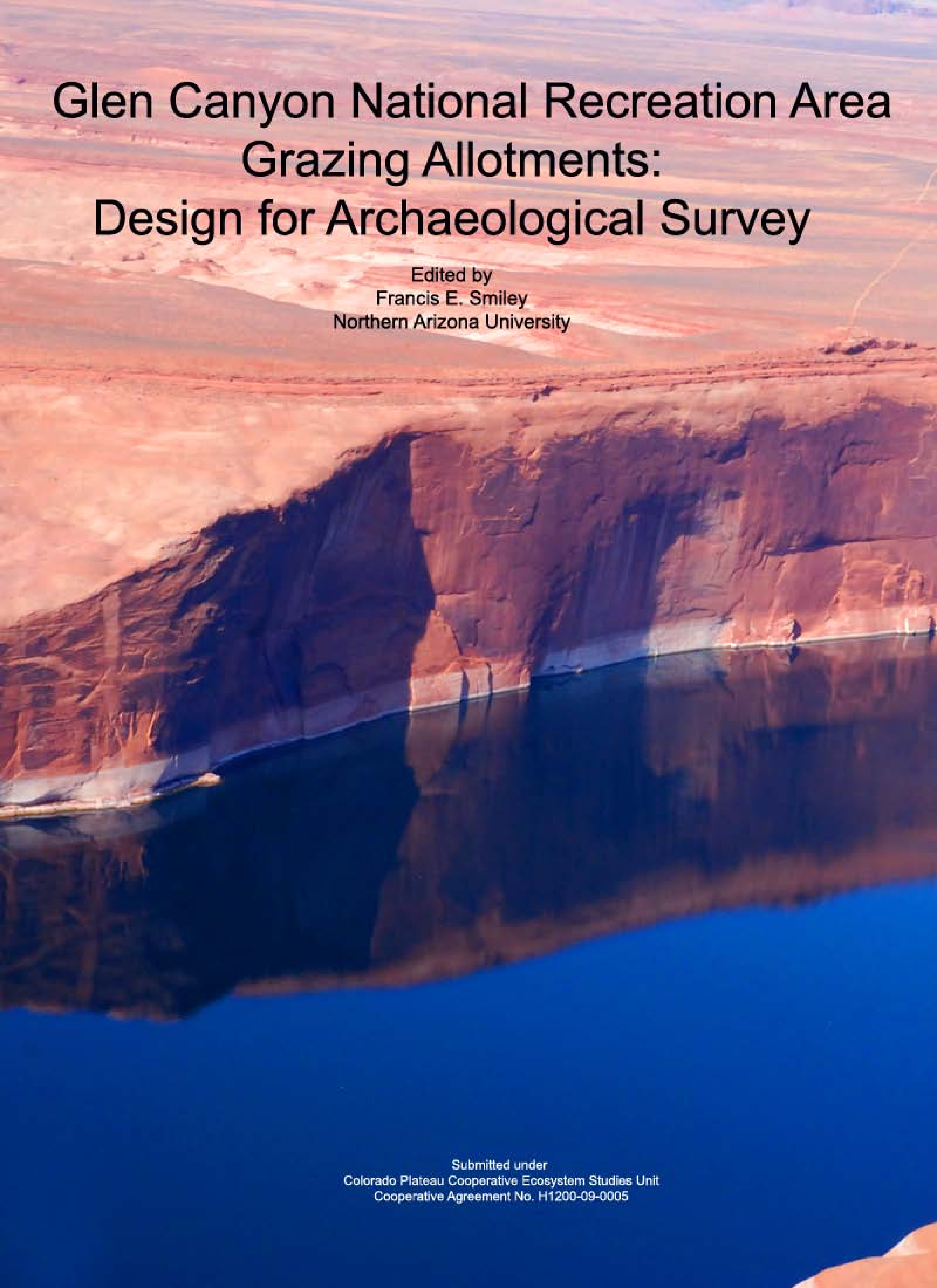
Glen Canyon National Recreation Area Grazing Allotments: Design for Archaeological Survey

Edited by
Francis E. Smiley
Northern Arizona University



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Design for Archaeological Survey

Developed and Edited by Francis E. Smiley, Ph.D.
Principal Investigator
Professor of Anthropology
Department of Anthropology
Northern Arizona University

Contributions by
Meghann M. Vance
William D. Bryce
Gregory M. Haynes

Copy Edited and Formatted by
Quinlan A. Stefaniak

Bibliography Compiled by
Dean M. Duryea, Jr.

Northern Arizona University

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Abstract

This document, *Glen Canyon National Recreation Area Grazing Allotments: Design for Archaeological Survey*, examines archaeological survey potential for all of the lands demarcated for grazing within the Glen Canyon National Recreation Area (GCNRA), an area of over 800,000 acres. The purpose of the design study is to provide foundation for the eventual development of archaeological survey work as part of federal compliance in accordance with the intent of Section 106 and Section 110(a) of the National Historic Preservation Act (NHPA) (16 U.S.C. 470f and 470h-2). In short, the design study provides theoretical, historical, and GIS analytical background for survey project planning in future years.

Glen Canyon National Recreation Area Grazing Allotments: Design for Archaeological Survey

Part I

by

Francis E. Smiley, Ph.D.
Gregory M. Haynes
Meghann M. Vance
William D. Bryce

Part I Contents

Design for Archaeological Survey: Document Structure

by Francis E. Smiley

This document, the *Design for Archaeological Survey*, examines archaeological survey potential for all of the lands demarcated for grazing within the National Recreation Area (GCNRA), an area of over 800,000 acres. The purpose of the design study is to provide foundation for the eventual development of a large-scale survey project as part of federal compliance in accordance with the intent of Section 106 and Section 110(a) of the National Historic Preservation Act (NHPA) (16 U.S.C. 470f and 470h-2). In short, the design study provides the basis for survey project planning in future years.

Contents

The Design for Archaeological Survey contains five components. The first component is a Summary of Archaeological Research across the GCNRA written by Gregory Haynes. The Summary of Archaeological Research also contains a wide range of research questions that might be adopted or built upon in the planning of the eventual archaeological survey. The second component, written by Meghann M. Vance, provides the theoretical background and context for survey archaeology and focuses primarily on archaeology in North America. The third component by William D. Bryce consists of a brief history of archaeological survey and provides historical context for future survey research at GCNRA. The fourth component, written and developed by Meghann M. Vance, contains the GIS analysis of the archaeological survey potential for all grazing allotments. The fifth and final component consists of the GIS data, layers, geodatabases, and analyses developed in the course of this study. Meghann M. Vance developed and compiled the GIS data.

Purpose and Scope

The GIS portion of the study examines each grazing allotment from the perspective of archaeological survey potential and problems. The GIS document and accompanying databases will provide detailed guidance during the process of eventual survey project planning. Each grazing allotment analysis contains GIS data clipped to the allotment boundary. We consider in this document only portions of grazing allotments that fall within the GCNRA. Project planners for large-scale survey work will find a great deal of detailed GIS analysis providing a range of survey sampling fraction alternatives. We provide a wide range of survey sampling fraction alternatives because: 1) we do not know the scale of the eventual project funding for survey in the GCNRA, as a whole, or for particular grazing allotments; 2) so that National Park Service planners can consider a range of alternative survey sampling fractions for each individual grazing allotment. The availability of discrete data for each allotment will vastly simplify large-scale survey preparations.

Previous Survey Work

The accompanying Research Summary and the Grazing Allotment GIS Analysis both provide a table of previous archaeological survey work in the GCNRA. The locations and boundaries of a large number of previous surveys are not yet available in georeferenced GIS-compatible form. However, in a separate project, we are developing GIS data containing the most up-to-date survey information, with the digitization of many additional projects already completed by NAU graduate student Tesa Villalobos and included herein.

Final Survey Sample Selection Using GIS Data

We designed the current report for use by eventual survey planners. We provide two "fishnet" maps for each individual allotment, one map oriented north-south, and one map oriented east-west. The fishnet units represent archaeological survey transects. At present, all transects in the fishnets are spaced at 200-meter intervals, allowing for a minimum crew of two spaced at 50-meter intervals, or a crew of 5-6 individuals spaced at the standard 15-20 meters required for Section 106 inventories in the states of Arizona and Utah. If changes to transect intervals are required or desired, survey planners and survey crews can easily use the ArcMAP GIS data we provide here in conjunction with the ArcToolbox Fishnet Utility to superimpose survey transects or even survey quadrats over any portion of the area at any orientation in order to establish a survey structure. From that point, it is a simple process to randomly or systematically select survey transacts or quadrats for specific surveys using whatever sampling fraction may be dictated by budgetary, research, and management priorities.

Acknowledgements

We are grateful for the help of all associated with the Shoreline Study. At the GCNRA, we thank Rosemary Sucec, Chief of Cultural Resources; Lex Newcomb, GIS Coordinator; Brian Sweatland, Chief of Planning, Compliance, and External Affairs; Chris Hughes, Chief of

Resource Management; and Michael Burney, Soils Specialist at GCNRA. We also thank Anne Trinkle Jones, NPS Cultural Resources Coordinator at CPCESU and Michael Berry, Regional Archaeologist at the Bureau of Reclamation. Quinlan Stefaniak did a major share of manuscript editing and formatting and we greatly appreciate her efforts. Dean Duryea compiled the bibliographic material and we are grateful for his work, as well. We are probably omitting some who helped us, and for any omissions, we apologize in advance.

Archaeological Investigations at Glen Canyon National Recreation Area: Previous Research and Proposed Research Questions

Gregory M. Haynes

We have designed this summary of previous research and compilation of potential research questions to facilitate the development of research designs for two separate but closely related Glen Canyon National Recreation Area (GCNRA) survey project contracts. Both survey design projects have components scattered across the entire GCNRA, so both projects involve the whole GCNRA. One project covers vast areas and the other focuses on selected, widely scattered parcels. The first of the projects is the Archaeological Sampling Strategy and Research Questions for High Priority Grazing Allotments in GCLA and will be referred to as the "Grazing Allotment Study" (Colorado Plateau Cooperative Ecosystem Studies Unit Cooperative Agreement Number HI200-09-0005). The Grazing Allotment Study includes all of the designated allotments within the GCNRA boundaries and is a survey research design project that can appropriately be characterized as "extensive." As an extensive project, eventual archaeological survey will sample huge areas and a wide range of macro- and micro-ecosystems and topographic provinces.

The second project, much smaller in scope and in area coverage, is the Archaeological Sampling Strategy for Lake Powell's Accessible Shorelines, herein referred to as the "Shoreline Study" (Colorado Plateau Cooperative Ecosystem Studies Unit Cooperative Agreement Number HI200-09-0005). The Shoreline Study examines parcels of various sizes at locations deemed at risk from approach by boat or vehicle. The risk stems from the propensity of GCNRA visitors to collect materials and otherwise damage archaeological sites. The Shoreline Study will develop survey information that will be used to plan archaeological survey to evaluate the number and types of archaeological sites exposed and vulnerable due to receding lake levels. The Shoreline Study specifically looks at lands below the Lake Powell full pool level of 3700 ft. ASL, which is the level at which shore-accessible grazing allotment boundaries end.

Because the two projects involve most of the area of the GCNRA, we include the background materials on GCNRA research and research questions as well at the survey theory and survey history in both project documents. The Grazing Allotment Study includes nearly all of the GCNRA across the allotments, while the Shoreline Study targets selected localities scattered from the Wahweap area on the southwest to the northeastern-most reach of the GCNRA. Moreover, as lake levels continue to fall, research into the vulnerabilities of cultural resources in the accessible shoreline areas will be generalizable to a potentially huge number of additional shoreline situations and localities.

Over the next several years, the GCNRA will conduct a number of large-scale, management-related archaeological inventories, including an evaluation of approximately 800,000 acres of grazing allotments. This work is being conducted in accordance with Section 106 of the National Historic Preservation Act of 1966, as amended, which stipulates that all federal agencies must "take into account the effect of [an] undertaking on any district, site, building, structure, or object that is included in or eligible for inclusion in the National Register" (National Historic Preservation Act 1966 [2006]:19). Given the size of the above mentioned project, GCNRA has contracted with Northern Arizona University to develop a GIS-based survey sampling design, along with a list of pertinent research questions that can feasibly be addressed by surface inventory and limited test excavations. Presented below is a brief synthesis of past archaeological work in the GCNRA, highlighting the size and scope of major projects, the locations of previous fieldwork, and what was found. Then, based on the information, we propose a list of pertinent research questions in order to guide archaeological work in the immediate future.

Setting and Physiography

The GCNRA is arguably one of the most scenic public recreation spots in the world. The GCNRA also comprises a huge administrative unit covering some 1.2 million acres (~500,550 ha) of rugged canyon land country. The centerpiece of the GCNRA is Lake Powell, formed as a result of Glen Canyon Dam. The GCNRA proper stretches along the course of the Colorado River from Lees Ferry, located about 14 mi (23 km) west of the dam in far north-central Arizona, eastward some 170 river miles (273 km), past the confluences of both the Escalante and the San Juan Rivers, to lower Cataract Canyon in southeastern Utah. With the exception of Navajo Nation lands positioned south of the San Juan River and the lower portion of the Colorado, all of the tributaries, plateaus and mountains on either side of these three rivers (Colorado, Escalante, San Juan) are incorporated into GCNRA. For the last couple of decades, several million people have visited the recreation area each year.

Lying in the heart of the canyon land region of the Colorado Plateau, there is roughly a 3,500 ft elevation range from the surface of Lake Powell to the tops of the highest landforms (e.g., Kaiparowits Plateau, Henry Mountains). The Colorado Plateau consists of a series of uplifted Paleozoic and Cenozoic sediments, composed mostly of limestone, siltstones, and sandstones (Hunt 1956). Glen Canyon was formed when the Colorado River, along with its major tributaries, experienced two major down-cutting events, the first during the early Miocene, some 23 to 14 million years ago, then a second in late Pliocene times, some five million years ago (Hunt 1956). With wide variability in elevation, geology and topography, a number of different ecological zones are present, offering alternative potentialities and constraints for past human use. Following Geib (1996:6), these ecozones can be broadly classified as follows:

1. Lowlands—hot riverine canyons with permanent water and an early growing season, below 4,500 ft
2. Midlands—arid benches and low plateaus with abundant, economically important, non-domesticated plants and animals, located between 4,500-5,500 ft
3. Highlands—cool, moist mountains and high plateaus, with pinyon-juniper woodland and large areas of potential dry farm land, generally above 5,500 ft.

The ecological zonation of the GCNRA has structured archaeological investigations and interpretations in the GCNRA since Jennings' (1966) contrast between uplands and lowlands. Tipps (1984) and then Geib (1994, 1996) broadened and refined Jennings' original zonation to include the Midlands zone, so that the above-listed zonation has become standard. Interpretations of the archaeological evidence of past human occupation of the GCNRA continue to incorporate these ecological zones as conditions, and at times, as deterministic, of prehistoric life in the GCNRA. Accordingly, NAU integrates the ecological triumvirate in the subsequent discussions.

Investigative Summary

Before launching discussions of the long history of GCNRA archaeological investigations, we take a quick look at the vernacular of chronology used in the region and in this report. The Pecos Classification (Kidder 1927), long used and still useful, designated the first farming groups the *Basketmaker II* peoples. In this report and elsewhere, a growing trend is to call the temporal period of early agriculture simply the *Early Agricultural Period* following Geib (1996). The ensuing Basketmaker III and Pueblo I periods can be designated the *Early Formative* and later prehistoric Ancestral Puebloan cultures (Pueblo II and III) become *Late Formative* cultures. The attentive reader will note considerable terminology variation in this report and across the archaeological literature on the northern Southwest.

The Earliest Investigations (1869-1957)

From 1869, when John Wesley Powell first traveled down the Colorado River by boat, to the start of the massive Glen Canyon Project in 1957, some 37 expeditions were made into the Glen Canyon area (Adams 1960:1). Powell's notes on a masonry ruin at the mouth of Red Canyon, dated July 28, 1869, contain the earliest information obtained on an archaeological site in the basin. While a number of river expeditions traversed Glen Canyon before the beginning of the twentieth century, the first by land was a group of Mormon pioneers who made famous the Hole-in-the-Rock passage and noted a cliff dwelling on Castle Creek (Adams 1960:6). Indeed, most explorations of the area before 1930 were accomplished by land rather than by river, which limited findings mainly to archaeological sites in the upland and midland zones and tributary canyon reaches.

The first explicitly archaeological explorations took place during the first three decades of the twentieth century. Many of these were conducted by the Wetherill brothers, who for three decades served as guides to academically-oriented archaeologists like Byron Cummings, Neil Judd, Charles Bernheimer, Earl Morris, and Noel Morss. It was Cummings, along with his student Judd, who identified Rainbow Bridge in 1909; both men would direct a number of reconnaissance projects in and around Glen Canyon from 1909 to 1923, although little of this information was ever formally published (Adams 1960:7). Working with the American Museum of Natural History, Charles Bernheimer and Earl Morris spent much of the 1920s looking for archaeological sites in the Glen Canyon Basin. Besides the development of a trail to Rainbow Bridge, their activities were focused in areas north and west of Navajo Mountain, including Cummings Mesa, and later in areas north of the San Juan River and west of the Clay Hills (Adams 1960:8).

The Peabody Museum at Harvard University was also active in the area in the 1920s. Noel Morss surveyed the Rainbow and Kaibito Plateaus; Donald Scott covered areas west of upper Glen Canyon, along with the Kaiparowits Plateau; and Henry Roberts reconnoitered the upper end of Glen Canyon. Clyde Kluckhohn, the famous Navajo ethnographer, made a number of trips into regions north and west of Navajo Mountain and onto the Kaiparowits Plateau, where he found sites in abundance (Adams 1960:8). Thus, documentation of prehistoric sites was primarily limited to midland plateaus and higher elevation mountains and mesas rather than in the canyon bottomlands.

By the 1930s, increasingly systematic work began to include detailed descriptions of specific sites, with relatively exact site location information. In addition, with the increasing availability of good maps, and later rubber rafts, inventory shifted from the more accessible midland and upland zones to the low-land river corridors. The first archaeological exploration of GCNRA by boat was overseen by Julian Steward (1941) in 1932. During the survey, Steward documented 28 sites along the main canyon. Members of the Rainbow Bridge-Monument Valley expedition also made a number of boat trips through the San Juan and lower Glen Canyon, as well as up to the Kaiparowits Plateau, in the 1930s (Beals et al. 1945:5-7). As a result of their work, some 40 archaeological sites were documented along the rivers, along with about 100 small sites on the Kaiparowits Plateau (Adams 1960:9). After the close of World War II, a river-runner named Gene Foster (1952, 1954) recorded about 100 archaeological sites primarily along the Colorado River, while another avocationalist, John Frost, identified many of the important petroglyph sites on the San Juan River (Adams 1960:9).[1]

The Glen Canyon Project

In 1956, with passage by Congress of Public Law 485, construction of the Glen Canyon Dam was authorized. This particular dam would be the lowest of four that would eventually be built in the upper Colorado River Basin, including dams associated with Flaming Gorge, Curecanti, and Navajo Reservoirs. Shortly after the passage, the National Park Service, under authorization of the Historic Sites Act of 1935, initiated the Upper Colorado River Basin Archaeological Salvage Project to oversee efforts in each of the abovementioned reservoir areas (Jennings 1966:3-4). NPS quickly made contractual obligations with the University of Utah (UU) and the Museum of Northern Arizona (MNA) to conduct investigations in different portions of the Glen Canyon region.

Eventually, MNA would be responsible for work along the entire San Juan River, the Colorado corridor below the San Juan, and the Colorado's south bank (Paiute Mesa, Cummings Mesa, Rainbow Plateau), as well as all related geological studies (Danson 1958:75-78; Jennings 1966:4). The UU would oversee archaeological work in all other areas (i.e., the Colorado River corridor above the San Juan River and the entire north bank of the Colorado, including the Escalante Basin and the Kaiparowits Plateau), all historic and ethnohistoric research, and all related ecological studies (Danson 1958:75-79; Jennings 1966:4). Fieldwork commenced almost immediately upon award and would largely be completed by the closing of the dam's floodgates in 1963, although analyses and report publications continued through the rest of the 1960s. While it remains uncertain exactly how many acres the two institutions inventoried, about 2,000 archaeological sites were recorded, several dozen excavated, and 31 total volumes published in the official Glen Canyon Series (Geib 1996; Jennings 1966).[2]

Jennings's (1966:5) primary goal was to "sample all the cultures thrust into jeopardy within a specified area." With this in mind, formal and functional analyses of architecture and artifact types were emphasized to identify occupational sequences and interpret the degree of cultural relatedness through time between the Kayenta, Mesa Verde, and Virgin Anasazi branches, as well as the Fremont culture group (Danson 1958; Geib 1996; Jennings 1966). Another research orientation was to understand how prehistoric populations, in particular the Anasazi, adapted to the Glen Canyon landscape to make a living (Danson 1958:76; Jennings 1966:44-45). Both of these research orientations followed common themes in the anthropological research agendas of the 1950s, detailing long-term culture-history (Lyman et al. 1997) and understanding prehistoric cultural-ecology (Steward 1955). Similar research orientations were identified by E. B. Danson, then director of MNA, for their portions of GCNRA: "This will also be the first study of the biological and geological relationships in the river area to prehistoric man. Man's intercultural relationships in this area has been suggested but never studied" (1958:76).

The Glen Canyon Project would, for all practical purposes, afford the only systematic documentation of sites within the canyon bottomlands. Accordingly, the first phases of the project were conducted within the reservoir impoundment zone. William Adams and others would oversee reconnaissance for MNA in the lower San Juan and Glen Canyon reaches (Adams and Adams 1959; Adams et al. 1961), while Don Fowler and Robert Lister conducted survey in the upper Glen Canyon and parts of the Escalante Basin (Fowler 1963; Fowler et al. 1959; Lister 1958). In conjunction with, and following up on these inventories, a plethora of excavations occurred between 1957 and 1962. In the lower San Juan, MNA's Alexander Lindsay reported on excavations at a Puebloan agricultural community (Lindsay 1961; Lindsay et al. 1962) and Paul Long described excavations along the Colorado corridor below the San Juan River (Long 1965; Long et al. 1963). For the University of Utah, James Gunnerson and Bill Lipe reported on the initial excavations in the upper Colorado corridor (Gunnerson 1959; Lipe, W. D. 1960; Lipe, W. D. et al. 1960). On-going excavations conducted in the upper

[1]For a list of expeditions, references, and areas of reconnaissance before 1960, see Adams 1960:Table III.

[2]For a list of publications covering the Glen Canyon Project, see Jennings 1966.

Table 1. Inventory Summary for NAU's Glen Canyon Archaeological Investigations.

Region	No. of Acres Surveyed	No. of Sites Documented	Site Density
Lees Ferry	1,114	25	1 / 44.5 acs
Lower GCNRA Benches	2,570	58	1 / 44.3 acs
Rainbow Bridge NM	70	25	1 / 2.8 acs
Cow Canyon (Escalante)	1,080	45	1 / 24 acs
25-Mile Wash (Escalante)	990	47	1 / 21 acs
Bowns Canyon (Escalante)	600	55	1 / 10.9 acs
San Juan Arm	2,320	40	1 / 58 acs
Bullfrog/Henry Mountains	3,450	27	1 / 127.7 acs
Orange Cliffs (upper GCNRA)	2,625	76	1 / 34.5 acs
Clearwater Canyon (upper GCNRA)	2,075	62	1 / 33.4 acs
North Point	1,130	26	1 / 43.4 acs
The Spur	950	20	1 / 47.5 acs
Totals	18,974	506	1 / 37.4 acs

Colorado during the early 1960s would be discussed by Floyd Sharrock (1964; Sharrock et al. 1961; Sharrock et al. 1963). Significantly, open archaeological sites throughout Glen Canyon were not particularly large, unlike those found at Chaco Canyon or the Navajo Reservoir area, nor were there large cliff dwellings of the sort found to the southwest in Tsegi Canyon or to the east in Mesa Verde. Jennings (1966:38) believed they would find large, visually impressive sites throughout the area with stratigraphic sequences that ranged from Basketmaker II through Pueblo III (c.f., Adams 1960:9; Geib 1996:2). In fact, the archaeological record at GCNRA does not include large, aggregated pueblos (see below).

Due to the paucity of large, stratigraphically complex pueblos in the midlands and lowlands, the Glen Canyon Project conducted later work in the surrounding uplands, concentrating on how the upland zones were related to sites in the midlands and lowlands. Each institution remained within its respective geographic regions, with MNA conducting survey and excavations on Cummings Mesa (Ambler et al. 1964) and the Rainbow Plateau (Lindsay et al. 1968), located south of lower Glen Canyon and west of Navajo Mountain. The UU conducted similar work on the Kaiparowits Plateau located on the north side of lower Glen Canyon (Fowler and Aikens 1963). As observations had indicated before the Glen Canyon Project, abundant Anasazi habitations were found in all of the upland zones, and unlike findings in the midlands and lowlands of Glen Canyon, a number of these sites contained upwards of 100 rooms.

Glen Canyon Revisited

Following the eventual conclusion of the Glen Canyon Project, archaeological investigations on a much smaller scale would continue in the 1970s and 80s. Alan Schroedl (1976a, 1976b, 1981a, 1981b), working with the UU, would conduct survey and excavations in Lake and Moqui Canyons, and in the Dangling Rope area. Compliance-related inventory and excavation would take place at Wahweap (Liestman 1986; Tipps 1987) and in the Orange Cliffs (Geib 1996). In addition, notable excavations would take place at Captains Alcove (Tipps 1984) and Bechan Cave (Agenbroad et al. 1989), along with lithic studies at Halls Crossing (Van West 1980; Warburton and Tipps 1983).

More important, NAU undertook a second long-term investigative project in Glen Canyon in the 1980s. Table 1 summarizes the survey work. Fieldwork for this project began in 1984 and continued through 1989, although comprehensive analyses and various final reports would not be completed until 1994. Over the course of the work, moderate- to large-scale inventory took place in most areas of the GCNRA. Initially, a research plan to guide the investigations was developed by J. Richard Ambler (1984), specifying inventory of 30 individual sections across the Park, but this would soon be modified (Geib, Fairley, and Ambler 1986). In all, NAU completed 11 separate inventory projects that covered 18,974 acres and documented 506 archaeological sites (Geib 1996:12). This work included test excavations at eight sites in Bowns Canyon and 12 sites in the Orange Cliffs (Geib 1996:12). NAU produced nine technical reports (Geib 1989a, 1989b, 1994; Geib and Bremer 1988; Geib and Bungart 1988; Geib et al. 1987; Geib, Fairley, and Ambler 1986; Geib, Fairley, and Bungart 1986), one MA thesis (Bungart 1990), and one monograph (Geib 1996).

The first phase of fieldwork included a complete inventory of Rainbow Bridge National Monument (Geib, Fairley, and Bungart 1986). This fieldwork documented 25 sites in a 70-acre area, an incredibly high site density (1/2.8 acs). Along with Rainbow Bridge, four other areas along the entire length of the GCNRA were inventoried (Geib, Fairley, and Bungart 1986). Below the Dam, 1,114 acres near Lees Ferry were surveyed and 25 sites documented (1 site / 44.5 acs). Another 2,075 acres were inventoried in Clearwater Canyon, located in the upper reaches of the Colorado River, where 62 sites were recorded (1 site / 33.4 acs). North Point, in the far northern portion of the GCNRA, and away from the Colorado River, received 1,130 acres of survey where 26 sites were found (1 site / 43.4 acs). Finally, while the latter inventories were driven by management considerations, 600 acres in Bowns Canyon, located just north of the confluence of the Escalante and Colorado Rivers, was chosen strictly for its research potential. Here, 55 sites were recorded, identifying yet another area of very high site density (1 site / 10.9 acs). While ceramic period sites dominated the findings, of particular interest were purported PaleoAmerican sites around the head of Clearwater Canyon (Geib 1996:227; Geib, Fairley, and Bungart 1986:28), along with Middle Archaic and Basketmaker II sites in Bowns Canyon (Geib, Fairley, and Bungart 1986:165-166).

By September of 1986, fieldwork was initiated in the southern Orange Cliffs area, in upper GCNRA (Geib and Bremer 1988). This work entailed survey of 2,625 acres, split up into 17 randomly chosen quarter sections throughout the region. Seventy-six sites were recorded (1 site / 34.5 acs), along with 85 isolated finds. The technical report by Geib and Bremer (1988) included not only the results of NAU's fieldwork, but would also summarize unreported investigations in the area by the Argonne National Laboratory and develop a predictive site location model.

Between the fall of 1985 and the fall of 1987, two inventory projects were conducted in the Escalante Basin. The first took place in Cow Canyon, a tributary in the lower Escalante, while the second took place in Twentyfive Mile Wash, in the middle Escalante Basin. The former inventory included 1,080 acres and documented 45 sites (1 site / 24 acs) (Geib et al. 1987). In the latter project, 990 acres were covered and 47 sites were newly recorded (1 site / 21 acs) (Geib 1994). These two projects revealed significantly higher site densities up the Escalante drainage, than below the Dam at Lees Ferry, at Clearwater Canyon in upper GCNRA, or at North Point (Table 1).

Other fieldwork in 1987 included the completion of two additional large inventory blocks, one at the far northern tip of GCNRA near the Green River (Geib 1994), the so-called *Spur*, and the other along the north side of the San Juan River. The area known as the Spur included some 46,000 acres of moderately level uplands, of which 950 acres were inventoried for sites. A total of 20 sites was recorded (1 site / 47.5 acs), with a density similar to that found earlier at North Point (1 site / 43 acs). The inventory along the San Juan included a total of 2,320 acres divided up into five general districts and sampled from a universe of 19,175 acres (Geib and Bungart 1988:1). In all, 40 sites were recorded, for a relatively low site density (1 site / 58 acs) as compared to other inventoried areas in the GCNRA (Table 1).

The final inventory projects involved two huge chunks of land. The Lower Glen Canyon Benches, located on the north side of the Colorado River, between the Dam and the Kaiparowits Plateau, included an area over 46,000 acres. Of this area, 2,570 acres were surveyed by randomly chosen one-quarter sections, which equaled about 5.5 percent of the total area. In all, 58 sites were found (1 site / 44.3 acs), with an average site density roughly comparable to most of the other areas of GCNRA, Rainbow Bridge excepted, and areas in the Escalante watershed (i.e., Cow Canyon, Twentyfive Mile Wash, Bowns Canyon). Finally, NAU conducted fieldwork from Bullfrog Creek north to the Henry Mountains. Comparable to the Bench survey in size, a sample of 3,450 acres of a 45,000-acre region was inventoried, with only 27 sites found (1 site / 127.7 acs). Site density in this region is dramatically lower than any other found during these investigations across the GCNRA (Table 1).

In addition to the abovementioned inventories, limited test excavations took place in two areas of the GCNRA. Eight sites were tested in Bowns Canyon, just north of the Escalante and Colorado confluence (Geib et al. 1987), while twelve other sites were tested in the Orange Cliffs of the upper GCNRA (Bungart 1990). The purpose of the two testing programs was to "obtain radiocarbon, artifactual, and subsistence data for interpreting the Archaic, Preformative, and Early Formative occupations" (Geib Bungart and Fairley 1987:i; c.f., Bungart 1990:3-4). Both sites tested in Bowns Canyon, 42KA2751 (Sunny Beaches Site) and 42KA2756 (Co-op Site), exhibited multiple loci with stratified deposits. At Sunny Beaches, an aceramic site, test excavations focused on a single cultural horizon, Locus A (Geib et al. 1987:51-73). Along with abundant artifacts and faunal remains, radiocarbon dates from this locus ranged from 540 B.C. to A.D. 250, a time frame associated with Basketmaker II of the Pecos chronology.

At the Co-op Site, three loci (Loci A-C) were tested (Geib et al. 1987e:73-96). Again, abundant artifacts and ecological remains were obtained, with a suite of radiocarbon dates from different stratigraphic positions that ranged from 2,380 B.C. to A.D. 600 (Geib et al. 1987:94-95). This time frame represents occupations that date from the Late Archaic Period into Early Basketmaker III. Hearths from six other sites—42KA2742, 42KA2743, 42KA2744, 42KA2745, 42KA2771, and 42KA2773—were also sampled. No radiocarbon material was obtained for 42KA2742; four sites yielded radiocarbon assays that ranged from A.D. 220 to A.D. 635; and, site 42KA2771 returned an assay at 3,350 B.C. (Geib et al. 1987:96-109). Not only were radiocarbon assays obtained from five of the six sites, but 156 macrobotanical specimens and 46 pieces of bone were recovered. In the Orange Cliffs, 19 hearths at 12 aceramic sites were sampled and 11 radiocarbon assays were obtained as a result (Bungart 1990:54, 56). While almost no floral or faunal remains were recovered, the assays range from 1,280 B.C. to A.D. 430 (Bungart 1990:54).

The Last Twenty Years

Since NAU concluded field investigations in 1989, a good deal of work has been conducted throughout GCNRA. Much of the work has been accomplished in support of federal undertakings, which require compliance with Section 106 of the NHPA. While technical reports have been written to summarize these more recent projects, most recent reports languish in the gray literature and are not widely circulated outside individual agencies. No large-scale synthetic monographs have been written to summarize the current state of archaeological knowledge at GCNRA on the scale of the regional Glen Canyon Project reports (see above), Jesse Jennings's (1966) summary, or Phil Geib's (1996) *Glen Canyon Revisited*, all of which are readily available at research libraries throughout the western U.S.

A review of the GCNRA's cultural resource GIS database is an easy way to understand the amount of work that has taken place in the park since 1990. From this information, a person can glean the number of projects undertaken in the form of authored technical reports, as well as the number of sites that have been documented in different regions of the park. It is important to recognize that this database is probably not entirely up-to-date for a variety of reasons. For instance, projects that have only recently been completed or those that have not yet gone through the agency review process for quality control/assurance may not be incorporated into the GCNRA's GIS database.

In addition to the two reports published in the 1990s that summarize NAU's fieldwork (Bungart 1990; Geib 1994), 27 technical reports are cited in the GCNRA GIS site database. Of these, 17 appear to be specific projects written by a variety of private contract firms, the GCNRA, or the National Park Service's Midwest Archaeological Center. The other 10 reports are annual agency summaries that describe investigative work accomplished during the course of a given year (e.g., Glen Canyon National Recreation Area 1992 Summary Report, etc.). The annual summary reports by the agency show that a great many sites have been newly recorded on the Kaiparowits Plateau, 118, and in Escalante Basin, 60. In sum, at least 594 new sites, in over 70 different geographic locations, have been documented on GCNRA over the past couple of decades.

Research Questions

We summarize past investigative efforts to identify research questions already examined, questions that remain unanswered from previous investigations, and to help form new questions relevant to current archaeological research. Because fieldwork proposed at GCNRA in the near future will primarily be archaeological inventory with limited NRHP eligibility testing, the research questions developed here focus on the kinds of data that can be gathered at the inventory level of inquiry (Table 2).

Obtaining Baseline Data and Confirming Previous Inventory Findings

In the current era of Geographic Positioning Systems (GPS), Geographic Information Systems (GIS), and extraordinarily powerful spatial analytical techniques, simple site location and temporal affiliation information continue to head the list of useful data. Accurate site location data and new survey work that focuses on making age and cultural affiliation estimates for newly discovered sites will, in turn, enable us to build predictive settlement models that feed both the research and management aspects of cultural resource stewardship. Accordingly, location and chronometry constitute both the simplest and highest form of baseline data.

One of the most important tasks is to conduct baseline inventory in areas of the GCNRA that have not yet received adequate treatment. According to Geib

Table 2. Summary of Proposed Research Questions.

Research Domain/ General Period	Cultural Periods	Research Question
Baseline Data Collection	All Periods	**Obtain baseline data in areas with insufficient inventory:** Escalante Desert, Waterpocket Fold, Wilson Mesa, Cane Spring Desert, Water Hole Flat, exposed impoundment zone
PaleoAmerican	Clovis through Eden Complex	**Identify PaleoAmerican components:** (1) Collect isolated PaleoAmerican projectile points on Pleistocene-age surfaces, Escalante Desert, Waterhole Flat. 2) Given the new developments in climate/extraterrestrial object impact, can the number of PaleoAmerican sites be significantly increased? 3) Can a paucity of extant and survey-identified PaleoAmerican sites be interpreted as extremely ephemeral Post-Pleistocene occupation of the central Colorado Plateau? 4) What patterns can be identified in PaleoAmerican settlement and land use?
Archaic	Early through Late Archaic	**Archaic site variability through time and space:** (1) Can temporally distinct (Early, Middle, and Late) Archaic components be positively identified by inventory? (2) What are the spatial patterns of sites across the long Archaic era? (3) Do Archaic temporal components co-occur or are Archaic temporal components found as separate sites? (4) What physiographic, ecological, and substrate-association patterns occur with Archaic sites? (5) Do material assemblages and the locations of sites suggest continuity through time, or do they reflect one or more hiatuses (i.e., the Middle Archaic)? (6) What functionally varying Archaic site types are present in GCNRA and how are the types distributed across time and space? (7) Can spatial shifts in Archaic settlement-subsistence be identified? (8) Can rock art styles be identified to Archaic populations and do the styles change through time? (9) Can survey data help identify changes in residential mobility during the Early, Middle, and Late Archaic?

Table 2. Summary of Proposed Research Questions (Continued).

Research Domain/ General Period	Cultural Periods	Research Question
	Basketmaker II	**Late Archaic-Early Agriculture relationships:** (1) Can we identify a relationship between Late Archaic and Early Agricultural populations? (2) Do Late Archaic and Early Agricultural components co-occur? (3) Do the material assemblages of Late Archaic and Early Agricultural sites reflect continuity or disjunction?
	Basketmaker II	**Subsistence:** (1) Can we use spatial patterns to infer the kinds of agricultural strategies practiced by early agriculturalists (i.e., irrigation, subirrigation, floodwater, dry farming)? (2) How important is hunting-and-gathering to Early Agricultural peoples? (3) How do agricultural strategies and hunting-gathering importance vary across the region?
	Basketmaker II	**Site Variability:** (1) Given the variability in open-air Basketmaker II site configurations on nearby regional manifestations, such as Black Mesa and Cedar Mesa, can we identify a range of open-air early farming sites?
Early Agriculture	Early through Late Archaic	**Origins:** (1) Can intensive survey coverage locate artifactual or architectural evidence of extra-regional affiliation for early farming populations?
	Fremont/Mesa Verde/Virgin/ Kayenta	New survey work should attempt to increase our understanding of the Fremont / Mesa Verde / Virgin / Kayenta relationships and cultural boundaries.
Formative Cultures	Fremont	(1) Are the Fremont and Ancestral Puebloan occupations chronologically discrete as current data suggest? (2) Are the Fremont and Kayenta Ancestral Puebloan occupations in the GCNRA spatially discrete and, if so, what evidence can be gathered to support the hypothesis of ethnic/ linguistic differences? (3) Does the Fremont settlement-subsistence system include midland and upland hunting-and-gathering sites?

