# District 12 Vegetation Inventory

## Aneth, Cudei, Hogback

**Prepared for:**

**Bureau of Indian Affairs**
**Northern Navajo Agency**
**Natural Resources**

**2014**


Ecosphere Environmental Services

Durango, CO
Cortez, CO
Pagosa Springs, CO
Santa Fe, NM
Farmington, NM

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# ABBREVIATIONS/ACRONYMS

| | |
|---|---|
| ADW | air-dry weight |
| AUM | animal unit month |
| BIA | Bureau of Indian Affairs |
| Ecosphere | Ecosphere Environmental Services |
| ESD | ecological site description |
| ft | foot or feet |
| $ft^2$ | square foot |
| g | grams |
| GIS | geographic information systems |
| GPS | global positioning system |
| HCPC | historic climax plant community |
| lb | pound |
| LMD | Land Management District |
| MLRA | Major Land Resource Area |
| NNDOA | Navajo Nation Department of Agriculture |
| NNDWR | Navajo Nation Division of Water Resources |
| NRCS | Natural Resource Conservation Service |
| PNC | potential natural community |
| RMU | range management units |
| SOW | statement of work |
| USDA | United States Department of Agriculture |

# ABSTRACT

Ecosphere Environmental Services was contracted by the Bureau of Indian Affairs to collect and compile vegetation data on portions of Land Management District 12, specifically in the Aneth, Cudei, and Hogback chapters of the Northern (Shiprock) Navajo Agency. Data were collected from 382 transect locations over approximately 276,354 acres. Data collection occurred during August of 2014. Measurements were taken for biomass production, ground cover, and species frequency. The data were analyzed to determine the carrying capacity of the range resource as well as the similarity to the historic climax plant community.

Data were analyzed by soil map units and ecological sites within 24 analysis units consisting of 3 communities, 17 allotments, and 1 range management unit (RMU) divided into 4 pastures. Carrying capacities and recommended stocking rates were calculated by analysis unit using available forage. The data were aggregated by ecological site and then analyzed according to the acreage within each soil within each analysis unit. Spatial analyses of slopes and distances to water sources were layered onto the data to improve stocking rate applications.

Overall, the similarity of the ecological sites in the study area to their historical potential ranged fromzero to 72 percent with a low median. Carrying capacity is less than the current permitted numbers.

# 1. INTRODUCTION

Ecosphere Environmental Services (Ecosphere) was contracted by the Bureau of Indian Affairs (BIA) to conduct under-story rangeland vegetation inventories on 25 analysis units within the Aneth, Cudei and Hogback communities in the Northern (Shiprock) Navajo Agency. Species-specific vegetation data measurements included annual production, cover, and frequency. These data were also used to calculate carrying capacity based on available forage production. Information derived from these calculations can be used to guide management decisions, including stocking rates. This report supplies the results of the vegetation inventory as well as the background, methodology, and discussion necessary for management planning.

## 1.1 Purpose and Need

Baseline range condition data is critical to establishing quality range management practices. The purpose of the inventory was to provide baseline information about the existing range resource to enable resource managers and permittees to improve and/or maintain the condition of the range resource. The results of this inventory will enable recommendations for adjusted stocking rates in the study area as well as more comprehensive range management plans that are crucial for future range productivity.

## 1.2 Regulatory Entities

The Navajo Nation Department of Agriculture (NNDOA) manages livestock grazing activities on the Navajo Nation primarily through District Grazing Committees. Livestock grazing permits are administered by the BIA Natural Resources Program in accordance with the Navajo Grazing Regulations (25 CFR §167). The BIA and the District Grazing Committees coordinate their activities in an effort to utilize and manage the range resources.

### 1.2.1 BIA Agency Natural Resources Program

All livestock grazing permits are issued by BIA Natural Resources. Master livestock grazing records are also maintained by the BIA Natural Resources. The BIA is responsible for complying with all federal statutes, orders, and regulations including measuring the carrying capacity of the range resource. According to the BIA, their obligation "is to protect and preserve the resources on the land, including the land itself, on behalf of the Indian landowners. Protection and preservation includes conservation, highest and best use, and protection against misuse of the property for illegal purposes. BIA will use the best scientific information available, and reasonable and prudent conservation practices, to manage trust and restricted Indian lands. Conservation practices must reflect local land management goals and objectives. Tribes, individual landowners, and BIA will manage Indian agricultural lands" (2003a). A summary of the BIA Range Policy as stated in the Agricultural and Range Management Handbook (2003a) is outlined below.

**BIA Range Policy**

- Comply with the American Indian Agricultural Resources Management Act of December 3, 1993, as amended
- Comply with applicable environmental and cultural resources laws
- Comply with applicable sections of the Indian Land Consolidation Act, as amended
- Unless prohibited by federal law, recognize and comply with tribal laws regulating activities on Indian Agricultural land, including tribal laws relating to land use, environmental protection, and historic and/or cultural preservation
- Manage Indian agricultural lands either directly or through contracts, compacts, cooperative agreements, or grants under the Indian Self-Determination and Education Assistance Act, as amended
- Administer land use as set forth by 25 CFR 162 – Leases and Permits and 25 CFR 167-Navajo Grazing Regulations
- Seek tribal participation in BIA agriculture and rangeland management decision-making.
- Integrate environmental considerations into the initial stage of planning for all activities with potential impact on the quality of the land, air water, or biological resources

### 1.2.2 District Grazing Committees

Districts, which are more formally called Land Management Districts, were established in 1936 by the Soil Conservation Service (now called Natural Resource Conservation Service, or NRCS) and adopted by the BIA. The periodic sampling of rangelands allows district grazing committees to evaluate the carrying capacity and resulting stocking rates of rangelands (Goodman 1982).

The Navajo Nation is organized into 110 Chapters. Chapters, also called communities, are locally organized entities similar to counties and are the smallest political unit. District grazing committees consist of elected representatives from each community who are responsible for monitoring livestock grazing within their respective chapters. District grazing committees approve the carrying capacities of their districts, as discussed in *Navajo Reservation Grazing Handbook and Livestock Laws* published in 1967 by the Navajo Tribal Council.

Individual grazing district committee members are directly accountable to their local chapters and administratively accountable to the Director of the NNDOA. The NNDOA is also responsible for annual livestock tallies to determine if permit holders are in compliance with their permit. In addition, the NNDOA and the district grazing committees are responsible for enforcement of range management and resolving grazing disputes. According to the Navajo Nation Code, Title 3, Subchapter 5, the district grazing committee members are responsible for attending district grazing committee meetings, as well as Chapter meetings, and for ensuring that permit holders respect applicable laws, regulations, and policies. The District Grazing Committee must approve all stocking rates for grazing permits issued by the BIA and "adjust livestock numbers to carrying capacity of ranges in such a manner that the livestock economy of the Navajo Nation is preserved."

## 1.3 Grazing Overview

Timing of grazing, movement and dispersal of livestock, and livestock numbers are factors that must be considered when optimizing livestock production. Prior to considering these factors, managers need an understanding of foraging behavior, as influenced by an animal's environment. Established grazing patterns are dictated by topography; plant distribution; composition; and location of water, shelter, and minerals (Heitschmidt 1991). The total forage production of a given pasture or grazing area does not necessarily reflect the amount of forage available to livestock; therefore, it is important to recognize specific factors restricting forage availability such as inaccessibility (fences), long distances to water, or steep slopes. Once identified, total forage production can be adjusted for these inaccessible areas. An example of a management strategy that would result from this type of analysis would be to develop additional water sources in areas rarely visited by livestock because of the long distance to water. Section 6.5 explains how fencing can be used to more accurately manage forage production.

After likely foraging patterns have been ascertained, production and forage value data can be used to help determine the number of animals that could sustainably graze in a given pasture. Stocking rates are a trade-off between short-term and long-term benefits. Low stocking rates benefit individual animals, as more resources are available due to lowered competition with other animals. Conversely, high stocking rates can inhibit individual animals, but the increase in total livestock production allows for greater short-term gains for the producer. The final stocking rate decision must consider the ecosystem as a whole. Maintaining long-term viable rangelands provides for the continued health of livestock and long-term financial gains for producers or permittees. Viable rangelands also provide for the continued health of the local air, water, and other ecological resources.

Stocking rates are correlated with the prevention of overgrazing. When livestock, wildlife, and feral horses graze and browse on a site, each selects its own preferred species. If the site is stocked too heavily and for too long a time, the desired forage species will become overgrazed. These preferred species are weakened and their mortality rate increases, resulting in a reduction of their percent composition on the site. If deterioration continues, invaders and noxious weeds replace the less valuable forage species.

Plant vigor and root development can be adversely affected when grazing occurs during initial plant growth or during seed development. This will remain a problem for rangeland managers as long as livestock grazing permits are issued for year-round grazing. However, Holecheck (1999) argues that stocking rates have a much greater impact on range condition than the season of use.

In general, managers should be aware that the final products of this inventory are subject to a variety of factors. The application of stocking rates and carrying capacity to grazing areas should be used with care and in context to dynamic seasonal, topographic, and behavioral factors.

# 2. RESOURCE DESCRIPTIONS

Knowledge of the resource issues that affect rangeland health and productivity is essential to any management plan. Stocking rates, season of use, annual precipitation, soil types, location of water sources, and topography strongly influence the variety and quality of forage on rangelands. The results of this vegetative inventory quantify the current conditions of the rangelands on Aneth, Cudei and Hogback communities. This information can be used to document future changes on the rangelands and assist with management decisions.

## 2.1 Geographic Setting

The study area is located within the Colorado Plateau (35) Major Land Resource Area (MLRA). The study area surveyed is diverse and encompasses portions of southeastern Utah (Aneth Community) and northwestern New Mexico (Cudei and Hogback Communities).

The Aneth Community is comprised of small mesas and numerous badland areas. The western border is formed by Montezuma Creek and the San Juan River makes up the southern boundary. Several other large drainages, including McElmo Creek, cut through the interior and ultimately drain into the San Juan River. Riparian vegetation can be found along the river and larger washes. The upland areas are primarily mixed shrub/grassland. The most intact plant communities, mostly grassland, are found on the mesa tops.

The Cudei Community occupies a stretch of land between the Colorado border and the San Juan River. U.S. Highway 491 runs through the community from north to south and divides it into two separate pastures. The West Pasture is approximately twice the size of the East Pasture and contains many badland areas, especially in the breaks by the San Juan River and the Mancos River which runs through the northwest corner. The interior of both pastures is mostly flat with numerous gullies and arroyos and consists of large expanses of salt-desert shrubland interspersed with pockets of desert grassland. The northern portion of the East Pasture is similar to the West Pasture, but includes several buttes and mesas. The highland portions contain a mix of grassland, shrubland and pinyon-juniper woodland. The lowlands are very dry, and vegetation is often scarce.

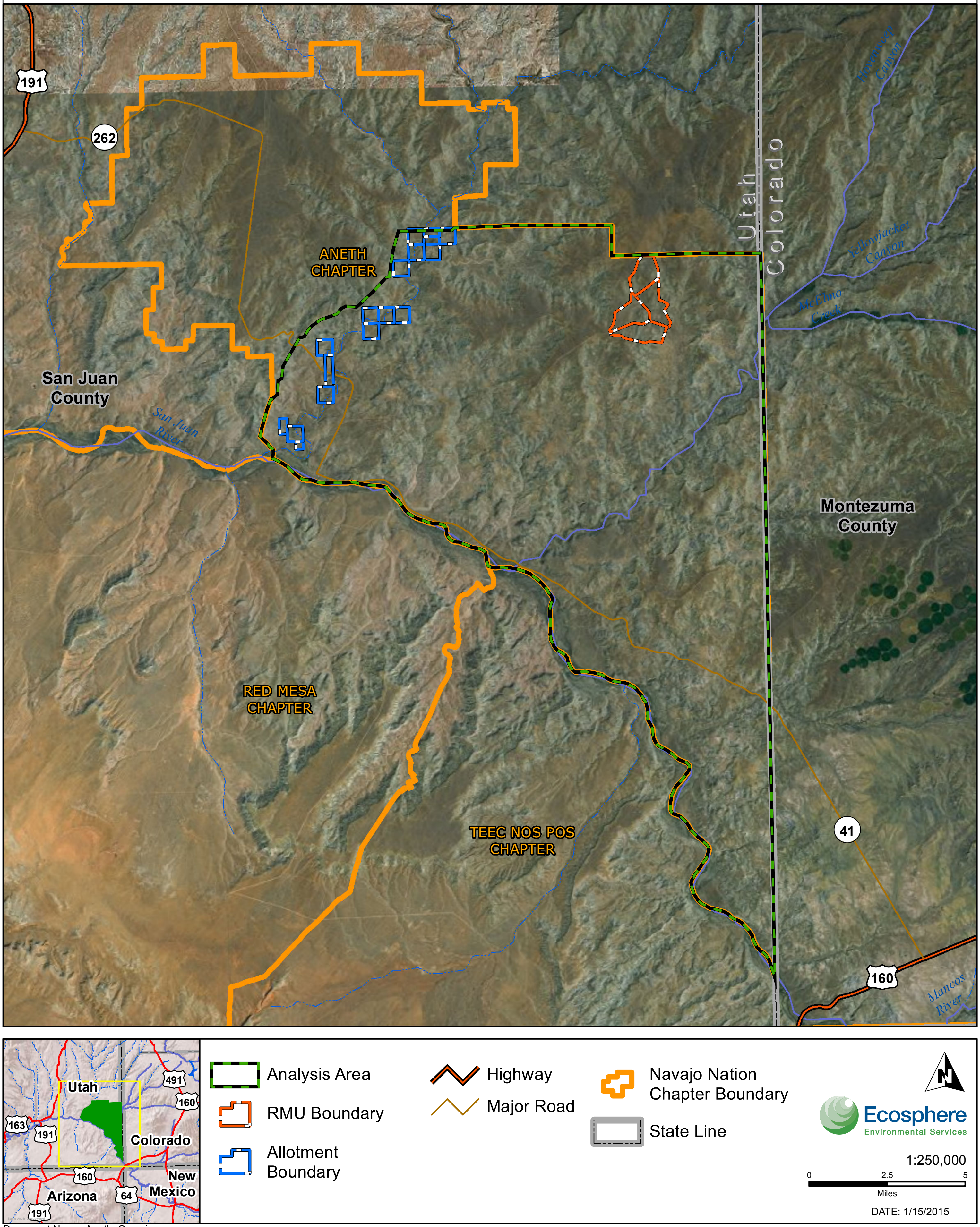
The Hogback Community is located about three miles northeast of Shiprock, New Mexico. The northern half of the community is composed of a mix of broad mesas and rocky canyons. The largest of these is Salt Creek, which drains much of the northern region and becomes a large, shrub-covered wash as it moves out into the low-lying areas. The southern half is much like the Cudei Community with numerous small gullies and washes cutting through relatively flat grass/shrubland. The Hogback formation and associated uplands establish much of the western border and U.S. Highway 64 forms the southern boundary.

Maps of each Community in the study area are provided on the following pages.

Acreages for each compartment were extracted from digital shapefiles provided by the BIA, Northern Navajo Agency. Using these shapefiles and the soil survey boundaries, the 24 analysis units (17 allotments, 3 communities plus 4 pastures of one RMU) covered 276,353.9 acres.

**BIA Shiprock Agency**
**Land Management District 12**
**2014 Range Inventory**

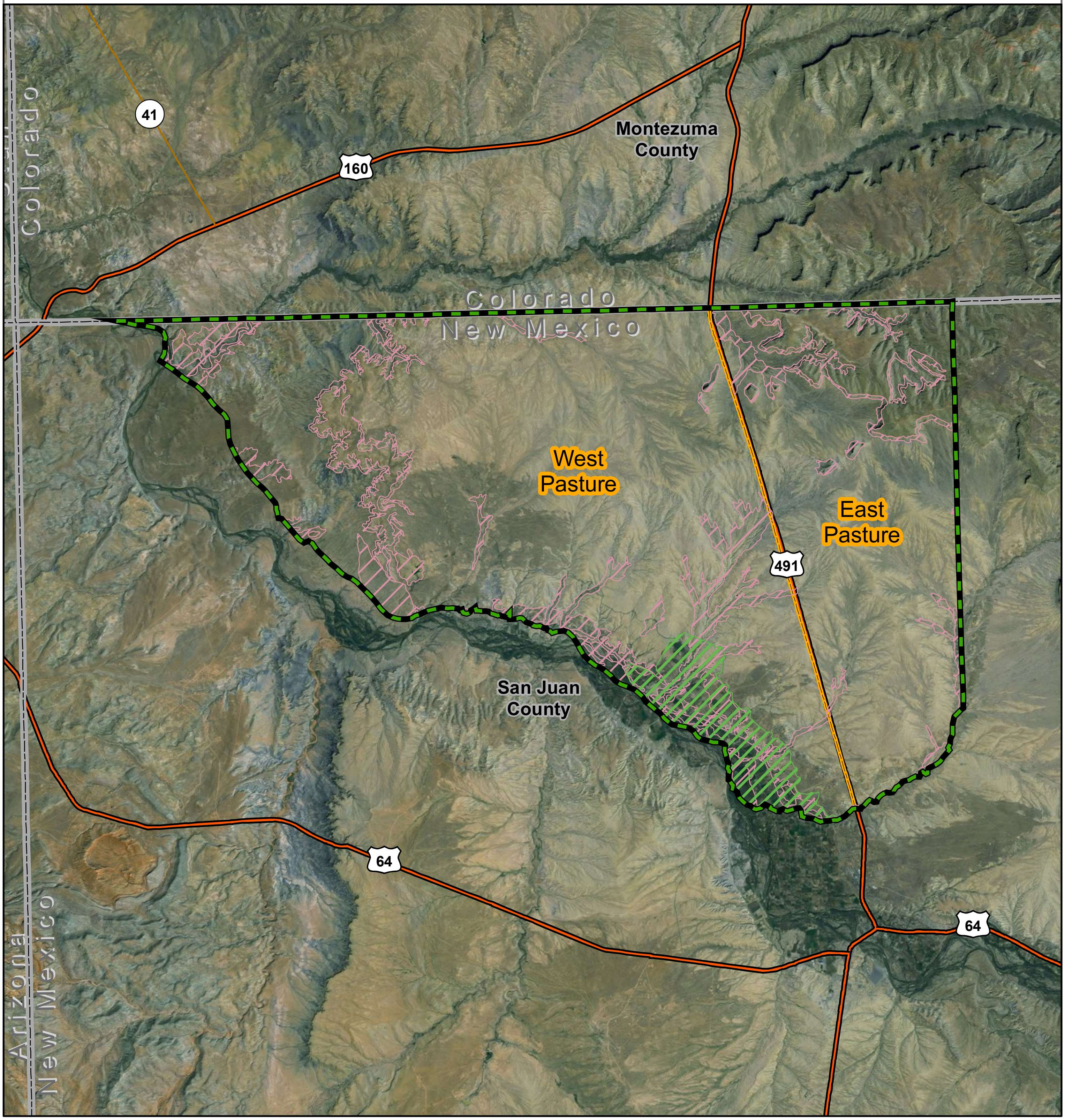
**Aneth**
**Overview Map**

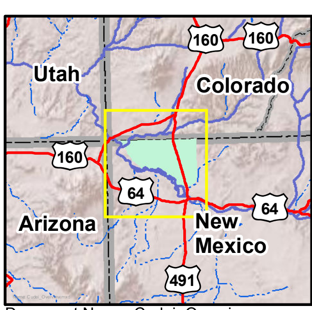



Document Name: Aneth_Overview

**BIA Shiprock Agency**
**Land Management District 12**
**2014 Range Inventory**

**Cudei**
**Overview Map**




Cudei Chapter

Highway

Pasture Boundary

Major Road

Non Range

Non Range Soils

Ecosphere
Environmental Services

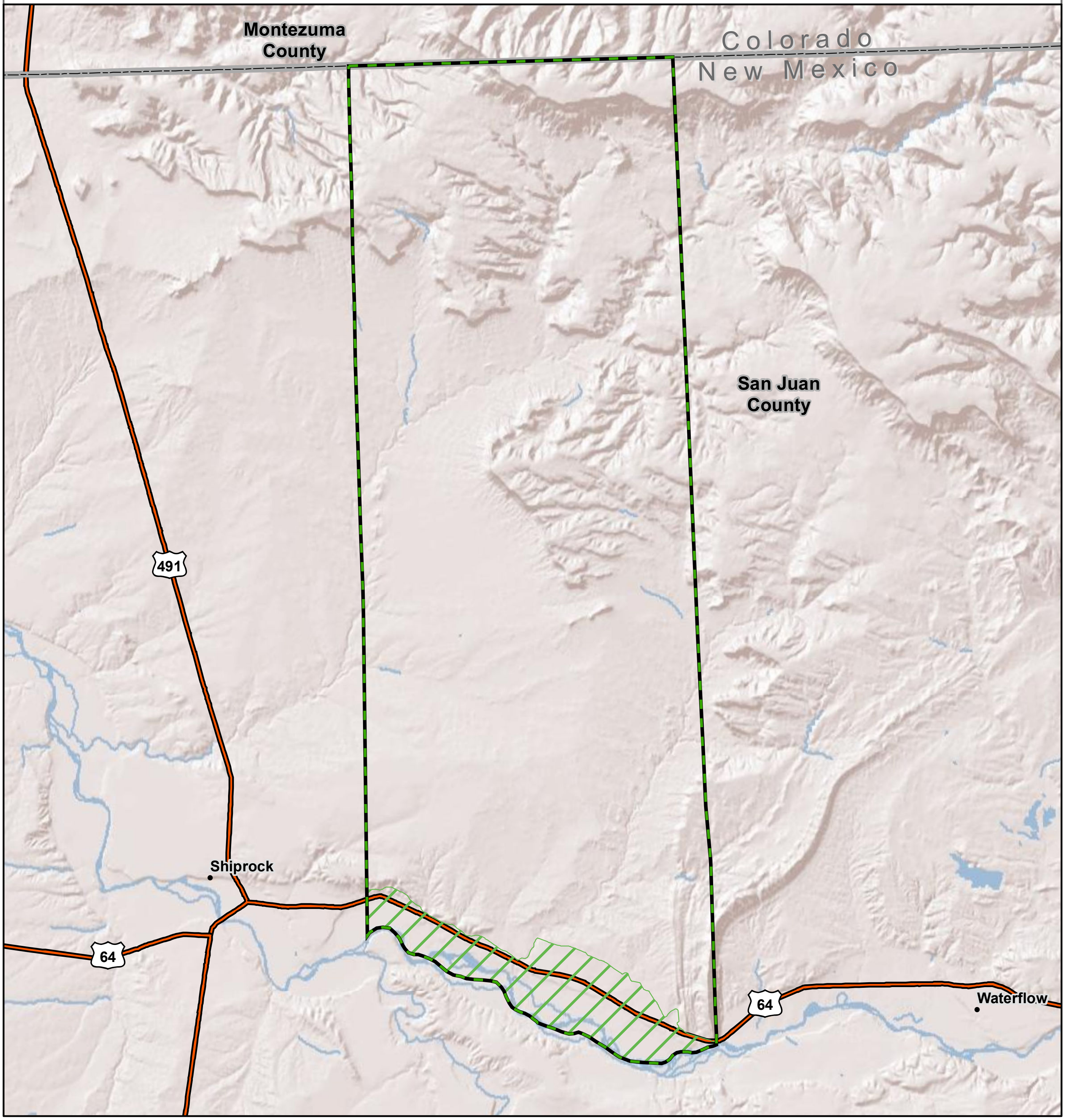
1:200,000
0 2.5 5
Miles

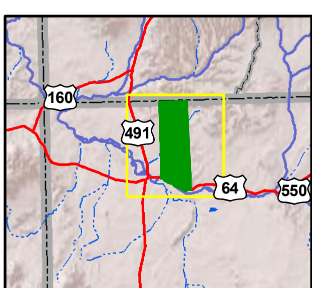
DATE: 2/6/2015

Document Name: Cudei_Overview

**BIA Shiprock Agency**
**Land Management District 12**
**2014 Range Inventory**

**Hogback**
**Overview Map**




Hogback Chapter
Highway
Agricultural
State Boundary

Ecosphere
Environmental Services

1:150,000

0 1 2
Miles

DATE: 2/9/2015

Document Name: Hogback_Overview

## 2.2 Precipitation

An accurate precipitation monitoring system is essential to range management programs. Biomass production estimates are directly affected by precipitation measurements when reconstructing the plant community to a normal production year. If precipitation is over estimated in the reconstruction factor, the total annual production estimate decreases. If precipitation is under estimated in the reconstruction factor, the total annual production estimate increases. Precipitation gauges are located throughout the Navajo Nation, and data are managed by the Navajo Nation Division of Water Resources (NNDWR). The NNDWR provided 14 years of precipitation data averaging all of the gauging stations in Shiprock Agency. The gauging stations are widespread and vary from mountainous areas to the San Juan River area and, therefore, provide a regional average not specific to the study area. The precipitation data are provided as Appendix A.

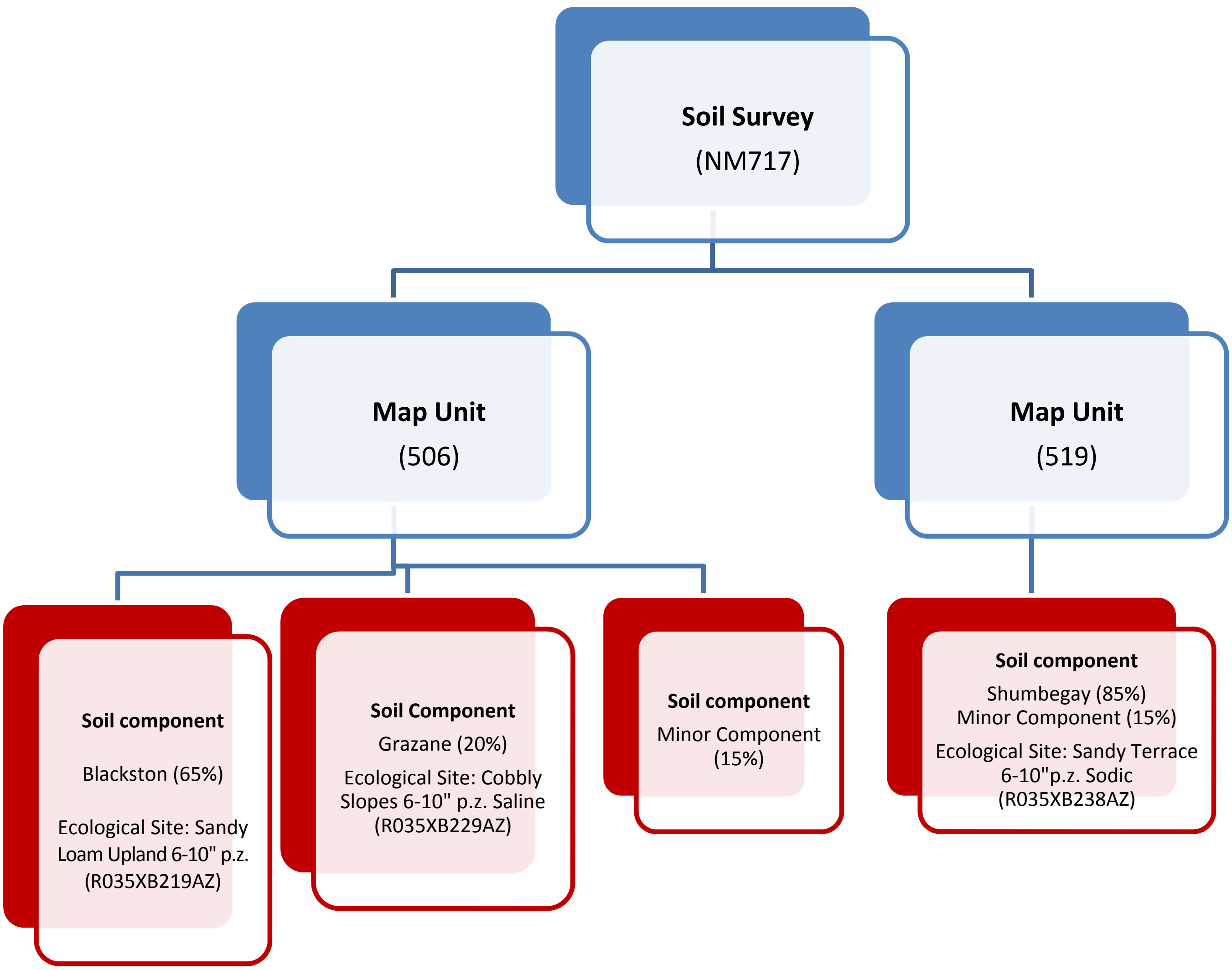
## 2.3 Soils

Knowledge of the soil properties in a particular area can help predict forage production. Soil properties such as texture, depth, moisture content, and capacity can dictate the type and amount of vegetation that will grow in that soil. The application of soil survey information enables rangeland managers to provide estimates of forage production in a range unit. According to the Agricultural and Range Management Handbook, “the type and size of map unit delineations, scale of data collection, sampling protocols, and date of the last inventory completed are all factors to consider when using existing soil surveys and rangeland inventories” (USDOI BIA 2003b).

This vegetation inventory study area is located within the boundaries of two soil surveys produced by the United States Department of Agriculture (USDA), Natural Resources Conservation Service: Soil Survey of San Juan County, Utah, Navajo Indian Reservation (UT643) and Soil Survey of Shiprock Area, Parts of San Juan County, New Mexico and Apache County, Arizona (NM717). Each soil survey is Order III mapped, which means it includes soil and plant components at association or complex levels (called map units). Within the map units, finer levels (called soil types) are generally described, but not mapped. Each of the delineated map units contains multiple soil types within it. Each soil type is correlated with a specific ecological site. Order II mapping would delineate soil types within map units, and boundaries of ecological sites could be determined directly from the soil map. Ecological sites cannot be assigned directly from Order III map information because they are not delineated at that level.

It is worth noting that biological soil crusts occur occasionally throughout the study area. Biological soil crusts are a complex mosaic of organisms that weave through the top few millimeters of soil, gluing loose particles together to stabilize and protect soil surfaces from erosive forces. Additionally, roughened soil surfaces created by biological crusts act to impede overland water flow, resulting in increased infiltration (Belnap et al. 2001). Biological soil crusts can provide a vital component for healthy, functioning soils.

Soil surveys and ecological site descriptions are valuable for rangeland managers, as long as their limitations are understood. Figure 2-1 illustrates the hierarchy of *unmapped* soil components and their corresponding ecological sites within a *mapped* soil unit within a given soil survey. The examples in the chart are extracted from one of the soil surveys used for this project. The soil survey and map units (indicated in blue) are mapped. The soil components and correlated ecological sites (indicated in red) are unmapped.




Notes: p.z. = precipitation zone.

**Figure 2-1. Soil Survey Hierarchy**

# 3. Ecological Sites

Ecological sites are differentiated from each other based on significant variances in species and species groups of the characteristic plant community and their proportional composition and production. Additional determining factors include soils, hydrology, and other differences in the overstory and understory plants due to distinctions in topography, climate, and environmental factors or the response of vegetation to management. Each ecological site description (ESD) describes the historic climax plant community (HCPC) that was present during European settlement of North America. Many rangelands have undergone significant transitions to the point that they are never again expected to display the characteristics of the HCPC. In their best condition, these rangelands would instead reach their reference or potential natural community. Reference communities may include non-native plant species and other factors, which differentiate them from an HCPC on the same site.

Ecological sites are directly associated with soil components. The determination of ecological site for each transect was complicated due to inconsistencies of scale in the soil surveys. As described in Section 2.3, the soil survey was mapped at the soil complex scale (Order III), meaning there are up to three soil components inside a mapped soil complex. The soil components are not mapped. Since each major soil component has a single ecological site assigned to it, the map unit has up to three unmapped ecological site possibilities. Therefore, ecological sites cannot be mapped directly from Order III soil map information because they are not correlated with the soil map units; ecological sites are correlated with the finer levels of unmapped soil components.

Rangeland managers should be aware that maps of ecological sites are available on NRCS Web Soil Survey website (USDA NRCS 2014e). The mapping, however, is by dominant ecological site. Unfortunately, this may grossly misrepresent soil units. For example, in soil map units where the dominant soil component/ecological site is 60 percent of the soil map unit, then the other 40 percent of the soil unit would be mapped incorrectly. An analogy might be a basket of fruit containing six apples and four oranges. Using the dominant system, the entire basket of fruit would be labeled as apples. While the dominant ecological site map may be appropriate at a landscape level, it is usually too coarse to use with rangeland management of pastures. In most cases of rangeland fieldwork, it is possible to provide field staff with descriptions of the dominant ecological site, as well as descriptions for non-dominant soil components and ecological sites. A decision regarding which ESD best fits a given transect can then be made based upon field examination of soils and the plant community.

For this inventory soil components and ecological sites for each transect were assigned primarily using soil profile and texture test results and the map unit descriptions from the soil survey, supplemented with interpretation of the current vegetative community compared to the expected HCPC. In cases where the ESD was not developed, no ESD was assigned. Generally, the ESDs represent the most up-to-date information available at the time of this study. It should be noted that they also are continually updated as new information is brought forth from field studies. The ESDs in this report should not be relied upon for future studies; instead the most recent information should be collected from the NRCS. Approved and published ESDs are available on the internet at http://esis.sc.egov.usda.gov/.

The ecological sites from the study area are listed below followed by representative photographs of ecological sites that contained transects, with transect identified. Some sites had only one transect located within the ecological site. Many ecological sites contained no transects, especially those with few acres and these ecological sites have no representative photographs. Ecological site information by analysis unit is presented in Section 5 Results. This table and following photographs are listed by consecutive ID number for general reference.

**Table 3-1. Ecological Sites in the Study Area**

| ID | ESD | Description | Number of Transects | Acres (By proportion in Soil Map Unit) |
|---|---|---|---|---|
| 1 | R035XY006UT | Alkali Fan (Castlevalley Saltbush) | 21 | 8,287 |
| 2 | R035XY012UT | Semiwet Saline Streambank (Fremont Cottonwood) | 2 | 2,002 |
| 3 | R035XY109UT | Desert Loam (Shadscale) | 75 | 30,420 |
| 4 | R035XY118UT | Desert Sandy Loam (Fourwing Saltbush) | 31 | 19,344 |
| 5 | R035XY215UT | Semidesert Sandy Loam (4-Wing Saltbush) | 13 | 5,207 |
| 6 | F035XG134NM | Pinus edulis-Juniperus monosperma/Quercus gambelii/Bouteloua gracilis | 28 | 11,483 |
| 7 | R035XA101AZ | Breaks 10-14" p.z. | 2 | 873 |
| 8 | R035XB016NM | Clay Loam Terrace 7-10" p.z. Sodic | 5 | 3,987 |
| 9 | R035XB017NM | Cobbly Slopes 6-10" p.z. | 4 | 2,174 |
| 10 | R035XB020NM | Loamy 6-10” p.z. Terrace | 0 | 61 |
| 11 | R035XB021NM | Loamy Upland 7-10” p.z. | 3 | 1,974 |
| 12 | R035XB022NM | Loamy Upland, Sodic | 1 | 598 |
| 13 | R035XB024NM | Saline Bottom 6-10" p.z. | 0 | 211 |
| 14 | R035XB028NM | Sandy Bottom 6-10" p.z. | 0 | 389 |
| 15 | R035XB030NM | Sandy Loam Upland 6-10" p.z. | 8 | 5,490 |
| 16 | R035XB034NM | Sandy Terrace 6-10" p.z. Sodic | 2 | 1,478 |
| 17 | R035XB035NM | Sandy Upland 6-10" p.z. | 3 | 2,450 |
| 18 | R035XB204AZ | Sandstone Upland 6-10" p.z. | 1 | 1,192 |
| 19 | R035XB224AZ | Clayey Slopes 6-10" p.z. Bouldery | 0 | 83 |

| ID | ESD | Description | Number of Transects | Acres (By proportion in Soil Map Unit) |
|---|---|---|---|---|
| 20 | R035XB267AZ | Sandy Loam Upland 6-10" p.z. Limy | 1 | 2,356 |
| 21 | R035XB269AZ | Loamy Bottom 6-10" p.z. Perennial | 0 | 81 |
| 22 | R035XB271AZ | Loamy Upland 6-10" p.z. Saline-Sodic | 3 | 25,055 |
| 23 | R035XB272AZ | Loamy Bottom 6-10" p.z. Perennial, Saline | 0 | 21 |
| 24 | R035XB273AZ | Sandy Bottom 6-10" p.z. | 0 | 202 |
| 25 | R035XB274AZ | Sandy Loam Upland 6-10" p.z. Saline | 4 | 3,295 |
| 26 | R035XB275AZ | Loamy Fan 6-10" p.z. | 18 | 7,944 |
| 27 | R035XB276AZ | Siltstone Upland 6-10" p.z. Saline | 0 | 278 |
| 28 | R035XB277AZ | Siltstone Upland 6-10" p.z. Limy | 60 | 24,503 |
| 29 | R035XB278AZ | Loamy Upland 6-10" p.z. Saline, Gypsic | 18 | 16,679 |
| 30 | R035XB279AZ | Clay Loam Upland 6-10" p.z. Sodic, Gypsic | 25 | 10,839 |
| 31 | R035XC313AZ | Loamy Upland 10-14" p.z. | 8 | 3,458 |
| 32 | R035XC314AZ | Sandstone Upland 10-14" p.z. | 0 | 226 |
| 33 | R035XC326AZ | Sandy Loam Upland 10-14" p.z. Saline | 7 | 862 |
| 34 | R035XC335AZ | Sandstone/Shale Hills 10-14" p.z. | 1 | 437 |
| | | Badland | 24 | 48,973 |
| | | Gullied Land | 0 | 1,964 |
| | | Marshes | 0 | 10 |
| | | Naki | 0 | 169 |
| | | Other Soils | 0 | 174 |
| | | Removed From Analysis | 3 | 0 |
| | | Riverwash | 0 | 257 |
| | | Rock Outcrop | 3 | 8,872 |
| | | Shallow Soils | 8 | 9,688 |
| | | Shepherd | 0 | 10 |
| | | Sheppard | 0 | 391 |
| | | Sogzie | 0 | 458 |
| | | Tohona Variant | 0 | 502 |
| | | Water | 0 | 842 |

| ID | ESD | Description | Number of Transects | Acres (By proportion in Soil Map Unit) |
|---|---|---|---|---|
| | | Whit | 0 | 368 |
| | | **Total[1]** | **382** | **266,615** |

p.z. = precipitation zone

[1] Total acres minus non-range acres, but including all slopes. Summed to two decimals and rounded.

## 1. R035XY006UT Alkali Fan (Castlevalley Saltbush)

Transects A_110 and A_124

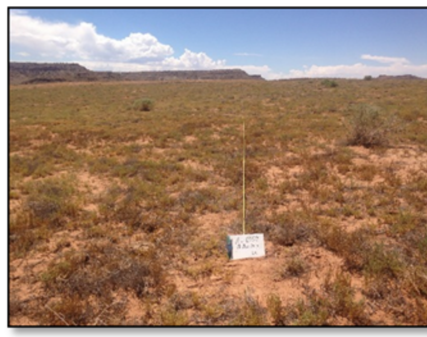
## 2. R035XY012UT Semiwet Saline Streambank (Fremont Cottonwood)

Transects A_076 and A_131

### 3. R035XY109UT Desert Loam (Shadscale)

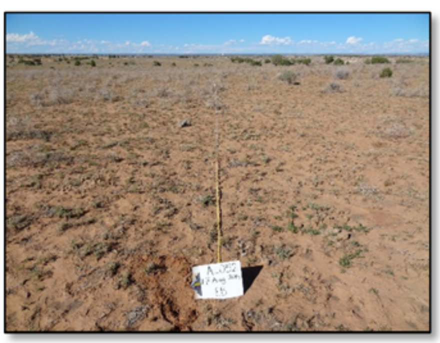

Transects A_062 and A_108

### 4. R035XY118UT Desert Sandy Loam (Fourwing Saltbush)

Transects A_149 and A_059

### 5. R035XY215UT Semidesert Sandy Loam (Fourwing Saltbush)




Transects A_052 and A_002

## 6. F035XG134NM Gravelly Woodland 10-17” p.z.

Transects C_047 and H_02

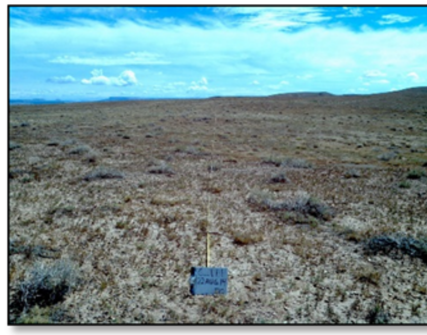
## 7. R035XA101AZ Breaks 10-14" p.z.

Transects H_16 and H_40

## 8. R035XB016NM Clay Loam Terrace (sodic) 7-10" p.z.

Transects H_66 and H_60

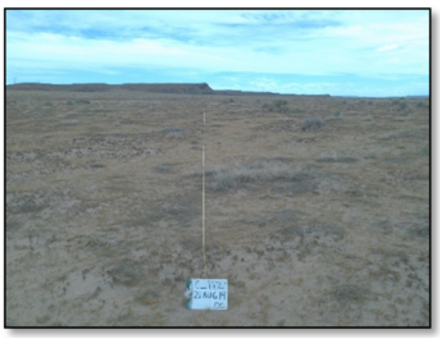
### 9. R035XB017NM Cobbly Slopes 6-10" p.z.



Transects C_054 and C_111

**10. R035XB020NM Loamy 6-10" p.z. Terrace -** No transects were located in this site (61 acres are in the study area).

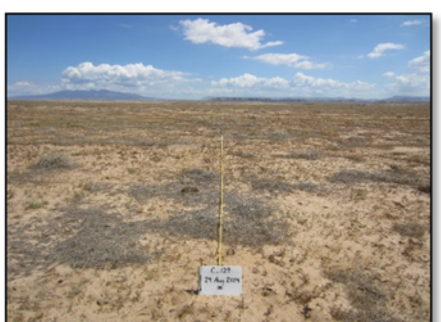
### 11. R035XB021NM Loamy Upland 7-10" p.z.





Transects C_112 and C_115

### 12. R035XB022NM Loamy Upland (sodic) 7-10" p.z.



Transect C_129

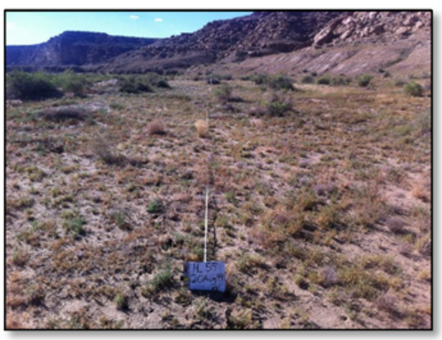
**13. R035XB024NM Saline Bottom 6-10" -** No transects were located in this site (211 acres are in the study area).

**14. R035XB028NM Sandy Bottom 6-10" -** No transects were located in this site (389 acres are in the study area).

**15. R035XB030NM Sandy Loam Upland 6-10" p.z.**


Transects C_040 and C_101

**16. R035XB034NM Sandy Terrace (sodic) 6-10" p.z.**




Transects H_55 and H_80

## 17. R035XB035NM Sandy Upland 6-10" p.z.

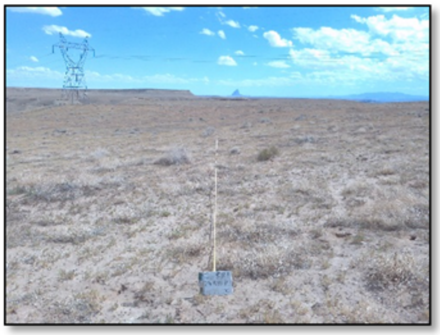
Transects C_013 and C_056

## 18. R035XB204AZ Sandstone Upland 6-10" p.z.


Transect H_37

**19. R035XB224AZ Clayey Slopes 6-10" p.z. Bouldery -** No transects were located in this site (83 acres are in the study area).

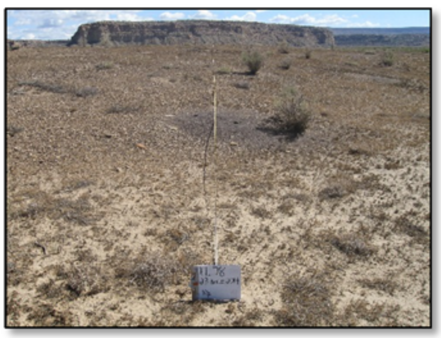
**20. R035XB267AZ Sandy Loam Upland 6-10" p.z. Limy**



Transect C_001

**21. R035XB269AZ Loamy Bottom 6-10" p.z. Perennial -** No transects were located in this site 81 acres are in the study area).

**22. R035XB271AZ Loamy Upland 6-10" p.z. Saline-Sodic**



Transects H_78 and C_099

**23. R035XB272AZ Loamy Bottom 6-10" p.z. Perennial, Saline -** No transects were located in this site (only 21 acres are in the study area).

**24. R035XB273AZ Sandy Bottom 6-10" p.z. -** No transects were located in this site (202 acres are in the study area).

**25. R035XB274AZ Sandy Loam Upland (saline) 6-10" p.z.**

Transects C_011 and C_110

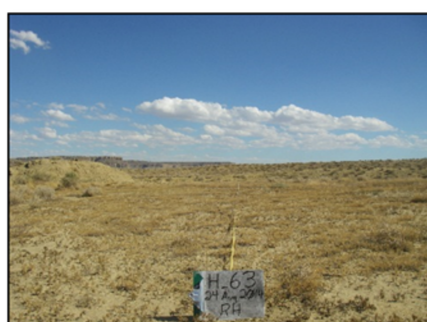
**26. R035XB275AZ Loamy Fan 6-10" p.z.**



Transects C_078 and C_108

**27. R035XB276AZ Siltstone Upland 6-10" p.z. Saline -** No transects were located in this site (278 acres are in the study area).

**28. R035XB277AZ Siltstone Upland 6-10" p.z. Limy**




Transects C_033 and H_63

## 29. R035XB278AZ Loamy Upland 6-10" p.z. Saline, Gypsic


Transects C_015 and H_15

## 30. R035XB279AZ Clay Loam Upland (sodic, gypsic) 6-10" p.z.

Transects C_018 and C_035

## 31. R035XC313AZ Loamy Upland 10-14" p.z.


Transects C_074 and H_32

**32. R035XC314AZ Sandstone Upland 10-14" p.z. -** No transects were located in this site (226 acres are in the study area).

**33. R035XC326AZ Sandy Loam Upland 10-14" p.z. Saline**

Transects C_098 and H_75

**34. R035XC335AZ Sandstone/Shale Hills 10-14" p.z.**


Transect H_62

# 4. METHODOLOGY

The methods used to collect this data included protocols provided by the BIA and modified to standards used in federally published technical references. The Statement of Work (SOW), provided by the BIA to Ecosphere, described the study design and cited specific methodologies for data collection (Coulloudon et al. 1999a; Habich 2001; USDA NRCS 2003). The field methodology was based on the SOW and the technical references, with modifications approved by the BIA.

## 4.1 Field Methodology

### 4.1.1 Transect Establishment

Data collection in the field occurred between 16 August and 25 August, 2014. The BIA provided Ecosphere with predetermined transect locations. The Universal Transverse Mercator (UTM) coordinates of these transect locations were downloaded into hand held Global Positioning System (GPS) units. The GPS unit was used in combination with topographic maps to navigate by vehicle and foot to the transect locations. Transects were established within ten meters of the GPS coordinates, and usually within one or two meters.

Transects consisted of a 200-foot line measured with an open reel tape placed flat and straight along the ground and stretched taut as much as possible. Using field maps and topography as a guide, each transect was placed within a single soil unit and vegetation community. The transect azimuth was randomly determined by selecting a prominent distant landmark, such as a mountain or lone tree. In some cases with no obvious landmark, a pen or pencil was tossed in the air to determine the random direction. The transect azimuth was read with a compass and recorded. The 200-foot tape was then extended along the transect azimuth. Vegetation attributes were recorded from ten plots at 20-foot intervals along the open reel tape. The plots were measured with a square 9.6-foot ($ft^2$) quadrant frame. The 9.6 $ft^2$ plot is generally used in areas where vegetation density and production are relatively light (Habich 2001). Care was taken to avoid bias by establishing each plot using a consistent method, in this case always laying the frame to the right side of the tape. The vegetative attributes measured at each transect were production, ground cover, and species frequency. Aspect, slope, soil texture, and notes were recorded. All plant species names were consistent with the USDA Plants Database (USDA NRCS 2014b).

### 4.1.2 Production Data Collection

Production is determined by measuring the weight of annual aboveground growth of vegetation because it has a direct relationship to feed units for grazing animals. For the purposes of this study, production was measured as standing forage crop and reconstructed to peak standing crop. Standing forage crop is the total herbaceous and woody plant biomass present aboveground and available to herbivores. The peak standing crop is the greatest amount of plant biomass aboveground present during a given year (Coulloudon et al. 1999a). Production includes the aboveground parts of all plants produced during a single growth year. Excluded are underground growth, production from previous years, and any increase in the stem diameter of shrubs.

Production and composition of the plant communities were determined using the USDA double sampling methodology with a combination of estimating and harvesting. For this survey, Ecosphere followed the double sampling methodology of the USDA, the NRCS modified standards outlined in the SOW, and the modifications generated from the pre-work conference. The double sampling method is detailed in the following sections.

#### 4.1.2.1 Establishing a Weight Unit

A weight unit is a part of a plant, an entire plant, or a group of plants of the same species used to assess production. A weight unit is created by visually selecting part of a plant, an entire plant, or a group of plants that will most likely equal a particular weight. For example, a fist-sized clump of healthy, un-grazed Indian ricegrass (*Achnatherum hymenoides*) may be visually estimated to equal 10 grams (g). This clump of grass is then harvested and weighed with a hand scale to determine actual weight. This process is repeated until 10g of Indian ricegrass can be visually estimated with accuracy. After weight units are established, field teams can accurately estimate production. The field team maintained proficiency by regularly harvesting and weighing to check estimates of production.

#### 4.1.2.2 Double Sampling Methodology (Estimating and Harvesting)

Production (in grams) was estimated by counting the weight units of each species in each plot. All plants and parts of plants inside a quadrant outlined by the 9.6 $ft^2$ frame up to a height of 4 feet were estimated by the field team (Figure 4-1). Plants outside the quadrant were excluded from the weight estimate. Two plots on each transect were chosen for harvesting. On the harvested plots, all species were estimated *in situ* and then harvested at ground level (¼ inch stubble height).

In many cases, vegetation in the transect was diverse and widespread, so two plots could not effectively represent all species. Furthermore, Ecosphere has determined, through several years of data collection and analysis, that intermittently occurring species are under-represented in the harvested material. In an effort to include more species in the harvested material, a weight unit of any species that contributed 10g or more of estimated production on the transect, but did not occur in the two selected harvested plots, was estimated and harvested individually outside of the transect. This was called a calibration sample.

Harvested biomass was weighed with a hand scale, and both estimated and harvested (green) weights were recorded. All harvested materials were collected and stored in paper bags labeled with tracking information including transect, date, species, and plot number. All of the harvested material was allowed to air dry for 10 days or more before re-weighing to convert from green weight to air-dry weight (ADW). The purpose of the double sampling was to correct any variability between the estimation of production and the actual weighed production. This was accomplished by using an estimation correction factor, which is calculated in the post-field data processing.

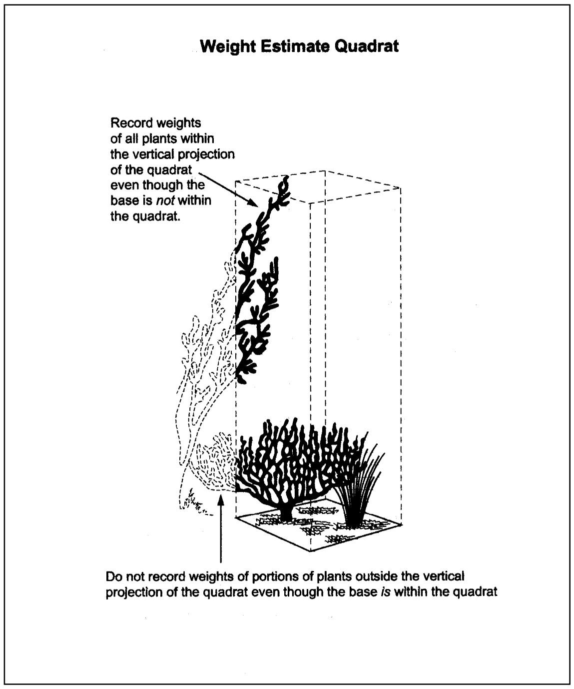



**Figure 4-1. Weight Estimate Box**

Source: Coulloudon et al. 1999a

## 4.1.1 Large Shrub Plots

Extended plots were established when the vegetation consisted of "large" shrubs. Neither the SOW or the National Range and Pasture Handbook (USDA NRCS 2003) adequately define the large shrub plot methodology. However, Ecosphere understands that the purpose of the large shrub plots is to capture the production of larger shrubs that are widely distributed and are too wide to be adequately measured within the 9.6 $ft^2$ frame.

Two extended plots were established at every transect containing shrubs. Shrubs were defined by USDA Plants Database (USDA NRCS 2013) and in addition to all woody shrubs, included all cacti and yucca. In cases where a species had potential to be a shrub or subshrub, the species in question was placed into a single category (shrub or subshrub) based on the growth form observed in the study area. The shrub species as defined for this project are included in the Plant List in Appendix B. Two extended square plots (0.1 acre) were measured from fixed locations along the 200 foot tape, and only the production weight of new growth on shrub species inside those plots was estimated. The shrub species were not estimated in the ten regular plots.

### 4.1.1.1 Ocular Estimates of Utilization

Utilization is the proportion of annual growth that has been consumed by grazing animals. The purpose of estimating utilization is to include in the vegetation measurements the forage that has been consumed prior to the vegetation inventory. With the Ocular Estimation Method (Coulloudon et al. 1999a), utilization is determined by visual inspection of forage species. This method is reasonably accurate, commonly applied, and suited for use with grasses and forbs. Field team personnel were thoroughly trained and practiced in making ocular estimates of utilization of plants. An attempt was made to locate un-grazed plants near the transect. These un-grazed plants were assumed to represent the species approximately before grazing occurred. Un-grazed plants were used as a comparison to estimate grazed plants. Some re-growth may have occurred before the inventory period; however, if grazing patterns are undetectable on the plant, it is impossible to determine what re-growth, if any, may have occurred. The percentage of un-grazed plant remaining was recorded for each species on each transect.

#### 4.1.1.2 Sensitive Plants Protocol

Threatened, endangered, culturally important, or otherwise sensitive plants were estimated rather than harvested for the purposes of this inventory. Weights for cacti and yucca species were estimated using standard protocols as described in the Bureau of Land Management (BLM) Technical Reference 1734-7 (Habich 2001). The recommended values are as follows: 10 percent of total weight for prickly pear (*Opuntia* spp.), five percent for barrel-type cacti (*Ferocactus* spp., *Sclerocactus* spp., and *Echinocereus* spp.), 15 percent for cholla cacti (*Cylindropuntia* spp. and *Grusonia* spp.), and 15 percent for yuccas (*Yucca* spp.). A list of all plant species recorded during the inventory is included as Appendix B.

### 4.1.2 Frequency Data Collection

Frequency describes the abundance and distribution of species. Frequency measurements are an easy and efficient method for monitoring changes in a plant community over time. Frequency is the number of times a species is present in a given number of sampling units, usually expressed as a percentage.

On rangeland, regeneration of desirable plants maintains good range conditions. Grazing by too many animals (livestock and wildlife) or heavy utilization by a few animals results in overuse, loss of vigor, and disappearance of the preferred and desirable plants. Deterioration of range vegetation begins when less valuable forage species replace the desirable species. If deterioration continues, invaders and noxious weeds replace the less valuable forage species. The frequency and composition of preferred and desirable species compared to less valuable forage is used as an indication of range condition.

### 4.1.3 Cover Data Collection

Ground cover measurements are used to quantify the amount of vegetation, organic litter, biological crusts, and exposed soil surface throughout an area. Cover also is important from a hydrologic perspective when examining basal vegetation and canopy (foliar) cover of perennial and annual species and litter cover. This study measured understory vegetation; no trees were included in the cover data measurements.

Ground cover data can assist in determining the soil stability and proper hydrologic function and biotic integrity of a site. For trend comparisons in herbaceous plant communities, basal cover is generally considered to be the most stable because it does not vary as much from climatic and seasonal conditions (compared to canopy cover). Canopy cover can vary widely over the course of the growing season, which can make it difficult to compare results from different portions of a large area where sampling takes weeks or months. For this reason, future ground cover monitoring for each ecological site within each grazing unit should replicate the sampling period from this baseline inventory.

The line-point intercept method employed on this study is described in *Monitoring Manual for Grassland, Shrubland and Savanna Ecosystems* (Herrick et al. 2005). There are 50 point measurements spaced evenly (every 4 feet) along a 200–foot measuring tape anchored securely at each end. At each point along the transect, a sighting device (pin flag) was placed perpendicular to the ground along the measuring tape. Three layers of point intercept were recorded as the pin flag was dropped into place: Top Canopy, Lower Canopy, and Soil Surface. The first cover category is determined by the first plant interception of the pin flag. The species of plant that the pin flag hits is recorded as the "Top Canopy." If no plants are intercepted, "None" is recorded. Up to three additional species intercepted by the pin flag below the top canopy are recorded as "Lower Canopy" layers. If herbaceous or woody litter is intercepted, this is recorded as a lower canopy layer. "Soil Surface" is recorded as either the base of a plant species (See Figure 4.2) or one of the following categories: Rock, Bedrock, Embedded Litter, Duff, Moss, Lichen Crust, or Soil. Bare ground occurs only when the Top Canopy is "None" and there are no Lower Canopy layers, and the Soil Surface is "Soil." Measuring cover by points is considered one of the least biased and most objective cover measures (Bonham 1989). Results of the ground cover data analysis are included in Section 5 Results.

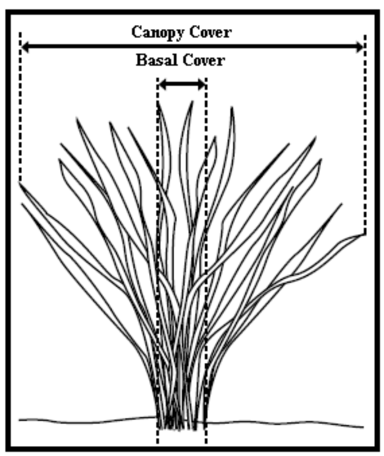



**Figure 4-2. Vegetative Cover**

Source: Elzinga, Salzer, and Willoughby 1998

### 4.1.1 Soil Surface Texture Test

At each transect, a small soil pit was dug to expose the soil profile. At diagnostic soil horizons, samples were analyzed using the USDA Soil Texturing Field Flow Chart. The Flow Chart uses a systematic procedure for estimating sand, silt, and clay content. The test also uses the ribbon method to determine the fraction of fine-grained particles within the sample. The field crew assigned a texture class to the sample based on its tested content and ribbon characteristics. The results of the soil sample determined or confirmed the soil component using Map Unit Descriptions from the Soil Survey as the primary reference.

## 4.2 Post-Field Methodology

After all field data were collected, the data were downloaded into a database. Harvested biomass was air dried for 10 days, and dry weights were entered individually into the database for each species on each transect. This initial field dataset was adjusted to compare the collected production data to the amount of vegetation that would occur in a "normal" year. These adjustments included factors for utilization, climate, growth curve, and ADW.

After the production estimates were "normalized" for every species on every transect, results were grouped by ecological sites within each analysis unit. Further analyses included similarity indices, available forage based on forage value and harvest efficiency factors, stocking rates, and carrying capacity.

### 4.2.1 Reconstructed Annual Production

Pounds per acre were estimated from field data through a series of calculations derived from technical reference 1734-7 Ecological Site Inventory (Habich 2001) and the National Range and Pasture Handbook (USDA NRCS 2003). This methodology reconstructs the measured weight of biomass to a "normal" annual air-dry production weight that accounts for physical, physiological, and climatological factors. First, the field-estimated green weight of a species was multiplied by an estimation correction factor and then by a reconstruction factor. The reconstruction factor is the percent ADW of the species divided by the product of the utilization, normal precipitation for the current water year, and growth curve for that time of year, as shown in the formula below:

$$\text{Corrected Green Weight} = \frac{(\%\ \text{ADW})}{(\%\ \text{Utilization})\ (\%\ \text{Normal Precipitation})\ (\%\ \text{Growth Curve})}$$

The result of multiplying the green weight of a species by the reconstruction factor is the "total reconstructed annual production." Details of each of the elements in this equation are described in the following sections.

#### 4.2.1.1 Estimation Correction Factor

The harvested plots provide the data for correction factors of estimated species weights from the field. Measured (harvested) weights of species were divided by the estimated weights of the same species in the same plot to establish a correction factor. This correction factor was then applied to all estimations of that species for the entire transect. For example, if alkali sacaton (*Sporobolus airoides*) was estimated to weigh 10g but the harvested weight was measured as 9g, then all estimates of alkali sacaton for that transect were multiplied by a correction factor of 0.90 as presented below:

$$\text{Estimation Correction Factor} = \frac{\text{Sum of Measured Weights}}{\text{Sum of Estimated Weights}} = \frac{9g}{10g} = 0.90$$

If the total estimated weight for alkali sacaton on all plots in this transect was 80g, the resulting corrected estimated green weight (g) x correction factor = 80g x 0.90 = 72g. The corrected green weight is 72g.

### 4.2.1.2 Biomass ADW Conversion

The ADW percentage is part of the reconstruction factor and accounts for the amount of water contained in the plant. The purpose is to remove the weight of water from the weight of the actual plant forage. All biomass collected from harvested plots was placed in paper bags; tracking information (date, transect identification, plot number, and species) was recorded on the bags. Harvested, or green, weights were immediately obtained with a hand scale, which was adjusted for the weight of the bag, and recorded. The paper bags filled with biomass were air dried for a minimum of 10 days. All bags were then weighed again, and dry weights were recorded into the dataset. After drying, the weights were divided by the green weights to give a percent ADW in grams to be used in the reconstruction factor. In the example in Section 4.3.1.1, the green weight of the harvested biomass was 9g. If the dry weight in the lab was measured at 8g, then the percent ADW would be 0.89.

$$\%\ ADW = \frac{Dry\ Weight\ (lab)}{Green\ Weight\ (field)} = \frac{8g}{9g} = 0.89$$

This value (0.89) represents the numerator of the reconstruction factor. The three values in the denominator are explained in the following sections. (Note: For species in a transect that were not harvested, an average percent ADW was used that was generated from the same species in the same analysis unit. In the case of remaining species, the percent ADW defaulted to 1.)

### 4.2.1.3 Utilization

The utilization estimate is applied to adjust for portions of plants that were not measured due to grazing of the plant prior to the survey. The default is 100 percent un-grazed. Grazed or utilized species were measured according to the average amount of plants that remained un-grazed near the transect. For example, if alkali sacaton was recorded at a utilization factor of 90 percent un-grazed, then the amount of alkali sacaton estimated would represent only 90 percent of the total.

$$Utilization = 0.9$$

The total weight of the species in the transect is divided by 0.9 to bring the measured weight up to 100 percent.

### 4.2.1.4 Growth Curves

Growth curves are used to reconstruct the aboveground portion of a plant that has not yet reached its full growth potential for the season. The application of a growth curve accounts for the amount of forage that has not yet grown and, thus, was not measured during the vegetation inventory. A weight measurement taken in June would normally be less than a measurement of the same plant taken in September, when the plant is nearing full growth. A growth curve calculates the average growth by month of plant species throughout the year within a specific region. For example, if alkali sacaton was measured in a transect during August, that measurement may represent only 88 percent of the full growth of that species.

Growth curves typically are presented in an ecological site description. However, many of the ESDs in the survey area did not have growth curves or had incorrect growth curves. If the growth curve in the ESD was absent or incorrect, then the ESD was replaced with the most suitable growth curve in the same common resource area, if possible

The growth curves used in this analysis are associated with the Common Resource Areas (CRAs) found within the project. A CRA is a subdivision of an MLRA and is defined by soils, climate, and landscape conditions. The only growth curve needed that was not in an ESD was CRA—35.2. The chart below shows the percent production by month for the 35.2 CRA growth curve.

**Percent production by month in AZ3521, 35.2, 6-10" p.z. (all sites) growth curve.**

| Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 1 | 9 | 20 | 27 | 14 | 10 | 11 | 5 | 3 | 0 | 0 |

Note: p.z. = precipitation zone

Each growth curve entry was a pro-rated value according to the day of the month. To illustrate, assume that a transect located in CRA 35.2 was sampled August 21. The first step in the growth curve analysis is to estimate, using growth curve AZ3521, the percentage of growth completed up to that date by adding up the preceding monthly categories as illustrated below:

| Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0% | 1% | 9% | 20% | 27% | 14% | 10% | 11% | 5% | 3% | 0% | 0% |

Then, for the month of August, 21 days would need to be prorated and added to the total. The value is determined by dividing the percent of growth occurring in August (11 percent) by the 31 days that occur during the month of August. This calculation yields a rate of 35 percent per day. The number of days that have occurred up to that date (21) is multiplied by the daily rate (35 percent) for 7.35 percent. This is added to the 81 percent that had occurred up to the end of July for a total of 88.35 percent of the growth curve completed. The growth curve value for the example sample collected on August 21 is 0.8835.

*Growth Curve = 0.88*

Therefore, the total weight of the species reported in that transect is divided by 0.88 to bring the measured weight up to 100 percent of growth for the year.

#### 4.2.1.1 Percent Normal Production

The Percent Normal Production in a sample area is directly affected by the relationship between growing conditions, especially precipitation amount, timing of precipitation, and temperature. Production varies each year depending on the favorability of these growing conditions. Biomass production measurements from year to year are not accurate without adjusting production to a "normal" year. The factors of precipitation, timing, and temperature are extremely difficult factors to quantify and apply to biomass production because the impacts vary by species. For this inventory, the variation in precipitation was used as the value for normal production percentage. All precipitation gauges in Northern (Shiprock) Navajo Agency were used in the calculations to determine the percent of normal production. The 13 years prior to 2014 were averaged and used as an historic comparison. The 2014 water year was 93 percent of the average, or just under "normal." It should be taken into consideration that the current long-term drought has been in effect longer than the 13 years of averaged "normal" condition.

For the example calculation, the water year was 102 percent of the average.

$$\textit{Percent Normal Production} = 1.02$$

The total weight of the species in the transect is divided by 1.02 to bring the measured water year down to 100 percent. Normalizing the precipitation to an average year helps to prevent over-allocating forage.

#### 4.2.1.2 Reconstruction Equation

Using the example carried through the previous sections, Ecosphere began with an estimated green weight (in the field) of 80g of alkali sacaton, multiplied by the estimation correction factor for a corrected green weight of 72g. This corrected green weight of 72g was then multiplied by the reconstruction equation:

$$\textit{Reconstruction Equation} = \frac{0.89}{(0.90 \times 1.02 \times 0.88)} = 1.10$$

The formula for the reconstruction equation, as explained earlier in Section 4.2.1, is repeated here:

$$\textit{Corrected Green Weight} = \frac{(\%\ ADW)}{(\%\ Utilization)\ (\%\ Normal\ Precipitation)\ (\%\ Growth\ Curve)}$$

When actual values from the alkali sacaton example are inserted into the formula, the equation becomes:

$$72g \times \frac{0.89}{0.90 \times 1.02 \times 0.88} = 72g \times 1.10 = 79.20g$$

The corrected green weight from the example above (72g) multiplied by the reconstruction factor (1.10) results in a total reconstructed annual production of 79.20g.

#### 4.2.1.3 Conversion from Grams to Pounds per Acre

The conversion from the working unit of grams (per transect) into the application of pounds per acre is also factored into production estimates. The plot size, 9.6 $ft^2$, was repeated ten times in each transect, thereby creating 96 $ft^2$ of sampling area. The sampling area size accounts for the conversion from grams to pounds (453.59 grams per pound) and $ft^2$ to acres (43,560 $ft^2$ per acre), which calculates into a 1:1 conversion (Coulloudon et al. 1999a). Therefore, in this case the conversion factor equals one and is not explicitly included into the total reconstruction annual production equation. Hence, in the example, there were 79.20 pounds per acre of alkali sacaton. The value 79.20 represents the total reconstructed annual production of the species in pounds per acre.

### 4.2.1 Calculating Ground Cover

Ground cover calculation categories were measured in terms of top canopy, basal cover, and bare soil surface. Fifty ground cover point intercepts were measured, so ground cover categories were divided by 50 and the result was multiplied by 100 to estimate a percentage of ground cover for each transect. For example, if 30 hits were recorded for bare ground, the percent bare ground on that transect would be 60 percent.

$$\frac{\text{30 "bare ground" hits}}{\text{50 total hits}} \text{ X 100 = 75\% bare ground}$$

It is important to note that bare ground refers to situations where soil was the only substrate present. A lack of foliar or basal cover in conjunction with duff, litter, rock, or bedrock is not considered bare ground. This is because true bare soil has less soil stability than duff, litter, rock, or bedrock. Cover data was averaged by analysis unit.

### 4.2.2 Calculating Frequency

Species frequency was measured when weights were estimated for all species in each production plot using the intensive method (Herrick et al. 2005). For example, if alkali sacaton occurred in six of the ten plots on a given transect, the frequency would be 60 percent. Frequency of species by plot on each transect is included in the database of production data with this report in digital format. Frequency of the five most common species (including large shrubs) to occur on transects within each analysis unit is presented in Section 5.

### 4.2.3 Calculating Similarity Index

Each ecological site has a unique reference plant community described in the ESD. The similarity index is a process of comparing the plant community that currently exists on the ground to the reference plant community. The similarity index is expressed as a percentage. One hundred percent would mean that the current plant community is at its climax stage and represents 100 percent of what is expected to be found on the site, while a lower percentage would indicate that the current vegetation community is dissimilar in species weight and composition from the reference plant community. A similarity index was calculated for all transects that were assigned to ecological sites with available ESDs.

The plant community that is currently present on a site may never reach its reference state, but instead may have changed such that its final successional state would result in a PNC. The PNC, unlike the reference plant community, is a result of natural disturbances and may include non-native species. For purposes of comparison, the reference plant community is used because this baseline has already been established for all ecological sites.

The recommended and accepted method of calculating a similarity index is to compare the median ESD production to the total reconstruction production value. Each ESD lists a range of expected production for above-average years and below-average years for each species (or group of species), as well as the total annual production for the site. The median of the above average and below average is used as the comparison production amount because all of the variable factors (such as above average precipitation) already have been factored into the reconstruction process. The sum total of these median values is used to compare the measured vegetation against the reference plant community.

The similarity index for this vegetation inventory was calculated by comparing the estimated production value for each plant species to the ESD. The ESD has an assigned production value for each species (or group of species) expected to occur in the reference community. Production that is expected to occur in the ecological site (up to the maximum percent listed) is termed “allowable production.” If an individual species (or group of species) is not listed in the ESD, no production is assigned or “allowed” from that species. For example, a transect had 79.20 pounds/acre of alkali sacaton. Based on the information in the ESD, the allowable production for alkali sacaton is 50 pounds/acre. No more than 50 pounds may be allowed for toward the similarity index for the transect. If the ESD had listed the allowable percentage of alkali sacaton at 200 pounds/acre, then all 79.20 pounds (and no more) would have been allowed to be counted toward the similarity index for the transect.

