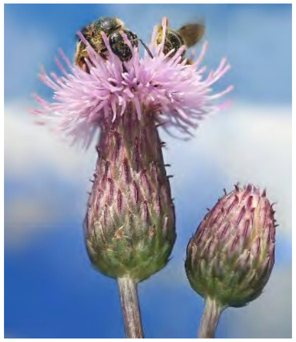
Figure L-5. Map of areas where vegetation has shifted due to exotic weeds on the Navajo Nation. These shifts were calculated through a vegetation departure analysis comparing pre-European land cover to LANDFIRE land cover from 2016. Areas with a large number of exotic vegetation shifts include the San Juan River, Chinle Valley, and the Little Colorado River.

Priority Noxious Weed Species Descriptions

The following are description and characteristics of the noxious weeds found within the project area that have been prioritized for management and control on the Navajo Nation. As defined in the weed management plan, weeds are exotic, invasive, aggressive, competitive, and persistent. Locations for known weed infestations are from recent BIA weed mapping efforts and the SWEMP. Names include common name, scientific name, USDA Plants Code, and Navajo name, if available. Navajo names are based on the New Mexico State University Selected Plants of the Navajo Rangeland database.

Category A Species

Name	Origin	Description	Concerns	Photo
African Rue *(Peganum harmala)* PEHA	North Africa Mediterranean	Small, bright green succulent perennial forb with a bushy growth. Plants die back to the root in the winter and grows in late March and early April.	Contains four poisonous alkaloids toxic to cattle, sheep, and horses. Toxins can cause a loss of appetite, trembling, and loss of coordination. Severe poisoning can cause hemorrhaging in the heart and liver. The seeds are the most toxic part, while leaves are less so (USFS 2005). Invades disturbed or barren areas with moist soils. Populations found near Navajo Bridge at business site leases in Western Navajo.	 *National Park Service*
Blue mustard ***(****Chorispora tenella)* CHTE2	Eurasia	Winter annual grows in late fall to early winter. Plants overwinter as a rosette and resumes growth in the spring. Flowers grow in pink to purple flowers with petals that extend outwards and twist. Plants have a distinct musky odor. Leaves are sinuate to dentate and plants are covered in glandular hairs.	Plants spread via seeds on disturbed sites. If eaten by cattle, can produce an off flavor in milk. In agricultural fields, blue mustard can reduce yields of several grain crops (Lyons et al. 2006). Detected outside of Chinle, AZ	 *EnviroPlan Partners 2018*

Name	Origin	Description	Concerns	Photo
Bull thistle (*Cirsium vulgare*) CIVU	Eurasia	Typically, biennial but can be perennial and grow up to 7 ft. in height. Leaves deeply lobed with coarse prickly hairs on top and woolly hairs underneath. Leaves have sharp spines on the midrib and tips, resembling a spear. Flowers in pink-magenta heads at the end of each stem, with spiny bracts surrounding each seed head (DiTomaso et al. 2013).	Invades disturbed sites along slash piles, old log desks, and roadsides. Regeneration solely from short lived seeds. However, each flower can produce between 100 – 300 seeds per flower. Can outcompete native vegetation and reduce site productivity and stocking rates (USFS 2005). Has been detected in numerous locations on the Navajo Nation, mostly along roads and highways.	
Canada thistle (*Cirsium arvense*) CIAR4 Azéé hakani yázhí	Southeastern Europe and eastern Mediterranean	Colony-forming perennial thistle grows up to 3 to 5 ft tall. Has an extensive creeping root system that can reach depths of 5 to 15 ft. Leaves spiny lobed, alternate, and oblong or lance shaped. Plants are dioecious and flowers are white to purple in clusters of 1 to 5 per branch. Flowerheads are glabrous with white woolly hairs. Can produce 1,000-5,000 seeds per stem (DiTomaso et al. 2013)	Underground roots can produce new plants, which makes eradication difficult. Can reduce forage consumption in rangelands and crop yields on agricultural lands (USFS 2005). Competes aggressively with native plants and is a host plant for several agricultural insects and diseases (DiTomaso et al. 2013). Has been detected on some rangelands and along roads near Window Rock and Leupp.	 *Richard Bartz, 2007*
Common Mediterranean grass (*Schismus barbatus*) SCBA	Africa and Mediterranean	Cool season annual grass grows erect to semi-prostrate up to 8 in tall. Forms large dense mats. Fine, narrow leaf blades with small dense panicles. Flowers appear in spring and are self-pollinating. Spikelets are small and lack awns with 3-8 florets per spikelet. Plants reproduce only by seed. (DiTomaso et al. 2013)	Found on dry slopes, bajadas, desert mesas, river bottoms, or valley bottoms and locally abundant in mountain ranges between 100 and 4,000 ft in elevation. Forms dense mats during years of favorable winter precipitation, outcompeting native species. Is a primary species fueling desert wildfires in the Mojave Desert and threatens species diversity in ecosystems that have not evolved to more frequent fire intervals (USFS 2005)	 *Max Licher*

Name	Origin	Description	Concerns	Photo
Dalmatian toadflax *(Linaria dalmatica)* LIDA	Eastern Europe	Ornamental perennial forb grows up to 3 ft tall. Stems rough and woody at the base, and waxy and smooth at the top. Leaves waxy and bluish-green, ovate to heart-shaped with smooth margins. Leaves alternate and clasping at the upper portion of the stem. Has deep taproots with adventitious buds that form new plants. Flowers resemble yellow to orange snapdragons (DiTomaso et al. 2013)	Plants reproduce from both seed and underground root stalks. One plant can produce up to on half million seeds, as well as lateral roots up to 10 feet from the plant (King County 2011). Can crowd out native plants and reduce forage of rangelands. Commonly occurs along roadsides in the southwestern United States and has been detected in Western and Fort Defiance Agency jurisdictions.	 *Renee Benally, BIA*
Fountaingrass *(Pennisetum setaceum)* PESE3	Northeastern Africa and western Asia	An attractive perennial grass grows in dense clumps with erect stems up to 4 ft high. Florets grow in bushy clusters of pink or purple and appear bristly in inflorescences 6-15 in. long.	Highly aggressive and fire-adapted. Outcompetes native plants after burns. Seeds are long-lived and disperse easily by wind or water, allowing them to travel great distances (USFS 2005).	 *Eric Guinter, 2005*
Leafy Spurge (*Euphorbia esula)* EUES Chi'il abcí tsoh	Eurasia	Perennial forb with greenish-yellow flower bracts. Flowers in May and June. Leaves are simple and opposite with a blue-grey hue. Plant can reach a maximum height of 4 ft.	Can reproduce by seeds and root buds. Roots can grow up to 30 ft from plants and seeds, which are forcefully expelled, can land up to 15 ft. from the original plant. Plant produces latex, which can cause lesions around the eyes and mouth of cattle (USFS 2005). Invades grasslands and can invade riparian areas, shrublands, and savannas. No populations documented but known near Mormon Lake in Flagstaff.	 *John Randall, The Nature Conservancy*

Name	Origin	Description	Concerns	Photo
Musk thistle *(Carduus nutans)* CANU4 Azee'okani'whooshi Azee'okani'deniní	Eurasia	Biennial forb can grow up to 5 ft. tall. Prickly leaves and stems with prickly wings. Forms deep taproots and germinates in the winter to early spring, forming a rosette and developing flowering stems in the spring and summer the next year. Purple to pink flowers form in summer in hemispherical thistles, that nod on long stalks. Reproduces only by seed (DiTomaso et al. 2013)	In one growing season, a single plant can produce over 100,000 seeds. Can increase from a single plant to a large infestation within 2 to 3 years. Seeds remain viable for around 15 years, requiring intensive monitoring of infested and treated sites (USFS 2017). Can crowded out native species and valuable forage plants and spines discourage animals from entering infested areas. Found throughout the Navajo Nation along roadsides, farm fields, and rangelands.	
Perennial pepperweed *(Lepidum latifolium*) LELA2 Os si tsóh	Eurasia	Long-lived perennial forb can grow from 2 to 4 ft tall from seeds or roots. Prefers moist or seasonally wet sites. Leaves are alternate and can be wider at the base and narrower along the stems, margins entire to slightly toothed. Flowers form in small white clusters at end of the stems.	Grows in a variety of areas, including floodplains, pastures, riparian areas, and near residential structures. Forms dense thickets that crowd out other plants. Seeds and plant fragments can spread easily and make dispersion difficult to control. Has been detected in Marble Canyon and at NAPI-NIIP lands (DiTomaso et al. 2013).	 *Joseph DiTomaso*
Ravenna grass *(Saccharum ravennae)* SARA3	Mediterranean	Perennial bunch grass with long-flowering cane-like stalks that can reach over 12 ft in tall and a basal area several feet in diameter. Flowers in summer with large plume like inflorescence. Distinguished from pampas grass by the dense villous hairs that grow along the lower leaf blades (Thomsen and Meyer 2007)	Planted often as an ornamental, can easily escape due to its lightweight seeds that disperse in wind and water. Establishes quickly in disturbed areas and is highly competitive in riparian areas. Can form dense monocultures, growing out from beneath established vegetation. Established stands can increase fire risk along riparian zones and anchor soils normally subject to shifting (PDCNR 2013). Populations detected on the Hopi Reservation and in Grand Canyon National Park.	 *Daderot*

Name	Origin	Description	Concerns	Photo
Sahara mustard *(Brassica tournefortii)* BRTO Oostse’	Mediterranean	Erect winter annual that forms a basal rosette with a span of around 3 feet and a height of 2 ft. Basal leaves are deeply pinnate-loved and lower stems have dense, stiff white hairs. Produces small yellow flowers that produce long linear fruits. Mature fruits open from the base to release the seeds. Reproduce solely by seed (DiTomaso et al. 2013)	Fast-growing and drought tolerant, these plants grow best in disturbed and sandy soils. Flowers are self-pollinating and create thousands of seeds. Dried plants can break off and form tumbleweeds, increasing seed spread. Can increase fire risk, lower biodiversity, and lower forage value of rangelands (USFS 2017c).	 *Mike Lewis, UCR*
Scotch thistle *(Onopordum acanthium)* ONAC Zéé hókaníił béí Whosh Waa’	Europe	Broad spiny stems with vertical rib. Large spiny leaves with dense hairs. Violet to reddish flowers in spherical to hemispherical shape. Plants grow in tall erect. Reproduces solely by seed (DiTomaso et al. 2013).	Plants can create an impenetrable thicket, with seeds viable for 6 years. Grows in disturbed areas along roadsides and in waste areas (USFS 2017). Produces large numbers of seeds that contain a water-soluble germination inhibitor that can delay maturation (DiTomaso et al. 2013). Found throughout the Navajo Nation along roadsides and in some riparian washes and farms.	 *CSU Extension*
Spotted knapweed (*Centaurea maculosa, C. stoebe)* CESTM Ch’it Bilat’a dootłizhigí	Central Europe	Biennial or short-lived perennial forb growing 1 to 3 feet tall with a long, sturdy taproot. Forms basal rosettes in winter and early spring and then develops erect, highly branched flowering steps in late spring to summer. Leaves are alternate, pinnately lobed and dotted with resin ducts. Each flowerhead forms 30 -40 disk flowers with white, pink, or purple flowers. Phyllaries have dark colored tips, giving them a spotted appearance (DiTomaso et al. 2013).	Forms monocultures that reduce native plant populations. Can inhibit growth of other nearby plants (USFS 2005). Can reproduce both vegetatively and from seed. Seeds can remain dormant in soils for 8 years and can germinate without sun exposure. Can hybridize with diffuse knapweed (DiTomaso et al. 2013). Population common along roads and near the Shonto Boarding School.	 *BIA*

Name	Origin	Description	Concerns	Photo
Squarrose knapweed *(Centaurea virgata*) CEVI	Western Asia	Long-lived perennial forb grows to 12-18 inches tall with small pink to purple flowers. Remain a rosette for several years under poor conditions before growing into a flowering stem. Grows in a bushy habit, with deep taproot. Leaves alternate and covered in short to medium grayish hairs. Upper leaves are entire and linear while lower leaves are 4-8 in. long and deeply pinnately lobed.	Invades rangelands with shallow soils and is adapted to harsh climates. Flowerheads have burs that allow them to cling easily to passing animals, vehicles, and clothing. Favors opens disturbed sites (USFS 2005)	 *Gerald-Carr 2013*
Sulphur cinquefoil *(Potentilla recta* L.) PORE5 Azee tsoxíí Chil di tsoxíí	Mediterranean and Eurasia	Perennial forb grows up to 3 ft tall. Flowers pale yellow with 5 heart-shaped petals and 5 enclosing green sepals. Leaves are palmate with serrate margins with narrow oblanceolate leaflets. Stems, underside of leaves, petioles, and calyx have long perpendicular hairs. Discern from natives by green underside and appressed hairs on the stem. Produces numerous seeds that can last for up to 4 years in soil (CDA 2019)	Can reproduce by seed or new root shoots. Commonly invades grasslands and shrub-dominated areas, especially disturbed sites or waste areas. Plants are unpalatable and avoided by animals due to high tannin content. Can quickly dominate grazing areas and out-compete native forage grasses (CDA 2019)	 *Robert Flogaus-Faust 2006*
Tall whitetop *(Cardaria draba*) (*Lepidium draba)* CADR Os si tsóh	Russia/Eurasia	Deep-rooted perennial that grows up to 2 ft tall with deep roots, growing 12-30 ft deep. Can produce 50 sheets in a square yard. Leaves alternate, gray green in color, and vary in shape. Lower blade surface is covered in short white hairs. Basal leaves are short-stalked and upper leaves are clasping. Numerous small, white fragrant flowers in spring to summer. Prolific seed production. (DiTomaso et al. 2013)	One plant can spread 12 feet in its first year. Plants are toxic to cattle. Can reproduce by seed or root segments. One plant can produce 1,200 to 4,800 seeds, which are short lived. Extensive and fast-growing root system are the main method of spread (DiTomaso et al. 2013). Found in alkaline, disturbed soils and is highly competitive once established (USFS 2005). Has been detected on the Navajo Nation along roadsides and washes in the eastern Chuska mountains.	 *Steve Dewey, USU*

Name	Origin	Description	Concerns	Photo
Tamarisk *(Tamarix* spp.) TAMAR K'eiłichii'its'óóz	Eurasia	Trees originally planted as ornamentals and for erosion control. Has deciduous tiny scale- or awl-like leaves, although athel varieties are evergreen. Deep, efficient root system with high evapotranspiration rates during warm seasons. Flowers are in racemes with simple, but occasionally compound panicle-like flowers. Different species can be identified by the nectar base at the flower. Flowers are small and white to dark pink. (DiTomaso et al. 2013)	Category A species are found in more isolated populations but can hybridize with similar species. Hybridization is not well understood but can increase spread and utilization of uninhabitable ecosystems. Deep roots extract salts from deeper soils and excrete it from the leaves, increasing salinity of surface soils. Can replace more desirable native species and displace native wildlife species, including the endangered Southwestern willow flycatcher.	 *Russ Kleinman & Rich Felger*
Tree of Heaven *(Ailanthus altissima)* AIAL T'iis Nattói	China	Deciduous tree can grow up to 90 feet tall with gray bark. Branches have a large pitch and heart-shaped leaf scars. Discerned from similar native trees by the leaves, which have a circular gland on each leaflet near the petiole. Flowers are small greenish clusters becoming straw-colored to reddish brown fruits in a pod-like structure.	Can reproduce from seed or roots which form extensive networks in dense colonies that out-compete native trees. Produces chemicals that prevent other trees from establishing. Roots can damage sewers and foundations of nearby structures (PCA 2009). Invades disturbed areas and can grow in forest openings and common areas. Does not establish well in wetlands or shaded areas. Populations in Shiprock.	 *Russ Kleinman, NMSU*
Uruguyan pampas grass *(Cortaderia selloana*) COSE4	South America, mainly in low elevation subtropical grasslands and riparian areas.	Fast-growing bunch grass forms densely tufted bunches with long basal leaves and tall-showy plumelike inflorescences, which are 1 – 3 ft long. Leaves sharply serrated. Inflorescences have fountain-like appearance. Forms dense fibrous roots that grow in shallow, short lateral rhizomes. Plants are dioecious and can only develop seeds if male or female plants are within pollination range. (DiTomaso et al. 2013).	A single plant can produce millions of seeds that can travel via wind for several miles. Can grow along roadsides, steep cliffs, streambanks, and open disturbed areas. Tolerant of intense sunlight, drought, and frost and can live for over a decade. Displaces native species, lowering biodiversity and reducing habitat quality. Leaves are extremely sharp and can harm wildlife, livestock, and humans (DiTomaso et al. 2013)	 *Joseph DiTomaso, UCD*