Table 2. Summary of Proposed Research Questions (Continued).

Research Domain/ General Period	Cultural Periods	Research Question
	Ancestral Puebloan—Basketmaker III and Pueblo I	(1) Survey work tends to find what the designers seek. Accordingly, can specific survey design locate the extremely scarce and apparently non-existent evidence for GCNRA occupation by Early Formative Basketmaker III and/or Pueblo I societies? (2) Is there additional evidence for a hiatus during the Basketmaker III and Pueblo I periods in GCNRA?
	Ancestral Puebloan—Pueblo II	(1) Is there evidence for a permanent Pueblo II Ancestral Puebloan residence in GCNRA? (2) What is the pattern of Pueblo II settlement across the GCNRA? (3) What is the variability in site size and environmental locational correlates in the GCNRA? (4) What is the range of variation in ceramic assemblages and can enough ceramic materials of enough wares and varieties be identified and counted to enable age estimates for Pueblo II sites in the GCNRA? (5) What patterns in storage facility locations are apparent for Pueblo II sites in the GCNRA? (6) Are Pueblo II Ancestral Puebloan hunting camps and kill sites present on the landscape?
Formative Cultures	Ancestral Puebloan—Pueblo III	(1) Is the previously identified community settlement system for Pueblo III found throughout GCNRA? (2) What is the variability in site size and environmental locational correlates in the GCNRA? (3) Are individual residences found dispersed in areas away from community clusters? (4) What is the range of variation in ceramic assemblages and can enough ceramic materials of enough wares and varieties be identified and counted to enable age estimate to be made on Pueblo III sites in the GCNRA? (5) What patterns in storage facility locations are apparent for Pueblo III sites in the GCNRA? (6) Are special function, limited activity, and resource exploitation sites found in the midlands and uplands?

Table 2. Summary of Proposed Research Questions (Continued).

Research Domain/ General Period	Cultural Periods	Research Question
Proto-Historic:	Navajo/Paiute	**Collect baseline inventory data:** **(1**) Description of assemblages and overall site context. (2) What artifacts, features, or other characteristics are used to identify these sites? (3) Do these sites co-occur with other prehistoric sites or as separate components? ` (4) Can any of the rock art found be attributed to these populations?

(1996:200), areas of the Park that need more survey are:

1. The Escalante Desert
2. Waterpocket Fold
3. Wilson Mesa
4. Cane Spring Desert
5. Waterhole Flat

In areas where substantial work has been conducted and where site types and densities are relatively well known (i.e., lower Glen Canyon Benches, Bullfrog, San Juan Arm, Clearwater Canyon, etc.), further work should seek to determine whether initial estimates are accurate. In addition, further survey in these areas should evaluate overall spatial variability and patterning in the types and densities of archaeological sites. These kinds of baseline data are crucial for long-term management of the Park's cultural resources and the overall appropriateness of future uses of agency land within various geographic regions.

With the decline in water levels at reservoirs across the West, sites that were once inundated are now becoming exposed. It is important to determine if long-term inundation has completely destroyed these resources or if some remnant remains. Site condition assessment is particularly important at GCNRA because so few archaeological investigations actually took place in the impoundment zone before the dam was built. As Geib (1996:3) states, "With conservation ethos hindsight, it is clear that more efforts should have been placed on sites in and immediately adjacent to the flooded areas." The decline in pool level may reveal that some sites remain intact despite years of inundation. Important Virgin Anasazi sites have recently been identified in similar settings at Lake Mead, and the overall effects of inundation evaluated in detail (Haynes 2008, 2009). Given the fact that ecological zones above the impoundment zone have received most of the attention—and provide only a portion of the archaeological resources present in the GCNRA—any sites that have survived inundation, both in whole or in part, now take on particular importance in understanding the prehistory of Glen Canyon.

The PaleoAmerican and Archaic Periods

The potential for GCNRA archaeological survey work to advance our knowledge and understanding of both PaleoAmerican and Archaic cultures is enormous. The two broad temporal cultural designations encompass more than ten millennia. The PaleoAmerican occupations last from approximately 14,000 to about 9,000 B.P. and the Archaic from 9,000 to somewhere in the range of 4,000 to 2,000 B.P. Advances in Archaic-period research in the northern Southwest are ably chronicled by Huckell (1996e). In addition, new studies of projectile point spatial distribution for projectile points found on sites (Lyndon 2005), projectile points recovered as isolated finds (Novotney 2007), and obsidian projectile points (Roberts 2008) can inform the analysis of newly discovered Archaic-period sites and isolated finds in the GCNRA.

The ambiguity in the late portion of the Archaic stems from the ongoing debate about the origins of the first farming-hunting-gathering groups—the Basketmaker II peoples of the Colorado Plateau. If the Basketmaker II peoples originate as intrusive populations from the south (Berry and Berry 1986; Berry 1982; LeBlanc 2007) the Archaic should end as the new groups bring farming to the region as early as 4,000 B.P. (Smiley 1994, 1997a). On the other hand, if the Basketmaker II groups and the influx of agricultural technology derive from the Great Basin, and if farming develops as a function of group-to-group diffusion (Merrill et al. 2009; Smiley 1997a), then the early farming period may be considered to ***be*** the Late Archaic (Huckell 1996). Semantics aside, the debate over the origins of the first Colorado Plateau food producers rages on as it has for the past century and large-scale survey investigations in the GCNRA may shed a great deal of light on the question of Basketmaker II origins.

Most of the excavations that have taken place at GCNRA were undertaken during the Glen Canyon Project at Formative Period sites with standing architecture or other kinds of features. Fieldwork since that time has shown there is an abundant pre-ceramic record that has been largely neglected. The earliest documented Archaic occupations on the Colorado Plateau come from Cowboy Cave and Dust Devil Cave, located at the north and south ends of the GCNRA, respectively.

To date, very little is known about the PaleoAmerican occupation of GCNRA. Given the amount of fieldwork that has been undertaken in certain regions, if a relatively sizable PaleoAmerican population were present, then previous archaeological investigations would likely have found evidence of the occupation. This makes survey in the abovementioned areas even more important. Future inventories should be tailored to include surfaces known to be Pleistocene in age. Geib (1e996:200) suggests looking for PaleoAmerican sites at the head of Waterhole Flat and in the Escalante Desert. In addition to identifying PaleoAmerican sites or components, any isolated PaleoAmerican artifacts found during inventory, including lanceolates or large-stemmed points, should be well documented, collected, and then analyzed to the fullest extent possible (i.e., geochemical source, manufacture techniques, use-wear, residue, etc.).

While many Archaic sites have been documented at GCNRA, very little is known about them. Geib's (1996:26-27) summary of 180 radiocarbon dates from 74 sites in the Glen Canyon region suggests occupational peaks during the Early Archaic (ca. 9100 to 6000 B.P.) and the Late Archaic (ca. 4,000 to 2500 B.P.), with an occupational hiatus or low during the Middle Archaic (ca. 6000 to 4000 B.P.). Data obtained from surface inventory and eligibility testing can typically identify Archaic sites, show site patterns across space, and identify common ecological associations. The purpose here is to not only document preceramic sites on the landscape, but to understand variability and interpret how the populations were organized to make a living at GCNRA (Geib 1996:200).

Perhaps the most basic question to ask of the Archaic record is how well can the Early and Late Archaic periods be identified during fieldwork? Presumably, early components will contain Pinto and large side-notched points, while later components will contain predominately Elko-eared and side-notched, Gypsum Cave contracting stem, and Gatecliff split-stem styles. Then, having identified Early and Late Archaic sites, do these components co-occur at sites or are they found as discrete entities? While the radiocarbon record suggests an occupational hiatus or low during the Middle Archaic Period, can Archaic components that date to this time period be identified? In terms of distribution, do Archaic sites cluster within specific regions at Glen Canyon or are they found relatively equally distributed across the GCNRA? Similarly, do Archaic sites occur within certain physiographic zones (i.e., lowlands, midlands, or uplands) or are the sites associated with specific ecological communities and/or soil types? How do physiographic associations vary through time? Moreover, does the archaeological record suggest cultural continuity through time or one or more hiatuses between the Early, Middle, and/or Late Archaic Periods? Glen Canyon contains phenomenal rock art, including the well-known Glen Canyon linear style that is thought to date to the Late Archaic (Malotki 2007; Schafsma 1980). Can different rock art styles and individual elements be distinguished for different Archaic time periods?

In order to understand how Archaic populations used the Glen Canyon area, inventory and eligibility testing data must be geared towards the identification of various pre-ceramic site settlement types. To what extent are hunter-gatherer temporary camps, limited activity sites, plant and animal processing stations, and toolstone quarries found in specific physiographic regions or elevational zones? To what extent is there variability in each of the kinds of sites across the GCNRA and between the Early and Late Archaic Periods? Basic but detailed documentation of flaked stone and ground stone tools, including raw materials, breakage patterns, and levels of completeness, plus macroscopic use-wear identification coupled with patterns in tool manufacture and maintenance at sites, will be crucial in the identification of different Archaic site types (see also Roberts 2008).

Many archaeologists believe that Early Archaic populations focused on a narrow subsistence base, like big-game hunting or high-grading a few particularly rich habitats, in contrast to later hunter-gatherer groups who were believed to be more generalized foragers and exploited most of a landscape's habitats (Huckell 1996). Can a shift from a narrow subsistence base to a more generalized base be observed between the Early and Late Archaic periods, particularly in terms of the distributions of projectile points, the locations of sites, and the variability in site types across the landscape?

Early Agriculture

There has long been debate whether the earliest farmers migrated onto the Colorado Plateau (among others: Berry and Berry 1986; Berry 1982; LeBlanc 2007; Matson 1991, Smiley 1997a, b) or whether over time, in-situ hunter-gatherer populations adopted agriculture (Irwin-Williams 1973; Merrill et al. 2009; Smiley 1994, 1997a, 1997b; Wills 1988). We are not likely to resolve the debate using only survey (surface) data, but significantly augmenting the spatial record of Early, Middle, and Late Archaic and Early Agricultural cultures will make a major contribution to the process.

While the radiocarbon data presented by Geib (1996:26-27) support a substantial Late Archaic Period occupation of the area, there is a dramatic increase in the number of radiocarbon assays after about 2500 B.P. (500 B.C.). Excavations at both Sunny Beaches (42KA2751) and the Co-op Site (42KA2756) show that Early Agricultural sites are present at GCNRA. Accordingly, an important question is whether there is continuity between Late Archaic hunter-gatherer populations and the people that began to incorporate domesticates into subsistence practices. Do Late Archaic sites co-occur with Early Formative sites, as found in the two above mentioned sites, or are Late Archaic sites found in different parts of the GCNRA landscape? Do the material assemblages from Late Archaic and Early Agricultural sites suggest continuity in artifact forms or discontinuity? What are the specific physiographic associations with Early Agricultural sites and is a gradual change in site locations observed between 3000 and 1500 B.P. (1,000 B.C. and A.D. 500)? In those instances where agriculture was conducted, what kind of agricultural techniques or methods were practiced: irrigation, subirrigation, floodwater, or dry-farming?

Radiocarbon assays on corn from the Glen Canyon region currently show that corn appears relatively late, that is, several hundred years after A.D. 1 (Geib 1996:60-61). However, south of the Colorado River, including the Rainbow and Shonto Plateaus, permanent or semipermanent residences that pre-date A.D. 1 by several hundred years were reliant on agricultural domesticates (Geib 1996:60-61). Similarly, Smiley (1997a) has documented early farming in the nearby Cedar Mesa/Bluff, Utah area well before A.D. 1 and to the south in the Marsh Pass area as early as 4,000 B.P. (1994, 1997a). Will Geib's and Smiley's findings extend to the GCNRA with the completion of new studies across the GCNRA? In addition, the question remains to what extent does hunting-and-gathering remain a component of early agricultural subsistence strategies (i.e., can early agricultural period food gathering sites be found during inventory).

Formative Cultures

The Fremont, Kayenta Anasazi, and Mesa Verde Anasazi populations once used the GCNRA and how these groups interacted was an important aspect of the Glen Canyon Project's research endeavors. Later work has demonstrated that while the Fremont and Anasazi did use the Glen Canyon area, the groups did so in different time periods. Fremont occupation appears to be limited to the Escalante River Basin and to date from A.D. 400 to 1000, while Anasazi populations expanded into Glen Canyon during the Pueblo II Period and continued to occupy the area through most of the Pueblo III Period, from A.D. 1050 to 1250 (Geib 1996:96).

The important point, here, is that sites affiliated with the Fremont culture appear to be spatially and temporally discrete from those of the Anasazi and that the Anasazi are found widespread throughout the GCNRA for a relatively short 250-year period of time. Geib (1996:97) believes that Fremont groups were an in-situ development from Early Agricultural populations with cultural affiliations to prehistoric groups lying north of GCNRA, rather than to the south and east (Anasazi). As more archaeological inventory is completed across the Park, does this culture-historical reconstruction hold true? Is Fremont style rock art really concentrated in and around the Escalante or can the rock art be identified in some abundance elsewhere? In addition, only the well-watered lowlands of the Escalante have been the focus of past research as opposed to the adjacent midland and upland zones. Perhaps Fremont settlement-subsistence strategies included residential bases or camps in higher elevations, where other hunting and gathering subsistence activities were undertaken. Can Fremont food collecting camps be found in these higher elevation zones? Inventory in the high elevation areas of the Escalante Basin is necessary to determine the range of settlement-subsistence practices by the Early Formative Fremont.

Based on the ceramic types identified by the Glen Canyon Project, Kayenta-affiliated populations were the first Anasazi to use the GCNRA, between A.D. 1050 and 1150. Sites show Mesa Verde ceramics and architectural styles in abundance only after A.D. 1150. Summarizing the Kayenta-affiliated Pueblo II sites, Geib (1996:181) writes:

> …structures are insubstantial and few in number, ceremonial structures (i.e., kivas) are rare, as are large storage features capable of putting up winter stores, trash middens are virtually absent, artifact numbers are relatively low, and grinding tools for maize processing are poorly represented.

The paucity of large architectural sites suggests the Pueblo II Anasazi sites in Glen Canyon reflect a seasonal occupation for growing domesticates, including cotton, and hunting mountain sheep (*Ovis canadensis*). An important research question lies in establishing whether permanent residences, albeit single family or extended family households, were ever established in the Glen Canyon lowlands, or were all habitation sites, as Geib (1996:183) suggests, only seasonally occupied or simply long-term campsites or logistical bases? In addition, if people from the adjacent highland plateaus used the area for hunting sheep and the acquisition of other resources, can these sites be identified on the landscape and what is site variability in terms of content, size, and distribution?

Finally, it is only after A.D. 1150 when Anasazi communities are established in GCNRA, of which three are particularly well known: one in Lake Canyon (Lipe 1970), one in Beaver Creek (Lindsay 1961), and one in Cow Canyon (Geib 1996). Ceramic assemblages show a strong mix of both Kayenta and Mesa Verde-affiliated wares. The communities consist of a number of small habitation sites, each containing one to four living rooms with associated storage rooms and work areas, concentrated around the heads of canyons where arable land is abundant (Geib 1996:192; Lindsay 1961). Other sites associated with these communities include agricultural facilities, at least one kiva, at least one defensive-type feature, trails, and highly visible and distinctive rock art. Population density during this time period is believed to reach a prehistoric high. It is important to determine whether this community pattern exists in other areas of the GCNRA. Also, are individual habitation sites found in areas outside of these community concentrations? To what extent are Pueblo III special function, limited activity, or resource exploitation sites located in the midland and upland zones away from the centers of these communities?

Navajo and Southern Paiute Archaeology

Various projects at the GCNRA have documented archaeological sites affiliated with the Navajo and the Numic-speaking Southern Paiute (GCNRA GIS cultural resources database). However, these resources have received no systematic investigations. Jennings's (1966) summary of the Glen Canyon Project and Geib's (1996) more recent synthesis barely note that these culture groups inhabited the GCNRA after the Anasazi people left the area sometime after A.D. 1250. With this in mind, it is necessary to obtain baseline information about Navajo- and Paiute-affiliated sites throughout GCNRA. The information needs to specify what artifacts or other site characteristics are used to identify these groups (i.e., pottery types, projectile points, architecture, position on the landscape, rock art, etc.). A detailed enumeration and description of assemblage composition, site size, and site location is needed. Do these sites co-occur with Archaic or Formative Period sites or are they found as separate, single component sites? Was any of the rock art in GCNRA made by these peoples? The objective here is to begin to obtain baseline data to address questions of settlement and subsistence, determine how these populations may have used or stayed away from the remains of other prehistoric culture groups, and establish the chronology of the populations, particularly with regard to the Pueblo III Anasazi communities.

Summary

The foregoing summary of previous research and the compilation of research problems, questions, and topics provide the basis for building survey designs for both the Grazing Allotment and Shoreline studies in the GCNRA. The primary consideration in such designs must be the budgets available. Once research priorities have been established, the size of the budget has a great deal to do with the extent and nature of survey coverage. In the accompanying GIS analyses and discussions of the proposed new survey in the GCNRA, we provide a range of strategies and alternatives for survey that should be adaptable to a range of budgetary situations and project parameters.

In the final analysis, archaeological field work is heavily contingent on the conditions on the ground. The extreme variability of the Colorado Plateau climate from month-to-month, season-to-season, and year-to-year is legendary and significant in the structuring of survey efforts. We have endeavored to provide research history, GIS analysis, cartographic specifics, and sampling alternatives so that the designers of eventual field projects will have the best information available.

From Region to Site: A Brief Examination of Sampling Theory in Archaeological Survey with Reference to the Glen Canyon National Recreation Area

By Meghann M. Vance

"…a less visible but just as essential tool in archaeology as the trowel…"

-- Green (2007:4)

Survey continues to grow as the primary data collection method in archaeology, especially in the Cultural Resource Management (CRM) arena. Any future effort to operationalize large-scale survey in the Glen Canyon National Recreation Area (GCNRA) should be thoroughly informed by the large body of previous theoretical and methodological works on archaeological survey. Accordingly, this section presents the basic structure of survey and sampling theory in archaeology. Although many CRM-related project areas are subjected to full-coverage investigations, very large project areas may necessitate the application of sampling strategies to the survey design. The considerations of management priorities, time constraints, and money limit the extent of sampling possible in very large areas.

The application of sampling theory and the development of solid sampling designs ensures that any survey provides the most representative sample of sites possible from within the project area, allowing best estimates of population parameters of the archaeological material detected in the field (Banning 2002; Drennan 1996; Mueller 1974; Orton 2000; Schiffer et al. 1978; Wobst 1983). A representative sample of the archaeology provides the means by which archaeological survey obtains results suitable for application to research-themed anthropological questions, such as those directed at understanding land use and settlement patterns in any given region.

Commonsense Basic Bayesian Sampling Approaches

Although a lot of archaeologists work largely in ignorance of Bayesian probability theory, archaeologists often intuitively incorporate the Bayesian approach. Bayesian probability differs from what statisticians call "classical" probability in that classical probability models work solely in terms of the probability output (outcomes) of a statistical selection from a sample space, while Bayesian models incorporate *a priori* knowledge about the sample space and the outcome process. Bayesian approaches use prior knowledge (*a priori*) in formatting the simple Bayesian statement:

***a priori* knowledge + *p* = *a posteriori* knowledge**

More informally stated, *a posteriori* probability is proportional to the likelihood times the *a priori* probability (Buck et al. 1996:21).

I include this brief discussion of Bayesian concepts because we consciously employ the *a priori* and *a posteriori* knowledge concepts in our survey design analysis program for the GCNRA. Examples of *a priori* knowledge include the results of prior surveys and individual site investigations across a vast region, providing us with information on the environmental situations that attracted prehistoric settlement. Environmentally favorable site locational conditions consist, in part, of areas with attributes of slope and aspect that makes settlement possible and advantageous. Other important conditions include soil type, vegetation regimes, and distance to water, to name a few. The conscious use of a Bayesian structure to develop the survey model can help move the process to a higher level of statistical inference.

Partitioning the Archaeological Landscape: Units of Classification in Survey

Effective investigation of archaeological materials and landscapes at any scale requires clear definitions of units of measurement and classifications employed. Units typically employed in archaeological survey include region, survey area, area surveyed, transect, quadrat, site, feature, artifact, and area, as defined below:

- *Region:* Typically based on environmental similarity (Mueller 1974). Regional units range in size and resolution; for example, Western North America is a region defined strictly by geographical location, whereas the Colorado Plateau constitutes a region defined by topographic and vegetative similarity within a space delineated by geography.
- *Strata:* Partitions of land within a region, typically based on elevation, vegetative zones, and/or geological context. Strata may also be defined by cultural sensitivity (Banning 2002), or a combination of factors.
- *Survey Area:* The entire research area investigated (Mueller 1974); equivalent to *project area*. Driving factors in defining a survey area may include specific research questions, the area of potential effect related to a construction project, or a specific management plan.

- *Area Surveyed*: Mueller (1974) argues specifically and cogently for the distinction between "survey area" and "area surveyed". The "survey area" encompasses the entire research area, whereas "area surveyed" comprises only those portions of the survey area actually investigated. In a sample survey, therefore, the "area surveyed" would consist only of those units (e.g., transects or quadrats) investigated.
- *Transect*: Linear investigative units, usually equal in size and equidistant from each other.
- *Quadrat*: Rectilinear investigative unit.

Types of Samples: The grab-bag approach vs. statistical significance

Orton (2000) defines three general types of samples applied in archaeological research: *unintentional*, *informal*, and *formal* samples. *Unintentional sampling* simply results from the work of natural processes on the archaeological material *before* the arrival of the archaeologist (Drennan 1996; Orton 2000). All sites encountered on survey, therefore, may be counted as members of unintentional samples, in that they have survived the rigors of geomorphic change, weather, animal disturbance, and prior human impacts before becoming a part of the known archaeological record.

Informal samples, also referred to as *prospective samples* (e.g., Banning 2002) or *purposive samples* (Neyman 1934), correspond to Mueller's "Traditional Archaeological Approach" to sampling (1974:3). In informal sampling, the archaeologist's subjective opinion drives both the type of sample employed and the location investigated (Drennan 1996; Orton 2000). Informal samples, therefore, often constitute a 'grab-bag' of the archaeological record, consisting of anything from a handful of ceramic sherds pulled from a site midden to sites selected simply on the basis of visibility and accessibility from an existing road.

The final class of sampling in archaeology consists of *formal samples*, or those samples resulting from the implementation of rigorous statistical procedures (Orton 2000). Also known as *statistical sampling*, formal samples provide the means of inferring population parameters from the recorded sample data (Banning 2002; Mueller 1974; Orton 2000). In addition, statistical sampling ensures that bias, or the application of criteria resulting in unrepresentative samples, remains absent from the sampling procedure (Drennan 1996; Mueller 1974, 1975; Plog 1978). Given that the aim of archaeological survey should be to provide data representative of the entire population, the various theoretical frameworks encompassing formal sampling are central to this chapter's discussion.

Statistical Sampling Theory: Probabilistic Sampling in Archaeological Survey

To develop sampling strategies for the GCNRA, as for any other regional candidate for archaeological survey, statistical sampling theory originates with Neyman (1934). Statistical sampling is part of the larger field of *inference,* which endeavors to draw conclusions about the general from specific information (Orton 2000). In archaeology, inference translates as using specific information (e.g., site characteristics) to form models of population parameters, such as land use patterns or settlement organization within a region. One particular objective of statistical sampling in archaeology attempts to eliminate, or at least reduce as much as possible, sampling bias. Bias, defined as the difference between the true value of a parameter and the expected value, often results from faults in the sampling procedure (Orton 2000), as in the case of the archaeologist selecting only those sites visible from a roadway. Bias, such as that in the above example, is largely overcome by Neyman's (1934) statistical approach. Neyman established probabilistic, or statistical sampling, as superior to purposive sampling (e.g., grab-bag) in representing the overarching population. Moreover, Neyman demonstrated that stratified random sampling is more efficient than simple random samples.

Future archaeological survey in the GCNRA is likely to be planned over large areas and should embrace both the concepts of probabilistic and stratified random sampling. Sample stratification can be structured on a range of criteria, including the potential association of human settlement with soils, vegetation zones, slope, aspect, and distance to perennial water, among others.

Random probability sampling provides each element of a given population an equal chance of selection (Banning 2002). In a random sample, the selection of each sample remains independent of other units, meaning that the selection of a given element does not affect the possibility of another element's selection (Orton 2000). Although simple and unbiased, random sampling often leaves large areas unsampled (Orton 2000; Shannon 1997), and therefore, cannot meet the general requirement of sampling in archaeological survey: a sample must be representative of the over-all population in question.

Stratified random sampling provides the means for balancing statistical adherences with prior information, thereby increasing the reliability of the outcome within the limits imposed by available resources (Neyman 1934; Orton 2000). As Neyman (1934) demonstrated, stratified samples are superior to simple random samples in representing the population. Stratified random sampling partitions the population into subgroups (Banning 2002; Drennan 1996; Neyman 1934; Orton 2000; Shannon 1997). Specific sample percentages, also called sampling fractions, may then be applied to the individual zones (Banning 2002). Sampling fractions may be calculated by simply dividing the sample size by the population size (Orton 2000). For example, in a regional survey, given a survey area of 20 km and a sample size of 5.5 km, the sampling fraction consists of approximately 36 percent of the whole.

When appropriately selected, the use of different sampling fractions in different subgroups, or *sampling strata*, reduce sampling errors and increase the consistency of the survey results (Banning 2002; Neyman 1934; Orton 2000; Wobst 1983). In large part, stratified random sampling draws from Bayesian statistics, which account for prior knowledge or data (Orton 2000). For example, stratification based on cultural sensitivity incorporates Bayesian approaches because of the reliance on prior knowledge of known sites within the region, and if the sampling strategy takes advantage of this knowledge, the reliability of the survey results should increase. This Bayesian approach, sometimes called adaptive sampling, specifically allows for modification of the sampling design based on observed phenomena encountered during the survey (Orton 2000; Thompson and Seber 1996; Wobst 1983).

Detection and Visibility: Sites and Landscape

The design of sampling strategies depends largely on factors affecting the detection of archaeological materials on the landscape. Detectability refers to both the probability that a survey will intersect archaeological materials and the possibility that even if archaeological materials are encountered the materials may not be recognized as archaeological (Banning 2002; Orton 2000). Across the GCNRA active geomorphological forces and the low-intensity adaptations of human groups over 90% of the period of human use of the region make site detection a major concern. Hunter-gatherer material culture tends to be archaeologically ephemeral because band-level societies have few possessions. Moreover, such groups do not modify the environment in ways that leave archaeological signatures.

The primary aspects of detectability are visibility, obtrusiveness, and accessibility. Visibility is a characteristic of the environment. For example, vegetative coverage may hinder the detectability of archaeological material (Banning 2002; Schiffer et al. 1978). Obtrusiveness, then, is a characteristic of the archaeological materials and depends specifically on the material's contrast with the environment (Banning 2002; Schiffer et al. 1978). Finally, the accessibility, or amount of effort required to reach a particular material, must also be taken into account (Banning 2002; Orton 2000). Archaeological surveys risk not detecting sites and artifacts because of factors such as land ownership, terrain, vegetative cover, or lake levels. For example, in the particular instance of lake levels, high water may cover archaeological materials that otherwise may have been encountered by the survey.

Detectability may also be thought of as recovery theory, or how discovery probabilities vary within the archaeological and environmental context of the study area in relation to the particular investigative techniques employed (Banning 2002; Schiffer et al. 1978). Estimations of discovery probabilities must take into account the factors affecting the discovery of archaeological materials: obtrusiveness (i.e. size), visibility, and accessibility. Banning (2002) summarizes these factors as the discovery radius, or the estimated distance at which a particular target should be detectible. For example, a surface scatter of flaked stone artifacts with little vegetative cover has an estimated discovery radius of half the diameter of the site (Banning 2002). A site containing masonry structures in a similar vegetative environment, however, has a much higher discovery radius, perhaps as much as several miles distant.

Coverage, Caveats, and Critiques: The Archaeologist's Perspective

Attaining a balance between cost (i.e. time and resources) and the data recovered constitutes the primary objective of archaeological sampling (Banning 2002; Orton 2000). Questions concerning coverage, or the proportion of archaeological material detected and recorded during survey (Banning 2002), are of obvious importance, particularly in the context of sampling (Ammerman 1981). The problem of bias also dominates the literature (Mueller 1974). Likewise, the technical and computational aspects of statistical sampling in archaeology are constantly under review and numerous academic arguments result from errors and disagreements on methodology (Ammerman 1981; see also Hole 1980; Plog 1978; Schiffer and House 1975).

In terms of coverage, *intensity*, or the amount of effort devoted to the survey, comprises a large part of the debate regarding use of sampling strategies in archaeological survey. Because the level of intensity affects both discovery probabilities and parameter estimation (Schiffer et al. 1978), many archaeologists argue that only full-coverage, or *intensive,* surveys, in which the entire survey area is covered at close investigative intervals, are capable of producing substantive archaeological results (Banning 2002; Fish and Kowalewski 1990; Kintigh 1990; Whalen 1990). This argument, however, fails to account for the fact that an arbitrarily selected survey area, such as a road alignment or cell-tower location, is in itself a sample of the region. Moreover, full-coverage surveys often fail to meet feasibility requirements related to accessibility, visibility, and cost (Fish and Kowalewski 1990).

A fear of sample bias drives many archaeologists to disapprove of sampling in archaeological survey. Whalen (Whalen 1990), for example, argues that sampling strategies cannot accurately portray the archaeological landscape of a region because the application of a single strategy cannot be capable of recognizing small and large sites equally. Kintigh (1990), elaborated on this argument, asserting that if both small and large sites are present within the region, sampling is bound both to miss small sites and to fail to delineate the boundaries of larger sites. Kintigh's argument implies that the more variability of sites within an area, the less effective a sample survey will be (1990). However, this argument does not account for the use of stratified random sampling, that is, the application of previous knowledge of site types and site distribution to the sampling design, nor the limitations of full-coverage survey. Since nearly all GCNRA sites are likely to be small, survey crews can focus on detecting small sites. Clearly, the detection problems in regions with both large and small sites will not affect GCNRA survey.

The reality of archaeological survey is simply this: whether an area is sampled or subjected to full-coverage survey, the resulting data produce only an approximation of reality. Full-coverage and sample surveys are both subject to many of the same conditions: the availability of sites for recording, the abilities of the recorders to correctly identify sites, and the classification schemes employed (Whalen 1990). Moreover, it may be argued that strong sampling designs that take into account the numerous factors affecting the detectability of sites in the project area, as well as prior knowledge of site types, land-use patterns, and site locations, will actually provide a more representative profile of the region than a full-coverage survey, because full-coverage survey may be less structured and therefore more subject to individual error.

Glen Canyon National Recreation Area in the Context of the History of Archaeological Survey

William D. Bryce

This section examines and synthesizes the history of the development of archaeological reconnaissance and survey to provide background and foundation for projected archaeological inventory projects in the Glen Canyon National Recreation Area (GCNRA) as part of federal compliance in accordance with the intent of Section 106 and Section 110(a) of the National Historic Preservation Act (NHPA) (16 U.S.C. 470f and 470h-2). The finalized survey structure and strategies for any future GCNRA survey projects will benefit from innovations and lessons learned in the long period of archaeological experimentation in North America and elsewhere.

The specifics of survey and survey history in the GCNRA can be found in the section of this monograph by Haynes. Archaeological survey, the "informal exploration to detailed and explicit prospection or sampling strategies designed to maximize the probability of detecting sites or artifacts over a region, or to provide representative samples of cultural materials" (Banning 2002:1), first appears in the literature in the 1800s (Clarke 1977; Ratzel 1896; Squier and Davis 1848; Thomas 1894). Through a century of documented material culture recording, archaeological survey has developed from explorations referred to as prospection (Banning 2002) or reconnaissance (Ruppé 1966) to highly sophisticated sampling procedures (Orton 2000; Plog and Hill 1971). Early archaeological survey, in the form of explorations (Banning 2002; McNitt 1957), was undertaken for profit, for artifact recovery through the auspices of institutions (Kidder and Guernsey 1919; McNitt 1957; Pepper 1902), or ancillary to geographical mapping (Banning 2002; Clarke 1977; Ratzel 1896).

By the mid 1900s, researchers were performing full coverage surveys, which Fish and Kowalewski define as "the systematic examination of contiguous blocks of terrain at a uniform level of intensity" (1990:2). Archaeological survey underwent significant changes in the mid-twentieth century with the use of aerial photography (Bewley and Rackowski 2001; Kennedy and Riley 1990; Willey 1953), the application of statistical testing procedures (Binford 1964; Brainerd 1951; Judge et al. 1975; Robinson 1951; Spaulding 1953; Vescelius 1960), and the development of survey sampling (Cochran 1963; Matson and Lipe 1975; Mueller 1975; Orton 2000). In addition, Salvage Archaeology (Jennings 1998), later to become Cultural Resource Management (CRM), developed out of federal legislative mandate (King 2008). By the late twentieth century, the digital age afforded researchers the ability to use high-powered computer programming and statistics to analyze spatial relationships and correlations through Geographical Information Systems (GIS) (Clarke 1977; Connolly and Lake 2006; Hodder and Orton 1976; Orton 2000). This chapter provides a thumbnail history of archaeological survey, focusing on the regional scale and beginning with the earliest documented survey methods. The chapter continues through the various approaches to archaeological survey during the mid-twentieth century, ending with the current status of survey.

The Early Years (1800-1930)

Archaeological survey began as expeditions by explorers, entrepreneurs, and scientists to find, procure, or understand the remains of by-gone cultures. In the old world, survey in the 1800s commonly occurred as an ancillary to geographic mapping, developing into efforts to study prehistoric settlement in relation to the environment (Clarke 1977:1; Ratzel 1896). Explorations seeking to understand the identity of past cultures as well as social organization and settlement patterns (Clarke 1977) drove much of the early archaeological survey in the new world (Squier and Davis 1848; Thomas 1894). The American interest and argument over the identity of the Moundbuilders provides one example.

The Moundbuilders occupied areas of North America from the Mississippi delta into Manitoba Canada (Bryce 1914). Many Americans adamantly claimed the Native Americans of the time could not be descendants of the Moundbuilders for a range of reasons, asserting 1) the Natives were too barbaric (Feder 2006); 2) the Moundbuilders existed before the Native Americans arrived in the new world (Atwater 1973 [1820]); 3) the Moundbuilders must have used a writing system, yet the Natives lacked a writing system at the time of the arrival of the Europeans (Feder 2006); 4) the Natives were not building mounds at the arrival of the Europeans; and 5) the Natives did not practice metallurgy, whereas the mounds contained a variety of metal artifacts (Feder 2006). The Bureau of American Ethnology (BAE) hired Cyrus Thomas to solve the Moundbuilder mystery (Feder 2006). Thomas conducted archaeological explorations and investigations of 2,000 mound sites located in twenty-one states and concluded native affiliation with the Moundbuilders (Feder 2006; Thomas 1894).

By the late 1800s and early 1900s, surveys encompassing large tracts of land consisted of institutionally sponsored explorations (Kidder and Guernsey 1919; McNitt 1957). The explorations existed to find ideal sites for excavation. The excavations varied from projects in which explorers recovered artifacts as examples of the skills of prehistoric artisans to fill the halls of museums (McNitt 1957; Pepeper 1902) to scientifically structured research plans developed to define cultures and chronologies (Guernsey and Kidder 1921; Kidder and Guernsey 1919). Unfortunately, the early explorers and researchers did not detail their methods of survey. Many of the early surveys, however, were undertaken by individuals with intimate knowledge of the land (McNitt 1957) or with correspondence and guidance from such individuals (Kidder and Guernsey 1919). These surveys resulted in the location and excavation of large, impressive sites while the smaller or less obvious sites remained unrecorded.

Growing Pains (1930-1970)

By the middle of the 20th century, archaeological survey underwent profound changes with the addition of new technologies, survey method innovations, and government mandated cultural resource management (Banning 2002; Binford 1964; Powell and Smiley 2002; Thomas 1975; Vescelius 1960; Willey 1953). In the mid-1940s, researchers began incorporating aerial photography into large-scale surveys to aid in systematic coverage and site location (Adams and Nissen 1972; Banning 2002; Willey 1953). In addition, following the lead of other scientific disciplines, researchers incorporated the use of statistics in data interpretation (Brainerd 1951; Judge et al. 1975; Robinson 1951; Spaulding 1953; Vescelius 1960). Beginning in the mid-twentieth century, federal mandate, first through the Historic Sites Act of 1935 and followed by the National Historic Preservation Act of 1966, required federally funded undertakings to consider effects to cultural resources (King 2008). This mandate resulted in Salvage Archaeology (Gumerman 1966; Jennings 1998), later developing into CRM (Powell and Smiley 2002). Brief examples illustrating the diversity of archaeological survey in the mid-twentieth century follow.

Archaeological survey in the mid-twentieth century largely involved institutionally sponsored anthropologists concerned with cultural adaptation to the natural environment, including settlement patterns, cultural development, and environmental manipulation (Adams and Nissen 1972; Ford and Willey 1949; Willey 1953). Anthropologists of the time undertook large-scale, or regional, surveys to gather adequate data in search of answers to these research questions. Fieldwork included aerial photography (Adams and Nissen 1972; Ford and Willey 1949; Willey 1953), or "strip mapping" (Sumner 1990); full coverage, or 100% pedestrian, survey (Banning 2002; Fish and Kowalewski 1990; Sanders et al. 1979); and sample surveys (Binford 1964; Judge et al. 1975; Matson and Lipe 1975), depending on the research design and funding.

Ford and Willey capitalized on previous data from the Virú Valley of Peru to study "a long continuum of culture growth within a small natural area" (1949:18). They incorporated 1:10,000 and 1:12,000 scale aerial photographs into the survey strategy, allowing quick recognition of site locations within the 900-km² valley (Ford and Willey 1949). This method of survey allowed Willey and Ford to document approximately 25% of the sites in the valley, providing a sample sufficient to consider settlement patterns, site types, site function, population sizes, and sociopolitical organization (Banning 2002; Ford and Willey 1949; Willey 1953). The incorporation of aerial photography into survey became common after the Virú Valley Project. Adams and Nissen (1972) applied a similar strategy in Mesopotamia, using aerial photographs of the areas around Warka. The aerial photos allowed Adams and Nissen to concentrate their efforts south of Warka and outside the alluviation zone to study the development of settlement and irrigation patterns (Adams and Nissen 1972). Further efforts involved building a regional chronology using ceramics (Adams and Nissen 1972). This study was later complimented by systematic resurvey of small areas around Warka.