Every species on a transect was compared against the ESD. If the species was not expected to occur in the ecological site, it was given a zero percent allowable production value. If the species was expected to occur on the site, it was assigned the maximum value allowable assigned in the ESD. The total allowed production in pounds of each species was summed for each transect.

### 4.2.4 Calculating Available Forage

The forage value of a species is defined in terms of palatability and availability, as they apply to a particular type of livestock. ESDs list only the values for common plant species; however, the Utah NRCS developed a comprehensive list of species from the Colorado Plateau area. This list was the primary source used to assign forage values to all species recorded in the survey. The list is included with the digital Excel data for this report. The plant list in Appendix B includes the forage values for the least palatable season for different livestock (sheep, goats, cattle). Species are grouped into categories, and each category is weighted according to palatability. The categories recognized by the National Range and Pasture Handbook (USDA NRCS 2003) have been amended to include both toxic and injurious notations in addition to palatability and are as follows:

- **Preferred** plants – These plants are abundant and furnish useful forage for a reasonably long grazing period. They are preferred by grazing animals. Preferred plants are generally more sensitive to grazing misuse than other plants, and they decline under continued heavy grazing.
- **Desirable** plants – These plants are useful forage plants, although not highly preferred by grazing animals. They either provide forage for a relatively short period, or they are not generally

abundant in the stand. Some of these plants increase, at least in percentage, if the more highly preferred plants decline.

- **Emergency** (or **Undesirable**) plants – These plants are relatively unpalatable to grazing animals, or they are available for only a very short period. They generally occur in insignificant amounts, but may become abundant if more highly preferred species are removed.

- **Nonconsumed** plants – These plants are unpalatable to grazing animals, or they are unavailable for use because of structural or chemical adaptations. They may become abundant if more highly preferred species are removed.

**Toxic plants (denoted in tables and in the database with a superscript t)** – These plants are poisonous to grazing animals. They have various palatability ratings and may or may not be consumed. Toxic plants may become abundant if unpalatable and if the more highly preferred species are removed.

**Injurious plants (denoted in tables and in the database with a superscript i)** – These plants are physically harmful to grazing animals. Specifically, these plants usually have spines or thorns that irritate the mouths or lower legs of domestic livestock. They may be utilized during seasons when they don't present serious harm, so these plants also have a palatability rating.

Many species have more than one forage value according to the season of use. For example, muttongrass (*Poa fendleriana*) is considered preferred by sheep in the spring, but only desirable during the remainder of the year. Northen Navajo agency currently allows for year-round grazing, so a single forage value is needed. The lowest seasonal forage value was chosen for each species as a conservative estimate of the forage available and to avoid overgrazing during times of the year when forage palatability is lowest. Ecosphere used forage values during the least palatable season, usually fall or winter, for sheep. Available forage for cattle would need to be calculated separately.

Each forage group is assigned a harvest efficiency factor. The harvest efficiency factor accounts for production that is actually consumed by grazers. Not all annual production is available for livestock consumption due to trampling, loafing, and other non-livestock factors such as loss to disease, insects, or utilization by wildlife. The harvest efficiency factor is applied to the amount of production within a management area, and its purpose is to ensure watershed protection and sustainability of the range resource by limiting allocation of the available forage.

The harvest efficiency factor generally averages 25 percent on rangelands with continuous grazing (USDA NRCS 2003). Using NRCS guidelines, the harvest efficiency factors applied for this project were 35 percent for preferred plants, 25 percent for desirable species, and 15 percent for undesirable/emergency plants. Non-consumed as well as any toxic and injurious species, regardless of their forage value, were excluded from the calculations. The available forage was calculated from the amount of production provided by preferred, desirable, and undesirable/emergency plants with harvest efficiency applied. Initial stocking rates were calculated from this estimate of available forage.

### 4.2.5 Grazing Area Adjustments

The amount of actual land available for grazing was quantified using geographic information systems (GIS) files from the BIA. Home sites, farmland, and roads were buffered and removed from the total acreage available for livestock grazing. Roads were buffered 1.5 to 15 meters from their center line. Washes and streams were also given a ten foot buffer.

Based on livestock behavior, carrying capacity was adjusted to account for distance to water and the steepness of slopes. Distance to water and slope percent were adjusted incrementally (Table 4-1) Slopes up to ten percent had no reduction in carrying capacity; moderate slopes had a 30 percent reduced carrying capacity, while steep slopes had a 60 reduction in carrying capacity. Slopes that are greater than 60 percent are generally inaccessible to livestock and were excluded from the available grazing acres.

**Table 4-1. Distance to Water Reduction and Slope/Reductions**

| Distance to Water/ Reduction | Slope/Reduction |
|---|---|
| 0-1 Mile/0% | 0-10%/0% |
| 1-2 Miles/50% | 11-30%/30% |
| >2 Miles/100% | 31-60%/60% |
| | >60%/100% |

Livestock will rarely range more than two miles from a water source Holechek (1988). Areas further than 2 miles from a water source can be considered un-grazeable and that acreage should be removed from stocking rate calculations. Permitting in areas beyond two miles will lead to overgrazing and deterioration. However, if permittees are hauling water to their stock, this should be considered when adjusting carrying capacity.

BIA recommendations include 100 percent stocking rates and carrying capacity between zero and one mile from a water source, 50 percent between one and two miles from the water source, and no grazing more than 2 miles from the water source (Table 4-1).

Water sources included windmill and artesian well data supplied by the BIA and wetland data created by Ecosphere for the Navajo Nation Wetland Mapping Project. Monitoring of the condition, addition, or loss of water sources should be continually updated in the geodatabase and resulting stocking rates.

### 4.2.6 Initial Stocking Rates and Carrying Capacity

The initial stocking rate and carrying capacities were calculated by the percentage of ecological sites within each pasture. Carrying capacity for rangeland management purposes is defined as the number of grazing animals that a specified area can support without depleting the forage resources. Carrying capacity may vary annually in response to forage production.

The calculations for carrying capacity are run in a GIS model to calculate the percentage of each ecological site of each soil map unit within each grazing unit. Soil map units that had no transects were not included in the GIS analysis. Carrying capacity numbers are derived by dividing the stocking rate by the total acreage of a given ecological site within a pasture.

Stocking rates represent the number of acres needed to support one sheep unit for 1 year. For this project, yearlong numbers are derived from a BIA-approved animal unit month (AUM) of 790 pounds. The AUM is multiplied by 12 months and the result is divided by the animal unit equivalent in order to derive the amount of forage necessary to support one sheep for a year. The stocking rate is determined by dividing this number by the average amount of available forage in each ecological site within a pasture. Table 4-2 is an example calculation for sheep using an available forage amount of 100 pounds per acre.

**Table 4-2. Example Stocking Rate Calculation**

| Description | Calculation |
|---|---|
| AUM multiplied by 12 months = Amount of forage needed to support one animal unit for a year. | (790 x 12) = 9,480 lbs per year |
| Amount of forage needed to support one animal unit for a year divided by sheep forage equivalent of AUM (4) = Amount of forage to support one sheep for a year. | 9,480/4 = 2,370 lbs per year |
| Amount of forage needed to support one sheep for a year/available forage = Number of acres necessary to provide the yearly forage amount for one sheep (stocking rate). | 2,370/100 lbs per acre = 23.7 acres per year |

Notes: AUM = animal unit month; lbs = pounds.

By law (25 CFR §167), the sheep forage equivalent of one animal unit in Northern Navajo Agency is four sheep. In other words, 790 pounds of forage can support one animal unit per month, or four sheep for a month, as shown in Figure 4.3.

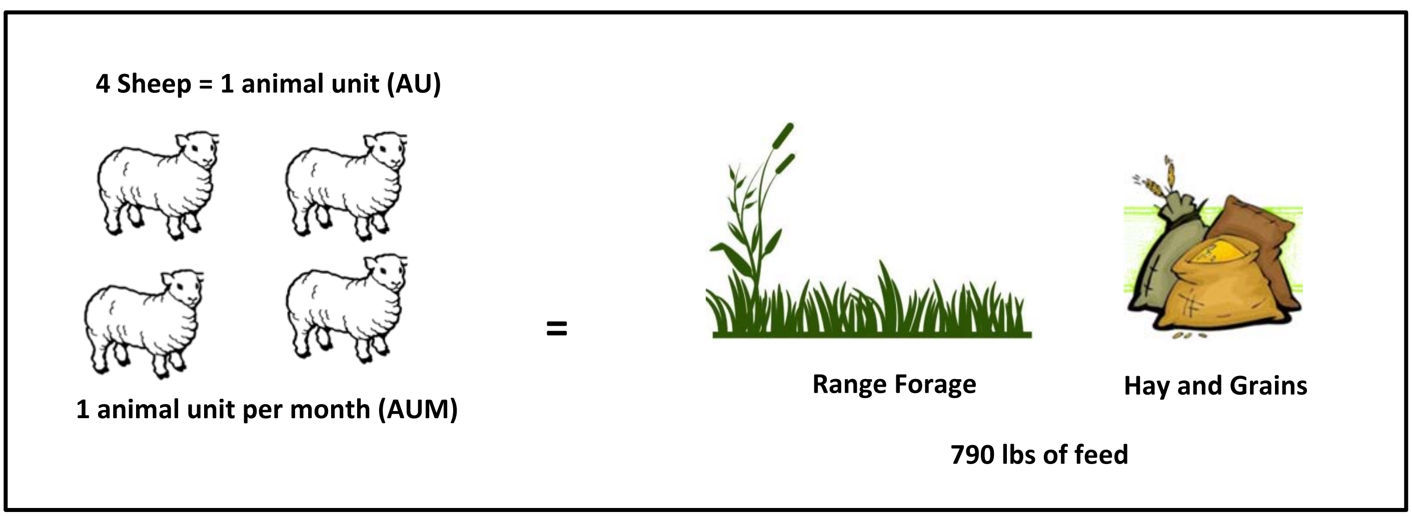



**Figure 4-3. Amount of Forage to Support One Animal Unit (AU).**

# 5. RESULTS

A total of 382 transects were located in the study area, which includes the communities of Aneth, Cudei, and Hogback. The attributes collected at each transect were total annual production, ground cover, and species frequency. From the production data, forage production and initial stocking rates were calculated by ecological sites and soil types in soil map units within each analysis unit. The majority of Aneth transects were analyzed at the community level, but a smaller proportion occurred within four pastures belonging to a Range Management Unit (RMU) and 14 small allotments, plus three containing no transects. The Cudei Community was analyzed as two separate pastures and all Hogback transects were analyzed at the community level.

The total size of the study area is 276,353.9 acres. Areas that were considered non-range were removed from the analysis; these included 13,584.04 acres of roads, home sites, and water as well as acres of slopes over 60 percent, which are considered inaccessible to livestock. There were 15,642.5 acres that could not be analyzed due to a lack of transects within the ecological sites in each analysis unit.

The results of the data analysis indicate the carrying capacity of the range resource is currently exceeded. Currently, there are 173 active grazing permits with a total of 7,846 sheep units year round. Initial calculations show an adjusted carrying capacity of822 initial sheep units year long, 814 sheep units with adjustments for steep slopes, and only 430 sheep units year long with adjustments for slopes and distance to water in the entire study area.

## 5.1 Study Area Summary Results

### Description of Results by Compartment

The results of this study have been arranged into the following categories: initial stocking rates and carrying capacity, available forage, ground cover, and species frequency. An initial description of each category is presented below, followed by a more detailed analysis of each analysis unit.

### Initial Stocking Rates and Carrying Capacity

In general, the derived stocking rates reflect an accurate depiction of available forage. However, in some cases, only one transect was located in an ecological site. If the single transect happened to have extra high or extra low production, the resulting high or low stocking rate was applied to all acres of the ecological site within the analysis unit. In these situations, it may be necessary to gather additional data prior to adjusting animal numbers.

Results include the number of transects in each ecological site in each analysis unit. Sites without transects, and therefore no carrying capacity, can be identified and range managers can collect site-specific data in those areas in order to assess the available forage and calculate carrying capacity.

A carrying capacity is not evenly dispersed across an analysis unit; therefore, it is important to examine the stocking rates of each ecological site to determine which areas may be able to tolerate more livestock and which areas may be exceeding the carrying capacity.

### Available Forage Production

Available forage is the portion of the total reconstructed production classified as preferred, desirable, and emergency forage (excludes toxic, injurious and non-consumed plants). Available forage is used to calculate stocking rates. Forage production is low throughout the study area. The highest average production of available forage is associated with ecological sites R035XB030NM (66 pounds [lbs]/acre), R035XA101AZ (42 lbs/acre), and R035XC326AZ (28 lbs/acre) in the Hogback Community and the R035XC313AZ site (31 lbs/acre) in the Cudei East Pasture.

The ecological site table, in the results section for each analysis unit, presents available forage values and the number of transects for each ecological site, as well as the total grazeable acres, stocking rates, and carrying capacities.

### Frequency and Composition

A list of the most commonly encountered species by transect and the top contributors of biomass production is included in the results section of each analysis unit. The individual species frequency data (by the ten plots within each transect) are included in the electronic database. Several species are repeatedly found in the top five of the frequency and composition data for most of the analysis units. These include prickly Russian thistle (*Salsola tragus*), James' galleta (*Pleuraphis jamesii*), saltlover (*Halogeton glomeratus*), and broom snakeweed (*Gutierrezia sarothrae*).

### Ground Cover

Ground cover values provide a baseline for determining the trend in future studies. An average of all ground cover data for the Land Management District 12 study area is included for comparison (Figure 5-1). The most represented ground cover category across the study area is bare ground. The highest percentage of bare ground was found in the southwest corner of the Cudei West Pasture, the western edge of the Cudei East Pasture, and the southern region of the Hogback Community. Bare ground is of particular concern in Land Management District 12, as much of the area is composed of clay soils that are highly susceptible to water erosion.

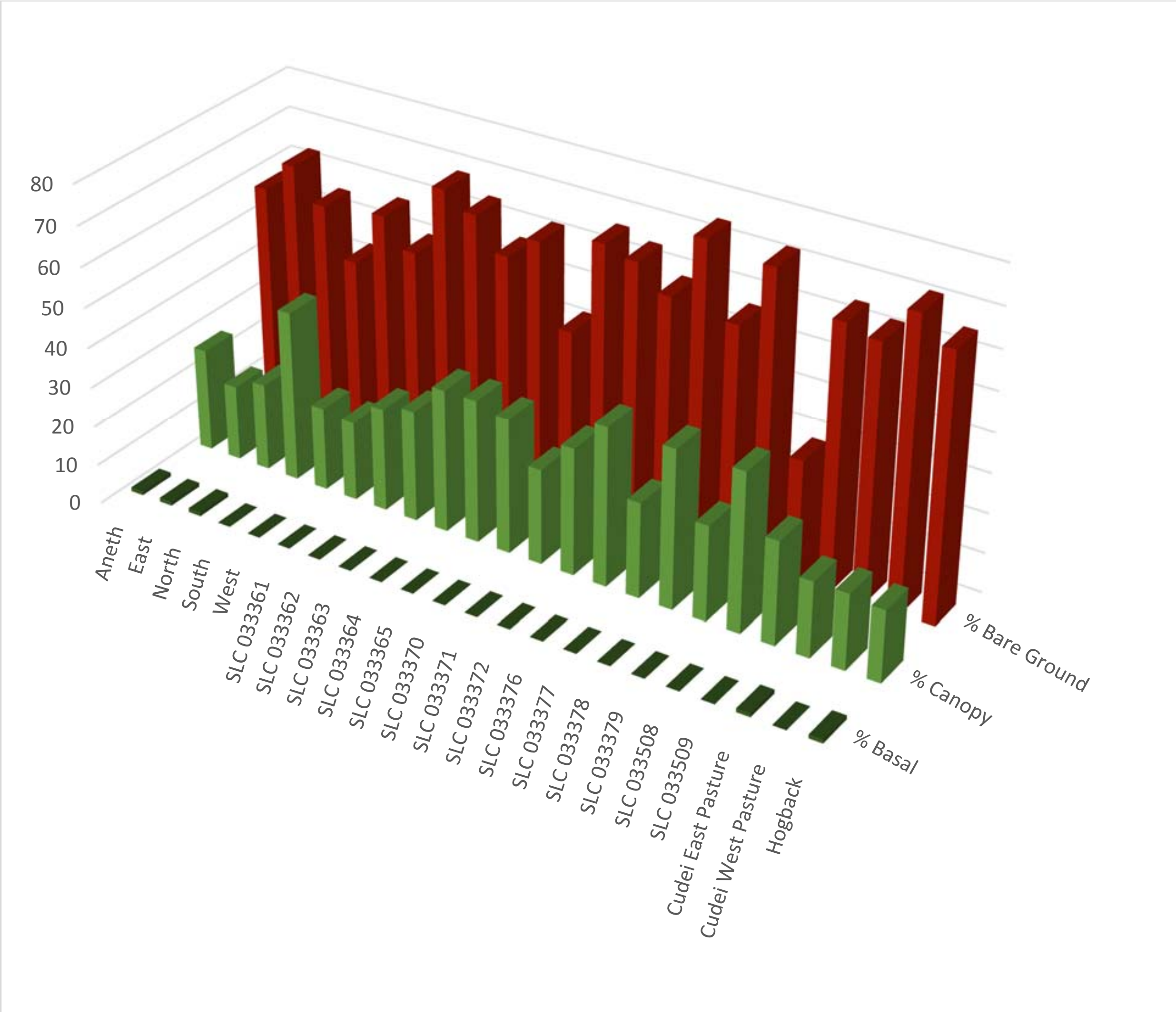



**Figure 5-1. Cover Results for Study Area**

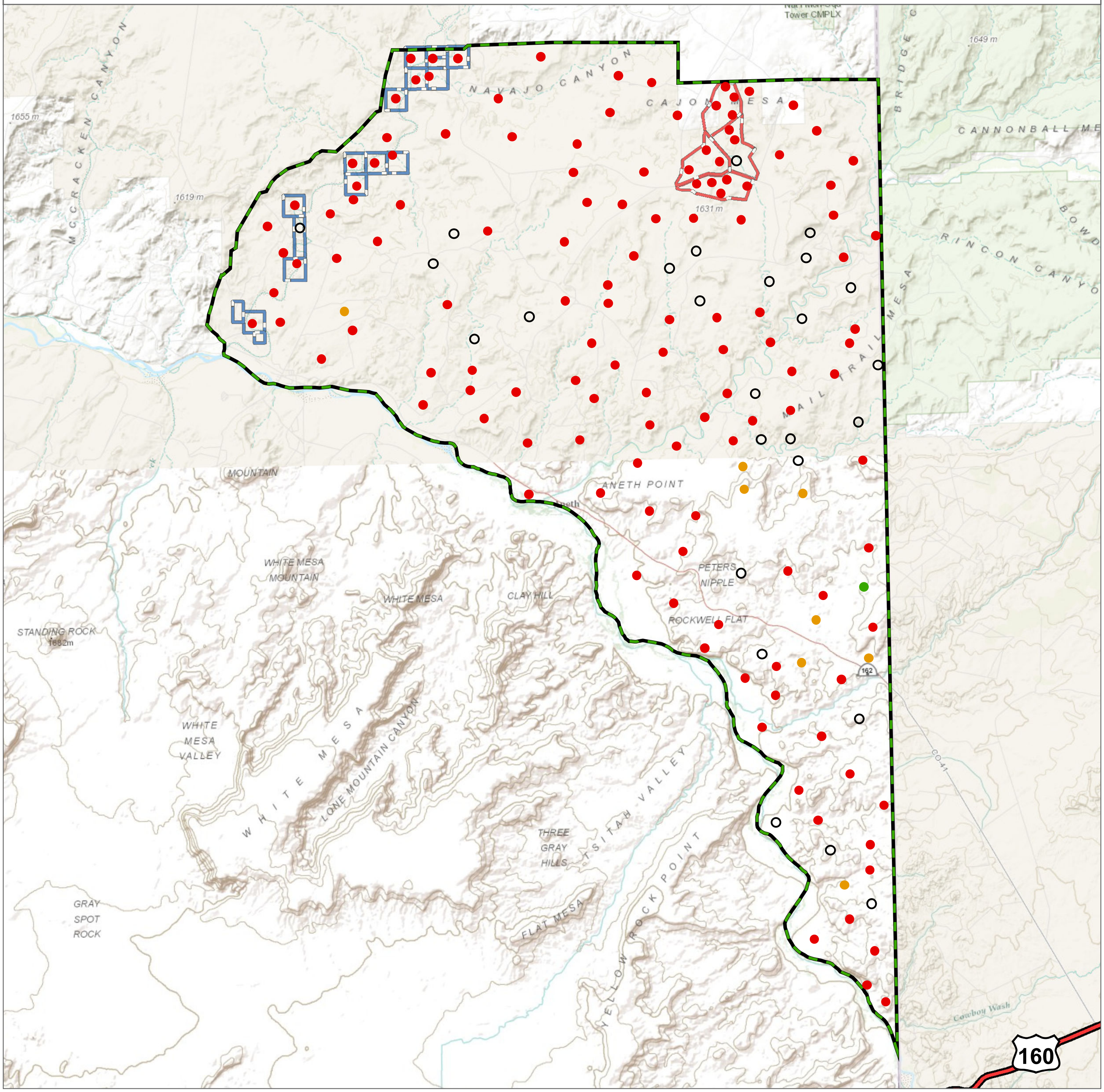
## Similarity Index

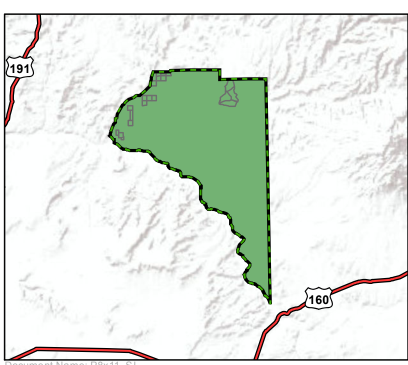
Similarity index is not discussed by analysis unit as it is only relevant to individual transects. The minimum, maximum and median similarity index is presented in the results plates.

Index values are meant to be used as a management tool and do not factor into stocking rate and carrying capacity. For example, a given ecological site may be producing over 2,000 pounds of galleta grass and alkali sacaton. These two grasses are considered to be "available forage," and all of this weight would be factored into the stocking rate and carrying capacity calculations. As a result, both the stocking rate and carrying capacity would be relatively high. However, the reference plant community in the ecological site description may be comprised of a small percentage of the two aforementioned grass species. This would likely result in a low similarity index. In this case, it becomes a management decision as to whether it is more beneficial to manage for the current, high producing plant community or try to establish a plant

# BIA Northern Navajo Agency
# Aneth Chapter, Land Management District 12
# 2014 Range Inventory

**Similarity Index**




Allotment Boundary

RMU Boundary

Community Boundary

**Similarity Index**

No Similarity Index

Poor

Fair

Good

0 1 2 4 6 8 10

Miles

1:200,000

Coordinate System: NAD 1983 UTM Zone 12N

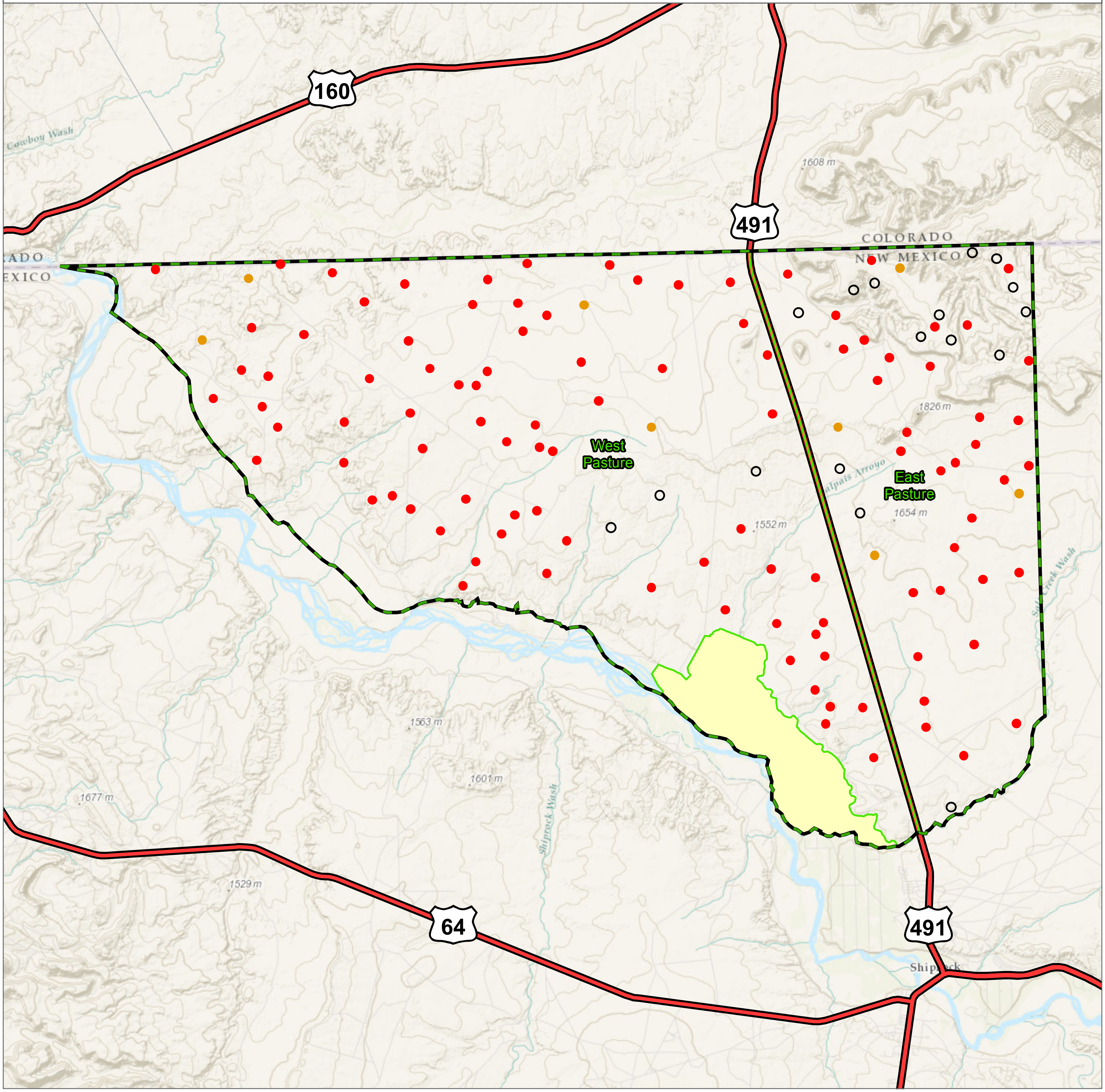
Ecosphere Environmental Services

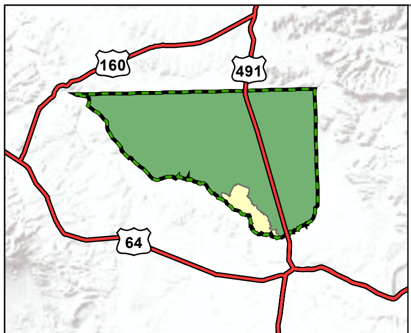
Date: 3/6/2015

Document Name: P8x11_SI

**BIA Northern Navajo Agency**
**Cudei Chapter, Land Management District 12**
**2014 Range Inventory**

**Similarity Index**




Analysis Unit Boundary

Community Boundary

Excluded Area

**Similarity Index**

No Similarity Index

Poor

Fair

0 1 2 4 6 8 10

Miles

1:170,000

Coordinate System: NAD 1983 UTM Zone 12N

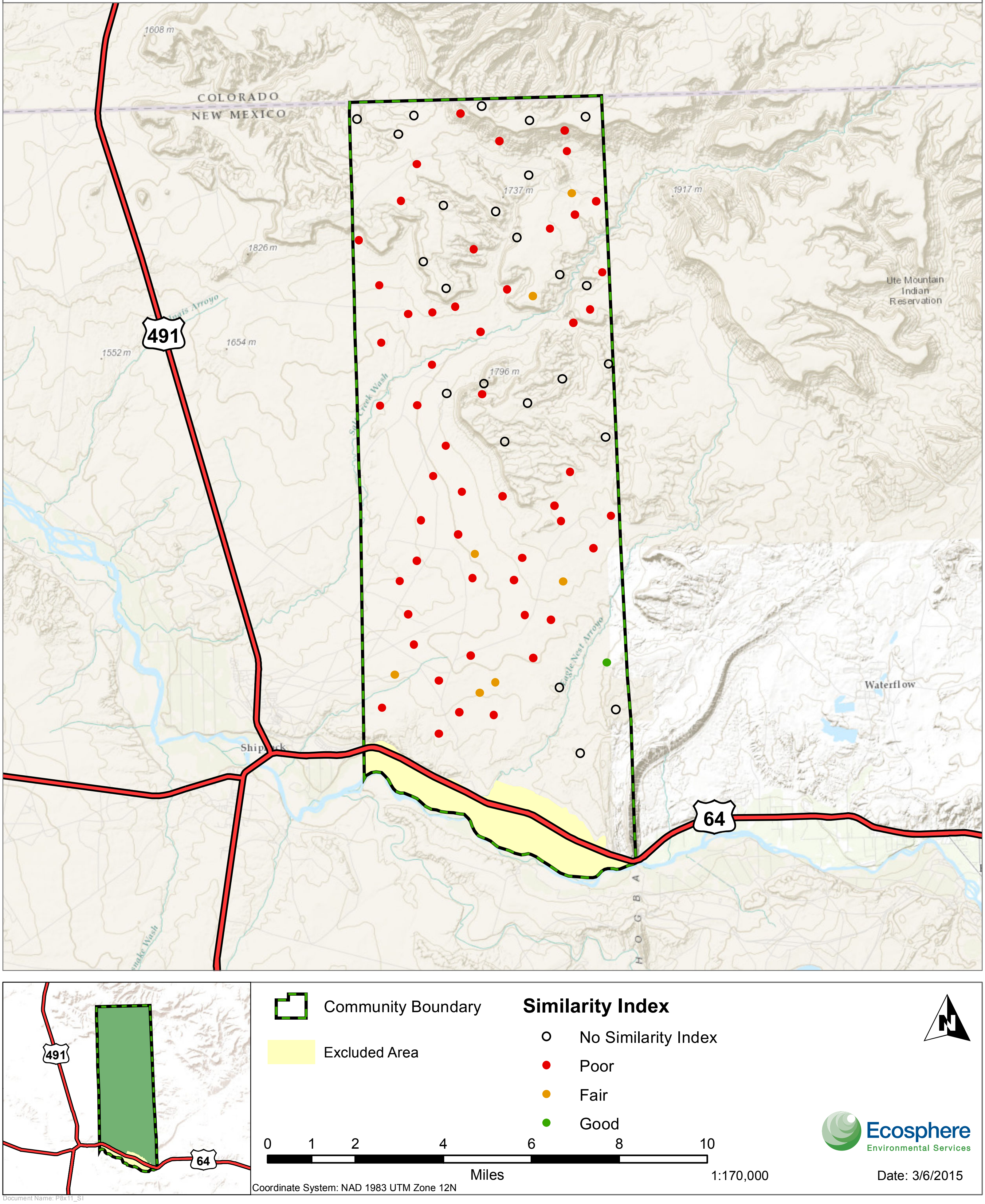
Ecosphere Environmental Services

Date: 3/6/2015

Document Name: P8x11_SI

**BIA Northern Navajo Agency**
**Hogback Chapter, Land Management District 12**
**2014 Range Inventory**

**Similarity Index**



assemblage more similar to the reference community. The benefit of managing toward this community is that the reference community is typically comprised of the suite of species best adapted to the area which, in turn, leads to improved biological functioning such as water retention, soil building, and plant growth. The type of livestock being grazed also should be taken into consideration. For example, if a given reference community is composed primarily of grass species, but the producer is raising sheep, then it would make more sense to manage for a community that contains a mix of grasses, forbs, and shrubs.

An overall map of similarity indices for each Community in the study area are on the following pages. When an ecological site description was not available, no similarity index could be calculated. A poor similarity index ranged from 0 to 25 percent, and a fair similarity index ranged from 26 to 50 percent. A similarity index considered good ranged from 51-75 percent. There were no excellent (greater than 75 percent) similarity indices.

### Results by Analysis Unit

The following sections provide a brief discussion of the results and current plant communities found in each analysis unit. This is followed by a plate displaying acreage summaries, cover calculations, similarity index, and initial and adjusted carrying capacity for each ecological site. Maps are also included of each area, showing soils, transect locations, slopes and distance to water.

## 5.2 Aneth

Aneth Community was analyzed separately without data from allotments or RMU pastures.

### 5.2.1 Aneth

**Ecological Site Summary**

The Aneth Community is located in Utah with the San Juan River making up the southern border, Montezuma Creek forming the western border, and McElmo Creek comprising much of the eastern border. It has 112,220 grazeable acres and 139 transects within eight ecological sites.

Available forage is quite low throughout the community. The highest reported amount is from the R035XY215UT ecological site. This site occupies the tops of the low mesas found in the northern part of the community. Soils tend to be deep, well drained, and composed of sandy loam. The reference plant community is characterized by winterfat (*Krascheninnikovia lanata*) and fourwing saltbush (*Atriplex canescens*) in the overstory and a mix of cool and warm season grasses in the understory. Fourwing saltbush is often more common at higher elevations, such as the mesa tops, while winterfat is more prevalent in valley bottoms and the lower slopes of mesas. As the site deteriorates, non-native species, especially annual forbs and grasses, invade and shrubs tend to increase. Prolonged disturbance eventually leads to a plant community composed primarily of annual species. At the time of this study, the plant community was in a degraded condition. Several invasive species were encountered including prickly Russian thistle (*Salsola tragus*), saltlover (*Halogeton glomeratus*), and cheatgrass (*Bromus tectorum*). Both prickly Russian thistle and saltlover are toxic to livestock and are difficult to control. Cheatgrass seedheads can be injurious to livestock after they have dried and this species is also hard to control once it has become established. Production from beneficial species is low, but species diversity is fairly high. Available forage is mostly from shrub species like Stansbury cliffrose (*Purshia stansburiana*), Utah serviceberry (*Amelanchier utahensis*), and fourwing saltbush. The primary forage grass is Indian ricegrass (*Achnatherum hymenoides*).

The Badland site has the highest carrying capacity, but this is due to the fact that it is widely represented in the Aneth Community. Average available forage is only 6 pounds per acre and nearly 400 acres are required to support one sheep unit for one year. This site does not have a written ecological site description, but even in relatively undisturbed states, annual forage production tends to be low. The transects located in badland areas revealed scarce vegetation with large amounts of bare ground and rock. Primary species found include James' galleta (*Pleuraphis jamesii*), mound saltbush (*Atriplex obovata*), winterfat, alkali sacaton (*Sporobolus airoides*), and desert needlegrass (*Achnatherum speciosum*). Invasive species were not observed during the survey.

The R035XY012UT ecological site comprises 2,000 acres of the Aneth community, but at the time of the study did not have any available forage. The site is found along semi-wet, saline stream banks which includes some of the braided channels along the San Juan River. Dominant species in the reference plant community are alkali sacaton, saltgrass (*Distichlis spicata*), and coyote willow (*Salix exigua*). Production in the current plant community is being supplied primarily from black greasewood (*Sarcobatus vermiculatus*), prickly Russian thistle, and seepweed (*Suaeda* sp.). A small amount of saltlover was also recorded from one transect.

The highest similarity index values are almost exclusively associated from the R035XY118UT site. This site is commonly found in valley bottoms and associated toe slopes. Soils are well-drained and sandy and dominant species in the reference plant community include Indian ricegrass, James' galleta, and fourwing saltbush. The main species in the current plant community that are most responsible for the higher similarity values are James' galleta and Indian ricegrass.

### *Frequently Encountered Species*

1. prickly Russian thistle (*Salsola tragus*) (occurred on 88% of all transects)
2. James' galleta (*Pleuraphis jamesii*) (occurred on 76% of all transects)
3. broom snakeweed (*Gutierrezia sarothrae*) (occurred on 54% of all transects)
4. shadscale (*Atriplex confertifolia*) (occurred on 31% of all transects)
5. saltlover (*Halogeton glomeratus*) (occurred on 29% of all transects)
6. cheatgrass (*Bromus tectorum*) (occurred on 29% of all transects)

### *Species by Weight*

1. prickly Russian thistle (*Salsola tragus*) (128 lbs/acre)
2. James' galleta (*Pleuraphis jamesii*) (17 lbs/acre)
3. Saltlover (*Halogeton glomeratus*) (10 lbs/acre)
4. Broom snakeweed (*Gutierrezia sarothrae*) (7 lbs/acre)
5. Mound saltbush (*Atriplex obovata*) ( 6 lbs/acre)

### Ground Cover

The percentage of bare ground in the Aneth Community is high, but below the study area average. Foliar canopy cover is a little below average, while percent basal is above average. The majority of advanced erosion is occurring in the southeast corner of the community.

**Analysis Unit** Aneth **Chapter** Aneth

## Summary of Grazeable and Non-Grazeable Acres in Analysis Unit

| | | |
|---|---|---|
| Chapter Acres | | 121,585.00 |
| Analysis Unit Acres | | 117,218.20 |
| Non-Grazeable Acres | Developed | 860.70 |
| | Hydro | 868.98 |
| | Roads | 1,983.70 |
| | Slope>60 | 1,285.30 |
| Total Grazeable Acres | | 112,219.52 |

## Summary of Similarity Indices, Cover, and Carrying Capacity within Anlysis Unit

| Similarity Indices (%) | |
|---|---|
| Minimum | 0 |
| Maximum | 72 |
| Median | 7 |

| Cover (%) | |
|---|---|
| Foliar Cover | 26.00 |
| Bare Ground | 57.00 |
| Basal | 1.00 |

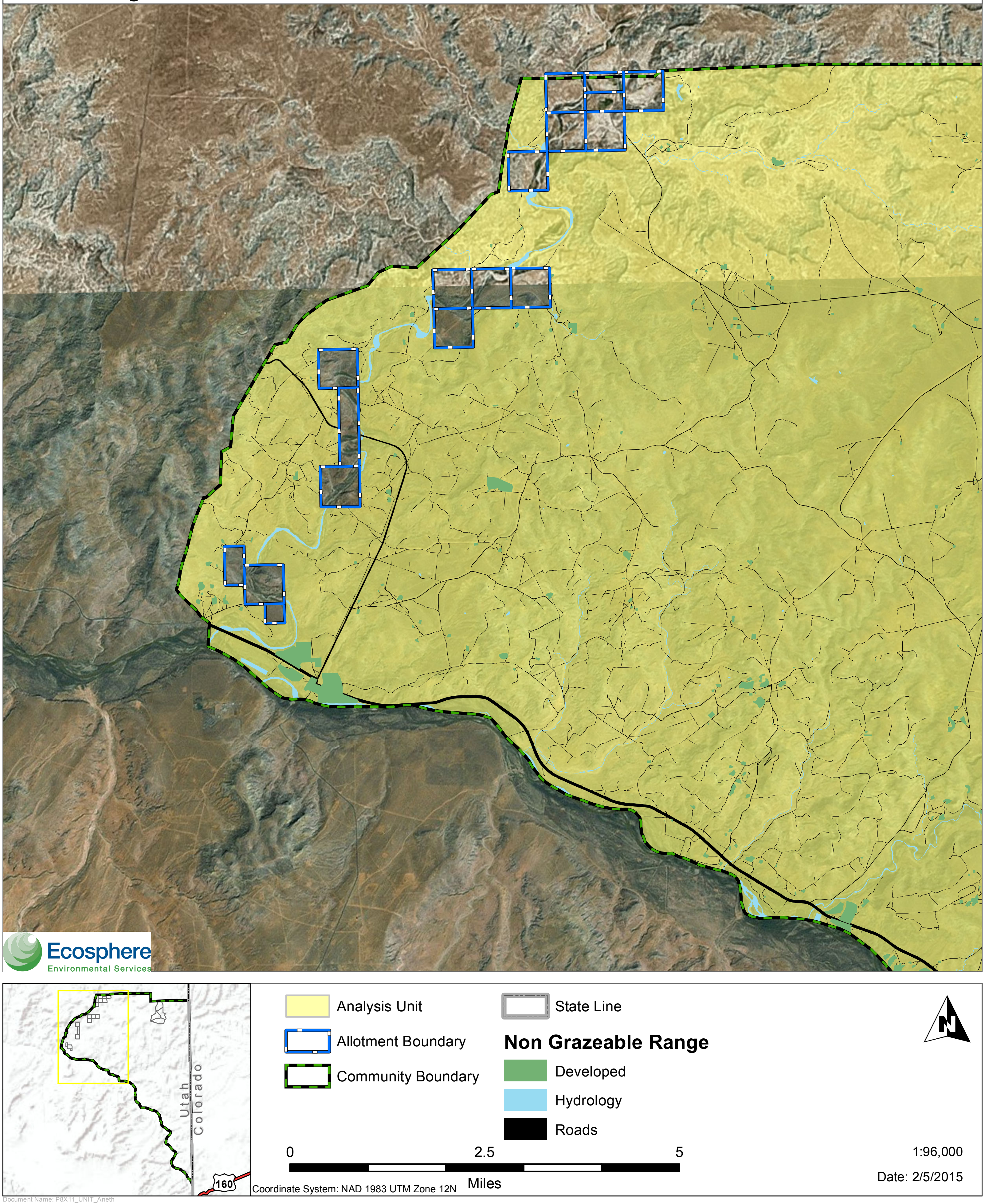
| Carrying Capacity (Sheep Units/Year) | |
|---|---|
| Initial CC | 296.72 |
| Slope Adjusted CC | 291.12 |
| DTW Adjusted CC | 249.12 |

## Results by Ecological Site in Sheep Units Year Long

| Ecological Site | Number of Transects | Percent of Analysis Unit Acres | Available Forage (Lbs/Acre) | Initial Grazeable Acres | Sheep Stocking Rate (Acres/ Sheep Unit) | Initial Sheep Carrying Capacity (Sheep Units/Year) |
|---|---|---|---|---|---|---|
| Badland | 15 | 32 | 6.08 | 37,794.90 | 389.80 | 96.96 |
| R035XY006UT Alkali Fan (Castlevalley Saltbush) | 10 | 6 | 3.13 | 7,221.90 | 757.19 | 9.54 |
| R035XY012UT Semiwet Saline Streambank (Fremont Cottonwood) | 2 | 2 | 0.00 | 1,999.40 | | |
| R035XY109UT Desert Loam (Shadscale) | 63 | 25 | 5.13 | 29,603.80 | 461.99 | 64.08 |
| R035XY118UT Desert Sandy Loam (Fourwing Saltbush) | 31 | 16 | 7.70 | 19,220.40 | 307.79 | 62.45 |
| R035XY215UT Semidesert Sandy Loam (Fourwing Saltbush) | 9 | 4 | 13.86 | 4,765.00 | 171.00 | 27.87 |
| Rock Outcrop | 1 | <1 | 6.02 | 663.50 | 393.69 | 1.69 |
| Shallow or very shallow soils | 7 | 8 | 8.59 | 9,415.60 | 275.90 | 34.13 |
| Naki | 0 | <1 | | 169.42 | | |
| OtherSoils | 0 | <1 | | 158.83 | | |
| Shepherd | 0 | <1 | | 9.46 | | |
| Tohona variant | 0 | <1 | | 502.10 | | |
| Riverwash | 0 | <1 | | 249.92 | | |
| Sheppard | 0 | <1 | | 383.70 | | |
| Sogzie | 0 | <1 | | 431.16 | | |
| Water | 0 | <1 | | 594.69 | | |
| Whit | 0 | <1 | | 320.98 | | |

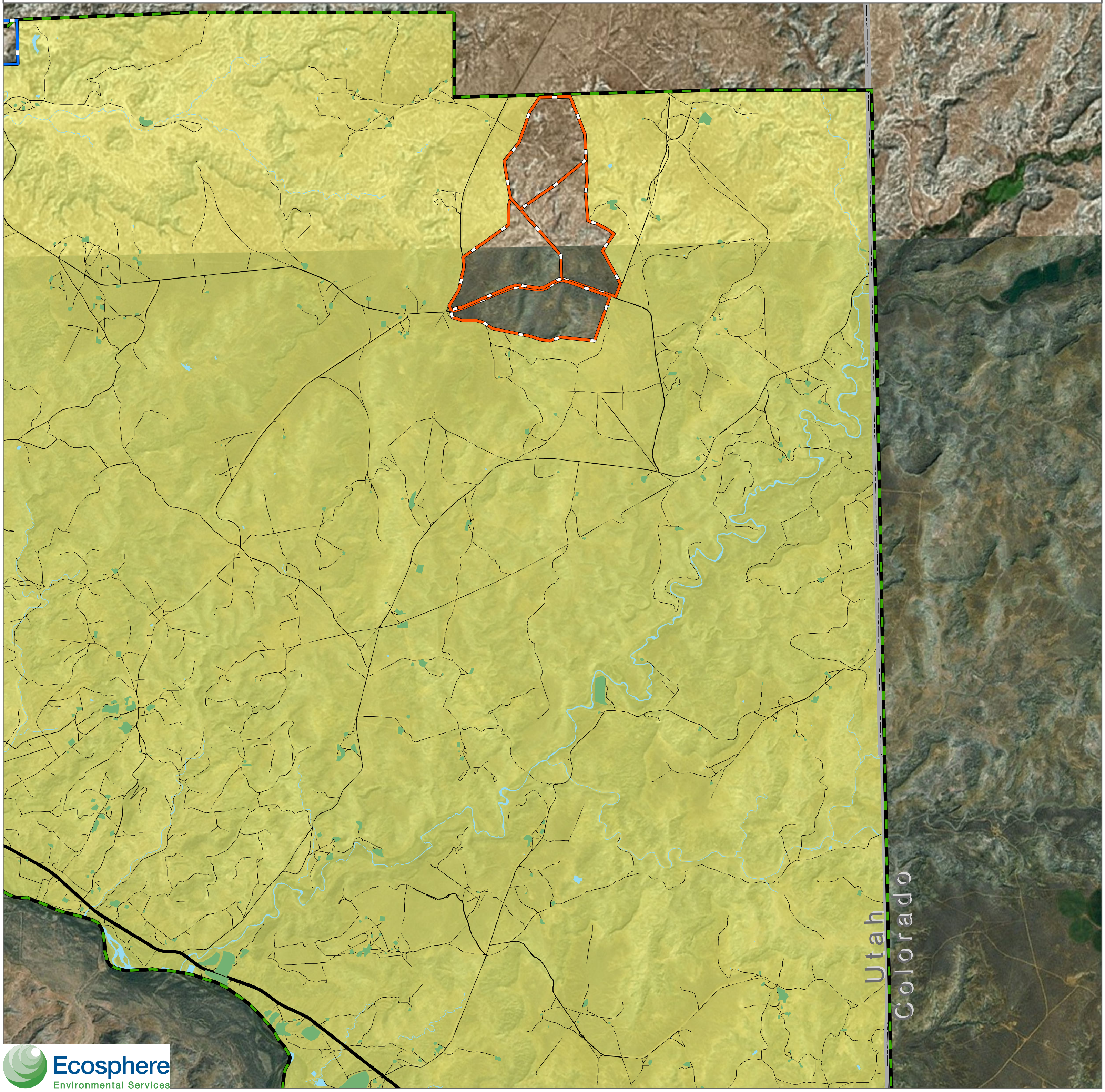
# 2014 Range Inventory
# BIA Northern Navajo Agency
# Land Management District 12

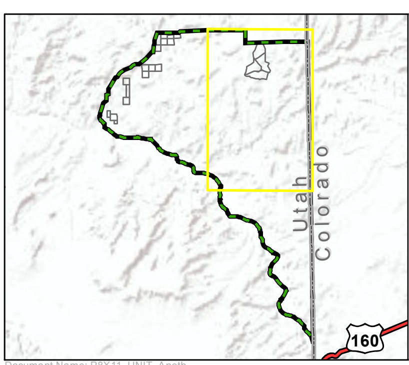
**Aneth Community**
**Northwest Portion**



# 2014 Range Inventory
# BIA Northern Navajo Agency
# Land Management District 12

**Aneth Community**
**Northeast Portion**




Analysis Unit

RMU Boundary

Allotment Boundary

Community Boundary

State Line

**Non Grazeable Range**

Developed

Hydrology

Roads

0 2.5 5

Miles

Coordinate System: NAD 1983 UTM Zone 12N

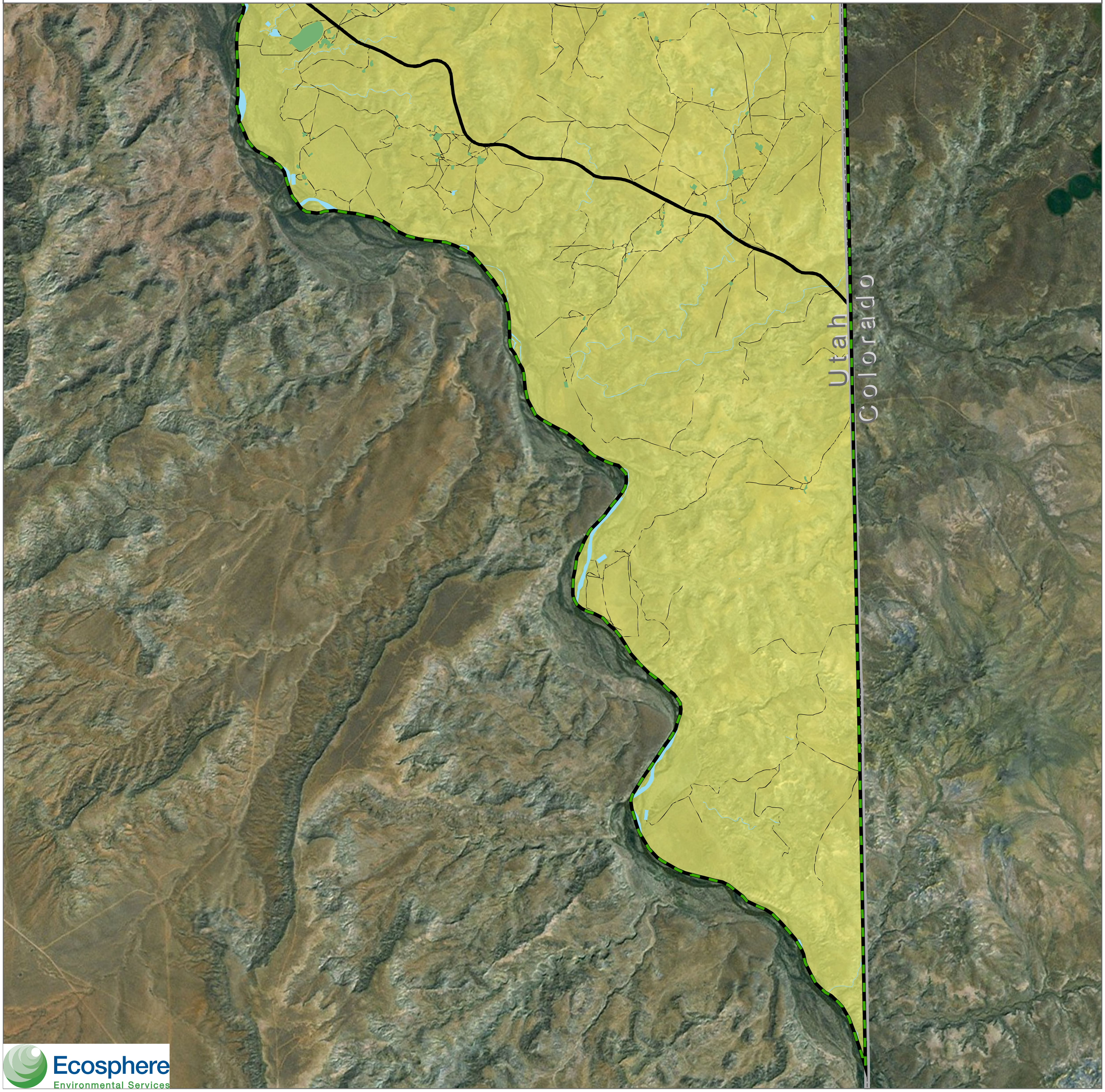
1:96,000

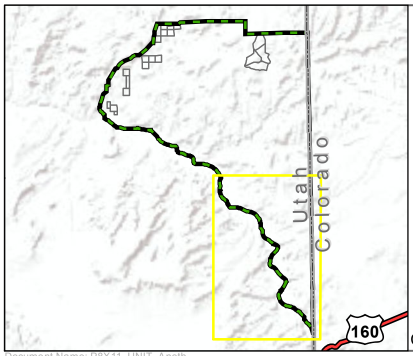
Date: 2/5/2015

Document Name: P8X11_UNIT_Aneth

# 2014 Range Inventory
# BIA Northern Navajo Agency
# Land Management District 12

**Aneth Community**
**South Portion**




Analysis Unit

Community Boundary

State Line

**Non Grazeable Range**

Developed

Hydrology

Roads

0 2.5 5

Miles

1:96,000

Date: 2/5/2015

Coordinate System: NAD 1983 UTM Zone 12N

Document Name: P8X11_UNIT_Aneth

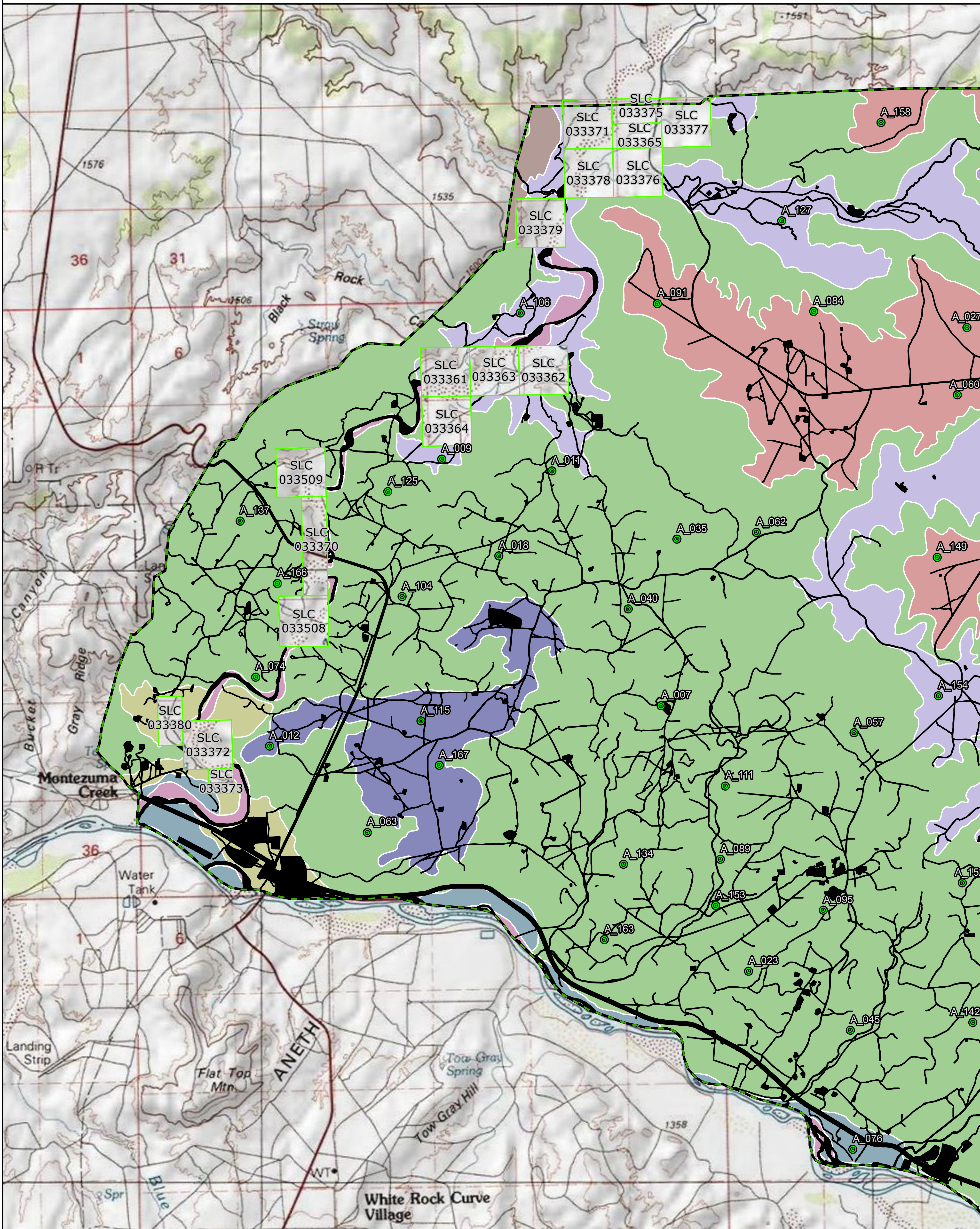
**2014 Range Inventory**
**BIA Northern Navajo Agency**
**Land Management District 12**

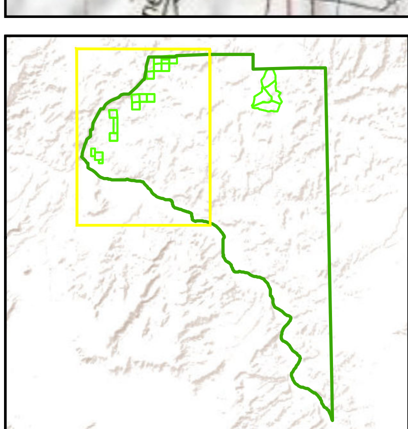
**Aneth Community, Northwest Portion**

Total Acres: 117,218
Grazeable Acres*: 112,220
*Total acres minus non grazeable areas and areas with > 60% slope.

Initial Annual Carrying Capacity:
37 Sheep

-



Transect Location

Non Grazeable Range

Analysis Unit Boundary

Soil Map Units

Community Boundary

N

Ecosphere Environmental Services

0 1 2
Miles

1:60,000

Date: 2/9/2015

Coordinate System: NAD 1983 UTM Zone 12N

Document Name: P11X17_Soils_InitialCC_Aneth1

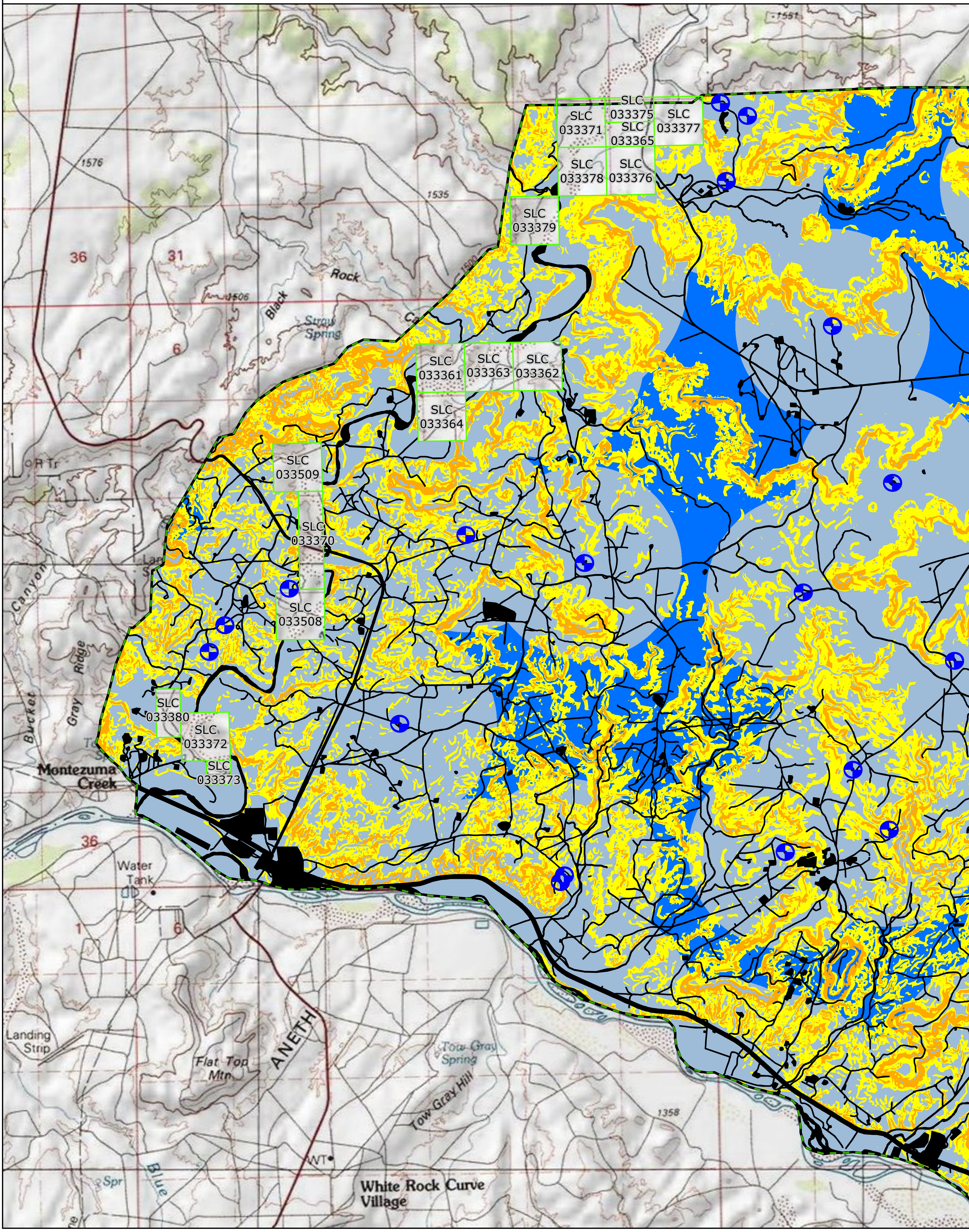
**2014 Range Inventory**
**BIA Northern Navajo Agency**
**Land Management District 12**

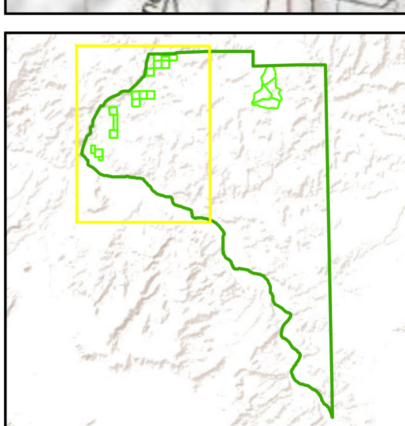
Total Acres: 117,218
Grazeable Acres*: 112,220
*Total acres minus non grazeable areas and areas with > 60% slope.

Adjusted Annual Carrying Capacity:
27 Sheep

**Aneth Community, Northwest Portion**

-



Water Source
Analysis Unit Boundary
Community Boundary
Non Grazeable Range

**Distance to Water**
0-1 Mile
1-2 MIles
> 2 Miles

**Slope**
10 - 30%
30 - 60%
>60%

0 1 2
Miles

Coordinate System: NAD 1983 UTM Zone 12N

1:60,000

Ecosphere Environmental Services

Date: 2/9/2015

Document Name: P11X17_Slope_AdjCC_Aneth1

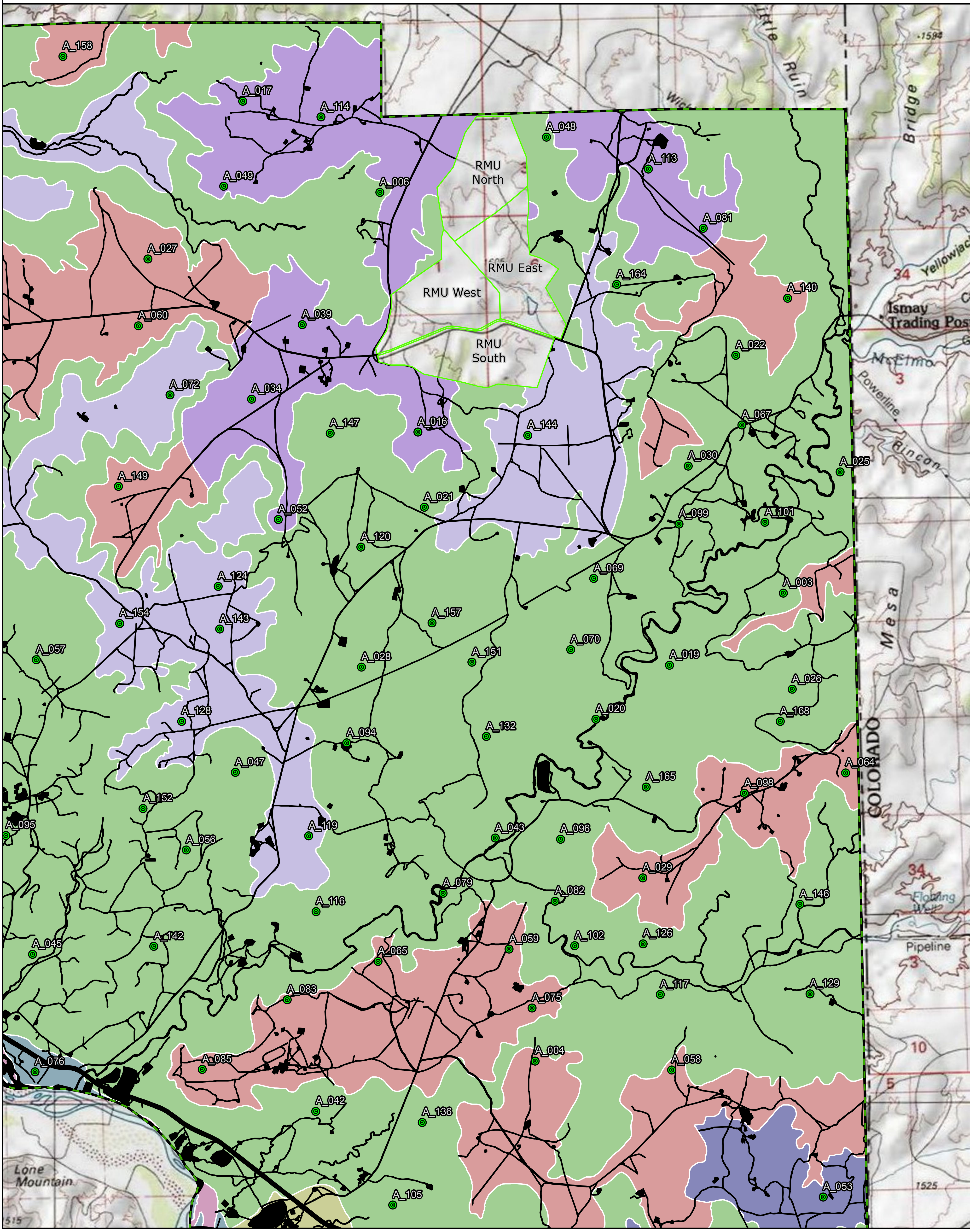
**2014 Range Inventory**
**BIA Northern Navajo Agency**
**Land Management District 12**

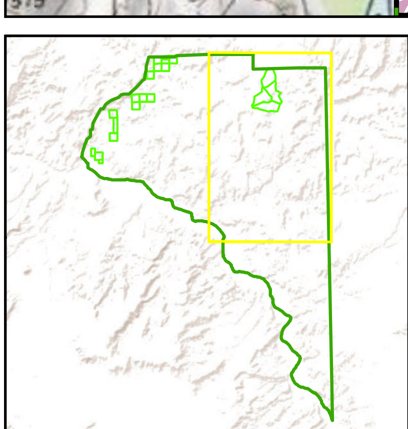
**Aneth Community, Northeast Portion**

Total Acres: 117,218
Grazeable Acres*: 112,220
*Total acres minus non grazeable areas and areas with > 60% slope.

Initial Annual Carrying Capacity:
37 Sheep

-



Transect Location

Non Grazeable Range

Analysis Unit Boundary

Soil Map Units

Community Boundary

0 1 2
Miles

Coordinate System: NAD 1983 UTM Zone 12N

Ecosphere Environmental Services

1:60,000

Date: 2/9/2015

Document Name: P11X17_Soils_InitialCC_Aneth1

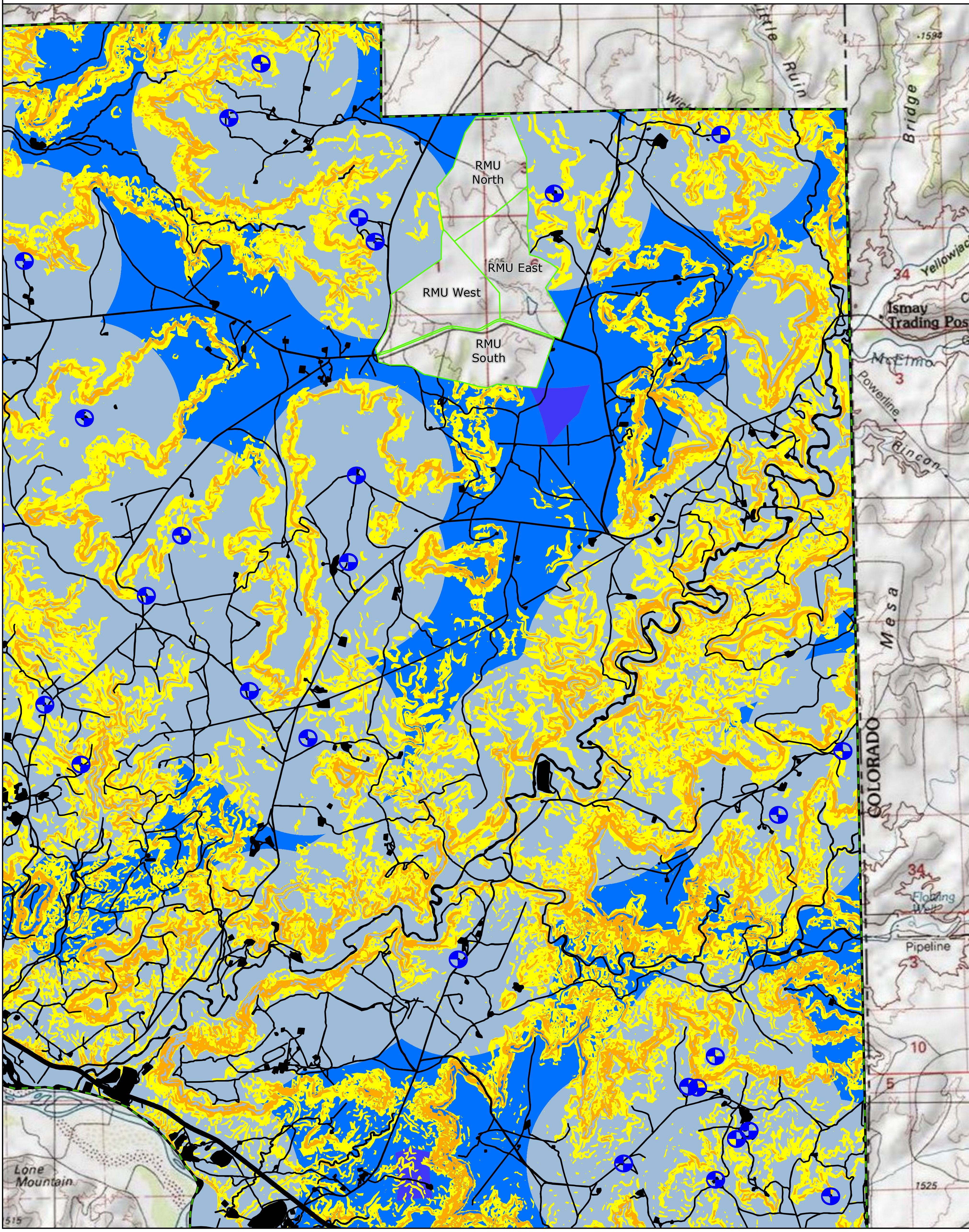
**2014 Range Inventory**
**BIA Northern Navajo Agency**
**Land Management District 12**

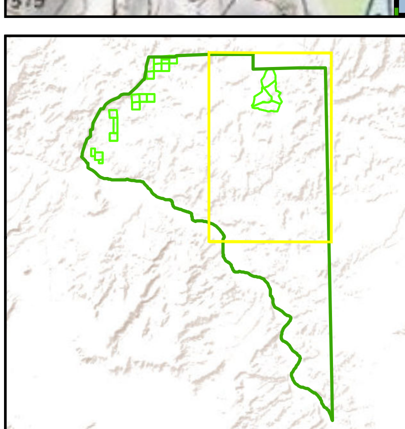
**Aneth Community, Northeast Portion**

Total Acres: 117,218
Grazeable Acres*: 112,220
*Total acres minus non grazeable areas and areas with > 60% slope.