Name	Origin	Description	Concerns	Photo
Yellow nutsedge *(Cyperus esculentus)* CYES Tłohi'gaí	Europe	Warm season perennial grass growing between 6 to 30 in tall. Leaves originate from the base of the stem and are grass-like, smooth, and glossy. Stems are triangular. Flowers are umbrella shaped spikelets with long, leaf-like bracts that are yellowish. Roots form prolific hard, round brown to black tubers that facilitate vegetative spread (CDA 2015)	Reproduces by seed and tubers, which make it difficult to control. Tubers develop rapidly and can persist in the soil for years, forming dense colonies and crowding out native vegetation. Can be damaging to crops with onions, potatoes, beans, and corn. Can grow in a variety of soils, and prefers wet or moist soils, but is drought-tolerant once established (CDA 2015).	 *Patrick Alexander*
Yellow starthistle *(Centaurea solstitialis*) CESO3 C'it Bilat'a dootłizhigí	Europe	Annual forb that grows 2-3 feet tall with wiry stems. Roots can grow at least 3 ft into a deep taproot. Flower heads are spiny and grow singly at the stem tips with narrow yellow petals. Plants starts as a low rosette with white hairs. Leaves and stems are gray to bluish green with fine white cottony hairs.	Horses grazing large quantities are susceptible to "chewing disease," a neurological disorder preventing the horse from swallowing. There is no cure of chewing disease and it is fatal (USFS 2005). Populations have been detected along roadsides on BIA-27 north of Ganado Lake and on I-40 outside of Window Rock.	 *Peggy Greb, USDA*

Category B Species

Name	Origin	Description	Concerns	Photo
Camelthorn *(Alhagi camelorum, A.maurorum)* ALMA12 Ch'ilhoshí	Eurasia	Aggressive perennial shrub with thick rhizomes that grow out 36 ft or more from the parent plant. Plants have greenish, ridged, hairless stems that are highly branched with thorny branches. Leaves alternate, sparse, and simple, thick, and leathery, and oval shaped. Flowers appear in summer and are two to six magenta pea-live flowers on short stalks. Fruits are reddish-brown pods with beaked tip in late summer.	Extensive root systems make this species difficult to eradicate. Seed also facilitate spread as they can be dispersed by water, animals, and winds, but reproduction is mostly vegetative. Can grow through pavement and thorns can flatten tires (USFS 2005). On the Navajo Nation, it grows quickly along roadsides, washes, and streams, and near communities. Heavy infestations documented near Shiprock, Tuba City, Chinle Wash, the San Juan River Basin, and along the Little Colorado River.	 *Susan Holiday*

Name	Origin	Description	Concerns	Photo
Halogeton *(Halogeton glomeratus*) HAGL Chil'bit'ą́ąh t'ó	Eurasia	Erect winter and summer annual with small fleshy leaves. Stems are tinged reddish or purple and leaves are alternative, sessile, dull green to bluish-green, and end in a needle-like spike. Flowers are numbers and dense on the leaf axils and lack petals. Reproduces mostly by seed. (DiTomaso et al. 2013)	Not extremely competitive but invades disturbed and overgrazed areas. Produces oxalates that are toxic to livestock (NRCS 2002). Found in heavy populations along roads and disturbed areas such as on Black Mesa near coal mine operations. Is widespread on the Navajo Nation.	 *Renee Benally, BIA*
Siberian elm *(Ulmus pumila*) ULPU Naasts'ósí bit'iis	China, Siberia, Manchuria, and Korea	Fast growing trees, from 50 to 70 ft tall. Leaves alternate, oblong in shape with serrate margins. Flowers greenish and clustered in short pedicels that appear before leaves in March and April. Bark light gray brow with irregular furrows. Fruits are samaras with a dry, compressed nutlet.	Widely grown in the southwestern United States as a shade tree, it can outcompete native species in riparian zones and other sensitive areas. Winged seeds can travel long distances by wind or vehicles. Tree produce abundant seeds that make it difficult to control (USFS 2005). In isolated populations on the Navajo Nation along roadsides, homesite leases, and business site lease areas.	 *Russ Kleinman*
Tamarisk/Saltcedar *(Tamarix ramossisima)* TARA K'eiłichii'its'óóz	Eurasia	Trees can grow to 20 ft tall with deciduous awl-like twig leaves that overlap with acute tips. Foliage is usually bluish-green with small flowers. Flowers are small and white to dark pink. Prolific seeders and able to reproduce vegetatively. (DiTomaso et al. 2013)	Outcompetes native riparian trees by forming deep root systems that access underground water not available to other species. Species can increase fire risk in riparian system by increasing flammable fuels (USFS 2005). Widespread on the Navajo Nation in riparian areas and washes where it alters stream flow, decreased habitat quality, and increased fire risk. Some populations have been impacted by the tamarisk leaf beetle (*Diorhabda* spp.), which defoliates large stands and increases fuel loads. Common along washes, roadsides, homesite leases, and business site lease areas.	 *Steve Dewey, USU*

Name	Origin	Description	Concerns	Photo
Diffuse knapweed *(Centaurea diffusa)* CEDI3 Ch'il lat'á dei nínigí	Mediterranean	Biennial or short-lived perennial forb forming 1 to 2 ft tall with a long single taproot. Leaves alternate and covered in short interwoven gray hairs. Upper leaves are entire and linear and lower leaves are longer and deeply pinnate-lobed. Flowers heads are spiny with comb-like phyllaries and white, pink, or pale purple flowers. Plants reproduce by seed only. (DiTomaso et al. 2013)	Seeds can remain viable for 12 years. Dead plants break off at ground level and form tumbleweeds that spread seeds. Can increase erosion and sedimentation while decreasing habitat and forage quality. Produces chemical compounds that inhibit growth of other species (USFS 2005). Can also hybridize with spotted knapweed. Widespread on Navajo Nation and found along roadsides, mining areas, and community areas.	 *Matt Lavin*
Russian knapweed *(Acroptilon repens)* ACRE3 Ch'ildích'l'iłibáhí	Central Asia	Deep-rooted perennial forb grows to 3 ft tall. Stems erect, branched, and covered with gray hairs. Leaves alternate and entire. Basal leaves are mostly oblong and longer than stem leaves, which are narrower. Old flower stems can persist for extended periods after senescence, forming thatch. Flowerheads hemispherical, in clusters, color white to lavender-blue. (DiTomaso et al. 2013)	Plants develop adventitious roots that enable the species to colonize areas quickly. Produces compounds the suppress the growth of native plants, allowing it to form dense monocultures. In two years, roots can grow 10 ft deep and 10 to 12 feet in diameter (USFS 2005). Found throughout the Navajo Nation on farms, rangeland, near waterways, and along roadsides.	 *Patrick Alexander*
Russian olive *(Elaeagnus angustifolia)* ELAN Tsin łibáhá	Asia	Large shrub to medium-sized tree with silvery foliage. Leaves alternate, simply, narrowly lanceolate to elliptical with smooth margins. Upper surface of leaf is grey-green and underside is silvery grey and covered in scales. Flowers are umbel-like clusters with small highly fragrant flowers. Plants mainly reproduce by seed.	Originally used as windbreaks and for erosion control, it was planted extensively throughout the southwestern United States. Invades riparian areas where it replaces native trees (USFS 2005). Has invaded several major washes and riparian areas on the Navajo Nation, including Long Canyon, Shonto Wash, Colorado Pueblo Wash, Fruitland, and streams and tributaries around Shiprock.	 *John Randall, The Nature Conservancy*

Name	Origin	Description	Concerns	Photo
Johnsongrass *(Sorghum halepense)* SOHA Akál	Mediterranean	Erect perennial grass that grows to 2 - 8 ft tall. Base of stalks are reddish pink,leaves are 0.5 – in wide and 6 to 20 in long. Blades are flat with a distinctive white midvein. Infloresence is a large open panicle, reddish to purple in color. Plants also have thick, fibrous rhizomes. (CDA 2009)	Spreads rapidly through seeds and rhizomes. Poses problems on disturbed sites and agricultural lands where it can hybridize with crops, such as sorghum. Leaves can produce a toxin that is poisonous to livestock if ingested (CDA 2009)	 *Harry Rose, 2005*

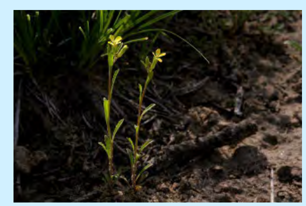
Category C Species

Name	Origin	Description	Concerns	Photo
Bald brome *(Bromus racemosus)* BRRA2	Eurasia	Annual grass with upright stem in clusters or tufts. Seeds are awn-less. Florets attached to main stem instead of axis of inflorescence.	Grows in agricultural fields, pastures, and disturbed areas. Can be grazed by livestock when young but dries up as it matures. Increases fire risk. Has been detected in Canyon de Chelly.	 *Rutger Barendse, Saxifraga*
California burclover *(Medicago polymorpha)* MEPO3 Tł'oh azee	Southern Europe	Forb grows as an annual or perennial in disturbed sites. Plants grow to 2 ft tall and likely prostrate. Leaves divide into 3 leaflets with reddish hue and serrated edges. Flowers small bright yellow clusters. Fruits tightly coiled pods with two to three rows of prickles.	While it can be used as forage, the prickly fruits can get caught in wool and animal fur. Tendency to spread quickly in poor and disturbed soils where it can outcompete native vegetation (UC IPM 2014). Detected in Canyon de Chelly in Canyon del Muerto.	 *Forest & Kim Starr, 2006*

Name	Origin	Description	Concerns	Photo
Cheatgrass *(Bromus tectorum*) BRTE Shíyináldzidí	Europe	Erect winter and spring annual grass growing around 2 ft tall, that typically droop to one side. Leaves covered in short, soft hairs. Florets have long awns. Flowers in spring and then become reddish purple.	Prolific seeder that increases in density with bare soil for germination. Increases fire frequency in areas where it invades, often in forests, near residential sites, and in open fields (USFS 2005). A widespread problem in southwestern United States with populations throughout the Navajo Nation. Known to invade rangelands and hiking and horse trails	 *EnviroPlan Partners, 2017*
Field bindweed *(Convolvulus arvensis)* COAR4 Ch'il natł'oi łigaí	Eurasia	Hardy perennial creeping vine. Leaves are ovate to heart-shaped and green. Flowers are bell or trumpet-shaped and white to pink in color. Plants reproduce vegetatively and by seeds.	Spreads quickly with extensive rhizomes and rootstocks. Seeds have long dormancy period, lasting up to 60 years. Drought-tolerant and can outcompete native and desirable vegetation. Roots can penetrate fabric, plastic, and other barriers (UC IPM 2011). Widespread on the Navajo Nation, affecting rangeland, farmlands, and roadsides.	 *EnviroPlan Partners 2017*
Field brome *(Bromus arvensis B. japonicus)* BRAR5	Eurasia	Winter annual grass that produces a dense, low leafy growth in the fall. Tillers profusely and produces seed heads in late spring and early summer. Seed stalks are 2 -3 ft tall. Extensive fibrous root system with short top growth. (NRCS 2002a)	Commonly planted as a winter cover crop, but can become invasive, displacing more desirable vegetation. Does well on medium textured soils that are moderately to well-drained. Sometimes identified as Japanese brome.	 *Daderot*
Horehound *(Marrubium vulgare)* MAVU	Eurasia	Cool season perennial forb about 2 ft tall. Stems are densely hairy, thick, and square in cross-section. Leaves are aromatic, opposite, ovate to nearly round with round toothed margins. Upper and lower leaf surfaces are hairy. Flowers white to deep magenta grown in head-like whorls. Reproduces only by seed.	Colonizes fields and other open/disturbed areas. Establishes in infertile soils and often a primary colonizer on in eroded areas. Considered naturalized in much of the U.S. Can outcompete native vegetation and form dense stands in annual grasslands. Populations near Ganado, east of Lukachukai on BIA-13, and east of South Sheba Crater.	 *Amy Smith Muise, NMSU*

Name	Origin	Description	Concerns	Photo
Jointed goatgrass *(Aegilops cylindrica)* AECY Cl'oh ałhe ni'lí	Eurasia	Tall winter annual grass grows up to 20 in tall. Foliage looks like to winter wheat but blades, auricles, ligules, and leaf sheaths have evenly spaced fine hairs along the margins. Seedheads have spikelets arranged alternately along a zigzag rachis with seeds 1 to 5 in long. Seed heads turn red to purple at maturity. Seeds break apart at joints. (DiTomaso et al. 2013)	Causes serious problems in agricultural fields, especially for grains, as it is very similar visually and genetically to winter wheat. Can hybridize with winter wheat and reduce overall crop yields (USFS 2017a). Has high silica content which accumulates into thatch that suppresses other species. Tough seedheads have long barbed awns that can injure livestock and survive field burns. (DiTomaso et al. 2013)	 *Patrick Alexander*
Kochia *(Bassia scoparia, Kochia scoparia)* BASC5 Ch'il nilt'ǫlí	Eurasia	Annual forb grows up to 7 ft tall. Foliage gray-green and covered in soft hairs. Leaves are mostly alternate, flat, linear-lanceolate turning reddish-brown as it matures. Has a deep taproot with several branched fibrous lateral roots. Flowers are inconspicuous and fruits have five thicken lobes and short horizontal wings.	Drought tolerant. Common in grasslands, pastures, prairies, roadsides, floodplains, riparian areas, and agricultural fields. Reduces crop yields, contaminates crops, and outcompetes native vegetation by releasing allelopathic chemicals into soils. If consumed in large quantities, can be toxic to livestock. Produces thousands of seeds and can become tumbleweeds, spreading seeds across the landscape.	 *EnviroPlan Partners, 2016*
Puncturevine *(Tribulus terrestris)* TRTE Ch'ilhoshiǫ Naakaibihosh	Southern Europe	Broadleaf summer annual that forms ground covering dense mats 2 to 3 ft in diameter. Green to reddish-brown stems that spread radially. Leaves are evenly pinnately compound with 3 to 7 pairs of leaflets per leaf. Small solitary yellow flowers that develop 5-sided burs with two stout spines. Reproduces only by seed. (DiTomaso et al. 2013)	Burs can stick to passing animals, tires, and people. A prolific seeder, a single plant can produce thousands of seeds that persist for up to 20 years. Has a deep taproot, allowing it to outcompete other plants for water and nutrients. Harmful to animals both from injury and from toxins. Toxins are harmful to sheep and contributes to nitrate poisoning in sheep and cattle (DiTomaso et al. 2013). Widespread on the Navajo Nation along roadsides, fields, disturbed sites, and near watering holes and windmills.	 *Steve Dewey, USU*