While the Virú Valley and Warka projects employed aerial photography to perform reconnaissance surveys, multiple researchers designed full coverage regional surveys (Dean 1990; Fish and Kowalewski 1990; Kowalewski 1990; Parsons 1990; Sanders et al. 1979; Sumner 1990; Wilson 1990). Sanders et al. (1979) designed a settlement pattern survey for the Basin of Mexico. The survey involved 100% coverage of 7,000 km² in an effort to understand the evolution of past cultural systems in regards to socioeconomic institutions and ecological processes (Sanders et al. 1979). The full coverage survey of Long House Valley in Arizona provides another example that looms as particularly relevant to the GCNRA. As Dean notes,

> The general problem that structured the research is the nature of long-term behavioral adaptations of the valley's inhabitants to well-documented changes in environmental and demographic conditions. We are particularly interested in the differential effects of low and high frequency environmental variability on human adaptation and in distinguishing the adaptive consequences of environmental variation from those of nonenvironmental factors such as

> population growth, social organization, competition and cooperation within and between communities, interaction with nonvalley populations… (1990:174)

The extensive research objectives required full coverage survey. Full coverage survey of the 50-km² project area resulted in the location and recording of over 1,600 sites (Dean 1975). The Long House Valley Project contributed vastly to our current understanding of the Kayenta area.

Federal Legislation during the twentieth century (i.e., the American Antiquities Act of 1906, the Historic Sites Act of 1935, and the National Historic Preservation Act of 1966) mandated the consideration of cultural resources during federally funded undertakings (King 2008). The Historic Sites Act declared the National Park Service as lead agency in CRM. The federal mandates manifested as Salvage Archaeology. Salvage Archaeology involved the quick retrieval, or salvage, of archaeological data within danger due to federal undertakings. The development of legislation requiring the recovery of scientific data revolutionized archaeology by introducing politics, funding, and timetables into the discipline.

The Glen Canyon Project provides one example of Salvage Archaeology. The project required "emergency research" (Jennings 1998:5) of the Colorado River canyon lands to be inundated by the future Lake Powell as well as the San Juan River system (Jennings 1998). Archaeological survey began with the coverage of the areas within the full pool level of Lake Powell (Geib 1996). Later survey extended into adjoining highland areas, including "the Kaiparowits Plateau, Rainbow Plateau, and Piute Mesa" (Geib 1996:2). During the survey work, the "project's problem orientation crystallized around two major themes: defining cultural boundaries and describing the relationships of prehistoric people to what was viewed as the precarious environment of Glen Canyon" (Geib 1996:3). The revolution of legislative mandate changing the interworkings of archaeological survey may be best summarized by Jennings:

> The Glen Canyon work reminds one that the randomness or arbitrariness of emergency archaeological assignments has great advantages. The emergency programs of the past two decades have advanced scholarship beyond anything 'problem research' would perhaps ever have done. Of first importance in this development is the obligation that the salvage operations must sample *all* the cultures thrust into jeopardy within a specified area. This responsibility is buttressed by the equally important enforcement of careful work and reporting from large geographic areas where 'problems' have never led, areas where the archaeological remains were of 'no value' to the investigator who pursued some other 'problem' (1998:7-8).

This work led to the recovery of vast amounts of archaeological data, the productions of literature, and substantial contributions to our current understanding of the long human occupation of the Glen Canyon area.

Contemporary Survey (1970-present)

During the mid to late 20th century, researchers continued to develop more complex methods of conducting sample surveys (Judge et al. 1975; Matson and Lipe 1975; Mueller 1975; Orton 2000; Plog and Hill 1971) and enhanced the concepts used as a basis for a survey, such as the definition of a site (Thomas 1975). By the late 1900s, the technological revolution brought on by computers, in combination with adept archaeologists and their focus on spatial distribution, resulted in Spatial Archaeology (Clarke 1977), Spatial Analysis (Hodder and Orton 1976), or GIS (Connolly and Lake 2006). CRM grew out of Salvage Archaeology to minimize the impact of developmental undertakings and salvage data from areas impacted by the undertakings (Green and Doershuk 1998; King 2008; Powell and Smiley 2002). The large-scale construction and development projects of the late twentieth century brought CRM to the forefront of archaeological fieldwork. Today, archaeologists build on the work of previous generations of archaeologists, employing full coverage and sample surveys in collaboration with statistics and high-powered GIS.

Before the 1960s, statistics were deemed inappropriate for archaeology (Vescelius 1960) or, at best, viewed with skepticism (Shepard 1956). In his seminal paper, Vescelius (1960) illustrates that all archaeological data is a sample and statistical sampling is required to retrieve adequate representative samples capable of producing quantitative data. Shortly thereafter, Binford (1964) suggested probability sampling provided the most appropriate method of studying cultural change and evolution on a regional scale, while Plog and Hill (1971) considered quadrat and transect sampling. In addition to sampling methods, Thomas introduced "non-site-oriented archaeology" (1975:62), focusing on the density and distribution of artifacts rather than sites across a region.

By the 1970's archaeologists began employing sampling in fieldwork. Matson and Lipe (1975) applied a stratified sampling procedure to Cedar Mesa, Utah, stratifying the region by canyon/non-canyon and north/south and using drainage areas as natural units. Random samples and subsamples of the natural units determined the areas intensively surveyed (Matson and Lipe 1975). Lipe and Matson's work on Cedar Mesa provided data on site types and distribution, settlement and subsistence patterns, and the evolution of cultural systems. Thomas (1975) performed a simple random sample of 10% of the 700-km² Reese River Valley, employing his non-site oriented archaeology and focusing on density and dispersion of artifacts in an effort to predict the occurrence of cultural items. Using a range of statistical methods, Thomas found that artifact clustering may be predicted to some degree and concluded that the contribution of non-site survey will be in the study of nonsedentary peoples (1975:81).

Early survey work concentrating on the recovery of artifacts lead to large-scale, regional surveys focused on settlement practices and locations. Spatial Archaeology grew out of this regional emphasis. Clarke presents the following definition of Spatial Archaeology:

> …the retrieval of information from archaeological spatial relationships and the study of the spatial consequences of former hominid activity patterns within and between features and structures and their articulation within sites, site systems, and their environments: the study of the flow and integration of activities within and between structures, sites and resource spaces from the micro to the semi-micro and macro scales of aggregation (1977:9).

Using Spatial Archaeology within high-powered computing applications such as GIS allows the researcher to create site-based models that may then be groundtruthed through survey efforts.

Contemporary surveys consist of both full coverage and sample-based projects involving the use of aerial photography and GIS. While institutionally sponsored researchers continue implementing surveys for problem-oriented projects, compliance with legislative mandate currently motivates the vast majority of archaeological work. CRM, largely dictated by development, requires surveys ranging from a few acres in area to thousands of acres. Compliance surveys involve the location and recording of cultural resources within a proposed development area. Consideration of the cultural resources in the development plan determines if the sites are excavated or the plan is changed.

Conclusion

The history of archaeological survey begins in the 1800s and, overtime, archaeological survey developed into the study of prehistoric settlement patterns, social organization (Clarke 1977), and identity (Squier and Davis 1848; Thomas 1894). By the turn of the twentieth century, institutions such as the Smithsonian Institute and the Bureau of American Ethnology sponsored researchers who performed reconnaissance surveys followed by excavation (Guernsey and Kidder 1921; Kidder and Guernsey 1919; Thomas 1894). The addition of new technologies, innovations in survey methods, and legislative mandates of the mid-twentieth century transformed archaeological surveys. Archaeologists created regional surveys using aerial photography (Adams and Nissen 1972; Ford and Willey 1949) and statistics (Thomas 1975; Vescelius 1960) in an effort to understand cultural development, adaptation to the natural environment, and settlement patterns.

During this transformation, federal legislation, including the Historic Sites Act of 1935 and the National Historic Preservation Act of 1966, mandated the consideration of cultural resources and the retrieval of scientific data from sites jeopardized by federal undertakings (Jennings 1998; King 2008). This mandate created a Salvage Archaeology Program later to develop into privatized CRM. By the latter portion of the twentieth century, archaeologists began developing complex sampling strategies (Plog and Hill 1971) and employing highly sophisticated spatial analyses programs (Connolly and Lake 2006) to develop survey strategies. CRM currently implements the majority of survey in the United States through the auspices of compliance with federal legislation. Such surveys include full coverage and sample surveys using aerial photographs and spatial data. Compliance surveys are not problem-oriented, but typically involve the location and recording of cultural resources within a proposed development area. Consideration of the cultural resources in the development plan determines if the sites are excavated or if the plan is changed.

As the section by Haynes (this volume) indicates, our archaeological understanding of the GCNRA has benefitted enormously from federal mandates and undertakings. Future GCNRA survey will benefit from advanced computer applications and previous work detailed in this and previous sections. In the sections to follow, we detail potential survey regions, areas, and localities and provide a range of survey sampling approaches and sampling fractions.

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Glen Canyon National Recreation Area Grazing Allotments: Design for Archaeological Survey

Part II: Geographic Information Systems Analysis

by
Meghann M. Vance

Part II Contents

Document Organization and Relevant Sources

This document consists of digital elevation model (DEM), slope, survey transect, lifezone, vegetation, soil, and geology maps and associated data for the Glen Canyon National Recreation Area (GCNRA) grazing allotments. Each allotment (n = 34) has been provided its own set of maps, so as to provide greater detail for the entirety of GCNRA. These sets of maps are included in alphabetical order.

As the purpose of this document is to provide information relevant to developing a cultural resources inventory of GCNRA, each map, associated tables, figures, and text directly relate to known cultural sites and previously conducted inventories.

Associated with each map are relevant text, tables, and figures. With the exception of the GCNRA section of maps, tables and figures are not labeled in this document; rather, these supplementary materials follow a consistent pattern throughout the document, and within each map section. For example, in each map set, known cultural sites are presented in figure format by affiliation and/or attribute information, Geib's lifezones characteristics are provided in table format, as are dominant vegetation zones and associated acreage and known sites, while vital information related to soils, geology, and known sites are presented in both table and figure format. If data is not available for the formation of either table or figure in any given map set, the absence is explained in the text.

Two appendices relate directly to the attributes used in this document and described below:

Appendix A: National Park Service map of GCNRA
Appendix B: Relevant soil information and sourcing

All maps are projected in NAD_1983_UTM_Zone_12N, in the geographic coordinate system GCS_North_American_1983. All area measures provided with the maps were calculated using a 2-dimensional model. Whenever necessary, coverages, shapefiles, and rasters were clipped to represent only the grazing allotments located within the GCNRA boundary.

Each map contains a set of attributes consistent through this document. As these attributes are repeated throughout the document, it is prudent to outline and explain in detail each of these attributes, and any relevant source information necessary to document the origin of said attributes.

DEM Map Panels

DEM map panels provide a digital representation of the actual elevation (provided in meters on the map, and in both meters and feet in the associated text) of each grazing allotment. Plotted on each DEM are known cultural sites (Cultural site), previous archaeological inventories (Previous survey), springs - presumably natural and those historically converted to stock tanks (Spring), rivers - including rivers, creeks, and intermittent streams (River), roads (Road), and the allotment boundary (Allotment boundary).

The maps depicting the above information for the entirety of all combined grazing allotments in GCNRA also include lake shapes at both 3,600 ft amsl and 3,700 ft amsl (Lake Powell...), the GCNRA boundary (GCNRA boundary), and county designations (County).

DEMs: The DEM used in this document was provided by GCNRA under the raster dataset title "bigmerge." The DEM represents elevation data at 30-meter resolution.

Cultural Sites: Cultural site information derives from the GCNRA cultural shapefile (cultural_CSI). Although no metadata was provided for the shapefile, this database represents the most recent, up-to-date cultural inventory for GCNRA, superseding GLCA_ASMIS_v301_Data.mdb and others.

**Important note: The term Ancestral Puebloan is used in this document to denote sites that would have previously have been identified as *Anasazi* and sites exhibiting Puebloan characteristics not specifically identifiable as Formative, Fremont, Kayenta, or Mesa Verde, although all of these affiliations could otherwise be placed within the same category.

Previous Surveys: Previous survey information derives from two separate cultural survey shapefiles: "survey_poly" (provided by GCNRA) and "GCLA_cultural_surveys" (digitized and georeferenced from scanned GCNRA paper maps by Tesa Villalobos, NAU, 2010). The two shapefiles were merged using ArcToolbox to create "cultural_surveys", and used to identify the cultural resources inventories previously conducted in each grazing allotment. In addition, a dissolved version of the merged file "cultural_surveys" was used to calculate actual acreage surveyed, thereby eliminating overlapping project areas from the total. Project references, acres surveyed by each project, and actual acreage covered are provided for each grazing allotment.

Springs: Spring information derives from the ArcInfo Coverage file entitled Glen Canyon NRA Springs, Seeps and Wells. According to the metadata provided with the file, this information derives from digitized USGS 7.5 Topographic paper maps.

Rivers: River, creek, and intermittent stream data derives from the ArcInfo Coverage file "riv24" provided by GCNRA. When possible, names are provided for river-water features in the associated text. These names were taken from the map entitled GLCAmap1.pdf, downloaded from the World Wide Web on October 16, 2009 from http://www.glencanyonnha.org/maps/GlenCanyonNRA_map.pdf. This map is included in Appendix A of this document.

Roads: The road information provided in this document derives from three different coverages/shapefiles provided by GCNRA, including the coverage "roadspk," the shapefile "GLCAGMPrds," and the shapefile "Roadsdraft." In some instances, the original polylines overlap, and in others, road-lines that presumably represent the same road deviate from each-other. All deviations were left in this document so that ground-truthing may provide the data appropriate to determining which poly-line, if any, is accurate. Road names derive from the map entitled GLCAmap1.pdf, downloaded from the World Wide Web on October 16, 2009 from http://www.glencanyonnha.org/maps/GlenCanyonNRA_map.pdf. This map is included in Appendix A of this document.

Allotment boundaries: Each grazing allotment boundary was clipped from the coverage entitled "graz24" provided by GCNRA. No metadata was provided with this coverage.

Lake Powell: The shapefiles for Lake Powell provide the lake boundary at elevation 3,600 ft amsl (LP3600MSL) and 3,700 ft amsl (LP3700ML). Both shapefiles were provided by GCNRA, and derive from digitized topographic maps edited into seamless representations of the lake at 1:4,800 scale (based on metadata provided with the files).

GCNRA boundary: The GCNRA boundary used in this document derives from the coverage entitled 2005 - Present Glen Canyon National Recreation Area Boundary (glca_bndry08). The metadata describes this file as derived from digitized 7.5 Topographic paper maps, and proclaims this coverage as the "Glen Canyon NRA official boundary."

Counties: County information for both Utah and Arizona derives from the coverage entitled "counties" provided by GCNRA. No metadata accompanied this file.

Slope Map Panels

Slope was calculated from the DEM using 3D Analyst to create surface analysis of the slope percentage. The resulting raster (slope_perc) was reclassified into the following categories: 0-12%, 12-20%, 20-25%, 25-45%, 45-50%, 50-75%, 75-100%, 100-125%, and 125-150%. These are the values displayed on each slope map panel.

Survey Transect Map Panels

For each allotment, two survey transect map panels, also called *fishnets,* are provided on DEMs, with one map depicting north-south oriented transects, and one depicting east-west oriented transects. In all instances, transects are spaced 200 meters apart, allowing for a minimum field crew of two individuals spaced 50 meters apart, or 5-6 individuals spaced at the standard 15-20 meters required for Section 106 inventories in the states of Utah and Arizona. Note: Fishnets are not provided for the sum grazing allotments of GCNRA, as the scale of maps provided in this document do not provide the resolution necessary for making such maps legible. As with all information provided in this document, however, the fishnets are also provided as shapefiles, so that scale adjustments may be been in ArcGIS when necessary.

Geib's Lifezones Map Panels

Geib's Lifezones maps consist of three shapefiles (Highlands, Midlands, Lowlands) created through the reclassification of the DEM into corresponding elevation classes (Highlands - above 1676 meters; Midlands - 1372-1676 meters; Lowlands - 1219-1372 meters). Once reclassed, the rasters were converted into the three polygon shapefiles listed above.

All information related to Geib's lifezones derives from pp 6, Table 2 in the following source:

Geib, Phil R.

1996 *Glen Canyon Revisited.* University of Utah Press Anthropological Paper No. 119, Salt Lake City.

Dominant Vegetation Map Panels

The dominant vegetation information derives from the coverage entitled "vegetation" provided by GCNRA. No metadata accompanied this file.

Soils Map Panels

Soil information used in this document derives from the project entitled Soils_Draft_SoilInfo provided by GCNRA. The shapefile "GLCA_SoilLines_draft" was clipped appropriately, and classed by the soil codes (MUSYM) present within each allotment. Coding descriptions for each MUSYM code are provided in Appendix B. Appendix B consists of the Word document GLCA_MUG_8oct09 included with the original Soils_Draft_SoilInfo folder.

Geology Map Panels

The geology information used in this document was provided by GCNRA in an electronic folder entitled 'Geology." This folder contained the following: Escalante_Prelim, HiteCrossing (MP xxxDM), LeesFerry, LowerEscalante, SanJuan, SmokeyMountain, and WhiteGoodHope. Each folder contained geology coverages for the geographic area for which the folder was named.

Geology for each region derived from the following listed files:

Escalante:

Escalante_Prelim/geology/polygon

File Name: geology

Metadata: None

Hite Crossing:

Hite Crossing (MP xxxDM)/geodatabase/HiteXing.gdb/geology/GeologicUnits

File name: Geologic Map of the Hite Crossing - Lower Dirty Devil River Area

Metadata: Data produced during recent Utah Geological Survey (created 2009).

Lee's Ferry

LeesFerry/MP-09-2DM (Lees Ferry)/geodatabase/LeesFerry.gdb/geology/geology_polys

File Name: Geologic Map of Part of the Lees Ferry Area, Glen Canyon National Recreation Area, Coconino County, Arizona | geology_polys

Metadata: Original data from:

Phoenix, D.A.

1963 *Geology of the Lees Ferry Area, Coconino County, Arizona. U.S.* Geological Survey Bulletin 1137.

Lower Escalante:

LowerEscalante/Autoplay/MP-06-3DM/coverage/geology/polygon

File Name: Geologic Map of the Lower Escalante River Area, Glen Canyon National Recreation Area, Eastern Kane County, Utah

Metadata: Original source:

Doelling, H.H. and Davis, F.D.

1989 *The Geology of Kane County, Utah: Geology, Mineral Resources, Geologic Hazards.* Utah Geological and Mineral Survey Bulletin 124.

Additional modifications by Grant C. Willis, Utah Geological Survey, 2005-2006.

San Juan:

SanJuan/SanJuanRiver/SanJuanRiver.gdb/SanJuanRiver_GeologyUnits

File Name: Interim Geologic Map of the Lower San Juan River Area, Eastern Glen Canyon National Recreation Area and Vicinity, San Juan County, Utah / Part of Alcove Canyon 7.5' Quadrangle.

Metadata: Map author: Grant C. Willis, Mapping Program, Utah Geological Survey. Created 2004.

Smokey Mountain:

SmokeyMountain/Autoplay/M-213DM (Smokey Mtn 30x60)/coverages/geology/polygon

File Name: Geologic Map of the Smokey Mountain 30' x 60' Quadrangle, Kane and San Juan | geology

Metadata: Digitized from original map by:

Doelling, H.H. and Davis, F.D.

1989 *The Geology of Kane County, Utah: Geology, Mineral rResources, Geologic Hazards.* Utah Geological and Mineral Survey Bulletin 124.

Revisions by J. Buck Ehler, map author (2008).

White Good Hope:

WhiteGoodHope/Autoplay/MP-08-3DM (White Canyon)/Geodatabase/WhiteCanyon-GoodHope-Bay.gdb/geology/GeologicUnits

File Name: Geologic Map of the White Canyon - Good Hope Bay Area

Metadata: Original source:

Thaden, Robert E., Albert T. Trites, Jr, and Tommy L. Finnell

1964 *Geology and Ore Deposits of the White Canyon Area, San Juan and Garfield Counties, Utah.* U.S. Geological Survey Bulletin 1125.

Additional modifications by Grant C. Willis, Utah Geological Survey, 2005-2007.

Geology - Not Identified:

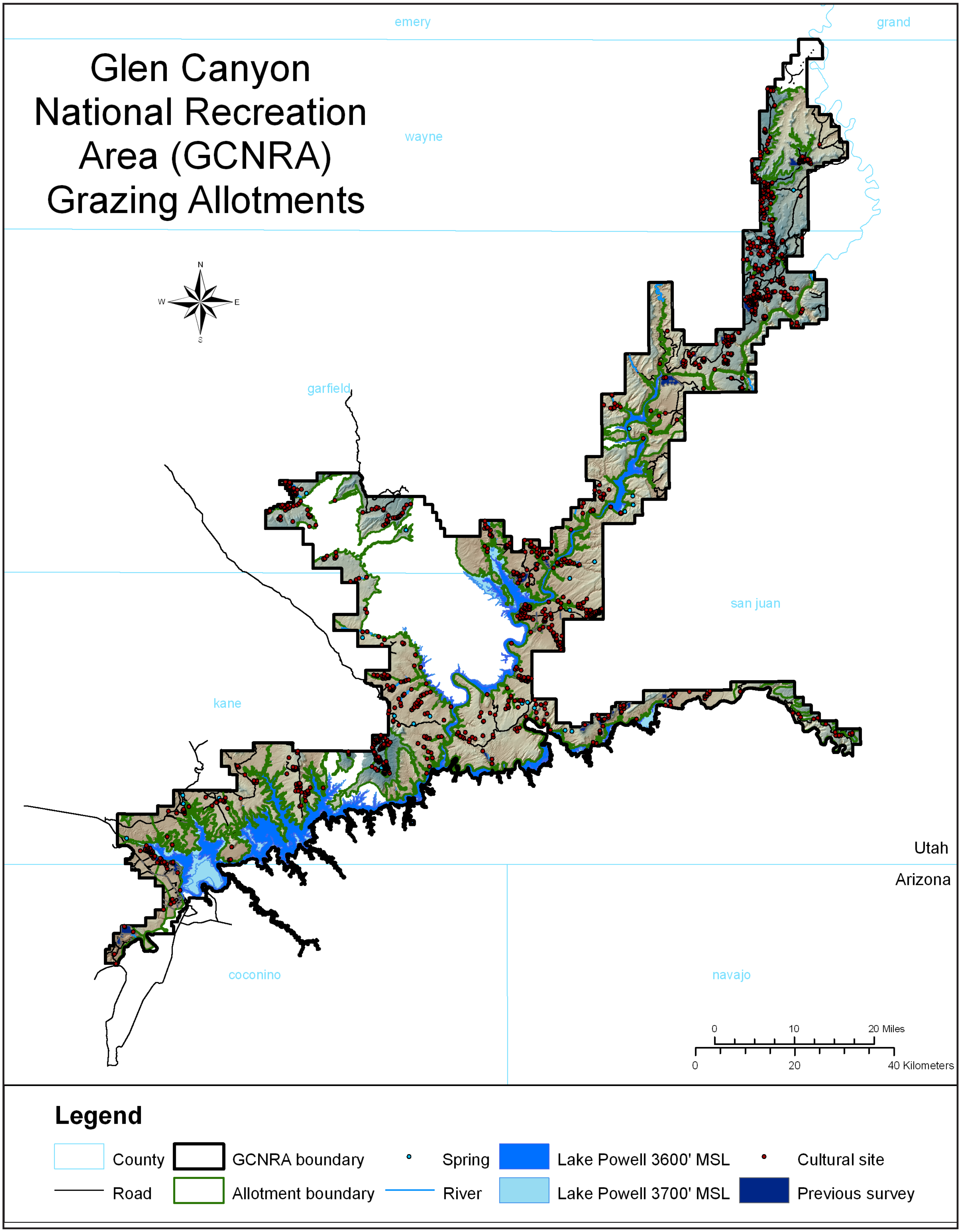
All portions of GCNRA for which geological information was not provided are simply classed as "Not Identified" within this document.

Grazing Allotments

of

Glen Canyon National Recreation Area

Map Panels


Glen Canyon
National Recreation
Area (GCNRA)
Grazing Allotments
emery
grand
wayne
garfield
san juan
kane
coconino
navajo
Utah
Arizona
N
S
E
W
0
10
20 Miles
0
20
40 Kilometers
Legend
County
Road
GCNRA boundary
Allotment boundary
Spring
River
Lake Powell 3600' MSL
Lake Powell 3700' MSL
Cultural site
Previous survey

GCNRA Grazing Allotment Summary:

Total allotment (n = 34) area: 828,913.92 acres.

Sampling fractions:
2 percent: 16578.28 acres
5 percent: 41445.70 acres
11 percent: 91180.53 acres
16 percent: 132626.23 acres
20 percent: 165782.78 acres

Roads:
US Hwy 89 and Alt 89 cross southwestern GCNRA, State Hwy 276 runs east-west across GCNRA, State Hwy 95 crosses GCNRA from the southeast to the northwest, passing through Hite, and State Hwy 261 provides access to the easternmost portion of the San Juan arm.

Numerous county highways also cross through GCNRA, including 230, 231, 254, 262, 265, 279, 330, 450, 430, 431, 530, 532, 533, 531, 650, 332, 656, 651, 657, 630, 632, 633, 730, 731, 756, 787, 763, 744, 765, 774, 775, and 777.

Major Locations:
Major locations within GCNRA include, from southwest to northeast, Lee's Ferry, Wahweap, Dangling Rope Marina, Halls Crossing, Bullfrog, Hite, and Hans Flat. Each of these locations contains, at minimum, a ranger station.

Campgrounds:
Campgrounds within the GCNRA boundaries include, from southwest to northwest, Lee's Ferry, Lone Rock, Wahweap, Halls Crossing, Stanton Creek, Bullfrog, Bullfrog South, Bullfrog North, Blue North Canyon, White Canyon, Farley Canyon, Hite, and Dirty Devil.

Springs = 43

Rivers, Creeks, and Intermittent Streams:
Major rivers include Escalante, Dirty Devil, Colorado, and San Juan. Other named waterways, beginning in the southwest and traveling clockwise around Lake Powell, include Wahweap Creek, Warm Creek, Last Chance Creek, Little Valley Canyon creeks, Rock Creek, Middle Rock Creek, Dry Rock Creek, Escalante River/branch of Lake Powell tributaries (Indian Creek, Clear Creek, Fiftymile Creek, Fortymile Creek, Hurricane Wash, Twentyfivemile Wash, Harris Wash, Silver Falls Creek); Halls Creek, Bullfrog Creek, Hansen Creek, Smith Fork, Warm Springs Creek, Sevenmile Creek, Trachyte Creek, North Wash, Dirty Devil tributaries (Fiddler Cove Canyon creek); and the San Juan tributaries/branch of Lake Powell (Wilson Creek, Castle Creek).

Table 1 provides acreage, area previously inventoried for cultural resources, and the number of sites known for each allotment. Table 2 (subsequent page) presents relevant project information for all currently known cultural resources inventories (n = 91) within the GCNRA grazing allotment areas.

Table 1. Summary of GCNRA grazing allotments, cultural resource inventories, and known cultural sites.

Allotment Name	Acres	Percent	Surveyed (acres)[1]	No. Sites
Big Bown Bench	4175.89	0.50	0.00	14
Bullfrog	757.84	<0.00	0.00	0
Bunting Well	691.29	<0.00	0.00	0
Clark Bench	9433.78	1.14	0.00	0
Ferry Swale	14,763.11	1.78	1017.63	52
Flint Trail	80,276.71	9.68	1389.89	93
Forty Mile Ridge	18,707.15	2.26	6.03	31
Harvey's Fear	2415.96	0.29	2.81	9
Indian Creek	20,725.77	2.50	0.00	7
Lake	5107.81	0.62	1022.85	123
Lake Canyon	186,075.68	22.45	6514.09	310
Last Chance	27,068.36	3.66	0.00	10
Lee's Ferry	6231.48	0.75	1223.37	6
Lower Cattle	18,740.22	2.26	0.00	17
Lower Warm Creek	18,369.15	2.22	16.59	7
Moody	22,449.48	2.71	128.04	38
Navajo Bench	13,966.00	1.68	0.84	6
Nipple Bench	486.22	<0.00	0.00	0
Perkins Brothers	13,767.95	1.67	10.11	12
Robber's Roost	23,954.31	2.89	1126.50	116
Rock Creek Mud-holes	29,133.99	3.51	0.00	52
Rockies	40,460.21	4.88	314.03	46
Sewing Machine	68,264.32	8.24	3790.82	252
Slickhorn	6906.79	0.83	0.00	2
Slickrock	27,518.45	3.32	2.02	4
Soda	53,449.37	6.45	171.36	74
Spencer Bench	3451.74	0.42	0.00	0
Texas Muley	1542.44	0.19	156.12	4
Upper Cattle	11,279.85	1.36	0.00	44
Upper Warm Creek	23,076.10	2.78	0.00	19
Wagon Box Mesa	692.78	<0.00	0.00	0
Wahweap	9199.52	1.11	1202.16	18
Waterpocket	30,037.49	3.62	1464.79	53
White Canyon	34,299.23	4.14	1405.80	15
Unassigned/ Flooded	1387.48	0.17	0.00	0
Total	828,863.92	100.08%	20,965.85	1434

[1] Actual acres surveyed; these calculations omit project overlap from the total.

Table 2. Summary of previously conducted cultural resources inventories within the GCNRA grazing allotment boundaries.

Project No.	Reference[1]	Acres[2]	Project No.	Reference[1]	Acres[2]
--	Baker 2004	629.88	8000A	Tipps 1984a	20.52
--	Bauman 1992	5.68	8000A	Tipps 1987	1317.30[3]
--	Berg 1993	1.45	8000C	Tipps 1980	14.63
--	Berg 1994	7.68	8100B	Nickens 1981	131.35
--	Dominguez and Vawser 1???	541.58	8100B	Nickens 1986a	987.18
--	Geib n.d.	221.24	8300F	Geib and Bremer 1988	1469.25
--	Greenwald and Berg 199?	7.21	860027	Kincaid 1986	55.21
--	Hagopian 2007	65.01	86004	Kincaid 1986a	0.60
--	Hauck 1982	18.72	86009	Kincaid 1986b	0.48
--	Janus and Associates 1987	0.59	8600B	Bungart and Geib 1986	1245.65
--	Johnson 2000	61.04	8600B	Fairley and Geib 1986	1972.26
--	Kincaid 1987	736.31	8600B	Geib 1986	974.63
--	Kincaid 2003	0.53	86010	Kincaid 1986a	67.09
--	Kincaid 2006	8.68	86016	Kincaid 1986c	0.16
--	Kincaid n.d.	26.13	86022	Kincaid 1986d	2.00
--	Moffitt et al. 1978	41.01	86030	Kincaid 1986h	3.14
--	Neal and Wenker 1997	2348.49	86035	Kincaid 1986j	3.06
--	Nielson 1989	71.48	86036	Kincaid 1986k	6.34
--	Sucec 2008	0.11	86037	Kincaid 1986i	7.61
--	Unknown n.d.	0.30	8700A	Geib and Bungart 1988	2781.56
--	Vetter 1985	17.58	8700A	Geib and Fairley 1986	166.23
--	Wells 1982	6.03	87015	Kincaid 1987a	2.21
--	Zier et al. 2002	1404.82	87016	Kincaid 1987b	10.75
01-018	Montgomery 2002	18.12	87017	Kincaid 1988b	0.73
04026	Unknown 2005	12.06	87024	Kitchell 1987	1.07
7800A	Schroedl 1981a	2643.43	87029	Kincaid 1988a	0.95
8000A	Tipps 1984	37.84	8800A	Stone 1998	29.51
88013	Kincaid 1988c	6.36	93002	Kincaid 1993a	15.93
88014	Kincaid 1988f	3.17	93025	Kincaid 1993b	10.04
88014	Kincaid 1998e	0.05	93025	Kincaid 1993c	6.72
88016	Kincaid 1988c	70.50	93026	Burchett and Goetze 19??	17.24
88020	Kincaid 1988g	0.04	93027	Kincaid and Goetze 199?	1.28
89002	Kincaid 1989a	1.91	93039	Kincaid 1993e	6.18
89005	Bungart 1989	0.47	9400A	Janus and Associates 1988	29.71
89008	Kincaid 1989b	21.87	94029	Goetze and Hall 1994	0.50
89013	Kincaid 1989c	9.63	9500C	Goetze 1995	346.08
89017	Kincaid 1989a	299.40	9500D	Horne et al. 1995	128.44
89017	Kincaid 1989b	39.28	96001	Burchett 1996	14.02
89024	Kincaid 1989e	29.35	9600A	SWCA 1997	1347.43
89026	Kincaid 1989d	2.59	98017	Burchett 1998	3.48
90047	Weaver 1990	27.76	GLCA 1994	--	234.21
90048	Phillips 1991	74.25	GLCA 1995	--	185.82
90056	Kincaid 1991b	13.61	GLCA 1996	--	285.26
90059	Bungart 1990	0.91	GLCA 1997	--	139.79
91031	Kincaid 1991c	5.63	GLCA 1999	--	181.72
92072	Leap and Neal 1992	0.34		**Total**	**23,765.44[4]**

[1] a, b, c… designations correspond to GCNRA's cultural resources library/database. Full references are available from GCNRA.
[2] Acreage provided for surveyed area within grazing allotment boundaries in GCNRA; many surveys covered more acreage in their entireties.
[3] Tipps (1987) is double-entered in GCNRA's database. Totals have been corrected here and elsewhere in this document to account for the duplication.
[4] Given overlap between projects, a total of 20,965.85 acres surveyed within the GCNRA grazing allotments is a more accurate figure than the total provided here.

A total of 1,434 cultural sites are currently recorded within the boundaries of GCNRA and included in the database provided for use in this document (Table 3). Sites with unestablished or unknown cultural affiliation currently dominate the database. Table 4 provides attribute information for these sites in order to provide a better understanding of site 'type' presence on the GCNRA grazing allotment landscape.

Figure 1 provides a graphic representation of Table 3, and Figure 2 provides a graphic representation of Table 4. Both figures are presented on the subsequent page.

Table 3. Summary of known cultural sites within GCNRA grazing allotment boundaries by affiliation.

Cultural Affiliation	No. Sites	Percent of Total
Ancestral Puebloan	123	8.58
Formative	112	7.81
Fremont	25	1.74
Kayenta	44	3.07
Mesa Verde	18	1.34
Basketmaker	6	0.42
Archaic	72	5.02
Paleoamerican	4	0.28
Navajo	3	0.21
Numic	8	0.56
Paiute	2	0.14
Late prehistoric/ Protohistoric	4	0.28
Historic	30	2.09
Unknown Prehistoric	494	34.45
Unknown	489	34.10
Total	**1,434**	**100.09%**

Table 4. Unknown prehistoric sites by attribute.

Dominant Site Attribute	No Sites.	Percent
Rock art, artifact scatter	8	1.62
Features present	181	36.64
Artifact scatter	52	10.53
Unknown	8	1.62
Rock art	28	5.67
Lithic scatter	215	43.52
Groundstone scatter	1	0.20
Quarry site	1	0.20
Total	**494**	**100%**

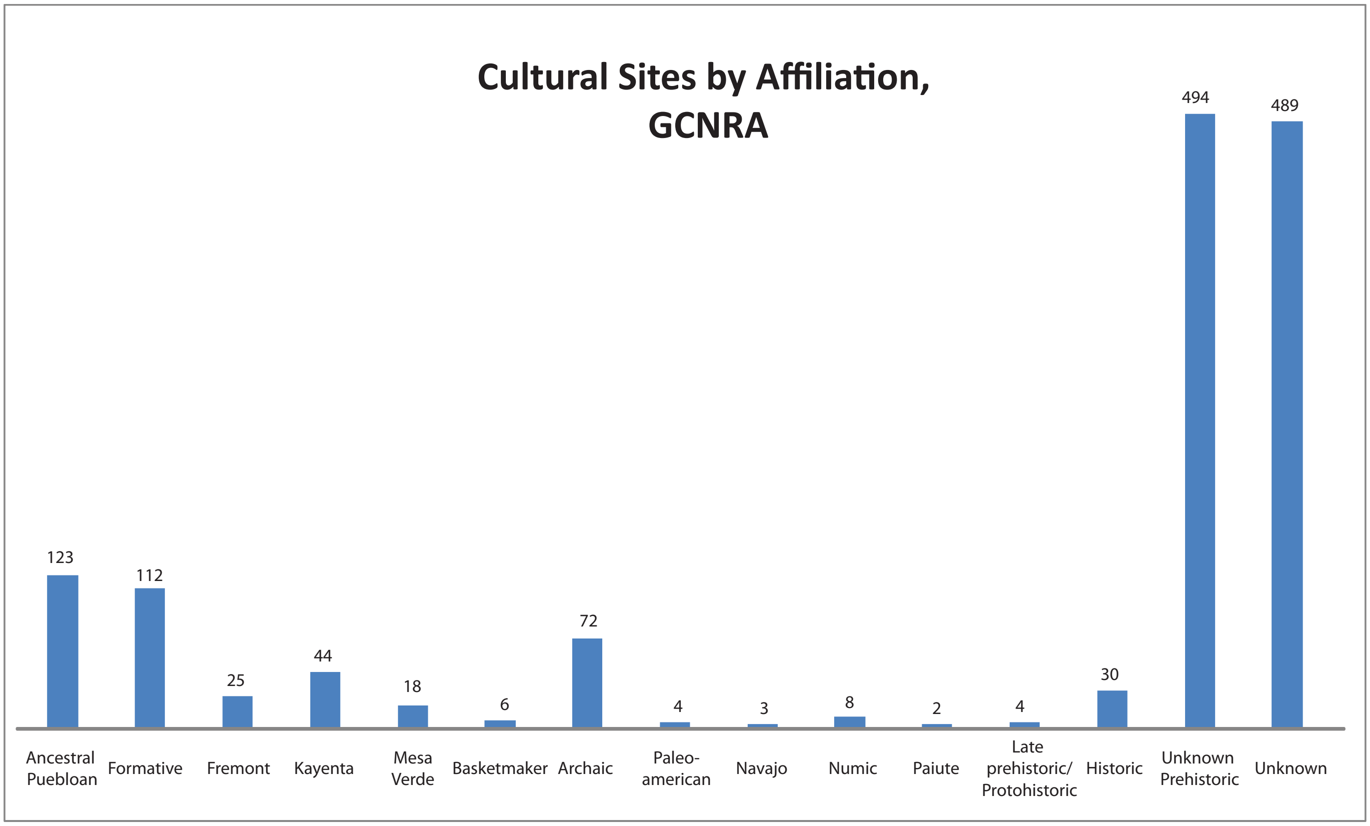


Figure 1. Cultural sites within GCNRA grazing allotment boundaries by affiliation.