Adjusted Annual Carrying Capacity:
27 Sheep

-



Water Source
Analysis Unit Boundary
Community Boundary
Non Grazeable Range

**Distance to Water**
0-1 Mile
1-2 MIles
> 2 Miles

**Slope**
10 - 30%
30 - 60%
>60%

Ecosphere Environmental Services

0 1 2
Miles

1:60,000

Date: 2/9/2015

Coordinate System: NAD 1983 UTM Zone 12N

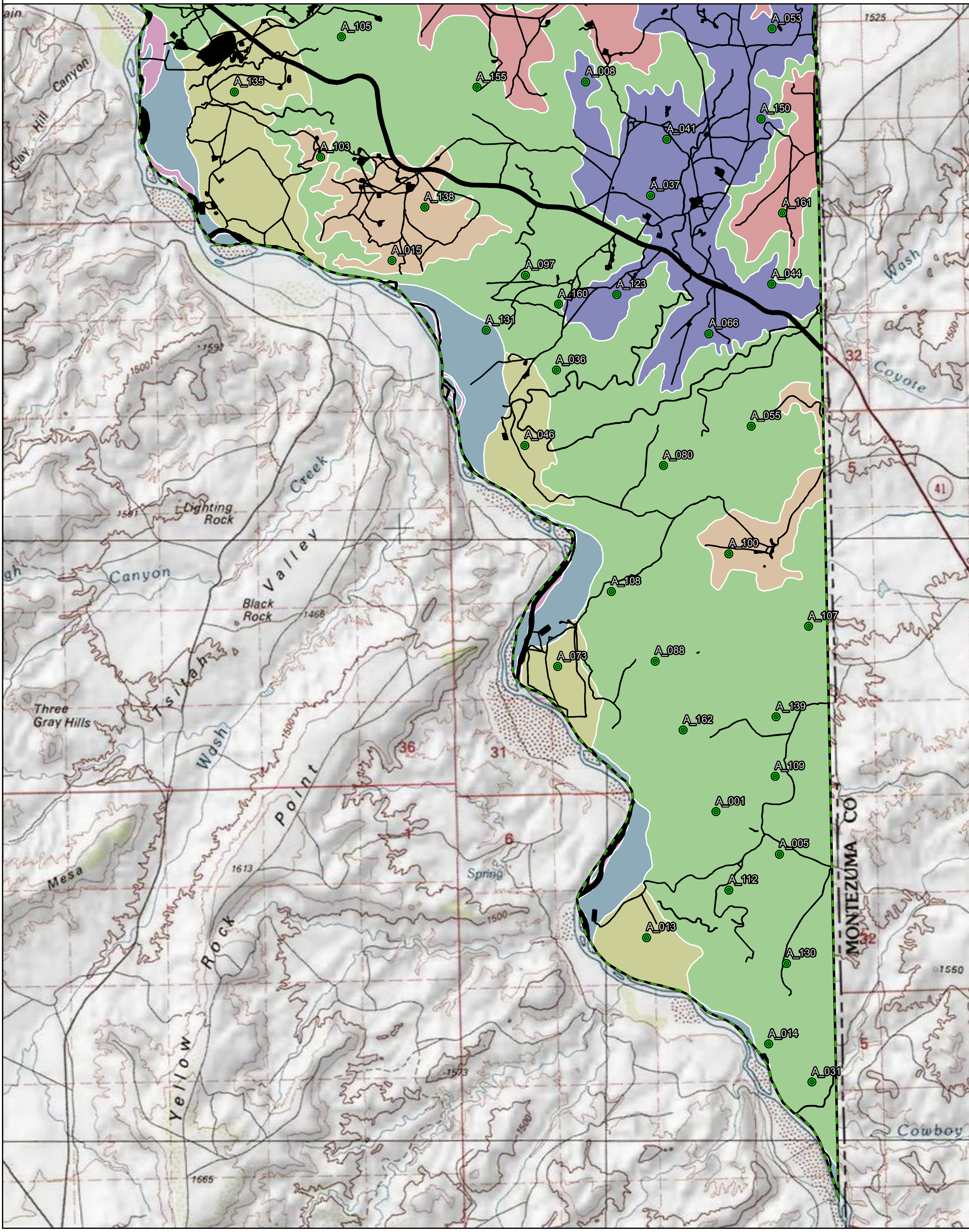
Document Name: P11X17_Slope_AdjCC_Aneth1

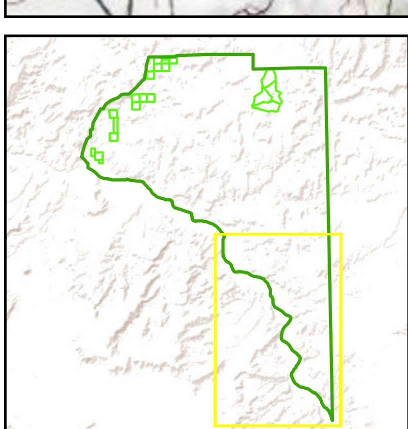
**2014 Range Inventory**
**BIA Northern Navajo Agency**
**Land Management District 12**

**Aneth Community, South Portion**

Total Acres: 117,218
Grazeable Acres*: 112,220
*Total acres minus non grazeable areas and areas with > 60% slope.

Initial Annual Carrying Capacity: 37 Sheep



- Transect Location
- Analysis Unit Boundary
- Community Boundary
- Non Grazeable Range
- Soil Map Units

0 1 2
Miles

1:60,000

Coordinate System: NAD 1983 UTM Zone 12N

Ecosphere Environmental Services

Date: 2/9/2015

Document Name: P11X17_Soils_InitialCC_Aneth1

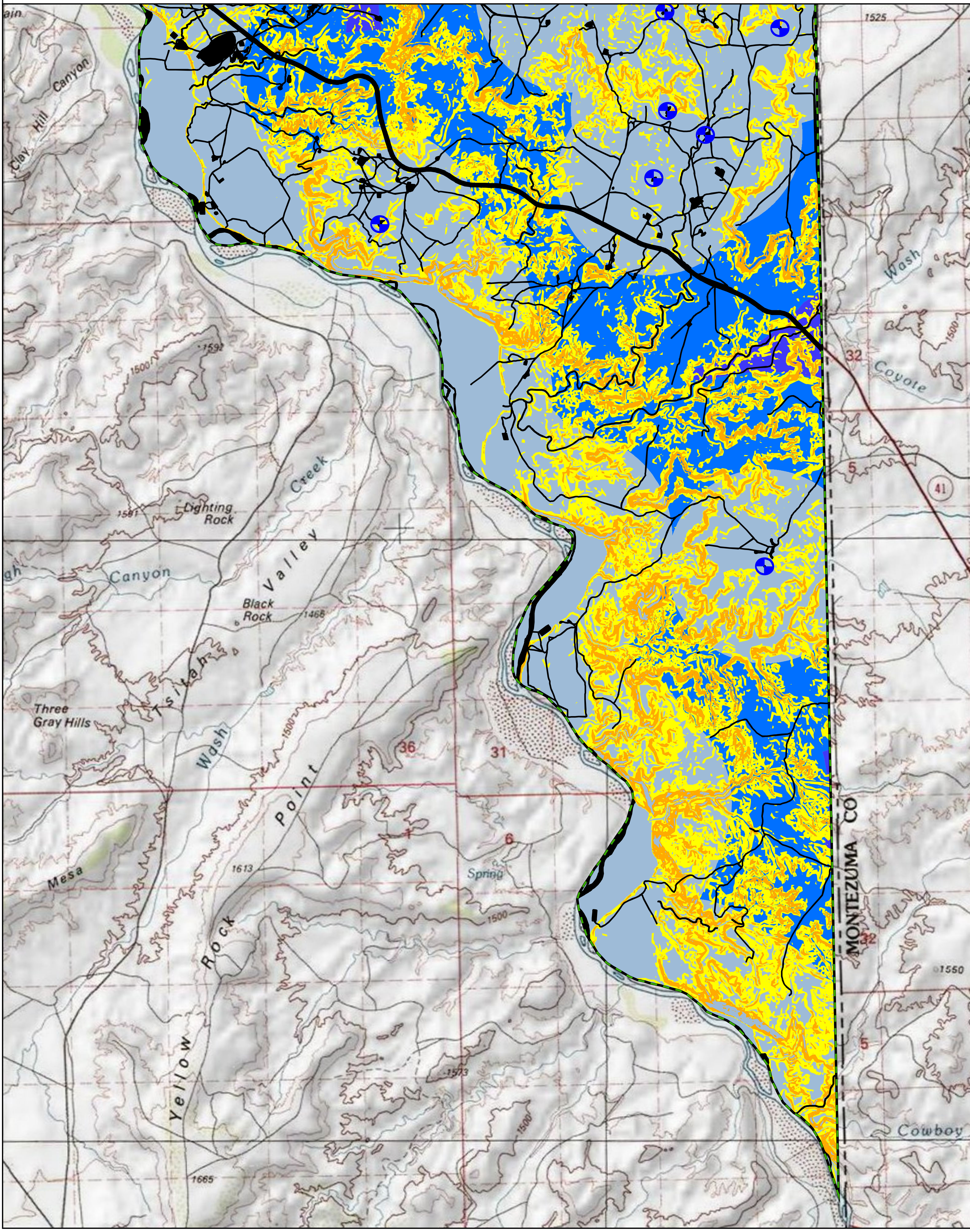
**2014 Range Inventory**
**BIA Northern Navajo Agency**
**Land Management District 12**

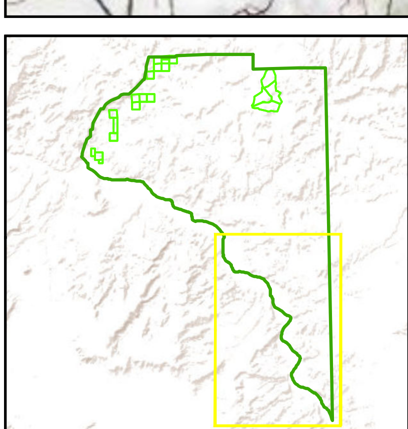
**Aneth Community, South Portion**

Total Acres: 117,218
Grazeable Acres*: 112,220
*Total acres minus non grazeable areas and areas with > 60% slope.

Adjusted Annual Carrying Capacity:
27 Sheep

-



Water Source
Analysis Unit Boundary
Community Boundary
Non Grazeable Range

**Distance to Water**
0-1 Mile
1-2 MIles
> 2 Miles

**Slope**
10 - 30%
30 - 60%
>60%

0 1 2
Miles

1:60,000

Coordinate System: NAD 1983 UTM Zone 12N

Ecosphere Environmental Services

Date: 2/9/2015

Document Name: P11X17_Slope_AdjCC_Aneth1

### 5.2.2 Allotments

The northwest corner of the Aneth Community contains a group of 17 small allotments. Fourteen of these allotments received one transect each; the remaining three allotments do not contain transects. Collectively, the allotments contain 2,164 grazeable acres and have three analyzed ecological sites.

The largest ecological site is the R035XY006UT site. This site occupies areas of fans and terraces with sodium affected soils. The reference plant community is fairly diverse and contains species like James' galleta (*Pleuraphis jamesii*), Indian ricegrass (*Achnatherum hymenoides*), dropseed (*Sporobolus* spp.), desert trumpet (*Eriogonum inflatum*), shadscale (*Atriplex confertifolia*), and valley saltbush (*Atriplex cuneata*). Overgrazing leads to a decrease in perennial grasses and valley saltbush and increases the likelihood of invasion by exotic annuals, such as saltlover (*Halogeton glomeratus*), prickly Russian thistle (*Salsola tragus*), and cheatgrass (*Bromus tectorum*). At the time of this study, available forage was very limited and being produced primarily from mound saltbush (*Atriplex obovata*) and fourwing saltbush (*Atriplex canescens*). The majority of total production is from black greasewood (*Sarcobatus vermiculatus*) and prickly Russian thistle. Cheatgrass and saltlover were also detected, but these invasive species are not yet well established in the plant community.

The second most represented site is the R035XY109UT site. Deep, well-drained soils and warm season grasses mixed with shadscale are typical of the reference state. Unmanaged grazing will cause rabbitbrush (*Chrysothamnus* spp.), broom snakeweed (*Gutierrezia sarothrae*), and annual species to increase and perennial grasses to decrease. Shadscale is fairly resistant to grazing, but high intensity grazing can damage individual plants. On all three transects that fell within this ecological site, prickly Russian thistle is a main component of the sampled plant community and bare ground is abundant. Other common species include shadscale, rubber rabbitbrush (*Ericameria nauseosa*), black greasewood, whitestem blazingstar (*Mentzelia albicaulis*), and Mojave seablite (*Suaeda moquinii*).

The final analyzed site is the Badland site, which contains only one transect. This site does not have a written ecological site description, but even in relatively undisturbed states, annual forage production tends to be low. At the time of the study, available forage was extremely low and primarily from rubber rabbitbrush. Most production on the transect is from prickly Russian thistle, broom snakeweed, and shadscale.

Similarity index values are all very low, the highest being 19 percent similar, in the allotments. The highest values were reported from the R035XY006UT site and the species contributing allowable production consist mostly of black greasewood and Mojave seablite.

#### *Frequently Encountered Species*

1. prickly Russian thistle (*Salsola tragus*) (occurred on 93% of all transects)
2. western tansymustard (*Descurainia pinnata*) (occurred on 71% of all transects)
3. black greasewood (*Sarcobatus vermiculatus*) (occurred on 71% of all transects)
4. cryptantha (*Cryptantha sp.*) (occurred on 50% of all transects)
5. mound saltbush (*Atriplex obovata*) (occurred on 43% of all transects)

### *Species by Weight*

1. prickly Russian thistle (*Salsola tragus*) (132 lbs/acre)
2. black greasewood (*Sarcobatus vermiculatus*) (55 lbs/acre)
3. Mojave seablite (*Suaeda moquinii*) (18 lbs/acre)
4. mound saltbush (*Atriplex obovata*) (6 lbs/acre)
5. shadscale (*Atriplex confertifolia*) (4 lbs/acre)

### Ground Cover

The amount of bare ground is variable throughout the allotments, with some having a relatively low amount and others averaging close to 80 percent. Foliar canopy cover values are clustered closer to the study area average and basal hits were all less than one percent. Wind and water erosion ranges from slight to moderate.

| Analysis Unit | SLC 033361 | Chapter | Aneth |
|---|---|---|---|

## Summary of Grazeable and Non-Grazeable Acres in Analysis Unit

| | | |
|---|---|---|
| Chapter Acres | | 121,585.00 |
| Analysis Unit Acres | | 159.79 |
| Non-Grazeable Acres | Developed | 0.00 |
| | Hydro | 8.60 |
| | Roads | 1.39 |
| | Slope>60 | 3.14 |
| Total Grazeable Acres | | 146.66 |

## Summary of Similarity Indices, Cover, and Carrying Capacity within Anlysis Unit

| Similarity Indices (%) | |
|---|---|
| Minimum | 1 |
| Maximum | 1 |
| Median | 1 |

| Cover (%) | |
|---|---|
| Foliar Cover | 20.00 |
| Bare Ground | 52.00 |
| Basal | 0.00 |

| Carrying Capacity (Sheep Units/Year) | |
|---|---|
| Initial CC | 0 |
| Slope Adjusted CC | 0 |
| DTW Adjusted CC | 0 |

## Results by Ecological Site in Sheep Units Year Long

| Ecological Site | Number of Transects | Percent of Analysis Unit Acres | Available Forage (Lbs/Acre) | Initial Grazeable Acres | Sheep Stocking Rate (Acres/ Sheep Unit) | Initial Sheep Carrying Capacity (Sheep Units/Year) |
|---|---|---|---|---|---|---|
| R035XY006UT Alkali Fan (Castlevalley Saltbush) | 1 | 67 | 0.00 | 107.60 | | |
| Badland | 0 | 9 | | 13.95 | | |
| R035XY109UT Desert Loam (Shadscale) | 0 | 7 | | 10.46 | | |
| Rock Outcrop | 0 | 2 | | 3.59 | | |
| Shallow or very shallow soils | 0 | 2 | | 3.49 | | |
| Water | 0 | 4 | | 5.95 | | |
| Whit | 0 | 3 | | 4.78 | | |

**Analysis Unit** SLC 033362 **Chapter** Aneth

## Summary of Grazeable and Non-Grazeable Acres in Analysis Unit

| | | |
|---|---|---|
| **Chapter Acres** | | 121,585.00 |
| **Analysis Unit Acres** | | 159.67 |
| **Non-Grazeable Acres** | **Developed** | 3.90 |
| | **Hydro** | 2.10 |
| | **Roads** | 5.35 |
| | **Slope>60** | 0.02 |
| **Total Grazeable Acres** | | 148.30 |

## Summary of Similarity Indices, Cover, and Carrying Capacity within Anlysis Unit

| Similarity Indices (%) | |
|---|---|
| **Minimum** | 16 |
| **Maximum** | 16 |
| **Median** | 16 |

| Cover (%) | |
|---|---|
| **Foliar Cover** | 26.00 |
| **Bare Ground** | 70.00 |
| **Basal** | 0.00 |

| Carrying Capacity (Sheep Units/Year) | |
|---|---|
| **Initial CC** | 0.01 |
| **Slope Adjusted CC** | 0.01 |
| **DTW Adjusted CC** | 0.01 |

## Results by Ecological Site in Sheep Units Year Long

| Ecological Site | Number of Transects | Percent of Analysis Unit Acres | Available Forage (Lbs/Acre) | Initial Grazeable Acres | Sheep Stocking Rate (Acres/ Sheep Unit) | Initial Sheep Carrying Capacity (Sheep Units/Year) |
|---|---|---|---|---|---|---|
| R035XY006UT Alkali Fan (Castlevalley Saltbush) | 1 | 71 | 0.11 | 113.90 | 21,545.45 | 0.01 |
| Badland | 0 | 59 | | 8.26 | | |
| R035XY109UT Desert Loam (Shadscale) | 0 | 4 | | 6.19 | | |
| Rock Outcrop | 0 | 2 | | 3.80 | | |
| Shallow or very shallow soils | 0 | 1 | | 2.06 | | |
| Water | 0 | 6 | | 9.06 | | |
| Whit | 0 | 3 | | 5.06 | | |

**Analysis Unit** SLC 033363 **Chapter** Aneth

## Summary of Grazeable and Non-Grazeable Acres in Analysis Unit

| | | |
|---|---|---|
| **Chapter Acres** | | 121,585.00 |
| **Analysis Unit Acres** | | 159.87 |
| **Non-Grazeable Acres** | **Developed** | 0.00 |
| | **Hydro** | 20.38 |
| | **Roads** | 2.37 |
| | **Slope>60** | 0.03 |
| **Total Grazeable Acres** | | 137.09 |

## Summary of Similarity Indices, Cover, and Carrying Capacity within Anlysis Unit

| **Similarity Indices (%)** | |
|---|---|
| **Minimum** | 18 |
| **Maximum** | 18 |
| **Median** | 18 |

| **Cover (%)** | |
|---|---|
| **Foliar Cover** | 28.00 |
| **Bare Ground** | 66.00 |
| **Basal** | 0.00 |

| **Carrying Capacity (Sheep Units/Year)** | |
|---|---|
| **Initial CC** | 0.02 |
| **Slope Adjusted CC** | 0.019 |
| **DTW Adjusted CC** | 0.019 |

## Results by Ecological Site in Sheep Units Year Long

| Ecological Site | Number of Transects | Percent of Analysis Unit Acres | Available Forage (Lbs/Acre) | Initial Grazeable Acres | Sheep Stocking Rate (Acres/ Sheep Unit) | Initial Sheep Carrying Capacity (Sheep Units/Year) |
|---|---|---|---|---|---|---|
| R035XY006UT Alkali Fan (Castlevalley Saltbush) | 1 | 62 | 0.43 | 98.90 | 5,511.63 | 0.02 |
| Rock Outcrop | 0 | 2 | | 3.30 | | |
| Water | 0 | 19 | | 30.51 | | |
| Whit | 0 | 3 | | 4.40 | | |

**Analysis Unit** SLC 033364 **Chapter** Aneth

## Summary of Grazeable and Non-Grazeable Acres in Analysis Unit

| | | |
|---|---|---|
| **Chapter Acres** | | 121,585.00 |
| **Analysis Unit Acres** | | 159.35 |
| **Non-Grazeable Acres** | **Developed** | 0.00 |
| | **Hydro** | 3.44 |
| | **Roads** | 2.62 |
| | **Slope>60** | 0.81 |
| **Total Grazeable Acres** | | 152.48 |

## Summary of Similarity Indices, Cover, and Carrying Capacity within Anlysis Unit

| Similarity Indices (%) | |
|---|---|
| **Minimum** | 19 |
| **Maximum** | 19 |
| **Median** | 19 |

| Cover (%) | |
|---|---|
| **Foliar Cover** | 36.00 |
| **Bare Ground** | 58.00 |
| **Basal** | 0.00 |

| Carrying Capacity (Sheep Units/Year) | |
|---|---|
| **Initial CC** | 0.17 |
| **Slope Adjusted CC** | 0.16 |
| **DTW Adjusted CC** | 0.16 |

## Results by Ecological Site in Sheep Units Year Long

| Ecological Site | Number of Transects | Percent of Analysis Unit Acres | Available Forage (Lbs/Acre) | Initial Grazeable Acres | Sheep Stocking Rate (Acres/ Sheep Unit) | Initial Sheep Carrying Capacity (Sheep Units/Year) |
|---|---|---|---|---|---|---|
| R035XY006UT Alkali Fan (Castlevalley Saltbush) | 1 | 56 | 4.46 | 89.90 | 531.39 | 0.17 |
| Badland | 0 | 169 | | 26.21 | | |
| R035XY109UT Desert Loam (Shadscale) | 0 | 12 | | 19.66 | | |
| Rock Outcrop | 0 | 2 | | 3.00 | | |
| Shallow or very shallow soils | 0 | 4 | | 6.55 | | |
| Water | 0 | 2 | | 3.92 | | |
| Whit | 0 | 3 | | 4.00 | | |

**Analysis Unit** SLC 033365 **Chapter** Aneth

## Summary of Grazeable and Non-Grazeable Acres in Analysis Unit

| | | |
|---|---|---|
| **Chapter Acres** | | 121,585.00 |
| **Analysis Unit Acres** | | 80.27 |
| **Non-Grazeable Acres** | **Developed** | 0.00 |
| | **Hydro** | 1.29 |
| | **Roads** | 1.26 |
| | **Slope>60** | 0.00 |
| **Total Grazeable Acres** | | 77.71 |

## Summary of Similarity Indices, Cover, and Carrying Capacity within Anlysis Unit

| **Similarity Indices (%)** | |
|---|---|
| **Minimum** | 12 |
| **Maximum** | 12 |
| **Median** | 12 |

| **Cover (%)** | |
|---|---|
| **Foliar Cover** | 36.00 |
| **Bare Ground** | 64.00 |
| **Basal** | 0.00 |

| **Carrying Capacity (Sheep Units/Year)** | |
|---|---|
| **Initial CC** | 0.1 |
| **Slope Adjusted CC** | 0.099 |
| **DTW Adjusted CC** | 0.099 |

## Results by Ecological Site in Sheep Units Year Long

| Ecological Site | Number of Transects | Percent of Analysis Unit Acres | Available Forage (Lbs/Acre) | Initial Grazeable Acres | Sheep Stocking Rate (Acres/ Sheep Unit) | Initial Sheep Carrying Capacity (Sheep Units/Year) |
|---|---|---|---|---|---|---|
| R035XY006UT Alkali Fan (Castlevalley Saltbush) | 1 | 83 | 3.59 | 66.70 | 660.17 | 0.10 |
| Badland | 0 | 4 | | 2.89 | | |
| R035XY109UT Desert Loam (Shadscale) | 0 | 3 | | 2.17 | | |
| Rock Outcrop | 0 | 3 | | 2.22 | | |
| Shallow or very shallow soils | 0 | <1 | | 0.72 | | |
| Water | 0 | <1 | | 0.02 | | |
| Whit | 0 | 4 | | 2.97 | | |

**Analysis Unit** SLC 033370 **Chapter** Aneth

### Summary of Grazeable and Non-Grazeable Acres in Analysis Unit

| | | |
|---|---|---|
| Chapter Acres | | 121,585.00 |
| Analysis Unit Acres | | 161.68 |
| Non-Grazeable Acres | Developed | 0.70 |
| | Hydro | 15.40 |
| | Roads | 5.27 |
| | Slope>60 | 3.56 |
| Total Grazeable Acres | | 136.74 |

### Summary of Similarity Indices, Cover, and Carrying Capacity within Anlysis Unit

| Similarity Indices (%) | |
|---|---|
| Minimum | |
| Maximum | |
| Median | |

| Cover (%) | |
|---|---|
| Foliar Cover | 34.00 |
| Bare Ground | 44.00 |
| Basal | 0.00 |

| Carrying Capacity (Sheep Units/Year) | |
|---|---|
| Initial CC | 0.06 |
| Slope Adjusted CC | 0.05 |
| DTW Adjusted CC | 0.05 |

### Results by Ecological Site in Sheep Units Year Long

| Ecological Site | Number of Transects | Percent of Analysis Unit Acres | Available Forage (Lbs/Acre) | Initial Grazeable Acres | Sheep Stocking Rate (Acres/ Sheep Unit) | Initial Sheep Carrying Capacity (Sheep Units/Year) |
|---|---|---|---|---|---|---|
| Badland | 1 | 33 | 2.81 | 52.60 | 843.42 | 0.06 |
| R035XY109UT Desert Loam (Shadscale) | 0 | 24 | | 39.42 | | |
| Shallow or very shallow soils | 0 | 8 | | 13.14 | | |
| Water | 0 | 22 | | 35.16 | | |

**Analysis Unit** SLC 033371 **Chapter** Aneth

## Summary of Grazeable and Non-Grazeable Acres in Analysis Unit

| | | |
|---|---|---|
| **Chapter Acres** | | 121,585.00 |
| **Analysis Unit Acres** | | 159.74 |
| **Non-Grazeable Acres** | **Developed** | 1.45 |
| | **Hydro** | 8.87 |
| | **Roads** | 2.02 |
| | **Slope>60** | 0.00 |
| **Total Grazeable Acres** | | 147.40 |

## Summary of Similarity Indices, Cover, and Carrying Capacity within Anlysis Unit

| Similarity Indices (%) | |
|---|---|
| **Minimum** | 6 |
| **Maximum** | 6 |
| **Median** | 6 |

| Cover (%) | |
|---|---|
| **Foliar Cover** | 24.00 |
| **Bare Ground** | 68.00 |
| **Basal** | 0.00 |

| Carrying Capacity (Sheep Units/Year) | |
|---|---|
| **Initial CC** | 0.21 |
| **Slope Adjusted CC** | 0.2 |
| **DTW Adjusted CC** | 0.2 |

## Results by Ecological Site in Sheep Units Year Long

| Ecological Site | Number of Transects | Percent of Analysis Unit Acres | Available Forage (Lbs/Acre) | Initial Grazeable Acres | Sheep Stocking Rate (Acres/ Sheep Unit) | Initial Sheep Carrying Capacity (Sheep Units/Year) |
|---|---|---|---|---|---|---|
| R035XY006UT Alkali Fan (Castlevalley Saltbush) | 1 | 65 | 4.77 | 104.00 | 496.86 | 0.21 |
| Rock Outcrop | 0 | 2 | | 3.47 | | |
| Water | 0 | 22 | | 35.31 | | |
| Whit | 0 | 3 | | 4.62 | | |

**Analysis Unit** SLC 033372 **Chapter** Aneth

## Summary of Grazeable and Non-Grazeable Acres in Analysis Unit

| | | |
|---|---|---|
| **Chapter Acres** | | 121,585.00 |
| **Analysis Unit Acres** | | 159.31 |
| **Non-Grazeable Acres** | **Developed** | 0.00 |
| | **Hydro** | 15.21 |
| | **Roads** | 1.60 |
| | **Slope>60** | 3.20 |
| **Total Grazeable Acres** | | 139.30 |

## Summary of Similarity Indices, Cover, and Carrying Capacity within Anlysis Unit

| **Similarity Indices (%)** | |
|---|---|
| **Minimum** | 7 |
| **Maximum** | 7 |
| **Median** | 7 |

| **Cover (%)** | |
|---|---|
| **Foliar Cover** | 32.00 |
| **Bare Ground** | 66.00 |
| **Basal** | 0.00 |

| **Carrying Capacity (Sheep Units/Year)** | |
|---|---|
| **Initial CC** | 0.05 |
| **Slope Adjusted CC** | 0.04 |
| **DTW Adjusted CC** | 0.04 |

## Results by Ecological Site in Sheep Units Year Long

| Ecological Site | Number of Transects | Percent of Analysis Unit Acres | Available Forage (Lbs/Acre) | Initial Grazeable Acres | Sheep Stocking Rate (Acres/ Sheep Unit) | Initial Sheep Carrying Capacity (Sheep Units/Year) |
|---|---|---|---|---|---|---|
| R035XY109UT Desert Loam (Shadscale) | 1 | 13 | 5.60 | 20.90 | 423.21 | 0.05 |
| Badland | 0 | 18 | | 27.89 | | |
| R035XY118UT Desert Sandy Loam (Fourwing Saltbush) | 0 | 29 | | 46.96 | | |
| Shallow or very shallow soils | 0 | 4 | | 6.97 | | |
| Sheppard | 0 | 2 | | 2.61 | | |
| Sogzie | 0 | 2 | | 2.61 | | |
| Water | 0 | 22 | | 34.54 | | |

**Analysis Unit** SLC 033376 **Chapter** Aneth

## Summary of Grazeable and Non-Grazeable Acres in Analysis Unit

| | | |
|---|---|---|
| Chapter Acres | | 121,585.00 |
| Analysis Unit Acres | | 160.28 |
| Non-Grazeable Acres | Developed | 11.72 |
| | Hydro | 2.74 |
| | Roads | 2.75 |
| | Slope>60 | 0.00 |
| Total Grazeable Acres | | 143.06 |

## Summary of Similarity Indices, Cover, and Carrying Capacity within Anlysis Unit

| Similarity Indices (%) | |
|---|---|
| Minimum | 11 |
| Maximum | 11 |
| Median | 11 |

| Cover (%) | |
|---|---|
| Foliar Cover | 40.00 |
| Bare Ground | 60.00 |
| Basal | 0.00 |

| Carrying Capacity (Sheep Units/Year) | |
|---|---|
| Initial CC | 0 |
| Slope Adjusted CC | 0 |
| DTW Adjusted CC | 0 |

## Results by Ecological Site in Sheep Units Year Long

| Ecological Site | Number of Transects | Percent of Analysis Unit Acres | Available Forage (Lbs/Acre) | Initial Grazeable Acres | Sheep Stocking Rate (Acres/ Sheep Unit) | Initial Sheep Carrying Capacity (Sheep Units/Year) |
|---|---|---|---|---|---|---|
| R035XY006UT Alkali Fan (Castlevalley Saltbush) | 1 | 55 | 0.05 | 88.00 | 47,400.00 | |
| Badland | 0 | 15 | | 24.12 | | |
| R035XY109UT Desert Loam (Shadscale) | 0 | 11 | | 18.09 | | |
| Rock Outcrop | 0 | 2 | | 2.93 | | |
| Shallow or very shallow soils | 0 | 4 | | 6.03 | | |
| Whit | 0 | 2 | | 3.91 | | |

**Analysis Unit** SLC 033377 **Chapter** Aneth

## Summary of Grazeable and Non-Grazeable Acres in Analysis Unit

| | | |
|---|---|---|
| **Chapter Acres** | | 121,585.00 |
| **Analysis Unit Acres** | | 160.92 |
| **Non-Grazeable Acres** | **Developed** | 0.00 |
| | **Hydro** | 0.00 |
| | **Roads** | 0.58 |
| | **Slope>60** | 0.50 |
| **Total Grazeable Acres** | | 159.84 |

## Summary of Similarity Indices, Cover, and Carrying Capacity within Anlysis Unit

| **Similarity Indices (%)** | |
|---|---|
| **Minimum** | 9 |
| **Maximum** | 9 |
| **Median** | 9 |

| **Cover (%)** | |
|---|---|
| **Foliar Cover** | 24.00 |
| **Bare Ground** | 76.00 |
| **Basal** | 0.00 |

| **Carrying Capacity (Sheep Units/Year)** | |
|---|---|
| **Initial CC** | 0.14 |
| **Slope Adjusted CC** | 0.13 |
| **DTW Adjusted CC** | 0.13 |

## Results by Ecological Site in Sheep Units Year Long

| Ecological Site | Number of Transects | Percent of Analysis Unit Acres | Available Forage (Lbs/Acre) | Initial Grazeable Acres | Sheep Stocking Rate (Acres/ Sheep Unit) | Initial Sheep Carrying Capacity (Sheep Units/Year) |
|---|---|---|---|---|---|---|
| R035XY006UT Alkali Fan (Castlevalley Saltbush) | 1 | 66 | 3.17 | 106.50 | 747.63 | 0.14 |
| Badland | 0 | 14 | | 22.76 | | |
| R035XY109UT Desert Loam (Shadscale) | 0 | 11 | | 17.07 | | |
| Rock Outcrop | 0 | 2 | | 3.55 | | |
| Shallow or very shallow soils | 0 | 4 | | 5.69 | | |
| Whit | 0 | 3 | | 4.74 | | |

**Analysis Unit** SLC 033378 **Chapter** Aneth

## Summary of Grazeable and Non-Grazeable Acres in Analysis Unit

| | | |
|---|---|---|
| Chapter Acres | | 121,585.00 |
| Analysis Unit Acres | | 159.10 |
| Non-Grazeable Acres | Developed | 0.00 |
| | Hydro | 10.63 |
| | Roads | 0.07 |
| | Slope>60 | 0.00 |
| Total Grazeable Acres | | 148.40 |

## Summary of Similarity Indices, Cover, and Carrying Capacity within Anlysis Unit

| Similarity Indices (%) | |
|---|---|
| Minimum | 9 |
| Maximum | 9 |
| Median | 9 |

| Cover (%) | |
|---|---|
| Foliar Cover | 40.00 |
| Bare Ground | 58.00 |
| Basal | 0.00 |

| Carrying Capacity (Sheep Units/Year) | |
|---|---|
| Initial CC | |
| Slope Adjusted CC | |
| DTW Adjusted CC | |

## Results by Ecological Site in Sheep Units Year Long

| Ecological Site | Number of Transects | Percent of Analysis Unit Acres | Available Forage (Lbs/Acre) | Initial Grazeable Acres | Sheep Stocking Rate (Acres/ Sheep Unit) | Initial Sheep Carrying Capacity (Sheep Units/Year) |
|---|---|---|---|---|---|---|
| R035XY006UT Alkali Fan (Castlevalley Saltbush) | 1 | 61 | 0.00 | 97.40 | | |
| Badland | 0 | 6 | | 8.99 | | |
| R035XY109UT Desert Loam (Shadscale) | 0 | 4 | | 6.74 | | |
| Rock Outcrop | 0 | 2 | | 3.25 | | |
| Shallow or very shallow soils | 0 | 1 | | 2.25 | | |
| Water | 0 | 16 | | 25.41 | | |
| Whit | 0 | 3 | | 4.33 | | |

**Analysis Unit** SLC 033379 **Chapter** Aneth

## Summary of Grazeable and Non-Grazeable Acres in Analysis Unit

| | | |
|---|---|---|
| **Chapter Acres** | | 121,585.00 |
| **Analysis Unit Acres** | | 159.33 |
| **Non-Grazeable Acres** | **Developed** | 0.00 |
| | **Hydro** | 14.20 |
| | **Roads** | 1.24 |
| | **Slope>60** | 0.02 |
| **Total Grazeable Acres** | | 143.85 |

## Summary of Similarity Indices, Cover, and Carrying Capacity within Anlysis Unit

| **Similarity Indices (%)** | |
|---|---|
| **Minimum** | 15 |
| **Maximum** | 15 |
| **Median** | 15 |

| **Cover (%)** | |
|---|---|
| **Foliar Cover** | 24.00 |
| **Bare Ground** | 74.00 |
| **Basal** | 0.00 |

| **Carrying Capacity (Sheep Units/Year)** | |
|---|---|
| **Initial CC** | 0.06 |
| **Slope Adjusted CC** | 0.058 |
| **DTW Adjusted CC** | 0.058 |

## Results by Ecological Site in Sheep Units Year Long

| Ecological Site | Number of Transects | Percent of Analysis Unit Acres | Available Forage (Lbs/Acre) | Initial Grazeable Acres | Sheep Stocking Rate (Acres/ Sheep Unit) | Initial Sheep Carrying Capacity (Sheep Units/Year) |
|---|---|---|---|---|---|---|
| R035XY006UT Alkali Fan (Castlevalley Saltbush) | 1 | 40 | 2.38 | 63.20 | 995.80 | 0.06 |
| Badland | 0 | 22 | | 34.96 | | |
| Shepherd | 0 | <1 | | 0.41 | | |
| R035XY109UT Desert Loam (Shadscale) | 0 | 13 | | 20.63 | | |
| Rock Outcrop | 0 | 1 | | 2.11 | | |
| Shallow or very shallow soils | 0 | 5 | | 7.29 | | |
| Water | 0 | 8 | | 12.52 | | |
| Whit | 0 | 2 | | 2.81 | | |

**Analysis Unit** SLC 033508 **Chapter** Aneth

### Summary of Grazeable and Non-Grazeable Acres in Analysis Unit

| | | |
|---|---|---|
| **Chapter Acres** | | 121,585.00 |
| **Analysis Unit Acres** | | 166.20 |
| **Non-Grazeable Acres** | **Developed** | 0.10 |
| | **Hydro** | 7.72 |
| | **Roads** | 3.43 |
| | **Slope>60** | 3.37 |
| **Total Grazeable Acres** | | 151.58 |

### Summary of Similarity Indices, Cover, and Carrying Capacity within Anlysis Unit

| **Similarity Indices (%)** | |
|---|---|
| **Minimum** | 5 |
| **Maximum** | 5 |
| **Median** | 5 |

| **Cover (%)** | |
|---|---|
| **Foliar Cover** | 40.00 |
| **Bare Ground** | 30.00 |
| **Basal** | 0.00 |

| **Carrying Capacity (Sheep Units/Year)** | |
|---|---|
| **Initial CC** | 0.02 |
| **Slope Adjusted CC** | 0.017 |
| **DTW Adjusted CC** | 0.017 |

### Results by Ecological Site in Sheep Units Year Long

| Ecological Site | Number of Transects | Percent of Analysis Unit Acres | Available Forage (Lbs/Acre) | Initial Grazeable Acres | Sheep Stocking Rate (Acres/ Sheep Unit) | Initial Sheep Carrying Capacity (Sheep Units/Year) |
|---|---|---|---|---|---|---|
| R035XY109UT Desert Loam (Shadscale) | 1 | 30 | 0.72 | 50.30 | 3,291.67 | 0.02 |
| Badland | 0 | 40 | | 67.07 | | |
| Shallow or very shallow soils | 0 | 10 | | 16.77 | | |
| Water | 0 | 13 | | 20.82 | | |

**Analysis Unit** SLC 033509 **Chapter** Aneth

## Summary of Grazeable and Non-Grazeable Acres in Analysis Unit

| | | |
|---|---|---|
| **Chapter Acres** | | 121,585.00 |
| **Analysis Unit Acres** | | 159.61 |
| **Non-Grazeable Acres** | **Developed** | 0.00 |
| | **Hydro** | 6.48 |
| | **Roads** | 3.10 |
| | **Slope>60** | 4.24 |
| **Total Grazeable Acres** | | 145.79 |

## Summary of Similarity Indices, Cover, and Carrying Capacity within Anlysis Unit

| **Similarity Indices (%)** | |
|---|---|
| **Minimum** | 5 |
| **Maximum** | 5 |
| **Median** | 5 |

| **Cover (%)** | |
|---|---|
| **Foliar Cover** | 26.00 |
| **Bare Ground** | 66.00 |
| **Basal** | 0.00 |

| **Carrying Capacity (Sheep Units/Year)** | |
|---|---|
| **Initial CC** | 0 |
| **Slope Adjusted CC** | 0 |
| **DTW Adjusted CC** | 0 |

## Results by Ecological Site in Sheep Units Year Long

| Ecological Site | Number of Transects | Percent of Analysis Unit Acres | Available Forage (Lbs/Acre) | Initial Grazeable Acres | Sheep Stocking Rate (Acres/ Sheep Unit) | Initial Sheep Carrying Capacity (Sheep Units/Year) |
|---|---|---|---|---|---|---|
| R035XY109UT Desert Loam (Shadscale) | 1 | 33 | 0.00 | 53.00 | | |
| Badland | 0 | 44 | | 70.63 | | |
| Shallow or very shallow soils | 0 | 11 | | 17.66 | | |
| Water | 0 | 5 | | 8.76 | | |

**Analysis Unit** SLC 033380 **Chapter** Aneth

## Summary of Grazeable and Non-Grazeable Acres in Analysis Unit

| | | |
|---|---|---|
| **Chapter Acres** | | 121,585.00 |
| **Analysis Unit Acres** | | 79.57 |
| **Non-Grazeable Acres** | **Developed** | 0.00 |
| | **Hydro** | 0.81 |
| | **Roads** | 2.75 |
| | **Slope>60** | 0.16 |
| **Total Grazeable Acres** | | 75.85 |

## Summary of Similarity Indices, Cover, and Carrying Capacity within Anlysis Unit

| Similarity Indices (%) | |
|---|---|
| **Minimum** | |
| **Maximum** | |
| **Median** | |

| Cover (%) | |
|---|---|
| **Foliar Cover** | |
| **Bare Ground** | |
| **Basal** | |

| Carrying Capacity (Sheep Units/Year) | |
|---|---|
| **Initial CC** | |
| **Slope Adjusted CC** | |
| **DTW Adjusted CC** | |

## Results by Ecological Site in Sheep Units Year Long

| Ecological Site | Number of Transects | Percent of Analysis Unit Acres | Available Forage (Lbs/Acre) | Initial Grazeable Acres | Sheep Stocking Rate (Acres/ Sheep Unit) | Initial Sheep Carrying Capacity (Sheep Units/Year) |
|---|---|---|---|---|---|---|
| Badland | 0 | 16 | | 12.98 | | |
| R035XY109UT Desert Loam (Shadscale) | 0 | 12 | | 9.73 | | |
| R035XY118UT Desert Sandy Loam (Fourwing Saltbush) | 0 | 57 | | 45.04 | | |
| Shallow or very shallow soils | 0 | 4 | | 3.24 | | |
| Sheppard | 0 | 3 | | 2.50 | | |
| Sogzie | 0 | 3 | | 2.50 | | |

**Analysis Unit** SLC 033375 **Chapter** Aneth

## Summary of Grazeable and Non-Grazeable Acres in Analysis Unit

| | | |
|---|---|---|
| Chapter Acres | | 121,585.00 |
| Analysis Unit Acres | | 80.18 |
| Non-Grazeable Acres | Developed | 4.01 |
| | Hydro | 2.85 |
| | Roads | 2.77 |
| | Slope>60 | 0.00 |
| Total Grazeable Acres | | 70.55 |

## Summary of Similarity Indices, Cover, and Carrying Capacity within Anlysis Unit

| Similarity Indices (%) | |
|---|---|
| Minimum | |
| Maximum | |
| Median | |

| Cover (%) | |
|---|---|
| Foliar Cover | |
| Bare Ground | |
| Basal | |

| Carrying Capacity (Sheep Units/Year) | |
|---|---|
| Initial CC | |
| Slope Adjusted CC | |
| DTW Adjusted CC | |

## Results by Ecological Site in Sheep Units Year Long

| Ecological Site | Number of Transects | Percent of Analysis Unit Acres | Available Forage (Lbs/Acre) | Initial Grazeable Acres | Sheep Stocking Rate (Acres/ Sheep Unit) | Initial Sheep Carrying Capacity (Sheep Units/Year) |
|---|---|---|---|---|---|---|
| R035XY006UT Alkali Fan (Castlevalley Saltbush) | 0 | 81 | | 64.87 | | |
| Rock Outcrop | 0 | 3 | | 2.16 | | |
| Water | 0 | <1 | | 0.64 | | |
| Whit | 0 | 4 | | 2.88 | | |

**Analysis Unit** SLC 033373 **Chapter** Aneth

## Summary of Grazeable and Non-Grazeable Acres in Analysis Unit

| | | |
|---|---|---|
| Chapter Acres | | 121,585.00 |
| Analysis Unit Acres | | 39.48 |
| Non-Grazeable Acres | Developed | 0.00 |
| | Hydro | 0.00 |
| | Roads | 0.00 |
| | Slope>60 | 0.00 |
| Total Grazeable Acres | | 39.48 |

## Summary of Similarity Indices, Cover, and Carrying Capacity within Anlysis Unit

| Similarity Indices (%) | |
|---|---|
| Minimum | |
| Maximum | |
| Median | |

| Cover (%) | |
|---|---|
| Foliar Cover | |
| Bare Ground | |
| Basal | |

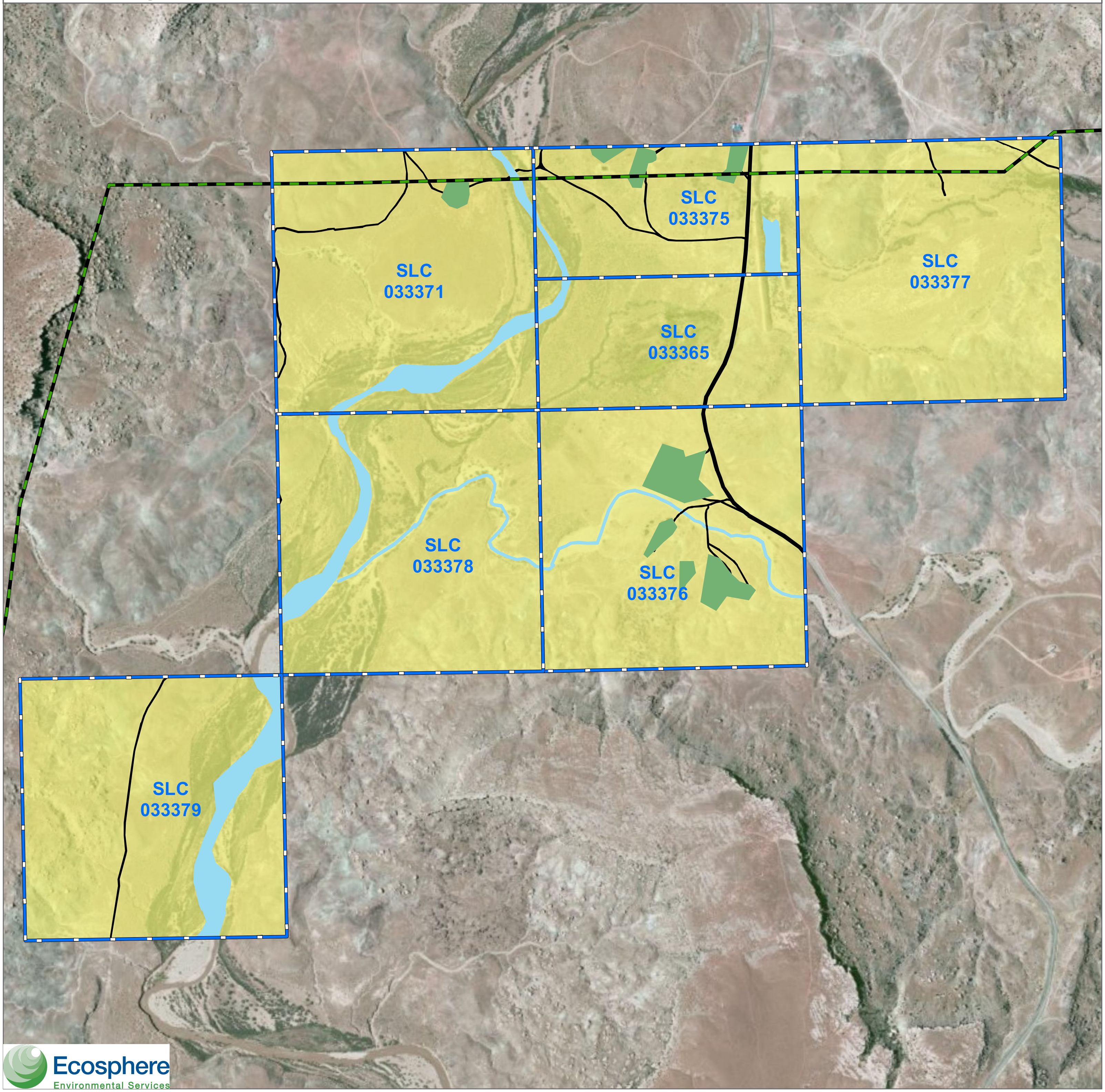
| Carrying Capacity (Sheep Units/Year) | |
|---|---|
| Initial CC | |
| Slope Adjusted CC | |
| DTW Adjusted CC | |

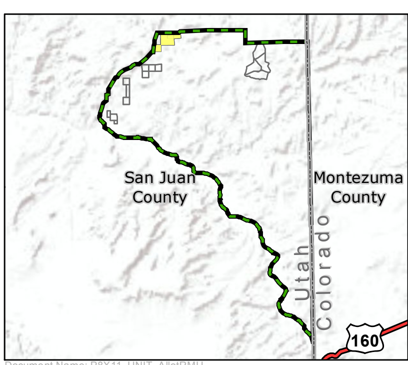
## Results by Ecological Site in Sheep Units Year Long

| Ecological Site | Number of Transects | Percent of Analysis Unit Acres | Available Forage (Lbs/Acre) | Initial Grazeable Acres | Sheep Stocking Rate (Acres/ Sheep Unit) | Initial Sheep Carrying Capacity (Sheep Units/Year) |
|---|---|---|---|---|---|---|
| R035XY012UT Semiwet Saline Streambank (Fremont Cottonwood) | 0 | 7 | | 2.92 | | |
| R035XY118UT Desert Sandy Loam (Fourwing Saltbush) | 0 | 80 | | 31.64 | | |
| Riverwash | 0 | <1 | | 0.36 | | |
| Sheppard | 0 | 43 | | 1.76 | | |
| Sogzie | 0 | 4 | | 1.76 | | |
| Water | 0 | 3 | | 1.05 | | |

# 2014 Range Inventory
# BIA Northern Navajo Agency
# Land Management District 12

**Aneth Community Allotments**




Analysis Unit

Allotment Boundary

Community Boundary

**Non Grazeable Range**

Developed

Hydrology

Roads

0 0.5 1

Miles

1:16,000

Coordinate System: NAD 1983 UTM Zone 12N

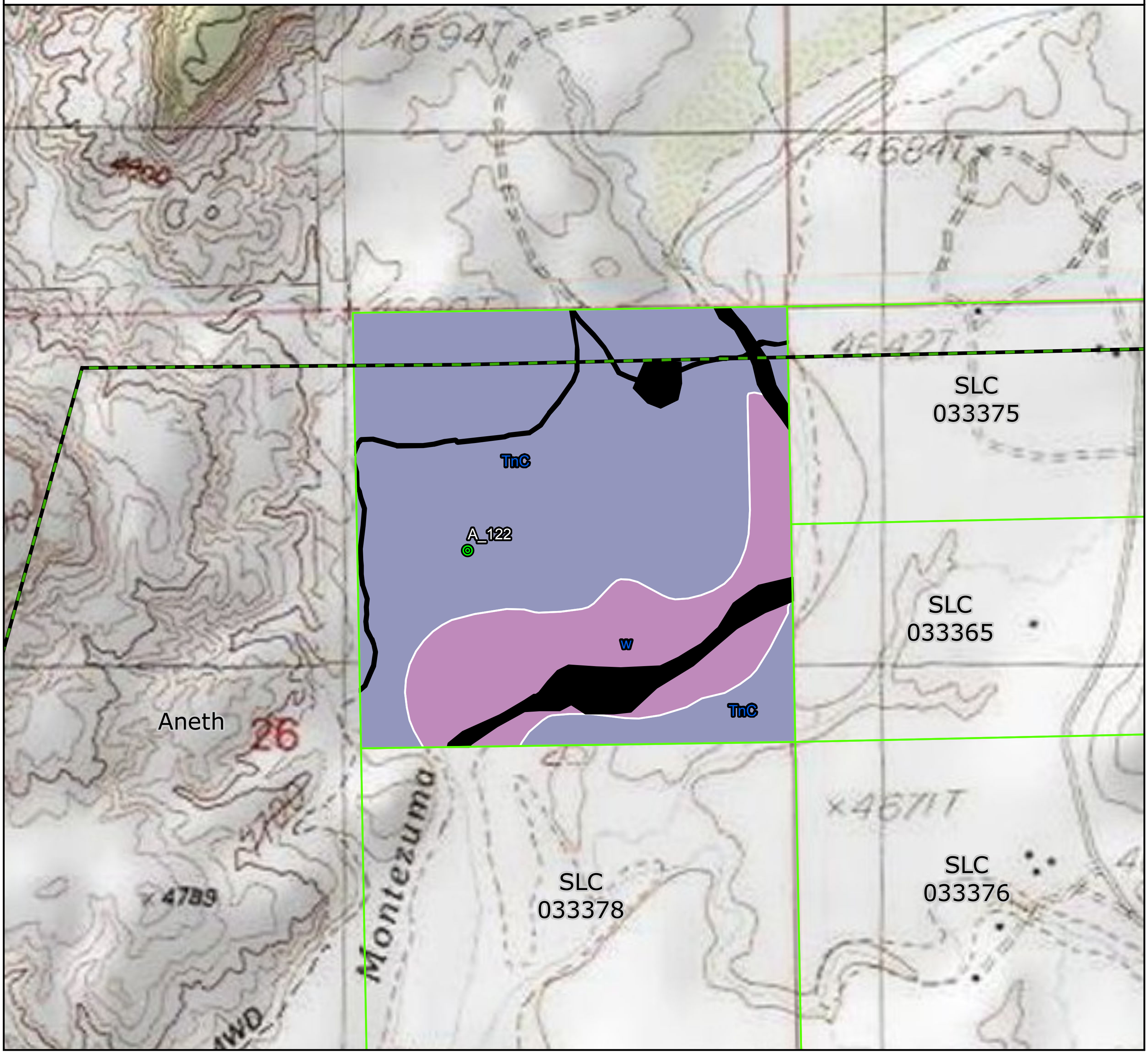
Date: 2/9/2015

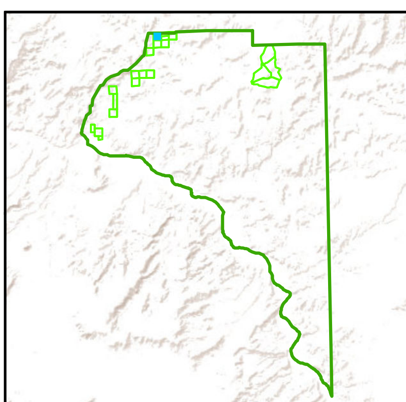
Document Name: P8X11_UNIT_AllotRMU

**2014 Range Inventory**
**BIA Northern Navajo Agency**
**Land Management District 12**
**Aneth Community, SLC 033371**

Total Acres: 160
Grazeable Acres*: 147
*Total acres minus non grazeable areas and areas with > 60% slope.

Initial Annual Carrying Capacity:
<1 Sheep



Transect Location
Analysis Unit Boundary
Community Boundary
Non Grazeable Range
Soil Map Unit

N

0 0.25 0.5
Miles
1:10,000

Ecosphere Environmental Services

Date: 2/9/2015

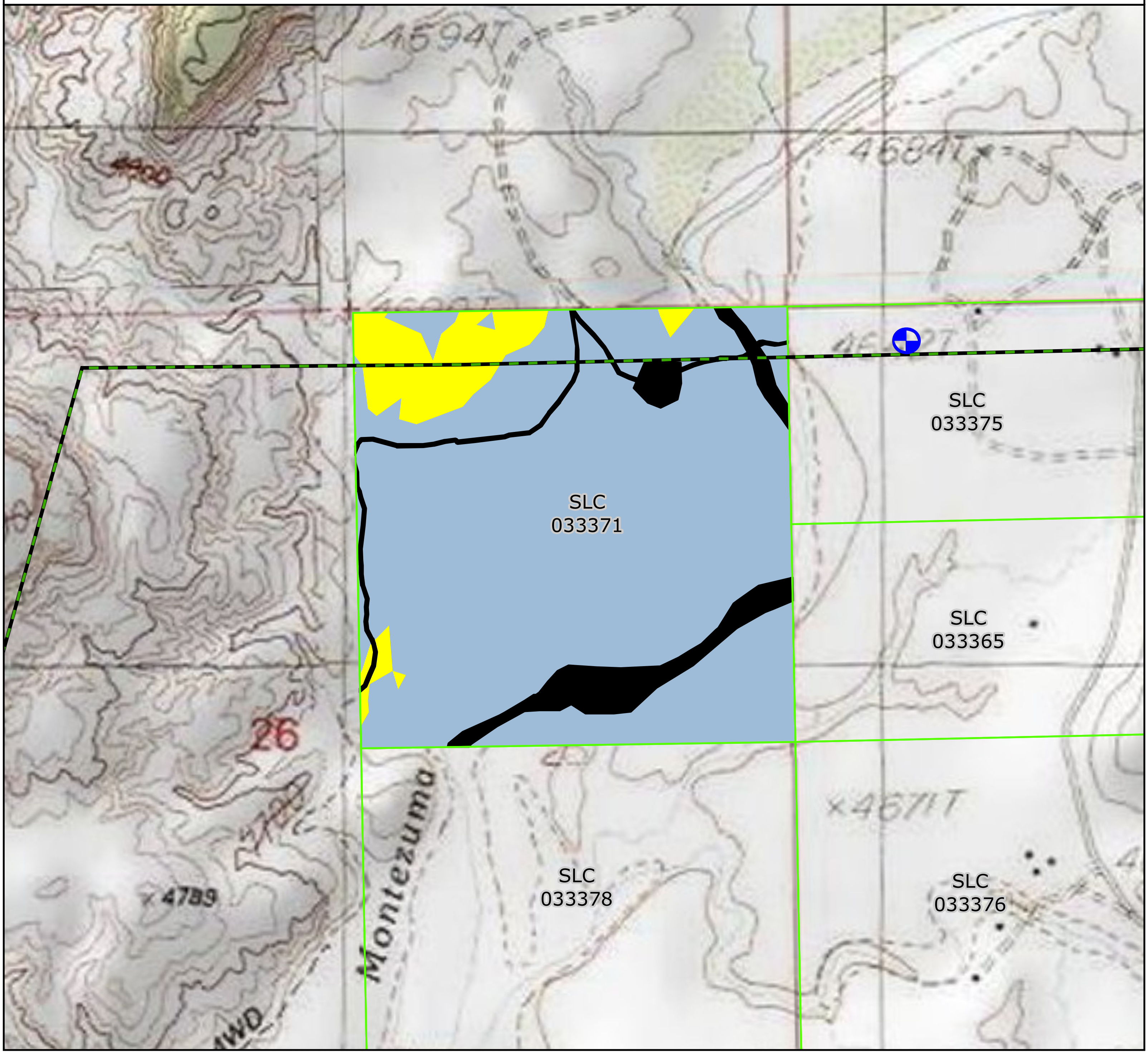
Coordinate System: NAD 1983 UTM Zone 12N

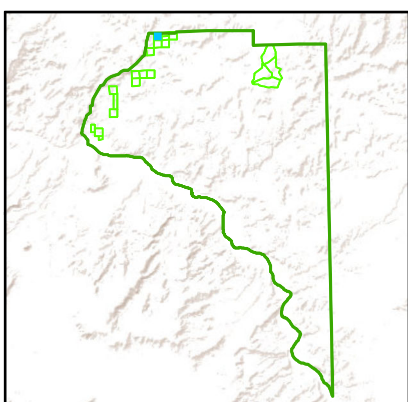
Document Name: P8X11_Soils_InitialCC_AllotRMU1

**2014 Range Inventory**
**BIA Northern Navajo Agency**
**Land Management District 12**
**Aneth Community, SLC 033371**

Total Acres: 160
Grazeable Acres*: 147
*Total acres minus non grazeable areas and areas with > 60% slope.

Adjusted Annual Carrying Capacity: 0 Sheep



Water Source
Analysis Unit Boundary
Community Boundary
Non Grazeable Range

**Distance to Water**
No Water Source
0-1 Mile
1-2 MIles
> 2 Miles

**Slope**
10 - 30%
30 - 60%
>60%

0 0.25 0.5
Miles

1:10,000

Ecosphere Environmental Services

Date: 2/9/2015

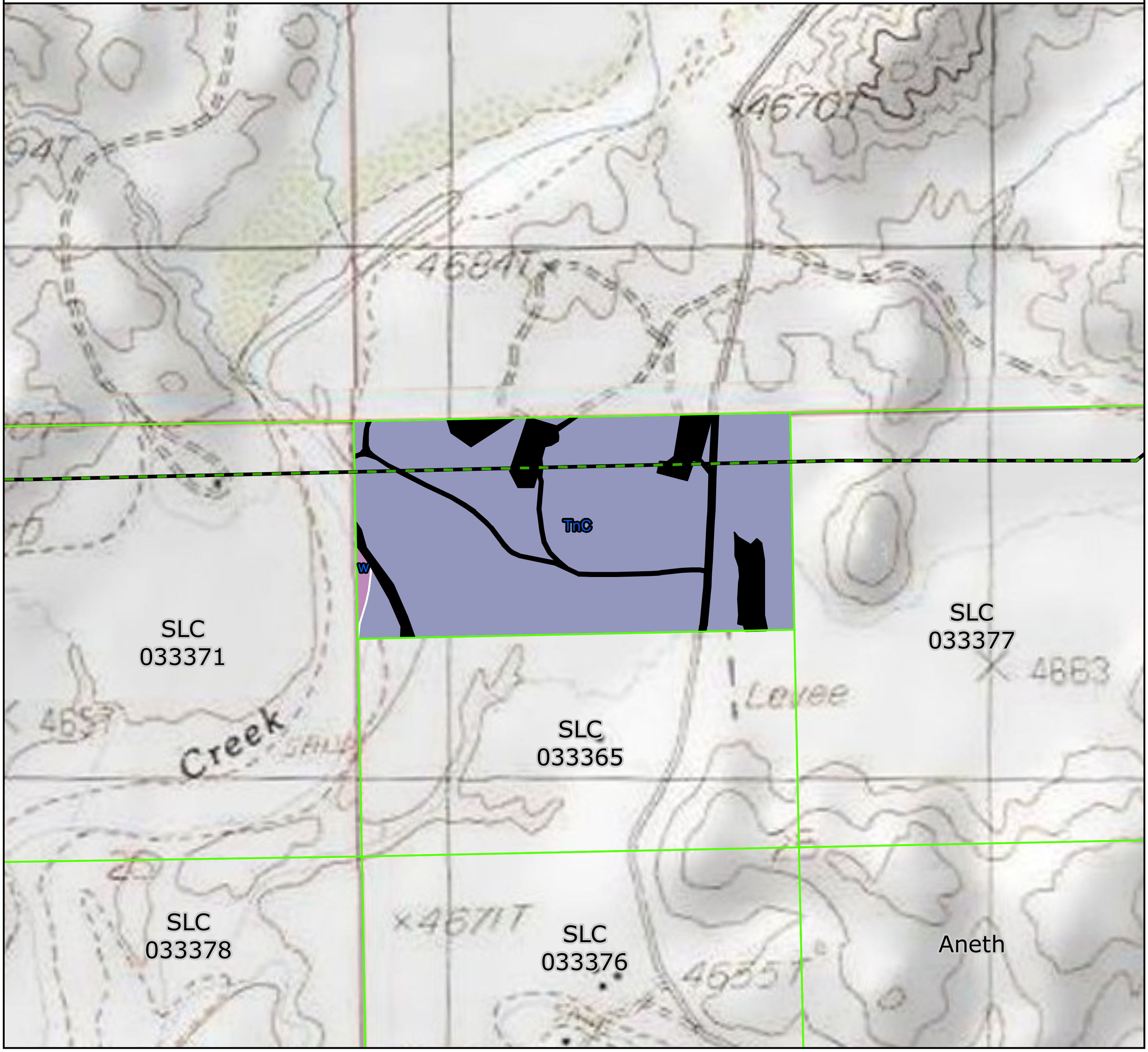
Coordinate System: NAD 1983 UTM Zone 12N

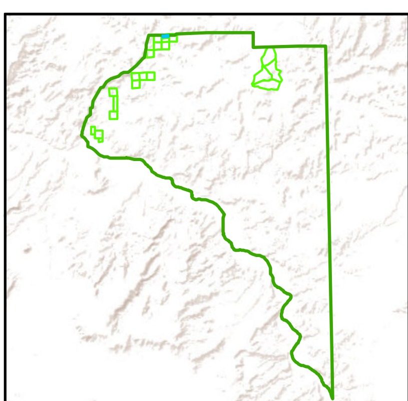
Document Name: P8X11_Slope_AdjCC_AllotRMU

# 2014 Range Inventory
# BIA Northern Navajo Agency
# Land Management District 12
## Aneth Community, SLC 033375

Total Acres: 80
Grazeable Acres*: 71
*Total acres minus non grazeable areas and areas with > 60% slope.

Initial Annual Carrying Capacity:
<1 Sheep



Transect Location
Analysis Unit Boundary
Community Boundary
Non Grazeable Range
Soil Map Unit

0 0.25 0.5
Miles

1:10,000

Ecosphere Environmental Services

Date: 2/9/2015

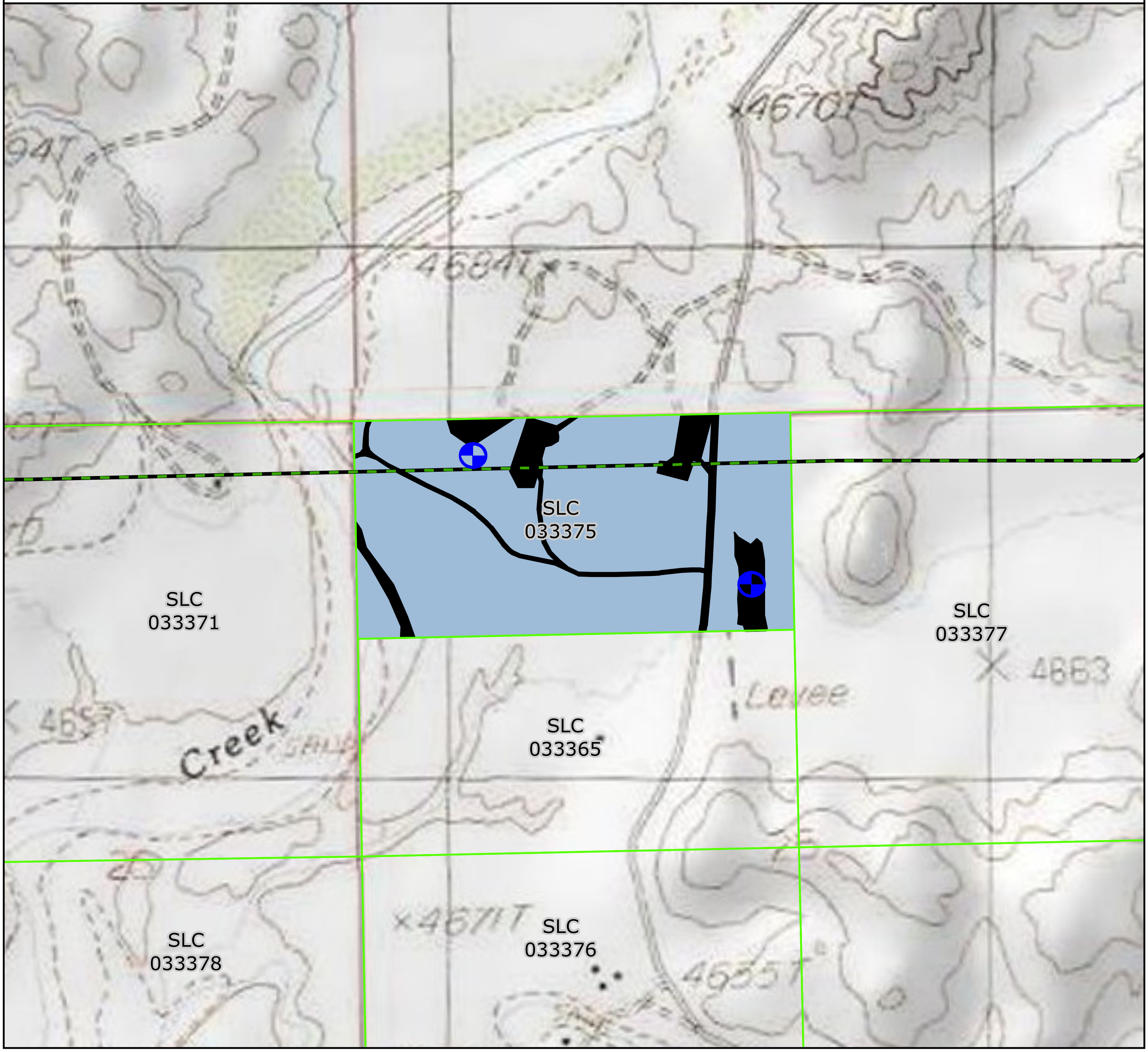
Coordinate System: NAD 1983 UTM Zone 12N

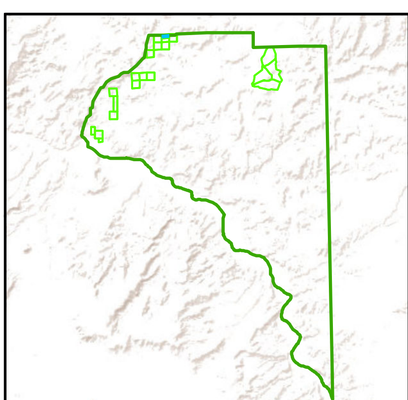
Document Name: P8X11_Soils_InitialCC_AllotRMU1

**2014 Range Inventory**
**BIA Northern Navajo Agency**
**Land Management District 12**
**Aneth Community, SLC 033375**

Total Acres: 80
Grazeable Acres*: 71
*Total acres minus non grazeable areas and areas with > 60% slope.

Adjusted Annual Carrying Capacity: 0 Sheep



Water Source
Analysis Unit Boundary
Community Boundary
Non Grazeable Range

**Distance to Water**
No Water Source
0-1 Mile
1-2 MIles
> 2 Miles

**Slope**
10 - 30%
30 - 60%
>60%

0 0.25 0.5
Miles

1:10,000

Ecosphere Environmental Services

Date: 2/9/2015

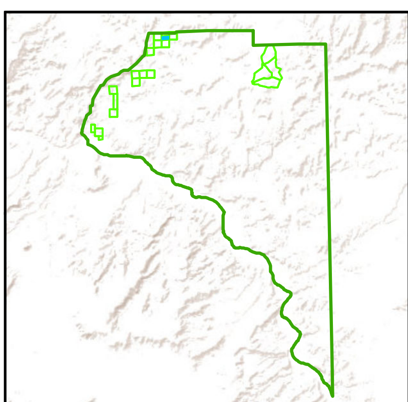
Coordinate System: NAD 1983 UTM Zone 12N

Document Name: P8X11_Slope_AdjCC_AllotRMU

**2014 Range Inventory**
**BIA Northern Navajo Agency**
**Land Management District 12**
**Aneth Community, SLC 033365**

Total Acres: 80
Grazeable Acres*: 78
*Total acres minus non grazeable areas and areas with > 60% slope.