Name	Origin	Description	Concerns	Photo
Red Brome *(Bromus rubens)* BRRU2 Bi'zé yilwo' lichi'í	Mediterranean	Short-lived cool season annual grass with sharp florets and straight awns. Leaves and leaf sheaths covered in short, soft hairs. Red brome is shorter than cheatgrass, growing 1.5 ft tall with narrower leaf blades. Panicles are compact and dense and dark red. Becomes dark red when dried and mature.	Prefers open spaces in shrub and grassland communities. Creates fine fuels that decompose slowly and increase fire risk, intensity, and spread. Sharp awns injure wildlife and livestock, reduce available forage, recreational opportunity, wildlife diversity and habitat, and land values. Seed can adhere to clothing and fur and as well as wind, water (USFS 2017b). Detected on the Utah side of Lake Powell, near Antelope Pass, along Highway 160 outside Tuba City, and in western part of Canyon de Chelly.	 *Ken Gishi, NRCS*
Rescuegrass *(Bromus catharticus)* BRCA6	South America	Cool-season annual bunchgrass that grow up to 3 ft tall. Openly branched seed heads with nodding appearance. Seed heads have many flattened flower spikelets, yellow in color. Stems robust, glabrous, and unbranched.	Used as forage in the southern U.S. but considered weedy in the U.S. and Mexico. Well adapted to warm climates and resistant to extreme cold. Found along roadsides, ditch banks, lawns, gardens, and small grained winter drops. Outcompete native vegetation, particularly in riparian areas. Seeds have barbed awns that adhere to clothing and animal fur and can be carried by wind, water, (Halvorson and Guertin 2003)	 *Patrick Alexander*
Ripgut brome *(Bromus diandrus)* BRDI3 Tł'oh da a gighí	Eurasia and Africa	Cool season annual grass with sharp florets and straight awns. Leaves and leaf sheaths are covered in short, soft hairs. Florets have long awns with open, loose, nodding panicles.	Found along roadsides, field borders, disturbed areas, and native rangelands. Threat to wildlife where it replaces native bunchgrasses. Seeds have barbed awns that adhere to clothing and fur. Currently detected east of Chinle near Canyon de Chelly	 *Joseph DiTomaso, UCD*

Name	Origin	Description	Concerns	Photo
Russian thistle *(Salsola kali, S. collina, S. paulsenii, S. tragus)* SATR12 Chi'ildeeníní	Eurasia	Warm-season annual forb growing between 0.5 to 4 ft tall. Densely branched, with globe-shaped habit and a deep taproot. Plants appear bluish-green with reduced, stiff, prickly upper stem leaves. Flowers are small and inconspicuous without petals and solitary on leaf axils.	Common in disturbed grasslands and desert communities, roadsides, railroad ROWs, trails, along streams and lakes, dry plains, agricultural fields, abandoned fields, waste lands, and overgrazed rangeland. When mature, can become tumbleweeds, spreading seeds across the landscape, persisting for years, collecting along waterways and fence lines, and creating a fire hazard. Ignited tumbleweeds carry fire across fire breaks to unburned areas. Produces oxalates and are toxic to livestock.	 *National Park Service*
Smooth brome *(Bromus inermis*) BRIN2 Bįįh tł'óh	Eurasia	Sod-forming perennial cool-season grass that spreads by rhizomes. Can vary in height from 2 to 4 ft. Leaves frequently marked by a transverse wrinkle resembling a "W" a few inches from the tip. Flower heads are purplish-brown and produce semi-compact panicles that spread out with maturity. Flat compressed seeds are awn-less and 1/3 in long.	Plants spread by rhizomes and are best adapted to cooler climates but are drought tolerant and cold resistant. Can be used for forage and hay production but can become highly invasive, outcompeting more desirable native plants. Populations have been detected in the Chuska Mountains north of Long Lake and along Highway 134.	 *Christian Fischer, 2011*
Spreading wallflower *(Erysimum repandum)* ERRE4 Bist'á azéé tsoh	Eurasia	Winter annual forb with stout stems 1-2 ft tall, square in cross-section. Grows in a single stem, with narrow linear leaves along the stems that wither when flowering. Flowers are an elongated cluster with four green sepals and four yellow petals. Petals are clawed with a white patch at the base. Fruits are green narrow pod about 3 in long and spreading. Deep stout taproot.	Commonly found among winter annual crops, along roadsides, and in disturbed sites (Hilty 2012). Some varieties can be herbicide resistant. Detected in Canyon de Chelly.	 *Patrick Alexander*

Federal and Tribally Listed Species Descriptions

Federally Listed Species

Brady Pincushion Cactus (*Pediocactus bradyi)* is a small, semiglobose cactus, ranging from 2.5 to 5 cm in diameter. Suitable habitat consists of Kaibab limestone chips overlaying soils derived from Moenkopi shale and sandstone. It is typically found on gently sloping benches and terraces with sparse vegetation from mid-March to late April. Populations are known from 3,340 – 5,200 ft. in elevation. The species is known only from Coconino County, within the vicinity of the Marble Canyon rim. On the Navajo Nation it is found south of Lee's Ferry on the east side of the Colorado River, south to the vicinity of Sheep Springs Wash. There is potential for the species to exist from Lee's Ferry south and west to the Echo Cliffs, along tributary canyons of the Colorado River, south to Shinumu Wash (NNDFW 2020). Listed as Group 2 by NNDFW

Mancos Milkvetch (*Astragalus humillimus*) is a small, mat forming, perennial shrub with persistent spiny leaf stalks. It is best surveyed during the flowering period from April to early May but can be identified by an expert year-round. The species forms highly localized populations from 4 – 20 acres in size, typically found on large, nearly flat sheets of exfoliating whitish-tan colored sandstone, in small depressions and sand filled cracks on or near ledges and mesa tops. It can be found on the Navajo Nation in San Juan County, New Mexico on Palmer Mesa east to the Hogback area and south of the San Juan River, to a hogback east of Little Water. There is potential for the species to exist throughout the Four Corners area on all slickrock formations consisting of Point Lookout and Cliffhouse Sandstone, and possibly other related features (NNDFW 2020). Listed as Group 2 by NNDFW.

Fickeisen Plains Cactus (*Pediocactus pebblesianus ssp. fickeiseniae)* is a spherical, usually solitary cactus with stems ranging from 2.5-6.0 cm tall. It is best surveyed from late March to late April. Suitable habitat consists of soils overlain by Kaibab limestone in Navajoan desert or Great Plains grassland, as well as canyon rims and flat terraces along washes, typically with limestone chips scattered across the surface. Populations are known to occur between 4,000 and 6,000 ft. in elevation. This species is known from Arizona in Coconino County from House Rock Valley and Gray Mountain to the Little Colorado and Colorado Rivers. On the Navajo Nation, this cactus can be found between Gray Mountain and Bitter Springs at elevations between 4,000 and 6,000 ft. There is potential for the species to occur between Marble Canyon and Gray Mountain (NNDFW 2020). Listed as Group 3 by NNDFW.

Mesa Verde Cactus (*Schlerocactus mesae-verdae)* consists of mostly solitary stems, though it can be found in clusters; stems are oval to depressed-globose, 3 – 11 cm long, and up to 10 cm in diameter. It can only be surveyed during the flowering and fruiting period from April through May. Suitable habitat can be surveyed year-round and consists of salt-desert scrub communities, typically in the Fruitland and Mancos shale formations, but also in the Menefee Formation overlaying Mancos shale. It is most frequently found on the tops of hills or benches and along slopes, from 4,900 to 5,500 ft. in elevation. Appropriate Mesa Verde cactus habitat must have an underlying layer of clay soils that can be overlain with either igneous or sedimentary gravel. On the Navajo Nation, it is found from the Colorado border south to near Naschitti, New Mexico. There is potential for the species to exist on the Navajo Nation only within its known distribution to the north, south, and west. The eastern limits are still unclear (NNDFW 2020). Listed as Group 2 by NNDFW.

Rhizome Fleabane (*Erigeron rhizomatus)* is an herbaceous perennial herb with creeping rhizomes, 25 – 45 cm tall. It is distinguished from other fleabane species by its rhizomatous habit, nearly hairless leaves and very few hairs on the stems and leaves. It is best surveyed during its flowering period between May and June but can be identified by an expert through July and possibly August. Suitable habitat can be identified year-round and consists of fine textured clay hillsides of mid to high elevation between ca. 7,000 and 8,300 ft. in elevation. It is known from clays derived from the Chinle Formation in the Zuni and Chuska Mountains, and to similar clays of the Baca Formation in the Datil and Sawtooth ranges in New Mexico. On the Navajo Nation, it has been recorded on the slopes of the Chuska Mountains from Lukachukai and west of Red Valley in Apache County, Arizona south to Navajo in McKinley County, New Mexico. There is potential for the species to occur on the Navajo Nation in the Chuska Mountains and in suitable habitat in the pinion-juniper associations between Lupton in Apache County, Arizona and Prewitt in McKinley County, New Mexico (NNDFW 2020). Listed as Group 2 by NNDFW.

Navajo Sedge (*Carex specuicola)* is a perennial grass-like plant with a dried persistent leaf base. Positive identification of the plant is only possible during the flowering/fruiting season, from late June through September; however, suitable habitat can be identified year-round. This sedge is typically found in seeps and hanging gardens on vertical sandstone cliffs and alcoves, from 4,600 ft. to 7,200 ft. in elevation. On the Navajo Reservation it has been documented from the Navajo Creek drainage in Coconino County; east to the Tsegi Canyon Watershed in Navajo County; south to Rock Point, Mexican Water, and Canyon de Chelly National Monument in Apache County, Arizona. It is also known from Chinle Creek in San Juan County, Utah. Within the Navajo Nation, there is potential for the species to occur in northern Arizona and southeastern Utah, especially in hanging gardens of the San Juan River drainage and Lake Powell (NNDFW 2020). Listed as Group 3 by NNDFW.

Welsh's Milkweed (*Asclepias welshii*) is an herbaceous perennial herb with large oval soft woolly leaves and globular clusters of cream-colored flowers that are rose-hued in the middle. It is best surveyed from June through September. Suitable habitat consists of active sand dunes derived from Navajo sandstone in sagebrush, juniper, and ponderosa pine communities. On the Navajo Nation, the species can be found in Coconino County, north of Tuba City and south of Monument Valley in Navajo County and Apache County. There is potential for the species to exist on all active sand dunes between Page and Tuba City, east to the Chinle Creek drainage (NNDFW 2020). Listed as Group 3 by NNDFW.

Navajo Listed Species

This section solely describes species listed by the Navajo Nation Department of Fish and Wildlife. Several species in Groups 1 and 2 are federally listed and described above.

Group 2

Cutler's Milk-vetch (*Astragalus cutleri)* is a short-lived perennial, often flowering as an annual, growing 10-35 cm tall. Because this is primarily an annual plant, it can only be located during its flowering/fruiting period, which is April through early June. Its habitat consists of warm desert shrub communities on sandy, seleniferous soils with level to moderate slopes on the Shinarump and Chinle Formations, from ca. 3,800 ft. in elevation. Within the Navajo Nation, it is found in Copper and Nokia Canyons; however, there is potential for the species to occur in canyons adjacent to Copper and Nokia Canyons, where there is suitable habitat (NNDFW 2020).

Group 3

Gooding's Onion (*Allium gooddingii)* is an herbaceous perennial with an elongate bulb terminating in a thick iris-like rhizome. It is best surveyed from mid-July through August. Its habitat generally consists of spruce-fir forests and mixed conifer forests in the Chuska Mountains and also under Gambel oak thickets interspersed with aspen, dogwood, and Douglas fir. It is most often found in moist, shady canyon bottoms and north-facing slopes, often along streams, from 6,400 – 9,400 ft. in elevation. On the Navajo Nation, it is found in Canyon de Chelly, the Chuska Mountains in Apache County, Arizona and McKinley County and San Juan Counties in New Mexico. There is potential for the species to occur throughout the Chuska Mountains and the Defiance Plateau (NNDFW 2020). Species does have federal protection in U.S. Forest Service lands through a Cooperative Agreement but does not have federal protection for other lands per ESA.

Aztec Gilia (*Aliciella formosa)* is an herbaceous perennial distinguished by entire leaves and woody bases on older plants. It must be surveyed during the flowering/fruiting period from late April to June. It is endemic to soils of the Nacimiento Formation in salt-desert scrub communities ranging from 5,000 to 6,400 ft. in elevation. On the Navajo Nation, it has been recorded in Kutz Canyon south of Bloomfield, New Mexico. There is potential for the species to exist south of Farmington and Bloomfield where the Nacimiento Formation occurs (NNDFW 2020).

Alcove Death Camas (*Zigadenus vaginatus)* is a stout perennial that sprouts from rhizomes. It is best surveyed from mid-July through August. Suitable habitat can be identified year-round. Habitat consists of hanging gardens, seeps, and alcoves, primarily on Navajo Sandstone. It is endemic to the Colorado Plateau in southern Utah and northern Arizona. On the Navajo Nation, it is known from hanging gardens in sandstone canyons surrounding Navajo Mountain in Coconino County, Arizona and San Juan County, Utah. There is a disjunct population in Canyon de Chelly National Monument (NNDFW 2020).

Marble Canyon Milkvetch (*Astragalus cremnophylax var. hevroni)* is a dwarf, evergreen, perennial herb, which forms a matt less than 1.5 cm high. It is best surveyed from April to May but can be identified year-round by an experienced botanist. Suitable habitat can be identified year-round. Habitat consists of crevices and depressions with shallow soils on Kaibab Limestone and on rimrock benches at the edge of Marble Canyon. The plants are associated with Great Basin Desert scrub communities at ca. 5,000 ft. in elevation. The species is only known from the rim of Marble Canyon near Shinumo Wash. Specifically, it is known from the east rim of Marble Canyon from the Little Colorado River Gorge to Navajo Bridge (NNDFW 2020)

Cronquist Milkvetch (*Astragalus cronquistii)* is a perennial plant that sprouts from a taproot and underground root crown. It must be surveyed from May to June, when seedpods are present. Suitable habitat can be identified year-round. Habitat consists of salt desert shrub and blackbrush communities on sandy or gravelly soils derived from the Cutler and Morrison Formations or Mancos Shale, from 4,750 to 5,800 ft. in elevation. On the Navajo Nation, it is reported from south of Bluff, Aneth, and near the Utah border with Colorado. There is potential for the species to occur on the Navajo Nation in southeastern Utah (NNDFW 2020).

Naturita Milkvetch (*Astragalus naturitensis)* is a low-growing perennial best surveyed from late April through May when seed pods are present. Habitat consists of sand filled pockets on sandstone slickrock and rimrock pavement along canyons in the pinyon-juniper zone. Known populations occur between 5,000—7,000 ft. in elevation. On the Navajo Nation, the species has been reported from the Hogback in San Juan County to the Pinetree Canyon area in McKinley County in Utah. Within the Navajo Nation there is suitable habitat for the species north of I-40 in McKinley County to the Hogback in San Juan County (NNDFW 2020).

Acoma Fleabane (*Erigeron acomanus)* is a mat-forming perennial which sprouts from a taproot. It is best surveyed from June to August, though suitable habitat can be identified year-round. Suitable habitat consists of sandy slopes beneath sandstone cliffs of the Entrada Sandstone Formation in pinion-juniper woodland communities. Populations are known from ca. 7,000 ft. in elevation. On the Navajo Nation, it is documented north of Thoreau and north of Prewitt; however, there is potential for the species to exist north of I-40 in McKinley County (NNDFW 2020).

Round Dunebroom (*Errazurizia rotundata)* is a low, woody shrub reaching up to 30 cm in height. It is best surveyed from mid-April through September. This species can occur on several types of outcrops, ranging from sandy soils in sandstone, gravelly soils in calcareous outcrops, to deep, alluvial cinders in sandstone breaks. Generally, this plant is found in exposed habitats in the semi-arid environment of the Great Basin Desert scrub. On the Navajo Nation, populations are known from sandy pockets between outcroppings of Moenave Sandstone, between 4,600 and 5,200 ft. in elevation. On the Navajo Nation this species has been found between Moenave and Willow Springs; however, suitable habitat exists between Gap, Arizona and Petrified Forest National Monument (NNDFW 2020).

Navajo Penstemon (*Penstemon navajoa)* is a short-lived perennial herb that grows between 20 and 45 cm tall. It is best surveyed from early July to early August, to ensure positive identification. Habitat consists of rocky, open places in ponderosa pine, aspen, and Douglas-fir communities ranging from 7,000 to 10,300 ft. in elevation. This plant is known only from the upper slopes of Navajo Mountain and upper Dark Canyon in San Juan County, Utah. There is potential for the species to occur on the upper slopes of Navajo Mountain and, potentially, on the upper elevations of Skeleton Mesa (NNDFW 2020).