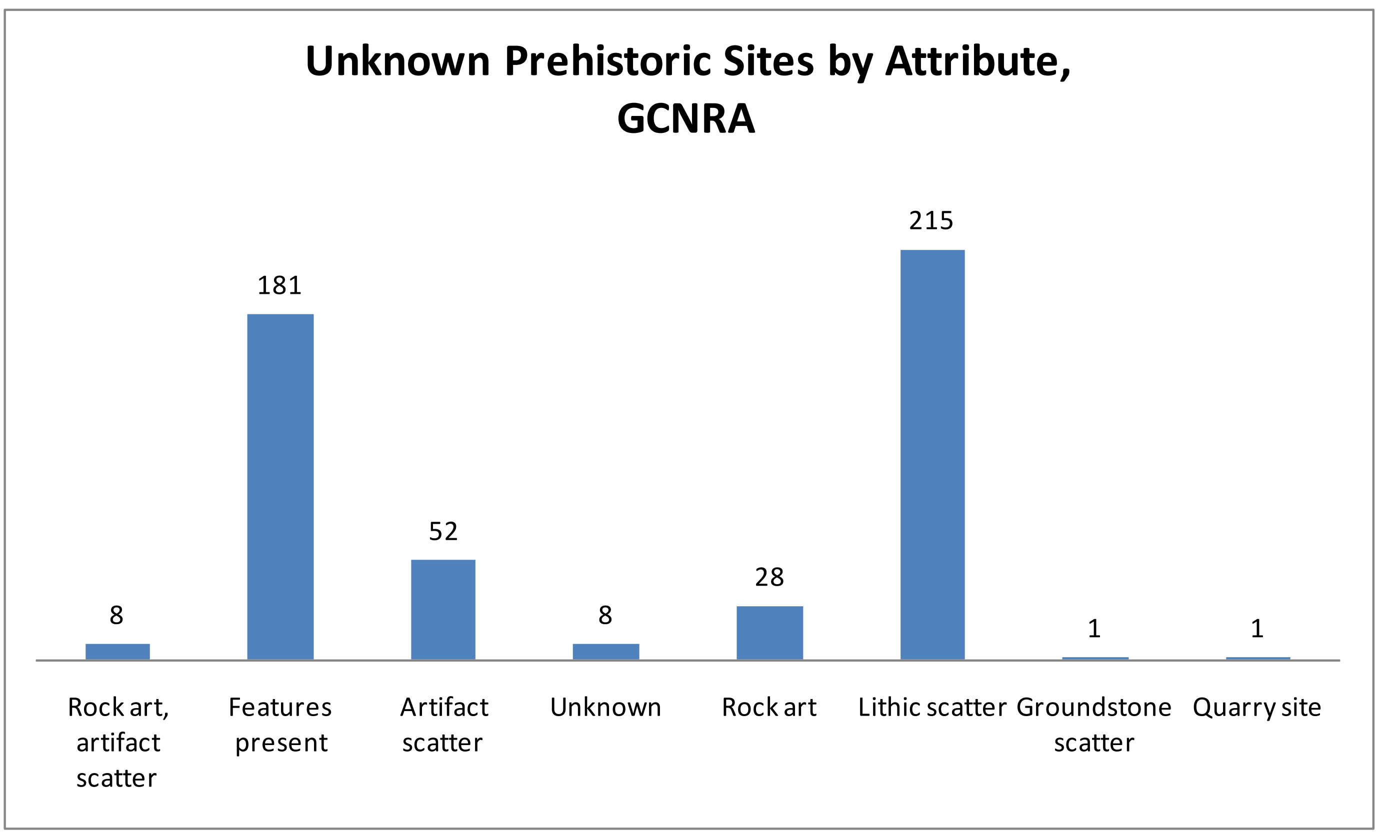
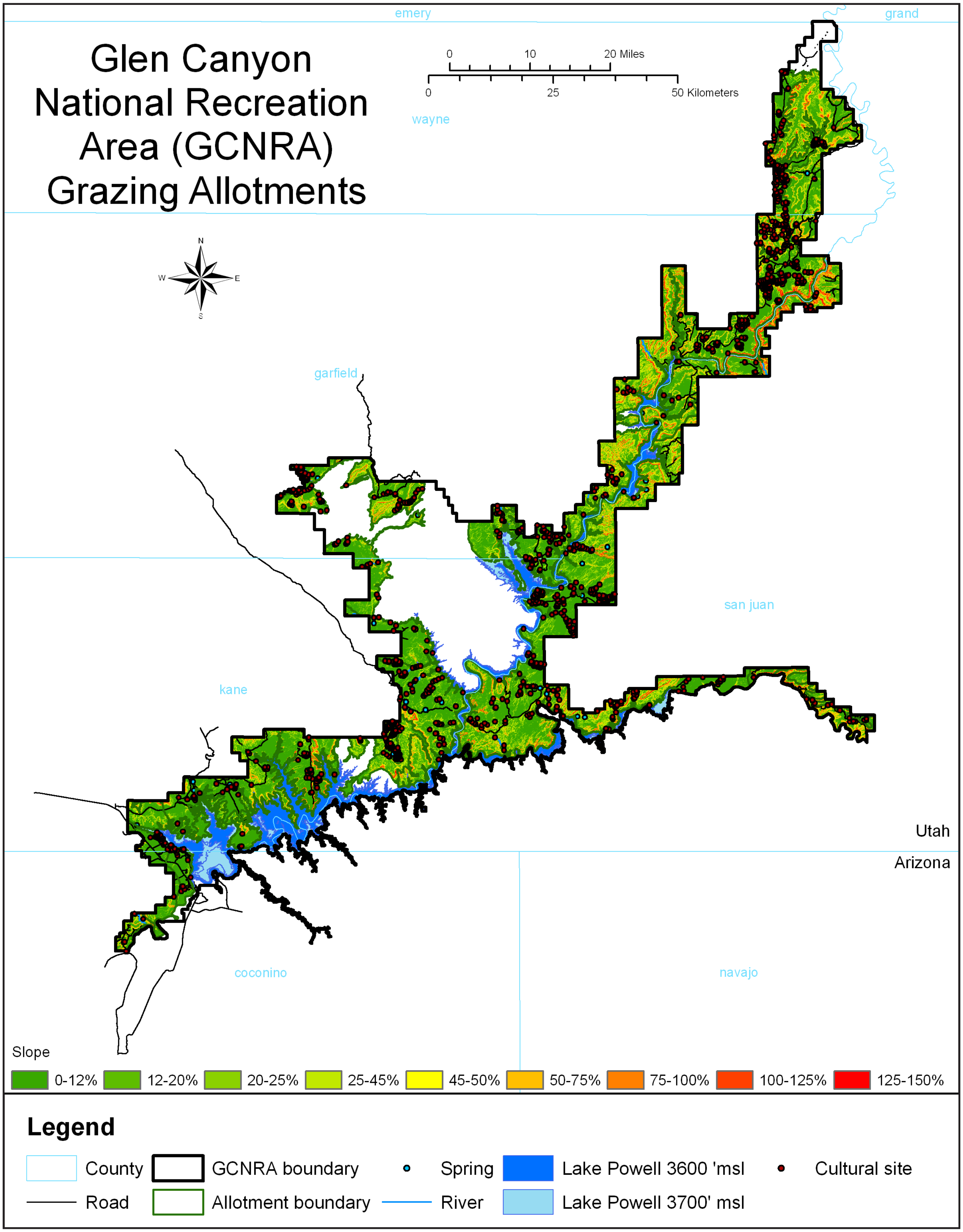


Figure 2. Unknown prehistoric sites within GCNRA grazing allotment boundaries by attribute.


Glen Canyon National Recreation Area (GCNRA) Grazing Allotments
0 10 20 Miles
0 25 50 Kilometers
emery
grand
wayne
garfield
san juan
kane
coconino
navajo
Utah
Arizona
N
W
E
S
Slope
0-12%
12-20%
20-25%
25-45%
45-50%
50-75%
75-100%
100-125%
125-150%
Legend
County
GCNRA boundary
Spring
Lake Powell 3600 'msl
Cultural site
Road
Allotment boundary
River
Lake Powell 3700' msl

Slope Considerations:

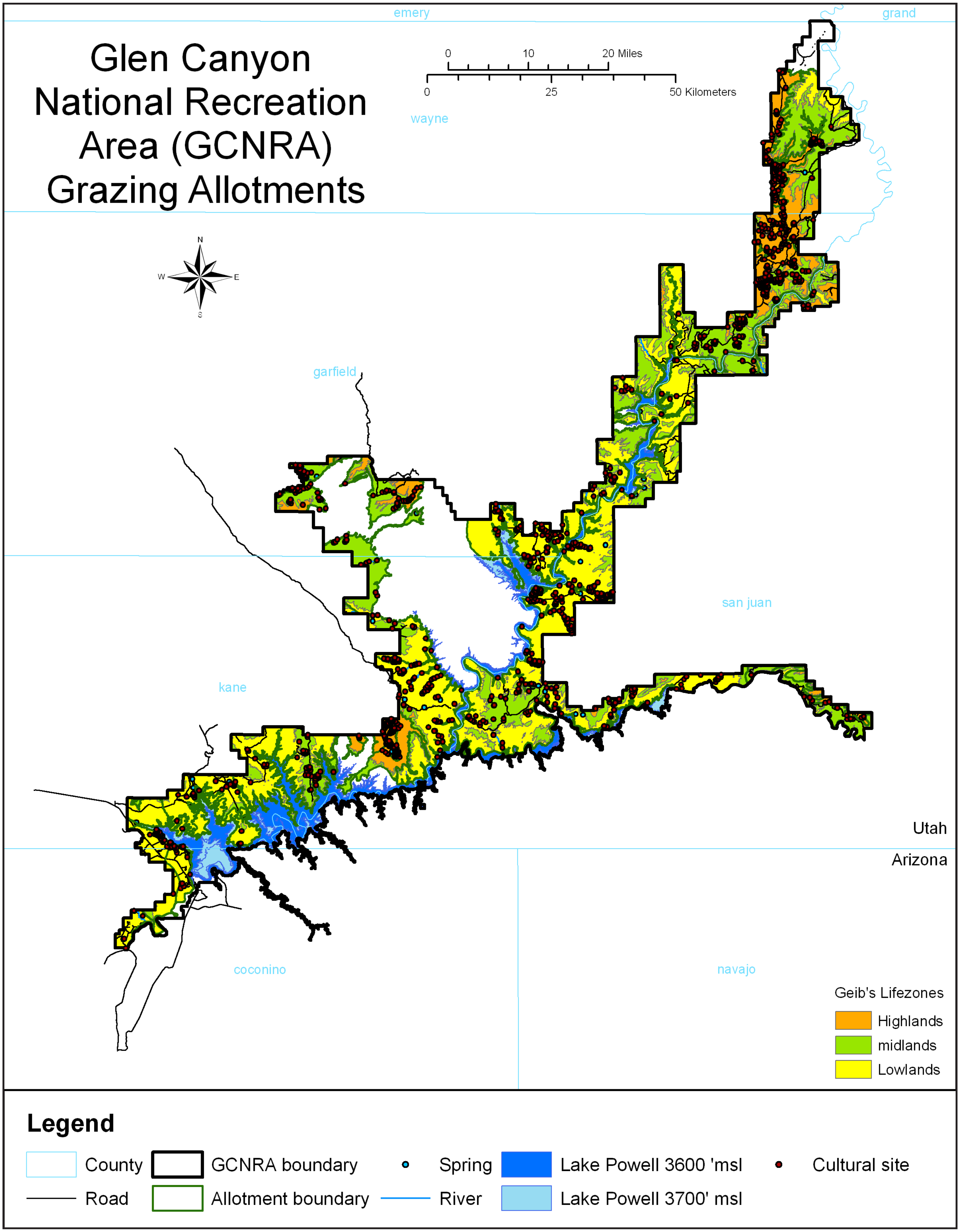
Slope plays a large role in terrain accessibility, and may be used in the stratification of survey areas. For example, GCNRA may wish to assign catagories such as low, moderate, and high to specific slope gradients. Such assignations are most often dependent on the factors guiding archaeological survey work, and as such, are not included in this document. However, GCNRA may find the following examples useful in future application of slope categories to the grazing allotment lands:

1. Cattle typically prefer slope gradients less than 10 percent. Sheep, however, regularly use up to 45 percent slopes. When surveys are driven by grazing presence, slope stratifications may be made based on the type of grazer currently or historically using the allotment land.

2. A common undertaking in grazing allotment lands is reseeding. Slope determines the type of machinery used (and therefore the amount of ground disturbance) used in reseeding. For example, drill seeding is often used on slopes with less than a maximum 25 percent gradient, and chaining is limited to slopes less than 45 percent.

Survey Zones Dictated by Slope:

Although the scale of the GCNRA map does not allow for specifics, survey zones dictated by slope are called out in the individual allotment map panels.


Glen Canyon National Recreation Area (GCNRA) Grazing Allotments
0
10
20 Miles
0
25
50 Kilometers
N
S
E
W
emery
grand
wayne
garfield
san juan
kane
Utah
Arizona
coconino
navajo
Geib's Lifezones
Highlands
midlands
Lowlands
Legend
County
GCNRA boundary
Spring
Lake Powell 3600 'msl
Cultural site
Road
Allotment boundary
River
Lake Powell 3700' msl

Lifezone Significance and Known Cultural Sites:

Geib's environmental categories provide useful divisions for the GCNRA grazing allotment landscape. These divisions are based on elevation, which in turn corresponds to terrain, environmental characteristics, and significance to prehistoric populations (Table 5.)

All three of Geib's environmental zones, or lifezones, are present within the GCNRA grazing allotments. These zones include the Lowlands, Midlands, and Highlands.

Highlands account for 118,351.44 acres, and contain 394 of the known cultural sites.

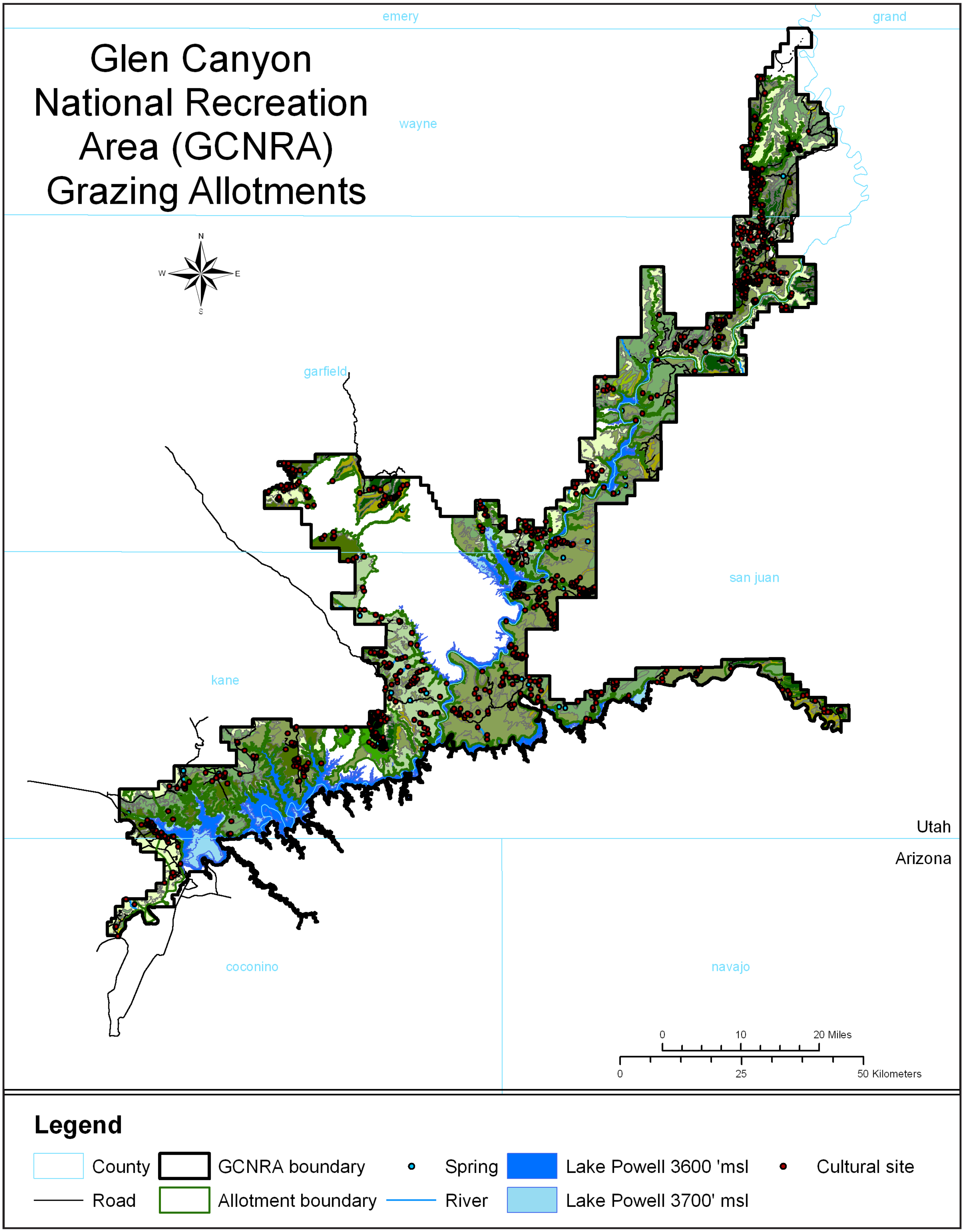
Midlands account for 256,734.15 acres, and contain 411 of the known cultural sites.

Lowlands account for 453,865.70 acres, and contain 629 of the known cultural sites.

Table 5. Summary of Geib's environmental zones.

	Elevation	Characteristics	Environment	Significance to Humans
Lowlands	1219-1372 m (4000-4500 ft)	Hot and arid steep-walled sandstone canyons.	Riparian plants; big-horn sheep	Permanent water, arable alluvium, long growing season, diverse plant communities, natural shelters, quality siliceous stone from river gravels
Midlands	1372-1676 m (4500-5500 ft)	Arid slickrock and dune fields on benchlands and low plateaus.	Blackbrush, shadscale, grasses; antelope.	Grasses, including dropseed and ricegrass, prickly pear and shadscale; good antelope habitat, quality siliceous stone in certain locations.
Highlands	Above 1676 m (Above 5500 ft)	High elevation mesas and plateaus with cooler temperatures and greater precipitation.	Pinyon-juniper woodlands; deer and rabbit.	Higher elevation plant foods (i.e. pinyon); later harvests; dry-farming; abundant fuel, deer and rabbit.

Shading indicates lifezones present in allotment.



***Vegetation key on subsequent page.*

The key to the vegetation map on the previous page is provided below:

Dominant Vegetation

- Not identified
- Utah juniper
- Big sagebrush
- Blackbrush
- Blackbrush-shadscale
- Fourwing saltbush
- Fremont cottowood
- Golden buckwheatbush
- Mat saltbush
- Pinyon-juniper
- Sand sagebrush
- Shadscale
- Torrey Mormon tea

Soils Associated with Dominant Vegetation:
Utah juniper grows in stony loam, often in associated with pinyon-juniper forest in gravelly loam.

Big sagebrush grows in loam, and can be associated with pinyon-juniper in stony loam.

Blackbrush grows in shallow sandy loam, sand, and sandy loam and may be found associated with sand sagebrush in sand and sandy loam, and with fourwing saltbush in sandy loam.

Blackbrush-shadscale vegetation occurs in talus, and may be associated with shadscale in shallow sandy loam and shallow clay, and with mat saltbush in shallow clay.

Fourwing saltbush occurs in sandy loam and sandy bottom, and may be associated with Fremont cottonwood in semiwet, saline streambanks, Cutler Mormon tea in shallow sand, blackbrush in shallow sandy loam, and sand sagebrush in sandy loam.

Fremont cottonwood grows in semiwet saline streambanks, often in association with shadscale in stony loam.

Golden buckwheatbush dominates in gypsum hills, and is limited in distribution in GCNRA.

Mat saltbush grows in sandy loam in association with shadscale in shallow sandy loam, and in shallow clay, with fourwing saltbush in sandy loam.

Pinyon-juniper dominates in shallow sandy loam, where it is associated with blackbrush, and in shallow sand, shallow loam, stony loam, gravelly loam, and very steep stony loam.

Sand sagebrush occurs in sand, where it is often associated with blackbrush in shallow sandy loam.

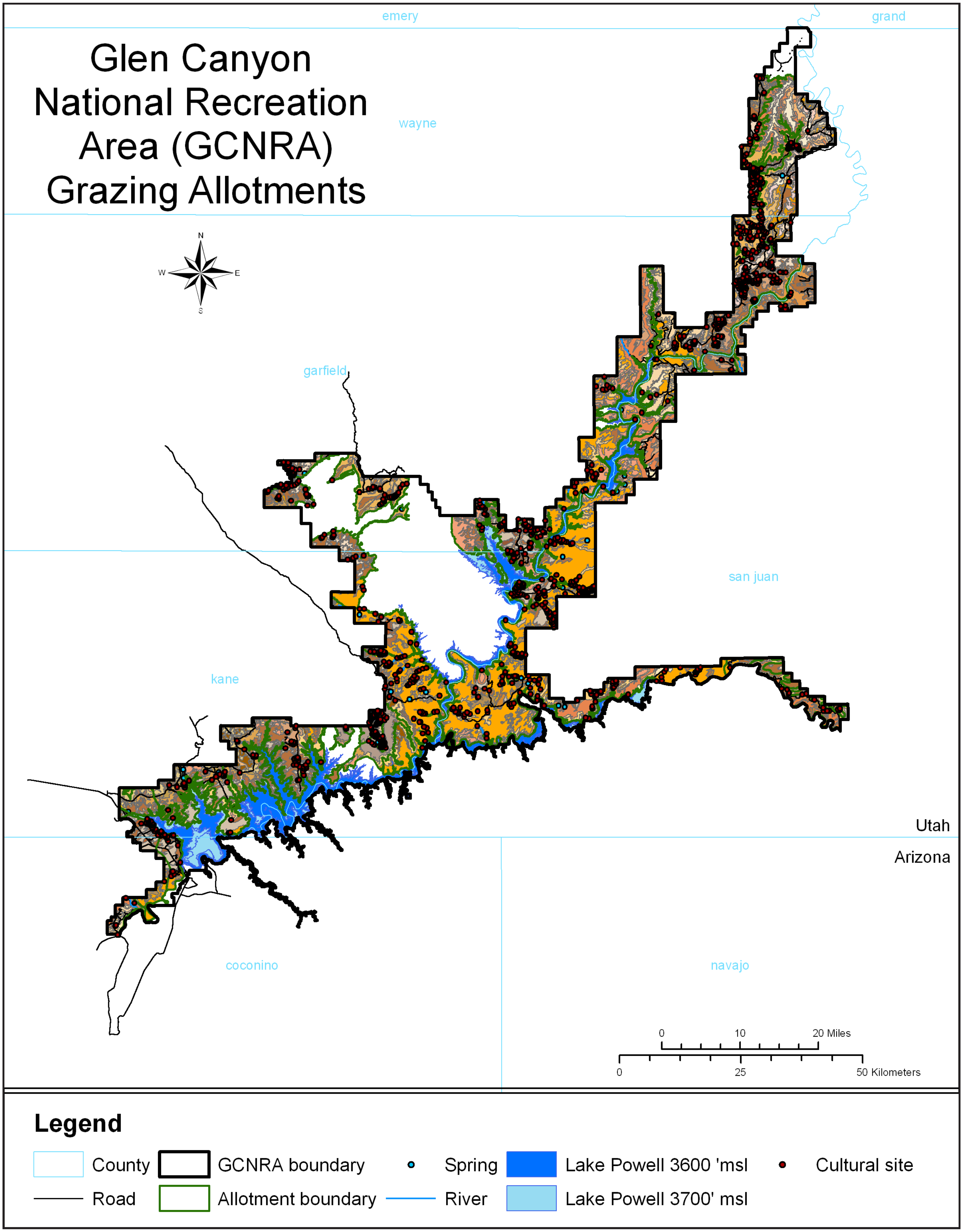
Shadscale occurs in stony loam in association with Castle Valley saltbush in alkali fans, in shallow sandy loam with blackbrush, in shallow loam with mat saltbush growing in shallow clay and Torrey Mormon tea in very shallow gypsum, in stony loam with fourwing saltbush in sandy loam, and in loam.

The last dominant species, Torrey Mormon tea, occurs in gypsum loam and very shallow gypsum with limited distribution in GCNRA.

Table 6 provides dominant vegetation zone attributes for the GCNRA grazing allotments.

Table 6. Summary of dominant vegetation zone attributes.

Dominant Species	Acres	No. Sites
Not identified	155,825.19	192
Utah juniper (*Juniperus osteosperma*)	6783.44	0
Big sagebrush (*Artemisia tridentata*)	3518.84	101
Blackbrush –shadscale (*Coleogyne ramosissima - Atriplex confertifolia*)	234,369.77	98
Fourwing saltbush (*Atriplex canescens*)	64,475.50	147
Fremont Cottonwood (*Populus fremontii*)	6849.30	15
Golden buckwheatbush (*Eriogonum corymbosum*)	884.23	3
Mat saltbush (*Atriplex confertifolia*)	7844.53	6
Pinyon-juniper (*Pinus edulis – Juniperus osteosperma*)	63,026.64	233
Sand Sagebrush (*Artemisia filifolia*)	69,119.91	85
Shadscale (*Atriplex confertifolia*)	166,372.82	147
Torrey Mormon tea (*Ephedra torreyana*)	1290.03	0
Cutler Mormon tea (*Ephedra cutleri*)	Secondary species	n/a
Castle Valley saltbush (*Atriplex cuneata*)	Secondary species	n/a



***Soil key on subsequent page.*

The key to the soils map on the previous page is provided below:

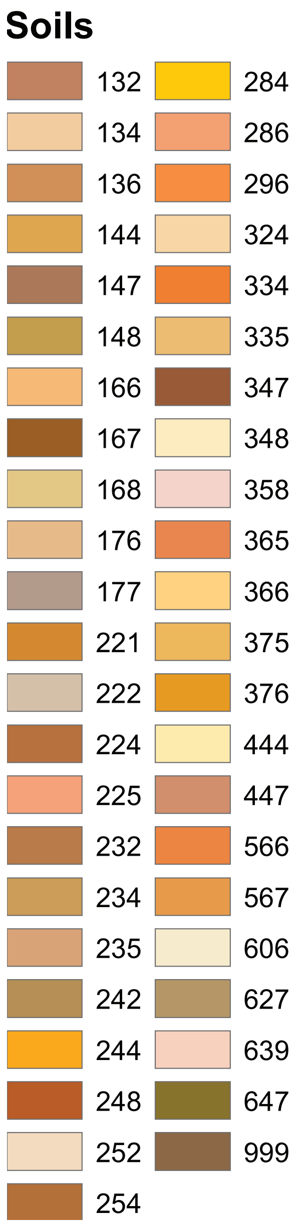


Table 7 provides acreage and the number of known sites for each soil type identified in the GCNRA grazing allotments.

Table 8 (subsequent pages) relates soil types to site types known in GCNRA grazing allotments.

Table 7. Soils and sites of GCNRA grazing allotments.

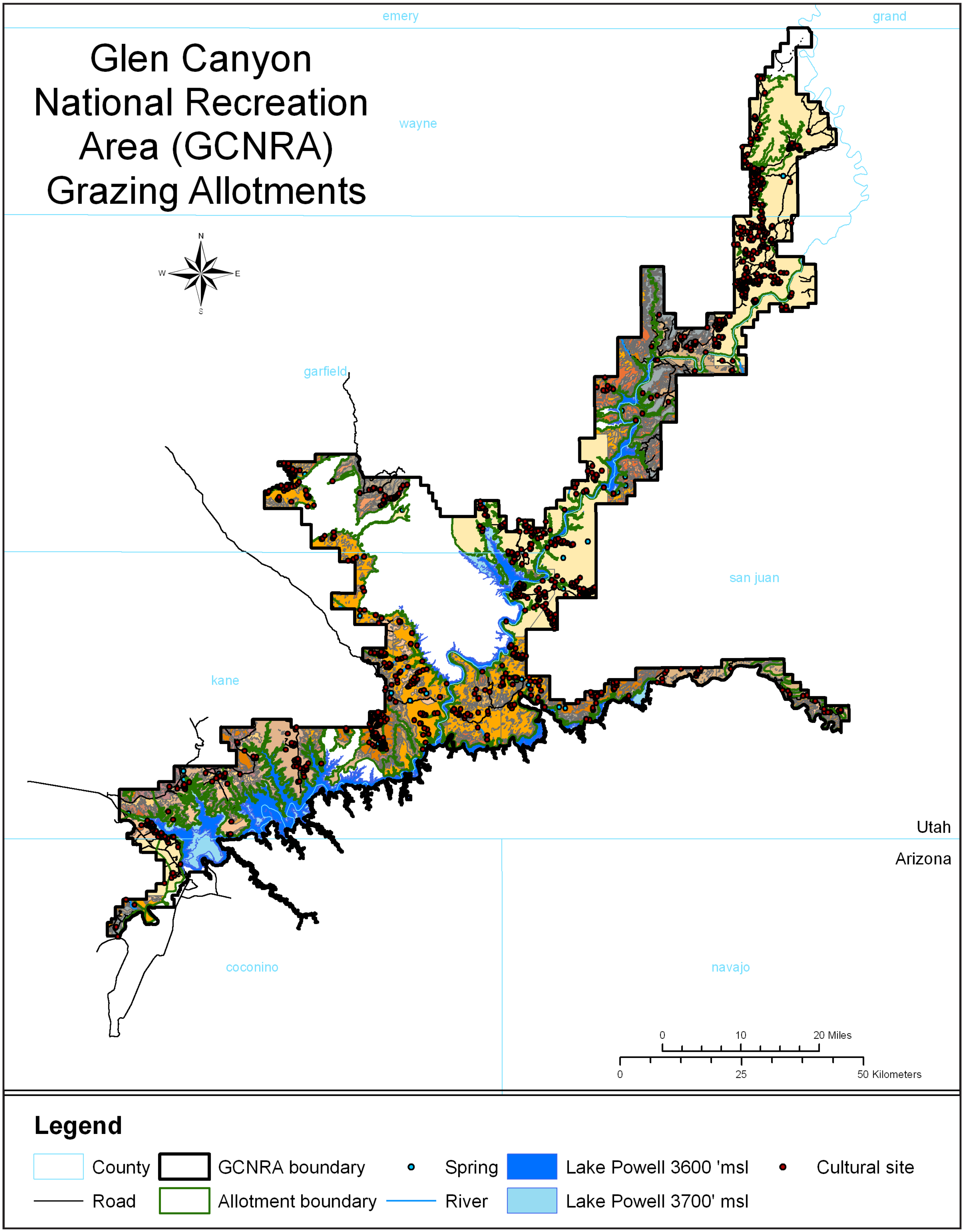
Soil Type	Acres	No. Sites
132	867.37	**31**
134	3285.12	**87**
136	877.06	**1**
144	12,262.27	**11**
147	2635.33	**1**
148	3879.88	**0**
166	12,085.45	**0**
167	6309.44	**2**
168	8268.99	**0**
176	2086.03	**19**
177	8611.53	**0**
221	2946.57	**2**
222	41,835.72	**82**
224	63,504.82	**96**
225	38,057.43	**50**
232	10,880.87	**14**
234	3246.16	**0**
235	30,836.41	**142**
242	14002.4	**5**
244	188,765.2	**202**
248	4151.71	**20**
252	17161.43	**28**
254	63,133.71	**251**
284	1517.3	**2**
286	201.19	**1**
296	388.38	**3**
324	18054.76	**6**
334	512.78	**0**
335	10,833.04	**43**
347	6801.79	**15**
348	9547.22	**4**
358	8206.36	**8**
365	51,256.51	**22**
366	93,560.79	**175**
375	31,048.72	**21**
376	15,161.59	**58**
444	396.02	**0**
447	864.41	**0**
566	5332.65	**3**
567	16,132.31	**7**
606	9565.59	**1**
627	381.17	**0**
639	4878.31	**1**
647	235.96	**0**
999	4221.26	**20**
Total	**828,789.01**	**1434**

Table 8. Summary of known cultural sites in GCNRA grazing allotments by soil type.

Soil Type	Ancestral Puebloan	Kayenta	Mesa Verde	Formative	Fremont	BM	Archaic	Paleoamerican
132	3	1	0	4	0	0	1	0
134	9	5	0	22	0	0	2	0
136	0	0	0	0	0	0	0	0
144	1	0	0	0	0	0	4	0
147	0	0	0	0	0	0	0	0
148	0	0	0	0	0	0	0	0
166	0	0	0	0	0	0	0	0
167	0	0	0	0	0	0	0	0
168	0	0	0	0	0	0	0	0
176	1	2	0	7	0	0	0	0
177	0	0	0	0	0	0	0	0
221	0	0	0	0	0	0	0	0
222	0	0	0	1	0	1	5	0
224	9	2	0	3	2	0	8	0
225	3	0	0	5	1	0	0	0
232	0	0	0	1	0	0	0	1
234	0	0	0	0	0	0	0	0
235	3	0	4	5	2	0	20	1
242	0	0	0	1	0	0	0	0
244	24	20	3	20	0	0	4	0
248	1	0	0	0	0	0	1	0
252	0	0	0	2	0	0	0	0
254	6	1	1	17	8	1	18	2
284	0	0	0	0	0	0	0	0
286	0	0	0	0	0	0	0	0
296	0	0	0	1	0	0	0	0
324	1	0	0	0	0	0	0	0
334	0	0	0	0	0	0	0	0
335	0	0	0	0	0	0	2	0
347	0	0	1	0	0	0	1	0
348	0	0	0	0	0	0	0	0
358	0	0	0	0	0	0	0	0
365	4	1	0	0	0	0	1	0
366	48	10	8	15	4	4	2	0
375	0	0	1	0	0	0	0	0
376	4	2	0	8	6	0	1	0
444	0	0	0	0	0	0	0	0
447	0	0	0	0	0	0	0	0
566	0	0	0	0	0	0	0	0
567	1	0	1	0	0	0	0	0
606	0	0	0	0	0	0	0	0
627	0	0	0	0	0	0	0	0
639	0	0	0	0	0	0	0	0
647	0	0	0	0	0	0	0	0
999	4	0	0	0	0	0	0	0
Total	**122**	**44**	**19**	**112**	**23**	**6**	**70**	**4**

Table 8. Summary of known cultural sites in GCNRA grazing allotments by soil type (continued).

Soil Type	Late Prehistoric/ Protohistoric	Paiute	Navajo	Numic	Unknown Prehistoric	Historic Anglo-European	Unknown Historic	Unknown site type	Total
132	0	0	0	0	11	0	0	11	**31**
134	0	0	0	0	34	2	0	14	**88**
136	0	0	0	0	1	0	0	0	**1**
144	0	0	0	0	6	0	0	0	**11**
147	0	0	0	0	0	1	0	0	**1**
148	0	0	0	0	0	0	0	0	**0**
166	0	0	0	0	0	0	0	0	**0**
167	0	0	0	0	1	0	1	0	**2**
168	0	0	0	0	0	0	0	0	**0**
176	0	0	0	0	1	0	0	8	**19**
177	0	0	0	0	0	0	0	0	**0**
221	0	0	0	0	0	0	0	2	**2**
222	0	0	0	0	52	0	0	23	**82**
224	0	0	0	0	54	0	1	17	**96**
225	0	0	0	0	20	0	0	21	**50**
232	0	0	0	2	3	2	0	5	**14**
234	0	0	0	0	0	0	0	0	**0**
235	0	0	0	2	33	3	2	67	**142**
242	0	0	0	0	4	0	0	0	**5**
244	1	1	0	0	41	1	1	85	**201**
248	0	0	0	0	17	0	0	1	**20**
252	0	0	0	1	10	0	1	14	**28**
254	2	0	0	2	113	3	5	72	**251**
284	0	0	0	0	1	0	0	1	**2**
286	0	0	0	0	1	0	0	0	**1**
296	0	0	0	0	0	1	1	0	**3**
324	0	0	0	0	0	0	0	5	**6**
334	0	0	0	0	0	0	0	0	**0**
335	1	0	0	1	26	0	1	12	**43**
347	0	0	2	0	2	0	0	9	**15**
348	0	0	0	0	1	1	0	2	**4**
358	0	0	0	0	4	1	0	3	**8**
365	0	0	1	0	2	0	0	13	**22**
366	0	0	0	0	21	1	1	61	**175**
375	0	0	0	0	4	1	0	15	**21**
376	0	0	0	0	25	0	0	12	**58**
444	0	0	0	0	0	0	0	0	**0**
447	0	0	0	0	0	0	0	0	**0**
566	0	0	0	0	3	0	0	0	**3**
567	0	0	0	0	0	0	0	5	**7**
606	0	0	0	0	0	0	0	1	**1**
627	0	0	0	0	0	0	0	0	**0**
639	0	0	0	0	0	1	0	0	**1**
647	0	0	0	0	0	0	0	0	**0**
999	0	0	0	0	10	0	0	6	**20**
Total	**4**	**1**	**3**	**8**	**501**	**18**	**14**	**485**	**1434**



**Geology key on subsequent page.

The key to the geology map on the previous page is provided below:

Geology

- Not identified
- Alluvial fan deposits
- Alluvial gravel
- Alluvial terrace deposits
- Alluvial and colluvial deposits
- Alluvial, colluvial, and eolian deposits
- Alluvium
- Carmel Formation
- Cedar Mesa Sandstone
- Chinle Formation
- Dakota Formation
- Entrada Sandstone
- Eolian sand
- Eolian sand, silt, and carbonate deposits
- Fault breccia
- Halgaito Formation
- Honaker Trail Formation
- Kaibab Limestone
- Kayenta Formation
- Lacustrine deposits
- Landslide and talus deposits
- Mixed eolian and alluvial sand deposits
- Moenave Formation
- Moenkopi Formation
- Morrison Formation
- Navajo Sandstone
- Organ Rock Shale
- Page Sandstone
- Paradox Formation
- Romana Sandstone
- Slumps and landslides
- Straight Cliffs Formation
- Talus deposits
- Tropic Shale
- Tufa
- White Rim Sandstone
- Wingate Sandstone

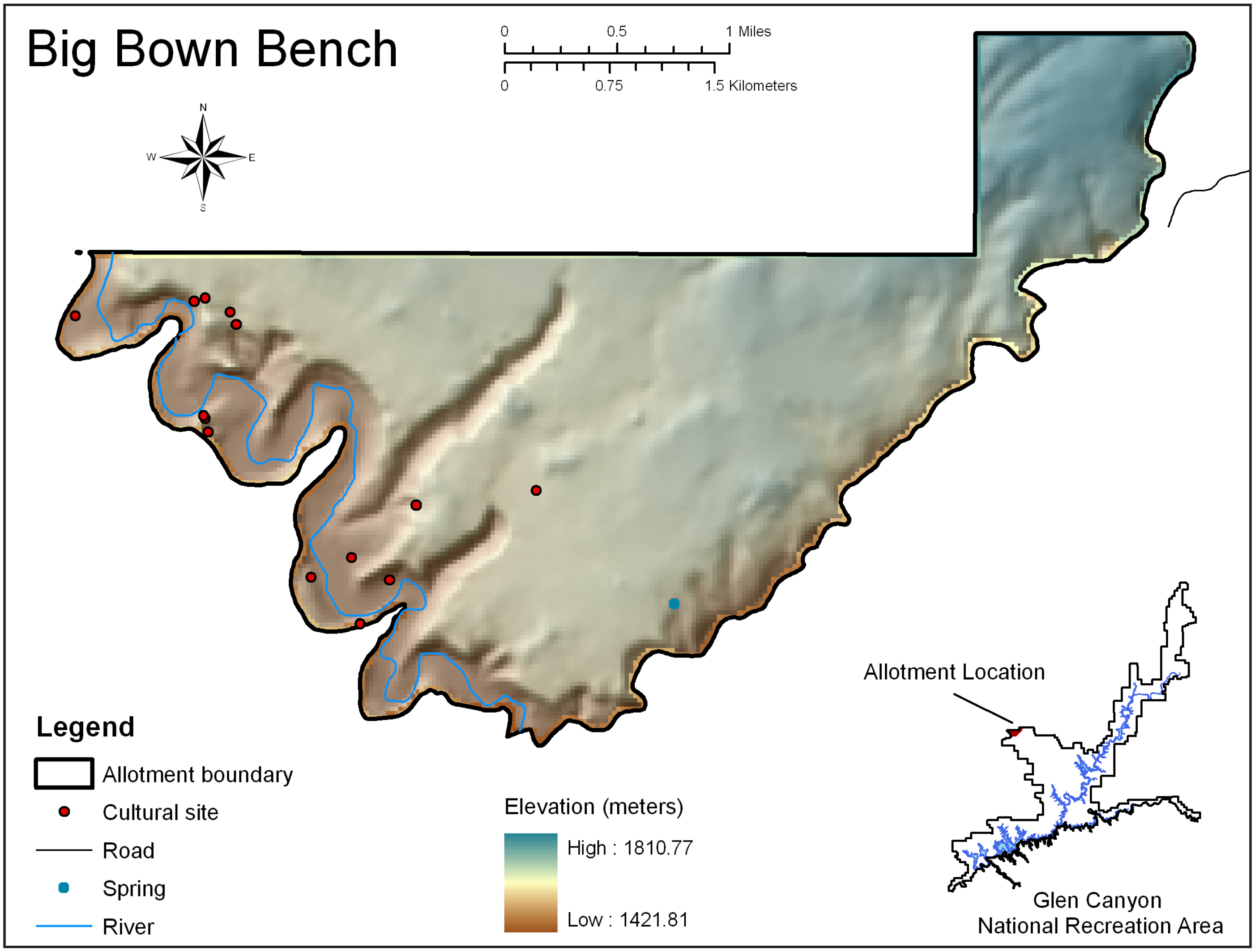
Table 9 provides acreage for each geology type present in the GCNRA grazing allotments.