Initial Annual Carrying Capacity:
<1 Sheep

Transect Location
Analysis Unit Boundary
Community Boundary
Non Grazeable Range
Soil Map Unit

N

0 0.25 0.5
Miles

1:10,000

Ecosphere
Environmental Services

Date: 2/9/2015

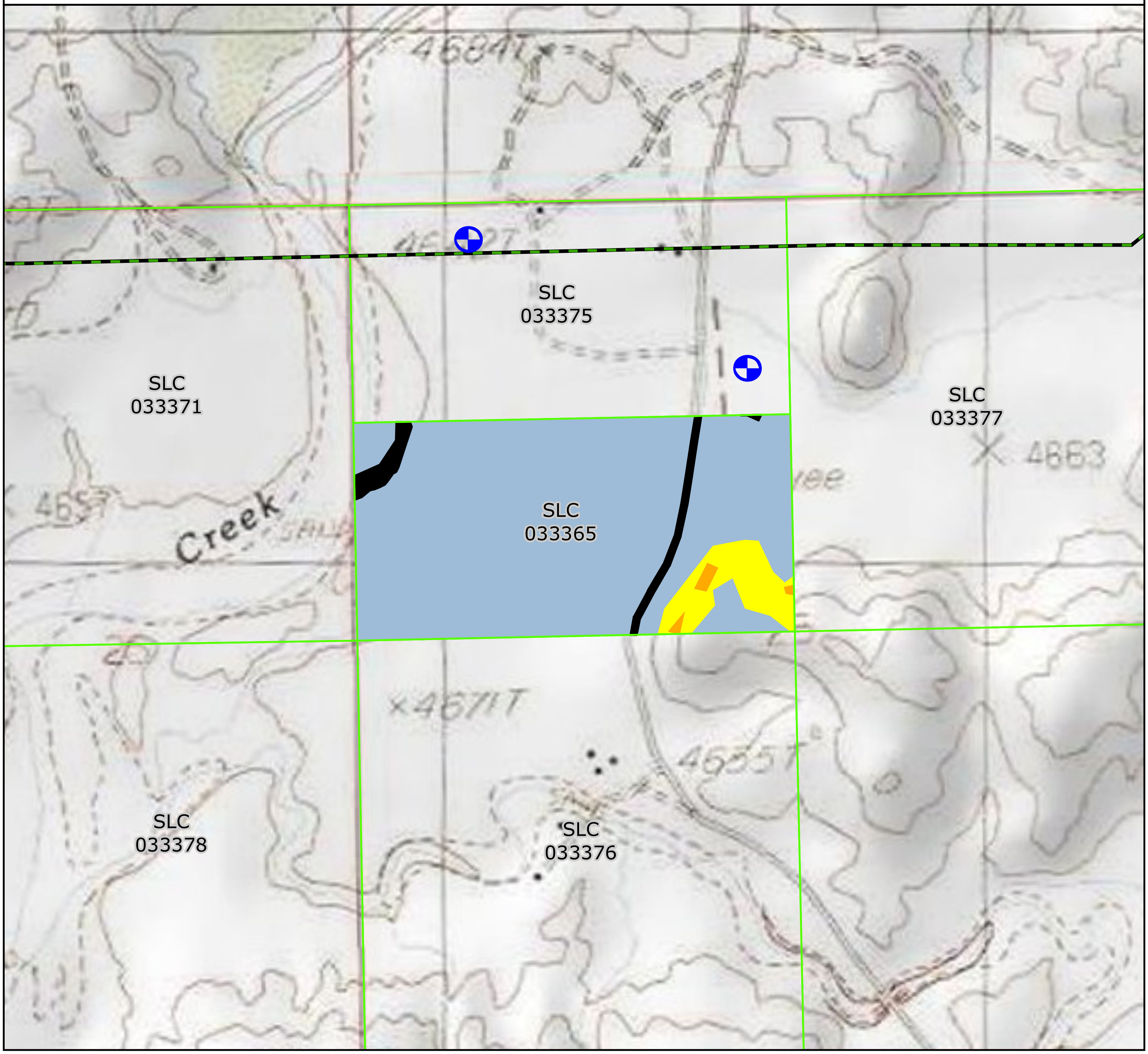
Coordinate System: NAD 1983 UTM Zone 12N

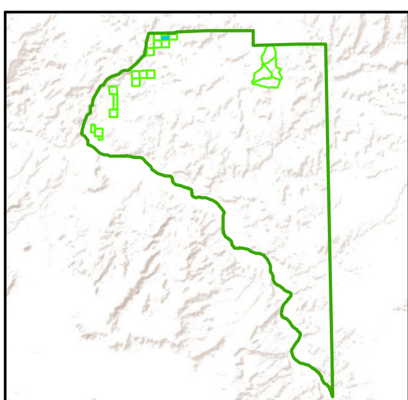
Document Name: P8X11_Soils_InitialCC_AllotRMU1

**2014 Range Inventory**
**BIA Northern Navajo Agency**
**Land Management District 12**
**Aneth Community, SLC 033365**

Total Acres: 80
Grazeable Acres*: 78
*Total acres minus non grazeable areas and areas with > 60% slope.

Adjusted Annual Carrying Capacity: 0 Sheep



Water Source
Analysis Unit Boundary
Community Boundary
Non Grazeable Range

**Distance to Water**
No Water Source
0-1 Mile
1-2 MIles
> 2 Miles

**Slope**
10 - 30%
30 - 60%
>60%

0 0.25 0.5
Miles

1:10,000

Ecosphere Environmental Services

Date: 2/9/2015

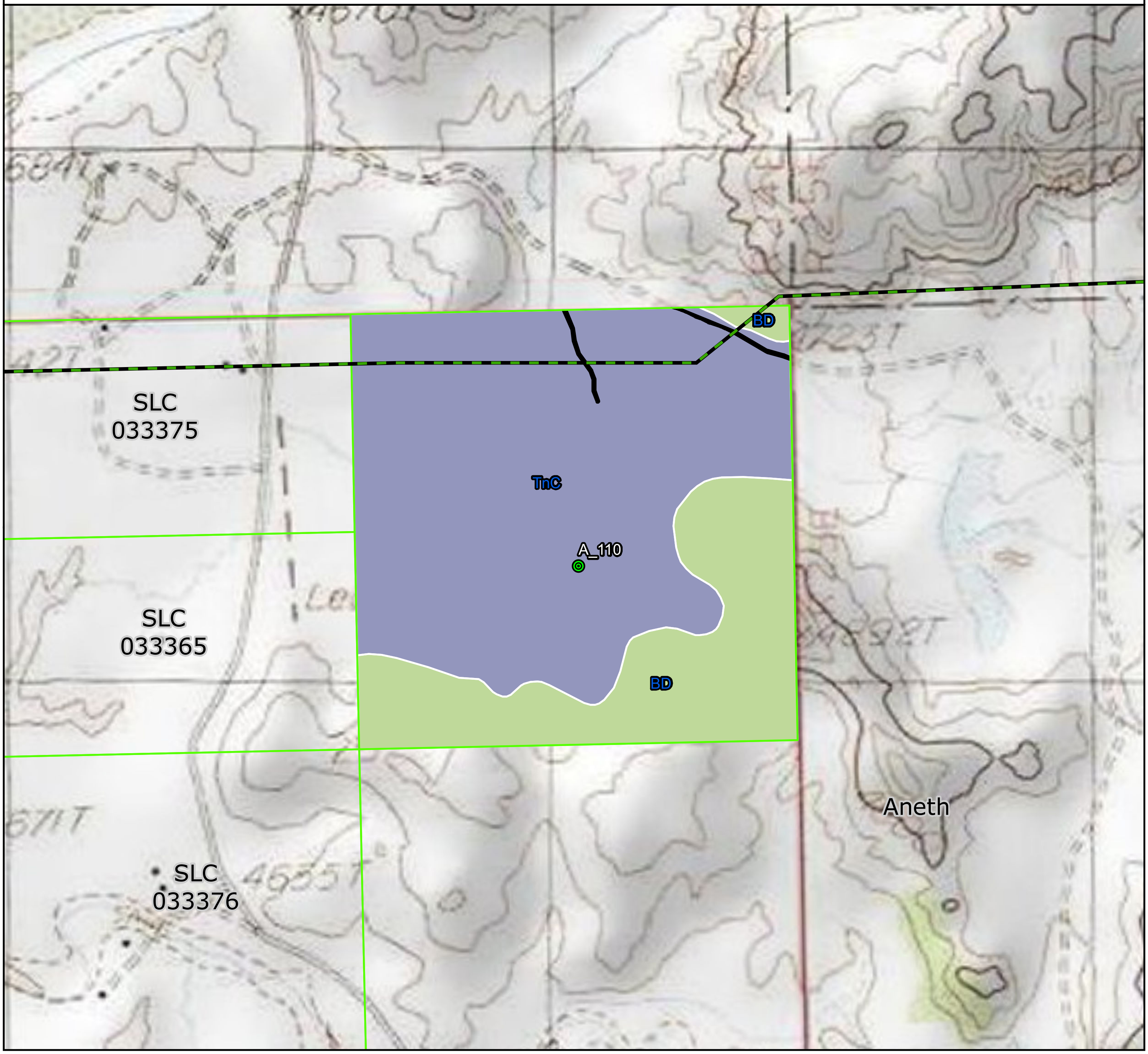
Coordinate System: NAD 1983 UTM Zone 12N

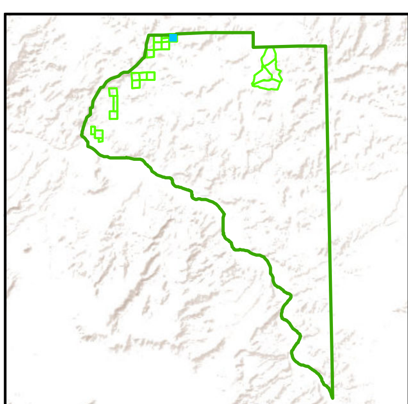
Document Name: P8X11_Slope_AdjCC_AllotRMU

# 2014 Range Inventory
# BIA Northern Navajo Agency
# Land Management District 12
## Aneth Community, SLC 033377

Total Acres: 161
Grazeable Acres*: 160
*Total acres minus non grazeable areas and areas with > 60% slope.

Initial Annual Carrying Capacity:
<1 Sheep



Transect Location
Analysis Unit Boundary
Community Boundary
Non Grazeable Range
Soil Map Unit

0 0.25 0.5
Miles
1:10,000

Ecosphere Environmental Services

Date: 2/9/2015

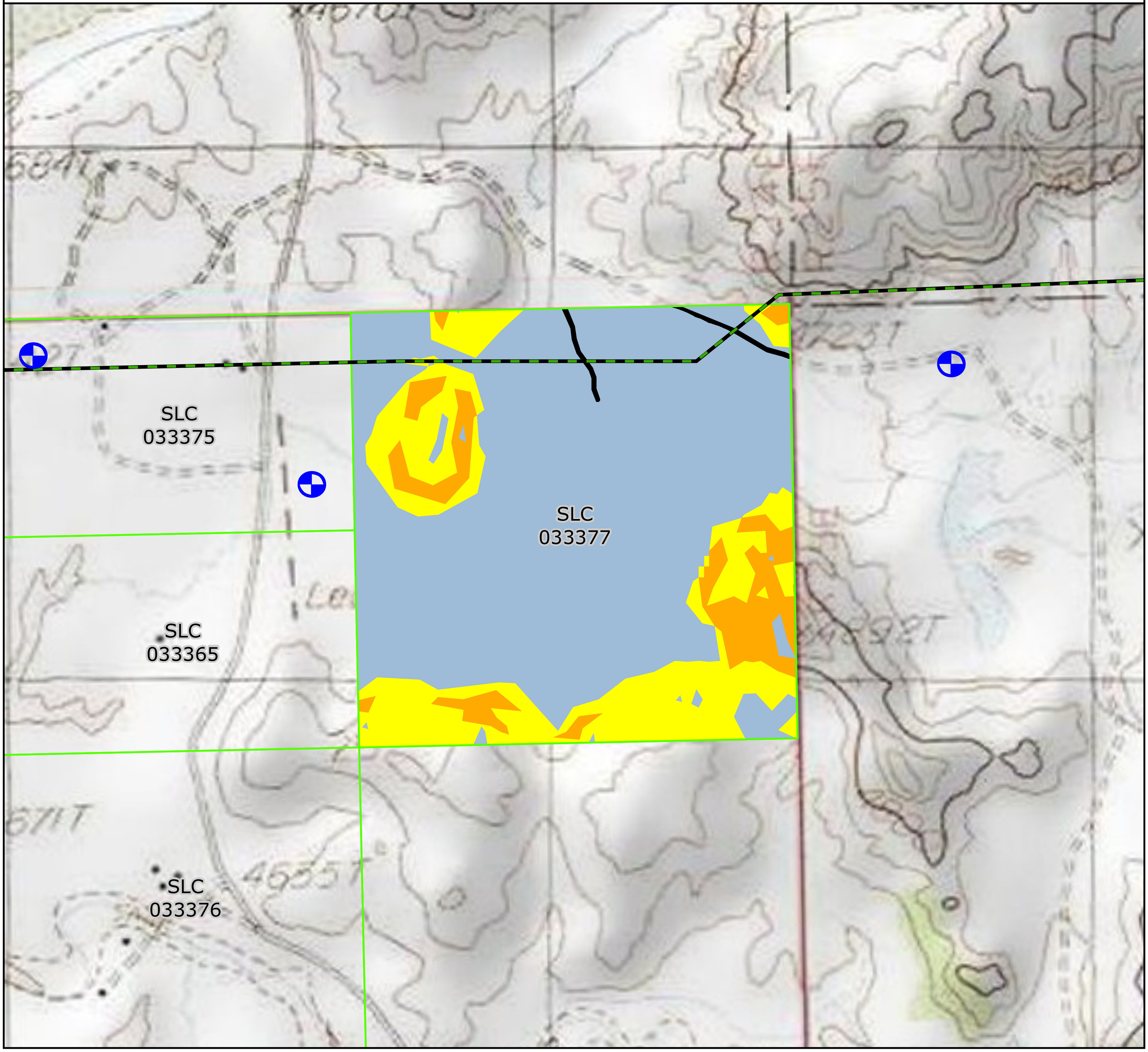
Coordinate System: NAD 1983 UTM Zone 12N

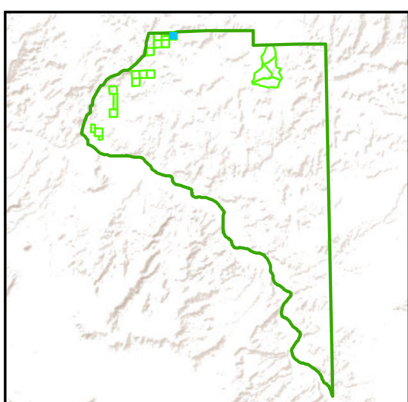
Document Name: P8X11_Soils_InitialCC_AllotRMU1

# 2014 Range Inventory
# BIA Northern Navajo Agency
# Land Management District 12
## Aneth Community, SLC 033377

Total Acres: 161
Grazeable Acres*: 160
*Total acres minus non grazeable areas and areas with > 60% slope.

Adjusted Annual Carrying Capacity: 0 Sheep



Water Source
Analysis Unit Boundary
Community Boundary
Non Grazeable Range

**Distance to Water**
No Water Source
0-1 Mile
1-2 MIles
> 2 Miles

**Slope**
10 - 30%
30 - 60%
>60%

0 0.25 0.5 Miles

1:10,000

Ecosphere Environmental Services

Date: 2/9/2015

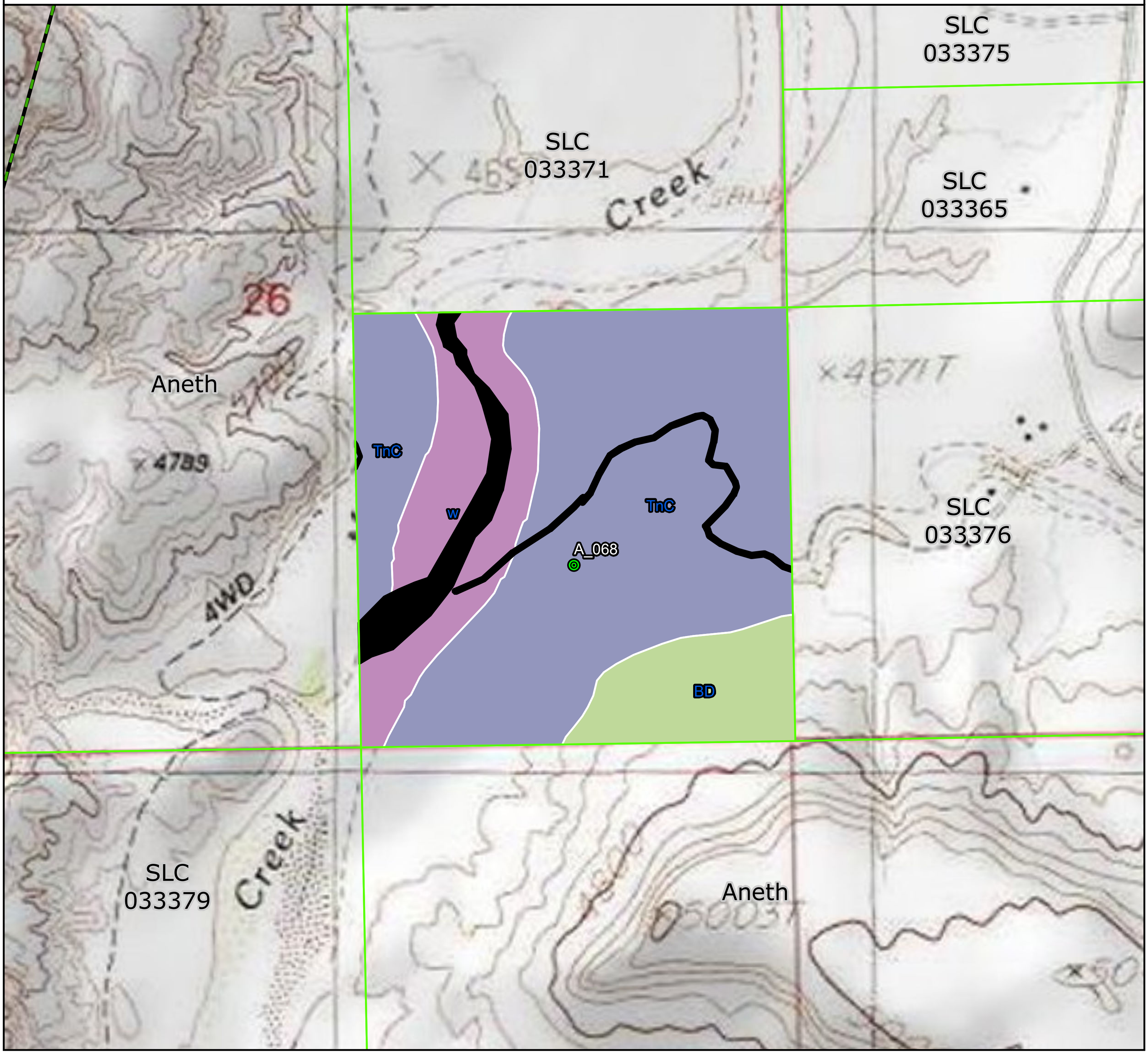
Coordinate System: NAD 1983 UTM Zone 12N

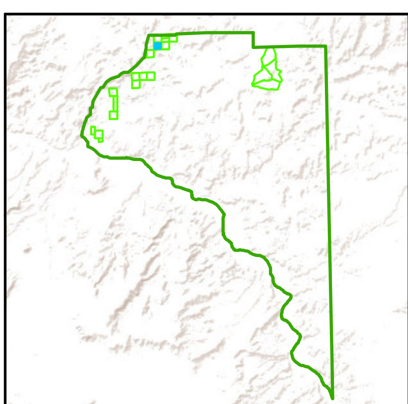
Document Name: P8X11_Slope_AdjCC_AllotRMU

**2014 Range Inventory**
**BIA Northern Navajo Agency**
**Land Management District 12**
**Aneth Community, SLC 033378**

Total Acres: 159
Grazeable Acres*: 148
*Total acres minus non grazeable areas and areas with > 60% slope.

Initial Annual Carrying Capacity:
<1 Sheep



Transect Location
Non Grazeable Range
Analysis Unit Boundary
Soil Map Unit
Community Boundary

0 0.25 0.5
Miles

1:10,000

Ecosphere Environmental Services

Date: 2/9/2015

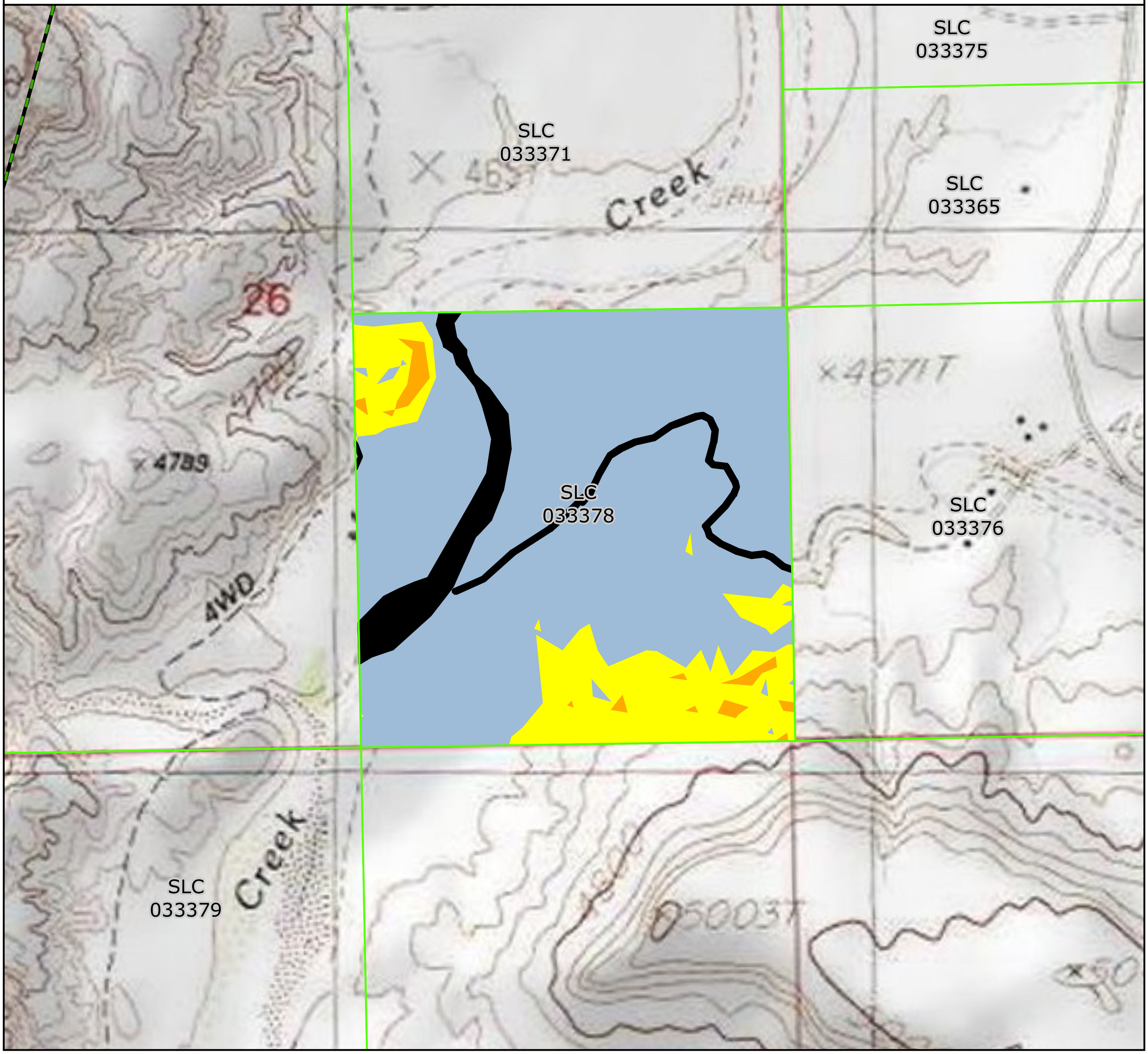
Coordinate System: NAD 1983 UTM Zone 12N

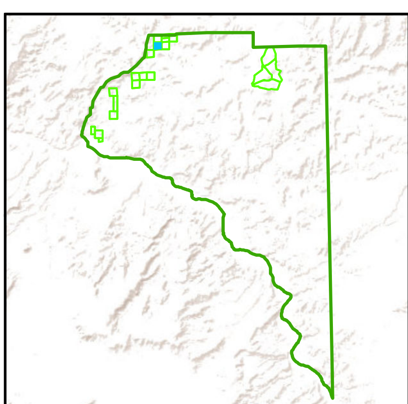
Document Name: P8X11_Soils_InitialCC_AllotRMU1

**2014 Range Inventory**
**BIA Northern Navajo Agency**
**Land Management District 12**
**Aneth Community, SLC 033378**

Total Acres: 159
Grazeable Acres*: 148
*Total acres minus non grazeable areas and areas with > 60% slope.

Adjusted Annual Carrying Capacity: 0 Sheep



Water Source
Analysis Unit Boundary
Community Boundary
Non Grazeable Range

**Distance to Water**
No Water Source
0-1 Mile
1-2 MIles
> 2 Miles

**Slope**
10 - 30%
30 - 60%
>60%

0 0.25 0.5
Miles

1:10,000

Ecosphere Environmental Services

Date: 2/9/2015

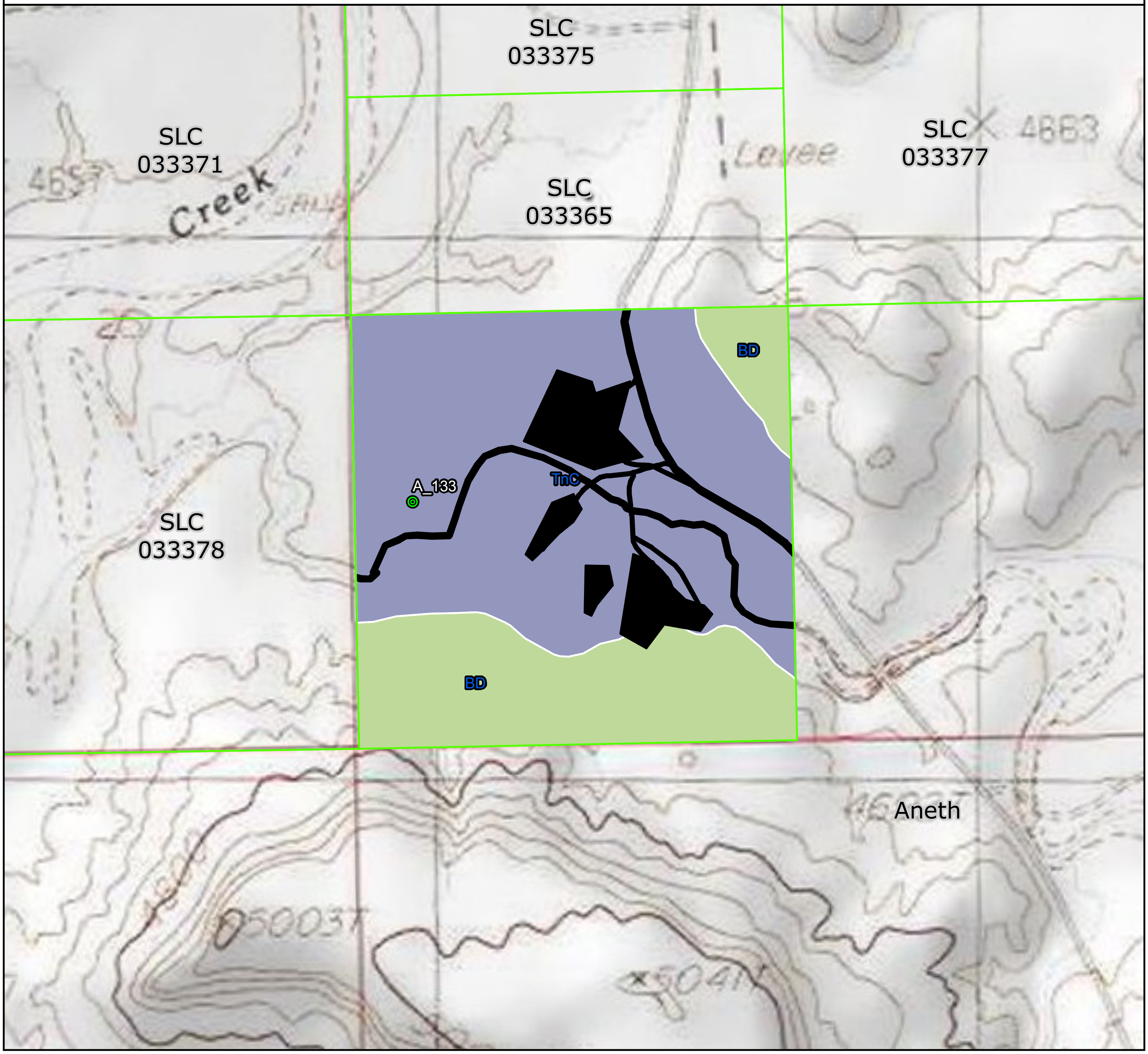
Coordinate System: NAD 1983 UTM Zone 12N

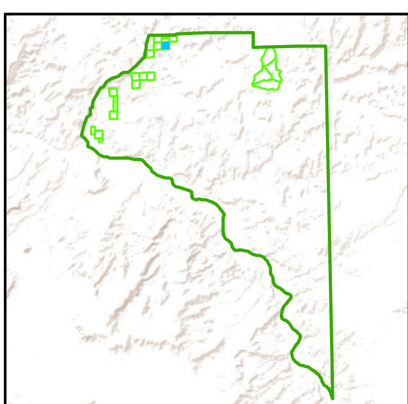
Document Name: P8X11_Slope_AdjCC_AllotRMU

**2014 Range Inventory**
**BIA Northern Navajo Agency**
**Land Management District 12**
**Aneth Community, SLC 033376**

Total Acres: 160
Grazeable Acres*: 143
*Total acres minus non grazeable areas and areas with > 60% slope.

Initial Annual Carrying Capacity: <1 Sheep



Transect Location
Non Grazeable Range
Unit Boundary
Soil Map Unit
Community Boundary

N

0 0.25 0.5
Miles

1:10,000

Ecosphere Environmental Services

Date: 2/9/2015

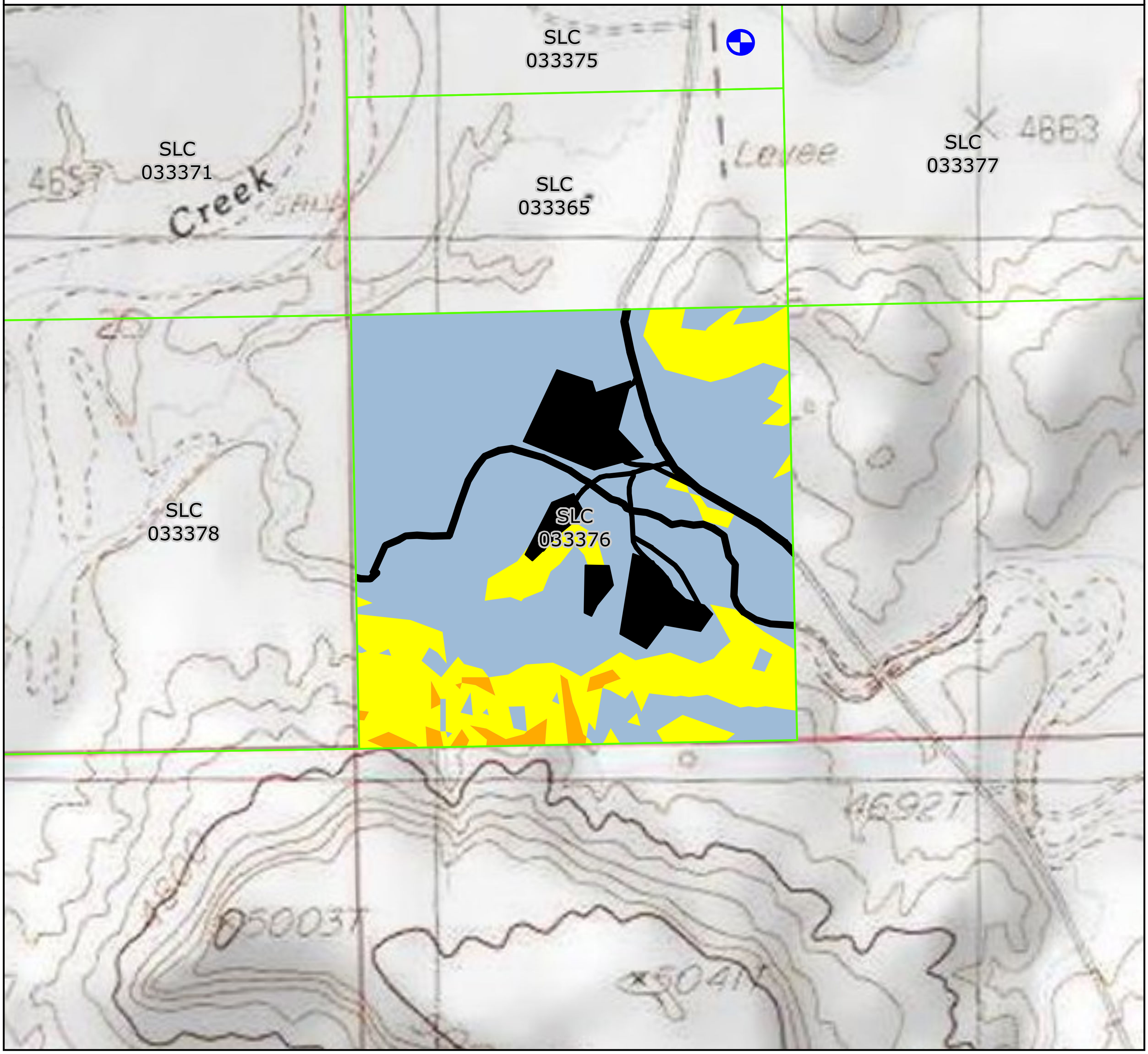
Coordinate System: NAD 1983 UTM Zone 12N

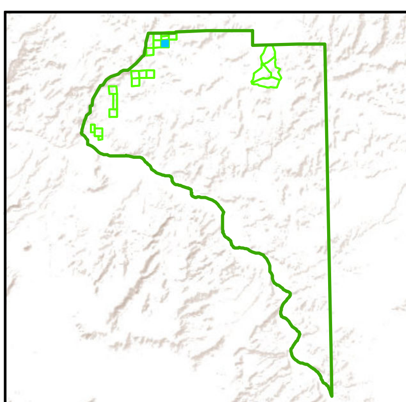
Document Name: P8X11_Soils_InitialCC_AllotRMU1

**2014 Range Inventory**
**BIA Northern Navajo Agency**
**Land Management District 12**
**Aneth Community, SLC 033376**

Total Acres: 160
Grazeable Acres*: 143
*Total acres minus non grazeable areas and areas with > 60% slope.

Adjusted Annual Carrying Capacity: 0 Sheep



Water Source
Analysis Unit Boundary
Community Boundary
Non Grazeable Range

**Distance to Water**
- No Water Source
- 0-1 Mile
- 1-2 MIles
- > 2 Miles

**Slope**
- 10 - 30%
- 30 - 60%
- >60%

0 — 0.25 — 0.5 Miles

1:10,000

Ecosphere Environmental Services

Date: 2/9/2015

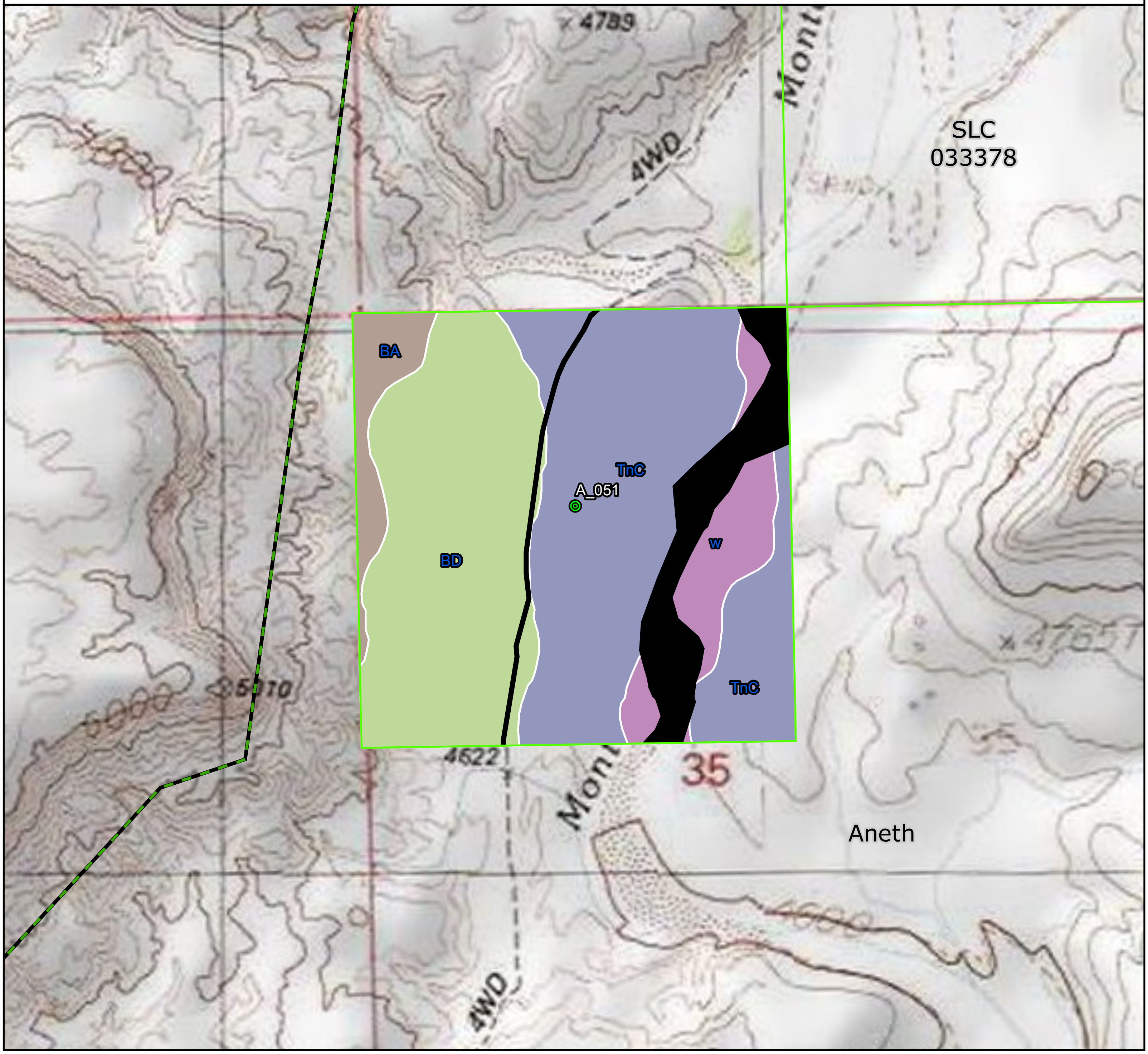
Coordinate System: NAD 1983 UTM Zone 12N

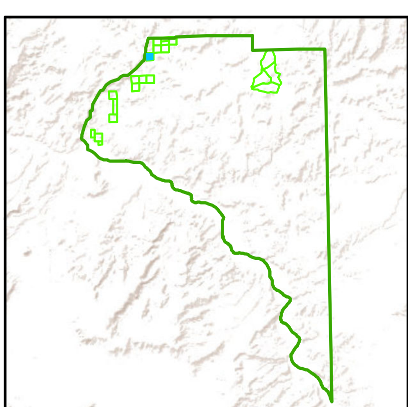
Document Name: P8X11_Slope_AdjCC_AllotRMU

## 2014 Range Inventory
## BIA Northern Navajo Agency
## Land Management District 12
### Aneth Community, SLC 033379

Total Acres: 159
Grazeable Acres*: 144
*Total acres minus non grazeable areas and areas with > 60% slope.

Initial Annual Carrying Capacity:
<1 Sheep



Transect Location
Analysis Unit Boundary
Community Boundary
Non Grazeable Range
Soil Map Unit

0 0.25 0.5
Miles

1:10,000

Coordinate System: NAD 1983 UTM Zone 12N

Ecosphere Environmental Services

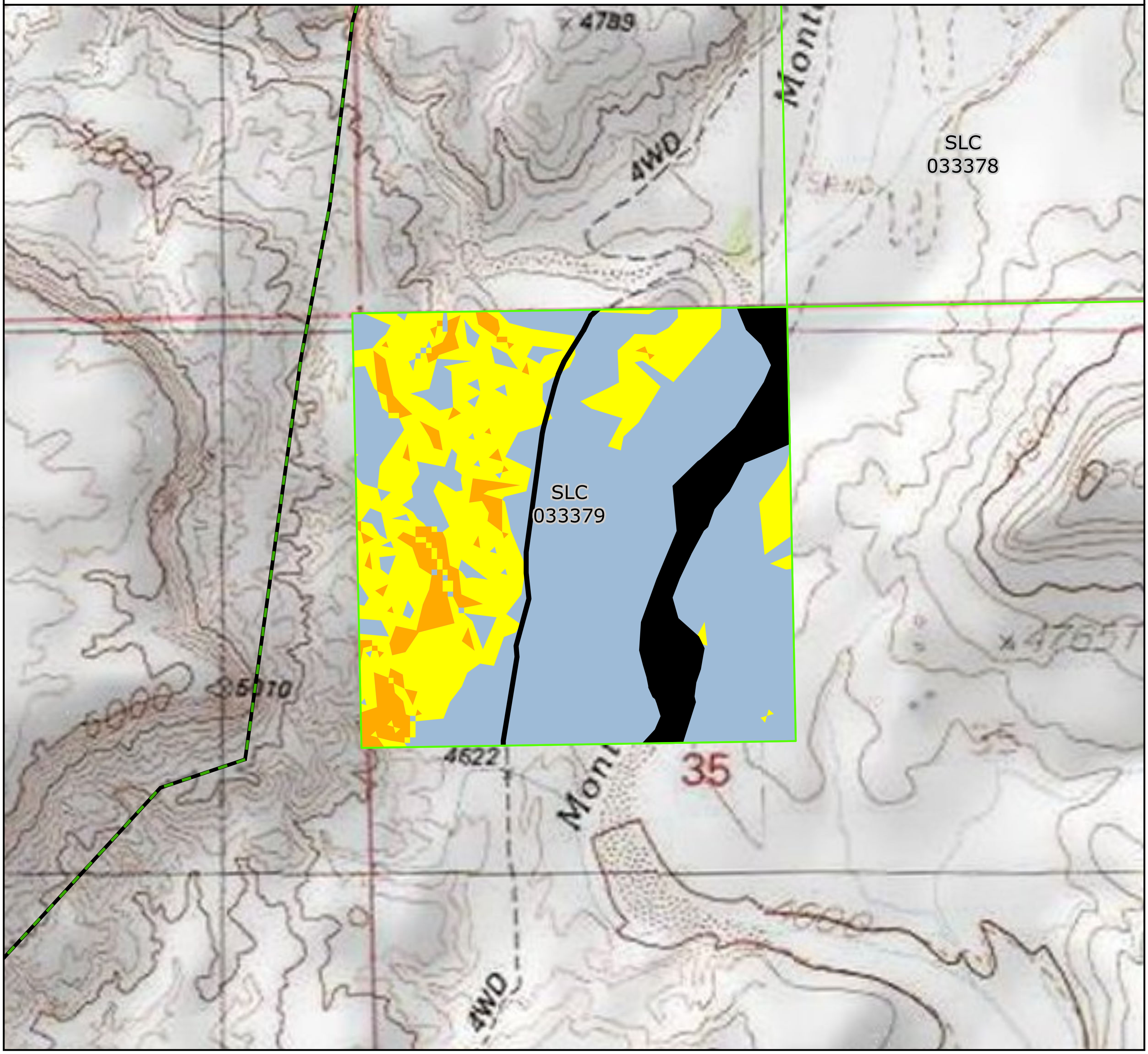
Date: 2/9/2015

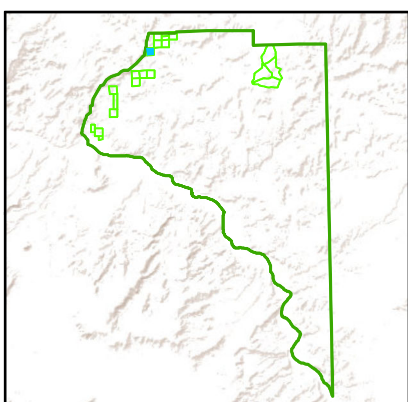
Document Name: P8X11_Soils_InitialCC_AllotRMU1

**2014 Range Inventory**
**BIA Northern Navajo Agency**
**Land Management District 12**
**Aneth Community, SLC 033379**

Total Acres: 159
Grazeable Acres*: 144
*Total acres minus non grazeable areas and areas with > 60% slope.

Adjusted Annual Carrying Capacity: 0 Sheep



Water Source
Analysis Unit Boundary
Community Boundary
Non Grazeable Range

**Distance to Water**

No Water Source
0-1 Mile
1-2 MIles
> 2 Miles

**Slope**

10 - 30%
30 - 60%
>60%

0 0.25 0.5
Miles

1:10,000

Ecosphere Environmental Services

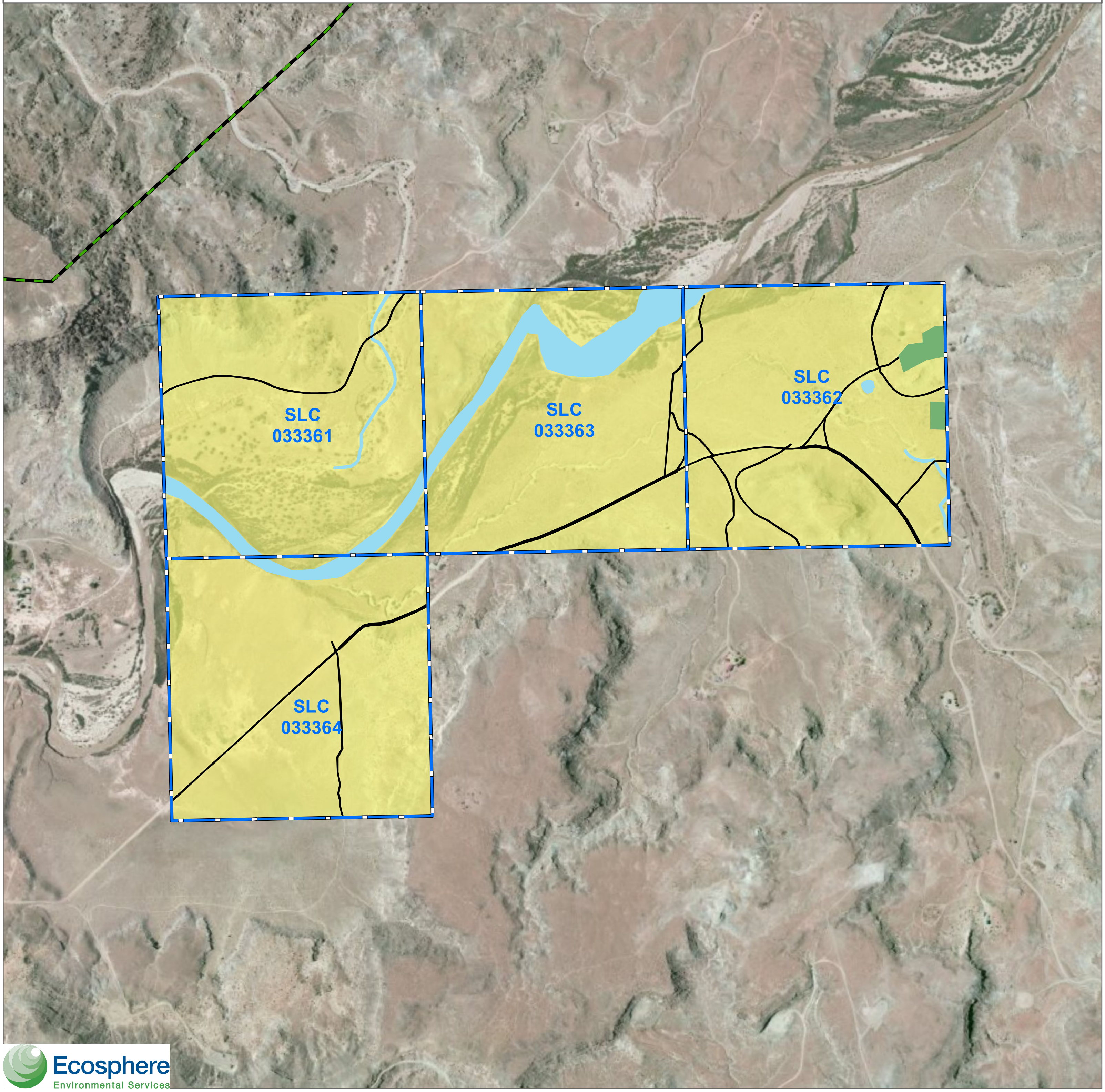
Date: 2/9/2015

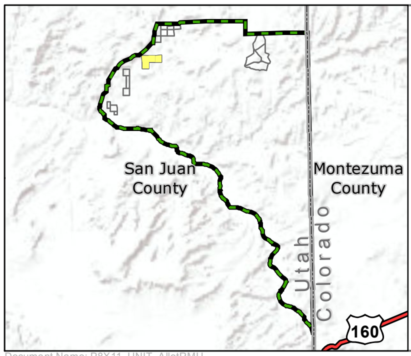
Coordinate System: NAD 1983 UTM Zone 12N

Document Name: P8X11_Slope_AdjCC_AllotRMU

**2014 Range Inventory**
**BIA Northern Navajo Agency**
**Land Management District 12**

**Aneth Community Allotments**




Analysis Unit

Allotment Boundary

Community Boundary

**Non Grazeable Range**

Developed

Hydrology

Roads

0 0.5 1

Miles

1:16,000

Date: 2/9/2015

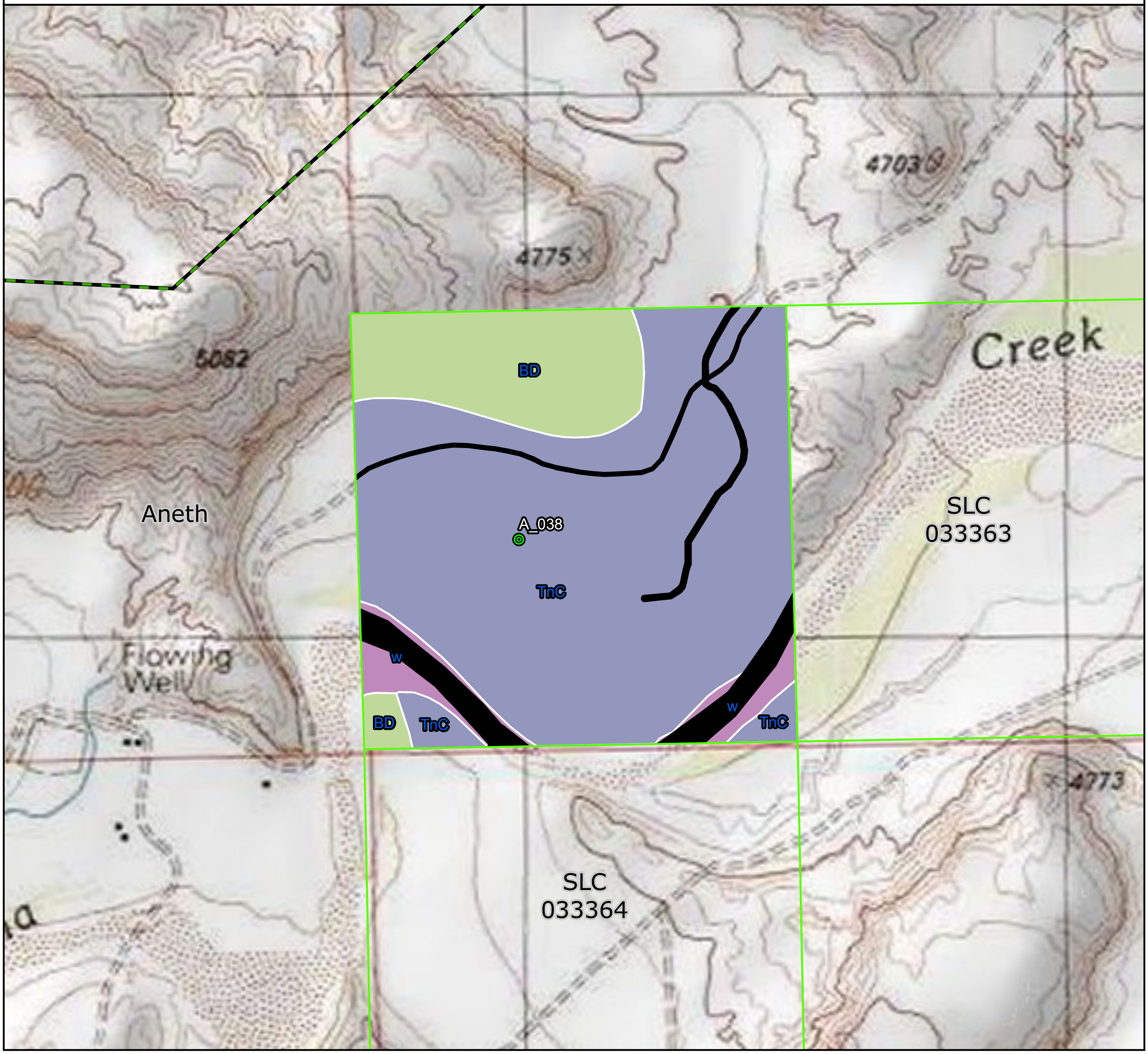
Coordinate System: NAD 1983 UTM Zone 12N

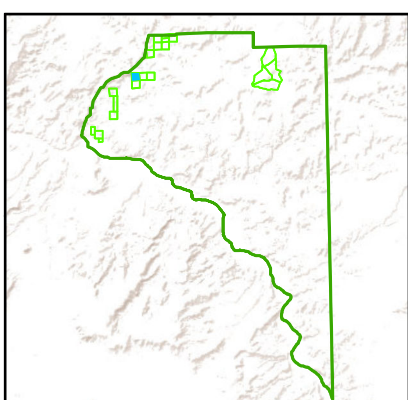
Document Name: P8X11_UNIT_AllotRMU

**2014 Range Inventory**
**BIA Northern Navajo Agency**
**Land Management District 12**
**Aneth Community, SLC 033361**

Total Acres: 160
Grazeable Acres*: 147
*Total acres minus non grazeable areas and areas with > 60% slope.

Initial Annual Carrying Capacity: <1 Sheep



Transect Location
Analysis Unit Boundary
Community Boundary
Non Grazeable Range
Soil Map Unit

0 0.25 0.5
Miles

1:10,000

Coordinate System: NAD 1983 UTM Zone 12N

Ecosphere Environmental Services

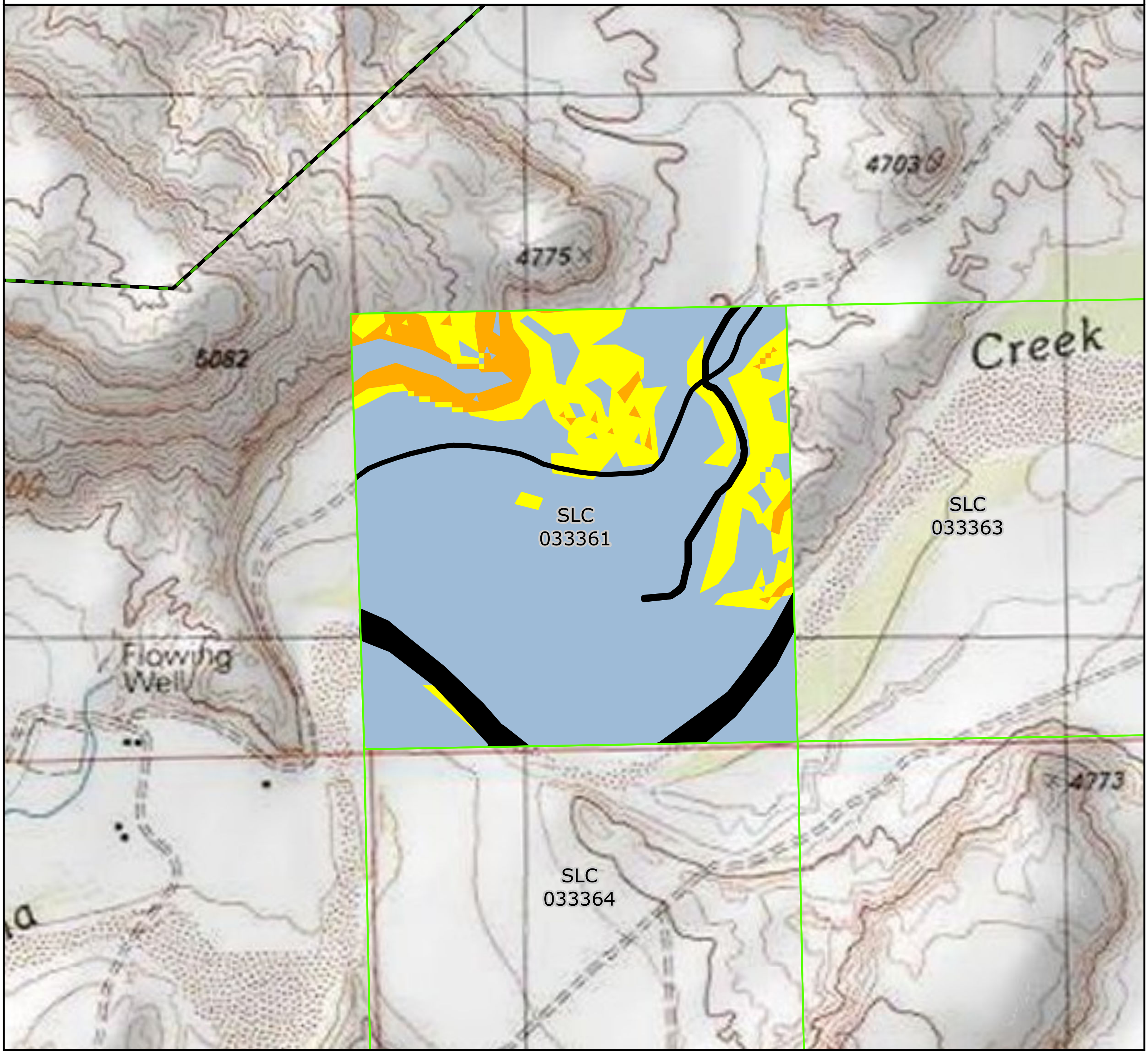
Date: 2/20/2015

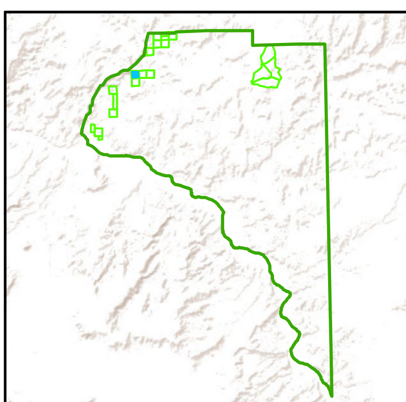
Document Name: P8X11_Soils_InitialCC_AllotRMU

**2014 Range Inventory**
**BIA Northern Navajo Agency**
**Land Management District 12**
**Aneth Community, SLC 033361**

Total Acres: 160
Grazeable Acres*: 147
*Total acres minus non grazeable areas and areas with > 60% slope.

Adjusted Annual Carrying Capacity: 0 Sheep



Water Source
Analysis Unit Boundary
Community Boundary
Non Grazeable Range

**Distance to Water**
No Water Source
0-1 Mile
1-2 MIles
> 2 Miles

**Slope**
10 - 30%
30 - 60%
>60%

0 0.25 0.5
Miles
1:10,000

Ecosphere Environmental Services

Date: 2/9/2015

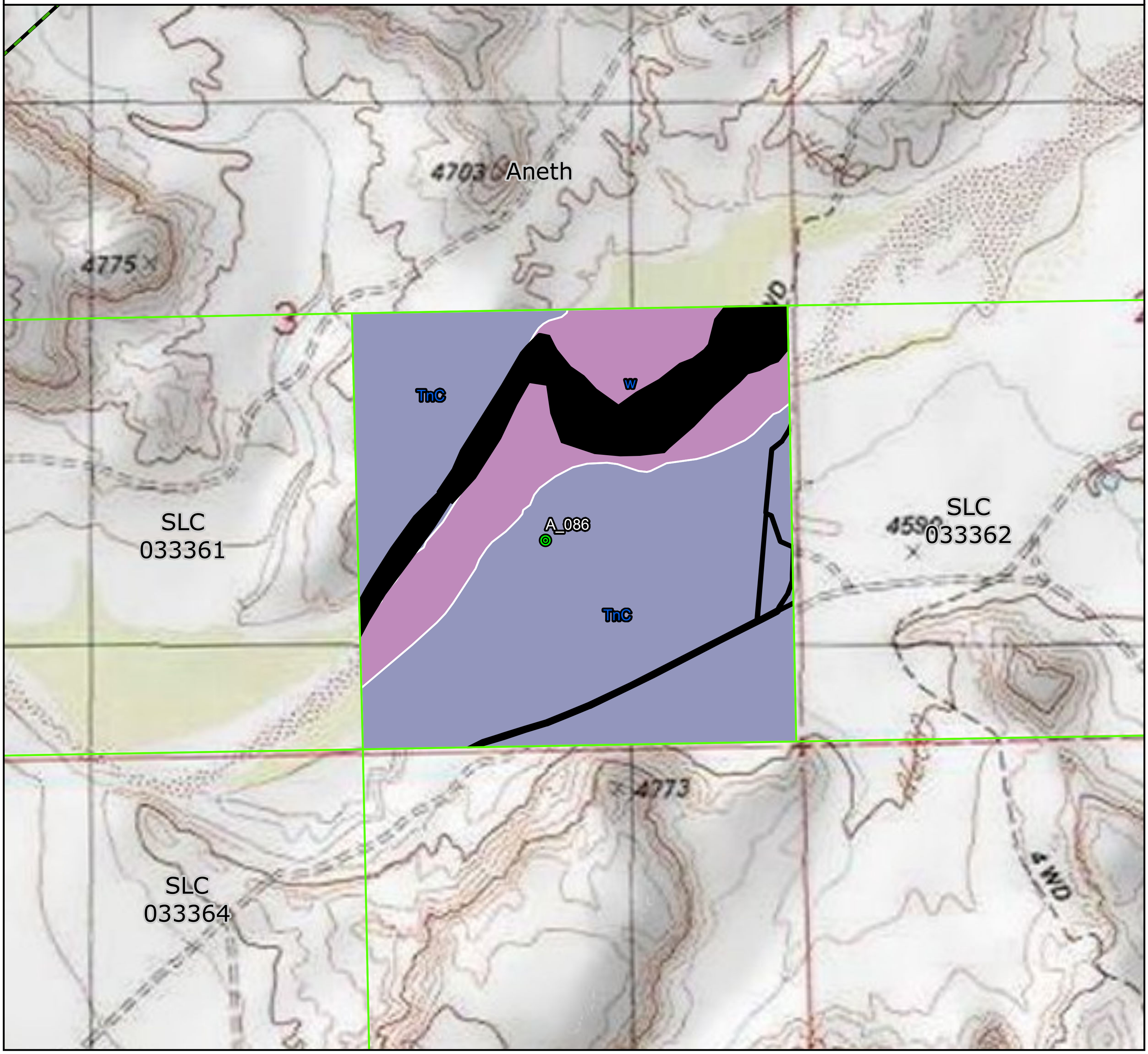
Coordinate System: NAD 1983 UTM Zone 12N

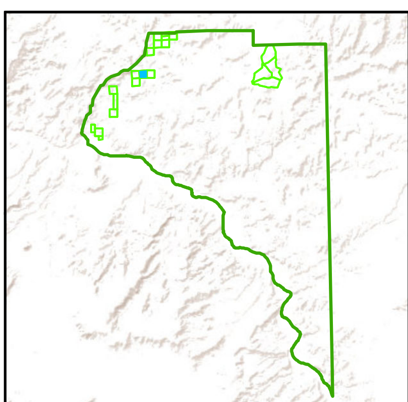
Document Name: P8X11_Slope_AdjCC_AllotRMU

**2014 Range Inventory**
**BIA Northern Navajo Agency**
**Land Management District 12**
**Aneth Community, SLC 033363**

Total Acres: 160
Grazeable Acres*: 137
*Total acres minus non grazeable areas and areas with > 60% slope.

Initial Annual Carrying Capacity:
<1 Sheep



Transect Location
Analysis Unit Boundary
Community Boundary
Non Grazeable Range
Soil Map Unit

0 0.25 0.5
Miles

1:10,000

Ecosphere Environmental Services

Date: 2/9/2015

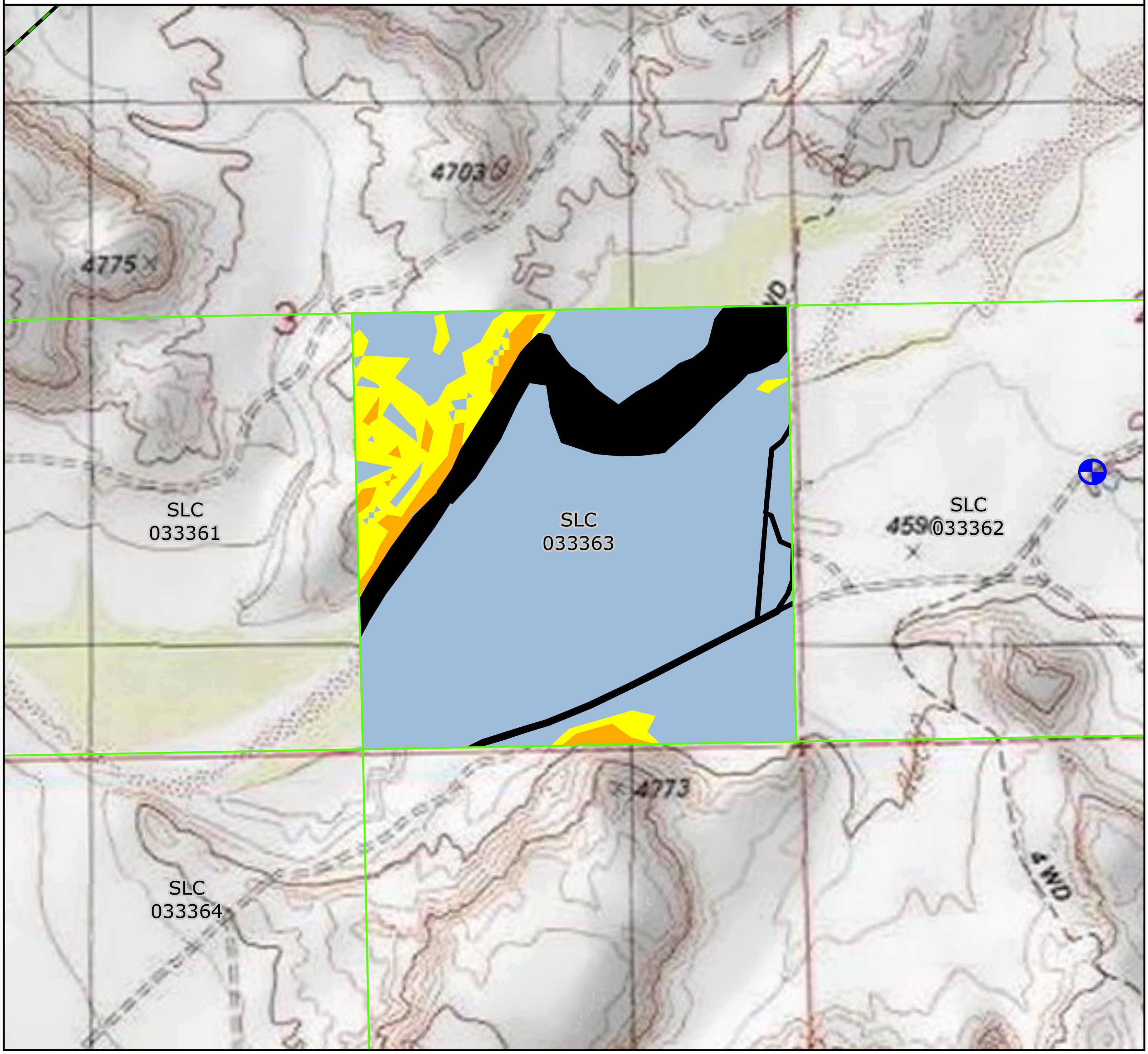
Coordinate System: NAD 1983 UTM Zone 12N

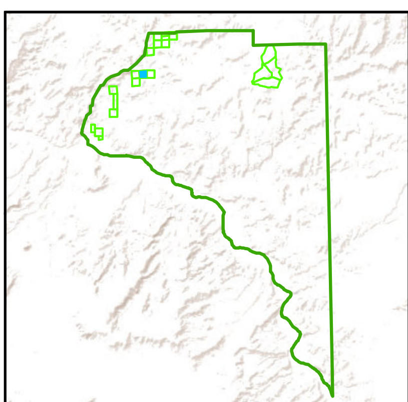
Document Name: P8X11_Soils_InitialCC_AllotRMU1

**2014 Range Inventory**
**BIA Northern Navajo Agency**
**Land Management District 12**
**Aneth Community, SLC 033363**

Total Acres: 160
Grazeable Acres*: 137
*Total acres minus non grazeable areas and areas with > 60% slope.