Alcove Rock Daisy (*Perityle specuicola)* is a perennial herb reaching 50 – 70 cm in height. Identification of this plant is only possible from late July through September. Habitat consists of hanging garden communities between 3,690 and 4,000 ft. in elevation. On the Navajo Nation, it is only known from one site on the San Juan River downstream from Goosenecks State Park; however, there is potential for the species to occur anywhere there are hanging gardens in the San Juan River drainages (NNDFW 2020).

Navajo Bladderpod (*Lesquerella navajoensis)* is a cushion-forming herbaceous perennial which grows from a thick taproot. Surveys for this plant should take place during the flowering period from May to early June. Suitable habitat primarily consists of windward, windswept mesa rims and nearby habitat with little vegetative cover and high insolation. It is also found at the base and slopes of small hills of the Chinle Formation; typically, this plant is only found in a combination of Todilto Limestone overlaying Entrada Sandstone or Chinle outcrops in pinion-juniper communities. On the Navajo Nation, it is found in New Mexico on mesa rims northwest of Thoreau and Continental Divide, in the Chuska Mountains at Todilto Park; in Arizona it is known from the Red Valley area to Wheatfields Lake. There is potential for the species to occur anywhere there are Todilto and Chinle outcroppings northeast and northwest of Thoreau and in the Chuska Mountians within McKinley and San Juan Counties in New Mexico. It is possible the species occurs in the Chuska and Carrizo Mountains in Apache County, Arizona as well (NNDFW 2020).

Alcove Bog-orchid (*Platanthera zothecina)* is a perennial orchid with erect stems 15 to 60 cm tall. It must be surveyed during the flowering period, between July and August, for positive identification. Suitable habitat consists of seeps, hanging gardens, and moist stream areas within desert shrub, pinion-juniper, and ponderosa pine/mixed conifer communities. Known populations occur between 4,000 and 7,200 ft. in elevation. Within the Navajo Nation, the plant has been documented in the headwaters of Oljeto Wash, Tsegi Canyon watershed, hanging gardens surrounding Navajo Mountain, and Chinle Wash drainages. There is potential for the species to occur in appropriate habitat within the Navajo Nation in northern Arizona and San Juan County, Utah (NNDFW 2020).

Brack's Hardwall Cactus (*Sclerocactus cloverae* ssp. *Brackii*) Cactus growing in solitary cylindrical stems 3-8 cm tall and 2-7 cm in diameter. Central spines are straw-colored to grown in clusters of 4-5 with the lower spine hooked. Flowers are purple 2.5 -3.5 cm long and 1.5 to 3 cm in diameter, appearing in late May. Grows in desert scrub and scattered juniper communities in the sandy clay hills of the Nacimiento Formation at 5,000 – 6,000 ft. On the Navajo Nation, it occurs south of the San Juan River. Also known as Clover's cactus.

Group 4

San Juan Milkweed (*Asclepias sanjuanensis)* is a perennial herb, 4-8 cm tall, which forms a woody taproot. It is distinguished from other milkweeds in its range by its greenish white petals. It is best surveyed from April through June. Habitat consists of primarily sandy or sandy loam soils in pinion-juniper woodlands and Great Basin grassland communities. Known populations occur from 5,000 to 6,200 ft. in elevation, often in disturbed sites. On the Navajo Nation, it is recorded from east of Highway 491 south of the San Juan River, and just south of the San Juan County line. There is potential for the species to occur on the Navajo Nation within suitable habitat throughout San Juan and McKinley Counties in New Mexico (NNDFW 2020).

Heil's Milkvetch (*Astragalus heilii)* is a tufted, low perennial best surveyed from mid-May through June. The species' habitat consists of rocky ledges of the Mesa Verde Group in pinion-juniper communities at ca. 7,200 ft. On the Navajo Nation, it is only documented from its type locality near Borrego Pass (NNDFW 2020).

Navajo Saltbush (*Atriplex garrettii var. navajoensis)* is a deciduous shrub growing up to 1.5 m in height. It is best surveyed from August through November. The species' habitat consists of salt desert shrub communities between 3,000 and 4,000ft. in elevation. It grows on Moenkopi Shale, often overlain with a Kaibab Limestone. On the Navajo Nation, it is located on the east side of Marble Canyon from Lee's Backbone to Jackass Canyon; however, there is potential for the species to exist on the east side of Marble canyon and Glen Canyon from Glen Canyon Dam south and west to the Echo Cliffs and along tributary canyons of the Colorado River, south to Shinumo Wash (NNDFW 2020).

Atwood's Camissonia (*Camissonia atwoodii)* is a winter annual herb that sprouts from a taproot. Surveys must occur during the flowering months from September to November for positive identification. The species' habitat consists of salt desert shrub communities growing on clay soils of the Tropic Shale and Carmel Formations. Known populations occur between 4,060 and 5,000 ft. in elevation. The species is endemic to the Last Chance drainage in Kane County, Utah. It has not been reported on the Navajo Nation; however, there is appropriate habitat along shores and drainages of Lake Powell (NNDFW 2020).

Rydberg's Thistle (*Cirsium rydbergii)* is a perennial herb ranging from 100 cm to 300 cm in height. It is best surveyed during the flowering and fruiting season from late spring through September and October. Suitable habitat consists of hanging gardens, seeps, and sometimes stream banks below hanging gardens, between 3,300- 6,500 ft. in elevation. On the Navajo Nation, the species occurs in southern San Juan County, Utah and in Coconino and Apache Counties in Arizona (NNDFW 2020).

Utah Bladder-fern (*Cystopteris utahensis)* is a fern consisting of creeping stems. The best time to survey is from June through August; however, the plant can be identified anytime there are fertile fronds. Habitat consists of seeps, cracks, and ledges on cliffs formed from calcareous substrates including sandstone, limestone, and dacite. Populations are known from 4,200 to 8,800 ft. in elevation. On the Navajo Nation, it is only found within Canyon de Chelly National Monument (NNDFW 2020).

Sivinski's Fleabane (*Erigeron sivinskii)* is a perennial herb that sprouts from a thick taproot. For positive identification of this species, surveys must occur during the flowering and fruiting period from May through June. Habitat consists of steep, barren, shale slopes of the Chinle Formation, in pinion-juniper woodland and Great Basin desert scrub communities. Known populations occur from 6,100 to 7,400 ft. in elevation. On the Navajo Nation, the plant is found on east and west facing slopes of the Carrizo and Chuska Mountians, the Cove area, the Round Rock area, and north of Navajo in San Juan County, New Mexico and Apache County, Arizona. Elsewhere on the Navajo Nation, there is potential for the species to exist north of I-40 in New Mexico and in the Chuska Mountains (NNDFW 2020).

Sarah's Buckwheat (*Eriogonum lachnogynum var. sarahiae)* is a perennial herb reaching 10 cm in height which grows in dense clusters and mounds. It is best surveyed from May through July. Suitable habitat consists of windswept mesa tops in pinion – juniper communities between 5,900- 7,500 ft. in elevation. This species is endemic to the Owl Rock Member of the Chinle Formation, topped by Todilto limestone. Only a few plants have been recorded on the Navajo Nation in the vicinity of Red Valley, north of Red Lake. There is potential for the species to exist in the Chuska Mountains between Lupton, Arizona and Prewitt, New Mexico (NNDFW 2020).

Bluff Phacelia (*Phacelia indecora)* is a 3-14 cm tall annual with spreading stems. It must be surveyed in May or June for positive identification. Suitable habitat consists of salt desert communities between 3,600 ft. and 4,500 ft. in elevation. This species is endemic to San Juan County, Utah, and has not been documented on the Navajo Nation; however, there is potential for it to occur within the San Juan River drainage (NNDFW 2020).

Cave Primrose (*Primula specuicola)* is a perennial herb that forms basal rosettes and grows to a height of 30 cm. It is best surveyed during the flowering season from March through April but can be identified by an expert year-round. Suitable habitat consists of hanging gardens and occasionally stream sides in Entrada and Navajo Sandstone Formations between 3,500 and 7,200 ft. in elevation. In the Grand Canyon it is known from seeps in Kaibab and Redwall limestone. On the Navajo Nation, it has been documented in the Chinle Wash area and in canyons surrounding Navajo Mountain. There is potential for the species to occur in any of the hanging gardens in the Chinle Wash drainage and in canyons north and south of Navajo Mountain (NNDFW 2020).

Marble Canyon Dalea (*Psorothamnus arborescens var. pubescens)* is a shrub ranging from 40 – 100 cm tall with small indigo flowers, linear leaflets, and distinctive seed ponds with large round discrete blister glands. It is best surveyed during the flowering and fruiting season in May and June. Suitable habitat consists of mixed desert shrub communities growing on soils derived from the Moenkopi Formation between 3,400 – and 4,900 ft. in elevation. On the Navajo Nation, it has been recorded in the Navajo Springs area south of Navajo Bridge. Within the Navajo Nation, there is potential for the species to occur from Lees' Backbone to Bitter Springs (NNDFW 2020).

Parish's Alkali Grass (*Puccinella parishii)* is a many-stemmed annual grass growing 5 – 28 cm tall. For positive identification, this species must be surveyed from mid-April to early June. Suitable habitat includes alkali seeps, springs, and seasonally wet areas such as washes. Populations are known to occur between 5,000 and 7,200 ft. in elevation. Within the Navajo Nation, this species has been documented in Utah in San Juan County northeast of Beclabito and in the vicinity of Two Grey Hills. There is potential for the species to exist anywhere on the Navajo Nation in alkali seeps, springs, or seasonally wet areas (NNDFW 2020).

Arizona Rose Sage (*Salvia pachyphylla ssp. eremopictus)* is a many-branched spreading shrub growing 35-50 cm tall with showy, bright violet flowers. It is best surveyed in the flowering period from mid-July to October but can be identified by an experienced individual year-round. Habitat consists of desert shrub lands and pinion-juniper communities on basalt or soils derived from the Chinle Formation, between 5,500 and 6,500 ft. in elevation. On the Navajo Nation, it is often found along the base of volcanic plugs, mesa tops, and slopes. It has been found north of Dilkon in Navajo County. There is potential for the species to occur along the southern boundary of the Navajo- Hopi Reservation to the southern boundary of the Navajo Nation, between just north of Winslow and Petrified Forest National Park (NNDFW 2020).

Welsh's American-aster (*Symphyotrichum welshii)* is an herbaceous perennial growing 30 – 100 cm tall. It is best surveyed during the flowering period from August to October. Suitable habitat consists of wet meadows, seeps, springs, and hanging gardens between 4,300 and 8,000 ft. in elevation. On the Navajo Nation, it is only known from one population in the Tsegi watershed in northern Navajo County. Within the Navajo Nation there is potential for it to occur in northern Coconino and Navajo Counties (NNDFW 2020).

Native Species Related to Candidate Noxious Weed Species for Biocontrol

This section outlines native species that occur on the Navajo Nation that may be closely related to those proposed for control through biological agents. This analysis was done by identifying species in the same genus as the exotic species based on county occurrence data provided by the USDA NRCS PLANTS Database (https://plants.sc.egov.usda.gov/java/). Under the IWMP, agencies should survey for these related native species prior to implementing biological control treatments.

Leafy Spurge *Euphorbia esula*
Family *Euphorbiaceae*
Genus *Euphorbia*
NATIVE RELATED SPECIES

Common Name	Scientific	T&E	County
Marble Canyon spurge	*Euphorbia aaron-rossii*		Coconino
Snow on the prairie	*Euphorbia bicolor*		NM State presence
Blackseed spurge	*Euphorbia bilobata*		Cibola
Horned spurge	*Euphorbia brachycera*		All
Mountain spurge	*Euphorbia chamaesula*		Coconino, Navajo, Apache
Chinese caps	*Euphorbia crenulata*		AZ State
Hairy-fruit spurge	*Euphorbia cuphosperma*		Apache
Toothed spurge	*Euphorbia dentata*		Coconino, Apache
Beetle spurge	*Euphorbia eriantha*		NM State presence
Squareseed spurge	*Euphorbia exstipulata*		Coconino, Cibola, Sandoval
Huachaca Mountain spurge	*Euphorbia macropus*	x	Sandoval
Snow on the mountain	*Euphorbia marginata*		San Juan (NM)
Woodland spurge	*Euphorbia palmeria*		Coconino
Mojave spurge	*Euphorbia schizoloba*		Coconino, Navajo
Warty spurge	*Euphorbia spathulata*	x	Apache, McKinley, San Juan (NM & UT)

Yellow starthistle *Centaurea solstitialis*
Family *Asteraceae*
Genus *Centaurea*
NATIVE RELATED SPECIES

Common Name	Scientific	T&E	County
American star-thistle	*Centaurea americana*		Navajo, Apache

Dalmatian toadflax *Linaria dalmatica*
Family *Scrophulariaceae*
Genus *Linaria*
NATIVE RELATED SPECIES

Common Name	Scientific	T&E	County
None identified			

Spotted knapweed *Centaurea maculosa*
Family *Asteraceae*
Genus *Centaurea*
NATIVE RELATED SPECIES

Common Name	Scientific	T&E	County
American star-thistle	*Centaurea americana*		Navajo, Apache

Diffuse knapweed *Centaurea diffusa*
Family *Asteraceae*
Genus *Centaurea*
NATIVE RELATED SPECIES

Common Name	Scientific	T&E	County
American star-thistle	*Centaurea americana*		Navajo, Apache

Russian knapweed *Acroptilon repens*
Family *Asteraceae*
Genus *Acroptilon*
NATIVE RELATED SPECIES

Common Name	Scientific	T&E	County
None identified			

Field bindweed *Convolvulus arvensis*
Family *Convolvulaceae*
Genus *Convolvulus*
NATIVE RELATED SPECIES

Common Name	Scientific	T&E	County
Texas bindweed	*Convolvulus equitans*		Coconino, Navajo, Apache, San Juan (NM)

Puncturevine *Tribulus terrestris*
Family *Zygophyllaceae*
Genus *Tribulus*

NATIVE RELATED SPECIES

Common Name	Scientific	T&E	County
None identified			

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Appendix M. Response to Comment Report

Navajo Nation Integrated Weed Management Plan
Final Programmatic Environmental Impact Statement

Response to Comment Report

July 2022

Prepared for:
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Comment Response Table

The Bureau of Indian Affairs (BIA) decision-making process is conducted in accordance with the requirements of the National Environmental Policy Act (NEPA), Council on Environmental Quality (CEQ) regulations, and U.S. Department of the Interior and BIA policies and procedures implementing NEPA. NEPA and the associated regulatory and policy framework require that all federal agencies involve interested groups of the public in their decision-making, consider reasonable alternatives to proposed actions, and prepare environmental documents that disclose the potential impacts of proposed actions and alternatives. Public involvement, consultation, and coordination have been at the core of the planning process leading to the Navajo Nation Integrated Weed Management Plan Programmatic Environmental Impact Statement (PEIS). These efforts were accomplished through public meetings, alternative means of comment submittal, news releases, a planning website, and Federal Register notices.

Comments on the Draft PEIS were analyzed in detail and systematically categorized by the subject of individual comments contained in each submittal. The categories for comment analysis included weed treatment projects, weed treatment methods, community land use plans, project funding and cost share, project planning, project compliance, community outreach, resource issues, Section 106 Consultation, legal authority, and project information and maps (listed alphabetically). Comments were further classified by the type of comment submittal (e.g., written letter, email, public hearing comments, or through the BIA project website comment form) and the source of the comment (e.g., individual, organization, tribal agency, federal agency, state agency, municipal government). The basic structure for how comments were coded and analyzed is presented below.

Individual comments received on the Draft PEIS were tagged as either “substantive” or “not substantive.” Generally speaking, “substantive” comments are those that call into question the accuracy of specific information provided in the Draft PEIS; provide alternative sources of technical or resource information; suggest project alternatives beyond those presented in the Draft PEIS; or question, on a reasonable basis, the analytical assumptions, methodologies, or conclusions presented in the Draft PEIS. “Not substantive” comments are those that merely express an opinion; raise issues that are beyond the scope of or irrelevant to the current project; take the form of vague, open-ended questions, or address minor edits. The BIA notes and records “not substantive” comments, but they do not receive a formal response. Some may note edits that were made to clarify the question being raised but did not result in considerable changes to the document.