Table 9. Geology of the GCNRA grazing allotments.

Geology Name	Acres	No. Sites
Not identified	28,7781.23	738
Alluvial fan deposits	273.73	0
Alluvial gravel	5375.23	16
Alluvial terrace deposits	930.83	3
Alluvial and colluvial deposits	28.27	0
Alluvial, colluvial, and eolian deposits	5244.83	0
Alluvium	2569.83	7
Carmel Formation	11,229.03	5
Cedar Mesa Sandstone	37271.84	51
Chinle Formation	29,578.00	38
Dakota Formation	11,177.14	10
Entrada Sandstone	19,399.71	9
Eolian sand	10,696.02	10
Eolian sand, silt, and carbonate deposits	1471.91	0
Fault breccia	52.79	0
Halgaito Formation	5823.49	11
Honaker Trail Formation	4365.41	1
Kaibab Limestone	274.75	0
Kayenta Formation	32,171.61	40
Lacustrine deposits	162.34	0
Landslide and talus deposits	25,710.54	2
Mixed eolian and alluvial deposits	34,075.89	59
Moenave Formation	19.75	0
Moenkopi Formation	26,830.89	7
Morrison Formation	46,282.83	64
Navajo Sandstone	132,608.30	183
Organ Rock Shale	12,301.70	3
Page Sandstone	4563.95	9
Paradox Formation	352.71	0
Romana Sandstone	6860.49	1
Slumps and landslides	32699.45	15
Straight Cliffs Formation	8972.14	138
Talus deposits	5151.76	6
Tropic Shale	11,084.75	0
Tufa	22.61	0
White Rim Sandstone	2407.01	0
Wingate Sandstone	13,091.16	8
Total	**828,913.92**	**1,434**

Big Bown Bench

Map Panels



Total Area: 4175.89 acres

Sampling Fractions:
2 percent: 83.52 acres
5 percent: 208.80 acres
11 percent: 459.45 acres
16 percent: 668.14 acres
20 percent: 835.12 acres

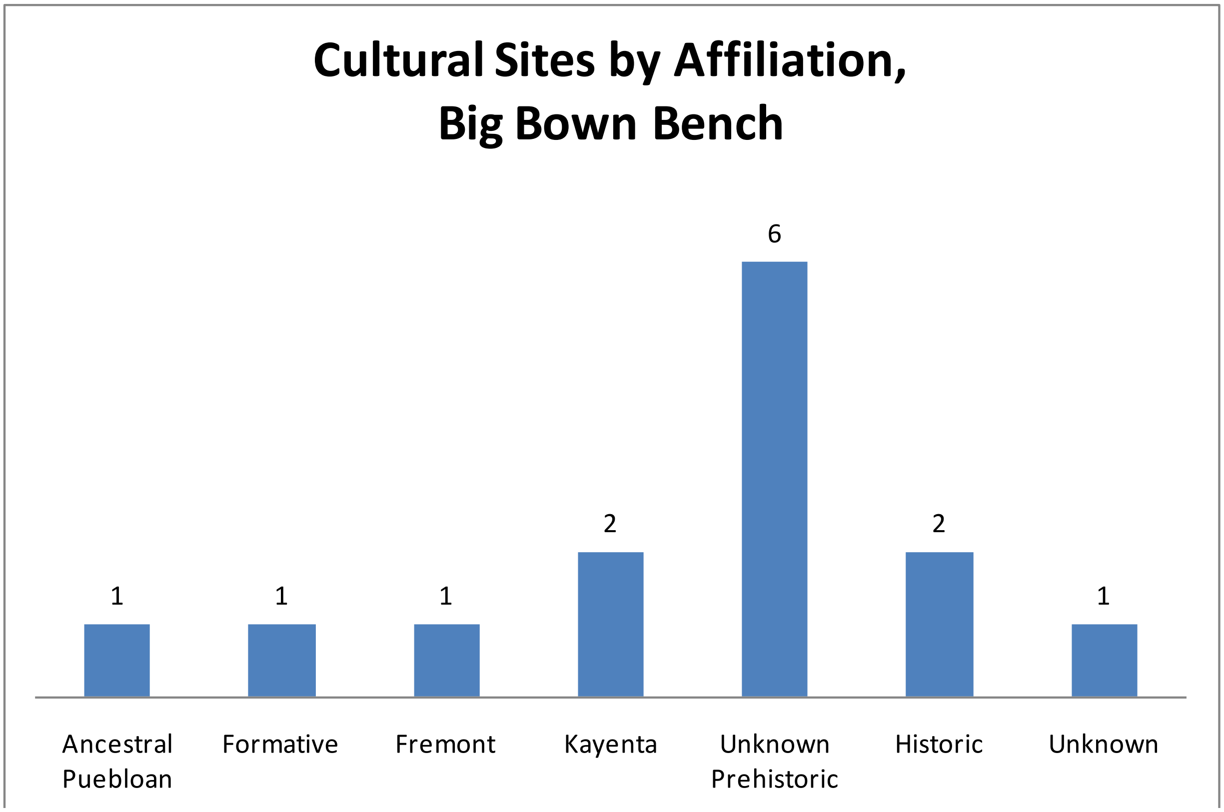
Elevation range amsl:
1421.81 - 1810.77 meters (4664.73 - 5940.85 feet)

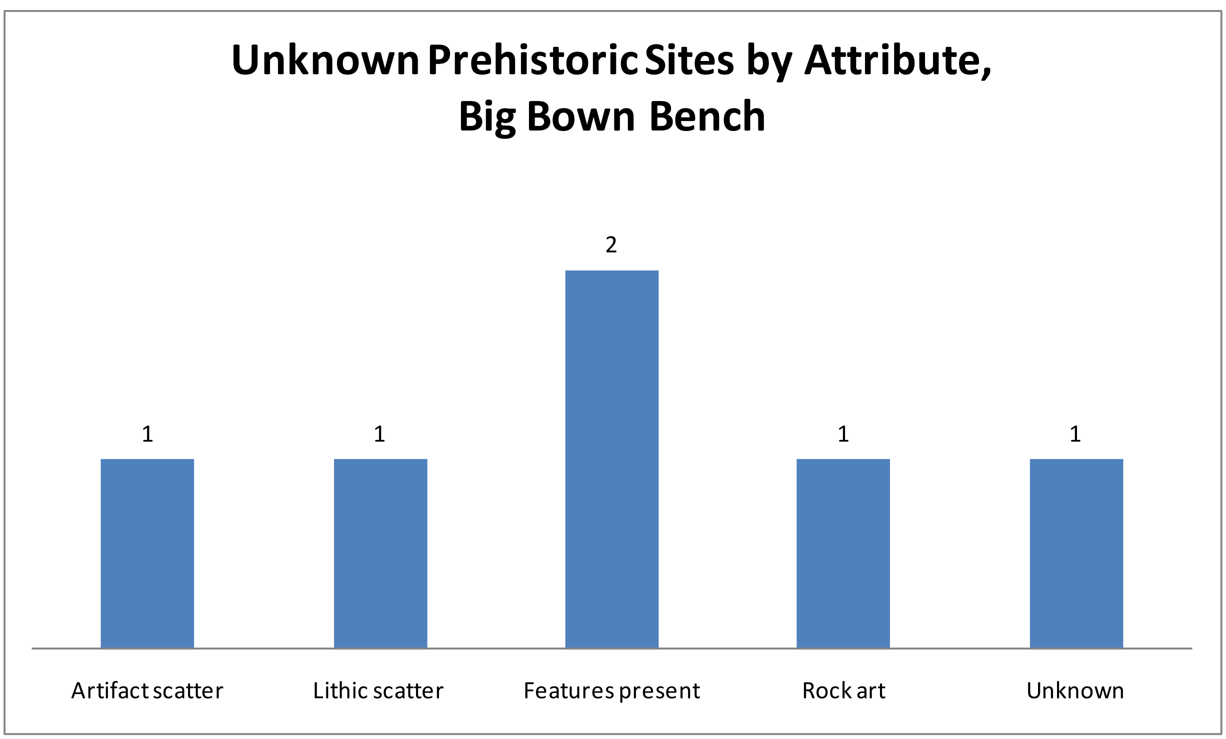
Rivers and Springs:
The Escalante River edges the western border of the Big Bown Bench Allotment. In addition, a single spring by the name of Cliff Spring is located within the allotment boundaries. Additional seasonal water sources are likely available within the allotment, but have not been documented at this time.

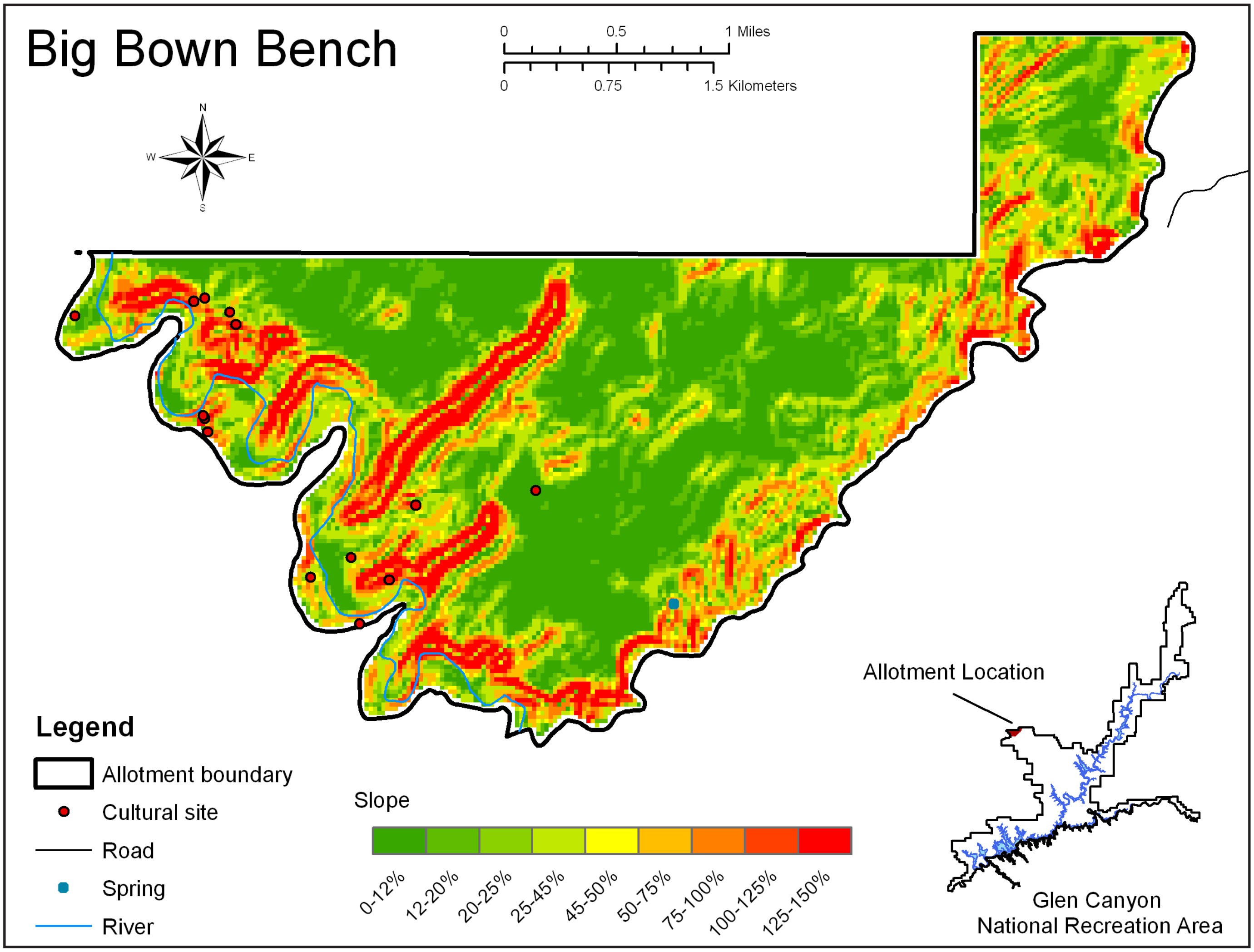
Accessibility:
Big Bown Bench may be reached by road by taking the east-west lateral road from Park Road 332 (Moody Canyon Road). The allotment is also potentially accessible from the southwest by taking the lateral road following Harris Wash from Hole-in-the-Rock Road.

No. Cultural Sites: 14
Area surveyed: 0.00 acres

The figures on the subsequent page depict cultural sites by affiliation, and for those prehistoric sites for which affiliation is not known, site attributes.


Cultural Sites by Affiliation,
Big Bown Bench
1
1
1
2
6
2
1
Ancestral Puebloan
Formative
Fremont
Kayenta
Unknown Prehistoric
Historic
Unknown


Unknown Prehistoric Sites by Attribute,
Big Bown Bench
1
1
2
1
1
Artifact scatter
Lithic scatter
Features present
Rock art
Unknown



Slope Considerations:

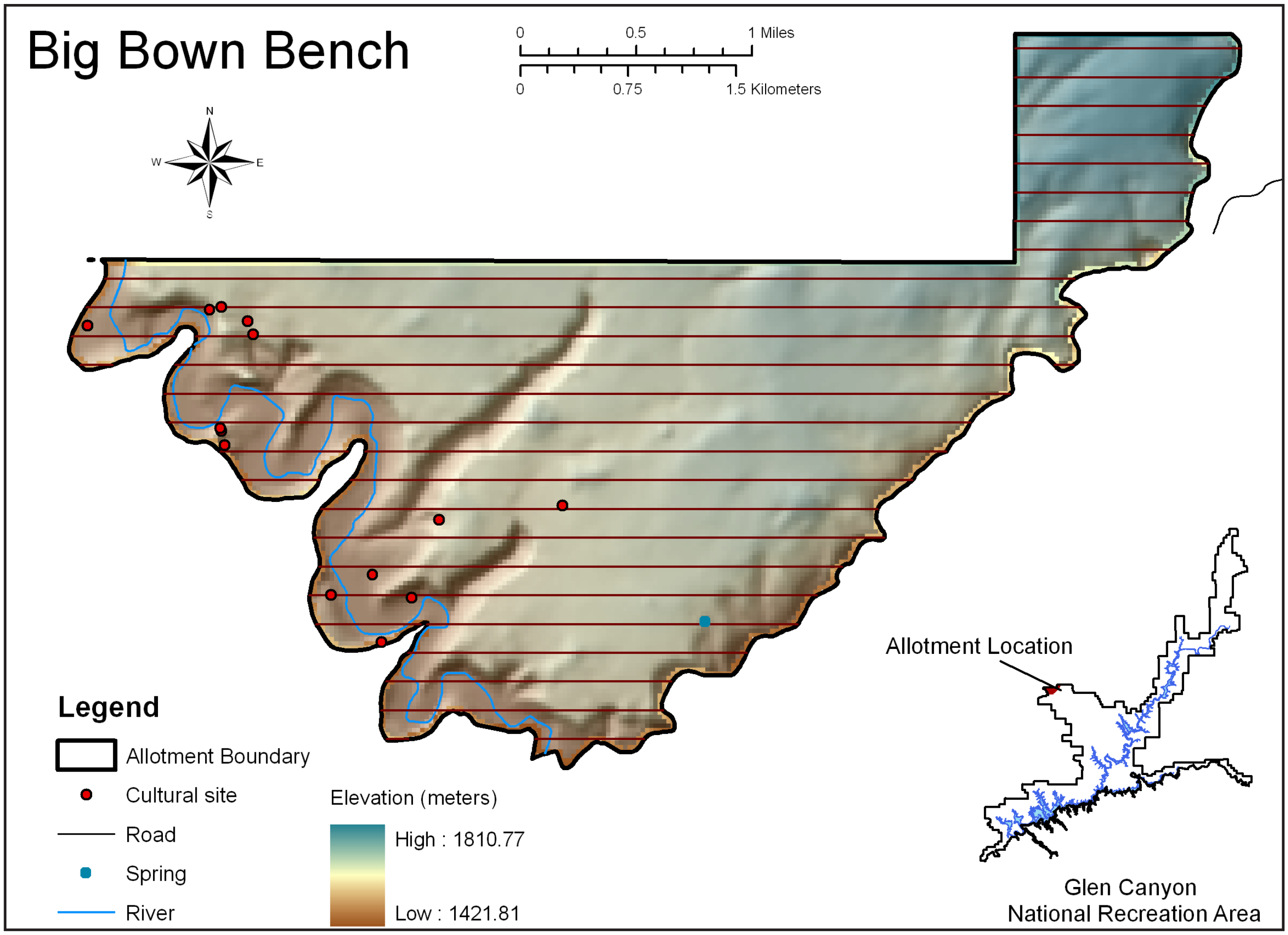
Slope plays a large role in terrain accessibility, and may be used in the stratification of survey areas. For example, GCNRA may wish to assign catagories such as low, moderate, and high to specific slope gradients. Such assignations are most often dependent on the factors guiding archaeological survey work, and as such, are not included in this document. Included herein, however, are suggestions for basic transect orientation based on the presence of topographical barriers identified by the presence of excessive slope gradients.

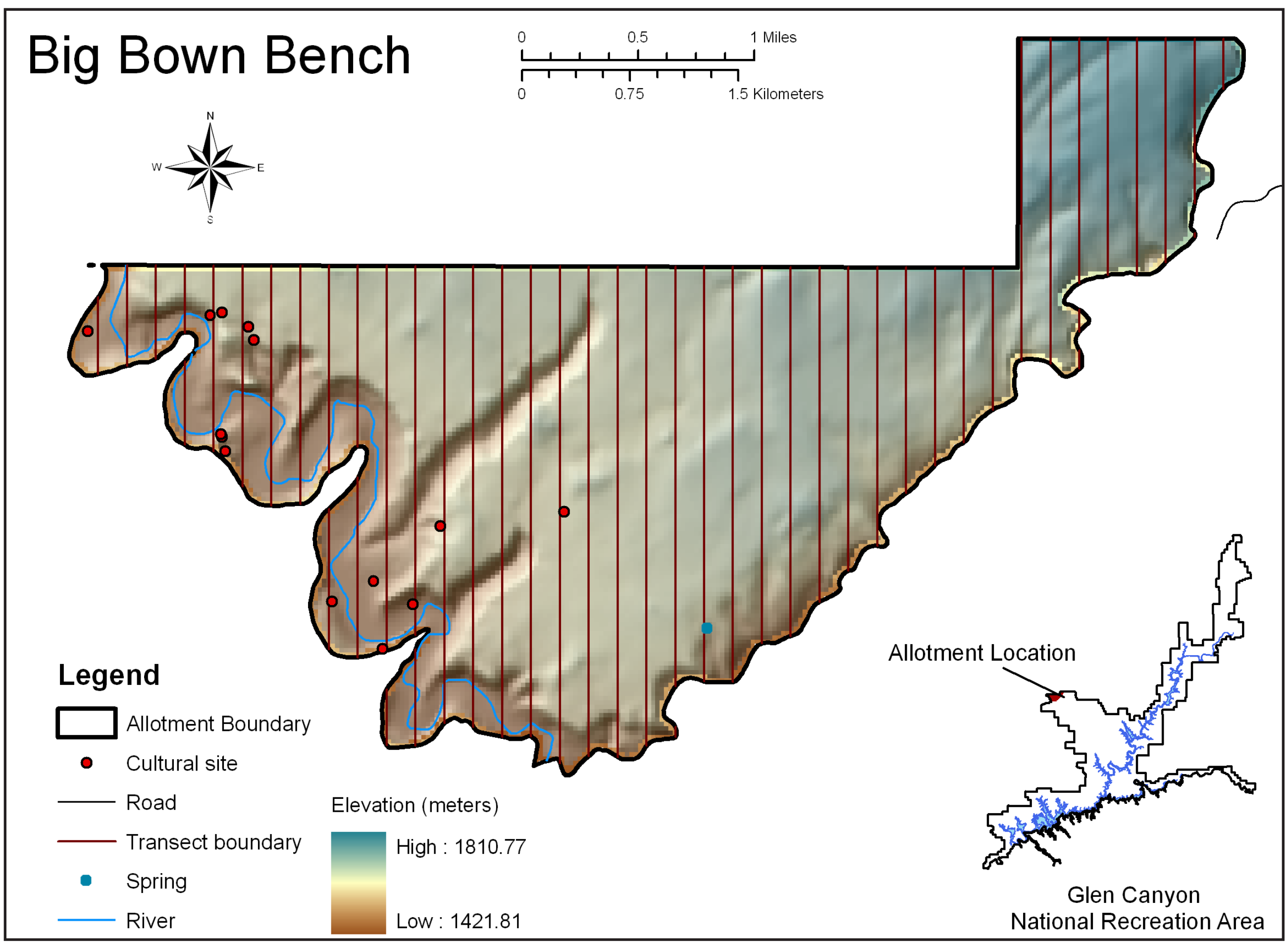
Survey Zones Dictated by Slope:

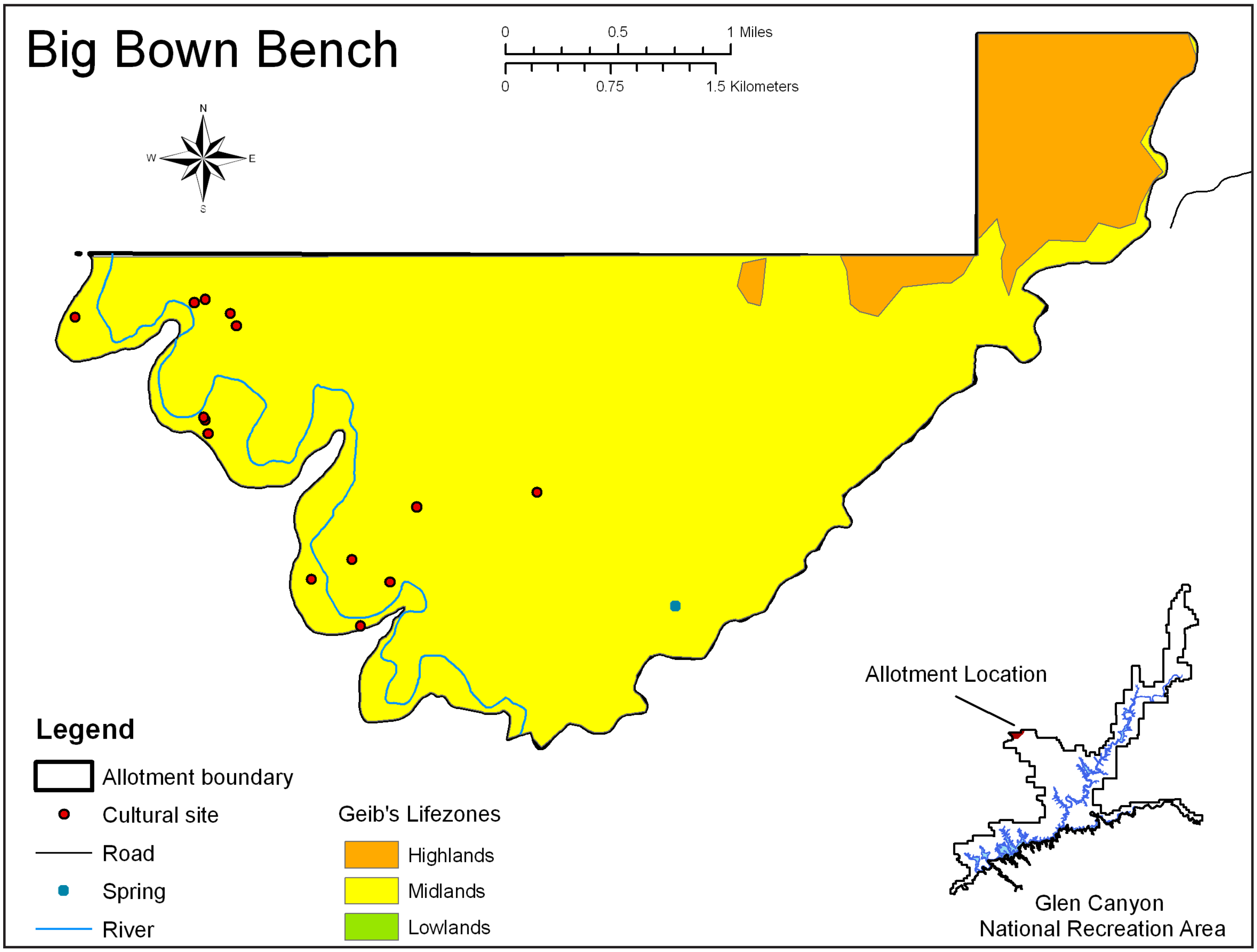
The Big Bown Bench allotment exhibits a exceedingly steep escarpment roughly paralleling the Escalante River. This escarpment effectively divides the western Escalante River canyon from the remainder of the allotment to the east. Given this barrier, the canyon surrounding the river would need to be surveyed separately from the rest of the allotment.

Moreover, given the excessive slope, the entirety of the southeastern edge of the allotment will not be surveyable by pedestrian means. Helicopter or small plane taken along the edge of the escarpment paralleling the river, and then along the southeastern boundary may provide some coverage and recognition of cultural sites and features, particularly when above-ground structures and/or handholds are present.

The 'fishnet' maps provided on the subsequent page provide transects spaced at 200 meter intervals for both east-west and north-south oriented pedestrian survey.


Big Bown Bench
0
0.5
1 Miles
0
0.75
1.5 Kilometers
N
W
E
S
Legend
Allotment Boundary
Cultural site
Road
Spring
River
Elevation (meters)
High : 1810.77
Low : 1421.81
Allotment Location
Glen Canyon
National Recreation Area


Big Bown Bench
0
0.5
1 Miles
0
0.75
1.5 Kilometers
N
W
E
S
Legend
Allotment Boundary
Cultural site
Road
Transect boundary
Spring
River
Elevation (meters)
High : 1810.77
Low : 1421.81
Allotment Location
Glen Canyon
National Recreation Area



Area of Each Lifezone:

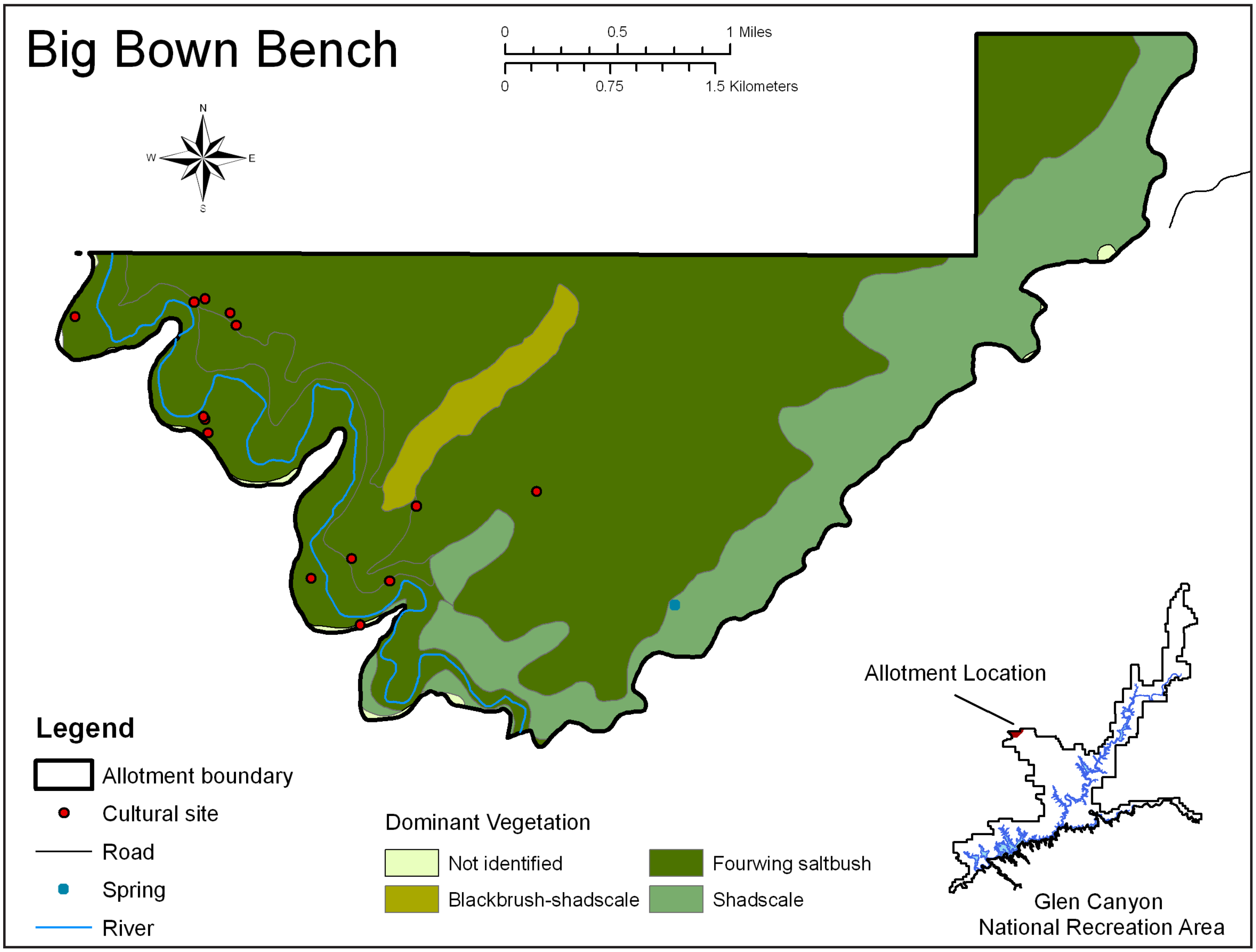
Highlands: 545.46 acres
Midlands: 3611.88 acres
Lowlands: 0.00 acres

No. Cultural Sites in Each Lifezone:

Highlands: 0
Midlands: 14
Lowlands: 0

Lifezone Significance and Known Cultural Sites: Currently, all recorded sites in Big Bown Bench occur in Geib's Midland Lifezone. Geib suggests that the Midland zone of the Glen Canyon area provided important grasses, cacti such as prickly pear, and shadscale to prehistoric people. In addition, Geib suggests the Midland lifezone provides excellent habitant for antelope, an important meat option in prehistoric times. Finally, quality raw material for stone tool manufacture may be found in select locations within the Midland zone.

	Elevation	Characteristics	Environment	Significance to Humans
Lowlands	1219-1372 m (4000-4500 ft)	Hot and arid steep-walled sandstone canyons.	Riparian plants; big-horn sheep	Permanent water, arable alluvium, long growing season, diverse plant communities, natural shelters, quality siliceous stone from river gravels
Midlands	1372-1676 m (4500-5500 ft)	Arid slickrock and dune fields on benchlands and low plateaus.	Blackbrush, shadscale, grasses; antelope.	Grasses, including dropseed and ricegrass, prickly pear and shadscale; good antelope habitat, quality siliceous stone in certain locations.
Highlands	Above 1676 m (Above 5500 ft)	High elevation mesas and plateaus with cooler temperatures and greater precipitation.	Pinyon-juniper woodlands; deer and rabbit.	Higher elevation plant foods (i.e. pinyon); later harvests; dry-farming; abundant fuel, deer and rabbit.
Shading indicates lifezones present in allotment.				



Area of Individual Vegetation Zones:

Dominant Species	Acres Covered	No. Sites
Not identified	23.61	0
Blackbrush–shadscale (*Coleogyne ramosissima* - *Atriplex confertifolia*)	119.01	0
Fourwing saltbush (*Atriplex canescens*)	2990.65	14
Shadscale (*Atriplex confertifolia*)	1029.57	0
Total	**4162.84**	**14**

No. Cultural Sites in Each Vegetation Zone:
Currently, all known cultural sites (n = 14) occur within fourwing saltbush.

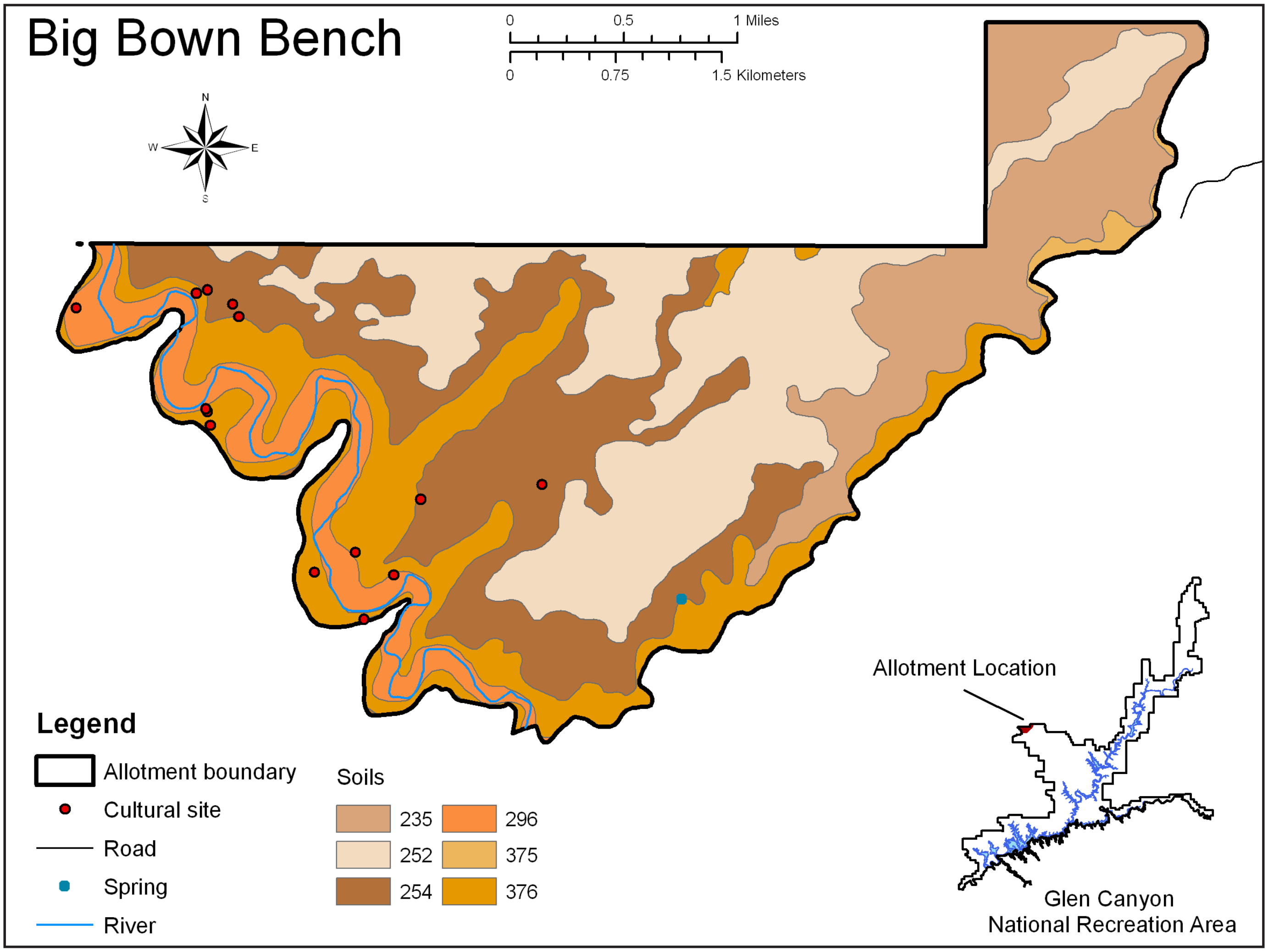
Visibility:
In general, the dominant vegetation of Big Bown Bench provide moderate - excellent visibility, with large portions of the ground between plants bare of vegetation. However, within areas with higher groundwater levels, such as the Escalante River bottom, visibility may decline substantially.