Adjusted Annual Carrying Capacity:
0 Sheep



Water Source
Analysis Unit Boundary
Community Boundary
Non Grazeable Range

**Distance to Water**
No Water Source
0-1 Mile
1-2 MIles
> 2 Miles

**Slope**
10 - 30%
30 - 60%
>60%

0 0.25 0.5
Miles
1:10,000

Ecosphere Environmental Services

Date: 2/9/2015

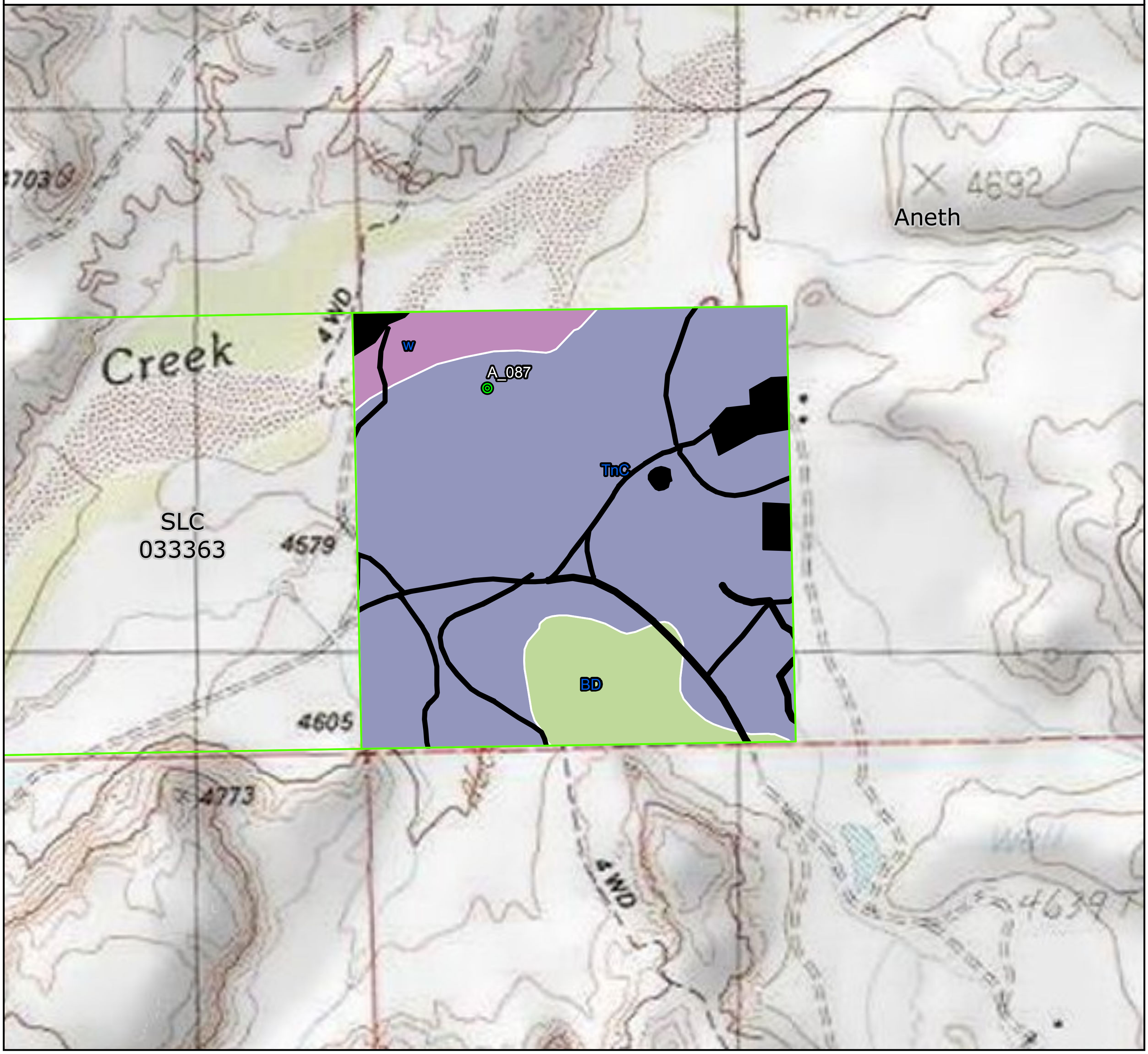
Coordinate System: NAD 1983 UTM Zone 12N

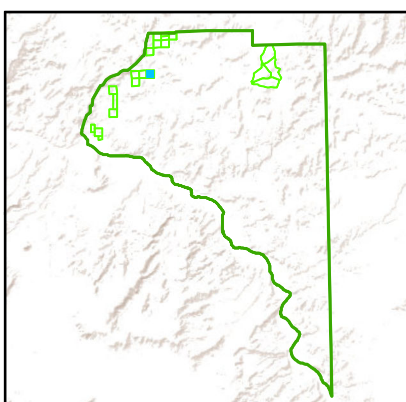
Document Name: P8X11_Slope_AdjCC_AllotRMU

**2014 Range Inventory**
**BIA Northern Navajo Agency**
**Land Management District 12**
**Aneth Community, SLC 033362**

Total Acres: 160
Grazeable Acres*: 148
*Total acres minus non grazeable areas and areas with > 60% slope.

Initial Annual Carrying Capacity: <1 Sheep



Transect Location
Non Grazeable Range
Analysis Unit Boundary
Soil Map Unit
Community Boundary

0 0.25 0.5
Miles

1:10,000

Ecosphere Environmental Services

Date: 2/9/2015

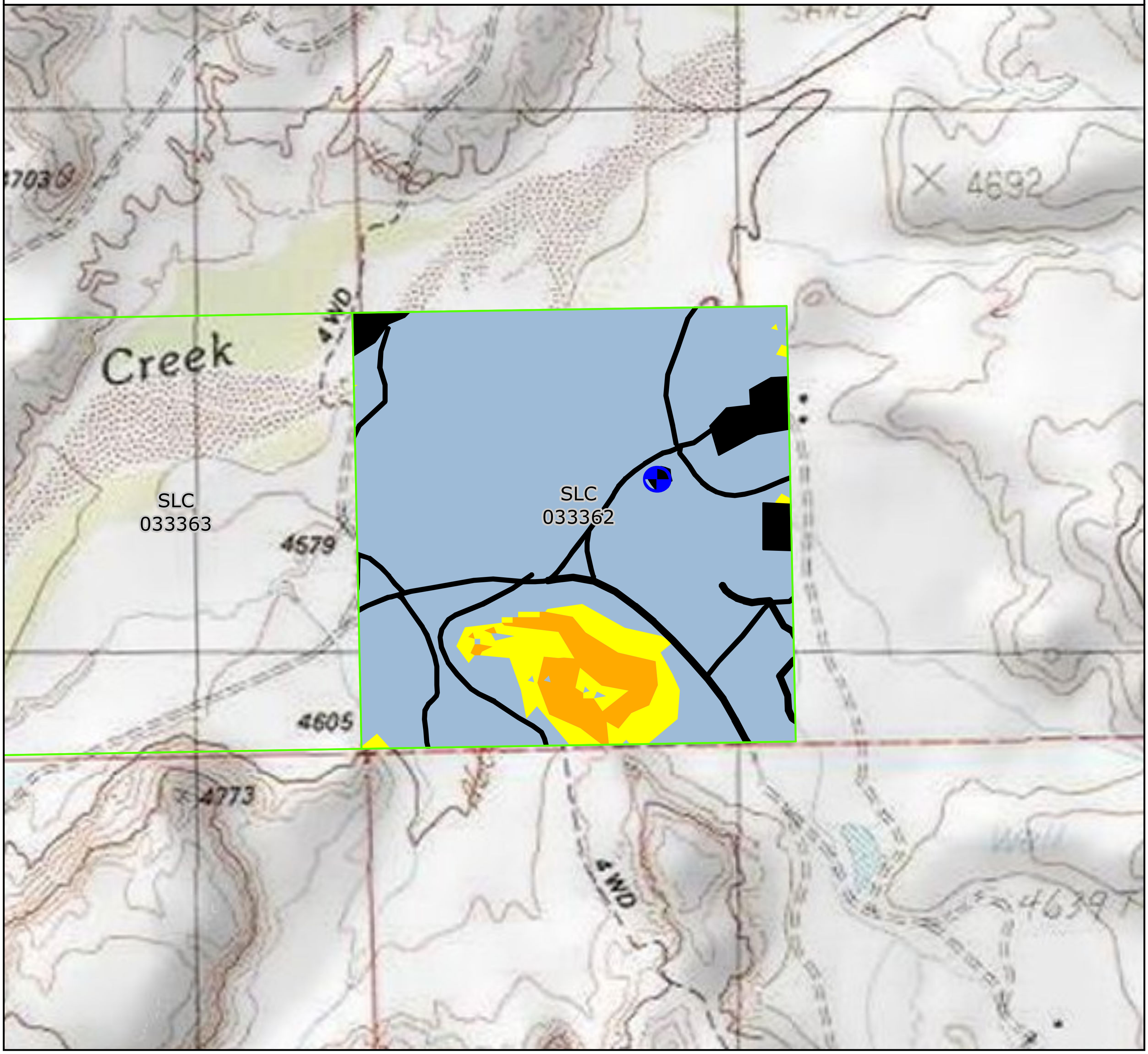
Coordinate System: NAD 1983 UTM Zone 12N

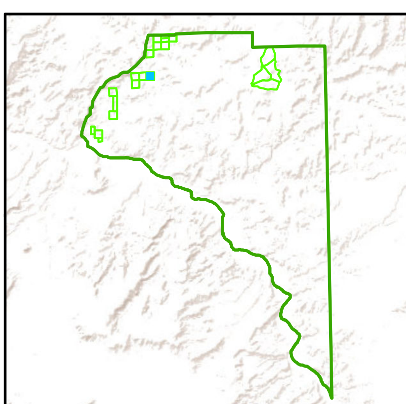
Document Name: P8X11_Soils_InitialCC_AllotRMU1

**2014 Range Inventory**
**BIA Northern Navajo Agency**
**Land Management District 12**
**Aneth Community, SLC 033362**

Total Acres: 160
Grazeable Acres*: 148
*Total acres minus non grazeable areas and areas with > 60% slope.

Adjusted Annual Carrying Capacity:
0 Sheep



Water Source
Analysis Unit Boundary
Community Boundary
Non Grazeable Range

**Distance to Water**
No Water Source
0-1 Mile
1-2 MIles
> 2 Miles

**Slope**
10 - 30%
30 - 60%
>60%

0 0.25 0.5
Miles

1:10,000

Ecosphere Environmental Services

Date: 2/9/2015

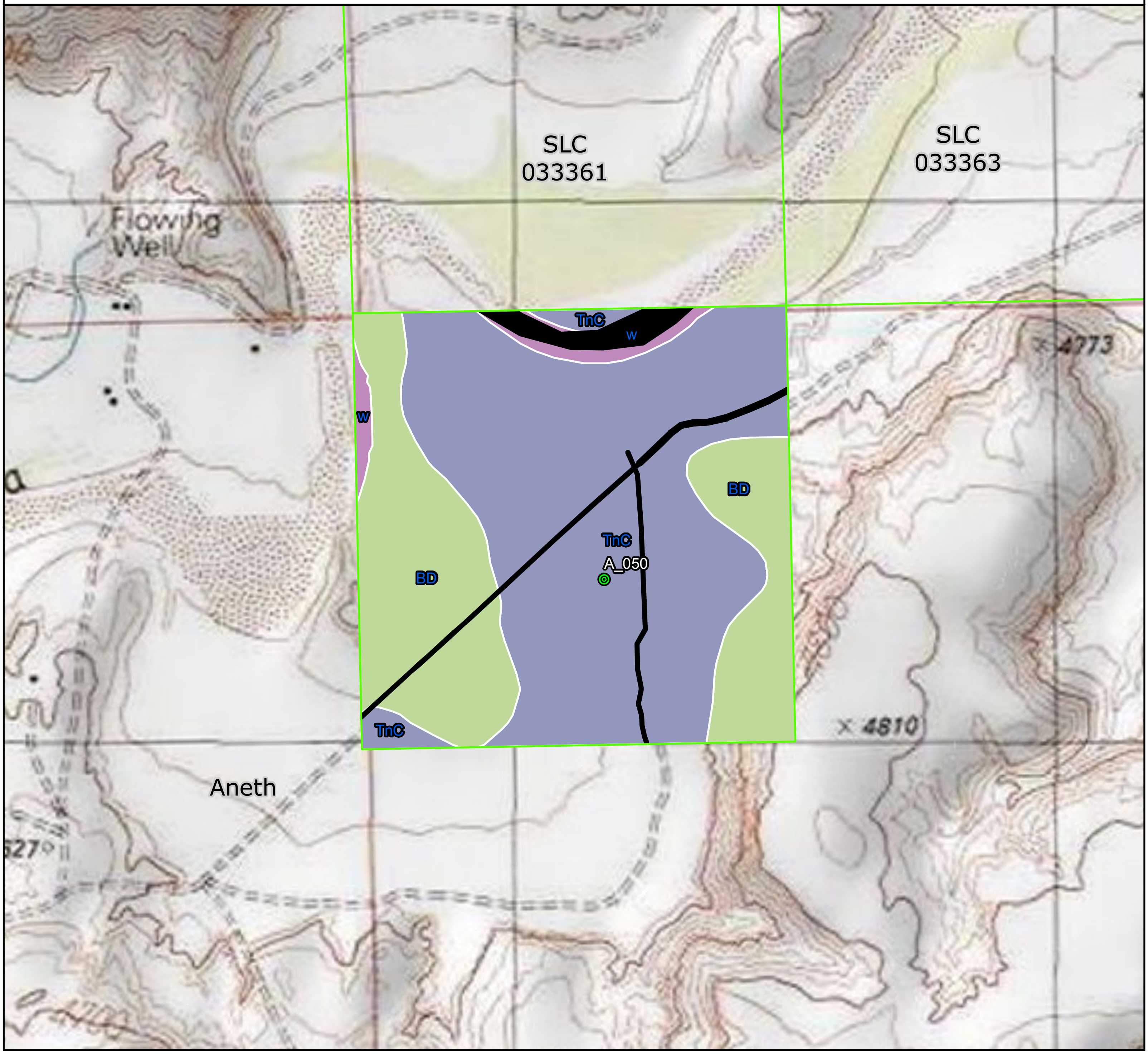
Coordinate System: NAD 1983 UTM Zone 12N

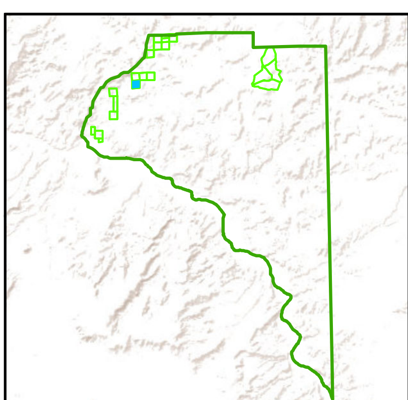
Document Name: P8X11_Slope_AdjCC_AllotRMU

**2014 Range Inventory**
**BIA Northern Navajo Agency**
**Land Management District 12**
**Aneth Community, SLC 033364**

Total Acres: 159
Grazeable Acres*: 152
*Total acres minus non grazeable areas and areas with > 60% slope.

Initial Annual Carrying Capacity:
<1 Sheep



Transect Location
Analysis Unit Boundary
Community Boundary
Non Grazeable Range
Soil Map Unit

N

0 0.25 0.5
Miles

1:10,000

Ecosphere Environmental Services

Date: 2/9/2015

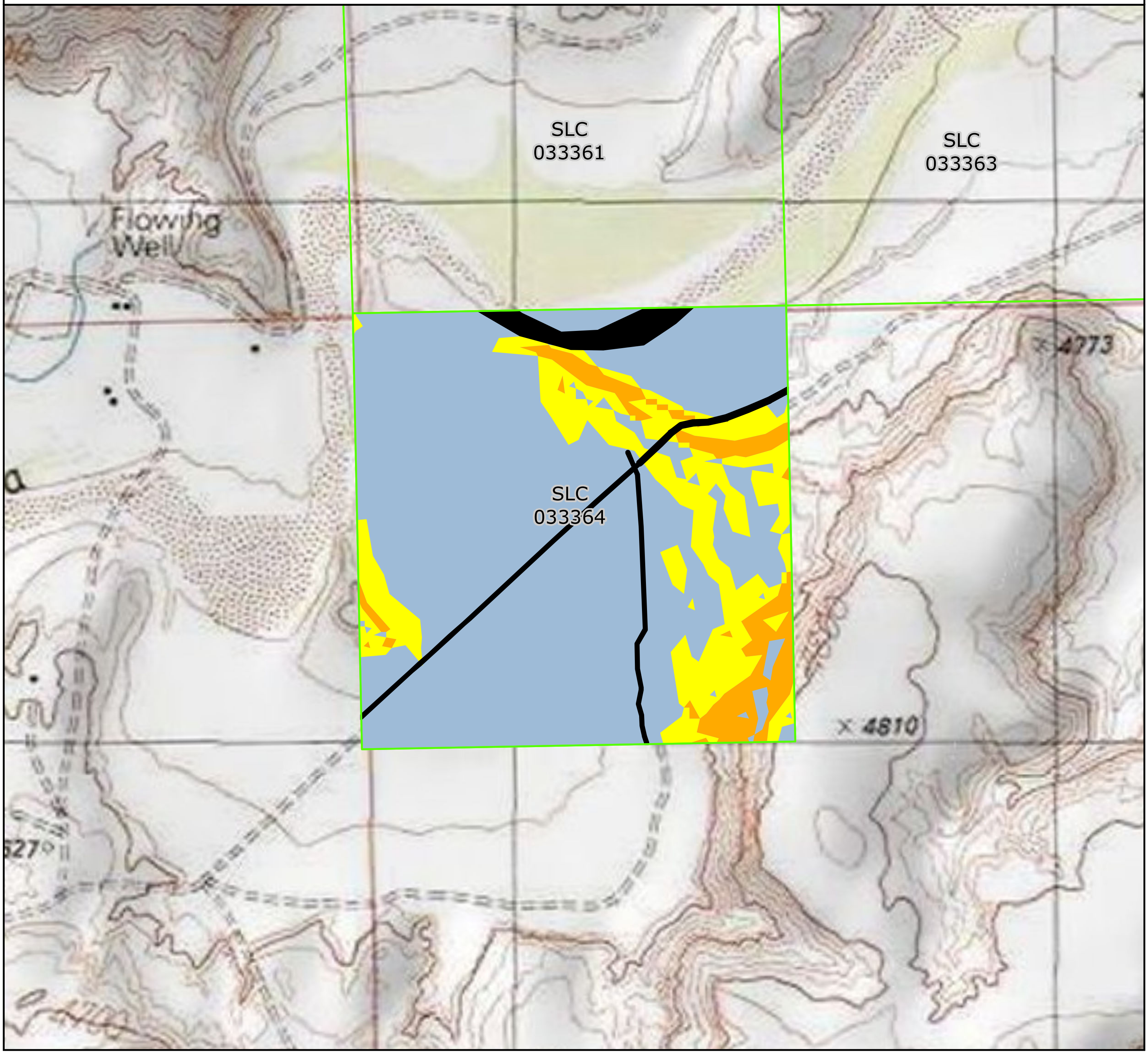
Coordinate System: NAD 1983 UTM Zone 12N

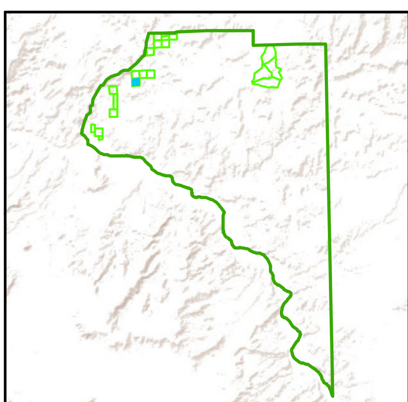
Document Name: P8X11_Soils_InitialCC_AllotRMU1

**2014 Range Inventory**
**BIA Northern Navajo Agency**
**Land Management District 12**
**Aneth Community, SLC 033364**

Total Acres: 159
Grazeable Acres*: 152
*Total acres minus non grazeable areas and areas with > 60% slope.

Adjusted Annual Carrying Capacity: 0 Sheep



Water Source
Analysis Unit Boundary
Community Boundary
Non Grazeable Range

**Distance to Water**
No Water Source
0-1 Mile
1-2 MIles
> 2 Miles

**Slope**
10 - 30%
30 - 60%
>60%

0 0.25 0.5
Miles

1:10,000

Coordinate System: NAD 1983 UTM Zone 12N

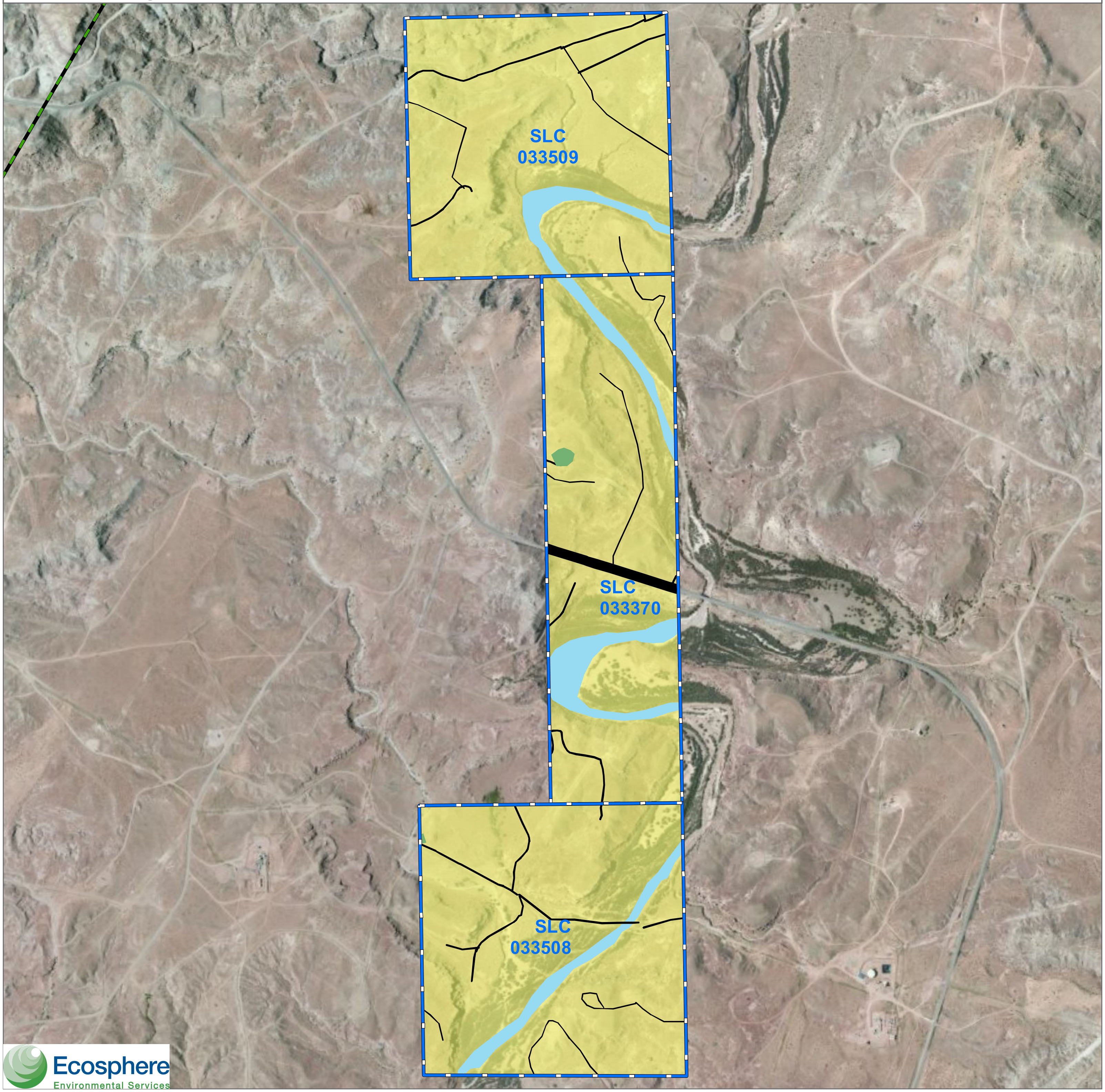
Ecosphere Environmental Services

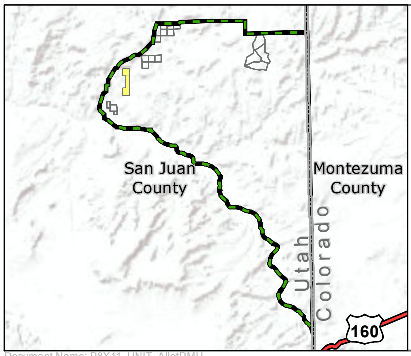
Date: 2/9/2015

Document Name: P8X11_Slope_AdjCC_AllotRMU

**2014 Range Inventory**
**BIA Northern Navajo Agency**
**Land Management District 12**

**Aneth Community Allotments**




Analysis Unit
Allotment Boundary
Community Boundary

**Non Grazeable Range**

Developed
Hydrology
Roads

0 0.5 1
Miles

1:16,000

Date: 2/9/2015

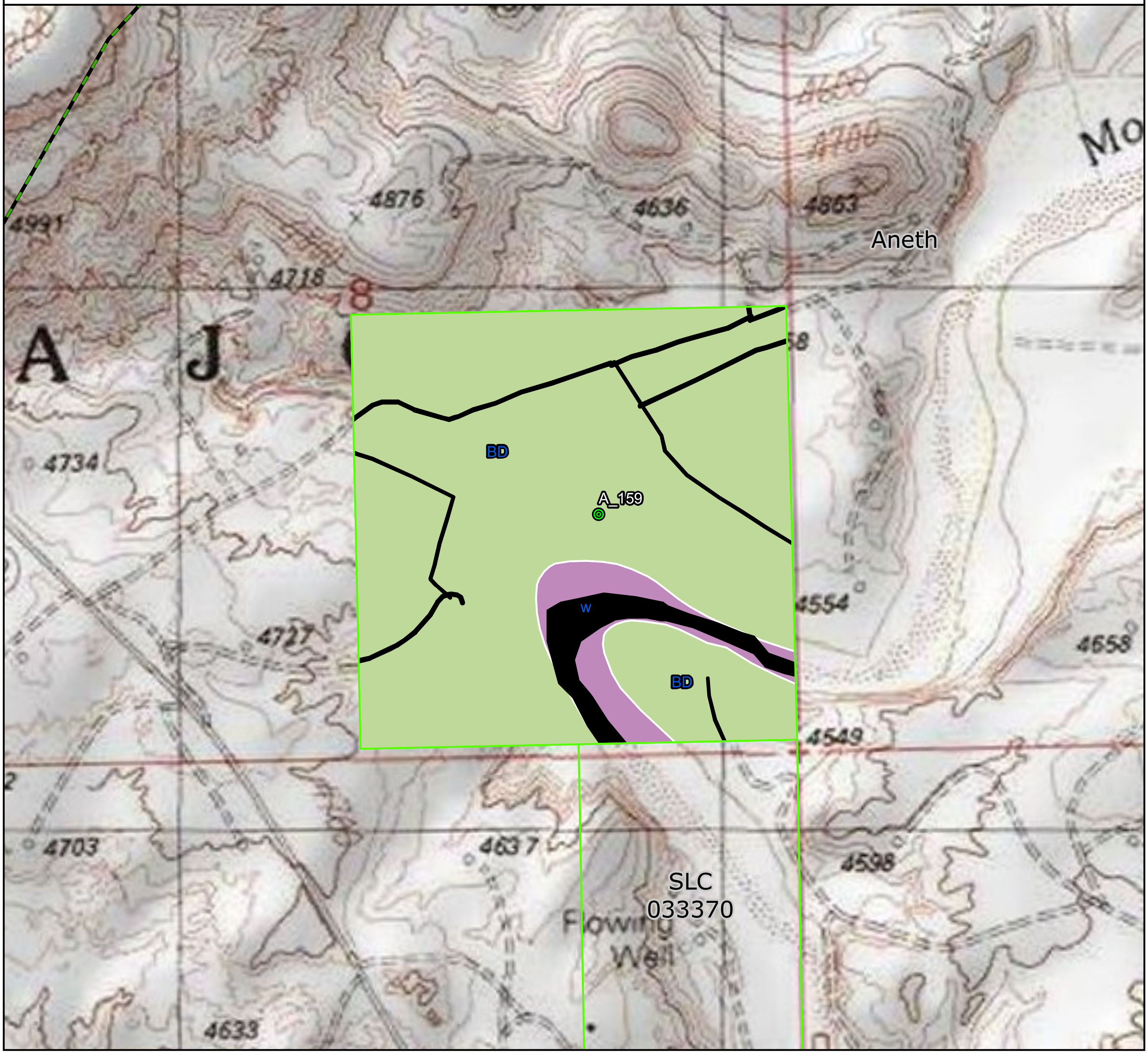
Coordinate System: NAD 1983 UTM Zone 12N

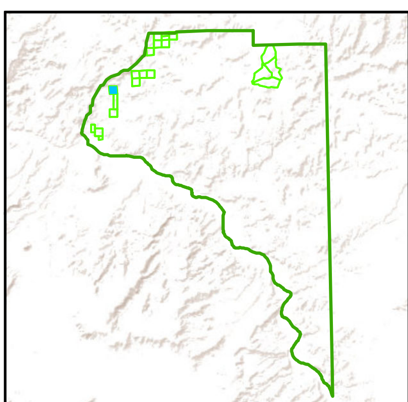
Document Name: P8X11_UNIT_AllotRMU

**2014 Range Inventory**
**BIA Northern Navajo Agency**
**Land Management District 12**
**Aneth Community, SLC 033509**

Total Acres: 160
Grazeable Acres*: 146
*Total acres minus non grazeable areas and areas with > 60% slope.

Initial Annual Carrying Capacity:
<1 Sheep



Transect Location
Analysis Unit Boundary
Community Boundary
Non Grazeable Range
Soil Map Unit

N

0 0.25 0.5
Miles

1:10,000

Ecosphere Environmental Services

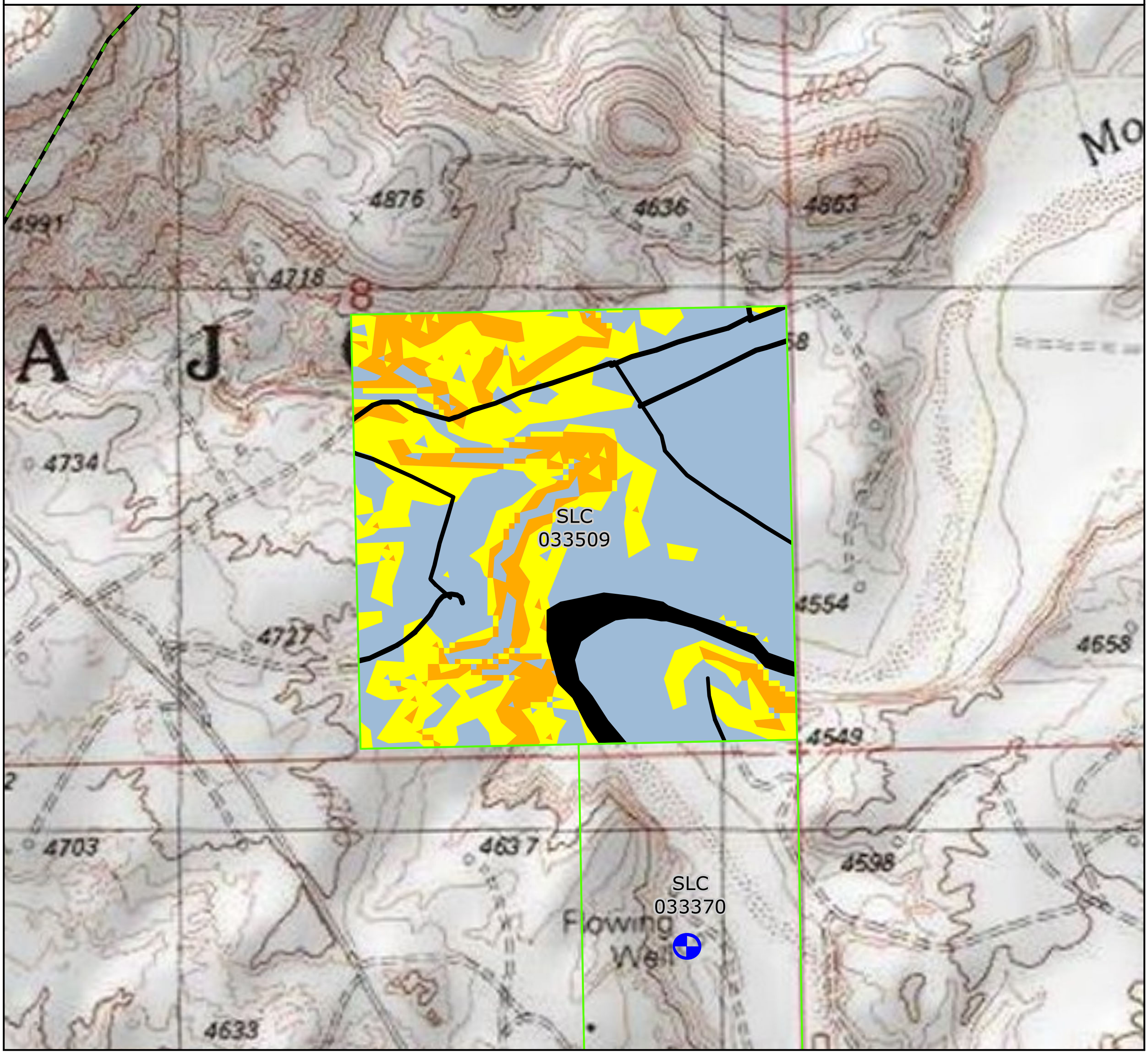
Date: 2/9/2015

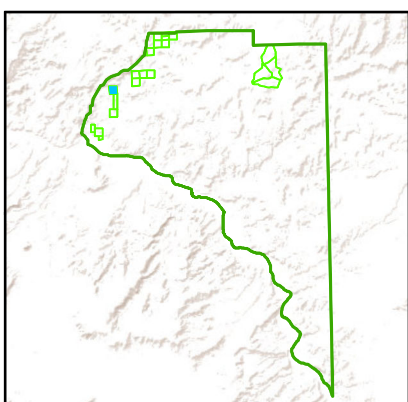
Coordinate System: NAD 1983 UTM Zone 12N

**2014 Range Inventory**
**BIA Northern Navajo Agency**
**Land Management District 12**
**Aneth Community, SLC 033509**

Total Acres: 160
Grazeable Acres*: 146
*Total acres minus non grazeable areas and areas with > 60% slope.

Adjusted Annual Carrying Capacity:
0 Sheep



Water Source
Analysis Unit Boundary
Community Boundary
Non Grazeable Range

**Distance to Water**
No Water Source
0-1 Mile
1-2 MIles
> 2 Miles

**Slope**
10 - 30%
30 - 60%
>60%

0 0.25 0.5
Miles

1:10,000

Ecosphere Environmental Services

Date: 2/9/2015

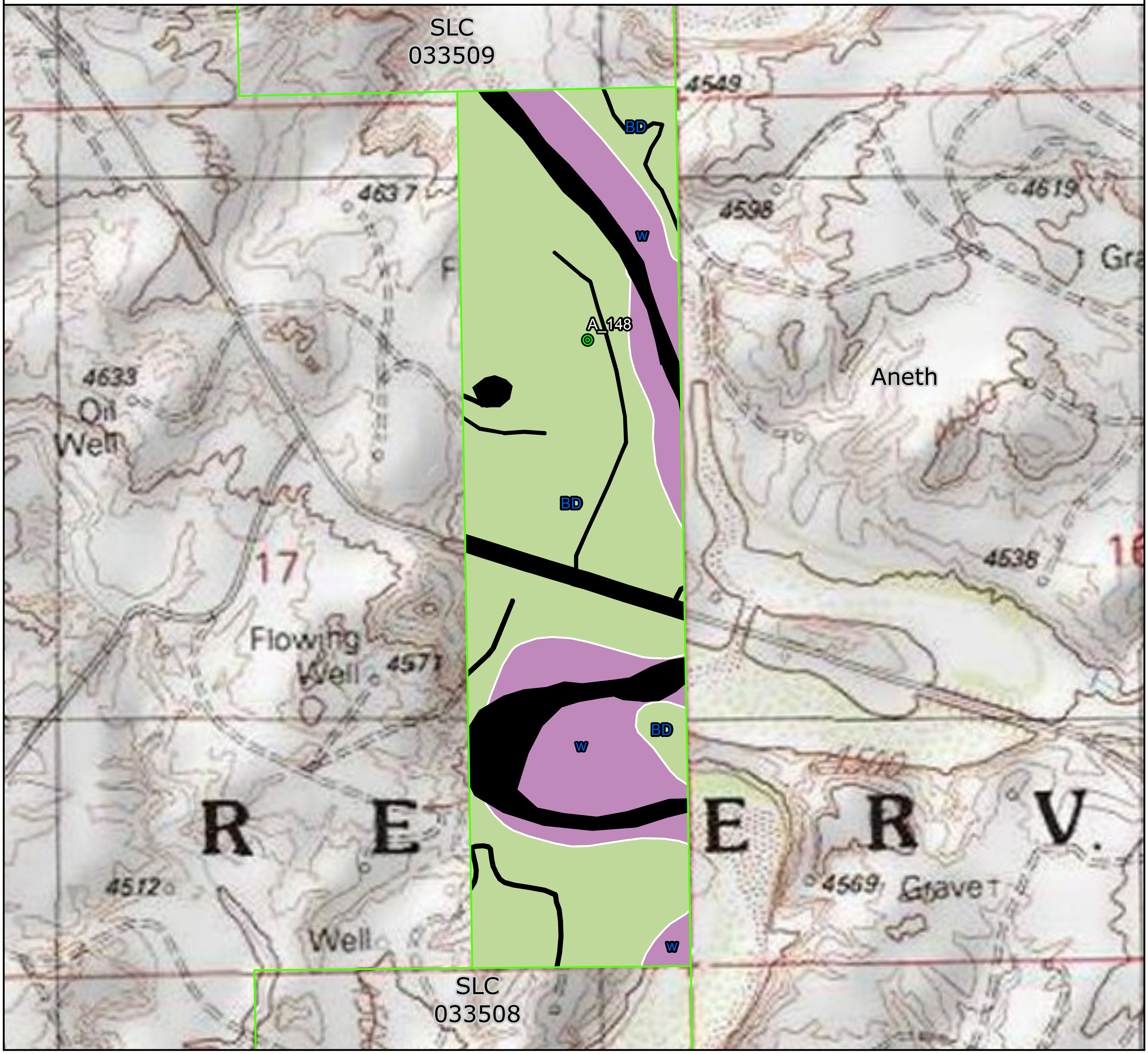
Coordinate System: NAD 1983 UTM Zone 12N

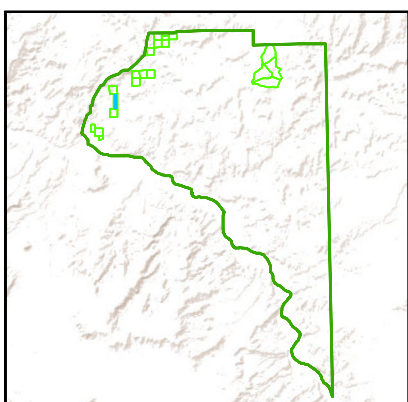
Document Name: P8X11_Slope_AdjCC_AllotRMU

## 2014 Range Inventory
## BIA Northern Navajo Agency
## Land Management District 12
## Aneth Community, SLC 033370

Total Acres: 162
Grazeable Acres*: 137
*Total acres minus non grazeable areas and areas with > 60% slope.

Initial Annual Carrying Capacity: <1 Sheep



Transect Location
Non Grazeable Range
Analysis Unit Boundary
Soil Map Unit
Community Boundary

0 0.25 0.5
Miles

1:10,000

Coordinate System: NAD 1983 UTM Zone 12N

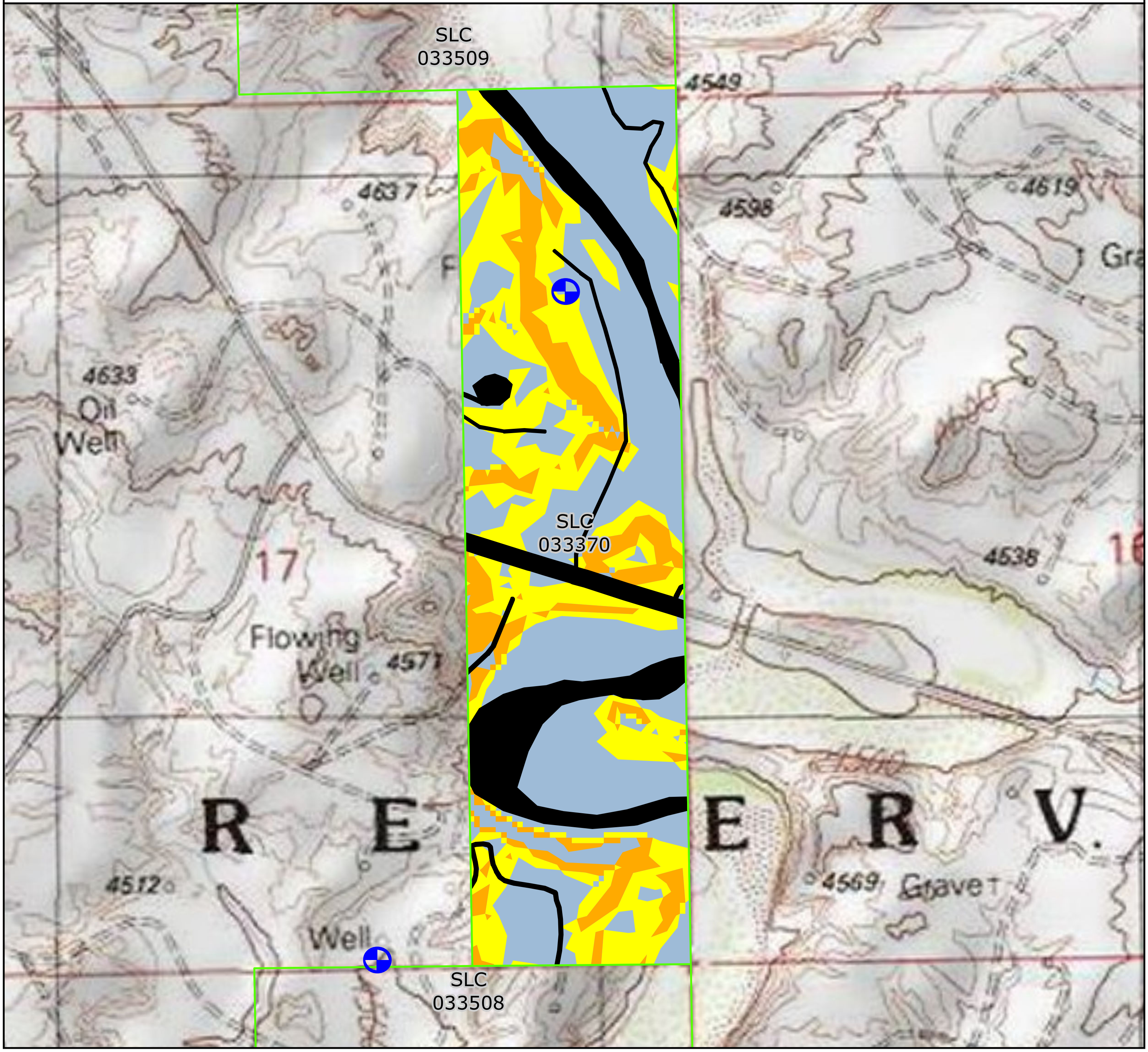
Ecosphere Environmental Services

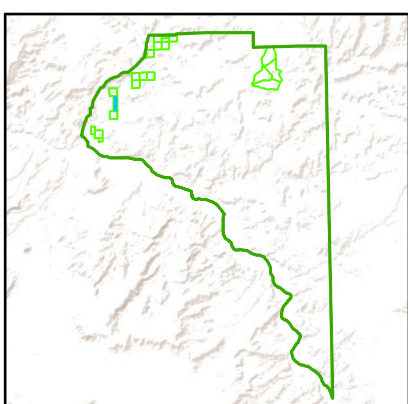
Date: 2/9/2015

**2014 Range Inventory**
**BIA Northern Navajo Agency**
**Land Management District 12**
**Aneth Community, SLC 033370**

Total Acres: 162
Grazeable Acres*: 137
*Total acres minus non grazeable areas and areas with > 60% slope.

Adjusted Annual Carrying Capacity:
0 Sheep



Water Source
Analysis Unit Boundary
Community Boundary
Non Grazeable Range

**Distance to Water**
No Water Source
0-1 Mile
1-2 MIles
> 2 Miles

**Slope**
10 - 30%
30 - 60%
>60%

N

0 0.25 0.5
Miles

1:10,000

Ecosphere Environmental Services

Date: 2/9/2015

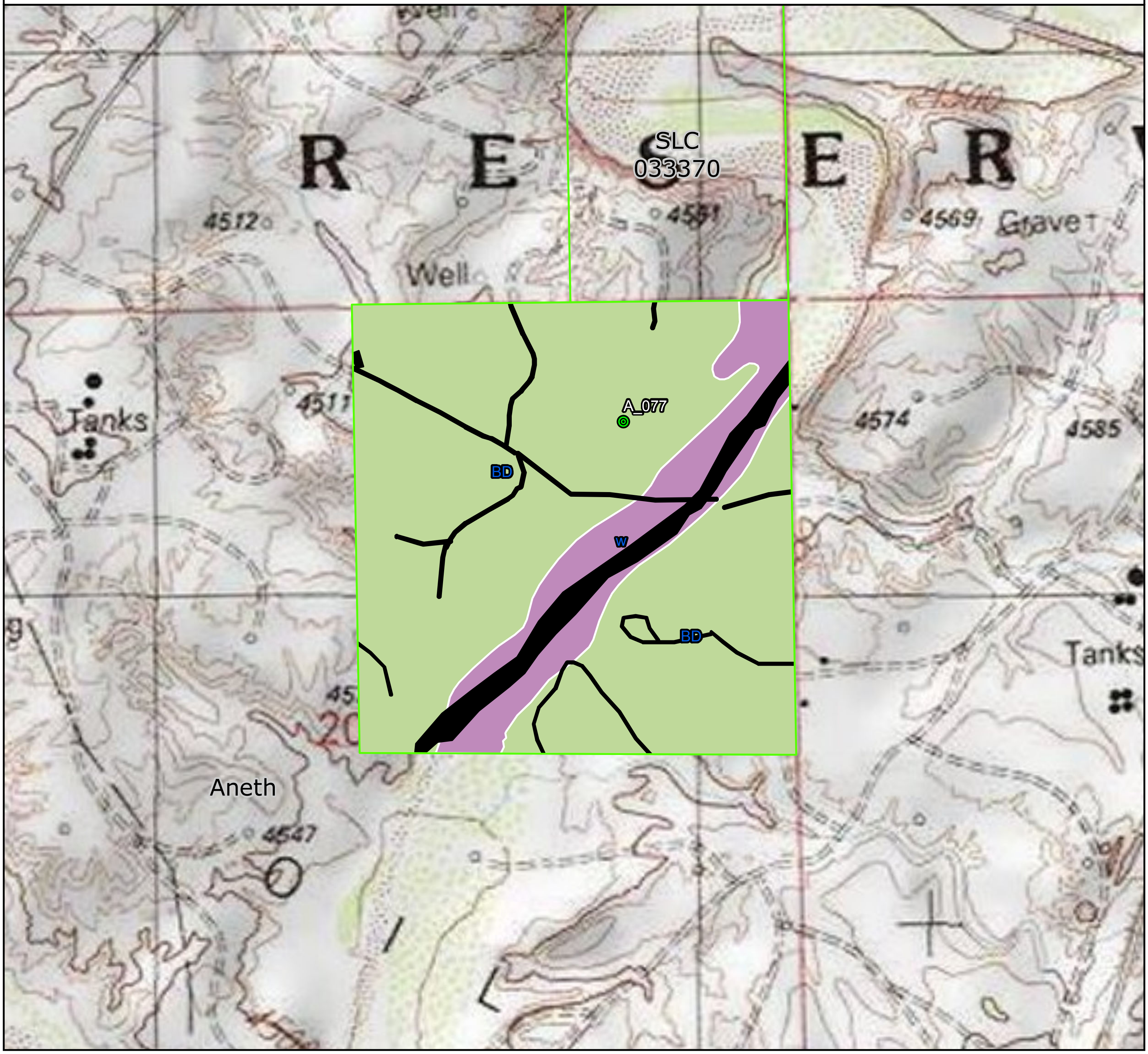
Coordinate System: NAD 1983 UTM Zone 12N

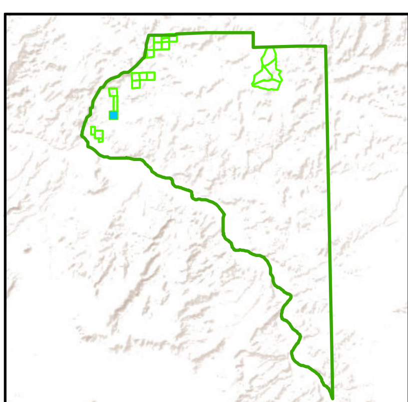
Document Name: P8X11_Slope_AdjCC_AllotRMU

**2014 Range Inventory**
**BIA Northern Navajo Agency**
**Land Management District 12**
**Aneth Community, SLC 033508**

Total Acres: 166
Grazeable Acres*: 152
*Total acres minus non grazeable areas and areas with > 60% slope.

Initial Annual Carrying Capacity: <1 Sheep



Transect Location
Analysis Unit Boundary
Community Boundary
Non Grazeable Range
Soil Map Unit

N

0 0.25 0.5
Miles

1:10,000

Ecosphere Environmental Services

Date: 2/9/2015

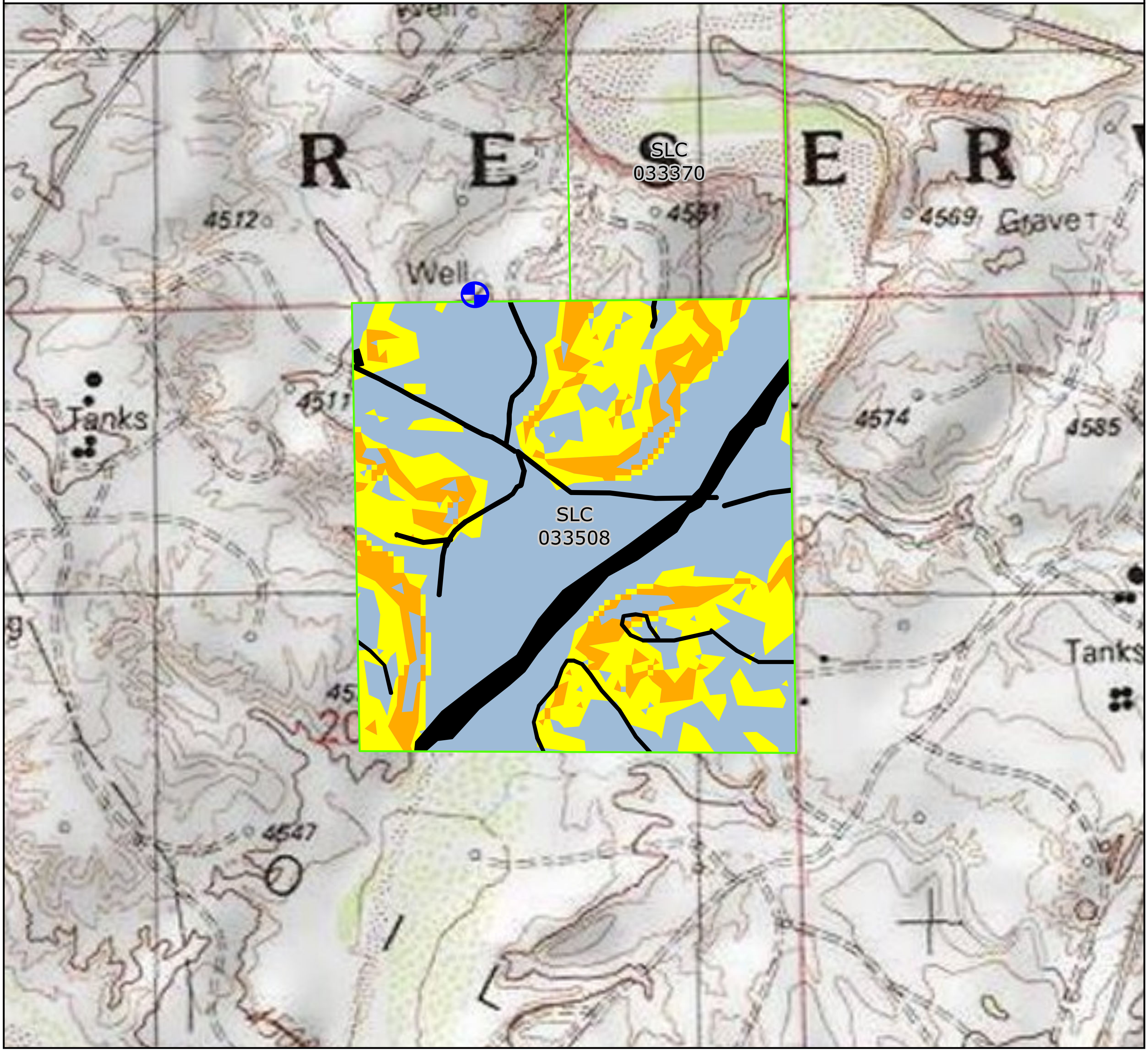
Coordinate System: NAD 1983 UTM Zone 12N

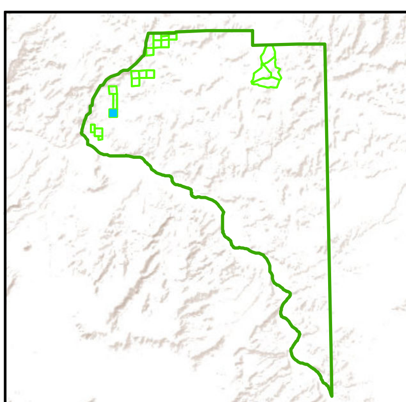
Document Name: P8X11_Soils_InitialCC_AllotRMU1

**2014 Range Inventory**
**BIA Northern Navajo Agency**
**Land Management District 12**
**Aneth Community, SLC 033508**

Total Acres: 166
Grazeable Acres*: 152
*Total acres minus non grazeable areas and areas with > 60% slope.

Adjusted Annual Carrying Capacity: 0 Sheep



Water Source
Analysis Unit Boundary
Community Boundary
Non Grazeable Range

**Distance to Water**
No Water Source
0-1 Mile
1-2 MIles
> 2 Miles

**Slope**
10 - 30%
30 - 60%
>60%

0 0.25 0.5
Miles

1:10,000

Ecosphere Environmental Services

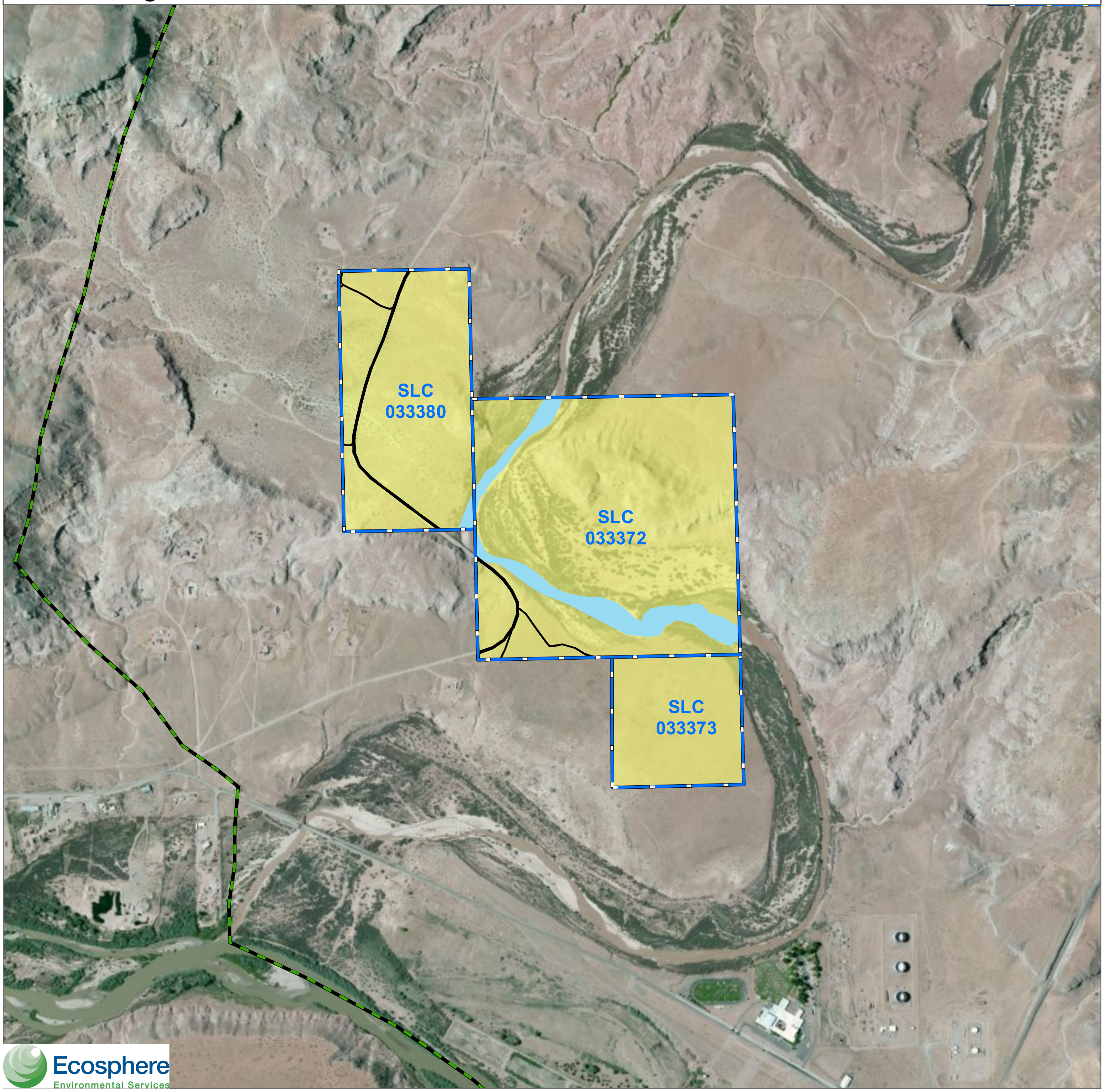
Date: 2/9/2015

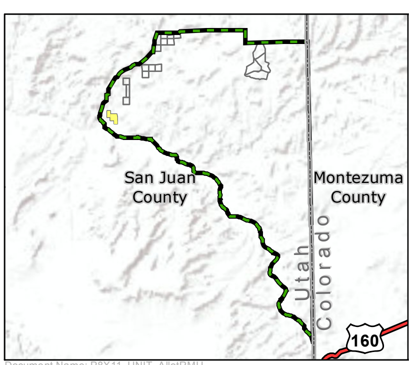
Coordinate System: NAD 1983 UTM Zone 12N

Document Name: P8X11_Slope_AdjCC_AllotRMU

**2014 Range Inventory**
**BIA Northern Navajo Agency**
**Land Management District 12**

**Aneth Community Allotments**




Analysis Unit

Allotment Boundary

Community Boundary

**Non Grazeable Range**

Developed

Hydrology

Roads

0 0.5 1

Miles

1:16,000

Coordinate System: NAD 1983 UTM Zone 12N

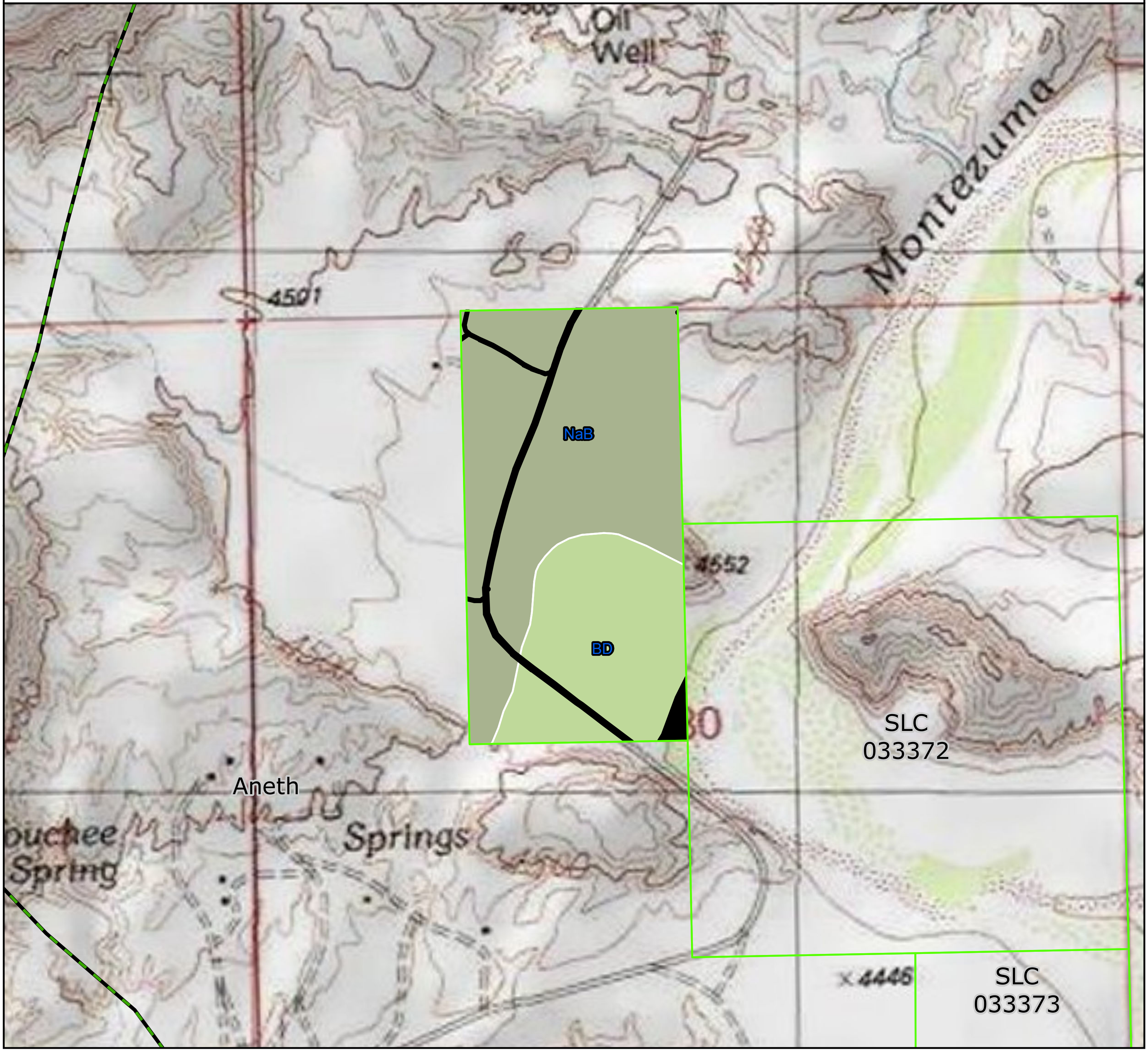
Date: 2/9/2015

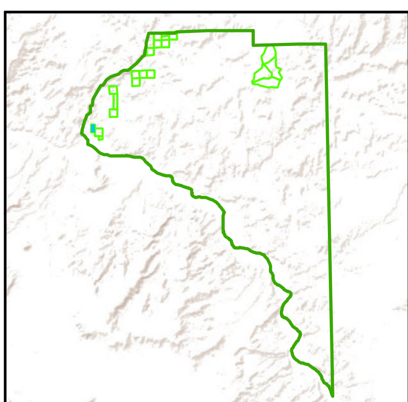
Document Name: P8X11_UNIT_AllotRMU

**2014 Range Inventory**
**BIA Northern Navajo Agency**
**Land Management District 12**
**Aneth Community, SLC 033380**

Total Acres: 80
Grazeable Acres*: 76
*Total acres minus non grazeable areas and areas with > 60% slope.

Initial Annual Carrying Capacity:
<1 Sheep



Transect Location
Analysis Unit Boundary
Community Boundary
Non Grazeable Range
Soil Map Unit

0 0.25 0.5
Miles
1:10,000

Ecosphere Environmental Services

Date: 2/9/2015

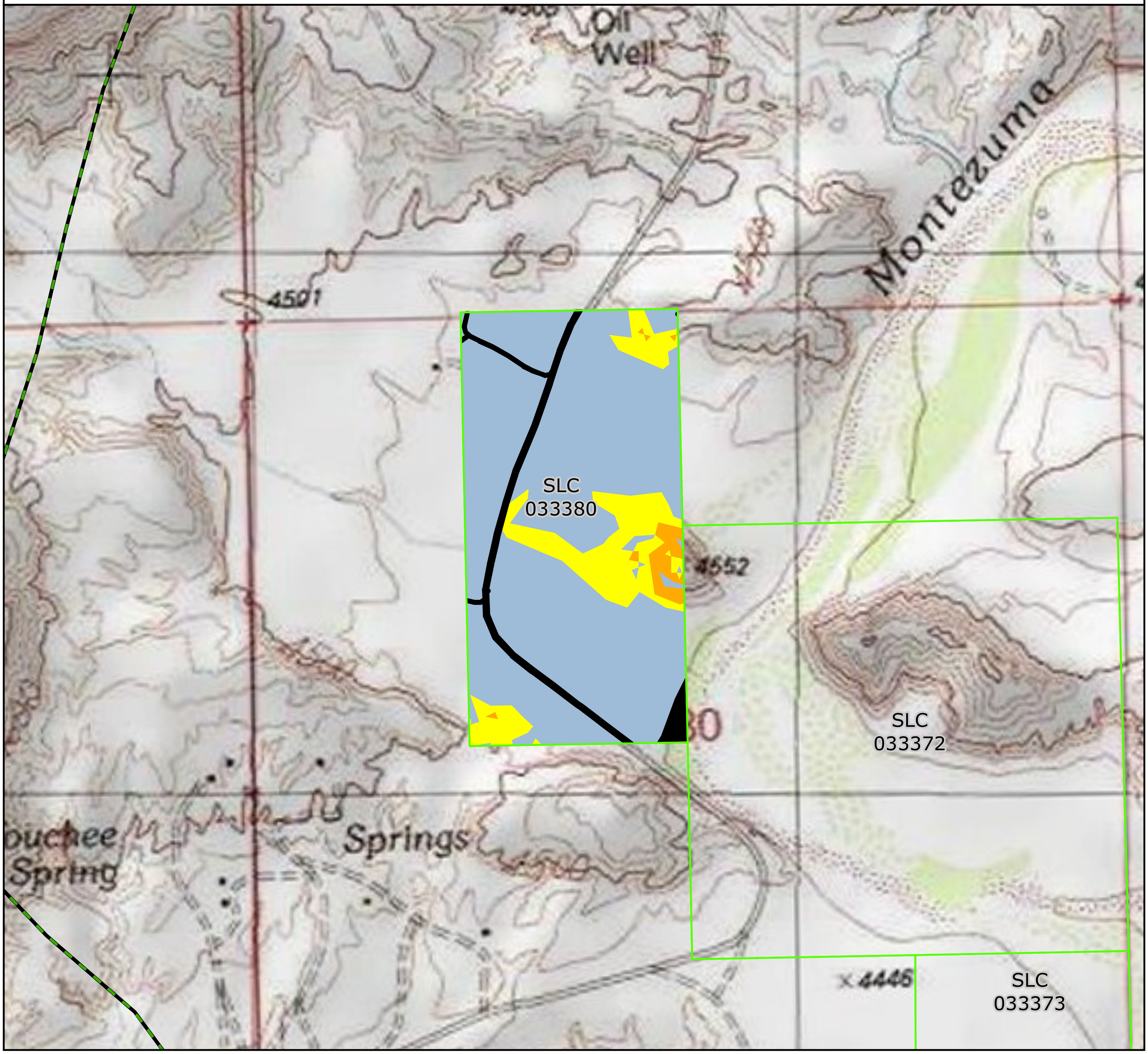
Coordinate System: NAD 1983 UTM Zone 12N

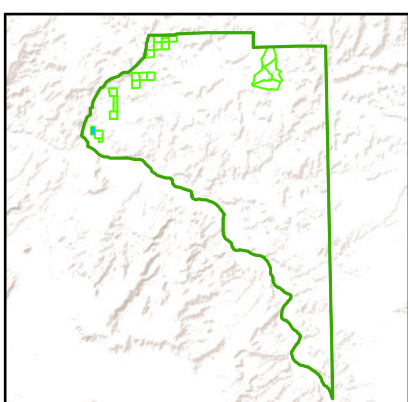
Document Name: P8X11_Soils_InitialCC_AllotRMU1

**2014 Range Inventory**
**BIA Northern Navajo Agency**
**Land Management District 12**
**Aneth Community, SLC 033380**

Total Acres: 80
Grazeable Acres*: 76
*Total acres minus non grazeable areas and areas with > 60% slope.

Adjusted Annual Carrying Capacity: 0 Sheep



Water Source
Analysis Unit Boundary
Community Boundary
Non Grazeable Range

**Distance to Water**
No Water Source
0-1 Mile
1-2 MIles
> 2 Miles

**Slope**
10 - 30%
30 - 60%
>60%

0 0.25 0.5
Miles

1:10,000

Ecosphere Environmental Services

Date: 2/9/2015

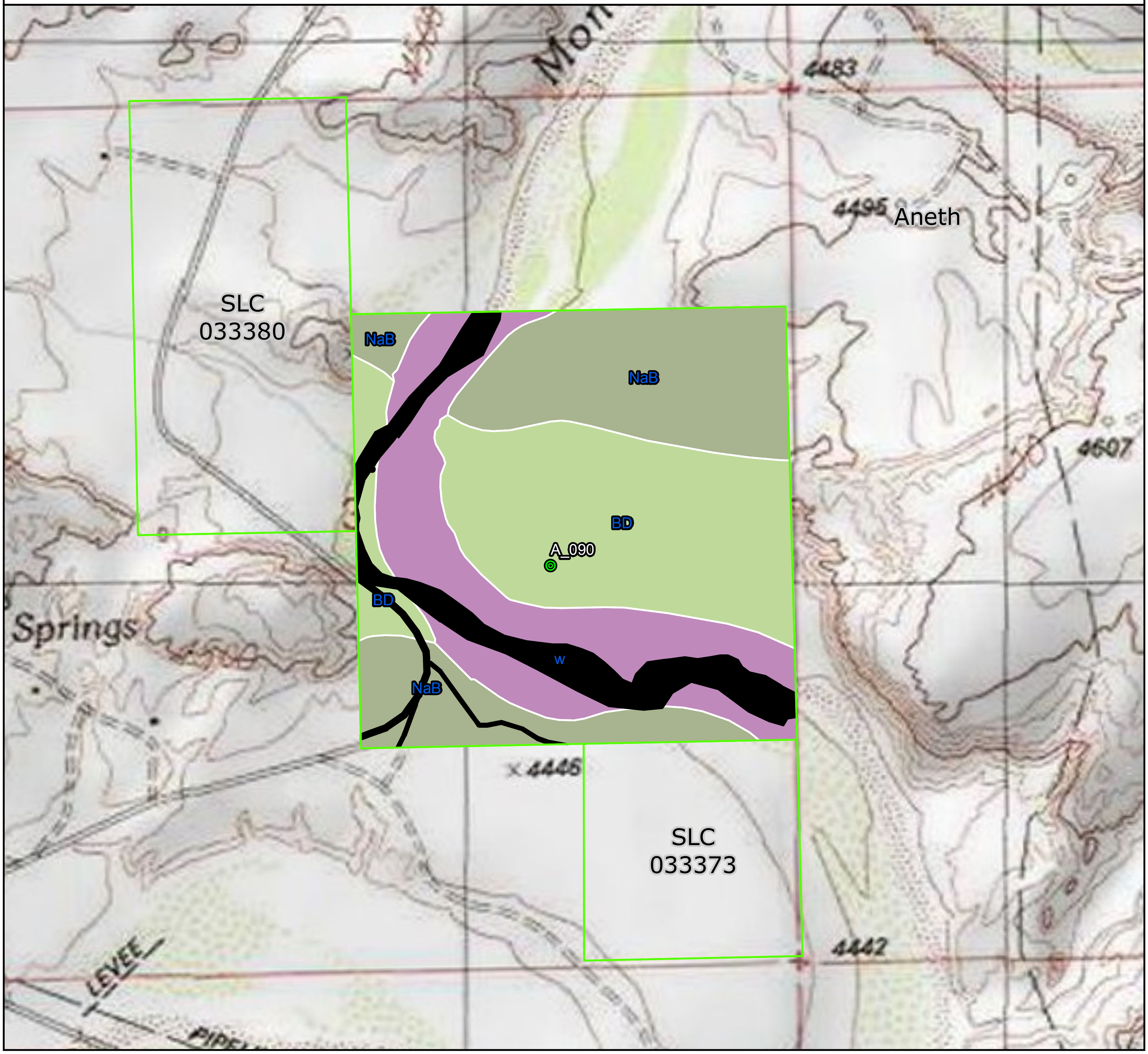
Coordinate System: NAD 1983 UTM Zone 12N

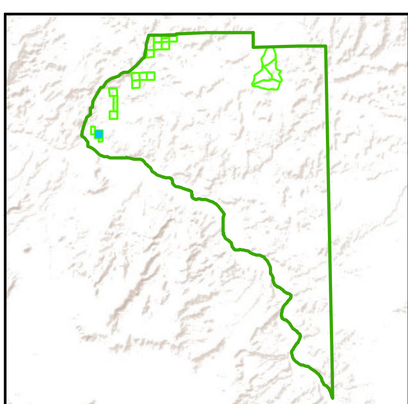
Document Name: P8X11_Slope_AdjCC_AllotRMU

**2014 Range Inventory**
**BIA Northern Navajo Agency**
**Land Management District 12**
**Aneth Community, SLC 033372**

Total Acres: 159
Grazeable Acres*: 139
*Total acres minus non grazeable areas and areas with > 60% slope.