Comments identified as “substantive,” on the other hand, formed the basis for much of the revision that occurred between publication of the Draft PEIS and the Final PEIS. The 45-day public comment period for the Navajo Nation Integrated Weed Management Plan Draft PEIS opened on October 29, 2021 (coinciding with the date of publication of the Draft PEIS) and ended on December 15, 2021. The BIA held five virtual public hearings from November 15 until November 20 to take public comments. A total of 55 members of the public attended the meetings. In all, 63 individual comments were submitted and received by the BIA. Of these, as recorded below, 52 comments were determined as “not substantive” and therefore not requiring formal BIA response or changes to the PEIS. After analysis, the “substantive” comment submittals were determined to contain a total of 11 individual substantive comments that would require BIA response. The material that follows in this appendix provides the reader with an overview of the comments received; how these were analyzed; and whether specific changes to the PEIS resulted from BIA consideration of these public comments.

Navajo Nation Integrated Weed Management Plan
Public Review Period Comment Matrix

Comment Theme: Availability of the Public Hearing Presentation

No.	Date	Type of Comment	Commenter Name	Comment	BIA Response	Edits Made
1	11/15/2021	Question asked at Public Hearing meeting	Saraphine Woody	I'm a Huerfano Chapter Land Board official. Will a copy of today's presentation be emailed to us?	Not substantive. A copy of the presentation is available on the project website. The BIA posted videos of the English and Navajo version to the website after the Public Hearings ended on November 20. All meeting attendees also received an email with a link to the meeting materials, including a recording of the presentation.	No edits made

Comment Theme: Weed treatment projects

No.	Date	Type of Comment	Commenter Name	Comment	Final BIA Response	Edits Made
2	11/16/2021	Question asked at Public Hearing meeting	Roland Smallcanyon	There are tumbleweeds along the power and waterlines that show up after the lines are installed and there's nowhere else out there for them to come from. As a grazing official, I applied for funding to eradicate them with Western Agency, but we didn't start it and the funding dried up or expired before we could do the project. I wish we could work on it again. Is there a way to reopen the funding and continue the job? Are there ways to control tumbleweeds to keep them from growing after construction jobs? And is there funding for eradicating Russian Olive because we had a few projects to work on them along riparian areas?	Not Substantive. The Plan includes recommendations for prioritizing weeds in rights-of-ways, for both utilities and roads, as well as recommendations for weed species. The BIA recommends reviewing the Plan and working with a local BIA Agency Weed coordinator on specific projects. Funding is available each year, but the BIA needs a proposal for a project as well as a cost share. To control tumbleweeds, there are some preventative measures, such as washing equipment before and after construction, which are outlined in the IWMP as Best Management Practices as well as Early Detection/Rapid Response measures to catch potential invasions early.	No edits made
3	11/17/2021	Question asked at Public Hearing meeting	Nelson Cody	What issues have been identified? I'm asking for this specific plan because you have to identify the problem before you come up with a solution. What are the problems here in Tuba?	Not substantive. Noxious weeds impact every habitat on the Navajo Nation, affecting the economic, historic, and cultural livelihood of the Navajo people. The IWMP provides the BIA with a strategic and integrated approach for addressing problematic populations throughout the Navajo Nation. In Tuba City, for example, camelthorn is a major concern and is widespread.	No edits made
4	11/17/2021	Question asked at Public Hearing meeting	Nelson Cody	We set aside funding for a beautification project and we're taking down weeds with skidster. We've hired 5 neighbors to manually hoe weeds in Tuba. Are we interfering with this plan? Could it part of the cost share?	Not Substantive. See response to Question #7 as this project could be part of a cost share. The project does not appear to interfere with the plan and likely benefits weed management efforts. We recommend meeting with your local BIA Agency Weed Coordinator to ensure the project complies with other Navajo Nation project planning requirements.	No edits made

No.	Date	Type of Comment	Commenter Name	Comment	Final BIA Response	Edits Made
5	11/17/2021	Question asked at Public Hearing meeting	Mae Franklin	Tamarisk is mostly along the river (Little Colorado River). Due to drought, how much weight does it get in comparison with the other weeds on the list? I hope because it uses a large amount of water, it will get huge attention by NN and BIA.	Not substantive. Tamarisk is a high priority species, especially in stream corridors. When looking at the IWMP, a prioritization strategy is used to evaluate projects based on the weeds being treated and the sites where projects are conducted. While the weeds are categorized in Table 3-1 (A-9 in Appendix A), the order of the species in the list is not an indication of priority within each category. Please refer to the description for the management goals for more information in Section 3.0 of the IWMP. Also, local areas can prioritize their own weed lists based on local concerns for weed management.	Species listed in Table 2-5 have been ordered by prioritization category (i.e. High, Medium and Low) and Management Goal. They are then listed in alphabetical order by common name. This was done to reduce confusion or assumptions that the order of the weeds indicates additional prioritization. A reference is also made to Appendix L where additional information each of the weed species can be found. Other tables updated to reflect the same ordering concern include Table 4-7, Table 4-2, and Table 3-7. In Appendix A. IWMP, Tables 3-1, 9-1, 9-2, and 9-4 were also edited in the same manner.
6	11/20/2021	Question asked at Public Hearing meeting	Carl Etsitty	Are issues being addressed at Black Mesa. One of the big concerns are a lot of impacts and that weeds have been introduced at the PWCC. Are there any other mines, such as Rain Mine or Navajo Mine being addressed for noxious weeds?	Not substantive. The BIA has worked with PWCC on weed management concerns for Black Mesa and other mining areas by working with the lease holders. Any work done in these areas must be done based on established protocols from OSM and Navajo Nation Minerals Department. For additional information, contact these offices for how weed management is incorporated into management of these areas.	No edits made

Comment Theme: Project Planning

No.	Date	Type of Comment	Commenter Name	Comment	BIA Response	Edits Made
7	11/20/2021	Question asked at Public Hearing meeting	Tanner Begay	Can grazing official request project planning? Who does the planning for addressing weeds in various areas? Would I have to get Shiprock Agency or can I work on it myself?	Not substantive. Yes, grazing officials and other concerned residents can request a project from a BIA Weed Coordinator at their local BIA Agency office. The Weed Coordinator can determine what planning may be needed and how the Weed Program can assist. Please refer to the Weed Project Checklist in the Integrated Weed Management Plan (Appendix A of the PEIS) for an outline of the project planning process. It is also described in the IWMP in Section 4.0 Implementation Strategy.	A flow chart for weed projects was added to accompany the Weed Project Checklist in Appendix C of the IWMP. The IWMP is provided as Appendix A of the PEIS.
8	11/20/2021	Question asked at Public Hearing meeting	Carl Etsitty	In regards to project planning for weeds, would I request the project plan from Shiprock BIA or do I need to work on one myself to get the weeds addressed?	Not Substantive. Refer to Question #7.	See Question #7.

No.	Date	Type of Comment	Commenter Name	Comment	BIA Response	Edits Made
9	12/9/2021	Email/Letter	Jean Prijatel, USEPA	According to the Plan, the BIA is required to involve the public in adaptive management by maintaining open channels of communication and providing for post-activity review by the public and other agencies (Plan, pg. A-58). Recommendation: To facilitate monitoring, mitigation, and continued feedback under the adaptive management strategy, consider developing a public website and a standard monitoring and mitigation plan reporting form to track and publish monitoring results. The EPA encourages the BIA to include monitoring and mitigation items which address potential discharges into waters of the U.S., especially wetlands, and status of required permits.	Substantive. The BIA is developing a public GIS website to share information on the location of existing weed populations and projects on the Navajo Nation. This will also provide a streamlined approach for collecting inventory data and assist in project planning. After discussion with related Navajo Nation Programs, the following materials can also be attached to project sites: the project treatment plan, the Navajo EPA approved Pesticide Use Proposal or a weed treatment flyer with information on the herbicide treatment plan, a link to eNOI announcements (if applicable), copies of the approved forest harvest permit (if required), and post-implementation monitoring results. Providing these public documents will serve as another form of public disclosure and notification on projects in conjunction with community meetings and postings to local Chapter Houses and allow for monitoring of mitigation measures and implementation requirements.	**Added to Section 6.0 of the IWMP (Appendix A):** The BIA Navajo Region plans to develop a website for the Navajo Region's Noxious Weed Program to inform the public on the location of current weed populations, planned projects, and post-project monitoring updates. The GIS features on site will also streamline the data collection process for future weed inventory projects and provide updates on the status of existing populations. The public can use the site for information on planned, current, or past projects, to see the extent of existing mapping efforts, or to report new weed populations as part of the BIA's early detection efforts. **Added to Section 9.2 of the IWMP (Appendix A)** *Education programs on how to recognize noxious weeds may help community members detect infestations when they are still small*. Community members can also use the BIA's planned weed program website to report new populations and assist with early detection efforts.
10	12/14/2021	Email	Lee Jim	I believe more of our Navajo medicine people should have been involved. I didn't hear the names of the weeds in question. It seems all plants and weeds travel to different locations. If these are not good for our animals and environment. Thanks for your help.	Not Substantive. The IWMP requires each project to conduct an ethnographic study with community members and local practitioners, including Navajo medicine people, herbalists, and others to identify culturally important plant populations as part of the project planning process. This will identify valuable local plant populations and how to best protect them during projects. The process is outlined in the Mitigation Measures (Appendix F) and in the NNHPD Process (Appendix H). The names of the priority weeds are listed in the Weed Management Plan in Table 3-1 (A-9) and in the Draft PEIS in Table 2-5 (pg. 16), Table 3-7 (pg. 39), and in Appendix L.	**Edited Section 4.2.2 for Cultural Control** However, ~~because targeted livestock grazing would only be used in Community Development areas and agricultural fields and will be prohibited in waterways, Highly Sensitive Areas, and where sensitive species occur, its potential to affect archaeological and~~ all treatments included targeted grazing, require an ethnographic study of community resources to identify potential TCP resources. Coordinating project specific mitigations to protect TCP resources would reduce potential impacts and loss to local communities. ~~TCP resources would be negligible and the effects may have already occurred if livestock grazing was practiced in these areas in the past.~~

Comment Theme: Compliance for Projects

No.	Date	Type of Comment	Commenter Name	Comment	BIA Response	Edits Made
11	11/16/2021	Question asked at Public Hearing meeting	Roland Small Canyon	Does the BIA still conduct environmental assessments for their work like they did in Shonto to determine how treatments may affect things like carrying capacity?	Not substantive. NEPA compliance is required for any federal action, including weed management. Under the IWMP, all projects must prepare an EA to evaluate site-specific impacts related to each project. The potential impacts of weed management on carrying capacity will depend on whether a project is conducted in a range unit. If a range management plan incorporates weed management, then a rangeland inventory could evaluate potential changes to carrying capacity related to weed management. This step is included in the Weed Project Checklist located at the end of the IWMP in Appendix A and in Section 4.0 of the IWMP.	No edits made.

No.	Date	Type of Comment	Commenter Name	Comment	BIA Response	Edits Made
12	12/13/2021	Email/Letter	Kristin Gade, ADOT	We would like to continue to coordinate regarding a programmatic way to receive approval for routine roadside vegetation management. ADOT has existing approvals for vegetation management activities along the roadways we maintain. There are some new requirements for approvals and reporting included in the PEIS/NNIWMP. We would like to establish an approach to streamline the procedures for approvals and reporting related to the Pesticide General Permit and the level of cultural review needed for non-ground disturbing activities such as herbicide application from a vehicle remaining on pavement, mowing, and removal of vegetation using handsaws or chainsaws	Not substantive. BIA met with ADOT to iron out their concerns regarding the PGP requirements and to determine potential ways to streamline the cultural review process. BIA recommends including NNEPA and NNHHPD in these meetings to clarify their requirements for these project planning needs. Per the BIA's meeting with ADOT it was determined that ADOT can develop a streamlined approved with Navajo Nation Programs to address issues related to cultural resources and federal and tribally listed species, similar to how it addresses those concerns now with its program. Additionally, coverage under the U.S. EPA's Pesticide General Permit is only required if treatments are expected to impact waters of the U.S., which ADOT avoids as part of its treatment plans.	**Added the following to IWMP Appendix C. Weed Project Checklist**: • **IF using herbicide**: • Any projects using herbicide are required to have a U.S. EPA certified pesticide applicator for the Navajo Nation. • Applicator must be available during projects and inspections conducted by the Navajo Nation EPA Pesticide Program. • Certified applicators are required for any projects using Restricted Use Pesticides. • Submit Pesticide Use Proposals for review and approval of project by NNEPA. PUP must identify the name and license number of certified pesticide applicator and supervised applicators, herbicides being used, application method, and application rate. • **IF herbicide is applied to a WOTUS**: - Submit an eNotice of Intent (eNOI) to the U.S. EPA . . . (same as before). These were added to clarify pesticide permit requirements for NNEPA and U.S. EPA programs for weed projects. **Edited in Section 4.4.1.2 under Cultural Control**: ~~The use of targeted grazing for cultural control would be limited to Community Development Areas and fenced agricultural fields on the Navajo Nation~~. Targeted grazing would be limited to ~~buildings and fenced~~ areas where noxious *weeds contribute more than 50% of total cover*, are common, and where the use of herbicides *and other treatments* may be a concern.
13	12/14/2021	Email/Letter	Nora Talkington, NNDFW	I'm not sure why Cultural treatments would need to be confined to Community Development Areas. These could occur anywhere with proper consultation and pre-treatment surveys (as needed) to ensure there are no impacts to NESL species. (pg. x)	Substantive. Refer to Question # 29	See response to Question #29.

No.	Date	Type of Comment	Commenter Name	Comment	BIA Response	Edits Made
14	12/14/2021	Email/Letter	Nora Talkington, NNDFW	I would also like to see a buffer implemented for aerial spraying around important wildlife native riparian species such as willow and cottonwood.	Substantive. Upon consultation with NNDFW, the BIA has added a 300 ft buffer around cottonwood-willow habitats for aerial herbicide treatments. This includes documentation of native plant communities prior to implementation. BIA has added mitigations for aerial spraying to document where cottonwood and willow stands exist so appropriate buffers can be implemented. GPS documentation would also be required to track where aerial spraying occurs. Herbicide treatments should be paired with native plant restoration, which can mitigate potential impacts from herbicide drift from aerial applications.	**Added to Section 8.2 for Chemical Treatment Mitigations in the IWMP (Appendix A)**: • For aerial herbicide treatments, native vegetation communities in or near treatment sites should be documented with GPS, especially cottonwood-willow woodlands and native sagebrush communities. • Native plant communities, such as cottonwood-willow woodlands and native sagebrush communities, require a 300 ft buffer during aerial herbicide treatments. • Aerial herbicide treatments should use GPS monitoring to track their position, provide a record of where treatments were done, and to ensure all applicable avoidance buffers are enforced. **Added to Table 5 (in Executive Summary) In Vegetation and Areas with Special Designation:** Aerial spraying requires a one-mile buffer around tribally listed species *and a 300-ft buffer around native habitat, such as cottonwood-willow woodlands and sagebrush communities.* **Added to end of Section 4.3.3.2:** Also aerial applications require a 300 ft. buffer around cottonwood-willow and native sagebrush vegetation communities to further protect native wildlife species. **Edited Section 4.2.2 for Cultural Control** However, ~~because targeted livestock grazing would only be used in Community Development areas and agricultural fields and will be prohibited in waterways, Highly Sensitive Areas, and where sensitive species occur, its potential to affect archaeological and~~ all treatments included targeted grazing, require an ethnographic study of community resources to identify potential TCP resources. Coordinating project specific mitigations to protect TCP resources would reduce potential impacts and loss to local communities. ~~TCP resources would be negligible and the effects may have already occurred if livestock grazing was practiced in these areas in the past.~~

Comment Theme: Community Outreach

No.	Date	Type of Comment	Commenter Name	Comment	BIA Response	Edits Made
15	11/17/2021	Question asked at Public Hearing meeting	Nelson Cody	We have a big following (20,000 on social media in Tuba City) and one of our drivers is community outreach. We want to get information and determine what's pertinent to disseminate.	Not substantive. All publicly posted information is available for public distribution.	No edits made.