Summary:
The primary dominant vegetation zones within the Big Bown Bench grazing allotment include fourwing saltbush (71.62 percent), shadscale (24.66 percent), and blackbrush-shadscale (0.01 percent).

Dominant Species:
Blackbrush (*Coleogyne ramosissima*)
Fourwing saltbush (*Atriplex canescens*)
Shadscale (*Atriplex confertifolia*)

Secondary Dominant Species:
Fremont Cottonwood (*Populus fremontii*)
Cutler Mormon-tea (*Ephedra cutleri*)
Mat saltbush (*Atriplex corrugata*)

Associated Soils:
The blackbrush-shadscale communities occur in talus and shallow clays. The fourwing saltbush and Cutler Mormon tea communities occur in sandy loam and shallow sands, and the shadscale communities grow predominately in shallow sandy loam. When present, the Fremont cottonwood communities occur along semiwet saline streambanks.

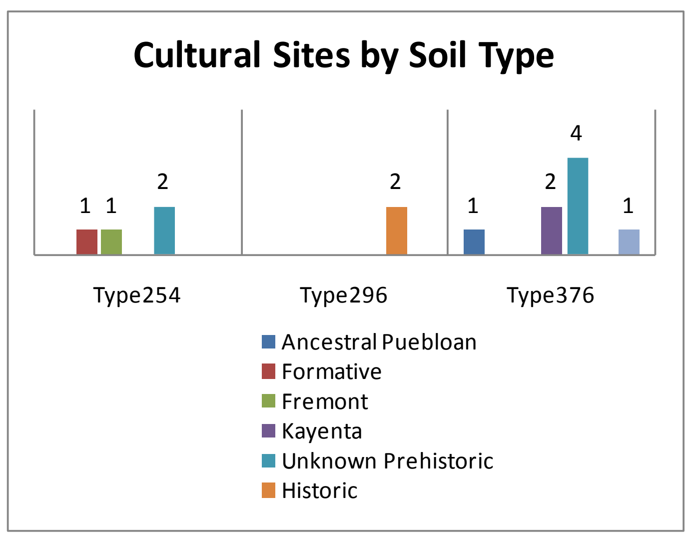


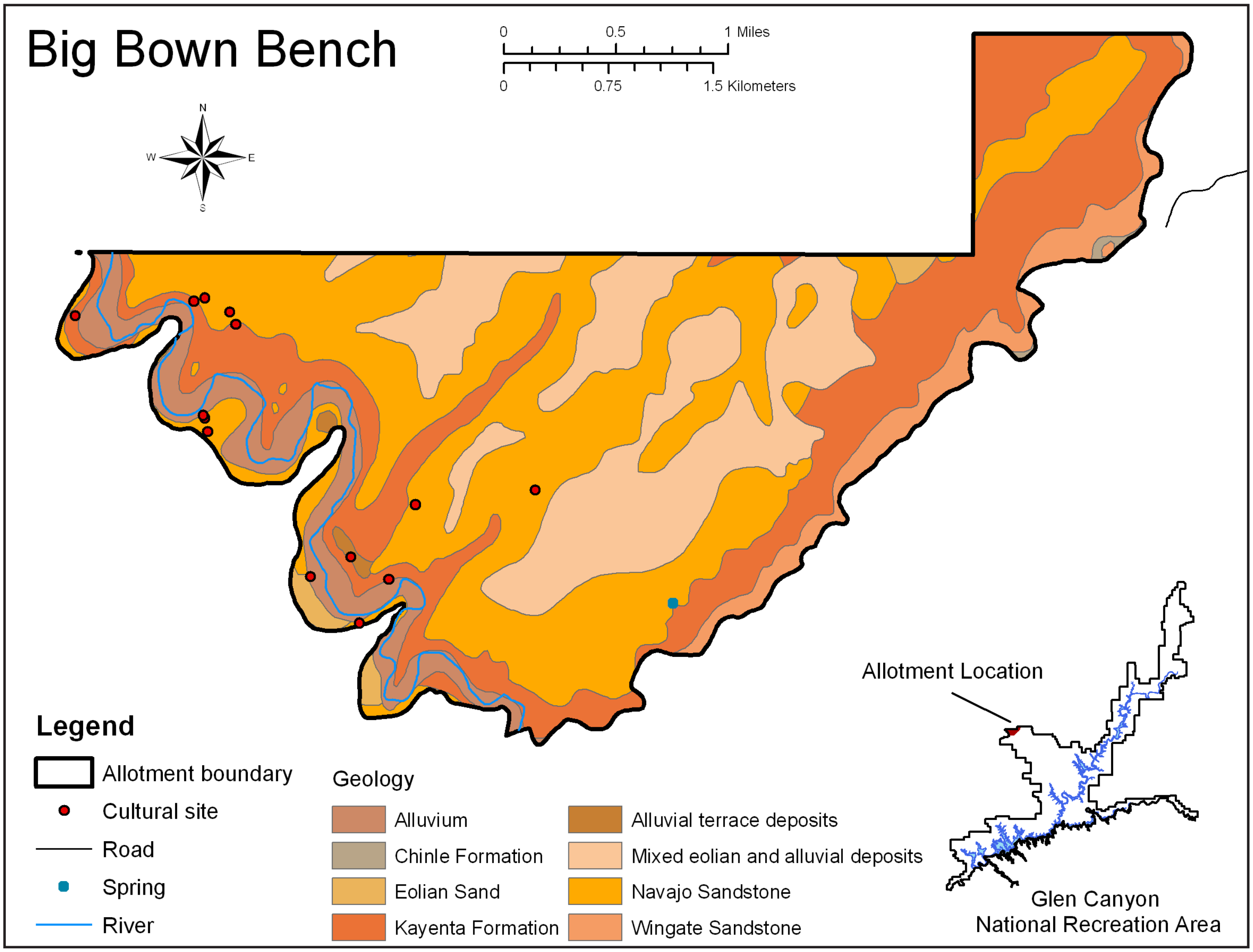
Allotment Divided by Soil Type (MUSYM):

Soil Type	Acres	Percent	No. Cultural Sites
235	716.03	17.15	0
252	1252.05	29.98	0
254	1025.00	24.46	4
296	349.16	8.36	2
375	37.98	0.91	0
376	795.67	19.05	8
Total	**4175.89**	**99.91%**	**14**

Distribution of Cultural Sites by Soil Type:

Four sites (n = 4) occur in soil type 254, including one Fremont, one Formative, and two prehistoric sites of unknown affiliation. Of the two unknown prehistoric sites, one consists of a rock art panel, and one of artifacts, corn cobs, and a midden. Two sites (n = 2), both historic, occur in soil type 296. The remaining eight sites (n = 8) occur in soil type 376. These sites include an Ancestral Puebloan site, two Kayenta sites, four prehistoric sites of unknown affiliation, and one site for which attributes or affiliations of any sort are currently unknown.



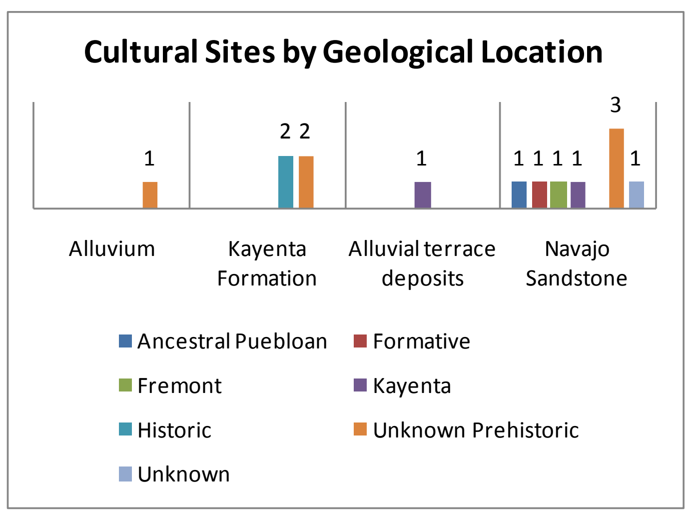


Allotment Divided by Geology:

Geology	Acres	Percent	No. Cultural Sites
Alluvium	316.58	7.58	1
Chinle Formation	8.88	0.21	0
Eolian Sand	42.85	1.03	0
Kayenta Formation	1087.46	26.04	4
Alluvial terrace deposits	13.40	0.32	1
Mixed eolian and alluvial deposits	847.16	20.29	0
Navajo Sandstone	1655.36	39.64	8
Wingate Sandstone	204.05	4.89	0
Total	**4175.74**	**100%**	**14**

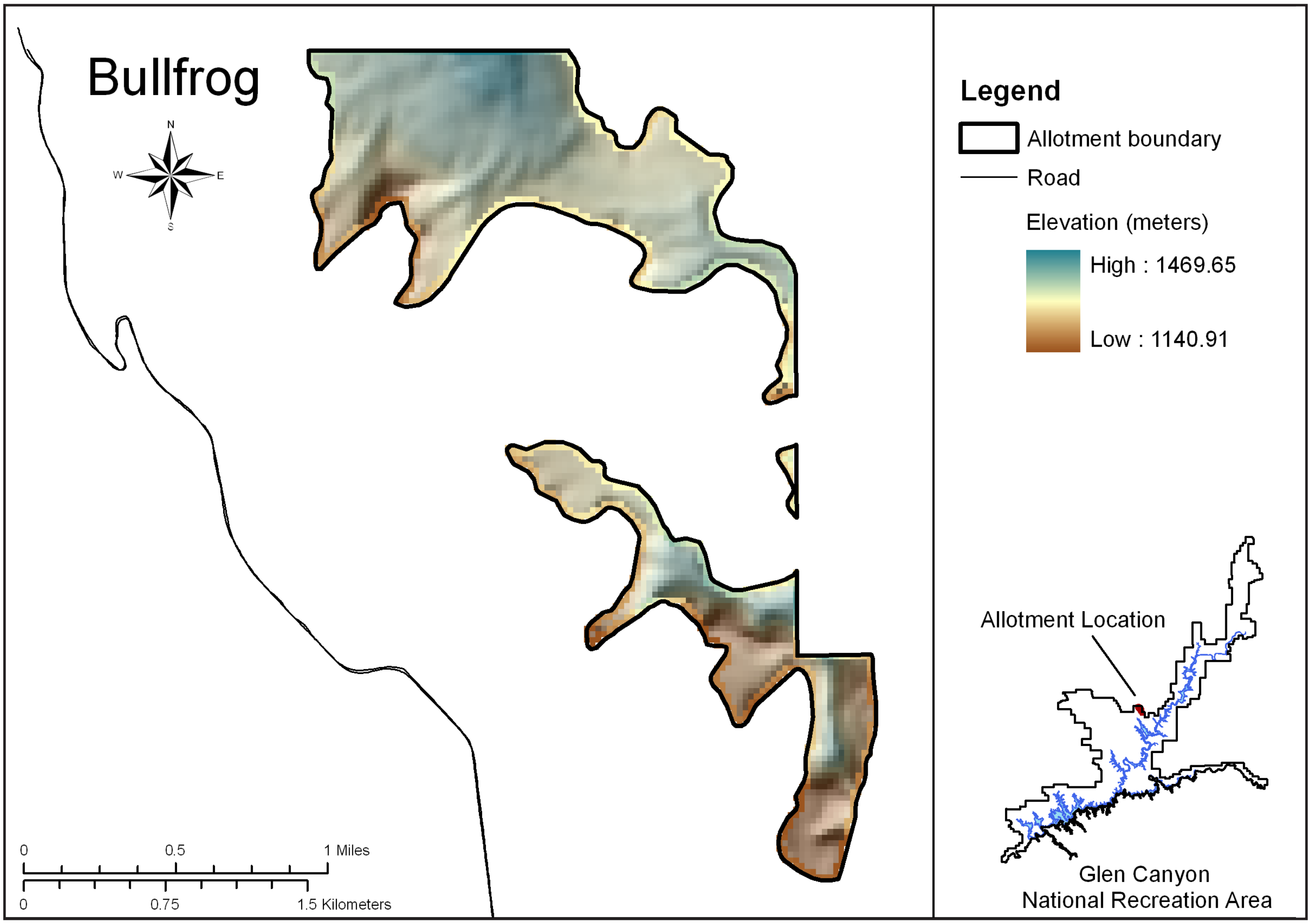
Distribution of Cultural Sites by Geological Location:

A single (n = 1) lithic scatter of unknown affiliation occurs in alluvium. Four sites (n = 4) occur along the Kayenta formation, including a prehistoric granary and rock art panel of unknown affiliation, and two historic sites. A single (n = 1) Kayenta site occurs on alluvial terrace deposits. The remaining eight sites (n = 8), including one each of Ancestral Puebloan, Formative, and Kayenta, three prehistoric sites of unknown affiliation, and a single site for which no attribute or affiliation information is currently known, all occur on Navajo Sandstone, often called slickrock.



Bullfrog

Map Panels



Total Area: 757.84 acres

Sampling Fractions:
2 percent: 15.16 acres
5 percent: 37.89 acres
11 percent: 83.36 acres
16 percent: 121.25 acres
20 percent: 151.57 acres

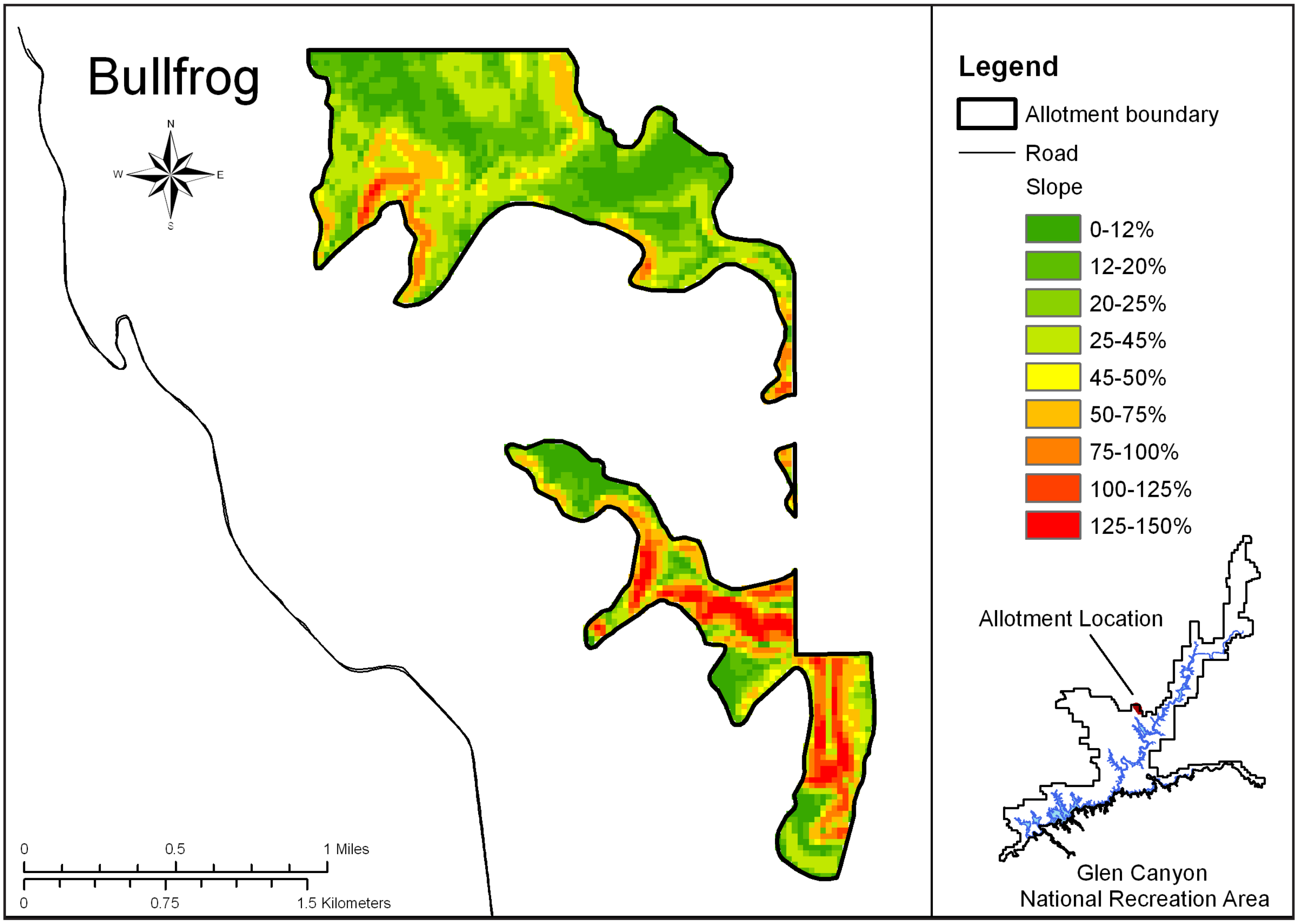
Elevation range amsl:
1140.91-1469.65 meters (3743.14 - 4821.69 feet)

Rivers and Springs:
None currently known.

Accessibility:
Bullfrog grazing allotment is accessible by County Hwy 531, which parallels the allotment on the west side. Note this road floods at lake level 3,695 feet.

Camping is also close, with campgrounds at Bullfrog North (located southwest of the allotment). A clinic, visitor's center, and paved airstrip are also located within a few miles of the allotment to the south.

No. Cultural Sites: 0
Area surveyed: 0.00 acres



Slope Considerations:

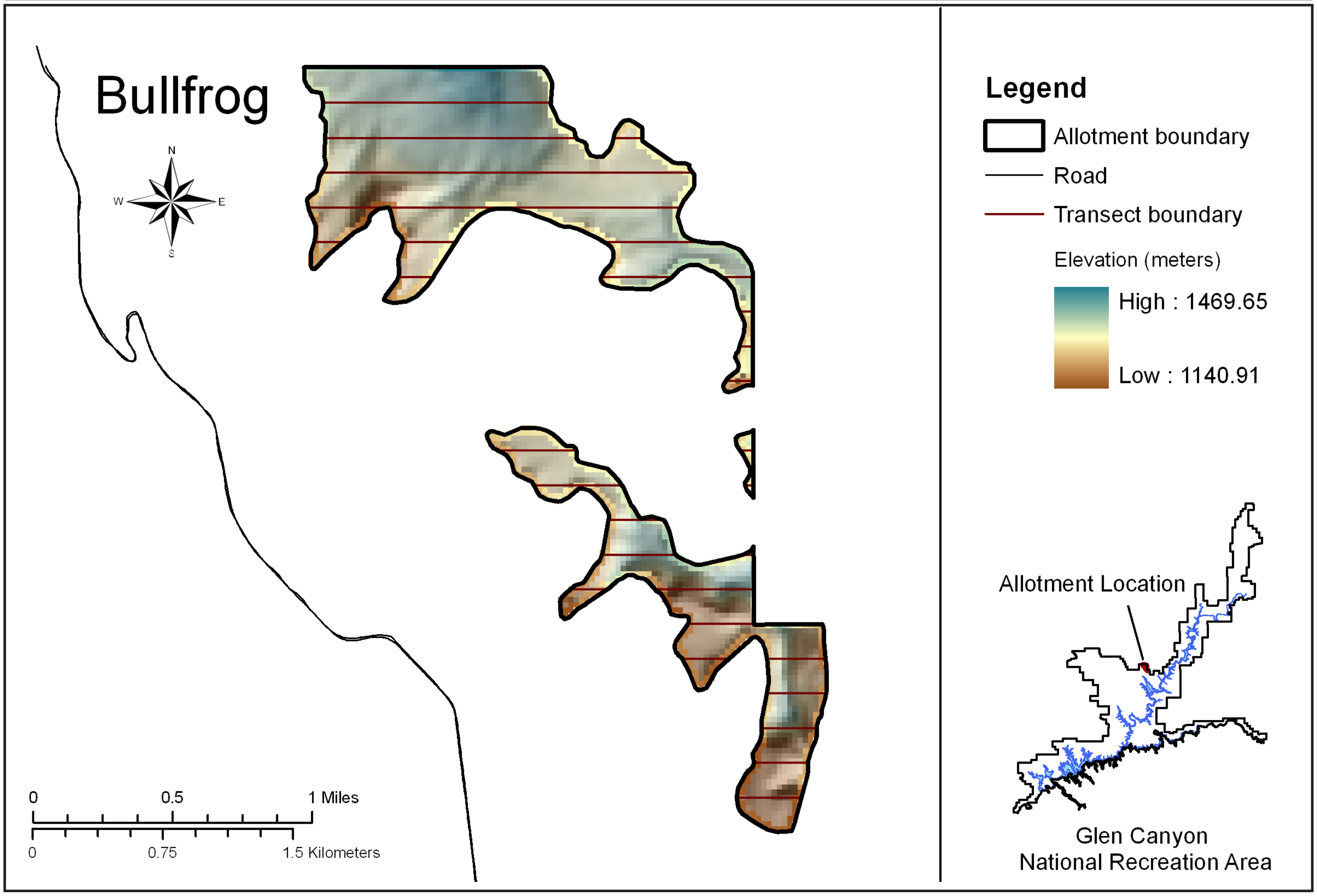
Slope plays a large role in terrain accessibility, and may be used in the stratification of survey areas. For example, GCNRA may wish to assign catagories such as low, moderate, and high to specific slope gradients. Such assignations are most often dependent on the factors guiding archaeological survey work, and as such, are not included in this document. Included herein, however, are suggestions for basic transect orientation based on the presence of topographical barriers identified by the presence of excessive slope gradients.

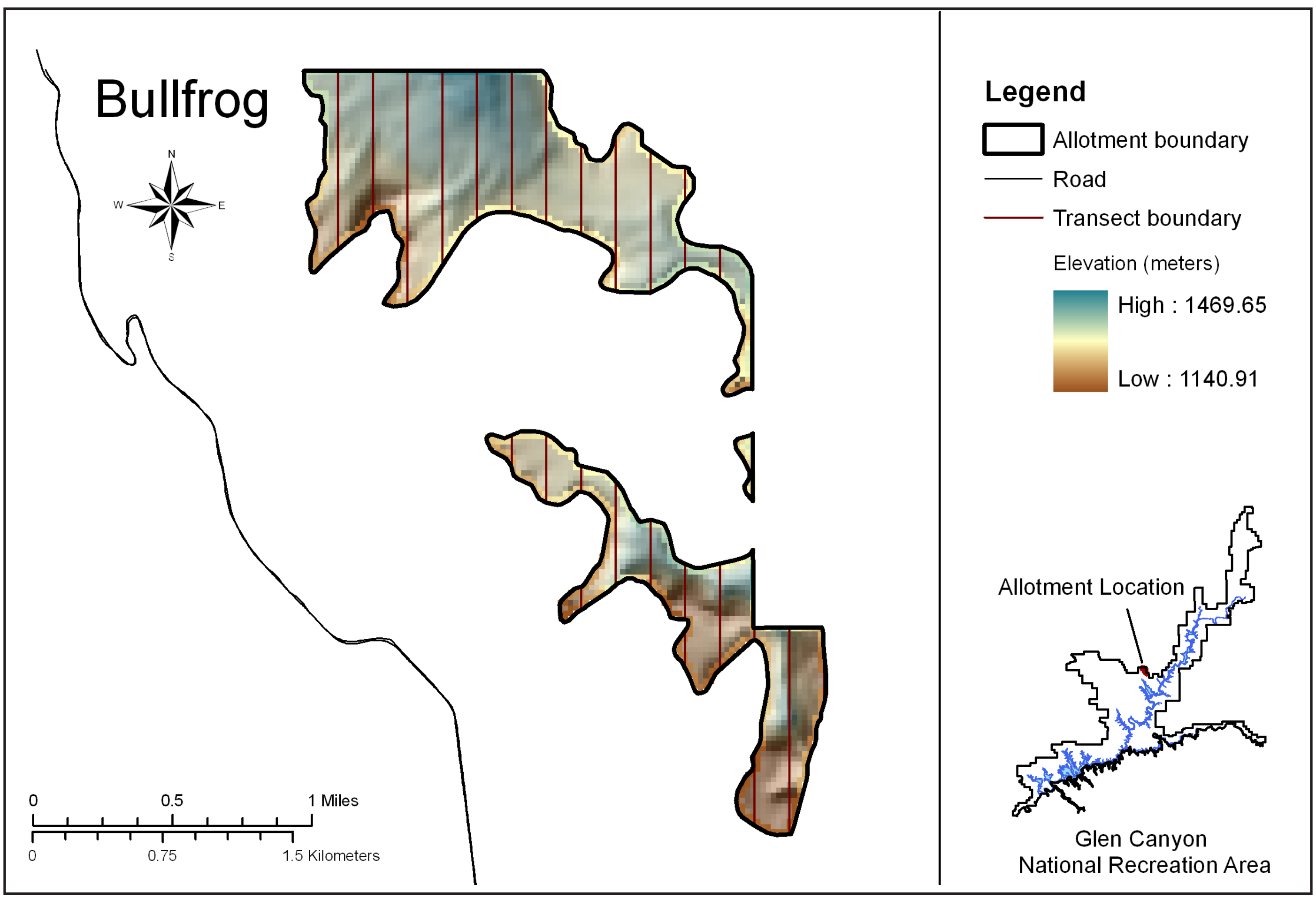
Survey Zones Dictated by Slope:

Excessive slope in the southern portion of the allotment dictates the use of east-west transects whenever possible. Most of the southern portion of the allotment, however, may necessitate aerial investigations because of excessive slope gradients.

The north is less affected by slope; therefore, both north-south and east-west transects are feasible in the northern portion.

The 'fishnet' maps provided on the subsequent page provide transects spaced at 200 meter intervals for both east-west and north-south oriented pedestrian survey.


Bullfrog
N
W
E
S
0
0.5
1 Miles
0
0.75
1.5 Kilometers
Legend
Allotment boundary
Road
Transect boundary
Elevation (meters)
High : 1469.65
Low : 1140.91
Allotment Location
Glen Canyon
National Recreation Area


Bullfrog
N
W
E
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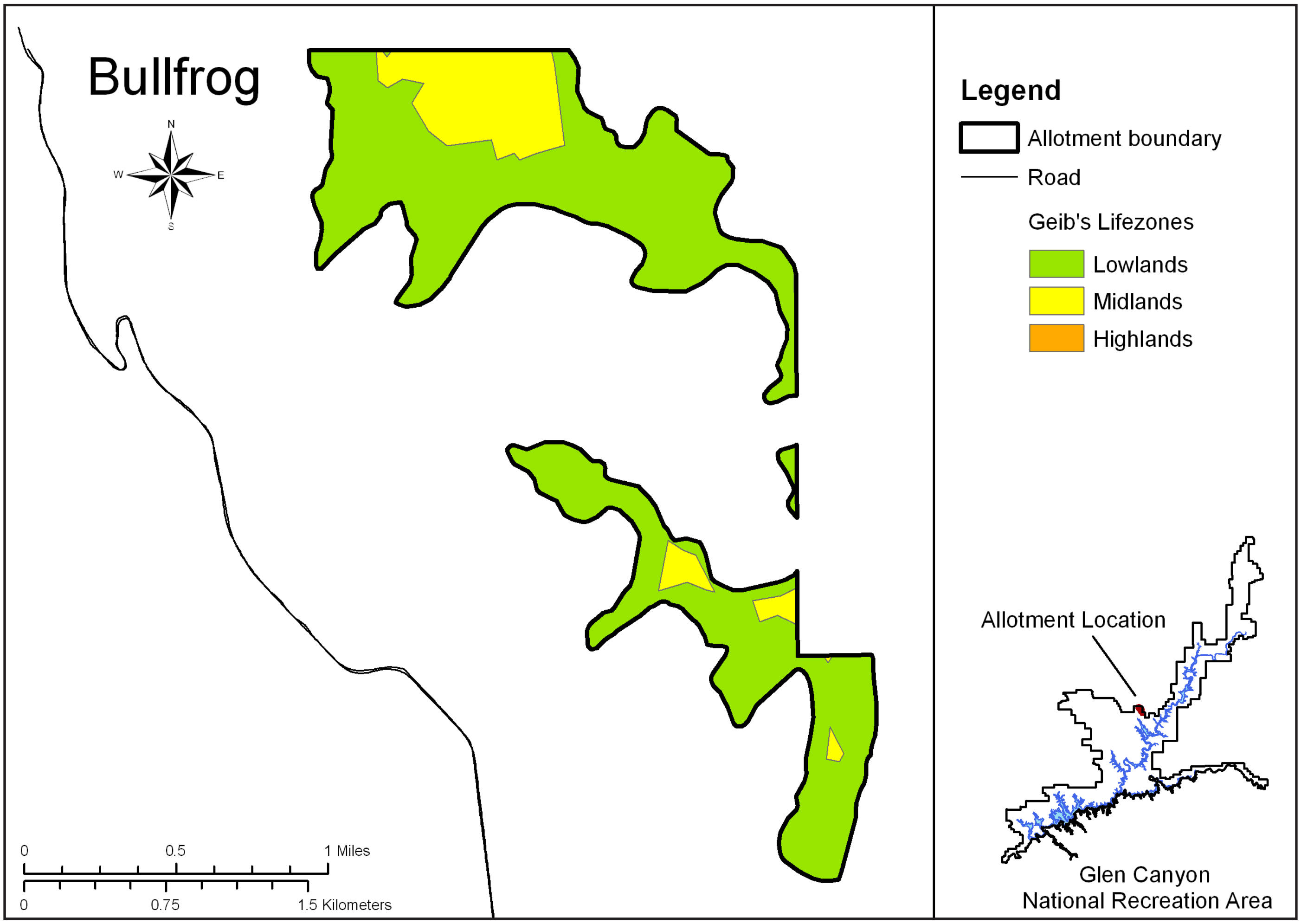
0
0.5
1 Miles
0
0.75
1.5 Kilometers
Legend
Allotment boundary
Road
Transect boundary
Elevation (meters)
High : 1469.65
Low : 1140.91
Allotment Location
Glen Canyon
National Recreation Area



Area of Each Lifezone:

Highlands: 0.00 acres
Midlands: 124.87 acres
Lowlands:633.49 acres

No. Cultural Sites in Each Lifezone:

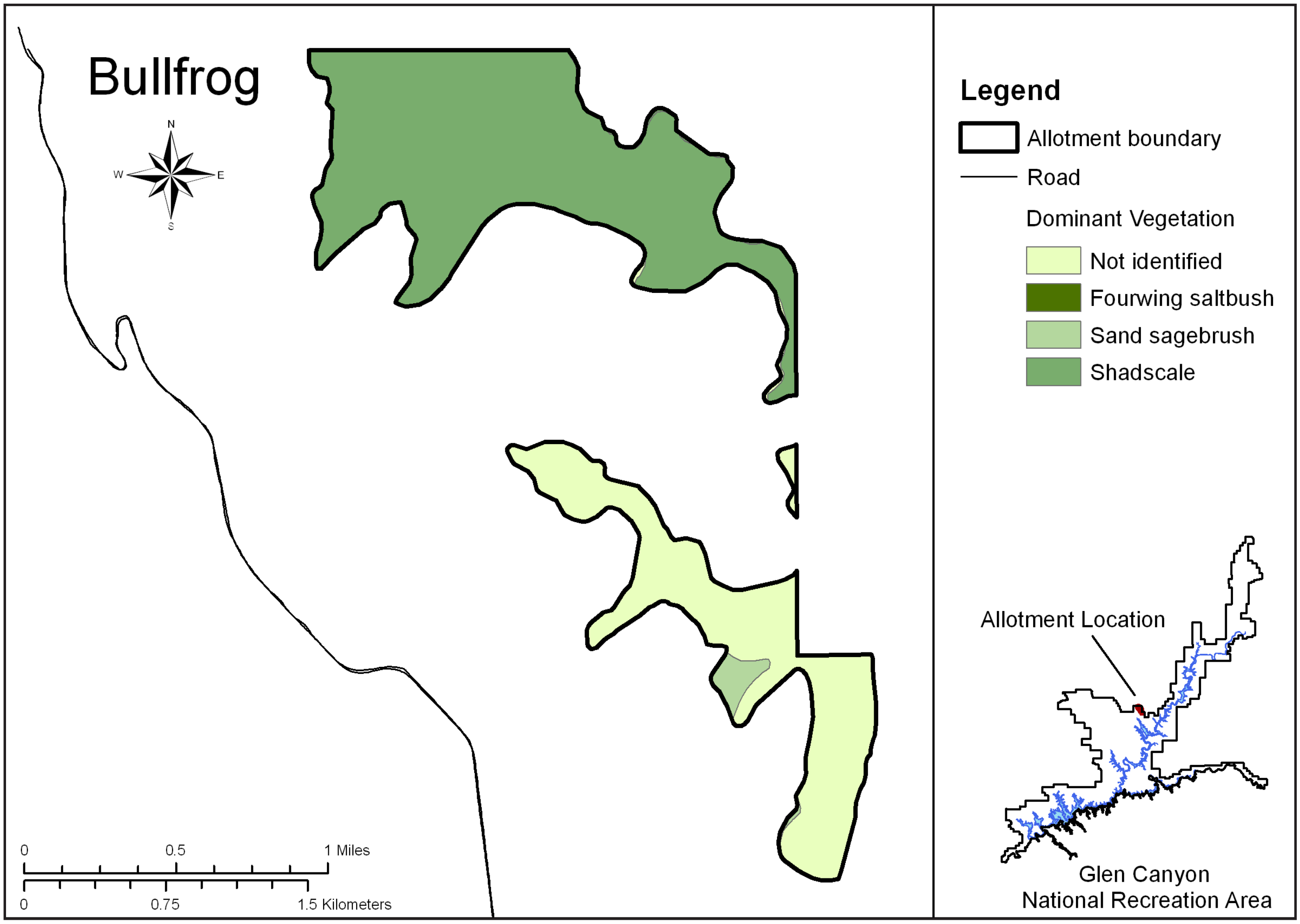
Highlands: 0
Midlands: 0
Lowlands: 0

Lifezone Significance and Known Cultural Sites:

No cultural sites are currently known for Bullfrog grazing allotment.

	Elevation	Characteristics	Environment	Significance to Humans
Lowlands	1219-1372 m (4000-4500 ft)	Hot and arid steep-walled sandstone canyons.	Riparian plants; big-horn sheep	Permanent water, arable alluvium, long growing season, diverse plant communities, natural shelters, quality siliceous stone from river gravels
Midlands	1372-1676 m (4500-5500 ft)	Arid slickrock and dune fields on benchlands and low plateaus.	Blackbrush, shadscale, grasses; antelope.	Grasses, including dropseed and ricegrass, prickly pear and shadscale; good antelope habitat, quality siliceous stone in certain locations.
Highlands	Above 1676 m (Above 5500 ft)	High elevation mesas and plateaus with cooler temperatures and greater precipitation.	Pinyon-juniper woodlands; deer and rabbit.	Higher elevation plant foods (i.e. pinyon); later harvests; dry-farming; abundant fuel, deer and rabbit.

Shading indicates lifezones present in allotment.



Area of Individual Vegetation Zones:

Dominant Species	Acres Covered	No. Sites
Not identified	254.96	0
Sand Sagebrush ***(Artemisia filifolia)***	13.97	0
Fourwing saltbush **(*Atriplex canescens*)**	0.06	0
Shadscale ***(Atriplex confertifolia)***	487.86	0
Total	**756.85**	**0**

No. Cultural Sites in Each Vegetation Zone:
No cultural sites are known for Bullfrog allotment at this time.

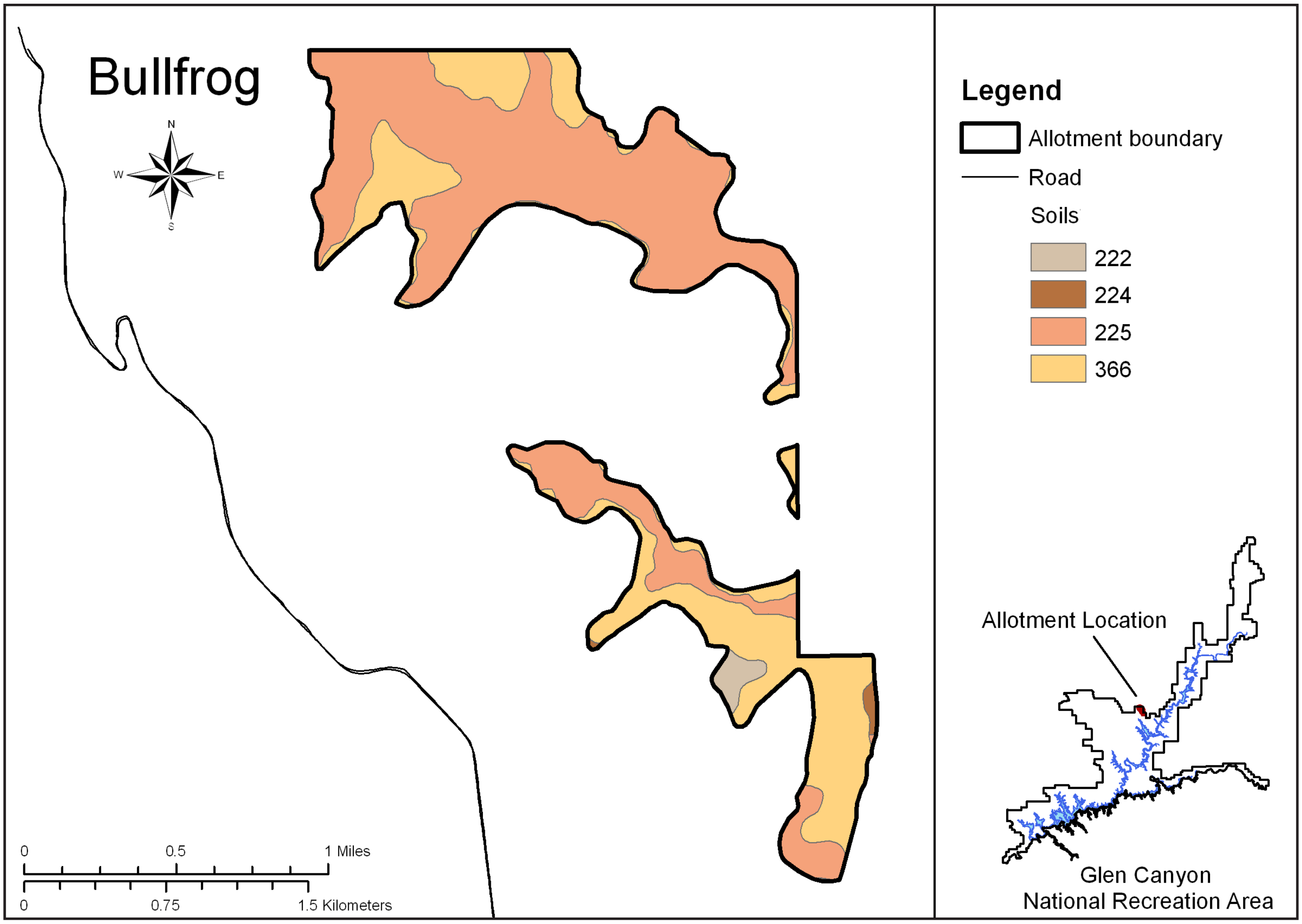
Visibility:
In general, the dominant vegetative communities of Bullfrog allotment provide moderate - excellent visibility for the archaeologist, with large portions of the ground between plants bare of vegetation.