Initial Annual Carrying Capacity:
<1 Sheep



Transect Location
Analysis Unit Boundary
Community Boundary
Non Grazeable Range
Soil Map Unit

0 0.25 0.5
Miles

1:10,000

Coordinate System: NAD 1983 UTM Zone 12N

Ecosphere Environmental Services

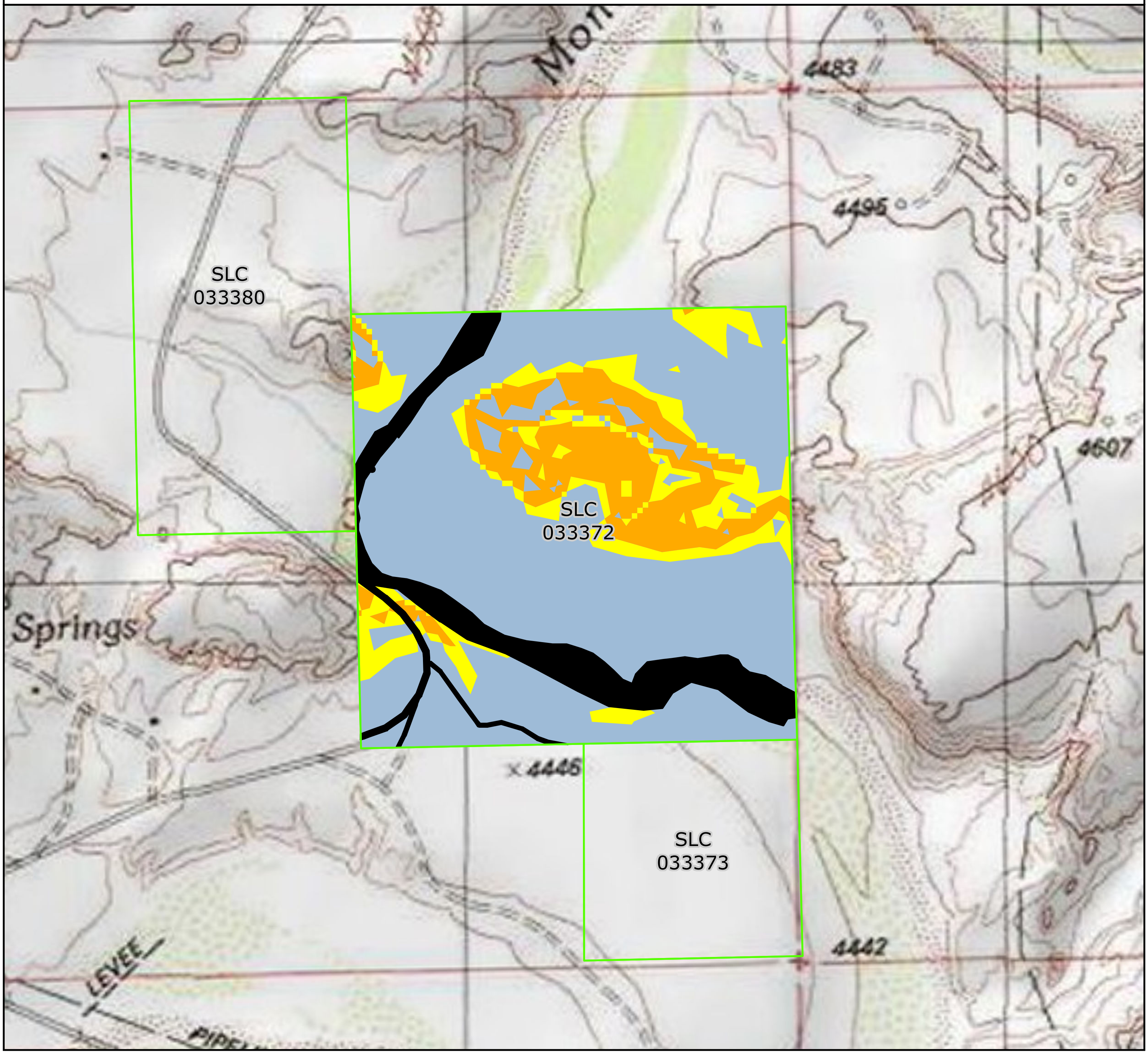
Date: 2/9/2015

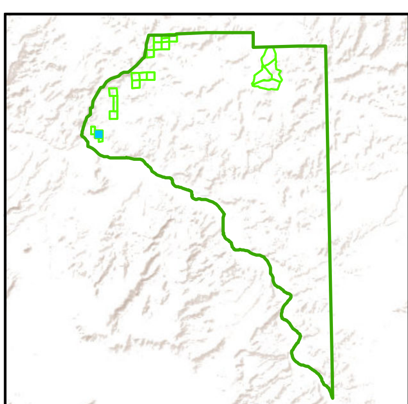
Document Name: P8X11_Soils_InitialCC_AllotRMU1

**2014 Range Inventory**
**BIA Northern Navajo Agency**
**Land Management District 12**
**Aneth Community, SLC 033372**

Total Acres: 159
Grazeable Acres*: 139
*Total acres minus non grazeable areas and areas with > 60% slope.

Adjusted Annual Carrying Capacity:
0 Sheep



Water Source
Analysis Unit Boundary
Community Boundary
Non Grazeable Range

**Distance to Water**
No Water Source
0-1 Mile
1-2 MIles
> 2 Miles

**Slope**
10 - 30%
30 - 60%
>60%

0 0.25 0.5
Miles

1:10,000

Ecosphere
Environmental Services

Date: 2/9/2015

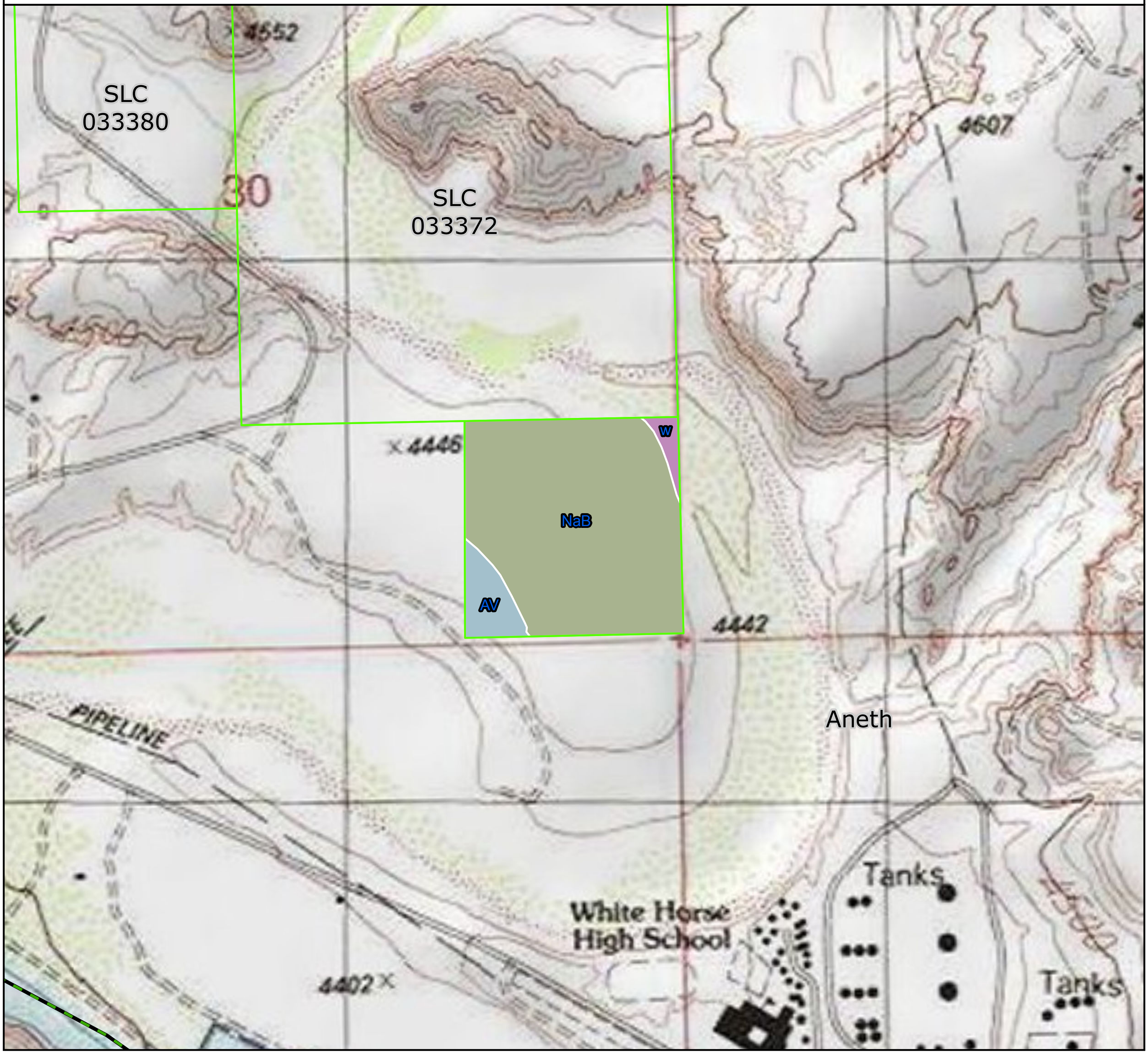
Coordinate System: NAD 1983 UTM Zone 12N

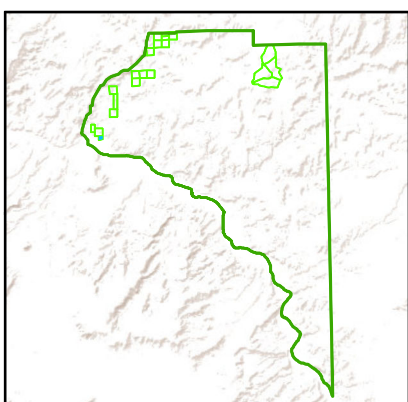
Document Name: P8X11_Slope_AdjCC_AllotRMU

**2014 Range Inventory**
**BIA Northern Navajo Agency**
**Land Management District 12**
**Aneth Community, SLC 033373**

Total Acres: 39
Grazeable Acres*: 39
*Total acres minus non grazeable areas and areas with > 60% slope.

Initial Annual Carrying Capacity:
<1 Sheep



Transect Location
Analysis Unit Boundary
Community Boundary
Non Grazeable Range
Soil Map Unit

0 0.25 0.5
Miles

1:10,000

Coordinate System: NAD 1983 UTM Zone 12N

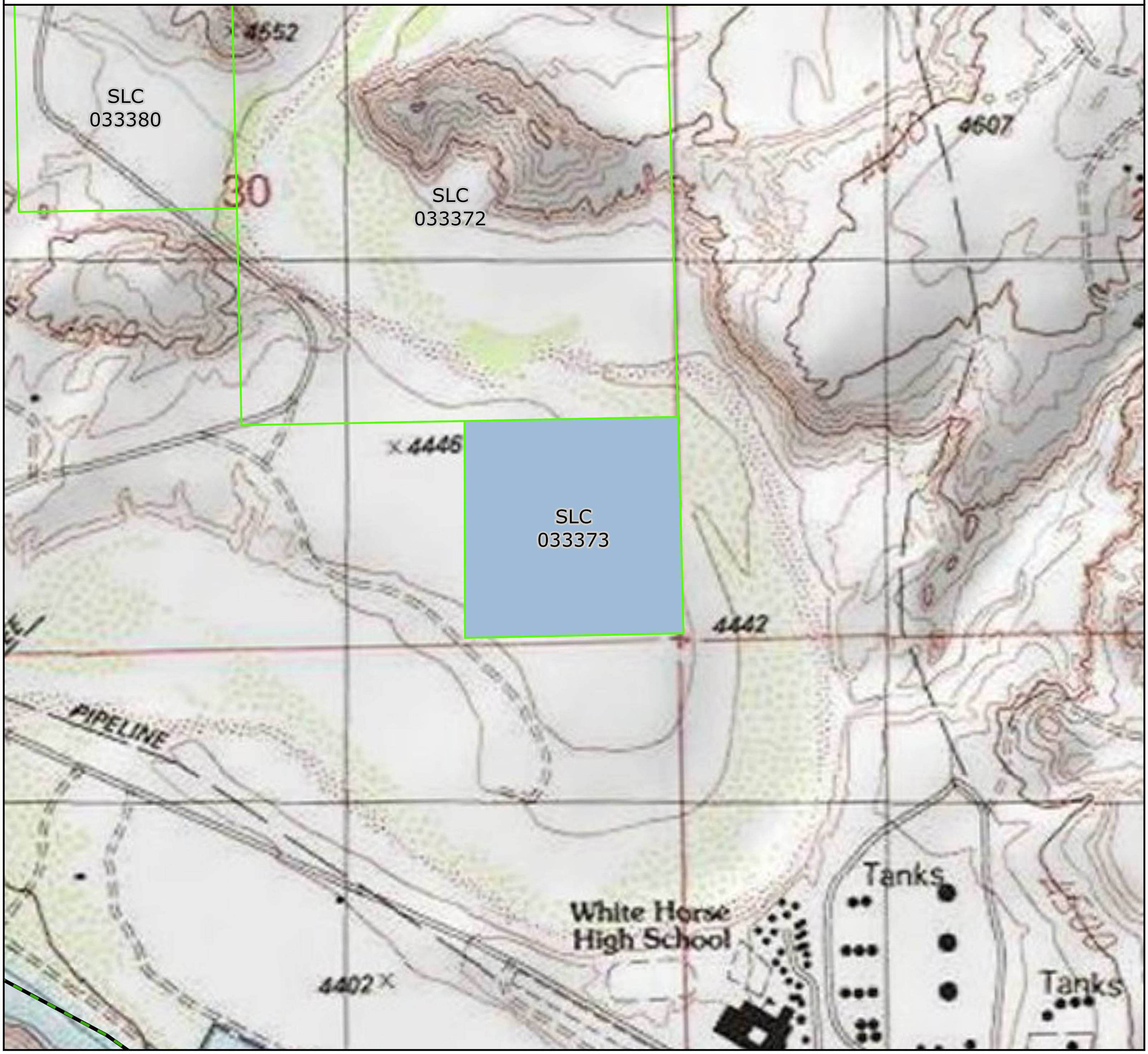
Ecosphere Environmental Services

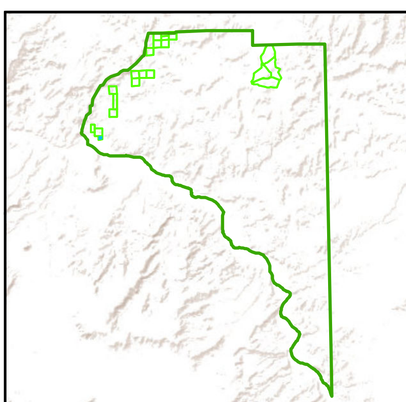
Date: 2/9/2015

# 2014 Range Inventory
# BIA Northern Navajo Agency
# Land Management District 12
## Aneth Community, SLC 033373

Total Acres: 39
Grazeable Acres*: 39
*Total acres minus non grazeable areas and areas with > 60% slope.

Adjusted Annual Carrying Capacity: 0 Sheep



Water Source
Analysis Unit Boundary
Community Boundary
Non Grazeable Range

**Distance to Water**
No Water Source
0-1 Mile
1-2 MIles
> 2 Miles

**Slope**
10 - 30%
30 - 60%
>60%

0 — 0.25 — 0.5
Miles

1:10,000

Ecosphere Environmental Services

Date: 2/9/2015

Coordinate System: NAD 1983 UTM Zone 12N

Document Name: P8X11_Slope_AdjCC_AllotRMU

### 5.2.3 RMU

The Aneth Community has one RMU, which is located in the northeast corner and is subdivided into four separate pastures. Each pasture was analyzed as a separate unit. The East pasture contains 506 grazeable acres and three transects within two ecological sites; the North pasture has 489 grazeable acres and four transects in two ecological sites; the South pasture has 506 grazeable acres and five transects within three ecological sites, and the West pasture contains 489 grazeable acres and three transects in two ecological sites.

The R035XY215UT site is found in the South, North, and West pastures, with the highest amount of available forage found in the South pasture. This site has deep, well-drained soils composed of sandy loam. The reference plant community is characterized by winterfat (*Krascheninnikovia lanata*) and fourwing saltbush (*Atriplex canescens*) in the overstory and a mix of cool and warm season grasses in the understory. Fourwing saltbush is often more common at higher elevations, such as the mesa tops found in this community, while winterfat is more prevalent in valley bottoms and the lower slopes of mesas. As the site deteriorates, non-native species, especially annual forbs and grasses, invade and shrubs tend to increase. Prolonged disturbance eventually leads to a plant community composed primarily of annual species. Available forage is scarce in the sampled plant community, with Indian ricegrass (*Achnatherum hymenoides*) and James' galleta (*Pleuraphis jamesii*) supplying the majority of forage that does exist. Shrub stands, especially of big sagebrush (*Artemisia tridentata*), are dense in some regions, but fairly open in other areas. Invasive species were not abundant, but several transects did encounter prickly Russian thistle (*Salsola tragus*) and cheatgrass (*Bromus tectorum*).

The R035XY109UT site is present in all four pastures. This site is characterized by deep, well-drained soils and warm season grasses mixed with shadscale in the reference state. Unmanaged grazing will cause rabbitbrush (*Chrysothamnus* spp.), broom snakeweed (*Gutierrezia sarothrae*), and annual species to increase and perennial grasses to decrease. Shadscale is fairly resistant to grazing, but high intensity grazing can damage individual plants. Available forage at the time of this study consisted mostly of James' galleta, alkali sacaton (*Sporobolus airoides*), big sagebrush, and Greene's rabbitbrush (*Chrysothamnus greenei*) with forage values highest in the East pasture. Prickly Russian thistle is abundant in all pastures and cheatgrass is fairly common in south pasture.

The R035XY006UT site is present only in the South pasture. This site occupies areas of fans and terraces with sodium affected soils. The reference plant community is fairly diverse and contains species like James' galleta, Indian ricegrass, dropseed (*Sporobolus* spp.), desert trumpet (*Eriogonum inflatum*), shadscale (*Atriplex confertifolia*), and valley saltbush (*Atriplex cuneata*). Overgrazing leads to a decrease in perennial grasses and valley saltbush and increases the likelihood of invasion by exotic annuals, such as saltlover (*Halogeton glomeratus*), prickly Russian thistle, and cheatgrass. At the time of the study prickly Russian thistle was widespread, and cheatgrass and saltlover, though not as abundant, were present, as well. Available forage is being supplied by mound saltbush (*Atriplex obovata*).

The final site found in the RMU is the "Shallow or Very Shallow Soils" site, which is located in the East pasture. This site does not have a written description, and plant communities can be highly variable and typically have low production. Common species found during the survey include prickly Russian thistle, shadscale (*Atriplex confertifolia*), pale desert-thorn (*Lycium pallidum*), and broom snakeweed.

Similarity index values in this RMU are very low (0-15%) with the highest values being associated with the R035XY215UT and R035XY109UT sites. Allowable production is mainly from Indian ricegrass and James' galleta in the R035XY215UT site and James' galleta and broom snakeweed in the R035XY109UT site.

### *Frequently Encountered Species*

1. prickly Russian thistle (*Salsola tragus*) (occurred on 93% of all transects)
2. James' galleta (*Pleuraphis jamesii*) (occurred on 80% of all transects)
3. cheatgrass (*Bromus tectorum*) (occurred on 67% of all transects)
4. broom snakeweed (*Gutierrezia sarothrae*) (occurred on 67% of all transects)
5. tansymustard (*Descurainia sp.*) (occurred on 47% of all transects)

### *Species by Weight*

1. prickly Russian thistle (*Salsola tragus*) (213 lbs/acre)
2. James' galleta (*Pleuraphis jamesii*) (17 lbs/acre)
3. broom snakeweed (*Gutierrezia sarothrae*) (8 lbs/acre)
4. Alkali sacaton (*Sporobolus airoides*) (6 lbs/acre)
5. mound saltbush (*Atriplex obovata*) (4 lbs/acre)

## Ground Cover

From a ground cover standpoint, the South pasture is in the best shape of all the pastures with the lowest amount bare ground (45%) and the highest amount of foliar cover (43%). However, as invasive plants are counted towards foliar cover, this does not mean that the plant community is necessarily in good condition, but it does indicate that the pasture is likely less vulnerable to wind and water erosion. The East pasture has the most bare ground and lowest percentage of foliar cover. For the most part, erosion was observed to be slight to moderate throughout the RMU, but a few areas are experiencing more severe erosion.

**Analysis Unit** East **Chapter** Aneth

## Summary of Grazeable and Non-Grazeable Acres in Analysis Unit

| | | |
|---|---|---|
| **Chapter Acres** | | 121,585.00 |
| **Analysis Unit Acres** | | 507.80 |
| **Non-Grazeable Acres** | **Developed** | 0.00 |
| | **Hydro** | 0.44 |
| | **Roads** | 1.39 |
| | **Slope>60** | 0.02 |
| **Total Grazeable Acres** | | 505.96 |

## Summary of Similarity Indices, Cover, and Carrying Capacity within Anlysis Unit

| **Similarity Indices (%)** | |
|---|---|
| **Minimum** | 2 |
| **Maximum** | 12 |
| **Median** | 5 |

| **Cover (%)** | |
|---|---|
| **Foliar Cover** | 19.00 |
| **Bare Ground** | 65.00 |
| **Basal** | 1.00 |

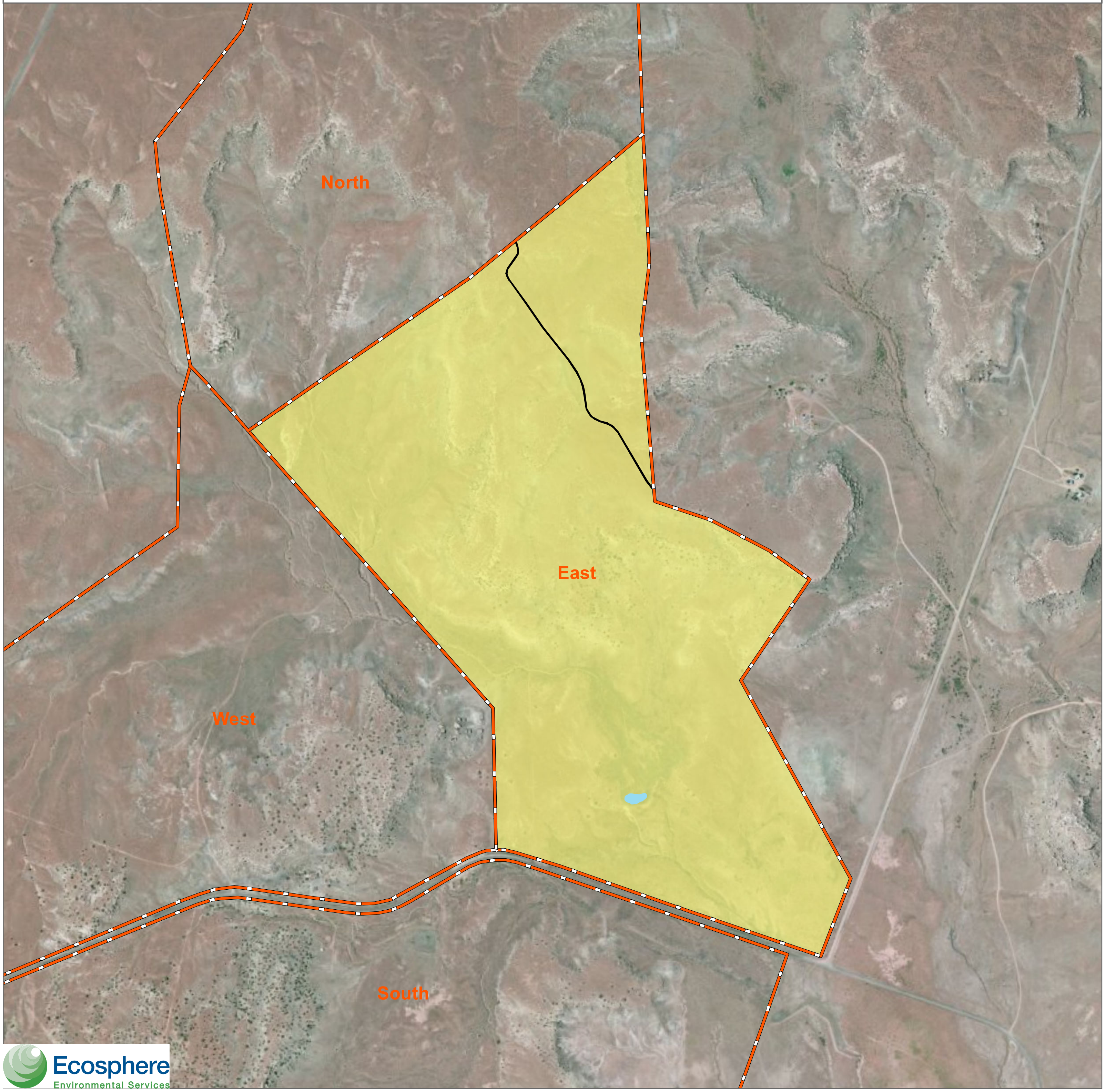
| **Carrying Capacity (Sheep Units/Year)** | |
|---|---|
| **Initial CC** | 1.13 |
| **Slope Adjusted CC** | 1.09 |
| **DTW Adjusted CC** | 0 |

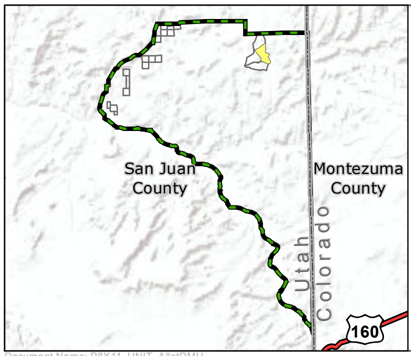
## Results by Ecological Site in Sheep Units Year Long

| Ecological Site | Number of Transects | Percent of Analysis Unit Acres | Available Forage (Lbs/Acre) | Initial Grazeable Acres | Sheep Stocking Rate (Acres/ Sheep Unit) | Initial Sheep Carrying Capacity (Sheep Units/Year) |
|---|---|---|---|---|---|---|
| R035XY109UT Desert Loam (Shadscale) | 2 | 35 | 14.13 | 178.20 | 167.73 | 1.06 |
| Shallow or very shallow soils | 1 | 12 | 2.88 | 59.40 | 822.92 | 0.07 |
| Badland | 0 | 47 | | 237.63 | | |
| OtherSoils | 0 | <1 | | 0.71 | | |
| R035XY006UT Alkali Fan (Castlevalley Saltbush) | 0 | 1 | | 7.29 | | |
| R035XY215UT Semidesert Sandy Loam (Fourwing Saltbush) | 0 | 4 | | 21.19 | | |
| RockOutcrop | 0 | <1 | | 0.24 | | |
| Sogzie | 0 | <1 | | 0.94 | | |
| Whit | 0 | <1 | | 0.32 | | |

# 2014 Range Inventory
# BIA Northern Navajo Agency
# Land Management District 12

**Aneth Community**
**RMU East**




Analysis Unit

RMU Boundary

Community Boundary

**Non Grazeable Range**

Developed

Hydrology

Roads

0 0.5 1

Miles

1:16,000

Date: 2/9/2015

Coordinate System: NAD 1983 UTM Zone 12N

Document Name: P8X11_UNIT_AllotRMU

| Analysis Unit | West | Chapter | Aneth |
|---|---|---|---|

## Summary of Grazeable and Non-Grazeable Acres in Analysis Unit

| | | |
|---|---|---|
| **Chapter Acres** | | 121,585.00 |
| **Analysis Unit Acres** | | 493.59 |
| **Non-Grazeable Acres** | **Developed** | 1.68 |
| | **Hydro** | 0.00 |
| | **Roads** | 3.21 |
| | **Slope>60** | 0.00 |
| **Total Grazeable Acres** | | 488.69 |

## Summary of Similarity Indices, Cover, and Carrying Capacity within Anlysis Unit

| Similarity Indices (%) | |
|---|---|
| **Minimum** | 0 |
| **Maximum** | 11 |
| **Median** | 2 |

| Cover (%) | |
|---|---|
| **Foliar Cover** | 21.00 |
| **Bare Ground** | 59.00 |
| **Basal** | 0.00 |

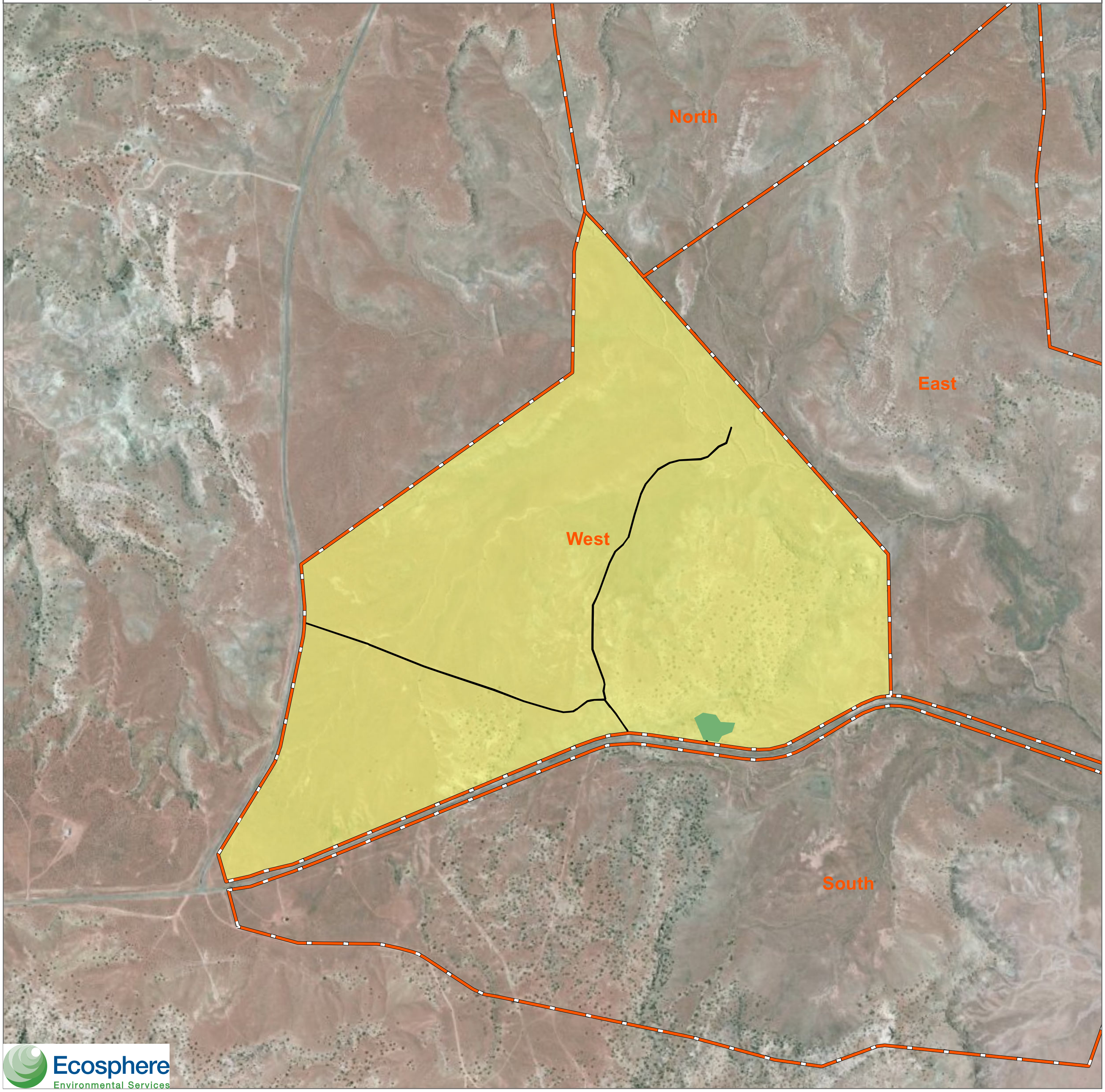
| Carrying Capacity (Sheep Units/Year) | |
|---|---|
| **Initial CC** | 0.11 |
| **Slope Adjusted CC** | 0.11 |
| **DTW Adjusted CC** | 0 |

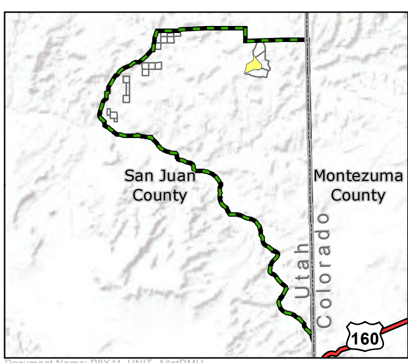
## Results by Ecological Site in Sheep Units Year Long

| Ecological Site | Number of Transects | Percent of Analysis Unit Acres | Available Forage (Lbs/Acre) | Initial Grazeable Acres | Sheep Stocking Rate (Acres/ Sheep Unit) | Initial Sheep Carrying Capacity (Sheep Units/Year) |
|---|---|---|---|---|---|---|
| R035XY109UT Desert Loam (Shadscale) | 2 | 27 | 0.82 | 131.90 | 2,890.24 | 0.05 |
| R035XY215UT Semidesert Sandy Loam (Fourwing Saltbush) | 1 | 26 | 1.10 | 127.10 | 2,154.55 | 0.06 |
| Badland | 0 | 36 | | 175.85 | | |
| OtherSoils | 0 | <1 | | 4.24 | | |
| ShallowSoils | 0 | 9 | | 43.96 | | |
| Sogzie | 0 | 1 | | 5.65 | | |

# 2014 Range Inventory
# BIA Northern Navajo Agency
# Land Management District 12

**Aneth Community**
**RMU West**




Analysis Unit

RMU Boundary

Community Boundary

**Non Grazeable Range**

Developed

Hydrology

Roads

0 0.5 1

Miles

1:16,000

Date: 2/9/2015

Coordinate System: NAD 1983 UTM Zone 12N

Document Name: P8X11_UNIT_AllotRMU

**Analysis Unit** South **Chapter** Aneth

## Summary of Grazeable and Non-Grazeable Acres in Analysis Unit

| | | |
|---|---|---|
| **Chapter Acres** | | 121,585.00 |
| **Analysis Unit Acres** | | 510.60 |
| **Non-Grazeable Acres** | **Developed** | 0.19 |
| | **Hydro** | 1.54 |
| | **Roads** | 2.70 |
| | **Slope>60** | 0.00 |
| **Total Grazeable Acres** | | 506.17 |

## Summary of Similarity Indices, Cover, and Carrying Capacity within Anlysis Unit

| **Similarity Indices (%)** | |
|---|---|
| **Minimum** | 1 |
| **Maximum** | 15 |
| **Median** | 6 |

| **Cover (%)** | |
|---|---|
| **Foliar Cover** | 43.00 |
| **Bare Ground** | 45.00 |
| **Basal** | 0.00 |

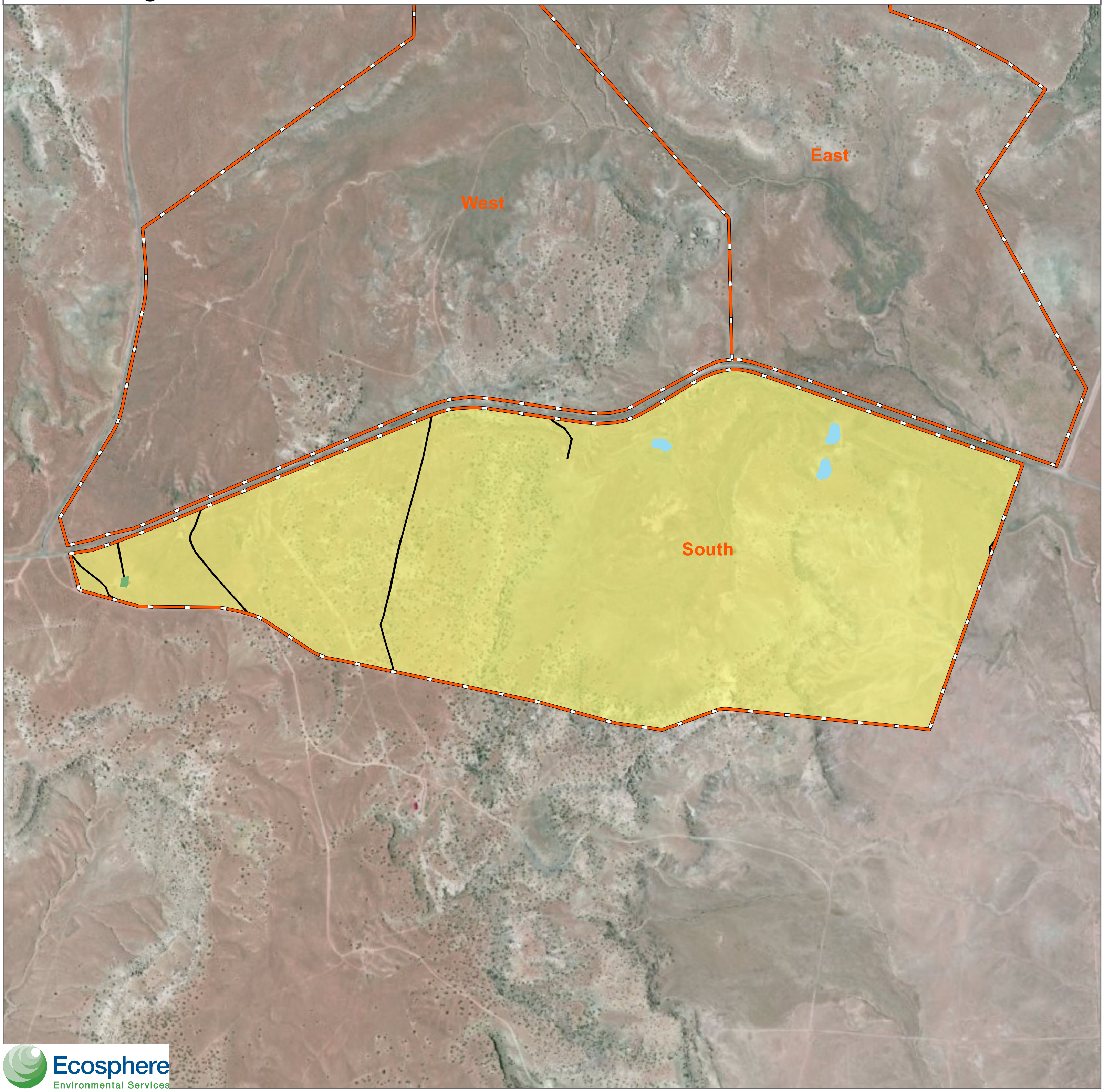
| **Carrying Capacity (Sheep Units/Year)** | |
|---|---|
| **Initial CC** | 1.3 |
| **Slope Adjusted CC** | 1.28 |
| **DTW Adjusted CC** | 0 |

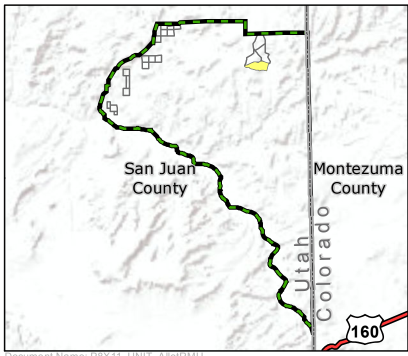
## Results by Ecological Site in Sheep Units Year Long

| Ecological Site | Number of Transects | Percent of Analysis Unit Acres | Available Forage (Lbs/Acre) | Initial Grazeable Acres | Sheep Stocking Rate (Acres/ Sheep Unit) | Initial Sheep Carrying Capacity (Sheep Units/Year) |
|---|---|---|---|---|---|---|
| R035XY006UT Alkali Fan (Castlevalley Saltbush) | 1 | 11 | 9.32 | 56.40 | 254.29 | 0.22 |
| R035XY109UT Desert Loam (Shadscale) | 3 | 23 | 2.19 | 118.90 | 1,082.19 | 0.11 |
| R035XY215UT Semidesert Sandy Loam (Fourwing Saltbush) | 1 | 23 | 19.34 | 119.20 | 122.54 | 0.97 |
| Badland | 0 | 31 | | 158.48 | | |
| OtherSoils | 0 | <1 | | 3.97 | | |
| RockOutcrop | 0 | <1 | | 1.88 | | |
| ShallowSoils | 0 | 8 | | 39.62 | | |
| Sogzie | 0 | 1 | | 5.30 | | |
| Whit | 0 | <1 | | 2.50 | | |

# 2014 Range Inventory
# BIA Northern Navajo Agency
# Land Management District 12

**Aneth Community**
**RMU South**




Analysis Unit

RMU Boundary

Community Boundary

**Non Grazeable Range**

Developed

Hydrology

Roads

0 0.5 1

Miles

1:16,000

Date: 2/9/2015

Coordinate System: NAD 1983 UTM Zone 12N

Document Name: P8X11_UNIT_AllotRMU

**Analysis Unit** North **Chapter** Aneth

## Summary of Grazeable and Non-Grazeable Acres in Analysis Unit

| | | |
|---|---|---|
| **Chapter Acres** | | 121,585.00 |
| **Analysis Unit Acres** | | 490.50 |
| **Non-Grazeable Acres** | **Developed** | 0.00 |
| | **Hydro** | 0.00 |
| | **Roads** | 1.75 |
| | **Slope>60** | 0.00 |
| **Total Grazeable Acres** | | 488.75 |

## Summary of Similarity Indices, Cover, and Carrying Capacity within Anlysis Unit

| **Similarity Indices (%)** | |
|---|---|
| **Minimum** | 2 |
| **Maximum** | 5 |
| **Median** | 3.5 |

| **Cover (%)** | |
|---|---|
| **Foliar Cover** | 22.00 |
| **Bare Ground** | 57.00 |
| **Basal** | 1.00 |

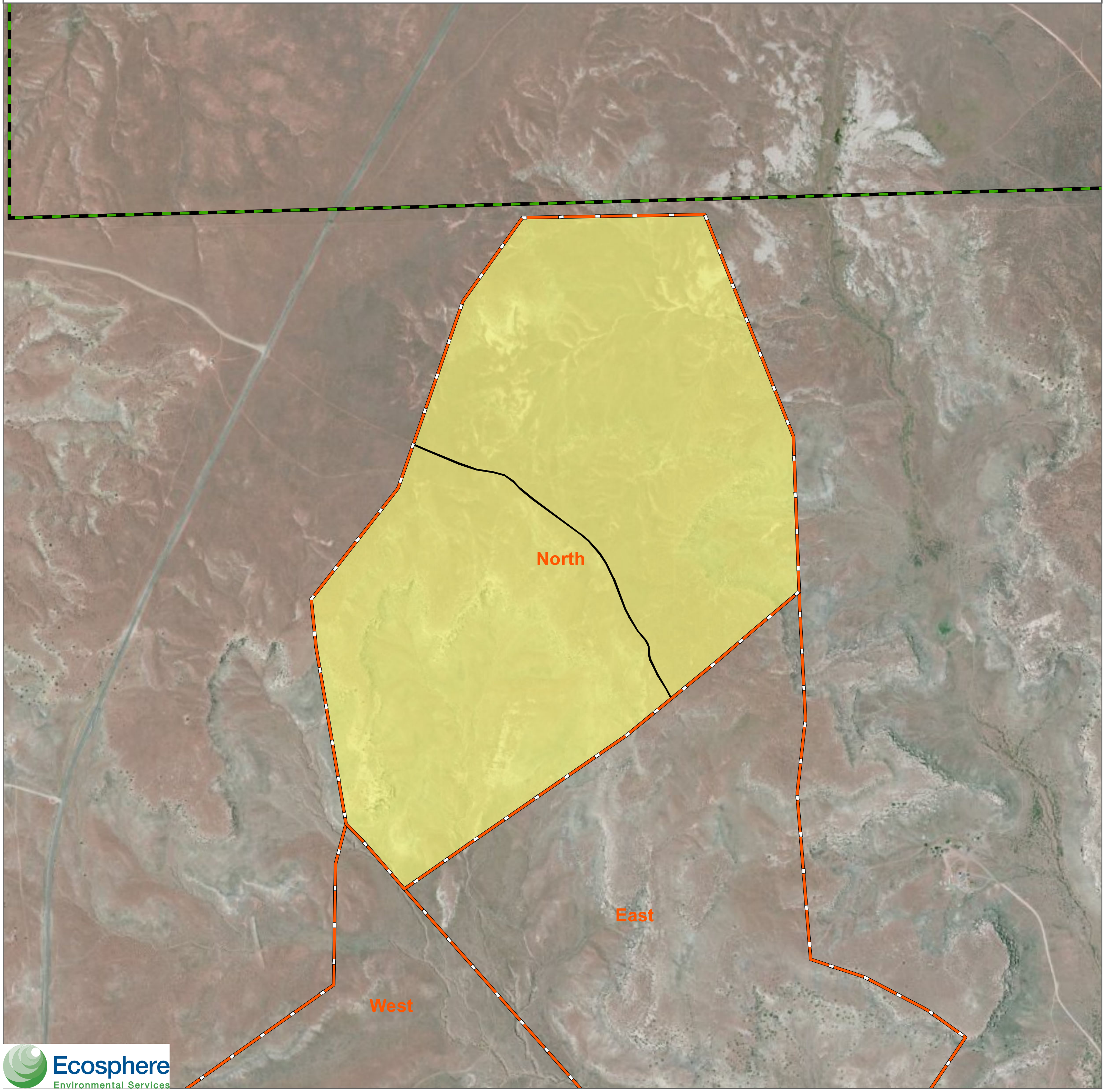
| **Carrying Capacity (Sheep Units/Year)** | |
|---|---|
| **Initial CC** | 0.55 |
| **Slope Adjusted CC** | 0.54 |
| **DTW Adjusted CC** | 0 |

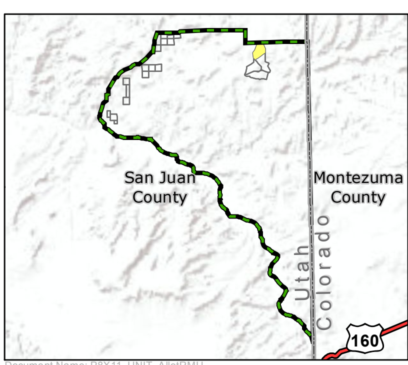
## Results by Ecological Site in Sheep Units Year Long

| Ecological Site | Number of Transects | Percent of Analysis Unit Acres | Available Forage (Lbs/Acre) | Initial Grazeable Acres | Sheep Stocking Rate (Acres/ Sheep Unit) | Initial Sheep Carrying Capacity (Sheep Units/Year) |
|---|---|---|---|---|---|---|
| R035XY109UT Desert Loam (Shadscale) | 2 | 23 | 3.47 | 112.60 | 683.00 | 0.16 |
| R035XY215UT Semidesert Sandy Loam (Fourwing Saltbush) | 2 | 36 | 5.34 | 174.80 | 443.82 | 0.39 |
| Badland | 0 | 31 | | 150.14 | | |
| OtherSoils | 0 | 1 | | 5.83 | | |
| Shallow or very shallow soils | 0 | 8 | | 37.54 | | |
| Sogzie | 0 | 2 | | 7.77 | | |

# 2014 Range Inventory
# BIA Northern Navajo Agency
# Land Management District 12

**Aneth Community**
**RMU North**




Analysis Unit

RMU Boundary

Community Boundary

**Non Grazeable Range**

Developed

Hydrology

Roads

0 0.5 1

Miles

1:16,000

Date: 2/9/2015

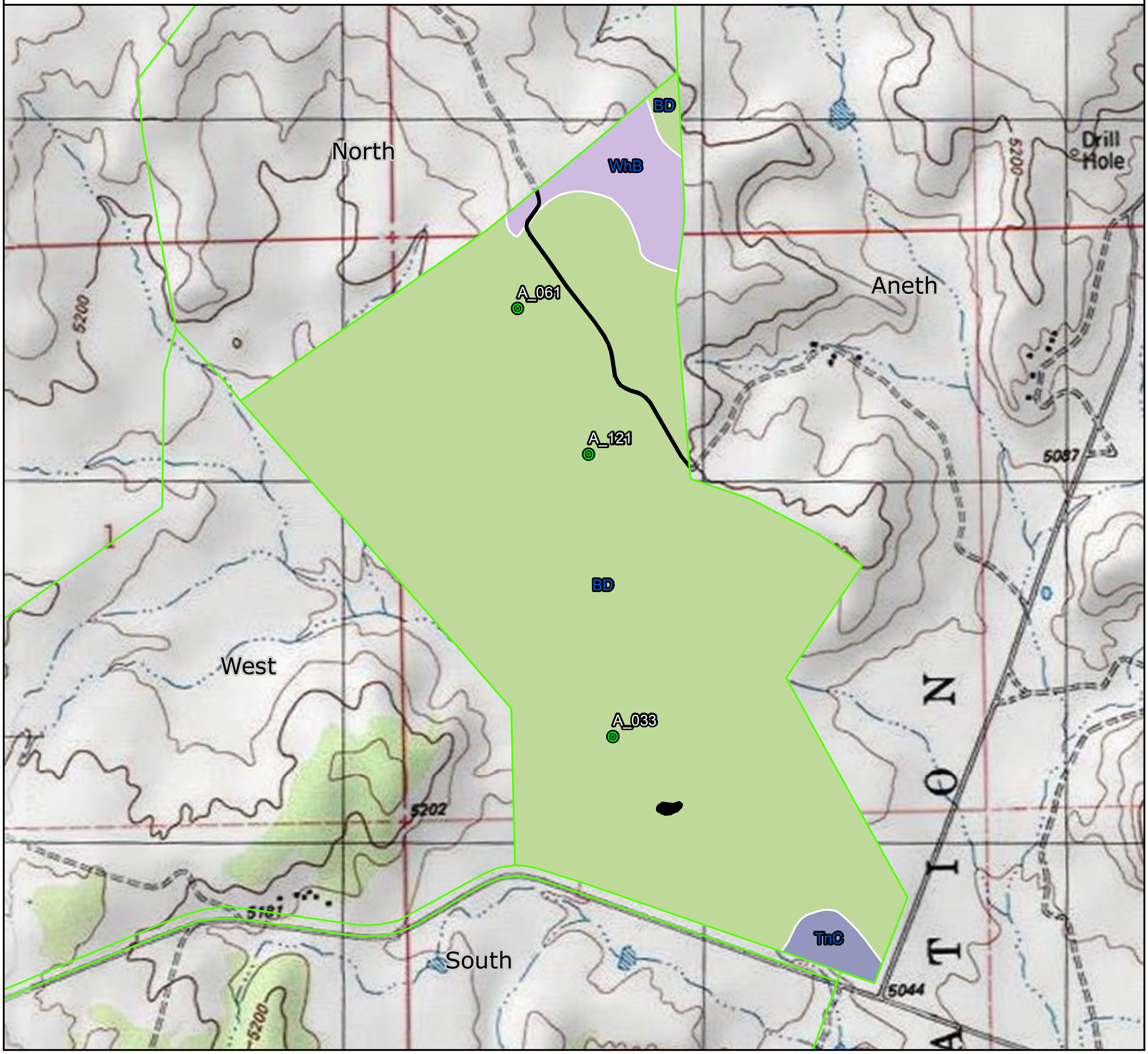
Coordinate System: NAD 1983 UTM Zone 12N

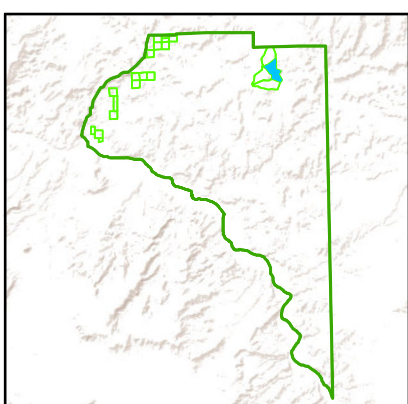
Document Name: P8X11_UNIT_AllotRMU

**2014 Range Inventory**
**BIA Northern Navajo Agency**
**Land Management District 12**
**Aneth Community, East RMU**

Total Acres: 508
Grazeable Acres*: 506
*Total acres minus non grazeable areas and areas with > 60% slope.

Initial Annual Carrying Capacity:
1 Sheep



Transect Location
Non Grazeable Range
Analysis Unit Boundary
Soil Map Unit
Community Boundary

0 0.25 0.5
Miles

1:15,000

Ecosphere Environmental Services

Date: 2/9/2015

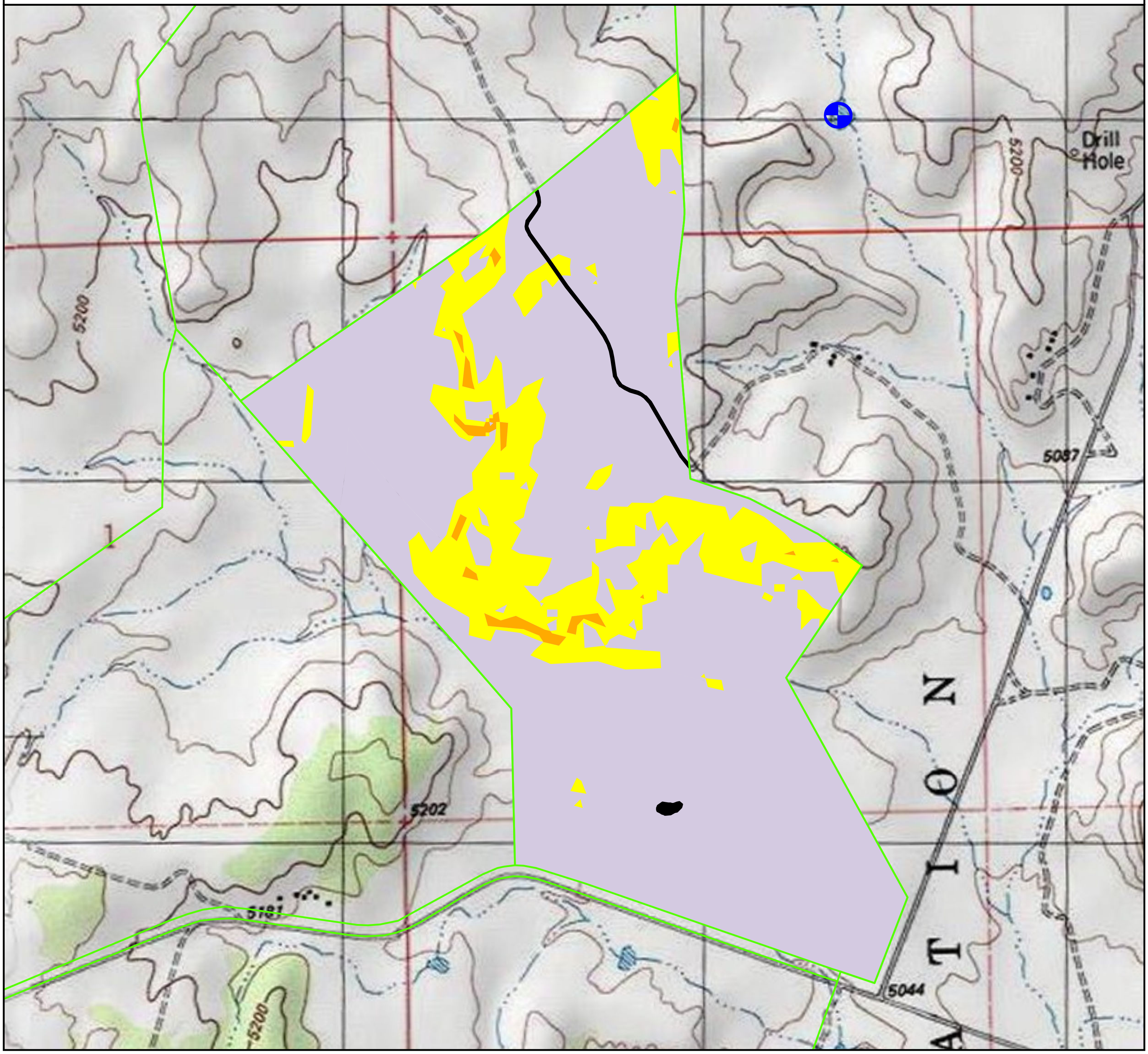
Coordinate System: NAD 1983 UTM Zone 12N

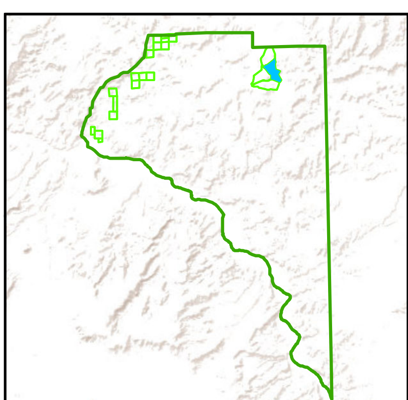
Document Name: P8X11_Soils_InitialCC_AllotRMU1

## 2014 Range Inventory
## BIA Northern Navajo Agency
## Land Management District 12
### Aneth Community, East RMU

Total Acres: 508
Grazeable Acres*: 506
*Total acres minus non grazeable areas and areas with > 60% slope.

Adjusted Annual Carrying Capacity: 0 Sheep



Water Source
Analysis Unit Boundary
Community Boundary
Non Grazeable Range

**Distance to Water**
- No Water Source
- 0-1 Mile
- 1-2 MIles
- > 2 Miles

**Slope**
- 10 - 30%
- 30 - 60%
- >60%

0 0.25 0.5
Miles

1:15,000

Ecosphere Environmental Services

Date: 2/9/2015

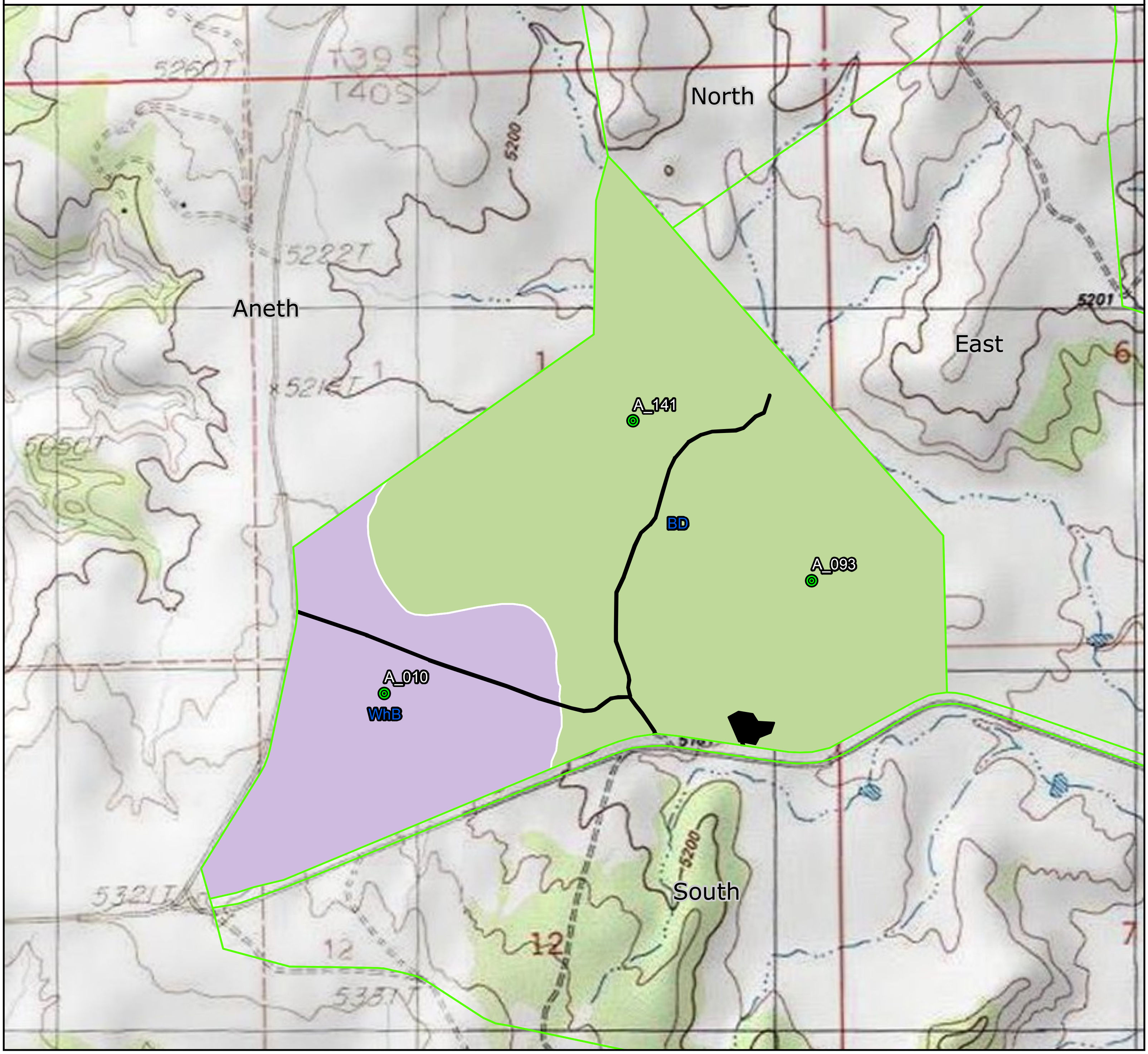
Coordinate System: NAD 1983 UTM Zone 12N

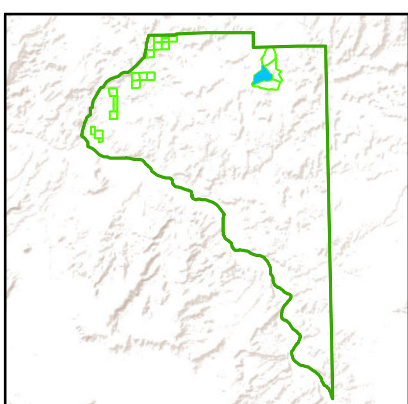
Document Name: P8X11_Slope_AdjCC_AllotRMU

**2014 Range Inventory**
**BIA Northern Navajo Agency**
**Land Management District 12**
**Aneth Community, West RMU**

Total Acres: 494
Grazeable Acres*: 489
*Total acres minus non grazeable areas and areas with > 60% slope.

Initial Annual Carrying Capacity:
<1 Sheep



Transect Location
Non Grazeable Range
Analysis Unit Boundary
Soil Map Unit
Community Boundary

0 0.25 0.5
Miles

1:15,000

Ecosphere Environmental Services

Date: 2/9/2015

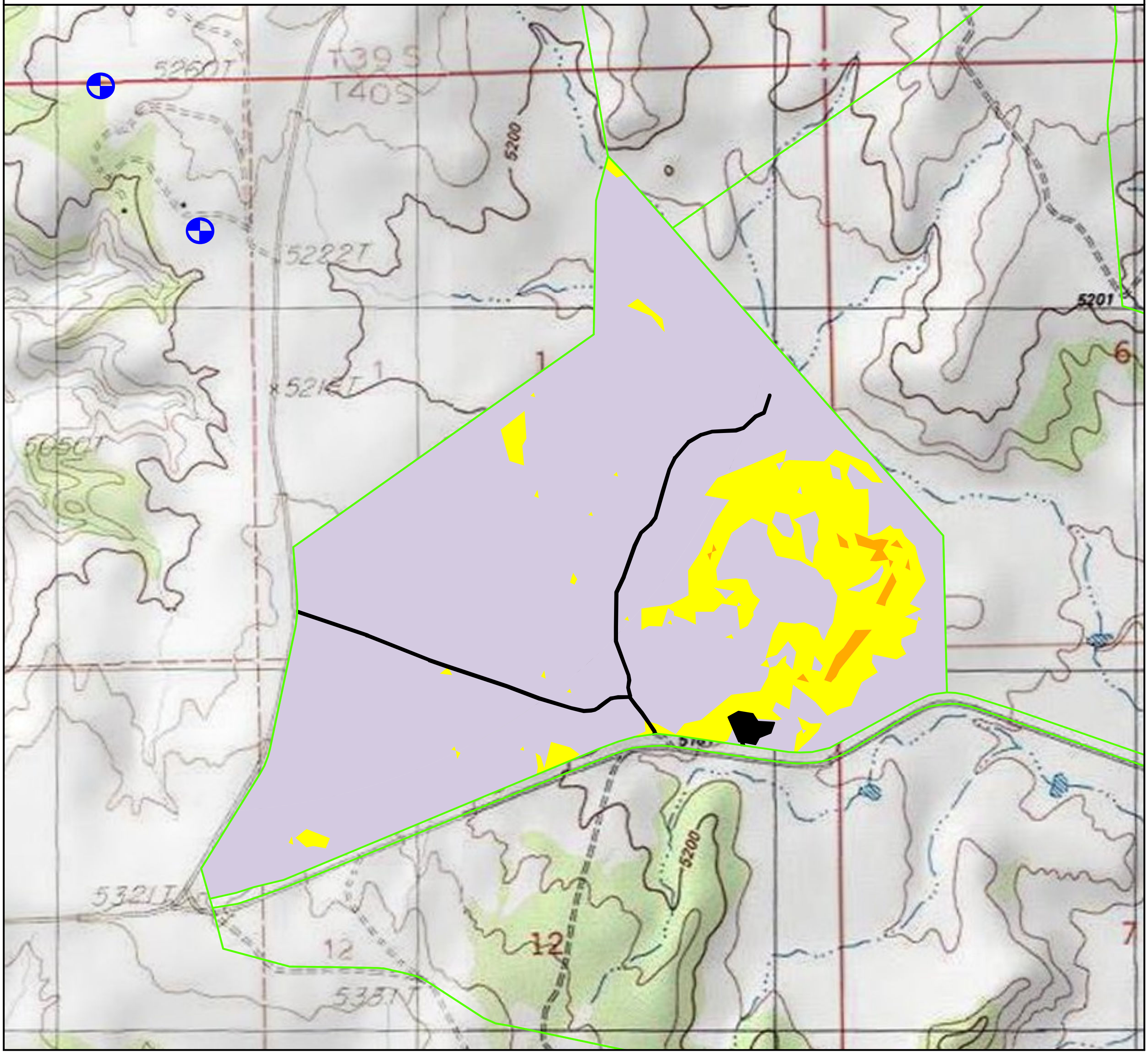
Coordinate System: NAD 1983 UTM Zone 12N

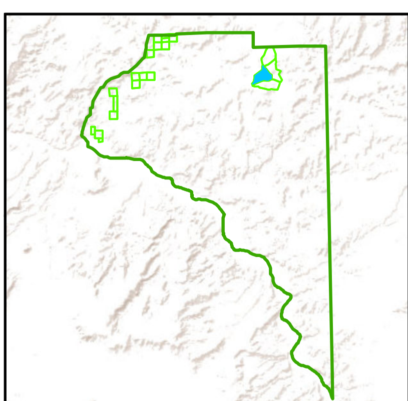
Document Name: P8X11_Soils_InitialCC_AllotRMU1

**2014 Range Inventory**
**BIA Northern Navajo Agency**
**Land Management District 12**
**Aneth Community, West RMU**

Total Acres: 494
Grazeable Acres*: 489
*Total acres minus non grazeable areas and areas with > 60% slope.

Adjusted Annual Carrying Capacity: 0 Sheep



Water Source
Analysis Unit Boundary
Community Boundary
Non Grazeable Range

**Distance to Water**
No Water Source
0-1 Mile
1-2 MIles
> 2 Miles

**Slope**
10 - 30%
30 - 60%
>60%

0 0.25 0.5
Miles

1:15,000

Ecosphere Environmental Services

Date: 2/9/2015

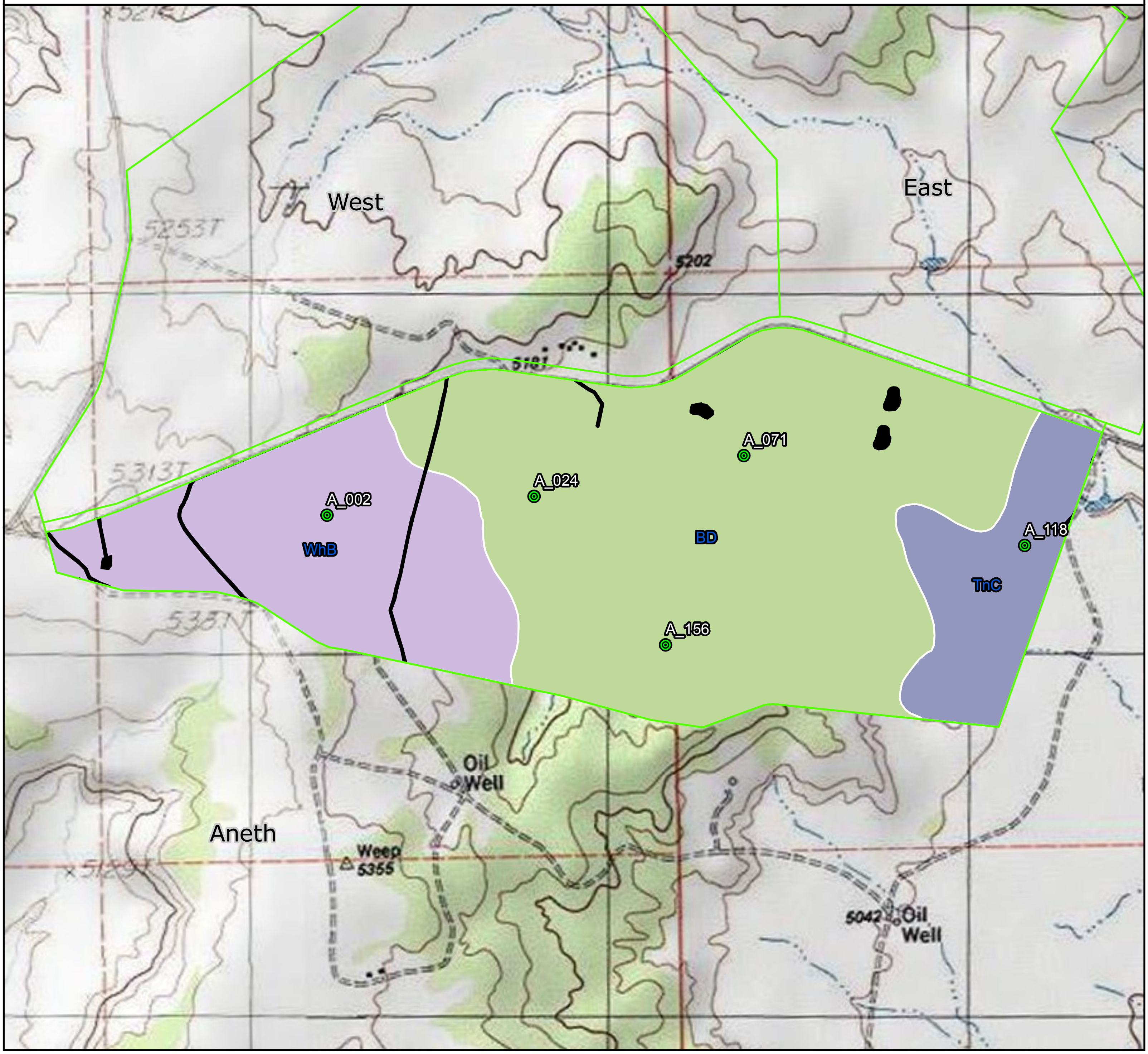
Coordinate System: NAD 1983 UTM Zone 12N

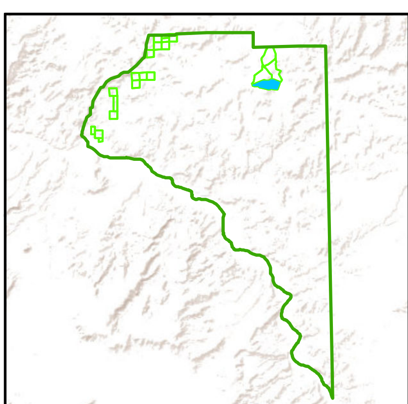
Document Name: P8X11_Slope_AdjCC_AllotRMU

# 2014 Range Inventory
# BIA Northern Navajo Agency
# Land Management District 12
## Aneth Community, South RMU

Total Acres: 511
Grazeable Acres*: 506
*Total acres minus non grazeable areas and areas with > 60% slope.