No.	Date	Type of Comment	Commenter Name	Comment	BIA Response	Edits Made
16	11/17/2021	Question asked at Public Hearing meeting	Nelson Cody	For the Tuba Chapter area, are there specific plans available to us here at the chapter that I can rely or we can sit down and work through as a Chapter to see if we need to disseminate this to the community.	Not substantive. Any publicly posted information is available for public distribution. This includes information posted to the BIA's website, on its social media account, or at local Chapter Houses. The plan outlines the approach BIA will take for conducting weed treatments throughout the Navajo Nation. There may be specific projects that take place in or around Tuba City. All projects will be planned and coordinated with the local community, as noted in the Weed Project Checklist in the IWMP. The checklist is found in Appendix A of the PEIS. It is also described in Section 4.0 of the IWMP under Implementation Strategy. Contact your local BIA Noxious Weed Coordinator for more information in your area.	No edits made.
17	11/17/2021	Question asked at Public Hearing meeting	Leslie Williams	The proper way to do thing, is to go to the local people and get them together to do things. I've brought this up to my Chapter many times and it's not been done, and we need to understand this from both sides.	Not substantive. Community involvement is an important component for planning weed projects and one the BIA has included as part of project planning. Each project should consider the needs and concerns of the community when planning projects, as indicated in Section 4.0 of the IWMP. The IWMP would require the BIA to meet with local community members to determine their goals and needs for weed removal, identify areas where plants may be used for cultural activities, and understand community concerns or hesitancy with specific treatment methods. This is also outlined in Weed Project Checklist in the IWMP. The checklist is found in Appendix A of the PEIS.	**Edited Section 4.2.2 for Cultural Control** However, ~~because targeted livestock grazing would only be used in Community Development areas and agricultural fields and will be prohibited in waterways, Highly Sensitive Areas, and where sensitive species occur, its potential to affect archaeological and~~ all treatments included targeted grazing, require an ethnographic study of community resources to identify potential TCP resources. Coordinating project specific mitigations to protect TCP resources would reduce potential impacts and loss to local communities. ~~TCP resources would be negligible and the effects may have already occurred if livestock grazing was practiced in these areas in the past.~~
18	11/18/2021	Question asked at Public Hearing meeting	Wynette Arviso	Would be possible to do a meeting or get the land use planning committees to attend these sessions or do a session specific to the LUP committees for each Chapter. Each Chapter has an LUP committee, and they could attend and share this with community members.	Not substantive. BIA has reached out to the Navajo Nation Division of Community Development to assist with notifying the Land Use Committees about this project. Land Use Plan can incorporate the IWMP in their documents by citing the Plan and indicating that weed management activities will be done based on the methods and project planning requirements outlined in the IWMP.	No edits made.

No.	Date	Type of Comment	Commenter Name	Comment	BIA Response	Edits Made
19	11/20/2021	BIA website	Norman Benally	I would like greater public notices informing the public via the media available on this action by the BIA. While a lot of comments may be repeated, it should be counted as such. While many well complain they were never informed, therefore the comment period should be extended as well.	Not substantive. The BIA decided not to extend the public review period for the Draft PEIS. The BIA advertised the comment period using radio and print announcements, as well as regular communications with the Navajo Nation Council, Navajo Nation Division of Community Development, NN Division of Natural Resources, Grazing Officials, and District Grazing Meetings to inform the public about the review period for the Draft PEIS and the IWMP. Media announcements ran for 1 week and print announcements ran for 2 week starting October 15, 2021. The Navajo Nation President and Speak of the House were notified about the Public Review period with a formal letter on October 26, 2022. Council Delegate Thomas Walker also announce the Public Hearings at the Navajo Nation Council NABI session on November 18, 2021 following an email from BIA NRO on November 17, encouraging attendance. All comments submitted have been considered.	No edits made.

Comment Theme: Weed Treatment Methods

No.	Date	Type of Comment	Commenter Name	Comment	BIA Response	Edits Made
20	11/17/2021	Question asked at Public Hearing meeting	Mae Franklin	Biological control has been applied, are we done as a treatment of Tamarisk along the LCR? Is that it?	Not substantive. BIA has not conducted biological control of tamarisk as there is a moratorium on the use of tamarisk leaf beetle by APHIS, so it is not considered an approved biological control agent. The BIA is aware of the impacts of the beetle on the Navajo Nation and is monitoring its range and impacts. Tamarisk is considered a priority weed species due to its impacts along water ways on the Navajo Nation. There are several effective management options for treating tamarisk depending on the density, location, and size of treated populations. Best options for treatment are outlined in the IWMP (Appendix A) in the Best Option for Control Appendix (Appendix E of the IWMP).	No edits made.

No.	Date	Type of Comment	Commenter Name	Comment	BIA Response	Edits Made
21	11/20/2021	Question asked at Public Hearing meeting	Tanner Begay	Is BIA using a lot of herbicide that would kill a lot of the native species of plants or trees where they are spraying those herbicides? Also, will burning be used on grazing land to promote healthy species and plant and if that was listed in the document.	Substantive. Use of herbicide under the IWMP requires implementation of several mitigation measures as outlined in Appendix F. These will limit the amount of herbicide used. Additional planning measures are outlined in Question #32. Further, the use of any herbicide is limited by its label requirements. These requirements include the maximum amount of herbicide that can be applied within a given time period, which limits how much herbicide can be applied during each application and over a given period of time. Herbicide applicators and project sponsors are required by law to abide by these requirements (40 CFR Part 156). Burning is included as a mechanical control method in the IWMP to reduce or limit the growth of noxious weeds and is described in Section 9.4 of the IWMP. However, it is not being used to restore native plants nor is it proposed as a method for rangeland management, which is outside the scope of the IWMP. Burning can be used to control the growth of some noxious weed species or to remove treated or dead plant material. Burning may be used for prescribed burning treatments or pile burns and must comply with Programmatic Wildland Fire Prevention Plan for the Navajo Nation. Underlying the concern noted here is the potential impacts that certain treatment methods can have on native plant species or local residents. Treatment plans should take these concerns into consideration when selecting treatment methods. This includes an analysis of potential environmental and human impacts for treatments and selecting treatment methods that prioritize the least harmful but most effective methods where possible. This information has been added to the IWMP in Section 9.0.	**Added to Section 9.0 of the IWMP (Appendix A)**: "Treatment method selection should consider several factors. Local community engagement should identify public health concerns, economic impacts, cultural resources (such as plant collection areas), and community-based goals for removing the infestations. Impact to natural resources such as sensitive plant and animal populations, soil erosion, and water quality, should also be evaluated. Projects should determine, based on the size, density, and the specific weed species, a reasonable level of treatment needed to reduce the population while minimizing impacts. For example, widespread but patchy clusters of yellow starthistle may be controlled with less intense treatments such as biological control or targeted grazing while dense isolated populations of Canada thistle may require more intensive mechanical removal followed by chemical treatments. Treatments should also prioritize the least harmful methods where possible by using the least toxic herbicide available for treating the targeted weed species (Appendix E) paired with other control methods to reduce the amount of herbicide needed to effectively reduce and minimize regrowth. These considerations ensure that projects address a wide array of concerns while maintaining treatment effectiveness through a multi-faceted and integrated management approach.
22	11/20/2021	Question asked at Public Hearing meeting	Carl Etsitty	As far as biological control goes, these agents are really specific to the agent it is, and they don't really go after other non-target species so usually they will drop back down to background levels. They don't really disappear as no biological entity will really do that. What kind of determination was made to make Alternative 3 no biological control?	Not substantive. NNDFW requested Alternative 3 during Public Scoping. NNDFW cited its policy with Arizona Game and Fish preventing the introduction of non-native fish on the Navajo Nation. Table 4 in the Executive Summary of the Draft PEIS provides a comparison of impacts anticipated for Alternative 2 and 3, which will inform BIA's decision. The BIA is considering the use of biological control only under Alternative 2. The Alternatives outlined in the PEIS indicate the options the BIA is considering addressing the Purpose and Need of the project. It does not indicate which alternative the BIA has selected. This will be provided in the Record of Decision provided by the BIA after the Final PEIS is released.	No edits made.

No.	Date	Type of Comment	Commenter Name	Comment	BIA Response	Edits Made
23	11/20/2021	Question asked at Public Hearing meeting	Marge Lantana	How will this affect livestock that graze in open range if chemicals are used to treat weeds or insects? Is it going to be done spraying using helicopters?	Not substantive. Livestock would be deferred from range units where chemicals are sprayed. There are also restrictions limiting aerial applications to using aquatic herbicides only, which reduces their potential impacts to wildlife and livestock after treatment. Rangeland areas should also be fenced to prevent and limit exposure to wildlife and other roaming animals. Please refer to Section 3.6 and 3.7 in the PEIS for more detailed information on potential impacts to wildlife and livestock.	No edits made.
24	11/20/2021	Question asked at Public Hearing meeting	Tanner Begay	Russian Olive is a very invasive plant in the Lukachukai Chapter and one of the concerns that I have is that Russian thistle and I saw that herbicide was to be used to treat it. It did state that for the control of some grasses and Russian thistle, does that mean the vegetation we want to remain on those lands that that herbicide [chlorosulfuron] will kill that grass also?	Not substantive. All herbicides carry the risk of impacting native vegetation when applied. However, the use of Best Management Practices can limit and reduce these impacts. These include spraying only when weather conditions do not contribute to drift, surveying for native plant populations prior to treatment, and monitoring the use and application of herbicide. The BMPs also require native plant restoration after all treatments, which can restore plant communities impacted by herbicide drift. The use of herbicide should be limited, with preference given to other control methods and the least toxic herbicides for the project. Project planning is needed to ensure that the most appropriate application method is used based on site-specific resources and concerns. These are outlined in the mitigation measures included in Appendix F of the Draft PEIS. Where necessary, Table 9-4 in the IWMP (Appendix A) can be used to select herbicides based on the weed species being targeted along with Appendix E to select the best management strategies by weed species and based on the less harmful herbicide. Further the BIA will include a method for prioritizing herbicide based on toxicity.	Table 4-8 of the Draft PEIS was reordered from lowest to highest toxicity based on oral exposure, which was added to Appendix E of the IWMP. **Added to Section 9.7 of the IWMP (Appendix A)**: *Use of herbicides can include concerns about human health, ecological risks, and potential impacts to native plants and animals. Projects using herbicides should always be paired with other treatment methods to (1) improve their effectiveness and (2) reduce the potential for harmful impacts. If more than one herbicide can be used for a project, treatments should prioritize the herbicide with the lowest toxicity. Herbicides are listed by toxicity in Appendix E.*
25	11/20/2021	Question asked at Public Hearing meeting	Tanner Begay	Using the chlorosulfuron on rangeland to address Russian thistle, will release of an herbicide like this affect native plants that cow, horses, and goats or is it just for that, I know it does say annual grasses and I wasn't sure on the answer.	Not substantive. Refer to Question #44. Additionally, the application rate (0.0625 pounds of active ingredient per acres) is well below the toxicity rate for this herbicide. Modeling done by U.S. Forest Service (SERA 2016) demonstrates that chlorsulfuron, when used as directed by its label, should not be harmful to large or small mammals in treated areas. This information was incorporated into the document by reference. Lastly, each project should select the treatment methods that are most appropriate based on-site conditions and the weed species treated. This includes the use of the best management options (Appendix G), selection of effective and appropriate herbicides (Table 9-4 in Appendix A), and use of the least effective herbicide where possible (based on Table 4-8).	Herbicides in Table 4-8 of the Draft PEIS are ordered from lowest to highest toxicity based on oral exposures. A note is added that the table can be used to select herbicides based on lowest toxicity and most effective herbicide for treatment. The table was also added as Appendix E in the IWMP (which is Appendix A in the Draft PEIS)

No.	Date	Type of Comment	Commenter Name	Comment	BIA Response	Edits Made
26	11/20/2021	Question asked at Public Hearing meeting	Fannie Lookingglass	I've noticed in some homes and some places, there's the growth of bullheads around them and extending away from the homes. What are some possible ways to get rid of it? I noted in past years when there was a bad drought and we didn't get any rain, these things didn't really grow but then after the last floods we had over the summer, these bullheads started multiplying again and growing vigorously in many areas. What is the best ways to treat that without endangering animals and human life because I know they grow close to the house? The best way I know is to hoe them, but then they multiply them away from home	Not substantive. For bullhead, it is best to treat when young and before they flower. Hoeing and pulling is recommended to treat sizeable populations. Plants should be removed, bagged, and disposed of at the local solid waste transfer station as remaining plants can germinate. The seeds can also remain on sites for long periods of time, so removal of seeds from plants, shoes, and equipment is needed to prevent new infestations. The BIA Noxious Weed Coordinators can provide information on noxious weed management and control in coordination with Cooperative Extensions' weed specialist. For other specific weed treatment recommendations, refer to Appendix G in the Draft PEIS for the best management option by species.	No edits made.
27	12/21/2021	Email	Annarita Begay	I am currently dealing with some very hard to maintain invasive weeds in our lease acreage for farming that is hindering our ability to farm the land. How can I get more information on your program? I have just found your comment and question time has been closed for the project please shoot me any information on how I can get signed up on the program. I was initially looking for assistance in burning out the field areas but with the fire restrictions I was wondering if it was possible.	Not substantive. Refer to Question #7 for information on contacting the Noxious Weed Coordinators and Question #21 for burning. Appendix G also outlines specific techniques by weed species for the best management options.	No edits made.
28	12/14/2021	Email/Letter	Nora Talkington, NNDFW	I agree with this statement! NNHP encourages reseeding temporary disturbance areas with a native species mix to reduce erosion and discourage weed infestation. We are also recommending NTUA uses "best management practices" to reduce transport of weeds by cleaning equipment, using weed free water for dust abatement, and saving topsoil for reclamation. (Pg. 7, referring to ROWs))	Not Substantive. The BIA supports the use of Best Management Practices by other agencies to help reduce weed spread and growth.	See Edits made to Item #29.

No.	Date	Type of Comment	Commenter Name	Comment	BIA Response	Edits Made
29	12/14/2021	Email/Letter	Nora Talkington, NNDFW	There is evidence that goat grazing is effective for Tamarisk Control: https://www.webpages.uidaho.edu/rx-grazing/WoodyPlants/Salt_Cedar.htm. I think that targeted grazing for Tamarisk and Russian olive should be considered as a cultural control within riparian areas, with proper EPA and NNHP consultation. If done correctly, there would be a temporary disturbance to water quality/ habitat, but the goat treatments could be followed up seeding or planting native species once weeds are controlled which would be a net benefit to the system. (Table 2-4. pg. 13)	Substantive. BIA met with NNDFW to iron out the changes to this specific request. In the Draft PEIS, targeted grazing was limited to Community Development Areas and agricultural areas. After consulting with NNDFW, targeted grazing can be used in other priority weed areas. However, targeted grazing would require additional consultation with NNDFW and NNEPA to ensure project specific mitigations, monitoring requirements, and project planning needs to ensure impacts are limited to water quality, cultural resources, vegetation, and soils. Targeted grazing would not be permitted in Highly Sensitive Areas and listed species habitat. Highly sensitive areas are identified and defined by NNDFW in their RCP policy and on their website (nndfw.org). Potential and suitable habitat for federally and tribally listed species and occurrence data is based on NNDFW data and is provided to project sponsors as part of the Biological Resource Compliance Form process outlined in Section 7.0 of the IWMP. It is also outlined in the Weed Project Checklist in the IWMP (Appendix A).	**Original Sentence in Table 2-4**: Targeted grazing will only be used in Community Development Areas, and agricultural fields and will be prohibited in waterways, Highly Sensitive Areas, and where sensitive species occur. **NEW SENTENCE IN TABLE 2-4**: Targeted grazing will be *focused in Community Development Areas and agricultural fields* and will be prohibited where federally or tribally listed species occur. *Its use in other areas, such as rights-of-way and riparian areas requires additional consultation with NNDFW and NNEPA. All projects will requirement some level of native plant restoration following removal of noxious weed species.*
30	12/14/2021	Email/Letter	Nora Talkington, NNDFW	I think targeted grazing should be considered outside these [CDAs] areas including riparian areas with consultation with NNHP to ensure no impacts to NESL species. (pg. 95, Sec 4.4.1.2)	Substantive. Refer to Question #29.	See Edits made to Item #29.
31	12/14/2021	Email/Letter	Traci Metzner	I do not support Alternative 3, no biological control, as I believe that the use of USDA APHIS approved biological controls are necessary. These insects and pathogens are specifically targeted toward the invasive weed species and are deemed effective by the USDA for their ability. The Navajo Nation Department of Fish and Wildlife (NNDFW) cites Louda et al.[3] as evidence that these insects and pathogens can not only affect their targeted species but closely related non-targeted species, which is why they have requested a plan to be created without biological controls. However, the evidence in Louda et al. is outdated and limited, with only three case studies, the most recent being over 50 years ago. The evidence in support of the efficacy of biological controls is substantial. And if the list of the 45 noxious weed species referenced in the PEIS is compared to a list of the 35 endangered plant species[4] compiled by the NNDFW, it is clear there is very little overlap in closely related species. Therefore, the potential threat to non-targeted species should be minimal.	Not substantive. Refer to Question #22.	No edits made.