Summary:
The primary dominant vegetation zones within the Bullfrog grazing allotment include fourwing saltbush (<0.00 percent), sand sagebrush (1.84 percent), and shadscale (64.38 percent). Dominant vegetation for the remainder of the allotment is not currently known.

Dominant Species:
Shadscale (*Atriplex confertifolia*)
Sand sagebrush (*Artemisia filifolia*)
Fourwing saltbush *(Atriplex canescens*)

Secondary Dominant Species:
Blackbrush (*Coleogyne ramosissima*)

Associated Soils:
Fourwing saltbush grows primarily in sandy loam. Sand sagebrush occurs in sand, and shadscale dominates in shallow sandy loam, where it often occurs alongside blackbrush.

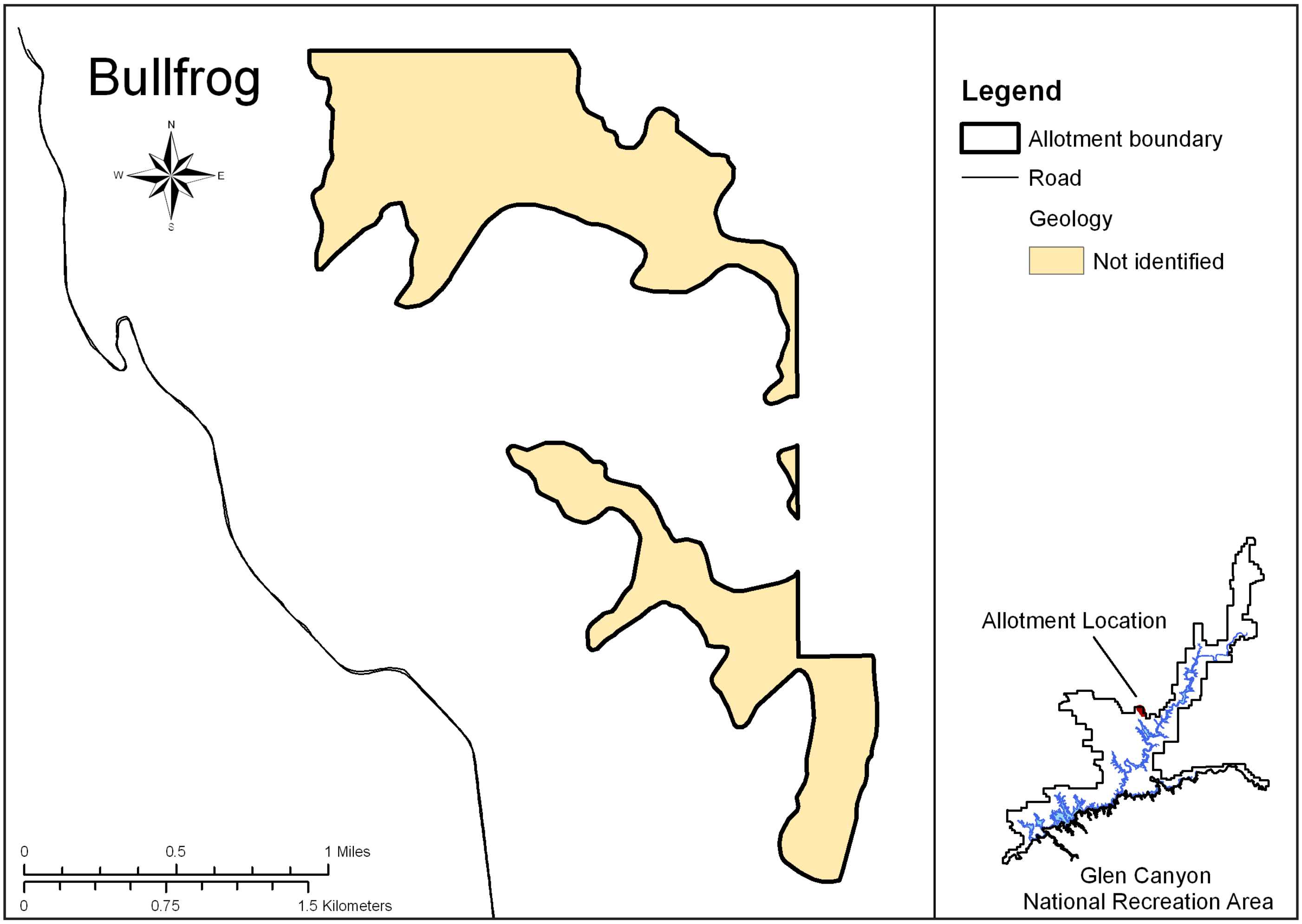


Allotment Divided by Soil Type (MUSYM):

Soil Type	Acres	Percent	No. Cultural Sites
222	11.77	1.55	0
224	4.80	0.63	0
225	476.03	62.81	0
366	265.23	35.00	0
Total	**757.83**	**99.99%**	**0**

Distribution of Cultural Sites by Soil Type:

No cultural sites are known for Bullfrog allotment at this time.



Allotment Divided by Geology:

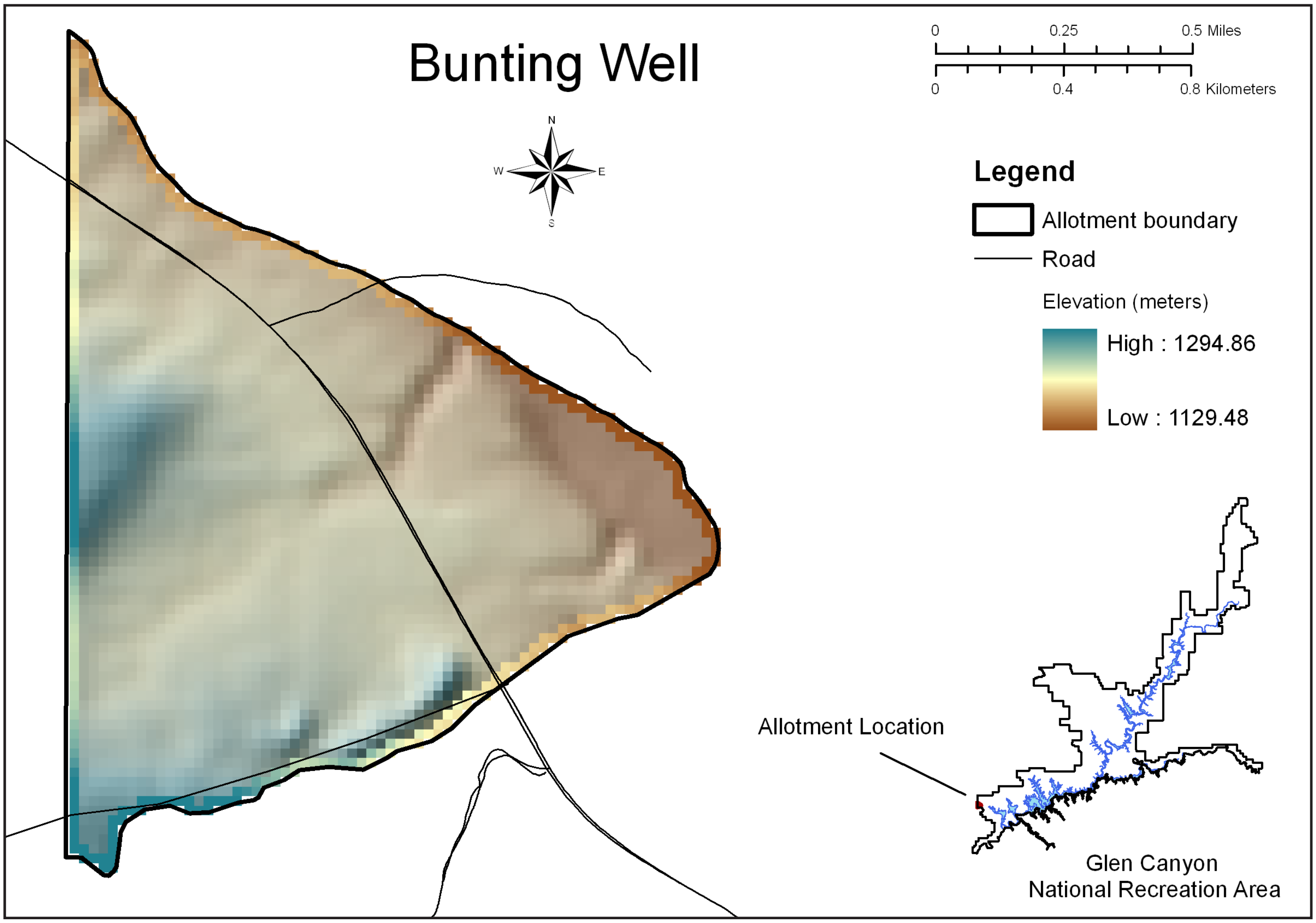
No geological information for Bullfrog grazing allotment is available at this time.

Distribution of Cultural Sites by Geological Location:

No cultural sites are known for Bullfrog allotment.

Bunting Well

Map Panels



Total Area: 691.29 acres

Sampling Fractions:
2 percent: 13.83 acres
5 percent: 35.56 acres
11 percent: 76.04 acres
16 percent: 110.61 acres
20 percent: 138.26 acres

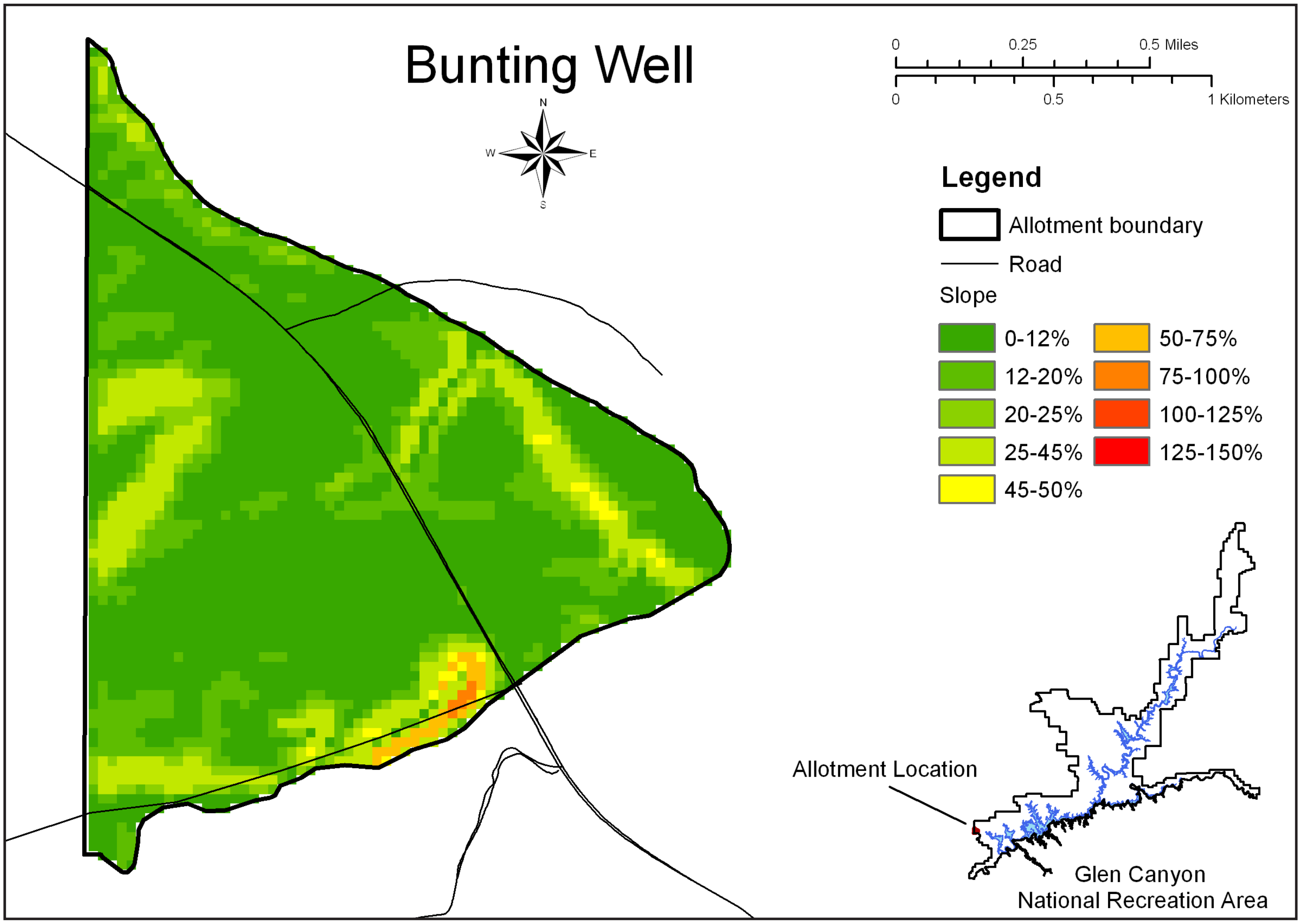
Elevation range amsl:
1129.48 – 1294.86 meters (3705.64 - 4249.23 feet)

Rivers and Springs:
None currently known.

Accessibility:
Bunting Well allotment is accessible by Hwy 89, which passes through the center of the allotment, and by lateral roadways.

Camping is available at Lone Rock Campground, located southeast of the allotment, just north of Wahweap.

No. Cultural Sites: 0
Area surveyed: 0.00 acres



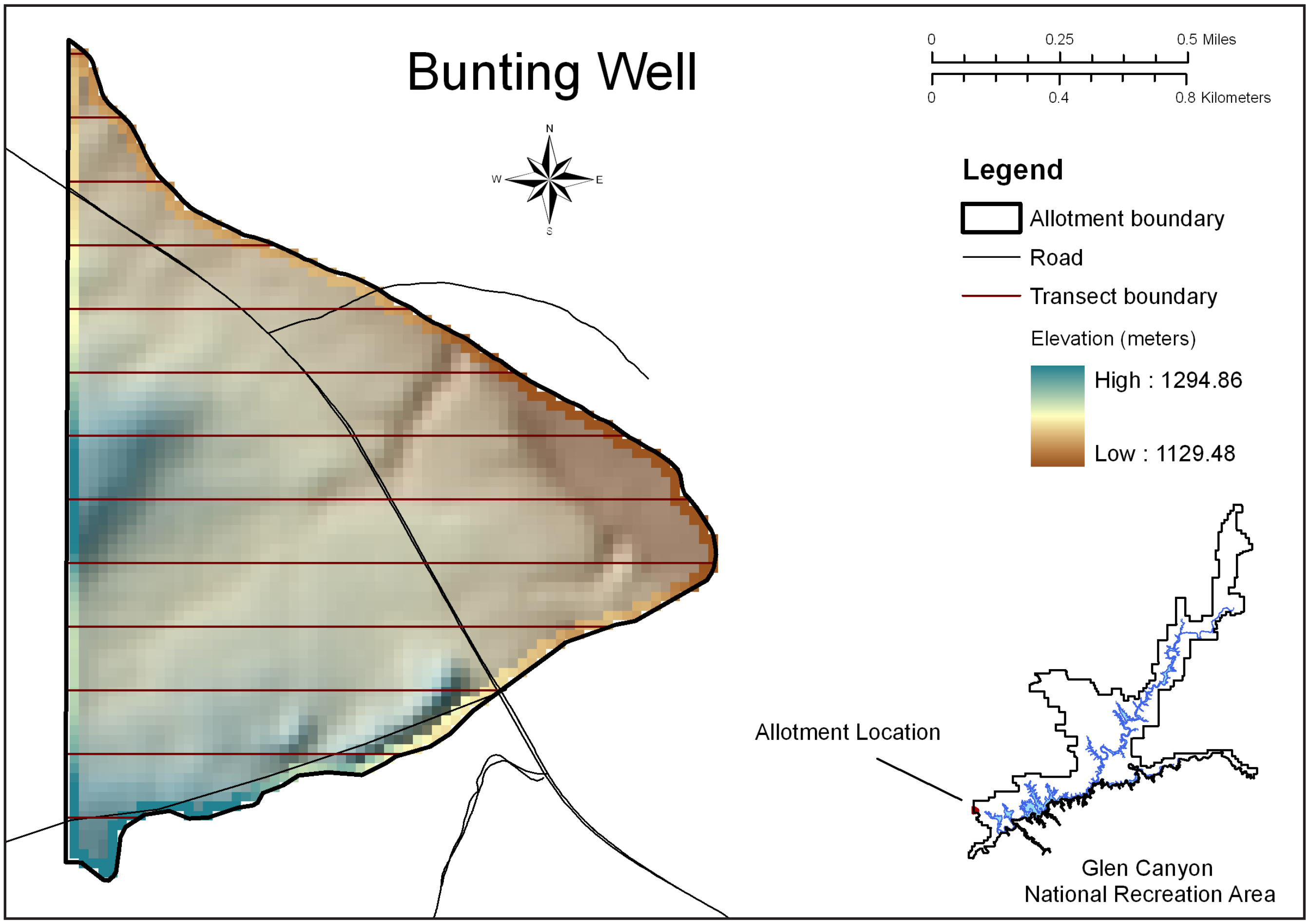
Slope Considerations:

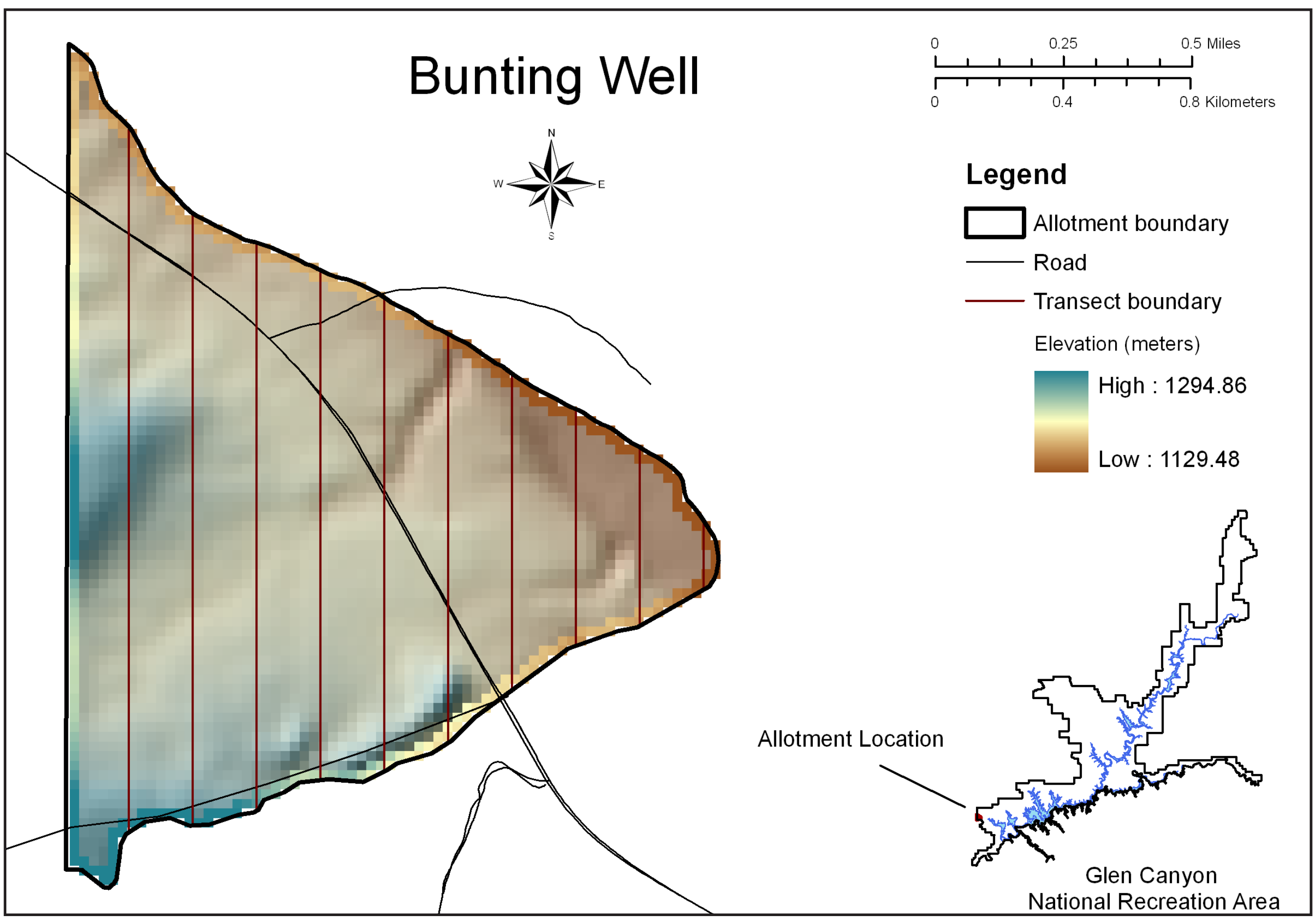
Slope plays a large role in terrain accessibility, and may be used in the stratification of survey areas. For example, GCNRA may wish to assign catagories such as low, moderate, and high to specific slope gradients. Such assignations are most often dependent on the factors guiding archaeological survey work, and as such, are not included in this document. Included herein, however, are suggestions for basic transect orientation based on the presence of topographical barriers identified by the presence of excessive slope gradients.

Survey Zones Dictated by Slope:

With the exception of one very small, steep slope, the entirety of Bunting Well is characterized by relatively low slope gradients. Recommended transects should be oriented east-west from Hwy 89 whenever possible, or set perpendicular to lateral roadways.

The 'fishnet' maps provided on the subsequent page provide transects spaced at 200 meter intervals for both east-west and north-south oriented pedestrian survey.


Bunting Well
0
0.25
0.5 Miles
0
0.4
0.8 Kilometers
N
W
E
S
Legend
Allotment boundary
Road
Transect boundary
Elevation (meters)
High : 1294.86
Low : 1129.48
Allotment Location
Glen Canyon
National Recreation Area


Bunting Well
0
0.25
0.5 Miles
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0.4
0.8 Kilometers
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Allotment boundary
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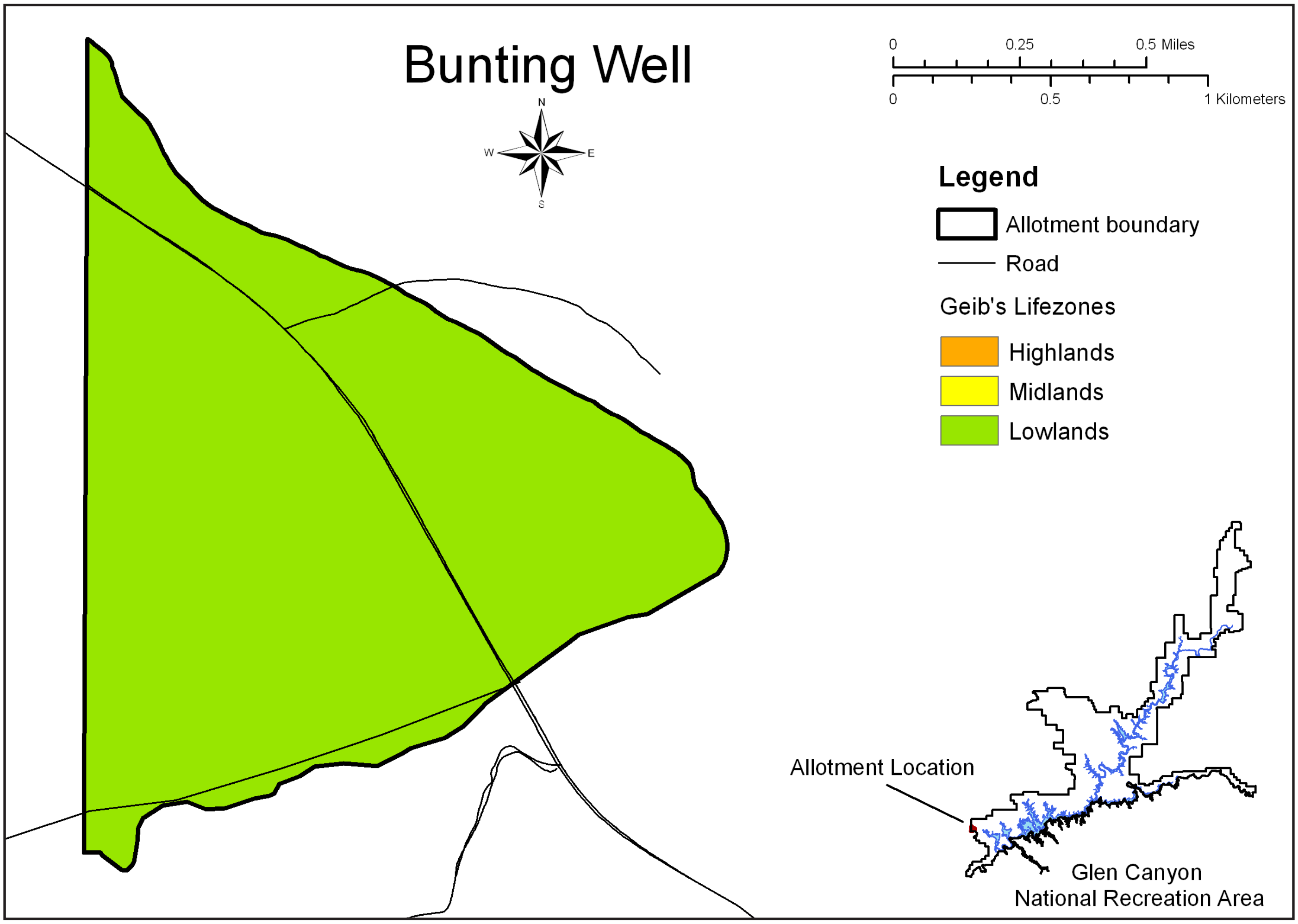
National Recreation Area



Area of Each Lifezone:

Highlands: 0.00 acres
Midlands: 0.00 acres
Lowlands: 691.29 acres

No. Cultural Sites in Each Lifezone:

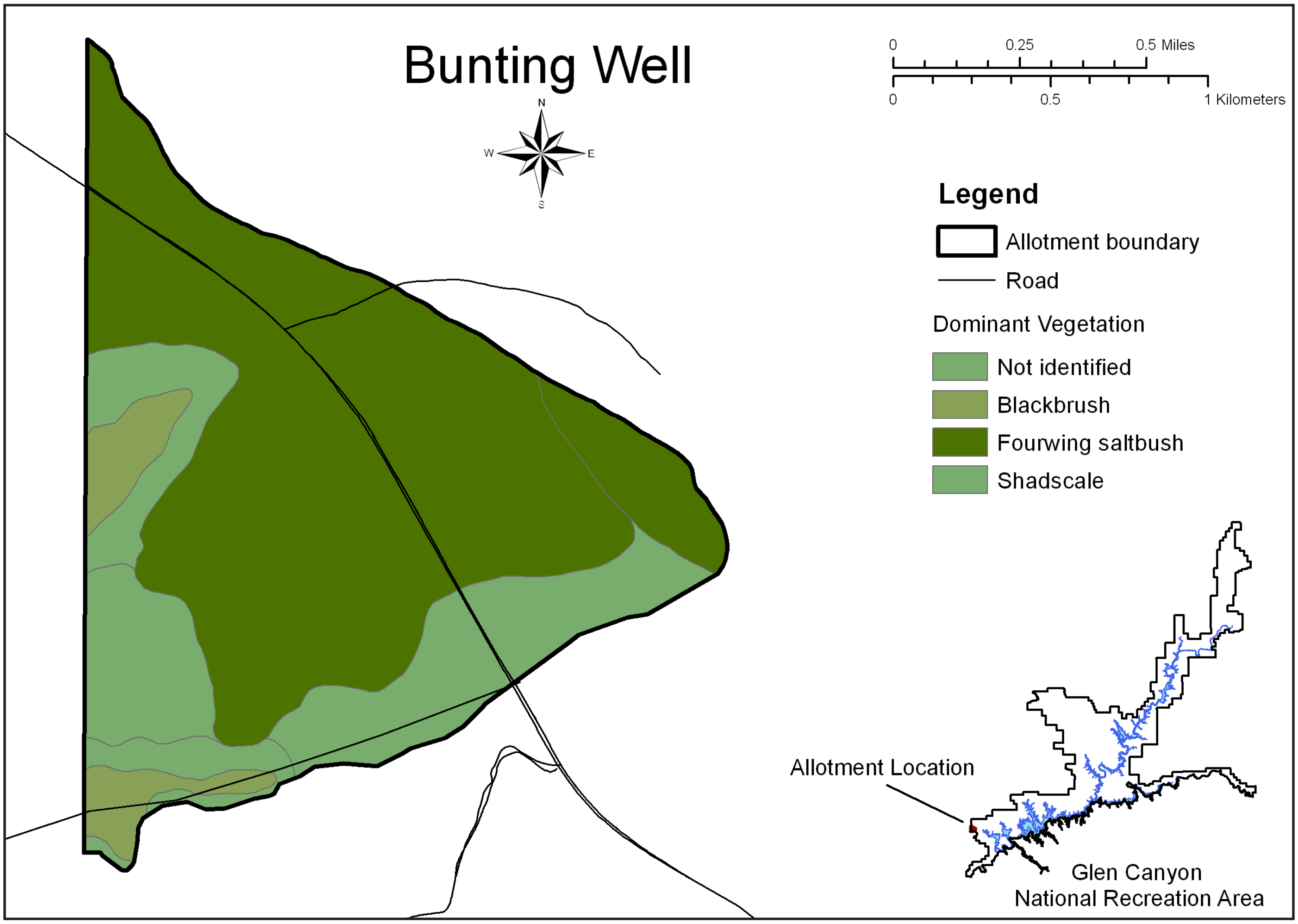
Highlands: 0
Midlands: 0
Lowlands: 0

Lifezone Significance and Known Cultural Sites:

No cultural sites are currently known for Bunting Well grazing allotment.

	Elevation	Characteristics	Environment	Significance to Humans
Lowlands	1219-1372 m (4000-4500 ft)	Hot and arid steep-walled sandstone canyons.	Riparian plants; big-horn sheep	Permanent water, arable alluvium, long growing season, diverse plant communities, natural shelters, quality siliceous stone from river gravels
Midlands	1372-1676 m (4500-5500 ft)	Arid slickrock and dune fields on benchlands and low plateaus.	Blackbrush, shadscale, grasses; antelope.	Grasses, including dropseed and ricegrass, prickly pear and shadscale; good antelope habitat, quality siliceous stone in certain locations.
Highlands	Above 1676 m (Above 5500 ft)	High elevation mesas and plateaus with cooler temperatures and greater precipitation.	Pinyon-juniper woodlands; deer and rabbit.	Higher elevation plant foods (i.e. pinyon); later harvests; dry-farming; abundant fuel, deer and rabbit.

Shading indicates lifezones present in allotment.



Area of Individual Vegetation Zones:

Dominant Species	Acres Covered	No. Sites
Not identified	58.64	0
Blackbrush (Coleogyne ramosissima)	36.53	0
Fourwing saltbush (*Atriplex canescens)*	459.79	0
Shadscale *(Atriplex confertifolia)*	136.34	0
Total	**691.30**	**0**

No. Cultural Sites in Each Vegetation Zone:
No cultural sites are currently known for Bunting Well grazing allotment.

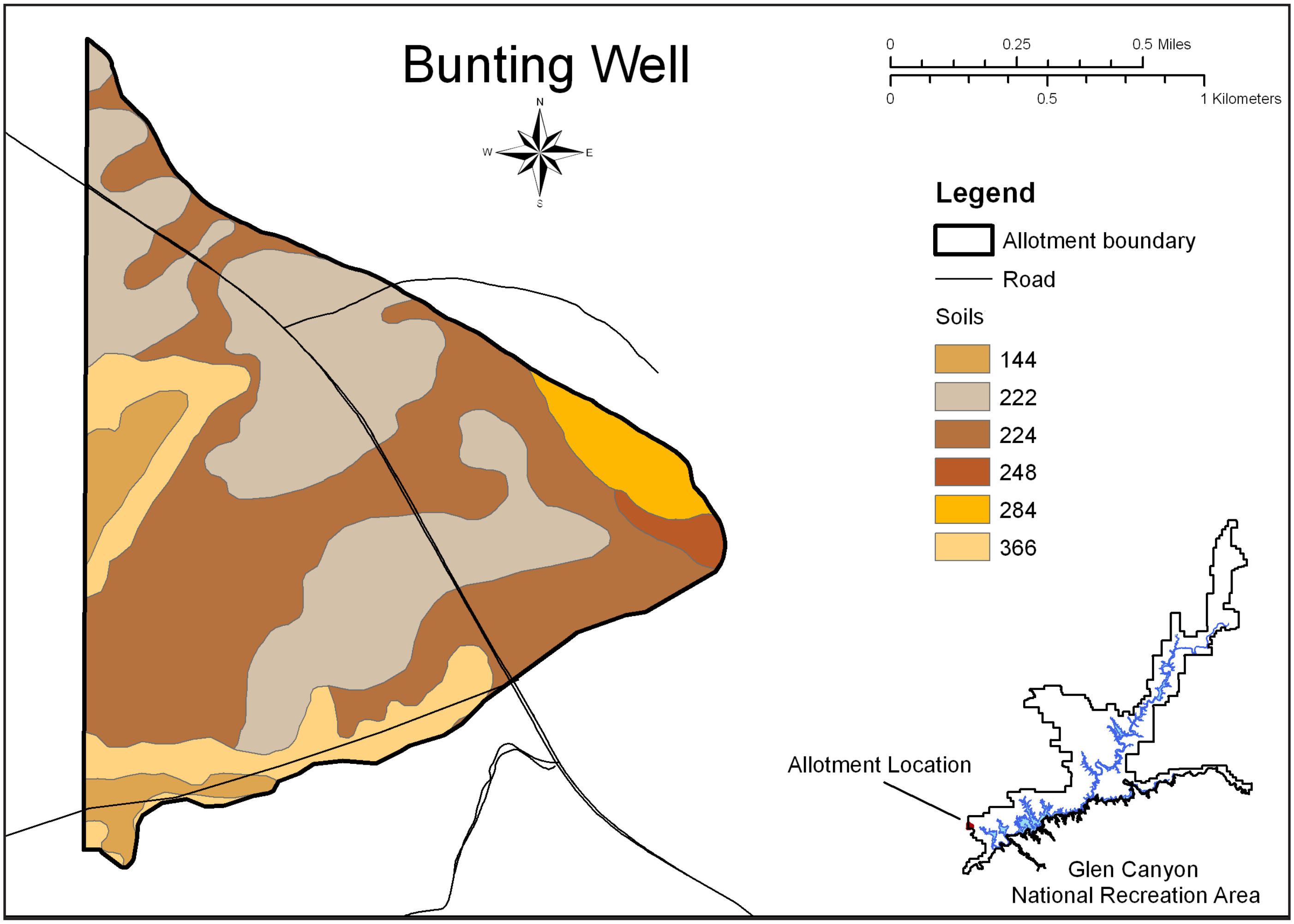
Visibility:
In general, the dominant vegetative communities of Bullfrog allotment provide moderate - excellent visibility for the archaeologist, with large portions of the ground between plants bare of vegetation.

Summary:
The primary dominant vegetation zones within the Bunting Well grazing allotment include fourwing saltbush (66.51 percent), blackbrush (5.28 percent), and shadscale (19.72 percent). Dominant vegetation for the remainder of the allotment is not currently known.

Dominant Species:
Blackbrush (*Coleogyne ramosissima*)
Fourwing saltbush *(Atriplex canescens*)
Shadscale (*Atriplex confertifolia*)

Secondary Dominant Species:
Fremont cottonwood (*Populus fremontii*)

Associated Soils:
Blackbrush grows primarily in shallow sandy loam. Fourwing saltbush dominates in sandy bottom, and may be associated with Fremont cottonwood growing in semiwet saline streambanks. Fourwing saltbush also occurs in sandy loam. The remaining dominant species for Bunting Well occurs in shallow loam.