Initial Annual Carrying Capacity: <1 Sheep



Transect Location
Non Grazeable Range
Analysis Unit Boundary
Soil Map Unit
Community Boundary

Ecosphere Environmental Services

0 | 0.25 | 0.5
Miles

1:15,000

Date: 2/9/2015

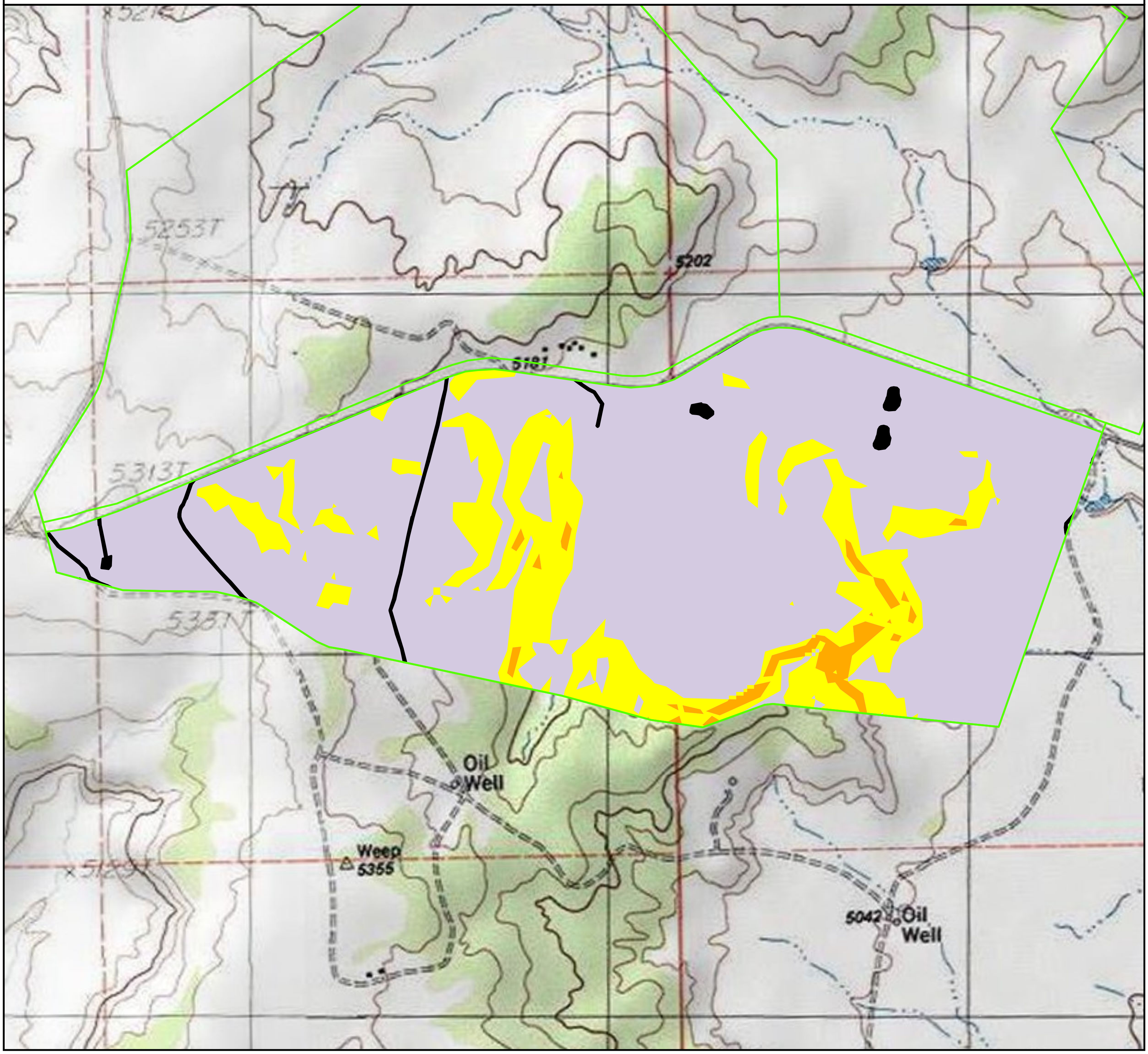
Coordinate System: NAD 1983 UTM Zone 12N

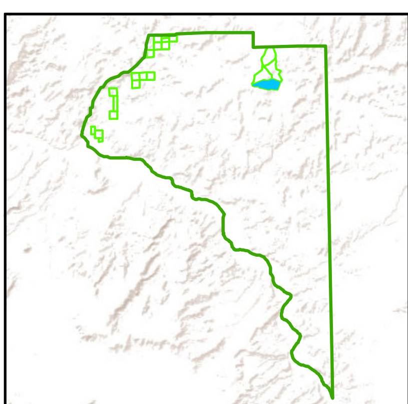
Document Name: P8X11_Soils_InitialCC_AllotRMU1

**2014 Range Inventory**
**BIA Northern Navajo Agency**
**Land Management District 12**
**Aneth Community, South RMU**

Total Acres: 511
Grazeable Acres*: 506
*Total acres minus non grazeable areas and areas with > 60% slope.

Adjusted Annual Carrying Capacity: 0 Sheep



Water Source
Analysis Unit Boundary
Community Boundary
Non Grazeable Range

**Distance to Water**
No Water Source
0-1 Mile
1-2 MIles
> 2 Miles

**Slope**
10 - 30%
30 - 60%
>60%

0 0.25 0.5
Miles

1:15,000

Ecosphere Environmental Services

Date: 2/9/2015

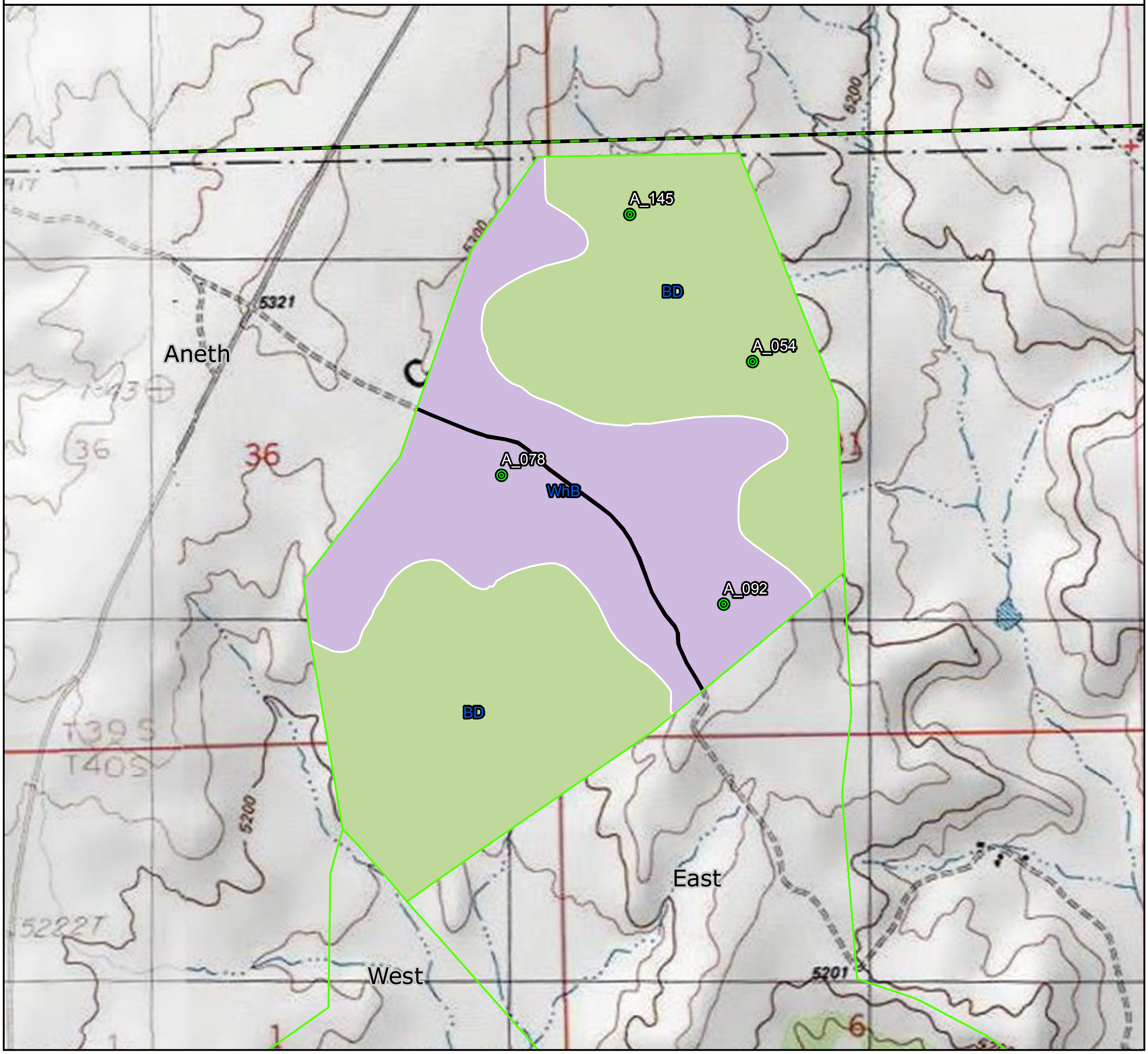
Coordinate System: NAD 1983 UTM Zone 12N

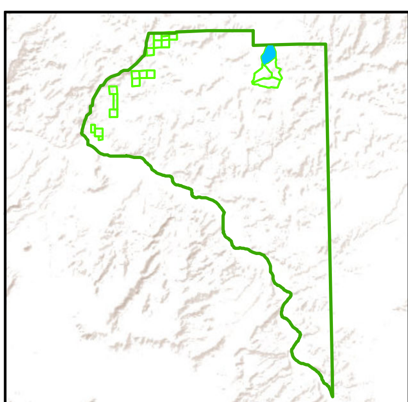
Document Name: P8X11_Slope_AdjCC_AllotRMU

**2014 Range Inventory**
**BIA Northern Navajo Agency**
**Land Management District 12**
**Aneth Community, North RMU**

Total Acres: 490
Grazeable Acres*: 489
*Total acres minus non grazeable areas and areas with > 60% slope.

Initial Annual Carrying Capacity:
<1 Sheep



Transect Location
Analysis Unit Boundary
Community Boundary
Non Grazeable Range
Soil Map Unit

0 0.25 0.5
Miles

1:15,000

Ecosphere
Environmental Services

Date: 2/9/2015

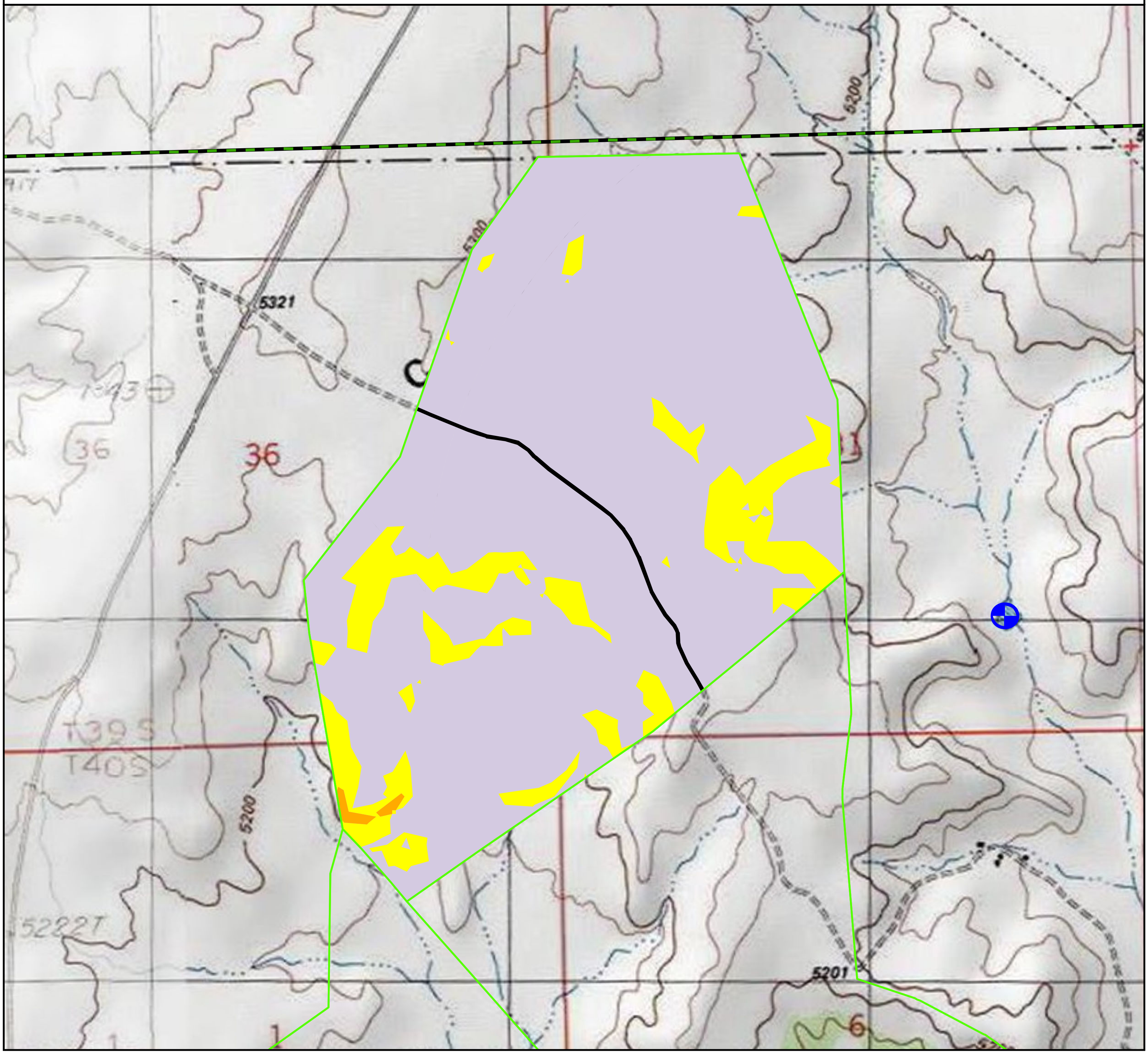
Coordinate System: NAD 1983 UTM Zone 12N

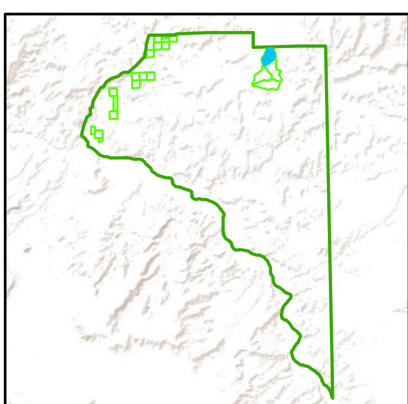
Document Name: P8X11_Soils_InitialCC_AllotRMU1

**2014 Range Inventory**
**BIA Northern Navajo Agency**
**Land Management District 12**
**Aneth Community, North RMU**

Total Acres: 490
Grazeable Acres*: 489
*Total acres minus non grazeable areas and areas with > 60% slope.

Adjusted Annual Carrying Capacity: 0 Sheep



Water Source
Analysis Unit Boundary
Community Boundary
Non Grazeable Range

**Distance to Water**
No Water Source
0-1 Mile
1-2 MIles
> 2 Miles

**Slope**
10 - 30%
30 - 60%
>60%

0 0.25 0.5
Miles

1:15,000

Ecosphere Environmental Services

Date: 2/9/2015

Coordinate System: NAD 1983 UTM Zone 12N

Document Name: P8X11_Slope_AdjCC_AllotRMU

## 5.3 Cudei

The Cudei Community is an area of grasslands and badlands that extends south from the Colorado border to the outskirts of Shiprock, New Mexico. The San Juan River makes up most of the southern and western boundary and several buttes and mesas occupy the northeast corner. Highway 491 runs from north to south through the community and divides it into two separate pastures. The West pasture is about twice the size of the East pasture and contains 60,095 grazeable acres and 85 transects within 13 ecological sites. The East pasture has 29,129 grazeable acres and 45 transects in 10 ecological sites.

### 5.3.1 Cudei West Pasture

Available forage is highest in the R035XB017NM site, which occupies areas of cobbly slopes along the upper portions of stream terraces. Soils are moderately deep and well-drained and can include sandy loams, silty loams, and clay loams. The reference plant community is composed of grasses, shrubs, and a small amount of forbs. Dominant species often include James' galleta (*Pleuraphis jamesii*), valley saltbush (*Atriplex cuneata*), and shadscale (*Atriplex confertifolia*). Grazing during the spring will reduce cool season grasses and cause an initial increase in less palatable warm season grasses. Eventually, unmanaged grazing will open the way for colonization by invasive annuals such as prickly Russian thistle (*Salsola tragus*) and cheatgrass (*Bromus tectorum*). Transect data show that most available forage at the time of study was supplied by valley saltbush, James' galleta, and alkali sacaton (*Sporobolus airoides*). Cool season grasses, such as Indian ricegrass (*Achnatherum hymenoides*), were in the sampled plant community, but were not very abundant and species diversity was low. Cheatgrass was not found along the transects, but prickly Russian thistle and saltlover (*Halogeton glomeratus*) were widespread in this ecological site.

The Badland site has the second highest amount of available forage. This is surprising because badland sites tend to have low production even when in excellent condition. However, when examining the other ecological sites, it can be seen that production of available forage is very low throughout the entire pasture and as the second most productive site, the Badland site still only averages about 12 pounds per acre of available forage. No perennial grasses were recorded on any of the three transects in this ecological site. Available forage consisted of mat saltbush (*Atriplex corrugata*) and valley saltbush. Saltlover was found on two of the three transects.

The R035XB271AZ site is one the largest in this pasture. Usually, large sites tend to have the highest carrying capacities by default due to having more acres in which to graze livestock. Because available forage is very low (less than 3 pounds per acre), the carrying capacity is much lower than expected. The reference state for this site does tend to have a low amount of annual production and consists primarily of low-growing shrubs with sparse grasses in the shrub interspaces. This is largely due to the soils containing high amounts of salt. The most common grass in the reference plant community is alkali sacaton, and shrubs usually include mat saltbush and valley saltbush. Mat saltbush is well adapted to saline soils and will often increase following grazing pressure. Prickly Russian thistle will often invade the site following disturbance. Despite its prevalence in the pasture, the R035XB271AZ site had only one transect, suggests that a more accurate portrayal of the plant community would be achieved by installing additional transects. The sampled area has a large proportion of bare ground and most production is coming from valley saltbush, mat saltbush, and cleftleaf wildheliotrope (*Phacelia crenulata*).

The least represented site in the pasture, R035XB022NM, also has the lowest amount of available forage and the lowest carrying capacity. Soils tend to have a high concentration of salt, which limits the suite of plant species able to grow in these areas. The reference plant community is dominated by species such as alkali sacaton, cattle saltbush (*Atriplex powellii*), and various annual forbs. Sodium tolerant species like cattle saltbush and prickly Russian thistle tend to increase following grazing disturbances. One transect was placed within this site. Production at this location is mostly from prickly Russian thistle and saltlover. Other species include James' galleta, Indian ricegrass, milkvetch (*Astragalus* sp.), globemallow (*Sphaeralcea* sp.), and broom snakeweed (*Gutierrezia sarothrae*).

Similarity index values in this pasture range from 0-37 percent with the highest values being associated with the R035XB277AZ and R035XB017NM sites. In both sites, allowable production is primarily from James' galleta, valley saltbush, and alkali sacaton.

### *Frequently Encountered Species*

1. prickly Russian thistle (*Salsola tragus*) (occurred on 82% of all transects)
2. saltlover (*Halogeton glomeratus*) (occurred on 62% of all transects)
3. James' galleta (*Pleuraphis jamesii*) (occurred on 58% of all transects)
4. Indian ricegrass (*Achnatherum hymenoides*) (occurred on 44% of all transects)
5. valley saltbush (*Atriplex cuneata*) (occurred on 38% of all transect)

### *Species by Weight*

1. prickly Russian thistle (*Salsola tragus*) (76 lbs/acre)
2. saltlover (*Halogeton glomeratus*) (26 lbs/acre)
3. James' galleta (*Pleuraphis jamesii*) (10 lbs/acre)
4. valley saltbush (*Atriplex cuneata*) (8 lbs/acre)
5. mat saltbush (*Atriplex corrugata*) (4 lbs/acre)

## Ground Cover

The percentage of bare ground in the Cudei West pasture is above the study area average and foliar canopy is below average. The most active erosion is mostly restricted to southern third of the pasture, but the high amount of bare ground throughout suggests that many areas will likely become more eroded unless foliar cover increases.

**Analysis Unit** Cudei West Pasture **Chapter** Cudei

## Summary of Grazeable and Non-Grazeable Acres in Analysis Unit

| | | |
|---|---|---|
| Chapter Acres | | 91,397.70 |
| Analysis Unit Acres | | 60,991.13 |
| Non-Grazeable Acres | Developed | 63.53 |
| | Hydro | 180.56 |
| | Roads | 500.93 |
| | Slope>60 | 151.02 |
| Total Grazeable Acres | | 60,095.10 |

## Summary of Similarity Indices, Cover, and Carrying Capacity within Anlysis Unit

| Similarity Indices (%) | |
|---|---|
| Minimum | 0 |
| Maximum | 37 |
| Median | 6 |

| Cover (%) | |
|---|---|
| Foliar Cover | 19.00 |
| Bare Ground | 73.00 |
| Basal | 0.00 |

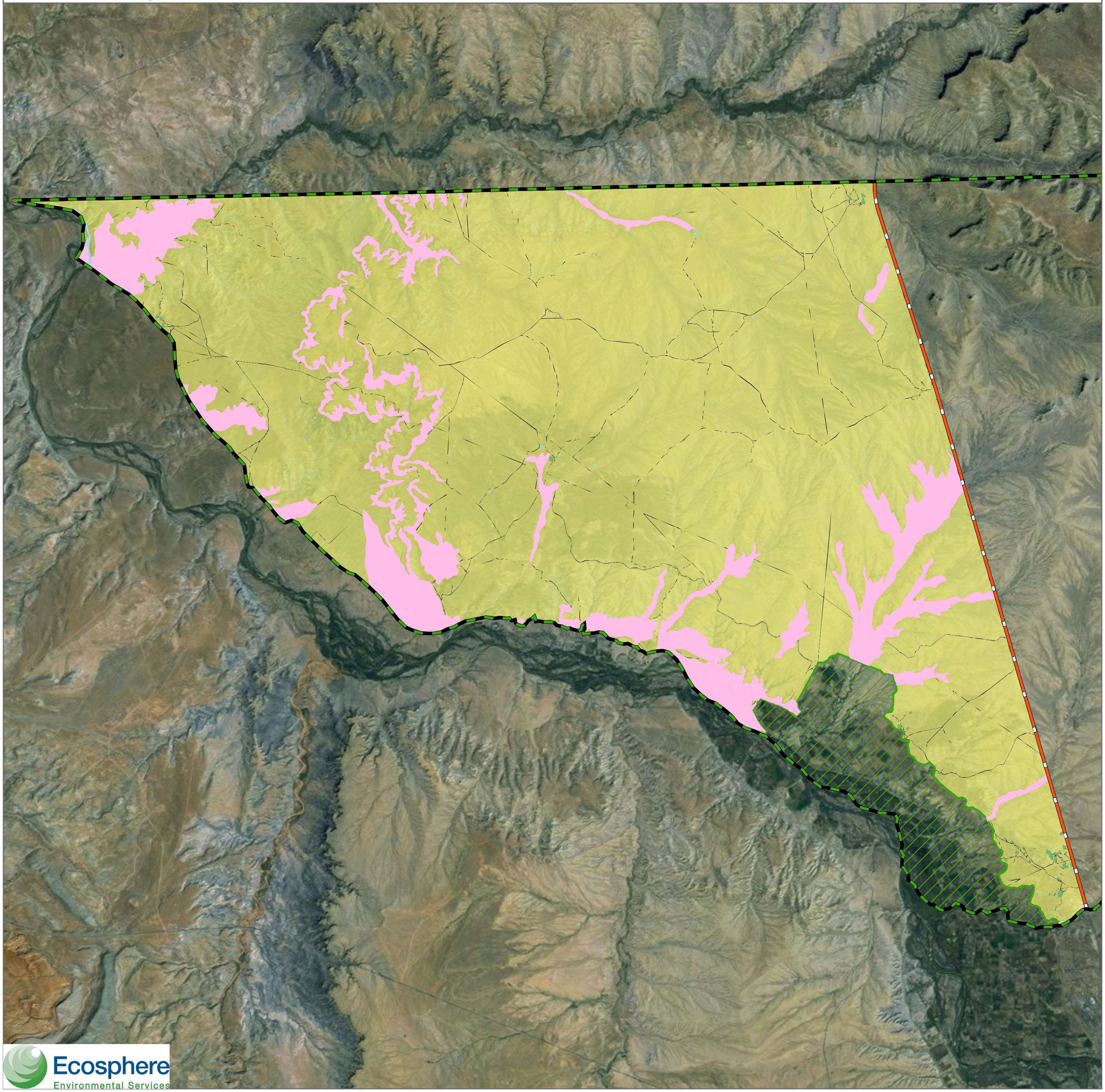
| Carrying Capacity (Sheep Units/Year) | |
|---|---|
| Initial CC | 148.94 |
| Slope Adjusted CC | 148.45 |
| DTW Adjusted CC | 78.01 |

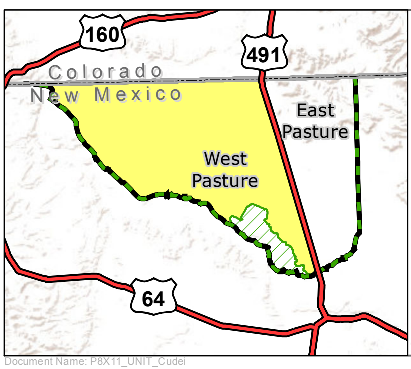
## Results by Ecological Site in Sheep Units Year Long

| Ecological Site | Number of Transects | Percent of Analysis Unit Acres | Available Forage (Lbs/Acre) | Initial Grazeable Acres | Sheep Stocking Rate (Acres/ Sheep Unit) | Initial Sheep Carrying Capacity (Sheep Units/Year) |
|---|---|---|---|---|---|---|
| Badland | 3 | 7 | 11.75 | 4,197.40 | 201.70 | 20.81 |
| R035XB017NM Cobbly Slopes 6-10" | 4 | 3 | 22.73 | 1,611.70 | 104.27 | 15.46 |
| R035XB021NM Loamy Upland 7-10 | 3 | 3 | 4.81 | 1,962.60 | 492.72 | 3.98 |
| R035XB022NM Loamy Upland sodic | 1 | <1 | 0.75 | 522.20 | 3,160.00 | 0.17 |
| R035XB030NM Sandy Loam Upland 6-10" | 7 | 8 | 7.15 | 4,631.20 | 331.47 | 13.97 |
| R035XB035NM Sandy Upland 6-10" | 2 | 3 | 10.68 | 1,621.10 | 221.91 | 7.31 |
| R035XB267AZ Sandy Loam Upland 6-10" Limy | 1 | 4 | 5.30 | 2,343.80 | 447.17 | 5.24 |
| R035XB271AZ Loamy Upland 6-10" p.z. Saline-Sodic | 1 | 17 | 2.66 | 10,127.20 | 890.98 | 11.37 |
| R035XB274AZ Sandy Loam Upland 6-10" p.z. Saline | 4 | 4 | 3.33 | 2,639.90 | 711.71 | 3.71 |
| R035XB275AZ Loamy Fan 6-10" p.z. | 7 | 5 | 1.58 | 3,199.30 | 1,500.00 | 2.13 |
| R035XB277AZ Siltstone Upland 6-10" p.z. Limy | 24 | 18 | 7.91 | 11,048.10 | 299.62 | 36.87 |
| R035XB278AZ Loamy Upland 6-10" p.z. Saline, Gypsic | 6 | 6 | 9.71 | 3,361.90 | 244.08 | 13.77 |
| R035XB279AZ Clay Loam Upland 6-10" p.z. Sodic, Gypsic | 21 | 14 | 4.06 | 8,260.70 | 583.74 | 14.15 |
| Gullied Land | 0 | 1 | | 883.48 | | |
| Marshes | 0 | <1 | | 9.66 | | |
| R035XB024NM Saline Bottom 6-10" | 0 | <1 | | 26.07 | | |
| R035XB028NM Sandy Bottom 6-10" | 0 | <1 | | 111.12 | | |
| R035XB224AZ Clayey Slopes 6-10" p.z. Bouldery | 0 | <1 | | 83.09 | | |
| R035XB269AZ Loamy Bottom 6-10" p.z. Perennial | 0 | <1 | | 80.51 | | |
| R035XB272AZ Loamy Bottom 6-10" p.z. Perennial, Saline | 0 | <1 | | 21.26 | | |
| R035XB273AZ Sandy Bottom 6-10" p.z. | 0 | <1 | | 201.69 | | |
| R035XB276AZ Siltstone Upland 6-10" p.z. Saline | 0 | <1 | | 99.88 | | |
| R035XB016NM Clay Loam Terrace (sodic) 7-10" | 0 | 3 | | 1,753.72 | | |
| R035XB034NM Sandy Terrace 6-10" sodic | 0 | <1 | | 182.48 | | |
| R035XB204AZ Sandstone Upland 6-10" p.z. | 0 | <1 | | 561.38 | | |
| Riverwash | 0 | <1 | | 6.66 | | |
| RockOutcrop | 0 | 1 | | 674.83 | | |
| Water | 0 | <1 | | 23.32 | | |

# 2014 Range Inventory
# BIA Northern Navajo Agency
# Land Management District 12

**Cudei Community**
**West Pasture**




- Analysis Unit
- Agricultural Area
- Pasture Boundary
- Community Boundary

**Non Grazeable Range**

- Developed
- Hydrology
- Roads
- Non Range Soils

0 2.5 5
Miles

1:136,000

Date: 2/9/2015

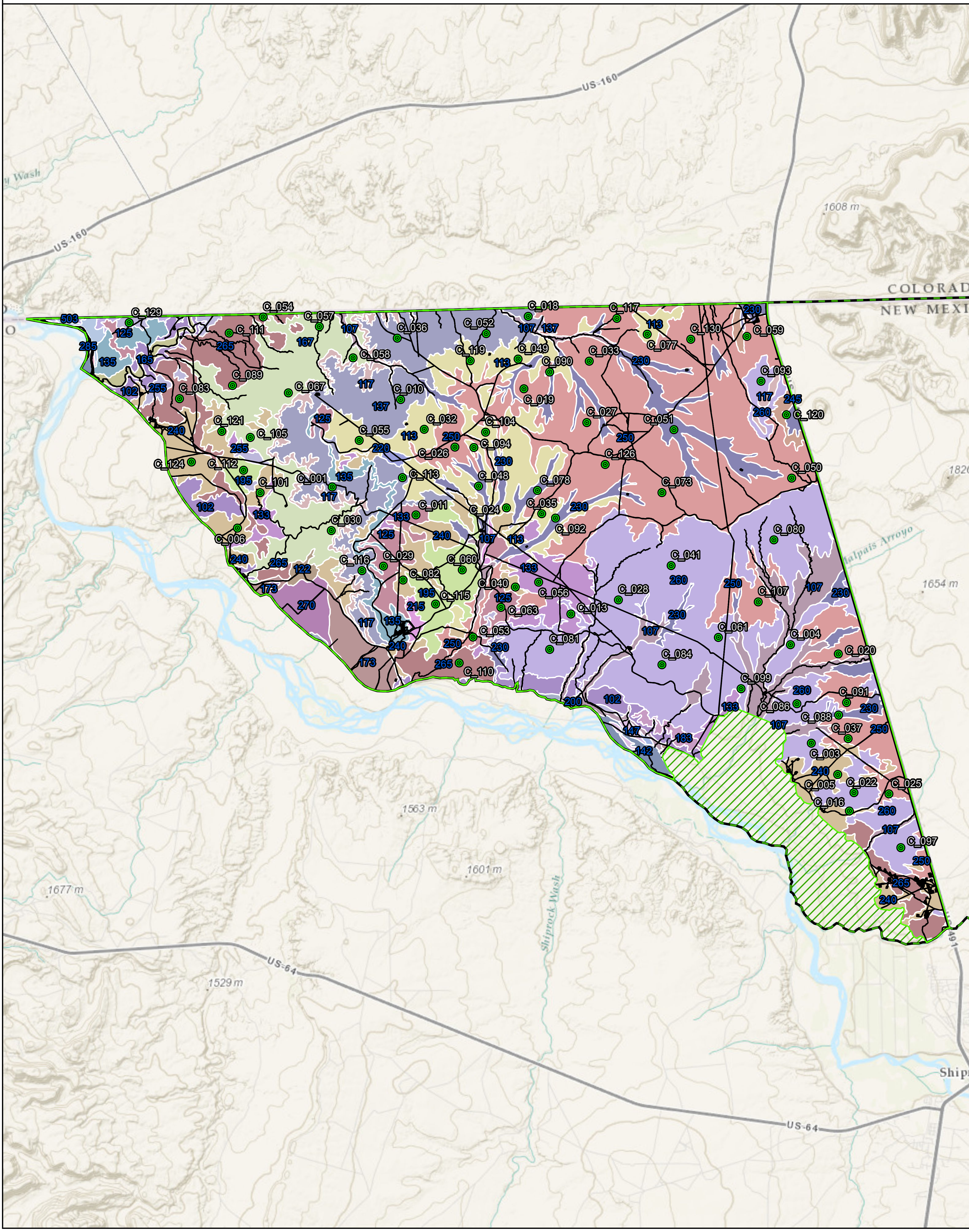
Coordinate System: NAD 1983 UTM Zone 12N

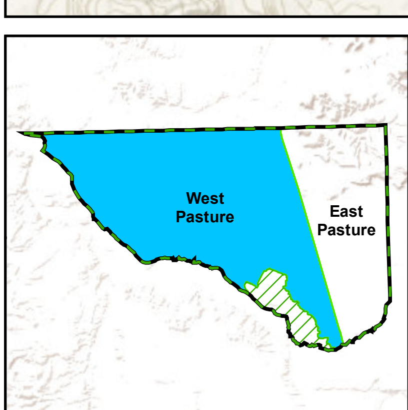
Document Name: P8X11_UNIT_Cudei

**2014 Range Inventory**
**BIA Northern Navajo Agency**
**District 12**
**Cudei Community, West Pasture**

Total Acres: 60,991
Grazeable Acres*: 60,095
*Total acres minus non grazeable areas and areas with > 60% slope.

Initial Annual Carrying Capacity:
11 Sheep




Transect Location
Agricultural Land
Analysis Unit Boundary
Non Grazeable Range
Community Boundary
Soil Map Units

0 1 2 4
Miles

Coordinate System: NAD 1983 UTM Zone 12N

1:110,000

Ecosphere Environmental Services

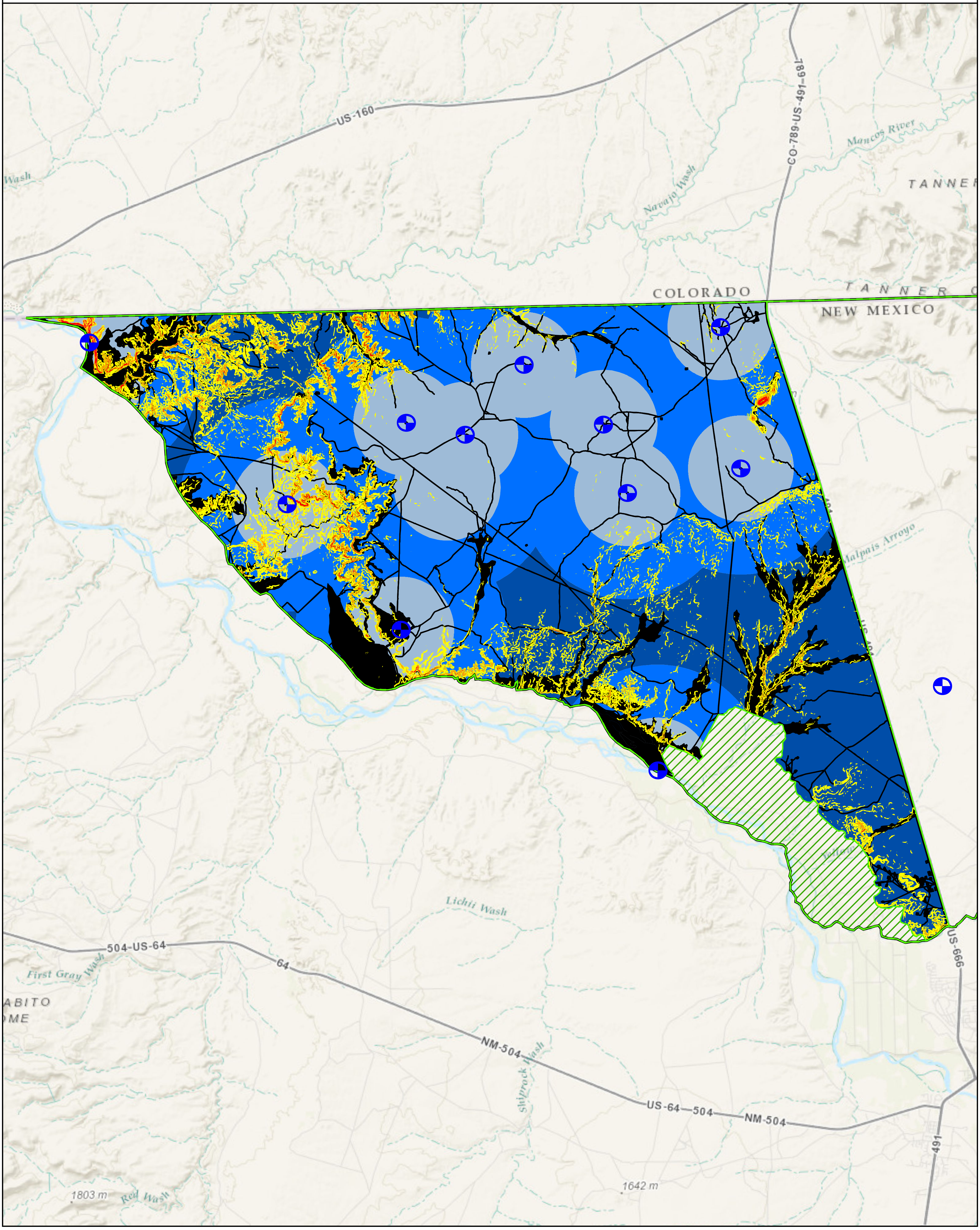
Date: 2/20/2015

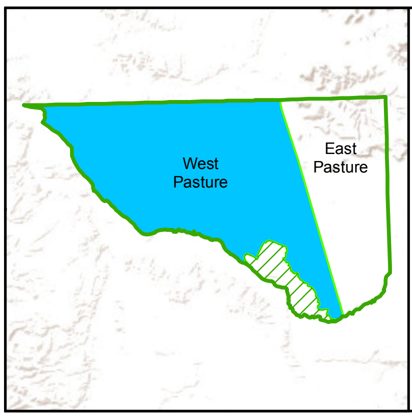
Document Name: P11X17_Soils_InitialCC_Cudei1

**2014 Range Inventory**
**BIA Northern Navajo Agency**
**District 12**
**Cudei Community, West Pasture**

Total Acres: 60,991
Grazeable Acres*: 60,095
*Total acres minus non grazeable areas and areas with > 60% slope.

Adjusted Annual Carrying Capacity: 6 Sheep




Water Source
Analysis Unit Boundary
Community Boundary
Agricultural Land
Non Grazeable Range

**Distance to Water**
0-1 Mile
1-2 MIles
>2 Miles

**Slope**
10-30%
30-60%
> 60%

0 1 2 4 Miles

1:110,000

Coordinate System: NAD 1983 UTM Zone 12N

Ecosphere Environmental Services

Date: 2/9/2015

Document Name: P11X17_Slope_AdjCC_Cudei1

### 5.3.2 Cudei East Pasture

The R035XC313AZ site is currently producing the most available forage. This site is associated with fan terraces and valley floors and soils tend to be deep and composed of clay loam. The reference plant community is composed mainly of grasses with a moderate amount of shrubs. Dominant species in the reference community include blue grama (*Bouteloua gracilis*), western wheatgrass (*Pascopyrum smithii*), Indian ricegrass (*Achnatherum hymenoides*), big sagebrush (*Artemisia tridentata*), and fourwing saltbush (*Atriplex canescens*). Unmanaged grazing often causes big sagebrush, rabbitbrush (*Chrysothamnus* spp.), broom snakeweed (*Gutierrezia sarothrae*), and annuals to increase and perennial grasses to decrease. In the current plant community, James' galleta (*Pleuraphis jamesii*) and alkali sacaton (*Sporobolus airoides*) are the primary producers of available forage. Two invasive annuals, cheatgrass (*Bromus tectorum*) and prickly Russian thistle (*Salsola tragus*), were found on several transects.

The R035XB278AZ and F035XG134NM sites also have high amounts of available forage relative to other sites in this pasture. The R035XB278AZ site is typically found on toe slopes and fans below mesas. Soils are sandy, loamy, and subject to wind erosion. The reference plant community is comprised of a mix of perennial grasses and low-growing shrubs. Common species include Indian ricegrass, alkali sacaton, and valley saltbush (*Atriplex cuneata*). Annual species tend to increase following disturbance. The current plant community contains several forage species. The most productive of these are winterfat (*Krascheninnikovia lanata*) and James' galleta. Three invasive species were present in the plant community at the time of sampling. These are cheatgrass, prickly Russian thistle, and saltlover (*Halogeton glomeratus*).

The F035XG134NM site is found on the mesa tops and upper slopes in the northeastern corner of the pasture. This site does not have a written ecological site description, but the general plant community typically has an overstory of twoneedle piñon (*Pinus edulis*), oneseed juniper (*Juniperus monosperma*), and Gambel oak (*Quercus gambelli*) with blue grama in the understory. The transects tend to lie in areas with light to moderate cover of piñon and juniper, large expanses of bare ground and rock, and moderately dense stands of shrubs. Available forage is largely from Utah serviceberry (*Amelanchier utahensis*) and alkali sacaton. Other common species include Greene's rabbitbrush (*Chrysothamnus greenei*), shadscale (*Atriplex confertifolia*), jointfir (*Ephedra* spp.), broom snakeweed, and James' galleta.

Forage is currently unavailable in the R035XB016NM site. Soils in this site contain a large amount of salt, which limits the suite of species to those able to tolerate highly saline conditions. These often include alkali sacaton, cattle saltbush (*Atriplex powellii*), and mound saltbush (*Atriplex obovata*). Non-native annuals are common in the plant community when it has deteriorated from its reference state and shrubs like black greasewood (*Sarcobatus vermiculatus*) tend to increase. This site contains only one transect, and the sampled area contains large expanses of bare ground and only two plant species; prickly Russian thistle and annual wheatgrass (*Eremopyrum triticeum*).

Similarity index values throughout this pasture range from 0-38 percent. The highest values were recorded from the R035XB277AZ site and the primary contributors of allowable production are valley saltbush and James' galleta.

### *Frequently Encountered Species*

1. prickly Russian thistle (*Salsola tragus*) (occurred on 87% of all transects)
2. James' galleta (*Pleuraphis jamesii*) (occurred on 62% of all transects)
3. cheatgrass (*Bromus tectorum*) (occurred on 56% of all transects)
4. saltlover (*Halogeton glomeratus*) (occurred on 51% of all transects)
5. annual wheatgrass (*Eremopyrum triticeum*) (occurred on 42% of all transect)

### *Species by Weight*

1. prickly Russian thistle (*Salsola tragus*) (43 lbs/acre)
2. James' galleta (*Pleuraphis jamesii*) (13 lbs/acre)
3. annual wheatgrass (*Eremopyrum triticeum*) (12 lbs/acre)
4. valley saltbush (*Atriplex cuneata*) (12 lbs/acre)
5. saltlover (*Halogeton glomeratus*) (11 lbs/acre)

## Ground Cover

The percentage of bare ground in the East pasture of Cudei is a little above the study area average, while foliar cover is below average. Areas currently experiencing advanced wind and water erosion are scattered throughout the pasture, with the exception of the mesa tops.

**Analysis Unit** Cudei East Pasture **Chapter** Cudei

## Summary of Grazeable and Non-Grazeable Acres in Analysis Unit

| | | |
|---|---|---|
| Chapter Acres | | 91,397.70 |
| Analysis Unit Acres | | 30,406.62 |
| Non-Grazeable Acres | Developed | 18.16 |
| | Hydro | 23.46 |
| | Roads | 354.99 |
| | Slope>60 | 881.00 |
| Total Grazeable Acres | | 29,129.02 |

## Summary of Similarity Indices, Cover, and Carrying Capacity within Anlysis Unit

| Similarity Indices (%) | |
|---|---|
| Minimum | 0 |
| Maximum | 38 |
| Median | 2.5 |

| Cover (%) | |
|---|---|
| Foliar Cover | 19.00 |
| Bare Ground | 64.00 |
| Basal | 1.00 |

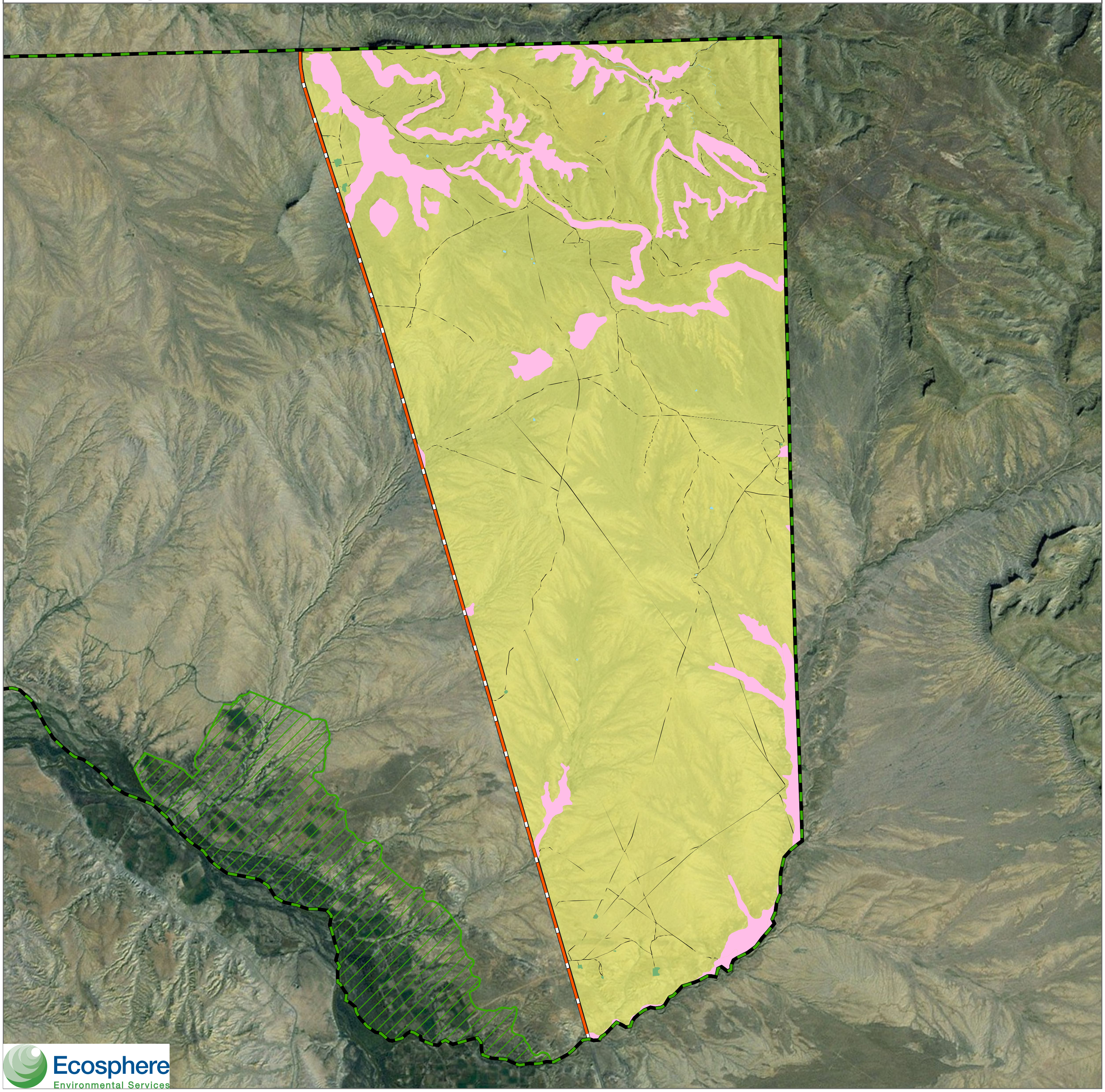
| Carrying Capacity (Sheep Units/Year) | |
|---|---|
| Initial CC | 106.79 |
| Slope Adjusted CC | 106.01 |
| DTW Adjusted CC | 24.49 |

## Results by Ecological Site in Sheep Units Year Long

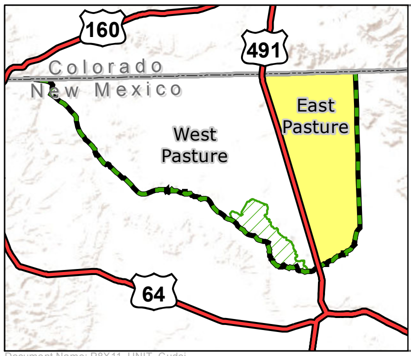
| Ecological Site | Number of Transects | Percent of Analysis Unit Acres | Available Forage (Lbs/Acre) | Initial Grazeable Acres | Sheep Stocking Rate (Acres/ Sheep Unit) | Initial Sheep Carrying Capacity (Sheep Units/Year) |
|---|---|---|---|---|---|---|
| Badland | 2 | 7 | 1.20 | 2,063.60 | 1,975.00 | 1.04 |
| F035XG134NM Gravelly - Woodland | 9 | 8 | 15.57 | 2,441.50 | 152.22 | 16.04 |
| R035XB016NM Clay Loam Terrace (sodic) 7-10" | 1 | 2 | 0.00 | 612.40 | | |
| R035XB275AZ Loamy Fan 6-10" p.z. | 8 | 10 | 3.18 | 3,161.00 | 745.28 | 4.24 |
| R035XB277AZ Siltstone Upland 6-10" p.z. Limy | 13 | 18 | 12.49 | 5,589.50 | 189.75 | 29.46 |
| R035XB278AZ Loamy Upland 6-10" p.z. Saline, Gypsic | 5 | 18 | 16.15 | 5,495.80 | 146.75 | 37.45 |
| R035XB279AZ Clay Loam Upland 6-10" p.z. Sodic, Gypsic | 1 | 2 | 0.50 | 642.20 | 4,740.00 | 0.14 |
| R035XC313AZ Loamy Upland 10-14" p.z. | 3 | 2 | 30.63 | 628.50 | 77.38 | 8.12 |
| R035XC326AZ Sandy Loam Upland 10-14" p.z. Saline | 2 | <1 | 11.26 | 53.80 | 210.48 | 0.26 |
| Rock Outcrop | 1 | 6 | 12.40 | 1,919.30 | 191.13 | 10.04 |
| Gullied Land | 0 | <1 | | 297.66 | | |
| R035XB020NM Loamy 6-10" terrace | 0 | <1 | | 60.90 | | |
| R035XB024NM Saline Bottom 6-10" | 0 | <1 | | 29.72 | | |
| R035XB028NM Sandy Bottom 6-10" | 0 | <1 | | 44.58 | | |
| R035XB276AZ Siltstone Upland 6-10" p.z. Saline | 0 | <1 | | 142.28 | | |
| R035XB017NM Cobbly Slopes 6-10" | 0 | <1 | | 54.42 | | |
| R035XB030NM Sandy Loam Upland 6-10" | 0 | <1 | | 108.66 | | |
| R035XB034NM Sandy Terrace 6-10" sodic | 0 | <1 | | 208.02 | | |
| R035XB204AZ Sandstone Upland 6-10" p.z. | 0 | <1 | | 140.49 | | |
| R035XB271AZ Loamy Upland 6-10" p.z. Saline-Sodic | 0 | 20 | | 6,183.69 | | |
| R035XB274AZ Sandy Loam Upland 6-10" p.z. Saline | 0 | <1 | | 132.03 | | |

# 2014 Range Inventory
# BIA Northern Navajo Agency
# Land Management District 12

**Cudei Community**
**East Pasture**



Ecosphere Environmental Services




Analysis Unit
Agricultural Area
Pasture Boundary
Community Boundary

**Non Grazeable Range**

Developed
Hydrology
Roads
Non Range Soils

0 2.5 5
Miles

1:100,000

Date: 2/9/2015

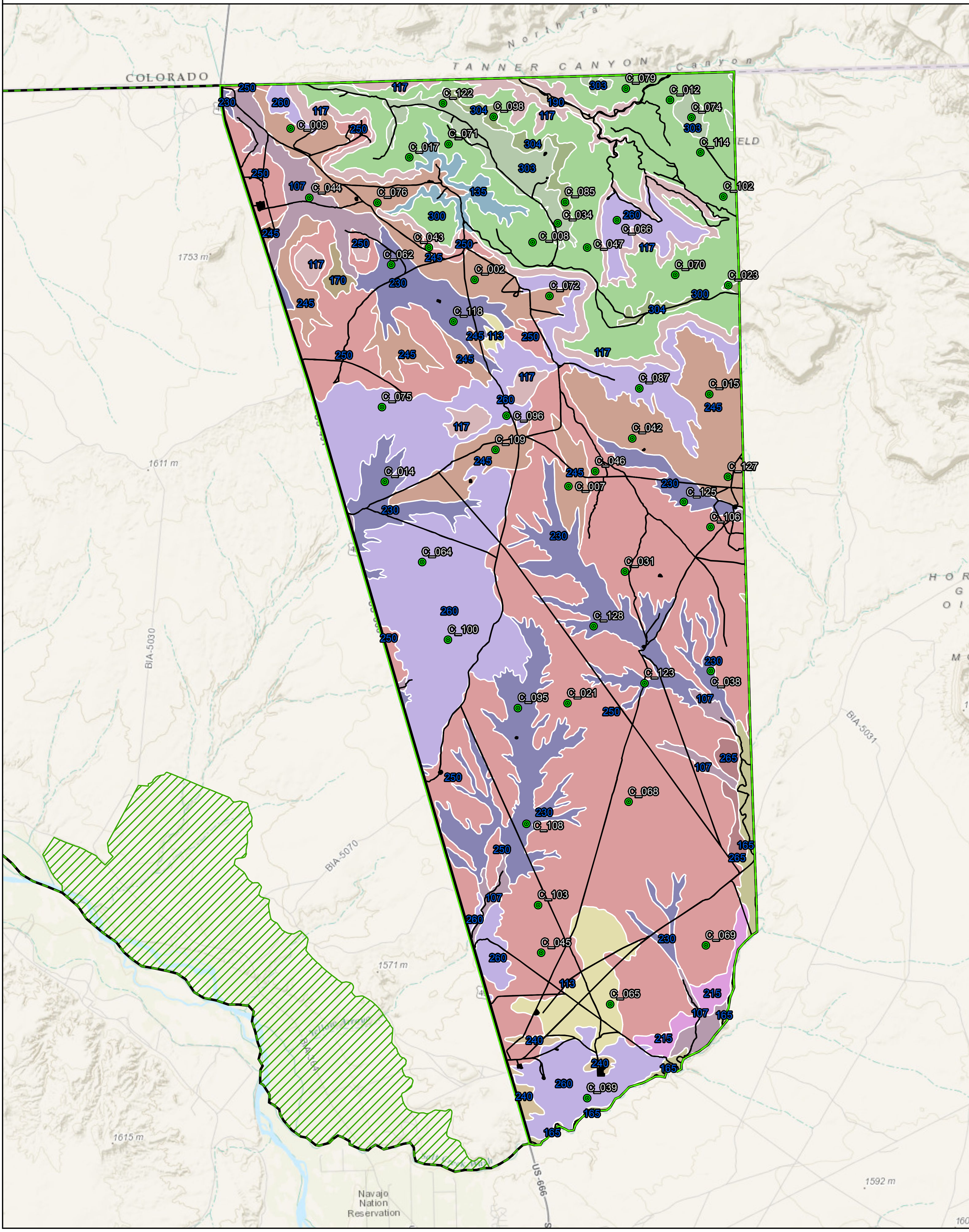
Coordinate System: NAD 1983 UTM Zone 12N

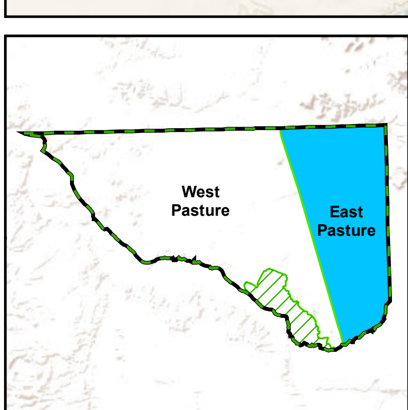
Document Name: P8X11_UNIT_Cudei

**2014 Range Inventory**
**BIA Northern Navajo Agency**
**District 12**
**Cudei Community, East Pasture**

Total Acres: 30,407
Grazeable Acres*: 29,129
*Total acres minus non grazeable areas and areas with > 60% slope.

Initial Annual Carrying Capacity:
11 Sheep




Transect Location
Analysis Unit Boundary
Community Boundary
Agricultural Land
Non Grazeable Range
Soil Map Units

0 1 2
Miles

Coordinate System: NAD 1983 UTM Zone 12N

1:65,000

Ecosphere Environmental Services

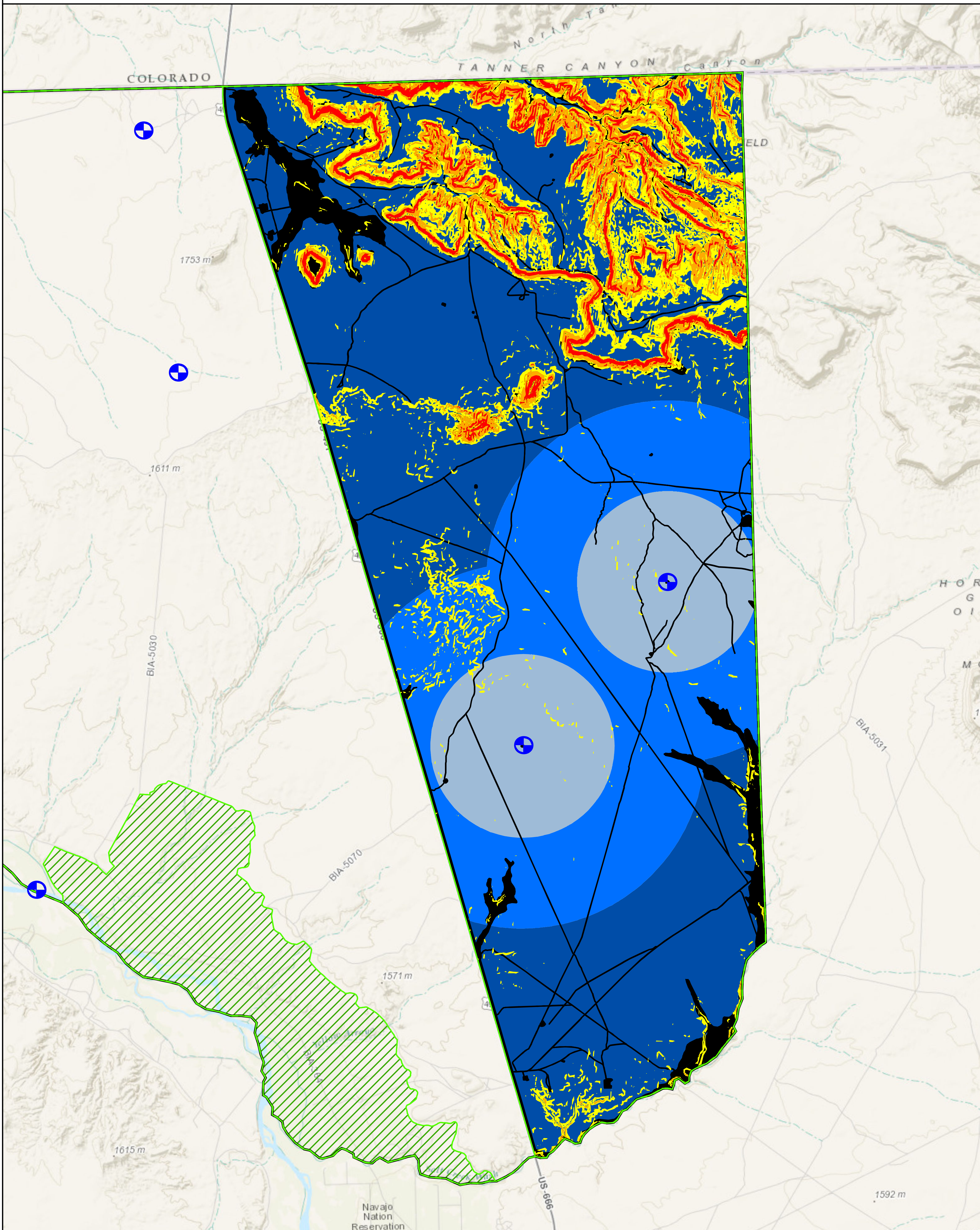
Date: 2/9/2015

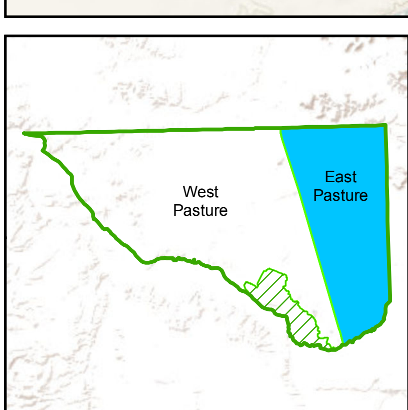
Document Name: P11X17_Soils_InitialCC_Cudei1

**2014 Range Inventory**
**BIA Northern Navajo Agency**
**District 12**
**Cudei Community, East Pasture**

Total Acres: 30,407
Grazeable Acres*: 29,129
*Total acres minus non grazeable areas and areas with > 60% slope.

Adjusted Annual Carrying Capacity: 2 Sheep




Water Source
Analysis Unit Boundary
Community Boundary
Agricultural Land
Non Grazeable Range

**Distance to Water**
0-1 Mile
1-2 MIles
>2 Miles

**Slope**
10-30%
30-60%
> 60%

0 1 2 Miles

1:65,000

Coordinate System: NAD 1983 UTM Zone 12N

Ecosphere Environmental Services

Date: 2/9/2015

Document Name: P11X17_Slope_AdjCC_Cudei1

## 5.4 Hogback

The Hogback Community is located northeast of Shiprock, New Mexico, just west of the Hogback geologic formation. The southern region is composed primarily of badland hills and pockets of grassland. The northern half is at a higher elevation and contains low mesas, buttes, and various, small canyons. This community has 57,172 grazeable acres and 84 transects within 17 ecological sites.

On average, forage is most available in the R035XB030NM ecological site. However, only one transect was placed within this site. Additional data should be collected to gain a more comprehensive assessment of forage availability. Soils in this site are composed of sand and sandy loams and the reference plant community is dominated by perennial grasses. Shrubs can be present, but make up only a minor portion of the plant community. As the site deteriorates, James' galleta (*Pleuraphis jamesii*) and broom snakeweed (*Gutierrezia sarothrae*) tend to increase and non-native annuals, such as cheatgrass (*Bromus tectorum*), often invade. Currently, available forage is being produced by winterfat (*Krascheninnikovia lanata*), Indian ricegrass (*Achnatherum hymenoides*), and James' galleta. Cheatgrass was not found on the transect, but one invasive annual forb, Prickly Russian thistle (*Salsola tragus*), was recorded along with several native annual species.

The second highest amount of available forage is associated with the R035XA101AZ site, which is found along slopes leading down from the mesa tops. Soils are shallow, slopes are usually steep, and exposed bedrock is common. The reference plant community is a shrub/grassland. Common species in the reference community include grama (*Bouteloua* spp.), Indian ricegrass, bottlebrush squirreltail (*Elymus elymoides*), globemallow (*Sphaeralcea* spp.), Bigelow sagebrush (*Artemisia bigelovii*), Stansbury cliffrose (*Purshia stansburiana*), and fourwing saltbush (*Atriplex canescens*). Twoneedle piñon (*Pinus edulis*) and juniper (*Juniperus* spp.) may be present in the overstory. Most forage in the sampled plant community is from Indian ricegrass. Other forage species include mound saltbush (*Atriplex obovata*), James' galleta, alkali sacaton (*Sporobolus airoides*), and Bigelow sagebrush. Cheatgrass and prickly Russian thistle make a minor component of the plant community.

Carrying capacity is highest in the R035XB271AZ site. This site has an average amount of available forage, but is one of the largest sites in the community. The reference plant community for this site consists primarily of low-growing shrubs with sparse grasses in the shrub interspaces. This is largely due to the soils containing high amounts of salt. The most common grass in the reference plant community is alkali sacaton and shrubs usually include mat saltbush and valley saltbush. Mat saltbush is well adapted to saline soils and will often increase following grazing pressure. Prickly Russian thistle will often invade the site following disturbance. Study results show that this site is in a degraded condition and has become invaded by prickly Russian thistle, cheatgrass, and saltlover (*Halogeton glomeratus*). Forage species include valley saltbush, mat saltbush, winterfat, and James' galleta.

Available forage is most limited in the R035XB279AZ site. Soils are moderately deep and well drained and the reference plant community is dominated by perennial grasses. Annual species, both native and non-native, tend to increase or invade following prolonged disturbance. What little forage is available in the contemporary plant community is being provided by valley saltbush and mat saltbush. Overall production is primarily from annual species including prickly Russian thistle, saltlover, and annual wheatgrass (*Eremopyrum triticeum*).

Similarity index values in the Hogback community range from 0-72 percent. The highest value was reported for one transect in the R035XB271AZ site with mat saltbush being the primary contributor to allowable production. The majority of remaining higher values are associated with the R035XB277AZ site. Allowable production from this site is being supplied by valley saltbush and James' galleta.

### *Frequently Encountered Species*

1. prickly Russian thistle (*Salsola tragus*) (occurred on 71% of all transects)
2. saltlover (*Halogeton glomeratus*) (occurred on 43% of all transects)
3. cheatgrass (*Bromus tectorum*) (occurred on 43% of all transects)
4. James' galleta (*Pleuraphis jamesii*) (occurred on 37% of all transects)
5. valley saltbush (*Atriplex cuneata*) (occurred on 36% of all transects)

### *Species by Weight*

1. prickly Russian thistle (*Salsola tragus*) (83 lbs/acre)
2. saltlover (*Halogeton glomeratus*) (19 lbs/acre)
3. annual wheatgrass (*Eremopyrum triticeum*) (17 lbs/acre)
4. alkali sacaton (Sporobolus airoides) (13 lbs/acre)
5. James' galleta (*Pleuraphis jamesii*) (10 lbs/acre)

### Ground Cover

The percentage of bare ground is a little above the study area average, while foliar cover is below average. The majority of severe erosion is occurring in the southern half of the community, particularly in the badland areas.