No.	Date	Type of Comment	Commenter Name	Comment	BIA Response	Edits Made
				Biological control has successfully been used to control several knapweed species in Colorado[5], Montana[6], and Arkansas[7]; the same knapweed species that have also been listed as noxious weeds in the Navajo Nation. While I understand that there is little data on biological controls' effect on non-targeted species, and those are the few cases on which Louda et al. focuses, I believe that the benefits outweigh the risks. And as long as there is continued monitoring of these areas in which biological controls are used, the risks will be minimal. If Alternative 3 were to be put into action, the use of chemical controls in lieu of biological control of these species could cause water contamination if used near water sources, as well as negative effects on the wildlife and people relying on those water sources (as outlined in the PEIS).		
				Due to this data, I strongly support Alternative 2 for the NNIWMP. As I have stated above, I believe the concerns surrounding biological controls to be minimal. And if the full management plan can be implemented, that is an increase of 50,000 acres that can be treated over the 10 years in which the plan will take place. This is such a large difference that the benefits outweigh the potential risks.		
				Therefore, it is my opinion that Alternative 2 is the best option to effectively control the noxious weeds on the Navajo Nation. The concerns regarding biological controls negatively impacting native or endangered species are outdated, and as long as they are addressed regularly with the NNDFW, should not be excluded based on a handful of examples where problems arose. As the goal of this proposed weed management plan is a more organized and cooperative system, that cooperation will be necessary to assuage any doubts regarding biological controls.		

No.	Date	Type of Comment	Commenter Name	Comment	BIA Response	Edits Made
32	12/9/2021	Email/Letter	Jean Prijatel, USEPA	The Navajo Nation Integrated Weed Management Plan and Draft PEIS include objectives for effectiveness, adaptive management, and community coordination and education, among others. The Plan does not appear to include an objective for using less-toxic chemicals or minimizing the use of chemical methods, as is typical of an integrated management approach. The EPA encourages consideration of Integrated Pest Management principles,1 to minimize the use of chemicals when possible. Recommendation: To reduce the risk of undesirable environmental and human health effects from the use of herbicides, modify the Navajo Nation Integrated Weed Management Plan to prioritize the use of lower risk management methods within the adaptive management approach. Commit to using broadcast spraying of non-specific pesticides only as a last resort.	Substantive. The BIA evaluated the recommendations provided by the U.S. EPA. The BIA has incorporated some measures to prioritize the use of non-herbicide techniques and further prioritize the use of multiple weed management methods, which will reduce the overall use of herbicide while increasing treatment effectiveness. The BIA will further prioritize the use of less toxicity herbicides when planning treatments. These are outlined in Section 9 of the IWMP, Section 2.1 of the PEIS, and the Best Options for Control in Appendix G of the PEIS. The BIA used the information in Table 4-8 to rank each herbicide as a way to prioritize herbicide selection based on toxicity. It has also been added to Appendix E of the IWMP along with best management option for each noxious weed. Appendix G of the PEIS outlines the best control option for each of the listed weed species, which identifies which control methods are most effective for each species.	**Added to Section 9.0 of the IWMP (Appendix A)**: Method selection should take several factors into consideration when developing treatment plans. Local community engagement should identify public health concerns, economic impacts, cultural resources (such as plant collection areas), and community-based goals for removing the infestations. How treatments may impact natural resources such as sensitive plant and animal populations, soil erosion, and water quality, should also be evaluated. Projects should determine, based on the size, density, and the specific weed species, a reasonable level of treatment is needed to reduce the population and while minimizing impacts. For example, widespread but patchy clusters of yellow starthistle may be controlled with less intense treatments such as biological control or targeted grazing while dense isolated populations of Canada thistle may require more intensive mechanical removal followed by chemical treatments. Treatments should also prioritize the least harmful methods where possible by selecting non-herbicide techniques where feasible and using the least toxic herbicide available for treating the targeted weed species (Appendix E) while pairing with other control methods to reduce the amount of herbicide needed to effectively reduce and minimize regrowth. These considerations ensure that projects address a wide array of concerns while maintaining treatment effectiveness through a multi-faceted and integrated management approach. **Added to Section 2.1.1.2 of the Final PEIS:** *Selection would be based on the most effective treatment methods and those that reduce or prioritize non-chemical methods. All projects should include native plant restoration when removing noxious weeds.*

No.	Date	Type of Comment	Commenter Name	Comment	BIA Response	Edits Made
33	12/9/2021	Email/Letter	Jean Prijatel, USEPA	Potential cumulative impacts could occur if herbicide use under the Plan occurs in combination with use of herbicides by people in the community in which they are applied. The Plan and Draft PEIS conclude that such impacts can be managed via required public notification; however, it remains unclear how effective this will be in preventing cumulative impacts. Although the Draft PEIS expects that project-specific Environmental Assessments will be prepared and the "Weed Project Checklist" in Appendix C of the Plan includes notification at least a week prior to treatment, a considerable variety in public participation can occur under NEPA EA processes and gathering information from potentially affected communities could be improved beyond simple notification. **Recommendation: In a revised Plan attached to the Final PEIS, add checklist items for project-specific planning to address the following: • Solicit information about current and planned herbicide use within the project's community. • To address questions or concerns with specific projects, include a means of contact, such as a phone hotline or email address, in required notifications that will be posted.**	Substantive. The planning guidance outlined in Section 7.0 and the Weed Project Checklist of the IWMP requires close coordination and consultation with local communities. The BIA has added the gathering of information on previous projects and weed management efforts as part of the project planning process and community coordination efforts in the Weed Project Checklist (Appendix C in the IWMP). However, given the lack of access and use of internet-based communication on the Navajo Nation, the BIA finds coordination with local Chapter Houses, District Grazing and Farm Boards, and Land Boards to be an effective means of notifying and meeting with local community members for projects. This also includes posting flyers and mailing letters to notify the public about projects. These outreach efforts and community coordination efforts are also described in Section 4.0, Section 7.0, Section 8.0, and the Weed Project Checklist appendix in the IWMP.	**Added to Section 9.0 of the IWMP (Appendix A)**: Method selection should take several factors into consideration when developing treatment plans. Local community engagement should identify public health concerns, economic impacts, cultural resources (such as plant collection areas), and community-based goals for removing the infestations.
34	12/9/2021	Email/Letter	Jean Prijatel, USEPA	Section 7.0 of the Plan, on Permitting, includes a description of the EPA requirement that "Restricted Use Pesticides" must have certified pesticide applicators; however, it is not clear how this will be enforced. **Recommendation: Consider measures to explicitly require certified applicators of "Restricted Use Pesticides" in project planning and monitor whether this requirement is met in adaptive management for the Plan, including potentially adding this in the "Weed Project Checklist."**	Substantive. The BIA added language to the Weed Project Checklist of the IWMP requiring a certified applicator when the use of Restricted Use Pesticides is proposed. The PUP application process with Navajo Nation EPA also requires identification of the certified pesticide applicator who will supervise application. NNEPA requires a certified applicator when a Restricted Use Pesticide is used. They also provide enforcement through project inspections, which include checking the credentials of the certified applicator overseeing the project. BIA also added their internal project planning forms to Appendix K of the IWMP to outline their planning process and requirements for the use of pesticide on the Navajo Nation. The Work Plan form in Appendix K includes identification of the state or tribal herbicide certifications for projects.	**Added to Section 9.7 Chemical Control of the IWMP:** All herbicides will be used according to their labels and a Navajo Nation Certified Pesticide Applicator *must* be on site. **Added to Weed Project Checklist in Appendix C of the IWMP**: Any projects using herbicide are required to have a U.S. EPA certified pesticide applicator for the Navajo Nation. Applicator must be available during projects and inspections conducted by Navajo Nation EPA Pesticide Program. Certified applicators are required for any projects that use Restricted Use Pesticides. Additionally RUPs have been noted in the following table of the IWMP: Table 9-3 and 9-4.

Comment Theme: Land Use Plans

No.	Date	Type of Comment	Commenter Name	Comment	BIA Response	Edits Made
35	11/17/2021	Question asked at Public Hearing meeting	Nelson Cody	How long does it take to make a weed management plan? If the plan cost is more than $100,000, should it be inserted into the Navajo WIND System? Should the weed management plans be inserted in the land use plans?	Not Substantive. Site specific projects and plans take about two years to develop. The IWMP was developed using only federal funding, and thus does not need to be reported in the Navajo WIND system. The BIA encourages the incorporation of the IWMP in Community Land Use Plans or any other Navajo Nation resource management plan. This can be done by referencing the plan and developing treatment project based on the mitigation measures and requirements described in the IWMP.	No edits made.
36	11/18/2021	Question asked at Public Hearing meeting	Wynette Arviso	In implementing this IWMP, how can we incorporate this with our conservation plans for these range units?	Not substantive. Other Resource Management Plans can reference the IWMP and includes a section on weed management to incorporate it. The plan can be referenced by its document number or title. For example, the NPL Agricultural and Range Resources Management Plan from 2018 is EA-19-36076.	**Added to the end of Section 4.0 of the IWMP (Appendix A.)**: *Additionally, this plan can be incorporated into other land management projects or plans by citing either its BIA NEPA Reference Number (#####) or by an in-text citation (i.e. BIA 2022). By incorporating this plan, it is agreed that the subsequent plans or projects will abide by the methods, planning requirements, and mitigation measures outlined in the NNIWMP.*
37	11/29/2021	Letter	Allen Nockideneh	There is a small percentage of land users that need a change in our management practices and are asking for Alternative II to be written into our Conservation Plan to defeat the spread of noxious weeds. My vision is to approve a living document that the Navajo Nation IWMP will abide by the rules and regulations governing all tribal/allotment trust lands.	Not Substantive. Refer to Question # 35 on how to incorporate the IWMP into other resource management plans.	See Question #36.

Comment Theme: Funding and Cost Share

No.	Date	Type of Comment	Commenter Name	Comment	BIA Response	Edits Made
38	11/17/2021	Question asked at Public Hearing meeting	Leslie Williams	Even though the officials are informed about this initiative, when we talk to the people, they want to know if they will be obtaining funding from them. They want to know how the process will work. Can you talk about cost-sharing? NRCS assist us and share some project. How long will it take to pay back the funding? If you can explain this carefully to the people, they can understand it and that it's a slow process. If a project is done in their presence and they can witness it, then they will understand. To them, if the plants are sprayed and treated, will they be fed stuff instead? You haven't really informed us of this yet. Explain this to the people, they can understand it and it's a slow process.	Not substantive. The BIA is open to cost-sharing and recognizes its benefit. However, the comment is outside the scope of the environmental analysis.	**Added Appendix K. Project Planning Forms (BIA Only)** to the IWMP which provides information on the criteria used for projects funded through the BIA Invasive/Noxious Weed Funding Program.

No.	Date	Type of Comment	Commenter Name	Comment	BIA Response	Edits Made
39	11/17/2021	Question asked at Public Hearing meeting	Nelson Cody	Can you give an example of a cost share?	Not substantive. Refer to Question #67. One example of a cost share was for a weed project conducted by Western Navajo Agency for RMU 814. This project was done in coordination with NRCS, who prepared the Environmental Evaluation and provided financial support to producers to defer cattle from the treatment site for 4-5 years. The producers at the site build fencing around the site and NNDWR provided technical assistance for water drilling and soil stability monitoring. NNDA provided funds for herbicides while Dine College provided students to install soil erosion structures at the site. Each of these additional contributions were considered cost shares for this project.	No edits made.
40	11/17/2021	Question asked at Public Hearing meeting	Walter Phelps	Is the Program sustainable now for this year and the next fiscal year because of ARPA funds and COVID funds and all these extra federal dollars pumped into federal agencies, even for personnel and hiring additional help? Are there sufficient funds that the BIA is working with now? Do the funds meet what is needed to work with?	Not substantive. Funding for this Program is specific for noxious weed projects for BIA. It's allocated to through the BIA Invasive Weed Program each year for projects outside of BIA base funding. All BIA Regions compete for the money for projects. These funds are not affected by the recent COVID or emergency funds.	See Question #38.
41	11/17/2021	Question asked at Public Hearing meeting	Leslie Williams	We're talking noxious weeds that livestock don't use, the question is, if it is eradicated and grazing plants are replanted and it's done, will there be funding attached to it.	Not substantive. Noxious weeds, as described in the IWMP, are non-native plants that "have negative impacts on desired native plants and wildlife (pg. A-1). Not all noxious weeds are avoided by livestock, but they may negative affect rangelands used by livestock, as described in Section 3.7.1 of the PEIS (pg. 56). All projects require native plant restoration, as noted in Task 5 of the Implementation Strategy (Section 4 of the IWMP), Section 8.4 of the mitigation measures of the IWMP. One of the intents behind the IWMP is to assist with project planning and development weed projects, which can be funded under the BIA's Invasive Species/Noxious Weed Program. Funding requirements for this Program are described in the Appendix K of the IWMP. Working with a BIA Noxious Weed Coordinator to develop a treatment plan for a specific population can also allow the BIA to apply for funding for projects through this Program.	No edits made.
42	11/17/2021	Question asked at Public Hearing meeting	Nelson Cody	Have all the funds ($3.8 million) been committed to projects or there still an opportunity or future deadline for when to review proposals and present projects? The annual funding vs. the new infusion of additional funds (COVID vs. ARPA or stimulus funds approved by Congress)? Because there are monies going to the tribes directly and those going to the federal agencies?	Not substantive. The funding provided for noxious weed projects is not connected to COVID or ARPA funds. They are provided annually through the BIA Invasive Species/Noxious Weed Funding Program. See Question #40 and #41 for more information on the process. There is also a project checklist for how to plan and project and request funding through the BIA Noxious Weed Program. (Appendix C in the IWMP).	See Question #38.

No.	Date	Type of Comment	Commenter Name	Comment	BIA Response	Edits Made
43	11/18/2021	Question asked at Public Hearing meeting	Wynette Arviso	Will funding be available for implementation of this plan?	Not substantive. Funding is available through BIA Invasive Species/Noxious Weed Funding Program. These funds are provided annually and competitively to support weed management projects for all BIA agencies. Information on the Program is provided in Appendix K of the IWMP.	See Question #38.

Comment Theme: EIS and IWMP Tables and Figures

No.	Date	Type of Comment	Commenter Name	Comment	BIA Response	Edits Made
44	11/18/2021	Question asked at Public Hearing meeting	Wynette Arviso	For Table 3.1, the list of invasive weeds. It would be helpful and really good if the Navajo names are also included as well as pictures.	Not Substantive. Appendix L has a table with more detailed information on each of the noxious weed species, including all available Navajo names and photos of the priority weed species. The BIA used the Navajo names for the plants as provided by the NMSU Selected Plants of Navajo Rangelands website [https://navajorange.nmsu.edu/]. Some invasive weeds do not have Navajo names associated with them, and thus are not provided.	A note was added to the caption for Table 3-1 and 2-7 that additional information on each weed species can be found in Appendix L. **Added to Section 3.0 of the IWMP**: Information, including photos, names, and management concerns for each species can be found in Appendix L of the PEIS associated with this Plan.
45	11/18/2021	Question asked at Public Hearing meeting	Wynette Arviso	The maps are difficult to read. One talks about development areas and you can't really tell because the agency colors are so strong. The maps starting on page 71-74 need improvements.	Not substantive. The BIA will adjust the map colors to make them easier to read.	BIA has adjusted the colors of the maps for the Priority Weed Areas in Appendix B of the IWMP. The agency colors were lightened, and the colors used for the priority areas in each map were adjusted to make them easier to see.
46	12/14/2021	Email/Letter	Nora Talkington, NNDFW	Why is this [tamarisk] also in the eradicate column? Seems pretty unlikely, at least in the short-term (Table 2-5, pg. 15)	Not substantive. Management of diffuse knapweed is focused on containment and long-term eradication. Long-term eradication means efforts will aim to eliminate the species from a project area over several years with the understanding that different sized populations may be found in different areas. Some populations may be controlled in a manner that may eventually achieve eradication in the project area (IWMP pg. A-8).	The textbox that describes the Treatment emphasis and Management Goals for each weed category was revised. Treatment emphasis for Category B species was changed from "Eradication" to "Local eradication."
47	12/14/2021	Email/Letter	Nora Talkington, NNDFW	*Speyeria nokomis* is misspelled for Washington Pass Silverspot Conservation Area (Table 3-21, pg. 72)	Not substantive. BIA will correct the type and will double check to determine if name is Washington Pass or Narbona Pass.	BIA has corrected the typo and changed the name of the biological preserve to the Narbona Pass Silverspot Conservation Area
48	12/14/2021	Email/Letter	Nora Talkington, NNDFW	Non-sensical sentence for first paragraph on pg. 93.	Not substantive. The BIA will revise the sentence.	**Edits on pg. 93 to**: *How vegetation is impacted will differ by Alternative.*

Comment Theme: Economic and Environmental Impacts

No.	Date	Type of Comment	Commenter Name	Comment	BIA Response	Edits Made
49	11/20/2021	Question asked at Public Hearing meeting	Carl Etsitty	Have the economic or environmental impacts on subsistence practices been addressed or has it been looked at?	Substantive. The BIA did look for information to assess impacts to informal economic activities on the Navajo Nation, including subsistence practices. The best available information on this subject is addressed in sections Section 3.9.1 of the PEIS. A sentence was added to this section to highlight the lack of information on informal economic activities.	**Added to Section 3.9.1 on Economic Setting**: *Other informal economic activities, such as flea markets, artisanal sales, and bartering for goods, may also contribute a considerable portion of economic support to Navajo residents, but their contributions are often understudied and the size of such contributions are unknown (Diné Policy Institute 2018)*

No.	Date	Type of Comment	Commenter Name	Comment	BIA Response	Edits Made
50	11/20/2021	Question asked at Public Hearing meeting	Alicia Chee	Are there social, economic, or environmental concerns. Are we looking at more Dust Bowls from weeds combined with weather, land erosion, or flooding?	Not Substantive. Social, economic, and environmental concerns and impacts are outlined in the Draft PEIS. The goal of the plan is to address noxious weed populations and their impacts to the environment, communities, and resources.	No edits made.
51	12/9/2021	Email/Letter	Jean Prijatal, USEPA	Appendix F to the Draft PEIS, Mitigation and Species Conservation Measures, is cited for Best Management Practices to avoid and reduce impacts from implementing projects under the Plan; however, it does not appear to include measures for mitigating air quality impacts aside from those due to pesticide drift. Potential air quality impacts could occur from use of on and off-road engines, surface disturbance and burning practices. **Recommendation: In the Final PEIS and revised Plan, include consideration of measures to avoid and reduce air quality impacts, especially related to particulate emissions. Such measures could include the following: • Smoke Management Plans for the area - Describe threshold weather conditions considered for prescribed burns and public notice requirements. • Best management practices (BMPs) to limit truck and equipment idling on site, including enforcement of idling limits. • Require advanced pollution controls and clean fuels for new equipment, and for older equipment to be retrofitted. Use particle traps and other appropriate controls to reduce emissions of diesel particulate matter and other air pollutants. Traps control approximately 80 percent of DPM, and specialized catalytic converters (oxidation catalysts) control approximately 20 percent of DPM, 40 percent of carbon monoxide emissions, and 50 percent of hydrocarbon emissions. 3 • Lease or buy newer, cleaner equipment (1996 or newer model)**.	Substantive. Currently the BIA is limited in how it can purchase vehicles and equipment as all purchases must be done through the General Services Administration (GSA). The BIA relies on the GSA to provide fleet vehicles and heavy equipment that meet current federal emissions guidelines, as well as the potential for pollution controls and use of cleaner fuels. Ultimately, the BIA does make efforts to improve fuel efficiency and limit emissions, but the options available are largely governed by those available through the GSA. There are also limitations on how old equipment must be, which would limit and prevent the use of higher emitting items. A mitigation measure has been added to limit idling during projects. Any treatments that use burning to treat noxious weeds or remove treated materials must comply with the Programmatic Wildfire Prevention Plan for the Navajo Nation. This Plan requires that any burn treatment must include modeling and planning measures for smoke. Smoke patterns are modeled based on fuel composition and predicted weather patterns from NOAA. The models are used as part of the BIA Fuel's Programs Go / No-Go Decision-Making tool for determining when treatments can be conducted. Smoke information is also included in all public notices prior to and during treatments.	**Added to Section 8.1 of the IWMP:** *Vehicles and equipment should be turned off if periods between use are longer than 15 minutes.* **Added to Section 4.3.3 intro**: Burning would be used by all alternatives and must follow the BIA's current protocols to reduce impacts from smoke and impacted air quality, including development of a burn plan in compliance with NNEPA *and the BIA's Wildfire Prevention 10-Year Plan for the Navajo Region (BIA 2018). This includes smoke modeling, coordination with regional fire support programs, and restricted seasons for when fire treatments can occur.*
52	11/20/2021	BIA website	Norman Benally	I would like to see a greater emphasis on surface water, soil conservation and revegetation of native plants, Integrated weed management should only be a part of that! I believe we lose billions of gallons of surface water downstream every storm season to the determent of the Navajo people and an unfortunate benefit to downstream users.	Not substantive. These issues and concerns are addressed in the Draft PEIS. Soils and surface water impacts are assessed in Section 3.4 and 4.3 of the Draft PEIS. Native plant restoration is described in Section 10 of the IWMP (Appendix A).	No edits made.

No.	Date	Type of Comment	Commenter Name	Comment	BIA Response	Edits Made
53	11/11/2021	Letter	Graham Zephirin	I am concerned about the impacts of herbicides on local aquatic systems. Not only are aquatic ecosystems very rare in occurrence on this landscape, but their inhabitants are among the most fragile when it comes to herbicides. Roundup has been shown to reduce survival and overall biomass in tadpoles by 40% (Relyea et al. 2005). If we are losing 40% of all amphibian biomass on an annual basis, it won't be too long until these waterways are completely devoid of these creatures. Obviously, the goal of this proposal is to help restore and preserve natural history, so I think destroying amphibian diversity should be treated as a worst-case scenario and that great care should be taken to avoid this.	Not substantive. The IWMP does outline protections for aquatic habitats and open water in Sections 8.2 and 8.3 of the IWMP and are discussed in Section 4.3.2 of the PEIS. The paper cited in the response (Relyea et al. 2005) is considered in the analysis of amphibian wildlife species in Section 4.5.1.2 (pg. 106). Overall, the mitigation measures (Appendix F) for treatments in or near open water include use of integrated methods that reduce the overall use while improving treatment effectiveness, and use of aquatic-only herbicides within 25 ft. of open water and herbicides that are non-toxic to aquatic organisms within 300 ft of open water should reduce potential impacts to amphibians. Additionally, projects must consult with Navajo Nation Department of Fish and Wildlife to identify and reduce potential impacts to species of concern, including amphibian species of concern.	No edits made.

Comment Theme: Cooperating Agencies

No.	Date	Type of Comment	Commenter Name	Comment	BIA Response	Edits Made
54	12/14/2021	Email/Letter	Nora Talkington, NNDFW	The management for the MEVE conservation areas have been finalized and there are chapter resolutions approving them. (pg. 71 reference to Biological preserves for Mesa Verde Cactus)	Not substantive. We will make note in the change in status of the plan where it is reference on pg. 71.	On page. 23 Changed citation to the MEVE conservation plan from *In Review* to *2021*.

Comment Theme: Section 106 Consultation

No.	Date	Type of Comment	Commenter Name	Comment	BIA Response	Edits Made
55	11/20/2021	Question asked at Public Hearing meeting	Carl Etsitty	One thing I wanted to ask is that I don't see as a lot of elders and people who practices subsistence living, they know and understand the land and they live and work on the land for years and years. Any consultation with them is not written in there and that should be one of the consultations. There are Hataalii Association and there are a lot of non-profit organizations you included, and I'm just surprised that none of those non-SMEs, especially the non-subsistence practitioners are not consulted at all or something you should consider as a cooperating agency.	Not substantive. Refer to Questions #10 and #17.	No edits made.

No.	Date	Type of Comment	Commenter Name	Comment	BIA Response	Edits Made
56	11/20/2021	Question asked at Public Hearing meeting	Carl Etsitty	Is there an accountability process when consultation [Section 106] is done, in this case with the Navajo Nation, that it's done with the impacted citizens on the Navajo Nation? I'm speaking on behalf of the Tse lajin community and I know we have never been consulted and this is a process that is being done with Public Hearings and I know the burden always gets thrown back that it's your responsibility and I don't think that's an adequate response. As meaningful consultation, what does that mean to you and is it blaming the citizens?	Not substantive. The BIA held 11 public scoping meeting between February 5 to March 15, 2013 for this project. These were announced through radio and print advertisements as outlined in the Scoping Report (Appendix D). Additionally, the BIA opened an additional public comment period on April 29, 2021 for 30-days to receive any updated comments or concerns from the public. This was announced on the BIA's website and social media accounts, as noted in Appendix D. For individual projects, the BIA will engage with local community members. Refer to Questions #10 and #17 for more information on community engagement for projects and the Section 106 requirements related to involvement of cultural practitioners for weed management projects.	No edits made.
57	12/14/2021	Document Comments	Nora Talkington	There are several native thistle species (referring to list of culturally significant plants that may overlap with the weed plan on page. 41)	Not substantive. Sentence in the PEIS on page 41 denotes overlap between existing cultural plant lists and the noxious weed list. One of the prominent cultural plant lists (Wyman and Harris 1941) lists thistle only by genus. It is understood that there are native *Cirsium* thistles, such as the Navajo-listed Rydberg's thistle (*Cirsium rydbergii*), which is also noted in the Native Species Related to Candidate Noxious Weed Species in Appendix L. The species is noted here to indicate that there may be instances where non-native thistles may have been used for traditional practices.	No edits made.

Comment Theme: NNIWMP Distribution List

No.	Date	Type of Comment	Commenter Name	Comment	BIA Response	Edits made
58	11/17/2021	Email Comment	Hugo Hoffman	Hugo requested to be added to the NNIWMP Distribution List. Contact information: Hugo Hoffman (he/him) NEPA Reviewer Environmental Review Branch Tribal, Intergovernmental & Policy Division U.S. Environmental Protection Agency, Region 9 (415) 972-3929 | hoffman.hugo@epa.gov	Not substantive. Mr. Hoffman's name has been added to the project distribution list so he can receive updates and notifications regarding this project.	No edits made.

Comment Theme: Legal Authority

No.	Date	Type of Comment	Commenter Name	Comment	BIA Response	Edits made
59	11/29/2021	Letter	Allen Nockideneh	Invasive species and noxious weeds are my biggest concern on the largest Indian Reservation in U.S. Indian country. We have no written policy or regulation in Navajo Nation Codes, Title III to prevent from bringing noxious weeds onto our reservation from other states or foreign countries. My utmost criticism is our tribal leaders were not present at the public hearings all week. I don't have patience any more to see livestock animals grazing and free roaming animals everywhere in each district spreading seeds. I've observed the hay vendors from other states, other semi-trucks with loads of alfalfa hay brought onto the reservation selling hay to Navajo producers throughout the reservation and spreading seed along State/BIA routes.	Not substantive. The BIA supports the adoption of a weed-free policy. The IWMP contains many recommendations in support for the use of certified weed-free plant and materials for projects as part of its prevention measures. See Sections 4.0 and 9.1 of the IWMP in Appendix A. The BIA recommends contacting local Navajo Nation Council representatives to support similar resolutions.	No edits made.

Comment Theme: Community Development Areas

No.	Date	Type of Comment	Commenter Name	Comment	BIA Response	Edits Made
60	12/14/2021	Email/Letter	Nora Talkington, NNDFW	Actually, this is incorrect. CDA areas are updated periodically internally by NNDFW staff along with all the RCP layers, which is then approved by the NN Resource Development Committee (RDC). NNHP uses sat photos of where development is being concentrated in community areas as well as data for NESL and big game wildlife species occurrences and knowledge of potential NESL and wildlife habitat to develop these layers.	Not substantive. The BIA will update the sentence on CDA development based on NNDFW's input.	**Original Sentence***:* Planning for CDAs is done through the Navajo Nation Department of Community Development with the local Navajo Chapters and input from the BIA*.* **New Sentence***: The CDAs are updated periodically by the Navajo Nation Department of Fish and Wildlife based on satellite imagery, and data on tribally listed species and big game species habitat and occurrences. These updates are then approved by the Navajo Nation Resource Development Committee.*

Comment Theme: Priority Weed Species

No.	Date	Type of Comment	Commenter Name	Comment	BIA Response	Edits Made
61	12/14/2021	Email/Letter	Nora Talkington, NNDFW	There is a ton of *Schismis barbatus* on Western Navajo in the Marble Canyon area. Are there any studies about the palatability of *Schismis* to wildlife? Just curious. (pg. 44, section 3.6.1)	Not substantive. Phillips et al. 1996 determined *Schismus barbatus* to have moderate palatability. Other weed species are also described in the paper. However, targeted grazing is not currently noted as a control method for the species. This paper is not cited as targeted grazing is noted as not being an effective control measure for *Schismus barbatus* (IWMP pg. A-41).	No edits made

No.	Date	Type of Comment	Commenter Name	Comment	BIA Response	Edits Made
62	12/14/2021	Email/Letter	Nora Talkington, NNDFW	However, some invasive species such as bull and musk thistles are important nectar sources for native and endangered pollinators. For example, NNHP has observed great basin silverspot butterflies utilizing invasive thistles for nectar forage, which are sometimes the only source available, since they are unpalatable to livestock. Land managers should replace invasive nectar sources with native ones as part of their BMPs for restoring pollinator habitat (pg. 45 before Sec. 3.6.2)	Not substantive. The BIA will note in the analysis on pg. 45 the importance of restoring native plants to support existing pollinator species for both generalized and specialists.	**Section 3.6.1 added to the Pollinators sections**: *These impacts underscore the importance of restoring native plant communities while reducing cover of problematic weeds and vegetation.* **Section 4.5.1.2 added to the Cultural, Manual, and Mechanical Control section**: Native plant revegetation in treated areas, particularly in riparian areas, *where pollinators are common*, *along* roadsides, and *on* cut banks or slopes, would be important to stabilize soils and improve wildlife habitat.
63	12/14/2021	Email/Letter	Jay Begay	Resolution from Hardrock Chapter for BIA to include cocklebur and silverleaf nightshade as a priority species in the IWMP.	Not substantive. While recognizing the impacts of these species to rangelands, both species are native plants and would not be eligible for treatment under the BIA Noxious Weed Program. The BIA recommends addressing these weeds as part of the ARMP for the Navajo Nation and/or in individual range management plans.	No edits made