**Analysis Unit** Hogback **Chapter** Hogback

## Summary of Grazeable and Non-Grazeable Acres in Analysis Unit

| | | |
|---|---|---|
| **Chapter Acres** | | 63,371.20 |
| **Analysis Unit Acres** | | 63,371.20 |
| **Non-Grazeable Acres** | **Developed** | 4,124.80 |
| | **Hydro** | 85.05 |
| | **Roads** | 479.84 |
| | **Slope>60** | 1,508.96 |
| **Total Grazeable Acres** | | 57,172.56 |

## Summary of Similarity Indices, Cover, and Carrying Capacity within Anlysis Unit

| Similarity Indices (%) | |
|---|---|
| **Minimum** | 0 |
| **Maximum** | 72 |
| **Median** | 3 |

| Cover (%) | |
|---|---|
| **Foliar Cover** | 18.00 |
| **Bare Ground** | 67.00 |
| **Basal** | 1.00 |

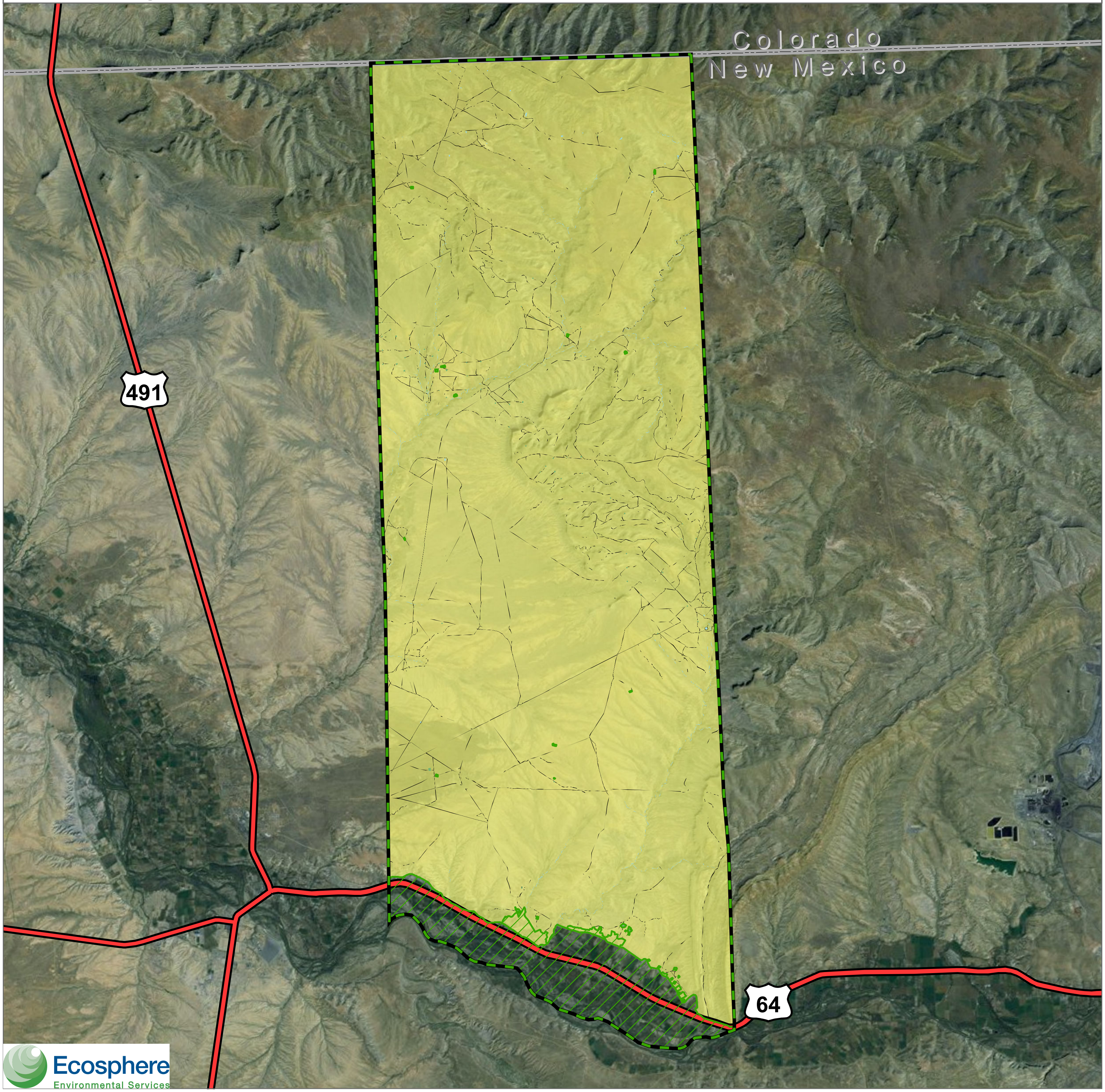
| Carrying Capacity (Sheep Units/Year) | |
|---|---|
| **Initial CC** | 266.88 |
| **Slope Adjusted CC** | 265.4 |
| **DTW Adjusted CC** | 77.56 |

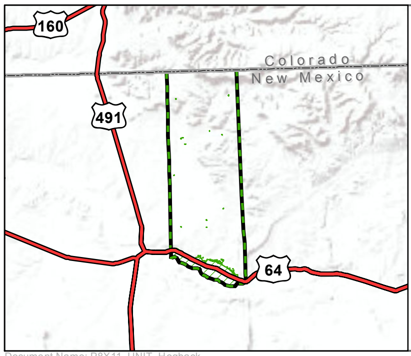
## Results by Ecological Site in Sheep Units Year Long

| Ecological Site | Number of Transects | Percent of Analysis Unit Acres | Available Forage (Lbs/Acre) | Initial Grazeable Acres | Sheep Stocking Rate (Acres/ Sheep Unit) | Initial Sheep Carrying Capacity (Sheep Units/Year) |
|---|---|---|---|---|---|---|
| Badland | 3 | 6 | 2.69 | 3,822.00 | 881.04 | 4.34 |
| F035XG134NM Gravelly - Woodland | 19 | 14 | 9.74 | 9,041.50 | 243.33 | 37.16 |
| R035XA101AZ Breaks 10-14" p.z. | 2 | 1 | 41.66 | 873.00 | 56.89 | 15.35 |
| R035XB016NM Clay Loam Terrace (sodic) 7-10" | 4 | 3 | 8.93 | 1,620.70 | 265.40 | 6.11 |
| R035XB030NM Sandy Loam Upland 6-10" | 1 | 1 | 65.88 | 750.50 | 35.97 | 20.86 |
| R035XB034NM Sandy Terrace 6-10" sodic | 2 | 2 | 3.38 | 1,087.30 | 701.18 | 1.55 |
| R035XB035NM Sandy Upland 6-10" | 1 | 1 | 5.90 | 828.50 | 401.69 | 2.06 |
| R035XB204AZ Sandstone Upland 6-10" p.z. | 1 | <1 | 15.40 | 489.70 | 153.90 | 3.18 |
| R035XB271AZ Loamy Upland 6-10" p.z. Saline-Sodic | 2 | 14 | 19.80 | 8,744.10 | 119.70 | 73.05 |
| R035XB275AZ Loamy Fan 6-10" p.z. | 3 | 2 | 1.50 | 1,584.20 | 1,580.00 | 1.00 |
| R035XB277AZ Siltstone Upland 6-10" p.z. Limy | 23 | 12 | 8.16 | 7,865.70 | 290.44 | 27.08 |
| R035XB278AZ Loamy Upland 6-10" p.z. Saline, Gypsic | 7 | 12 | 11.07 | 7,821.30 | 214.09 | 36.53 |
| R035XB279AZ Clay Loam Upland 6-10" p.z. Sodic, Gypsic | 3 | 3 | 1.28 | 1,935.60 | 1,851.56 | 1.05 |
| R035XC313AZ Loamy Upland 10-14" p.z. | 5 | 4 | 9.54 | 2,829.70 | 248.43 | 11.39 |
| R035XC326AZ Sandy Loam Upland 10-14" p.z. Saline | 5 | 1 | 28.27 | 808.10 | 83.83 | 9.64 |
| R035XC335AZ Sandstone/Shale Hills 10-14" p.z. | 1 | <1 | 18.93 | 436.50 | 125.20 | 3.49 |
| Rock Outcrop | 1 | 9 | 5.54 | 5,578.40 | 427.80 | 13.04 |
| Gullied Land | 0 | 1 | | 783.35 | | |
| R035XB024NM Saline Bottom 6-10" | 0 | <1 | | 155.32 | | |
| R035XB028NM Sandy Bottom 6-10" | 0 | <1 | | 232.99 | | |
| R035XB276AZ Siltstone Upland 6-10" p.z. Saline | 0 | <1 | | 36.32 | | |
| R035XC314AZ Sandstone Upland 10-14" p.z. | 0 | <1 | | 225.81 | | |
| R035XB017NM Cobbly Slopes 6-10" | 0 | <1 | | 507.82 | | |
| R035XB021NM Loamy Upland 7-10 | 0 | <1 | | 11.78 | | |
| R035XB022NM Loamy Upland sodic | 0 | <1 | | 75.58 | | |
| R035XB267AZ Sandy Loam Upland 6-10" Limy | 0 | <1 | | 12.52 | | |
| R035XB274AZ Sandy Loam Upland 6-10" p.z. Saline | 0 | <1 | | 523.08 | | |

# 2014 Range Inventory
# BIA Northern Navajo Agency
# Land Management District 12

**Hogback Community**




Analysis Unit

Agricultural Area

Community Boundary

**Non Grazeable Range**

Developed

Hydrology

Roads

0 2.5 5

Miles

1:150,000

Date: 2/9/2015

Coordinate System: NAD 1983 UTM Zone 12N

Document Name: P8X11_UNIT_Hogback

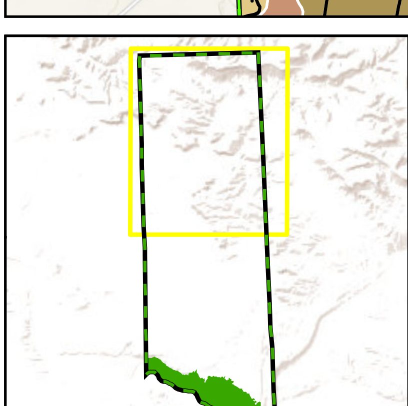
**2014 Range Inventory**
**BIA Northern Navajo Agency**
**District 12**

**Hogback Community, North Portion**

Total Acres: 63,371
Grazeable Acres*: 57,173
*Total acres minus non grazeable areas and areas with > 60% slope.

Initial Annual Carrying Capacity:
16 Sheep

-

Transect Location
Analysis Unit Boundary
Community Boundary
Agricultural Land
Non Grazeable Range
Soil Map Units

Ecosphere Environmental Services

0 1 2
Miles

1:48,000

Date: 2/9/2015

Coordinate System: NAD 1983 UTM Zone 12N

Document Name: P11X17_Soils_InitialCC_Hogback

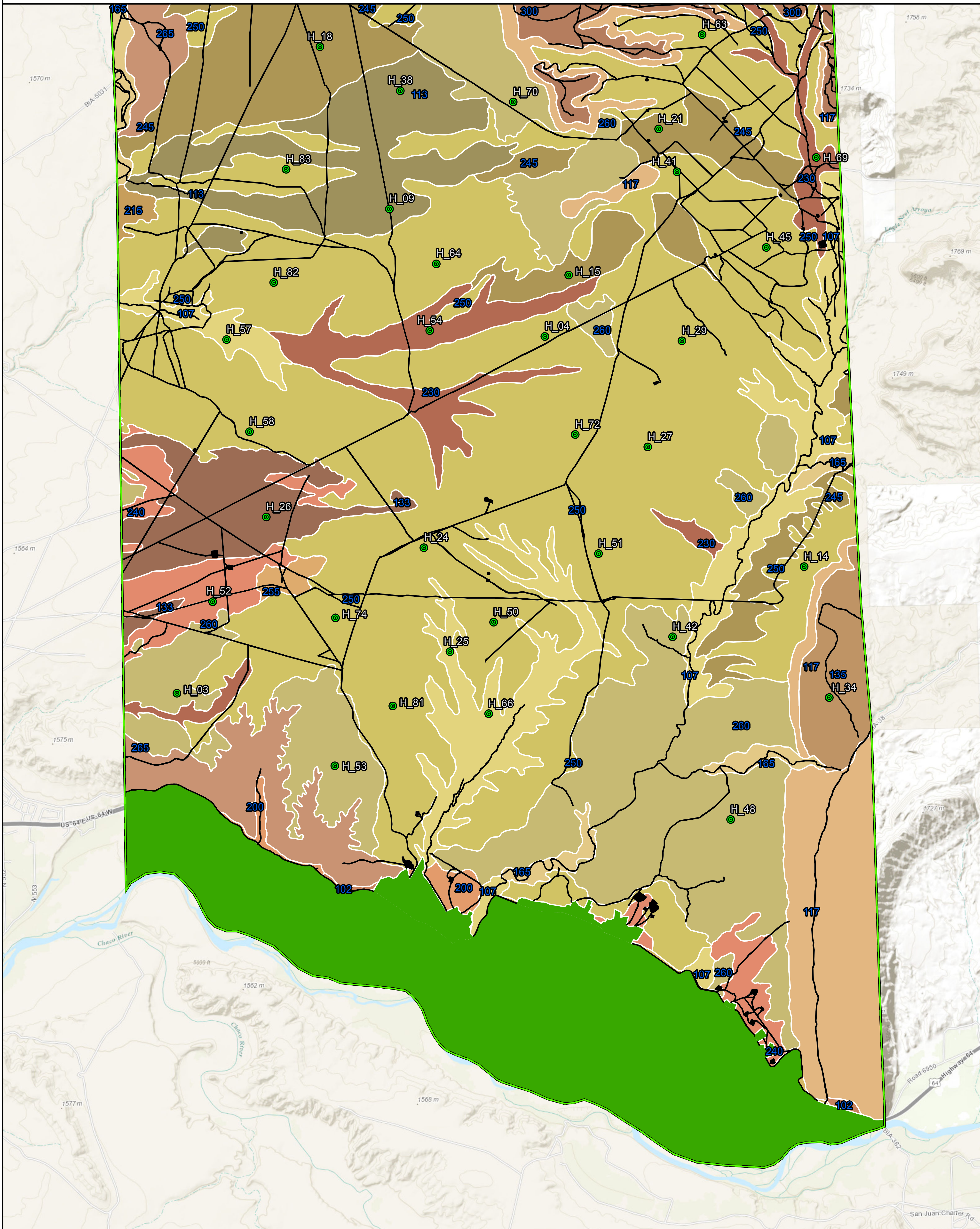
# 2014 Range Inventory
## BIA Northern Navajo Agency
## District 12

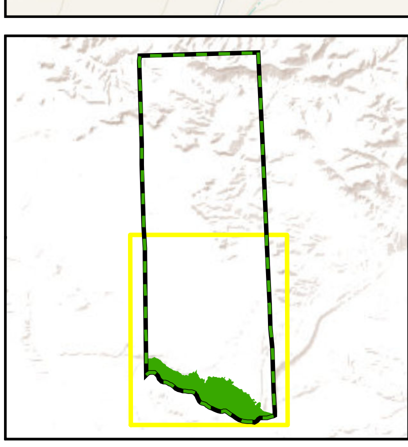
Total Acres: 63,371
Grazeable Acres*: 57,173
*Total acres minus non grazeable areas and areas with > 60% slope.

Initial Annual Carrying Capacity:
16 Sheep

### Hogback Community, South Portion

-



Transect Location
Analysis Unit Boundary
Community Boundary
Agricultural Land
Non Grazeable Range
Soil Map Units

0 1 2
Miles

1:48,000

Coordinate System: NAD 1983 UTM Zone 12N

Ecosphere Environmental Services

Date: 2/9/2015

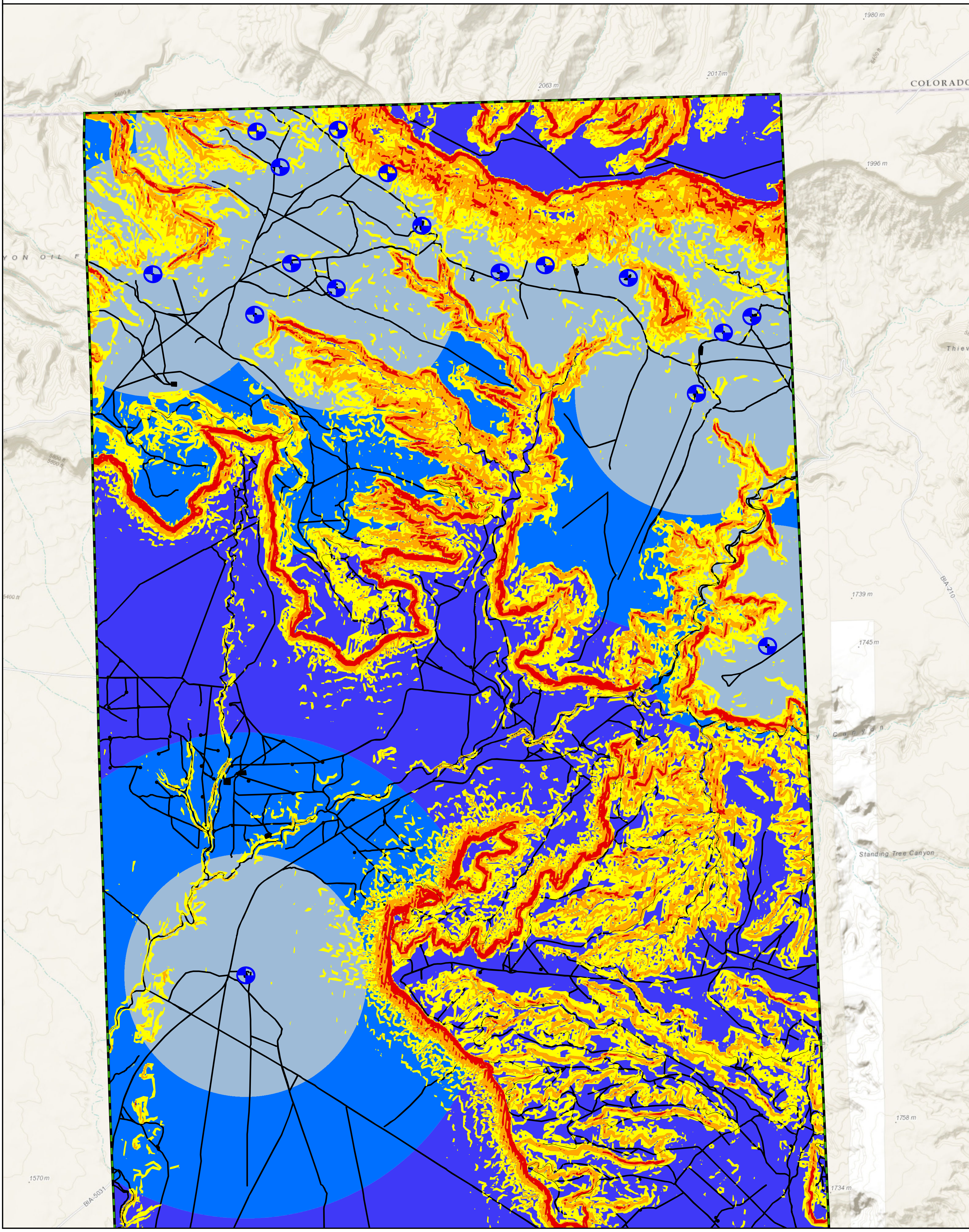
Document Name: P11X17_Soils_InitialCC_Hogback

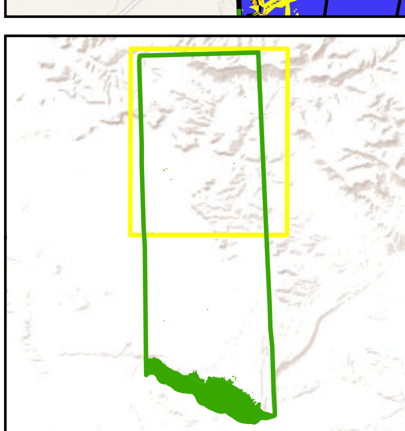
**2014 Range Inventory**
**BIA Northern Navajo Agency**
**District 12**

**Hogback Community, North Portion**

Total Acres: 63,371
Grazeable Acres*: 57,173
*Total acres minus non grazeable areas and areas with > 60% slope.

Adjusted Annual Carrying Capacity:
4 Sheep



Water Source
Analysis Unit Boundary
Community Boundary
Agricultural Land

**Distance to Water**
0-1 Mile
1-2 MIles
> 2 Miles

**Slope**
10 - 30%
30 - 60%
> 60%

0 1 2
Miles

1:48,000

Coordinate System: NAD 1983 UTM Zone 12N

Ecosphere Environmental Services

Date: 2/9/2015

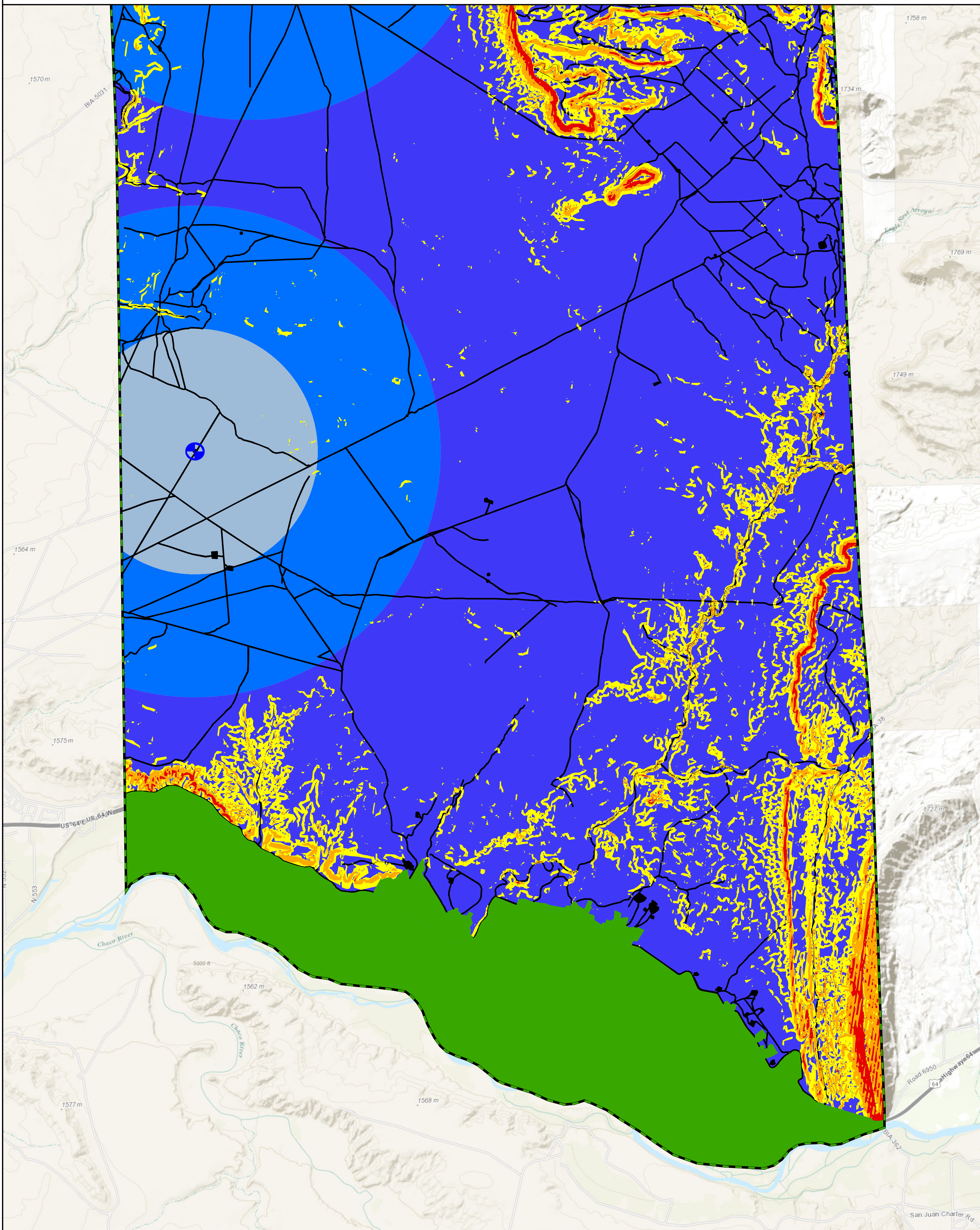
Document Name: P11X17_Slope_AdjCC_Hogback

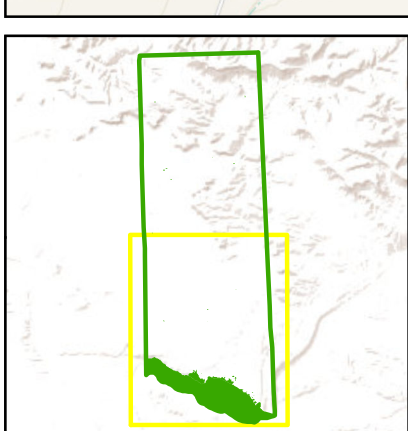
**2014 Range Inventory**
**BIA Northern Navajo Agency**
**District 12**

**Hogback Community, South Portion**

Total Acres: 63,371
Grazeable Acres*: 57,173
*Total acres minus non grazeable areas and areas with > 60% slope.

Adjusted Annual Carrying Capacity:
4 Sheep



Water Source
Analysis Unit Boundary
Community Boundary
Agricultural Land

**Distance to Water**
0-1 Mile
1-2 MIles
> 2 Miles

**Slope**
10 - 30%
30 - 60%
> 60%

0 1 2
Miles

Coordinate System: NAD 1983 UTM Zone 12N

1:48,000

Ecosphere Environmental Services

Date: 2/9/2015

Document Name: P11X17_Slope_AdjCC_Hogback

# 6. Conclusions and Recommendation

District 12 contains a mix of low mesas, badlands, and shrub/grasslands. Overall production is low, and most areas have become invaded by various, non-native, annual species. Sites in the best condition are largely found on mesa tops, while those in the worst condition are most often associated with valley bottoms containing salt-effected soils. Evidence of water erosion is prominent in areas of clay soils and portions of all analysis units are showing signs of active soil loss. The high percentage of bare ground in the study area suggests that erosion will likely increase unless perennial vegetation cover is increased. The decline in plant communities is largely a result of continuous grazing pressure and drought conditions. The following sections provide some recommendations regarding drought and grazing management, shrub reduction, weed control, and data analysis and monitoring.

## 6.1 Drought

Precipitation is one of the greatest obstacles to overcome when managing and restoring rangeland. Local precipitation monitoring stations recorded lower than average precipitation for much of the 2014 growing season and precipitation levels throughout the southwest indicate ongoing long-term drought conditions (NDMC 2014). Therefore, it is extremely important to maintain healthy plant communities, not only for forage purposes, but to reduce soil exposure and loss. To complicate matters, moisture arriving during the monsoon season often is in the form of severe thunderstorms that can produce several inches of rain in a short time. As the percentage of bare ground is high in the study area, many areas are at risk of accelerated water erosion during this type of storm event. This increases soil loss while decreasing water retention. The potential for soil loss due to wind erosion is also high as much of the surface soil in the study area is loose and unstable. Development of plant cover in soils with high salinity can be difficult. It may be necessary to encourage growth of less palatable species initially. Grasses such as alkali sacaton (*Sporobolus airoides*) and James' galleta (*Pleuraphis jamesii*) are excellent cover plants that can tolerate saline conditions.

It also is very important to collect accurate precipitation data. Calculations for annual production (and resulting stocking rates) incorporate average precipitation for a given water year. Location-specific precipitation gauges allow managers to more closely monitor precipitation, giving them the opportunity to proactively implement drought management plans. Plants demonstrate rapid growth during a certain portion of the growing season; cool-season plants tend to experience this between March and the beginning of June, with a smaller growth surge in the fall, while warm-season plants grow more quickly during mid-summer. These are critical time periods for forage species and a lack of adequate moisture will compromise growth for the duration of the growing season. Moisture that arrives outside of these windows of rapid growth will help plants, but will be much less effective. Semiarid regions generally are considered to be experiencing drought conditions when the cumulative growing season precipitation is 20 to 25 percent below average during these periods of rapid growth (NDMC 2014). Closely monitoring precipitation would alert managers to impending drought toward the beginning of the growing season and allow for drought mitigation plans to be put into place in a more timely fashion. This is particularly important for the lower-elevation sites in District 12 as the majority of forage plants are warm-season grasses like James's galleta and alkali sacaton. Monsoonal moisture arriving in mid to late July corresponds well with the period of rapid growth for these grasses. However, in years where the monsoons are delayed or largely absent, it will be necessary to adjust grazing plans. Ultimately, it is up to the individual livestock owner to gain the most thorough knowledge possible of the area being grazed. The best way to mitigate the effects of drought is to keep or restore rangeland to a good condition with a healthy diversity of plants species.

## 6.2 Soil and Grazing Management

Soils are an extremely important component of rangeland ecosystems. Well-developed soils retain water and provide the substrate and nutrients necessary to produce vibrant plant communities. In areas with large patches of bare ground and/or active erosion, the best way to recover forage production is to build up the soils so they are capable of supporting viable plant populations. Rebuilding soils requires a combination of erosion control, revegetation, and periodic disturbance of the soil surface. Deeply eroded gullies and arroyos are the most difficult and cost-prohibitive features to restore. In their immature form, the sides of channels usually are very steep or even vertical, which makes it difficult for stabilizing vegetation to establish. An effective technique for decreasing slope gradient is to use earthmoving equipment to reshape or terrace the banks, thus creating substrates suitable for plant colonization. This method is particularly effective in arid regions, where work can be completed prior to seasonal flows (Valentin et al. 2005). Unfortunately, the cost and logistics involved with getting equipment into more remote locations can make this option prohibitive. Another alternative is to focus efforts upstream from deeply eroded channels. In areas where channels are just beginning to develop and the rate and volume of surface runoff is lower, effective countermeasures to erosion include simple hand-constructed rock check dams. In addition to capturing soil and preventing further loss, check dams redistribute water, especially during the monsoon season. Spreading runoff across the landscape and retaining water for longer periods leads to more plant growth and cover, which increases infiltration and soil moisture (Nichols et al. 2012). Seeding programs that utilize fast-growing, native pioneer species tend to produce better and quicker results when working to stabilize channel walls (Valentin et al. 2005). Water erosion is a potential problem for most of the study area, especially in regions containing moderate to steep slopes and high clay content in the soils.

Revegetation may require reseeding programs, particularly in areas experiencing channelization and in regions largely devoid of vegetation or areas dominated by invasive species; however, elements of the native plant community are still present within much of the study area. In the low-lying areas, this includes alkali sacaton, James' galleta, winterfat (*Krascheninnikovia lanata*), fourwing saltbush (*Atriplex canescens*) and valley saltbush (*Atriplex cuneata*). Native species still present in the upland areas include Indian ricegrass (*Achnatherum hymenoides*), muttongrass (*Poa fendleriana*), jointfir (*Ephedra* spp.), mountain mahogany (*Cercocarpus montanus*), and Stansbury cliffrose (*Purshia stansburiana*). With careful and proactive management, native species production and frequency should increase naturally without much intervention. In areas that are more deteriorated, seeding with local, drought-tolerant species that can germinate early, such as scarlet globemallow (*Sphaeralcea coccinea*) and sand dropseed (*Sporobolus cryptandrus*), may speed up revegetation, and increase the likelihood of success.

The lack of native herbaceous diversity is due, in large part, to unmanaged continuous grazing systems. Determining forage production based upon a normal precipitation year allows managers to establish a "ceiling" or carrying capacity for their land. These determinations should not be used to generate stocking rates when precipitation is below normal, especially during drought conditions. In a continuous grazing system, it is difficult to prepare for times of scarce moisture; however, this situation can be partially mitigated by allowing managers to reduce and increase stock numbers based on current resource conditions. Ideally, permits would require an estimate of the current climate and production of the range resource at periodic intervals. Expected precipitation generally falls during late summer and through the winter. If precipitation is low during the winter, then spring and early summer production also are expected to be low and livestock numbers should be adjusted accordingly.

The final part of rebuilding soil is to make sure it undergoes periodic disturbance. This is where livestock play a very important role. The trampling effect of livestock works to incorporate manure and litter into the soil, which increases aeration and organic matter content. Hoof indentations also create microsites that encourage seedling growth and moisture retention; however, controlling the timing and duration of grazing is the key to reaping these benefits. Many of the ecological site descriptions available for the study area recommend deferring grazing from late winter through early spring. This practice alone would help increase available forage. Other areas are better suited for winter/spring grazing and can be utilized to provide forage while less suitable areas are rested. Data collected from this survey can help identify these areas. A critical part of grazing management is allowing the forage to grow before being grazed and allowing it to recoup following grazing. Fences greatly facilitate the process of pasture deferment, rest, and rotation. They also are valuable tools for excluding stray livestock, especially horses. NRCS programs such as the Environmental Quality Incentives Program can aid in providing the technical and financial support needed for this to occur.

## 6.3 Shrub Composition

Shrubs play a valuable role in maintaining healthy, functioning rangelands, but the ratio of shrubs to forb and grass species is a little higher than it should be in many parts of the study area. For example, dense stands of black greasewood (*Sarcobatus vermiculatus*) exist along many of the floodplain areas and many of the grassland areas contain numerous small shrubs like Broom snakeweed (*Gutierrezia sarothrae*) and Greene's rabbitbrush (*Chrysothamnus greenei*).

However, in most cases, employing proper grazing management should be sufficient to encourage the re-establishment of native forbs and grasses. As the herbaceous component begins to flourish, woody species will cease to dominate and a more balanced plant community will develop. A number of mechanical and chemical methods have been used to control shrubs on rangelands, but as shrub density is not large problem in the majority of District 12, these methods would likely not produce enough gain to offset the expense of employing them.

## 6.4 Invasive Species

### Prickly Russian thistle *(Salsola tragus)*

Prickly Russian thistle is a drought tolerant, disturbance-loving species that is present to some degree in nearly every plant community sampled during the field survey. This species can provide forage for sheep and cattle in its immature form and when softened by snow or rain (USDA USFS 1937). However, consumption of large quantities of this plant has been known to cause diarrhea, especially in lambs, which can compromise the heath of animals already in a weakened condition (Cook et al. 1954). This can be an issue in areas where little else is growing and consumption is likely to be high.

Although not an ideal species in general, prickly Russian thistle can accelerate revegetation of disturbed areas by supporting the growth of soil mycorrhiza. Soil mycorrhizae are fungi that form associations with many native plant species. The fungi help the plants absorb more water and nutrients and, in return, receive carbohydrates from the plant roots. Certain mycorrhiza invade the roots of prickly Russian thistle and do not form an association with this plant, but rather kill the infected roots and move on to the roots of neighboring plants. In this manner, the fungi population increases while prickly Russian thistle populations begin to die (Allen and Allen 1988; Allen et al. 1989). The dead plants provide cover for seedlings of other species that are capable of forming associations with the newly established mycorrhiza colonies (Allen and Allen 1988; Grilz et al. 1988). Typically, prickly Russian thistle will persist on a site for about 2 years and then will be replaced by annual and biennial mustards like tall tumblemustard (*Sisymbrium altissimum*) and various tansymustard (*Descurainia* spp.) (Chapman et al. 1969). The mustard species continue to build up the soil substrate by maintaining soil mycorrhiza populations and adding organic matter to the soil as the plants die. However, it is important to note that this process can only occur in sites where disturbance factors, such as grazing, are removed or at least minimized. In most parts of the study area, continuous, year-round grazing effectively causes this plant to persist in the plant community due to the fact that native species are consumed before they have the chance to become established and seeds from thistle plants are free to sprout and establish additional populations.

Prickly Russian thistle also helps prepare a site by releasing oxalates into the soil. These chemicals work to change inorganic phosphorous into a soluble form that can be taken up by plants (Cannon et al. 1995). Phosphorus often is a limiting nutrient in the soil and by increasing its availability, favorable forage plants can become established more quickly. Prickly Russian thistle can be controlled or even eradicated through various mechanical and chemical treatments (Burrill et al. 1989; Young and Whitesides 1987); however, this process is time consuming and expensive. Given the potential benefits of the plant, it is generally better to leave it and focus on encouraging the establishment of desirable perennial species through proper grazing management and seeding treatments.

### Saltlover (Halogeton glomeratus)

Saltlover is summer annual that readily invades saline soils when disturbances remove the pre-existing vegetation. Once established, it can quickly spread and out-compete other species due to its ability to germinate early in the spring, produce large quantities of long-lived seed, resist predation, and withstand harsh conditions (Duda et al. 2003). There also is evidence that this species alters the soil chemistry around individual plants by increasing soil pH, electrical conductivity, and soluble sodium content. This alteration makes it difficult for native species to become re-established even if saltlover plants are removed (Duda et al. 2003; Eckert and Kinsinger 1960; Lancaster et al. 1987). In the study area, saltlover is widely spread in the Aneth and Hogback Communities and both pastures in the Cudei Community. The most affected ecological sites include the R035XB275AZ, R035XB277AZ, and R035XB279AZ sites in Cudei and Hogback and the R035XY006UT and R035XY109UT sites in the Aneth Community.

A second concern is that saltlover is highly toxic to livestock, especially sheep. Sodium oxalate, the lethal component of this species, is sequestered in the leaves and stems and the highest levels are achieved during the fall, winter, and spring when the plant reaches maturity. This also is the time frame when this plant is more likely to be consumed, since desirable forage plants are typically scarce or too dry to be palatable (USDA ARS 2006; Whitson 1987).

Saltlover control is difficult. Seeds, which are abundant, can remain viable in the soil for up to 10 years, requiring annual applications of herbicide for many years to effectively deplete seed reserves (West 1983). In addition to being expensive, this approach is not particularly agreeable as the main herbicide that has proven to be effective is 2,4-D. This chemical, when applied at the rates necessary to control saltlover, also will have a negative impact on native species (Cook and Stoddart 1953). The best approach is to establish alternate species that can grow in saline conditions and compete with saltlover. Two species in particular have successfully become established in saltlover invaded sites: forage kochia (*Bassia prostrata*) and desert wheatgrass (*Agropyron desertorum*) (Asay and Johnson 1987; McArthur et al. 1990; Stevens and McArthur 1990). Reducing or excluding grazing pressure during the late winter/early spring is important, as well, to allow desirable species the opportunity to grow and develop prior to consumption. Establishing a diverse, perennial plant community that undergoes light to moderate grazing towards the end of the growing season appears to be the best strategy to prevent saltlover invasions (Blaisdell and Holmgren 1984; Keller 1979; West 1983; Whisenant and Wagstaff 1991).

### Cheatgrass (Bromus tectorum)

Production of cheatgrass is not overly high in the study area, but it is widespread in most analysis units, and the lack of robust native plant communities indicates that it can easily become more established in the future. Cheatgrass is difficult to control due to its ability to produce large quantities of seed, which either germinate in the fall or carry over in the seed bank to germinate in the following spring (Smith et al. 2008). Germination typically occurs well in advance of most native species, which works to deplete soil moisture (Floyd et al. 2006; Melgoza et al. 1990; Smith et al. 2008). Additionally, seedling emergence can occur under a variety of soil temperatures and plants germinating in the fall continue to experience root growth during the winter. This gives individuals a significant advantage the following spring (Beckstead et al. 2007; Mack and Pike 1983; Meyer et al. 2007; Thill et al. 1979). The best way to prevent the spread of cheatgrass is to reestablish viable native plant communities. In invaded areas, use of the herbicide imazapic (Plateau®) has proven to be very effective control measure. A moderate application rate (0.6 L ha-1) was found to kill virtually all cheatgrass and seeds when applied in the fall to infestations in Zion

Nation Park (Brisbin et al. 2013; Dela Cruz 2008). However, the control affected by this herbicide only provides a window of about 1-2 years. If alternate vegetation has not reestablished in sprayed areas at this time, it is very probable that cheatgrass will reoccupy the area. A good practice is to spray in the fall and apply seeding treatments in the following late winter/early spring season. The NRCS is a valuable resource for obtaining site specific seed mixes as well as technical and financial support.

## 6.5 Data Analysis and Monitoring

Data analysis revealed several patterns including areas with large populations of invasive species, areas lacking in ground cover, and other sites that are maintaining good populations of key forage species such as Indian ricegrass (*Achnatherum hymenoides*), James' galleta *(Pleuraphis jamesii*), alkali sacaton *(Sporobolus airoides*), and fourwing saltbush (*Atriplex canescens*). The next step is to use this data to identify specific locations that would benefit most from improvement measures and then organize field visits to gain an "on-the-ground" perspective. Groups of transects that yielded low production and high counts of bare ground may be in severely eroded areas and great effort would be necessary to improve these sites. On the other hand, these groups of transects may just have a high potential for erosion and simple improvements could greatly enhance the soil and plant community. Using the data to pinpoint areas with the highest densities of shrubs would serve as a starting point for assessing whether chemical control measures are necessary. In some cases, it may be better to focus on grazing strategies and let natural succession run its course. Identifying places with high forage production can be helpful for implementing rotational grazing schemes. These areas would be able to withstand higher grazing pressures, while more fragile locations are rested. Visits to these areas would allow managers to determine the feasibility of adding water sources if none are present. If data from certain transects show that native forage species are not present, it may be necessary to implement reseeding programs. Agriculture extension offices and the NRCS are good resources to help determine appropriate seed mixes and find seed sources.

Grazing programs should make use of available tools. When it is possible to erect fences, they should be designed to ease movement and exclusion of livestock, as dictated by the condition of the vegetation. Designating pastures where fences already exist, such as the highway fences that bisect grazing units, also would be useful for monitoring forage in those pastures. Currently, the forage on one of side the highway is applied to the carrying capacity on both sides of the highway. Separating the grazing units into pastures would allow for more site-specific data collection and monitoring, as well as livestock management. Water sources and salt blocks can also be situated to move animals out of areas or to encourage them to use underutilized locations. In addition, the initial stocking rates and carrying capacities provided in this report should be used as a guide to be adjusted appropriately with consideration of forage value, seasonal palatability of forage, and variability of precipitation. For example, a conservative initial stocking rate is appropriate under drought conditions. If there is very little precipitation during the winter and early spring, stock numbers should not be permitted at the rate of a normal year production. The same is true when an area endures several years of precipitation below normal levels. However, placement of check dams and other water catchment systems such as ponding dikes can greatly offset the negative impacts associated with drought and lessen the need to cut livestock numbers.

After restoration efforts have begun, it is important to establish monitoring programs. Now that the initial baseline data have been collected, it is not necessary to sample vegetation at each transect. Instead, a smaller number of permanent transects and photo-monitoring points can be set up at locations targeted for restoration and in representative areas for each ecological site. In addition to monitoring species composition and production, it also would be valuable to assess soil stability and hydrologic function. Numerous references can be utilized to develop monitoring programs and help interpret the results, such as the Monitoring Manual for Grassland, Shrubland, and Savanna Ecosystems published by the Arid Lands Research Program (Herrick et al. 2005) and the Bureau of Land Management's Technical Reference 1734-6: Interpreting Indicators of Rangeland Health (Pellant et al. 2005).

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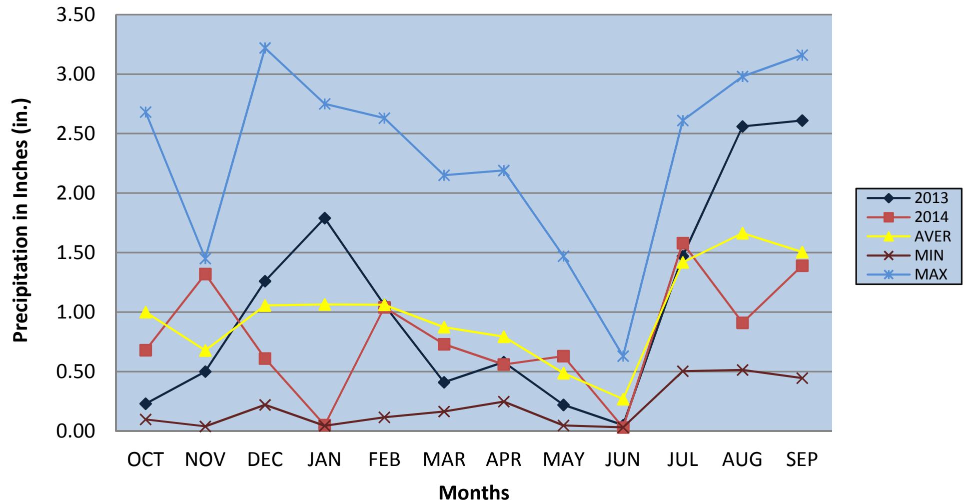
# Appendix A – Precipitation Data

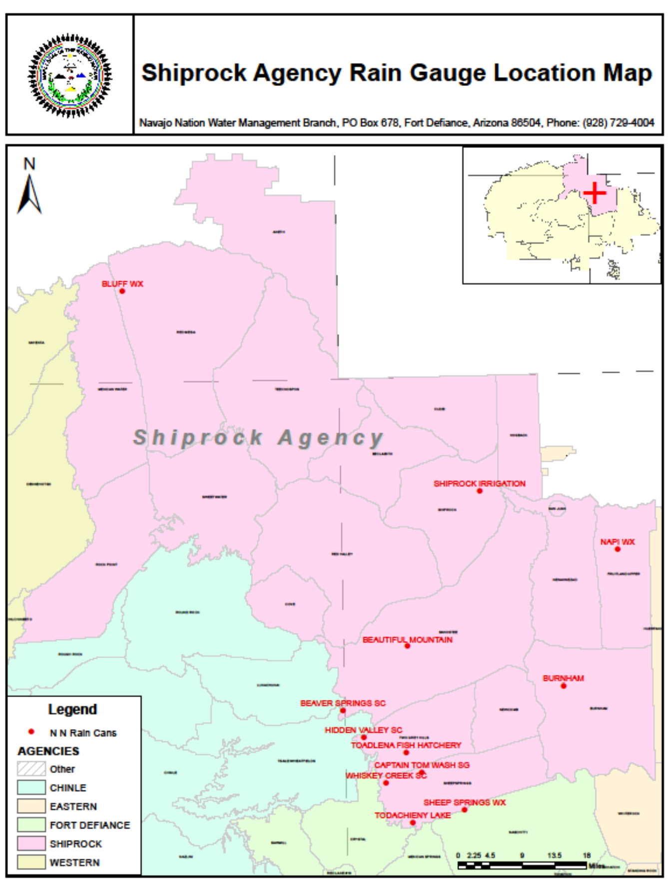
**Navajo Nation Precipitation Report**
**Department of Water Resources * Water Management Branch**
**PO Box 678 * Fort Defiance, Arizona 86504 * Phone: (928) 729-4004 * Fax: (928) 729-4126**

***MONTHLY AVERAGES (INCHES) FOR ALL RAINCANS IN SHIPROCK AGENCY***

| WATER YEAR | OCT | NOV | DEC | JAN | FEB | MAR | APR | MAY | JUN | JUL | AUG | SEP | WY Monthly AVG |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **2000** | 0.10 | 0.09 | 0.52 | 1.49 | 0.73 | 2.15 | 0.75 | 0.31 | 0.63 | 0.96 | 2.04 | 0.48 | 0.85 |
| **2001** | 2.68 | 0.61 | 0.44 | 1.22 | 0.98 | 1.01 | 0.91 | 0.86 | 0.27 | 1.61 | 2.07 | 0.65 | 1.11 |
| **2002** | 0.33 | 0.71 | 0.82 | 0.27 | 0.17 | 0.40 | 0.67 | 0.10 | 0.12 | 0.99 | 1.24 | 3.16 | 0.75 |
| **2003** | 1.32 | 1.07 | 0.76 | 0.43 | 1.86 | 1.60 | 0.43 | 0.42 | 0.28 | 1.16 | 1.40 | 1.67 | 1.03 |
| **2004** | 1.20 | 1.43 | 0.71 | 0.85 | 1.02 | 0.82 | 2.19 | 0.05 | 0.33 | 1.13 | 0.63 | 2.13 | 1.04 |
| **2005** | 1.45 | 1.18 | 1.25 | 1.75 | 2.63 | 1.06 | 1.63 | 0.47 | 0.31 | 0.78 | 2.98 | 1.17 | 1.39 |
| **2006** | 0.85 | 0.04 | 0.22 | 0.62 | 0.12 | 1.25 | 0.52 | 0.19 | 0.36 | 1.64 | 1.54 | 1.74 | 0.76 |
| **2007** | 2.36 | 0.17 | 0.90 | 0.65 | 1.24 | 0.97 | 1.00 | 1.47 | 0.51 | 0.79 | 2.28 | 1.43 | 1.15 |
| **2008** | 0.24 | 0.04 | 3.22 | 2.75 | 2.02 | 0.16 | 0.25 | 0.47 | 0.37 | 1.37 | 1.56 | 0.45 | 1.07 |
| **2009** | 0.54 | 0.67 | 2.32 | 0.60 | 0.74 | 0.48 | 0.66 | 0.92 | 0.49 | 0.50 | 0.51 | 1.16 | 0.80 |
| **2010** | 0.51 | 0.41 | 0.96 | 2.70 | 0.95 | 0.87 | 0.51 | 0.21 | 0.16 | 2.43 | 2.36 | 1.45 | 1.13 |
| **2011** | 1.32 | 0.47 | 1.14 | 0.32 | 0.55 | 0.51 | 0.95 | 0.90 | 0.03 | 2.24 | 1.36 | 2.25 | 1.00 |
| **2012** | 1.26 | 1.45 | 0.72 | 0.48 | 0.81 | 0.65 | 0.28 | 0.11 | 0.09 | 2.61 | 1.52 | 0.84 | 0.90 |
| **2013** | 0.23 | 0.50 | 1.26 | 1.79 | 1.06 | 0.41 | 0.58 | 0.22 | 0.05 | 1.47 | 2.56 | 2.61 | 1.06 |
| **2014** | 0.68 | 1.32 | 0.61 | 0.05 | 1.04 | 0.73 | 0.56 | 0.63 | 0.03 | 1.58 | 0.91 | 1.39 | 0.79 |
| *Summary for SHIPROCK AGENCY (15 detail records)* | | | | | | | | | | | | | |
| ***Average*** | *1.00* | *0.68* | *1.06* | *1.06* | *1.06* | *0.87* | *0.79* | *0.49* | *0.27* | *1.42* | *1.66* | *1.50* | |
| ***Minimum*** | *0.10* | *0.04* | *0.22* | *0.05* | *0.12* | *0.16* | *0.25* | *0.05* | *0.03* | *0.50* | *0.51* | *0.45* | |
| ***Maximum*** | *2.68* | *1.45* | *3.22* | *2.75* | *2.63* | *2.15* | *2.19* | *1.47* | *0.63* | *2.61* | *2.98* | *3.16* | |

***AVERAGE PRECIPITATION FOR SHIPROCK AGENCY (SEPTEMBER 2014)***



# Appendix B – Plant list

2014 District 12 Plant List Aneth, Cudei, Hogback

| GenusSpecies | Code | Growth | Family | Duration | Sheep | Goat | Cattle |
|---|---|---|---|---|---|---|---|
| Achnatherum hymenoides | ACHY | Graminoid | Poaceae | Perennial | Desirable | Emergency | Preferred |
| Agropyron cristatum | AGCR | Graminoid | Poaceae | Perennial | Emergency | Emergency | Desirable |
| Ambrosia acanthicarpa | AMAC2 | Forb | Asteraceae | Annual | Not Consumed | Not Consumed | Not Consumed |
| Amelanchier utahensis | AMUT | Shrub | Rosaceae | Perennial | Desirable | Desirable | Desirable |
| Aristida purpurea | ARPU9 | Graminoid | Poaceae | Perennial | Not Consumed | Not Consumed | Not Consumed |
| Artemisia bigelovii | ARBI3 | Shrub | Asteraceae | Perennial | Emergency | Emergency | Not Consumed |
| Artemisia ludoviciana | ARLU | Forb/Subshrub | Asteraceae | Perennial | Desirable | Desirable | Emergency |
| Artemisia nova | ARNO4 | Shrub | Asteraceae | Perennial | Desirable | Emergency | Emergency |
| Artemisia tridentata | ARTR2 | Shrub | Asteraceae | Perennial | Emergency | Emergency | Not Consumed |
| Astragalus nuttalianus | ASNU4 | Forb | Fabaceae | Annual | Not Consumed | Not Consumed | Not Consumed |
| Astragalus sp. | ASTRA | Forb | Fabaceae | Annual | Emergency T | Emergency T | Emergency T |
| Astragalus sp. | ASTRA | Forb | Fabaceae | Perrenial | Emergency T | Emergency T | Emergency T |
| Atriplex canescens | ATCA2 | Shrub | Chenopodiaceae | Perennial | Desirable | Desirable | Desirable |
| Atriplex confertifolia | ATCO | Shrub | Chenopodiaceae | Perennial | Not Consumed I | Not Consumed I | Not Consumed I |
| Atriplex corrugata | ATCO4 | Subshrub | Chenopodiaceae | Perennial | Emergency | Emergency | Not Consumed |
| Atriplex cuneata | ATCU | Subshrub | Chenopodiaceae | Perennial | Desirable | Desirable | Desirable |
| Atriplex obovata | ATOB | Subshrub | Chenopodiaceae | Perennial | Emergency | Emergency | Emergency |
| Atriplex powellii | ATPO2 | Forb | Chenopodiaceae | Annual | Not Consumed | Not Consumed | Not Consumed |
| Atriplex sp. | ATRIP | Forb/Sub/Shrub | Chenopodiaceae | Annual | Not Consumed | Not Consumed | Not Consumed |
| Bassia americana | BAAM4 | Forb | Chenopodiaceae | Perennial | Desirable | Emergency | Desirable |
| Bouteloua barbata | BOBA2 | Graminoid | Poaceae | Annual | Not Consumed | Not Consumed | Not Consumed |
| Bouteloua gracilis | BOGR2 | Graminoid | Poaceae | Perennial | Emergency | Not Consumed | Desirable |
| Bouteloua simplex | BOSI2 | Graminoid | Poaceae | Annual | Not Consumed | Not Consumed | Not Consumed |
| Brickellia microphylla | BRMI | Subshrub | Asteraceae | Perennial | Not Consumed | Not Consumed | Not Consumed |
| Brickellia sp. | BRICK | Forb/Sub/Shrub | Asteraceae | Perennial | Not Consumed | Not Consumed | Not Consumed |
| Bromus tectorum | BRTE | Graminoid | Poaceae | Annual | Desirable I | Emergency I | Desirable I |
| Calochortus sp. | CALOC | Forb | Liliaceae | Perennial | Not Consumed | Not Consumed | Not Consumed |
| Cercocarpus montanus | CEMO2 | Shrub | Rosaceae | Perennial | Desirable | Desirable | Emergency |
| Chaenactis stevioides | CHST | Forb | Asteraceae | Annual | Not Consumed | Not Consumed | Not Consumed |
| Chaetopappa ericoides | CHER2 | Forb | Asteraceae | Perennial | Not Consumed | Not Consumed | Not Consumed |
| Chamaesyce chaetocalyx | CHCH5 | Forb/Subshrub | Euphorbiaceae | Perennial | Not Consumed | Not Consumed | Not Consumed |
| Chamaesyce fendleri | CHFE3 | Forb | Euphorbiaceae | Perennial | Not Consumed | Not Consumed | Not Consumed |
| Chamaesyce parryi | CHPA28 | Forb | Euphorbiaceae | Annual | Not Consumed | Not Consumed | Not Consumed |
| Chamaesyce sp. | CHAMA15 | Forb | Euphorbiaceae | Annual | Not Consumed | Not Consumed | Not Consumed |
| Chamaesyce sp. | CHAMA15 | Forb | Euphorbiaceae | Perennial | Not Consumed | Not Consumed | Not Consumed |
| Chenopodium leptophyllum | CHLE4 | Forb | Chenopodiaceae | Annual | Not Consumed | Not Consumed | Not Consumed |
| Chenopodium sp. | CHENO | Forb | Chenopodiaceae | Annual | Not Consumed | Not Consumed | Not Consumed |
| Chrysothamnus greenei | CHGR6 | Shrub | Asteraceae | Perennial | Emergency | Emergency | Emergency |
| Chrysothamnus pulchellus | CHPU4 | Shrub | Asteraceae | Perennial | Not Consumed T | Not Consumed T | Not Consumed T |
| Chrysothamnus sp. | CHRYS9 | Subshrub/Shrub | Asteraceae | Perennial | Not Consumed | Not Consumed | Not Consumed |

| GenusSpecies | Code | Growth | Family | Duration | Sheep | Goat | Cattle |
|---|---|---|---|---|---|---|---|
| Chrysothamnus viscidiflorus | CHVI8 | Shrub | Asteraceae | Perennial | Emergency | Emergency | Emergency |
| Cleome lutea | CLLU2 | Forb | Capparaceae | Annual | Not Consumed | Not Consumed | Not Consumed |
| Coleogyne ramosissima | CORA | Shrub | Rosaceae | Perennial | Not Consumed | Emergency | Not Consumed |
| Cryptantha crassisepala | CRCR3 | Forb | Boraginaceae | Annual | Not Consumed | Not Consumed | Not Consumed |
| Cryptantha sp. | CRYPT | Forb/Subshrub | Boraginaceae | Annual | Not Consumed | Not Consumed | Not Consumed |
| Cryptantha sp. | CRYPT | Forb/Subshrub | Boraginaceae | Perennial | Not Consumed | Not Consumed | Not Consumed |
| Cylindropuntia sp. | CYLIND | Cactus | Cactaceae | Perennial | Not Consumed | Not Consumed | Not Consumed |
| Dasyochloa pulchella | DAPU7 | Graminoid | Poaceae | Perennial | Not Consumed | Not Consumed | Not Consumed |
| Descurainia pinnata | DEPI | Forb | Brassicaceae | Annual | Not Consumed | Not Consumed | Not Consumed |
| Descurainia sp. | DESCU | Forb | Brassicaceae | Annual | Not Consumed | Not Consumed | Not Consumed |
| Dimorphocarpa wislizeni | DIWI2 | Forb | Brassicaceae | Ann./Bienn./Perenn. | Emergency | Emergency | Emergency |
| Distichlis spicata | DISP | Graminoid | Poaceae | Perennial | Not Consumed | Not Consumed | Not Consumed |
| Draba cuneifolia | DRCU | Forb | Brassicaceae | Annual | Not Consumed | Not Consumed | Not Consumed |
| Echinocereus triglochidiatus | ECTR | Cactus | Cactaceae | Perennial | Not Consumed | Not Consumed | Not Consumed |
| Elymus elymoides | ELEL5 | Graminoid | Poaceae | Perennial | Emergency | Emergency | Emergency |
| Ephedra cutleri | EPCU | Shrub | Ephedraceae | Perennial | Desirable | Desirable | Desirable |
| Ephedra torreyana | EPTO | Shrub | Ephedraceae | Perennial | Desirable | Desirable | Desirable |
| Ephedra viridis | EPVI | Shrub | Ephedraceae | Perennial | Desirable | Desirable | Desirable |
| Eremopyrum triticeum | ERTR13 | Graminoid | Poaceae | Annual | Not Consumed | Not Consumed | Not Consumed |
| Eriastrum sp. | ERIAS | Forb | Polemoniaceae | Annual | Not consumed | Not consumed | Not consumed |
| Ericameria nauseosa | ERNA10 | Shrub | Asteraceae | Perennial | Emergency | Emergency | Emergency |
| Eriogonum cernuum | ERCE2 | Forb | Polygonaceae | Annual | Emergency | Desirable | Emergency |
| Eriogonum corymbosum | ERCO14 | Shrub | Polygonaceae | Perennial | Not Consumed | Not Consumed | Not Consumed |
| Eriogonum inflatum | ERIN4 | Forb | Polygonaceae | Annual/Perennial | Emergency | Desirable | Emergency |
| Eriogonum jamesii | ERJA | Forb | Polygonaceae | Perennial | Not Consumed | Not Consumed | Not Consumed |
| Eriogonum leptocladon | ERLE9 | Shrub | Polygonaceae | Perennial | Emergency | Emergency | Emergency |
| Eriogonum microthecum | ERMI4 | Shrub | Polygonaceae | Perennial | Emergency | Desirable | Emergency |
| Eriogonum ovalifolium | EROV | Forb | Polygonaceae | Perennial | Emergency | Desirable | Emergency I |
| Eriogonum sp. | ERIOG | Forb | Polygonaceae | Annual | Not Consumed | Not Consumed | Not Consumed |
| Eriogonum subreniforme | ERSU5 | Forb | Polygonaceae | Annual | Not Consumed | Not Consumed | Not Consumed |
| Erodium cicutarium | ERCI6 | Forb | Geraniaceae | Annual/Perennial | Not Consumed | Not Consumed | Not Consumed |
| Erysimum capitatum | ERCA14 | Forb | Brassicaceae | Biennial/Perennial | Not Consumed | Not Consumed | Not Consumed |
| Euphorbia sp. | EUPHO | Forb | Euphorbiaceae | Annual | Not Consumed | Not Consumed | Not Consumed |
| Frankenia jamesii | FRJA | Subshrub | Frankeniaceae | Perennial | Not Consumed | Not Consumed | Not Consumed |
| Frasera albomarginata | FRAL5 | Forb | Gentianaceae | Biennial | Not Consumed | Not Consumed | Not Consumed |
| Fraxinus anomala | FRAN2 | Shrub/Tree | Oleaceae | Perennial | Emergency | Emergency | Not Consumed |
| Gilia sp. | GILIA | Forb | Polemoniaceae | Annual | Not Consumed | Not Consumed | Not Consumed |
| Grayia spinosa | GRSP | Shrub | Chenopodiaceae | Perennial | Emergency I | Desirable I | Emergency I |
| Gutierrezia sarothrae | GUSA2 | Subshrub | Asteraceae | Perennial | Emergency T | Emergency T | Emergency T |
| Halogeton glomeratus | HAGL | Forb | Chenopodiaceae | Annual | Not Consumed T | Not Consumed T | Not Consumed T |

| **GenusSpecies** | **Code** | **Growth** | **Family** | **Duration** | **Sheep** | **Goat** | **Cattle** |
|---|---|---|---|---|---|---|---|
| Hesperostipa comata | HECO26 | Graminoid | Poaceae | Perennial | Desirable I | Emergency I | Desirable I |
| Heterotheca villosa | HEVI4 | Subshrub | Asteraceae | Perennial | Not Consumed | Not Consumed | Not Consumed |
| Hymenopappus filifolius | HYFI | Forb | Asteraceae | Perennial | Not Consumed | Not Consumed | Not Consumed |
| Hymenoxys sp. | HYMEN7 | Forb | Asteraceae | Annual | Not Consumed T | Not Consumed T | Not Consumed T |
| Ipomopsis aggregata | IPAG | Forb | Polemoniaceae | Perennial | Not Consumed | Not Consumed | Not Consumed |
| Ipomopsis gunnisonii | IPGU | Forb | Polemoniaceae | Annual | Not Consumed | Not Consumed | Not Consumed |
| Ipomopsis sp. | IPOMO | Forb | Polemoniaceae | Annual | Not Consumed | Not Consumed | Not Consumed |
| Isocoma rusbyi | ISRU2 | Shrub | Asteraceae | Perennial | Not Consumed T | Not Consumed T | Not Consumed T |
| Krascheninnikovia lanata | KRLA2 | Subshrub | Chenopodiaceae | Perennial | Preferred | Desirable | Desirable |
| Lappula occidentalis | LAOC3 | Forb | Boraginaceae | Annual | Not Consumed | Not Consumed | Not Consumed |
| Lappula sp. | LAPPU | Forb | Boraginaceae | Annual | Not Consumed | Not Consumed | Not Consumed |
| Lepidium montanum | LEMO2 | Subshrub | Brassicaceae | Ann./Bienn./Perenn. | Not Consumed | Not Consumed | Not Consumed |
| Lepidium sp. | LEPID | Forb | Brassicaceae | Annual | Not Consumed | Not Consumed | Not Consumed |
| Leymus salinus | LESA4 | Graminoid | Poaceae | Perennial | Emergency | Emergency | Emergency |
| Linanthus pungens | LIPU11 | Subshrub | Polemoniaceae | Perennial | Not Consumed | Not Consumed | Not Consumed |
| Lycium pallidum | LYPA | Shrub | Solanaceae | Perennial | Emergency | Desirable | Emergency |
| Machaeranthera canescens | MACA2 | Forb | Asteraceae | Ann./Bienn./Perenn. | Not Consumed | Not Consumed | Not Consumed |
| Machaeranthera pinnatifida | MAPI | Subshrub | Asteraceae | Perennial | Not Consumed | Not Consumed | Not Consumed |
| Machaeranthera sp. | MACHA | Forb | Asteraceae | Annual | Not Consumed | Not Consumed | Not Consumed |
| Machaeranthera sp. | MACHA | Forb | Asteraceae | Perennial | Not Consumed | Not Consumed | Not Consumed |
| Mentzelia albicaulis | MEAL6 | Forb | Loasaceae | Annual | Not Consumed | Not Consumed | Not Consumed |
| Mentzelia multiflora | MEMU3 | Forb | Loasaceae | Perennial | Not Consumed | Not Consumed | Not Consumed |
| Mentzelia pumila | MEPU3 | Forb | Loasaceae | Biennial | Not Consumed | Not Consumed | Not Consumed |
| Mentzelia sp. | MENTZ | Forb | Loasaceae | Annual | Not Consumed | Not Consumed | Not Consumed |
| Mentzelia sp. | MENTZ | Forb | Loasaceae | Perennial | Not Consumed | Not Consumed | Not Consumed |
| Monroa squarrosa | MOSQ | Graminoid | Poaceae | Annual | Not Consumed | Not Consumed | Not Consumed |
| Muhlenbergia pungens | MUPU2 | Graminoid | Poaceae | Perennial | Not Consumed | Not Consumed | Not Consumed |
| Opuntia macrorhiza | OPMA2 | Cactus | Cactaceae | Perennial | Emergency I | Emergency I | Emergency I |
| Opuntia phaeacantha | OPPH | Cactus | Cactaceae | Perennial | Emergency I | Emergency I | Emergency I |
| Opuntia polyacantha | OPPO | Cactus | Cactaceae | Perennial | Emergency I | Emergency I | Emergency I |
| Opuntia sp. | OPUNT | Cactus | Cactaceae | Perennial | Not Consumed | Not Consumed | Not Consumed |
| Packera multilobata | PAMU11 | Forb | Asteraceae | Perennial | Not Consumed T | Not Consumed I | Not Consumed T |
| Packera sp. | PACKE | Forb | Asteraceae | Perennial | Not Consumed T | Not Consumed | Not Consumed T |
| Pascopyrum smithii | PASM | Graminoid | Poaceae | Perennial | Desirable | Desirable | Desirable |
| Penstemon sp. | PENST | Forb | Scrophulariaceae | Perennial | Not Consumed | Not Consumed | Not Consumed |
| Petradoria pumila | PEPU7 | Forb | Asteraceae | Perennial | Not Consumed | Not Consumed | Not Consumed |
| Phacelia crenulata | PHCR | Forb | Hydrophyllaceae | Annual | Not Consumed | Not Consumed | Not Consumed |
| Phacelia sp. | PHACE | Forb | Hydrophyllaceae | Annual | Not Consumed | Not Consumed | Not Consumed |
| Phacelia sp. | PHACE | Forb | Hydrophyllaceae | Perennial | Not Consumed | Not Consumed | Not Consumed |
| Phacelia sp. | PHACE | Forb | Hydrophyllaceae | Annual | Not Consumed | Not Consumed | Not Consumed |

| GenusSpecies | Code | Growth | Family | Duration | Sheep | Goat | Cattle |
|---|---|---|---|---|---|---|---|
| Phlox hoodii | PHHO | Forb | Polemoniaceae | Perennial | Emergency | Not Consumed | Emergency |
| Physalis sp. | PHYSA | Forb | Solanaceae | Perrenial | Not Consumed T | Not Consumed T | Not Consumed T |
| Physaria rectipes | PHRE9 | Forb | Brassicaceae | Perennial | Not Consumed | Not Consumed | Not Consumed |
| Physaria sp. | PHYSA2 | Forb | Brassicaceae | Perennial | Not Consumed | Not Consumed | Not Consumed |
| Picrothamnus desertorum | PIDE4 | Shrub | Asteraceae | Perennial | Emergency I | Desirable I | Emergency I |
| Plantago patagonica | PLPA2 | Forb | Plantaginaceae | Annual | Not Consumed | Not consumed | Not Consumed |
| Plantago sp. | PLANT | Forb | Plantaginaceae | Annual | Not Consumed | Not consumed | Not Consumed |
| Pleuraphis jamesii | PLJA | Graminoid | Poaceae | Perennial | Emergency | Not Consumed | Emergency |
| Poa fendleriana | POFE | Graminoid | Poaceae | Perennial | Desirable | Desirable | Preferred |
| Poliomintha incana | POIN3 | Shrub | Lamiaceae | Perennial | Not Consumed | Not consumed | Not Consumed |
| Portulaca oleracea | POOL | Forb | Portulacaceae | Annual | Not Consumed | Not consumed | Not Consumed |
| Purshia stansburiana | PUST | Shrub | Rosaceae | Perennial | Desirable | Desirable | Desirable |
| Purshia tridentata | PUTR2 | Shrub | Rosaceae | Perennial | Desirable | Preferred | Desirable |
| Quercus turbinella | QUTU2 | Shrub | Fagaceae | Perennial | Emergency | Desirable | Emergency |
| Rhus trilobata | RHTR | Shrub | Anacardiaceae | Perennial | Not Consumed | Emergency | Not Consumed |
| Rumex hymenosepalus | RUHY | Forb | Polygonaceae | Perennial | Not Consumed | Not consumed | Not Consumed |
| Salsola tragus | SATR12 | Forb | Chenopodiaceae | Annual | Emergency I | Emergency I | Emergency I |
| Sarcobatus vermiculatus | SAVE4 | Shrub | Chenopodiaceae | Perennial | Not Consumed | Not Consumed | Not Consumed |
| Sclerocactus sp. | SCLER10 | Cactus | Cactaceae | Perennial | Not Consumed I | Not Consumed I | Not Consumed I |
| Senecio flaccidus | SEFL3 | Forb | Asteraceae | Perennial | Not Consumed T | Not Consumed T | Not Consumed T |
| Silene sp. | SILEN | Forb | Caryophyllaceae | Annual | Not Consumed | Not Consumed | Not Consumed |
| Sisymbrium altissimum | SIAL2 | Forb | Brassicaceae | Annual | Not Consumed | Not Consumed | Not Consumed |
| Sphaeralcea  leptophylla | SPLE | Forb | Malvaceae | Perennial | Not Consumed | Not Consumed | Not Consumed |
| Sphaeralcea ambigua | SPAM2 | Forb | Malvaceae | Perennial | Not Consumed | Not Consumed | Not Consumed |
| Sphaeralcea coccinea | SPCO | Forb | Malvaceae | Perennial | Not Consumed | Not Consumed | Not Consumed |
| Sphaeralcea grossulariifolia | SPGR2 | Forb | Malvaceae | Perennial | Not Consumed | Not Consumed | Not Consumed |
| Sphaeralcea parvifolia | SPPA2 | Forb | Malvaceae | Perennial | Not Consumed | Not Consumed | Not Consumed |
| Sphaeralcea sp. | SPHAE | Forb | Malvaceae | Perennial | Not Consumed | Not Consumed | Not Consumed |
| Sporobolus airoides | SPAI | Graminoid | Poaceae | Perennial | Emergency | Emergency | Emergency |
| Sporobolus contractus | SPCO4 | Graminoid | Poaceae | Perennial | Emergency | Not Consumed | Emergency |
| Sporobolus cryptandrus | SPCR | Graminoid | Poaceae | Perennial | Not Consumed | Not Consumed | Desirable |
| Sporobolus sp. | SPORO | Graminoid | Poaceae | Perennial | Emergency | Emergency | Emergency |
| Stanleya pinnata | STPI | Forb | Brassicaceae | Perennial | Not Consumed | Not Consumed | Not Consumed |
| Streptanthella longirostris | STLO4 | Forb | Brassicaceae | Annual | Not Consumed | Not Consumed | Not Consumed |
| Suaeda moquinii | SUMO | Subshrub | Chenopodiaceae | Perennial | Not Consumed | Not Consumed | Not Consumed |
| Suaeda sp. | SUAED | Forb/Sub/Shrub | Chenopodiaceae | Perennial . | Not Consumed | Not Consumed | Not Consumed |
| Tetraneuris acaulis | TEAC | Forb | Asteraceae | Perennial | Not Consumed | Not Consumed | Not Consumed |
| Townsendia annua | TOAN | Forb | Asteraceae | Annual | Not Consumed | Not Consumed | Not Consumed |
| Townsendia sp. | TOWNS | Forb | Asteraceae | Annual | Not Consumed | Not Consumed | Not Consumed |
| Vulpia octoflora | VUOC | Graminoid | Poaceae | Annual | Not Consumed | Not Consumed | Not Consumed |

| GenusSpecies | Code | Growth | Family | Duration | Sheep | Goat | Cattle |
|---|---|---|---|---|---|---|---|
| Yucca angustissima | YUAN2 | Shrub | Liliaceae | Perennial | Not Consumed I | Not Consumed I | Not Consumed I |
| Yucca baccata | YUBA | Shrub | Liliaceae | Perennial | Not Consumed I | Not Consumed I | Not Consumed I |
| Yucca baileyi | YUBA2 | Shrub | Liliaceae | Perennial | Not Consumed I | Not Consumed I | Not Consumed I |
| Yucca sp. | YUCCA | Shrub | Liliaceae | Perennial | Not Consumed I | Not Consumed I | Not Consumed I |