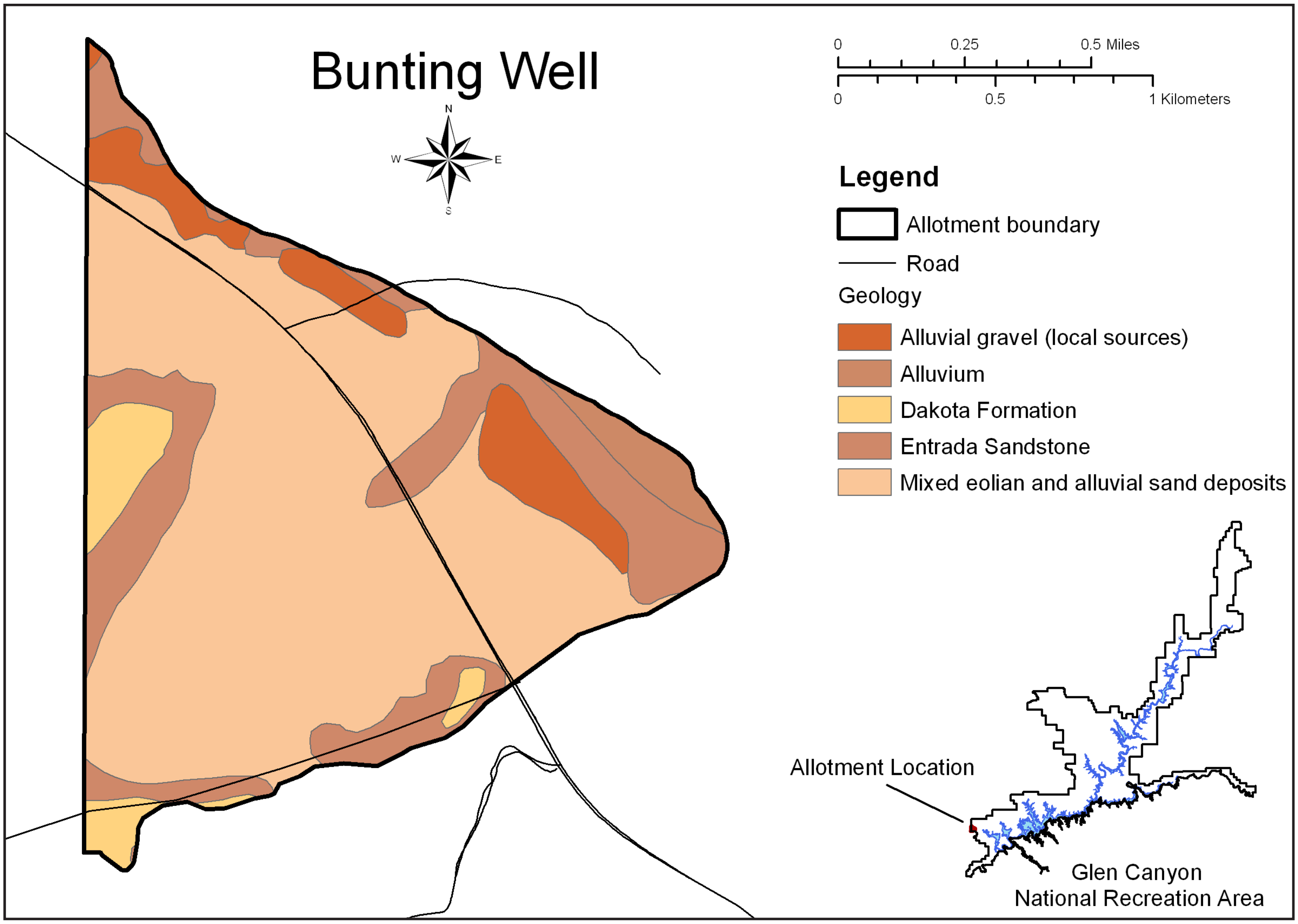


Allotment Divided by Soil Type (MUSYM):

Soil Type	Acres	Percent	No. Cultural Sites
144	34.40	4.98	0
222	248.87	36.00	0
224	293.62	42.47	0
248	8.71	1.26	0
284	25.76	3.73	0
366	79.93	11.56	0
Total	**691.29**	**100%**	**0**

Distribution of Cultural Sites by Soil Type:

No cultural sites are known for Bunting Well allotment at this time.



Allotment Divided by Geology:

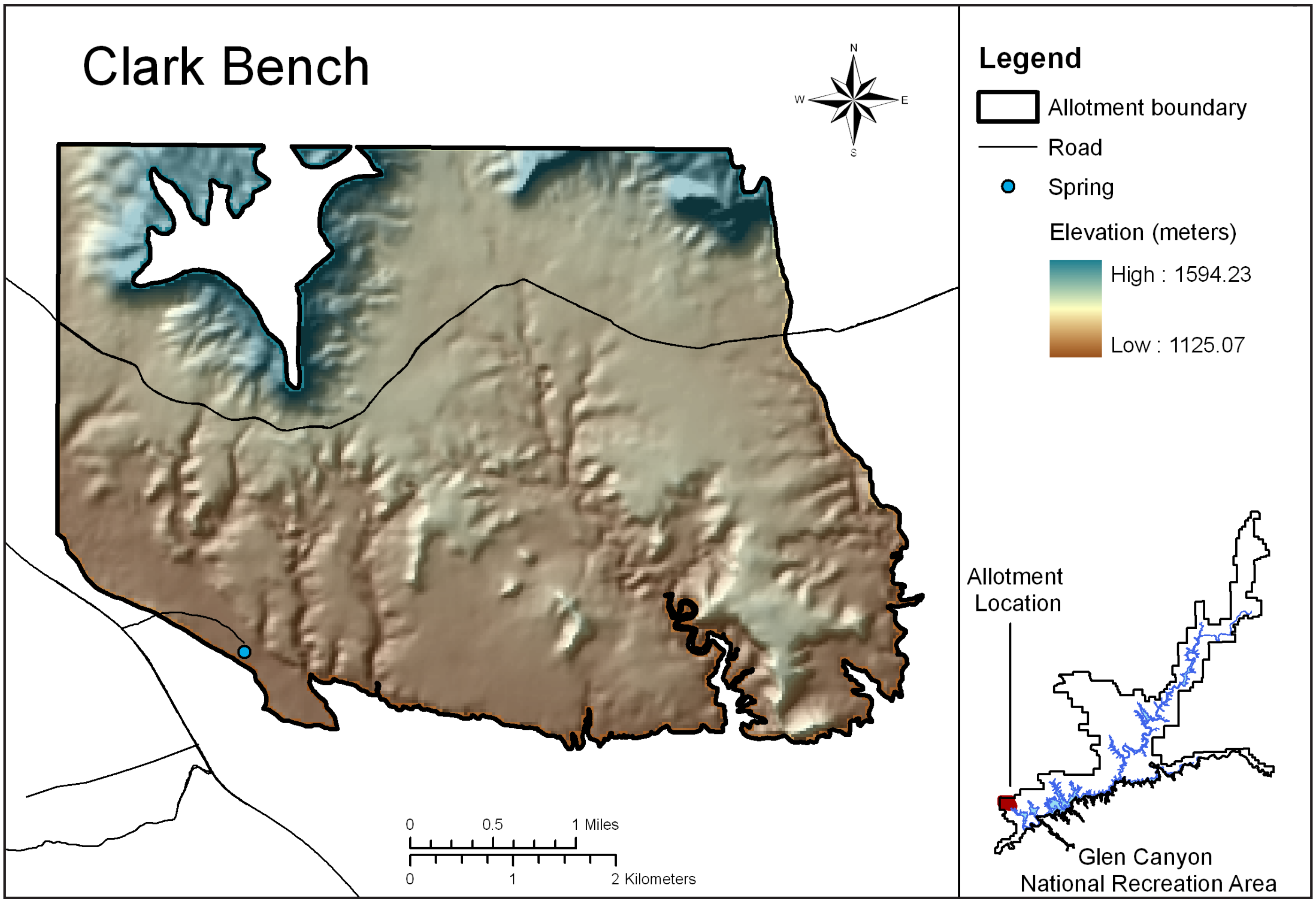
Geology	Acres	Percent	No. Cultural Sites
Alluvial gravel (local sources)	54.63	7.90	0
Alluvium	16.87	2.44	0
Dakota Formation	33.03	4.78	0
Entrada Sand-stone	137.24	19.85	0
Mixed eolian and alluvial deposits	449.50	65.02	0
Total	**691.27**	**99.99%**	**0**

Distribution of Cultural Sites by Geological Location:

No cultural sites are known for Bunting Well at this time.

Clark Bench

Map Panels



Total Area: 9433.78 acres

Sampling Fractions:
2 percent: 188.68 acres
5 percent: 471.69 acres
11 percent: 1037.72 acres
16 percent: 1509.41 acres
20 percent: 1886.76 acres

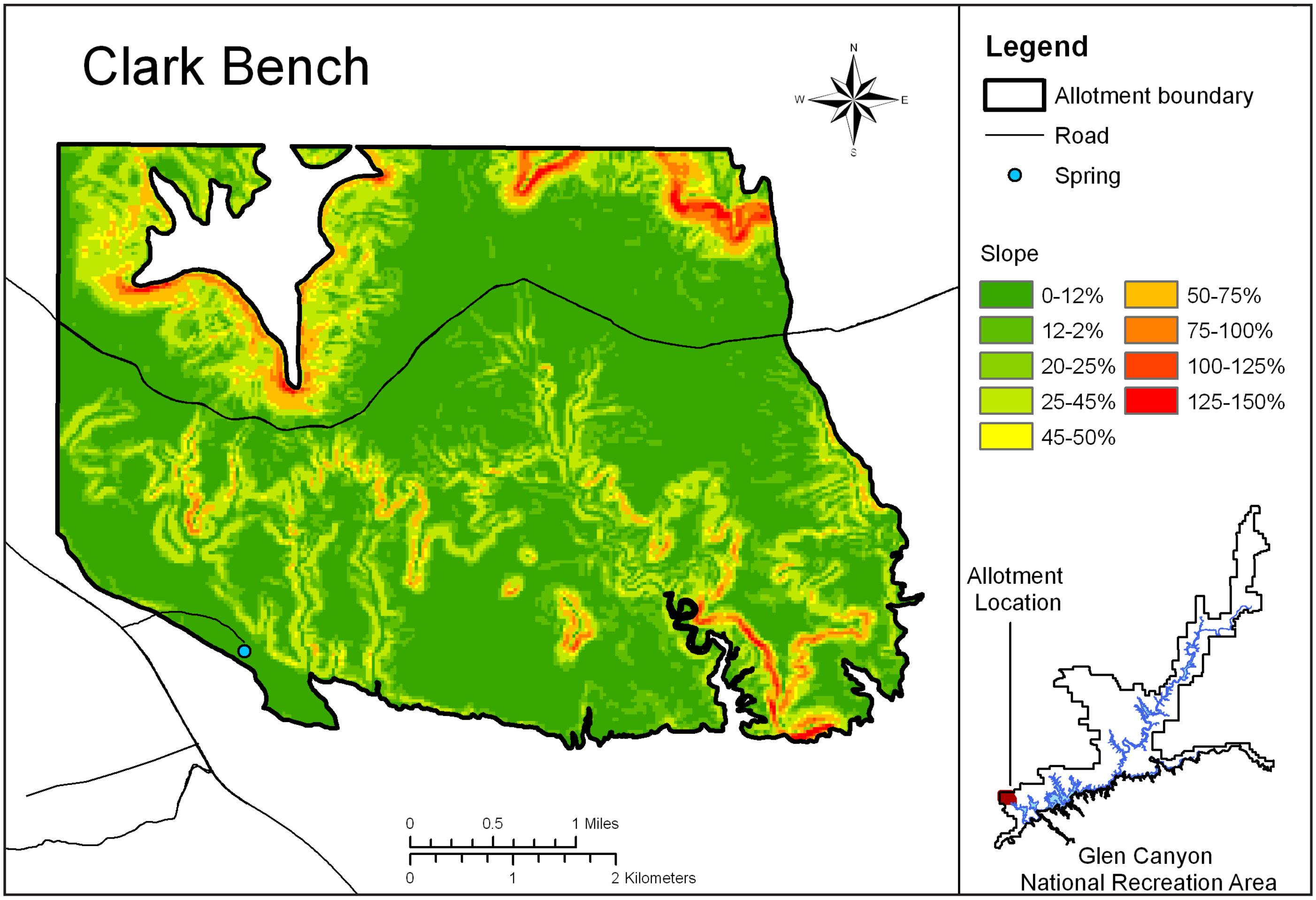
Elevation range amsl:
1125.07 – 1594.23 meters (3691.17 - 5230.41 feet)

Rivers and Springs:
A single spring, called Wiregrass, is located within Clark Bench grazing allotment.

Accessibility:
Clark Bench is accessible on County Hwy 230, which passes east-west across the allotment. Hwy 89 also parallels the allotment on the west side.

Camping is available at Lone Rock Campground, located south of the allotment, just north of Wahweap.

No. Cultural Sites: 0
Area surveyed: 0.00 acres



Slope Considerations:

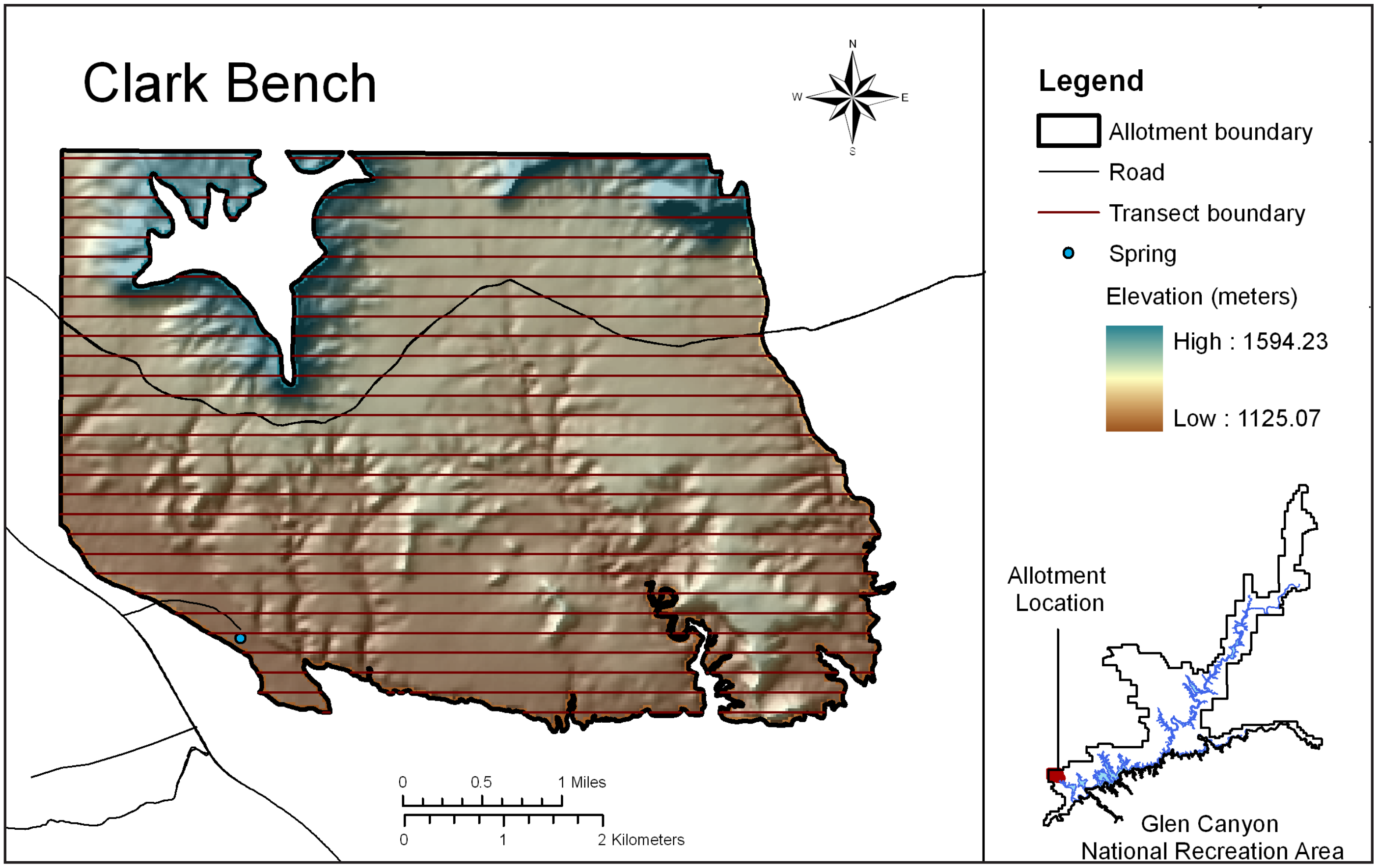
Slope plays a large role in terrain accessibility, and may be used in the stratification of survey areas. For example, GCNRA may wish to assign catagories such as low, moderate, and high to specific slope gradients. Such assignations are most often dependent on the factors guiding archaeological survey work, and as such, are not included in this document. Included herein, however, are suggestions for basic transect orientation based on the presence of topographical barriers identified by the presence of excessive slope gradients.

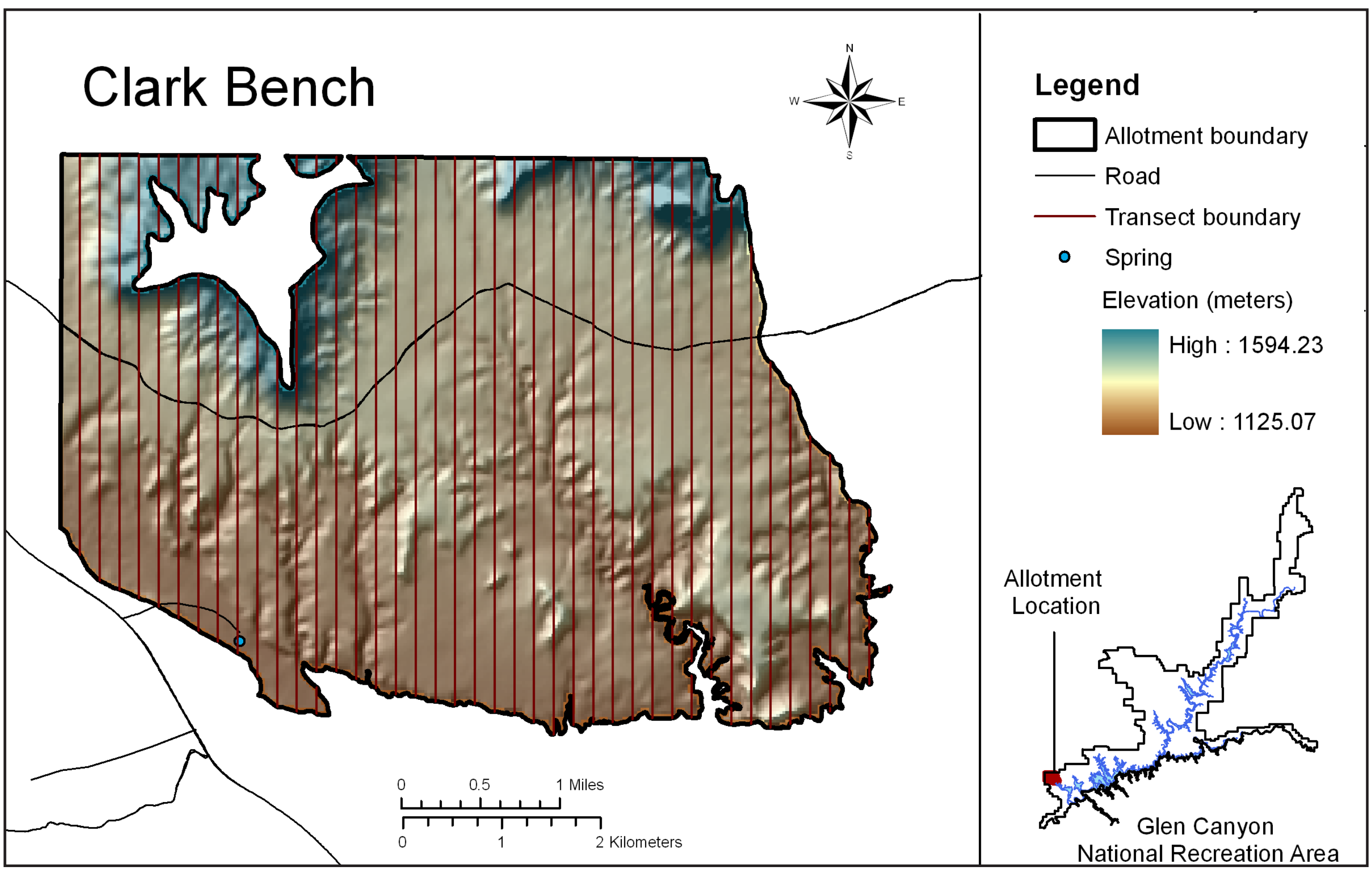
Survey Zones Dictated by Slope:

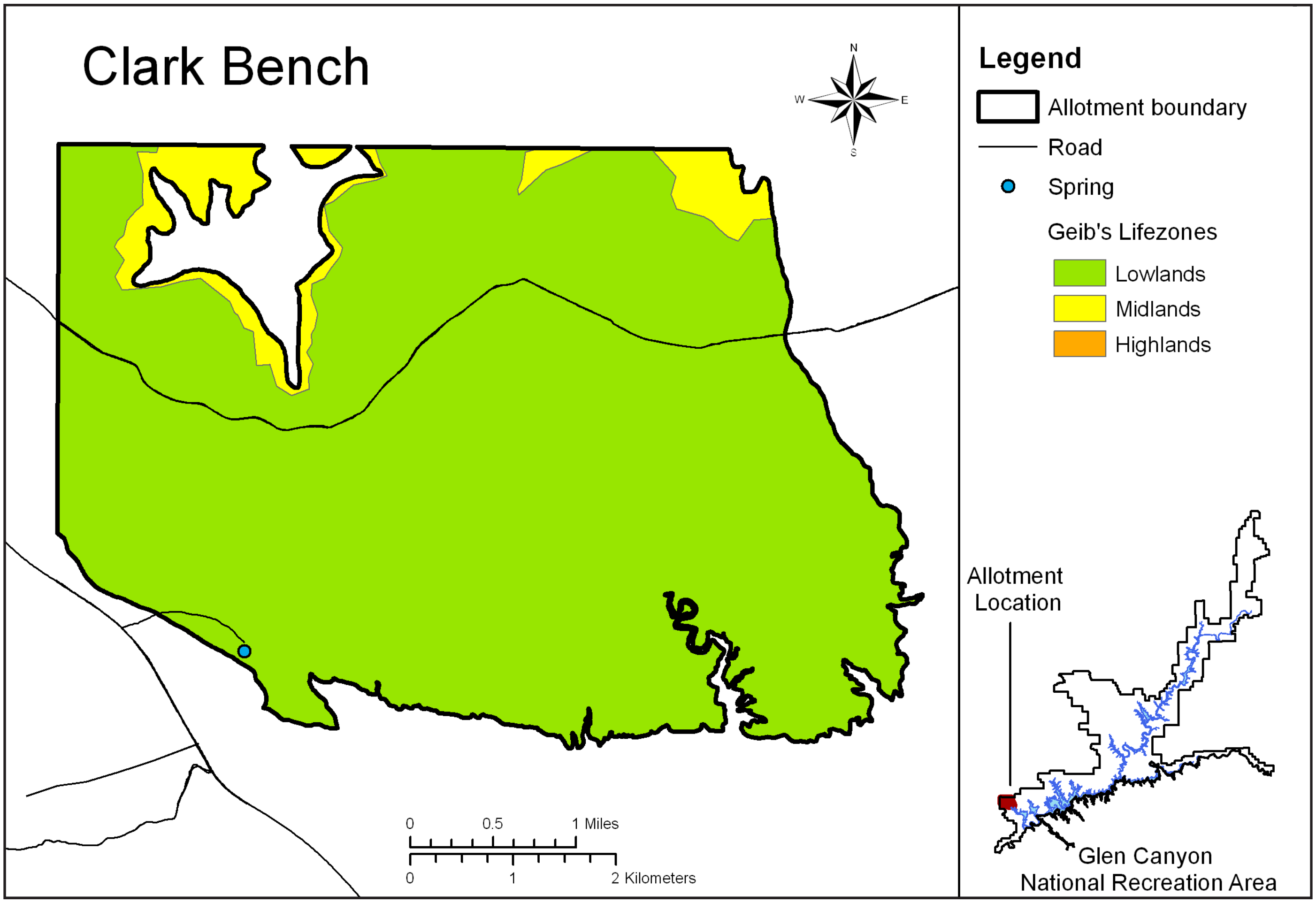
Slope provides some difficulties in both the northern and southern portions of the allotment. In the north, the recommendation is to begin at County Hwy 230, placing transects north-south until reaching the escarpments. North of the escarpments may necessitate separate survey.

In the southern portion of the allotment, transects should run north-south. However, transects placed perpendicular to County Hwy 230 will by necessity stop at the escarpment running east-west across the southern portion of the allotment, and all land south of the escarpment will have to be accessed from Hwy 89 or from along the lake edge.

The 'fishnet' maps provided on the subsequent page provide transects spaced at 200 meter intervals for both east-west and north-south oriented pedestrian survey.


Clark Bench
N
W
E
S
Legend
Allotment boundary
Road
Transect boundary
Spring
Elevation (meters)
High : 1594.23
Low : 1125.07
Allotment Location
Glen Canyon National Recreation Area
0 0.5 1 Miles
0 1 2 Kilometers


Clark Bench
N
W
E
S
Legend
Allotment boundary
Road
Transect boundary
Spring
Elevation (meters)
High : 1594.23
Low : 1125.07
Allotment Location
Glen Canyon National Recreation Area
0 0.5 1 Miles
0 1 2 Kilometers



Area of Each Lifezone:

Highlands: 0.00 acres
Midlands: 537.18 acres
Lowlands: 8875.18 acres

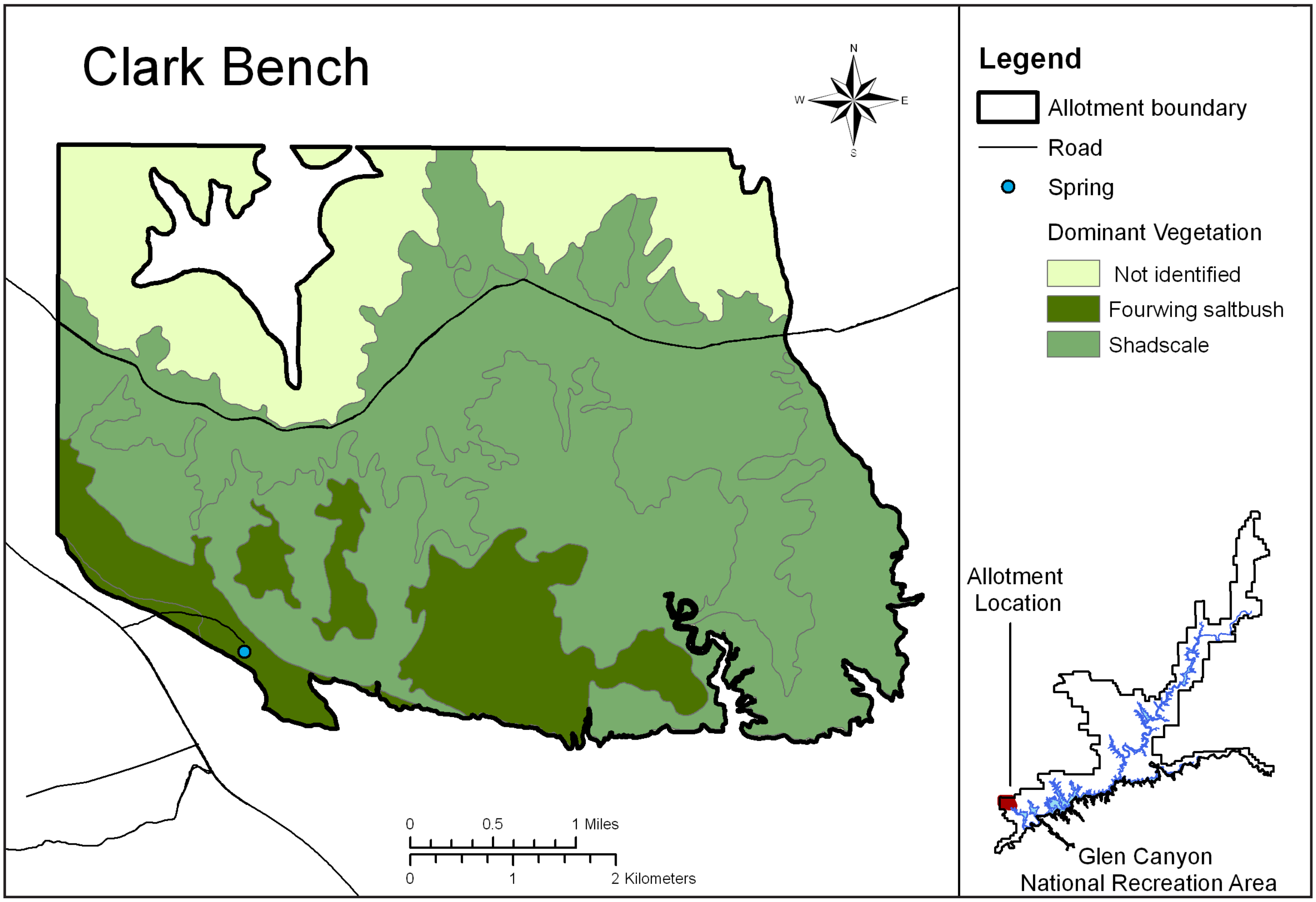
No. Cultural Sites in Each Lifezone:

Highlands: 0
Midlands: 0
Lowlands: 0

Lifezone Significance and Known Cultural Sites:

No cultural sites are currently known for Clark Bench grazing allotment.

	Elevation	Characteristics	Environment	Significance to Humans
Lowlands	1219-1372 m (4000-4500 ft)	Hot and arid steep-walled sandstone canyons.	Riparian plants; big-horn sheep	Permanent water, arable alluvium, long growing season, diverse plant communities, natural shelters, quality siliceous stone from river gravels
Midlands	1372-1676 m (4500-5500 ft)	Arid slickrock and dune fields on benchlands and low plateaus.	Blackbrush, shad-scale, grasses; antelope.	Grasses, including dropseed and ricegrass, prickly pear and shadscale; good antelope habitat, quality siliceous stone in certain locations.
Highlands	Above 1676 m (Above 5500 ft)	High elevation mesas and plateaus with cooler temperatures and greater precipitation.	Pinyon-juniper wood-lands; deer and rabbit.	Higher elevation plant foods (i.e. pinyon); later har-vests; dry-farming; abundant fuel, deer and rabbit.
Shading indicates lifezones present in allotment.				



Area of Individual Vegetation Zones:

Dominant Species	Acres Covered	No. Sites
Not identified	2150.71	0
Fourwing saltbush (*Atriplex canescens)*	1405.60	0
Shadscale *(Atriplex confertifolia)*	5877.47	0
Total	**9433.78**	**0**

No. Cultural Sites in Each Vegetation Zone:
No cultural sites are currently known for Clark Bench grazing allotment.

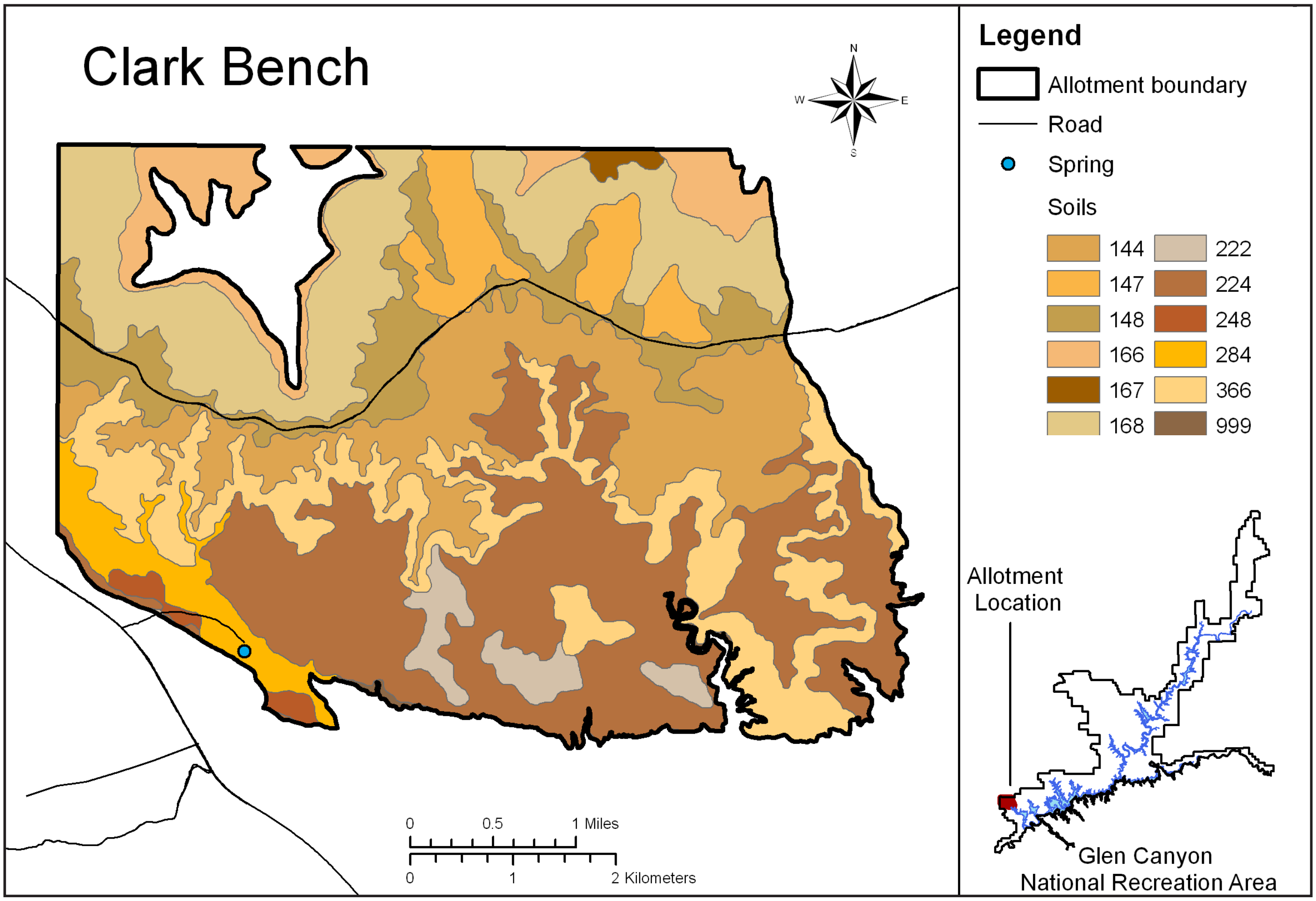
Visibility:
In general, the dominant vegetative communities of Clark Bench allotment provide moderate - excellent visibility for the archaeologist, with large portions of the ground between plants bare of vegetation.

Summary:
The primary dominant vegetation zones within the Clark Bench grazing allotment include fourwing saltbush (14.90 percent) and shadscale (62.30 percent). Dominant vegetation for the remainder of the allotment is not currently known.

Dominant Species:
Fourwing saltbush *(Atriplex canescens*)
Shadscale (*Atriplex confertifolia*)

Secondary Dominant Species:
Fremont cottonwood (*Populus fremontii*)
Sand Sagebrush (*Artemisia filifolia*)
Mat saltbush (*Atriplex confertifolia*)
Torrey Mormon tea (*Ephedra torreyana*)

Associated Soils:
Fourwing saltbush dominates in sandy loam and sandy bottoms, where Fremont cottonwood grows along semiwet saline streambanks. Shadscale occurs in shallow loam, and may be associated with mat saltbush in shallow clays or Torrey Mormon tea in very shallow gypsum.

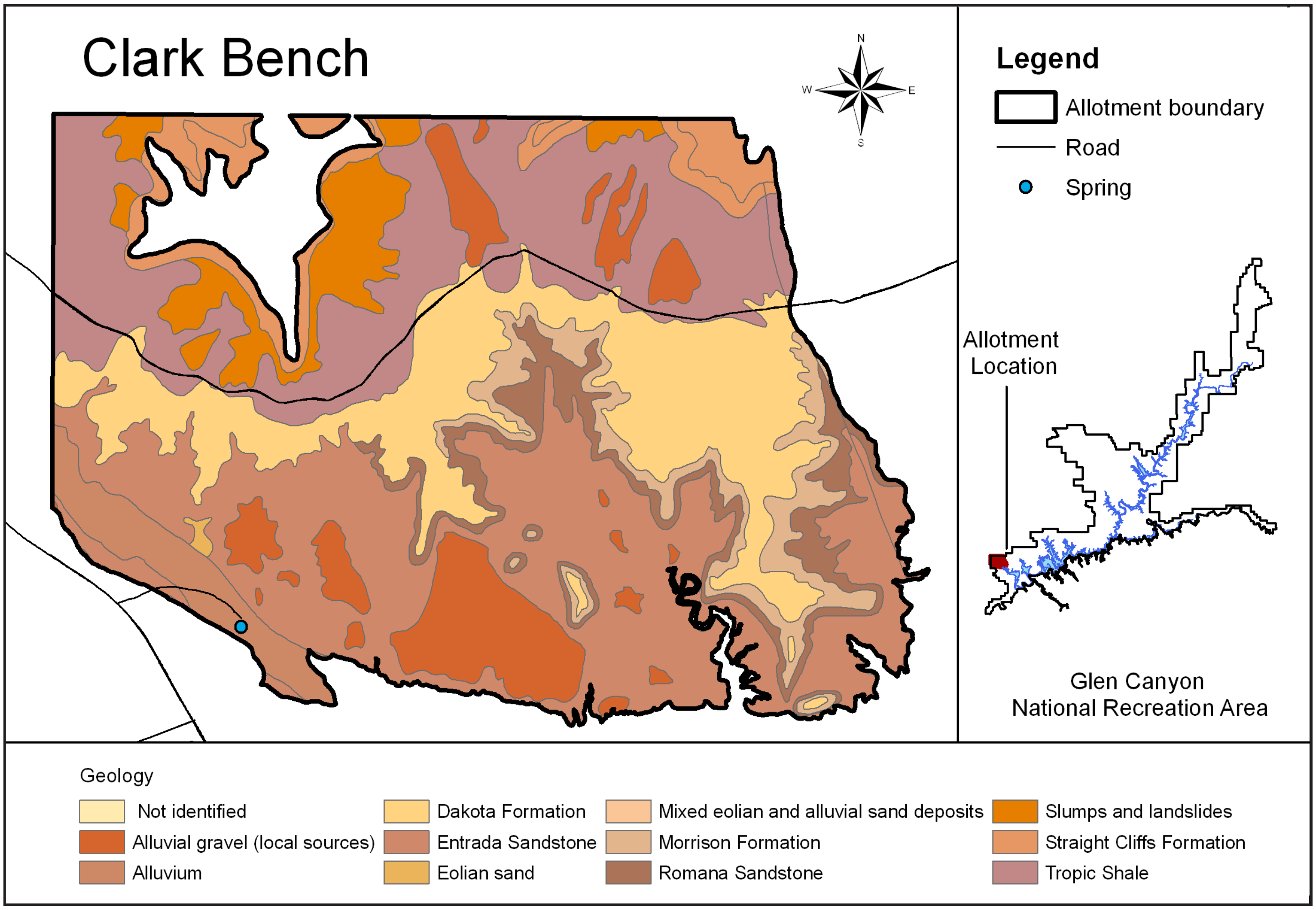


Allotment Divided by Soil Type (MUSYM):

Soil Type	Acres	Percent	No. Cultural Sites
144	1632.20	17.30	0
147	189.88	2.01	0
148	844.11	8.95	0
166	519.07	5.50	0
167	37.23	0.39	0
168	1523.73	16.15	0
222	250.90	2.66	0
224	2562.62	27.16	0
248	70.34	0.75	0
284	354.13	3.75	0
366	1410.23	14.95	0
999	39.36	0.42	0
Total	**9433.80**	**99.99%**	**0**

Distribution of Cultural Sites by Soil Type:

No cultural sites are known for Clark Bench allotment at this time.



Allotment Divided by Geology:

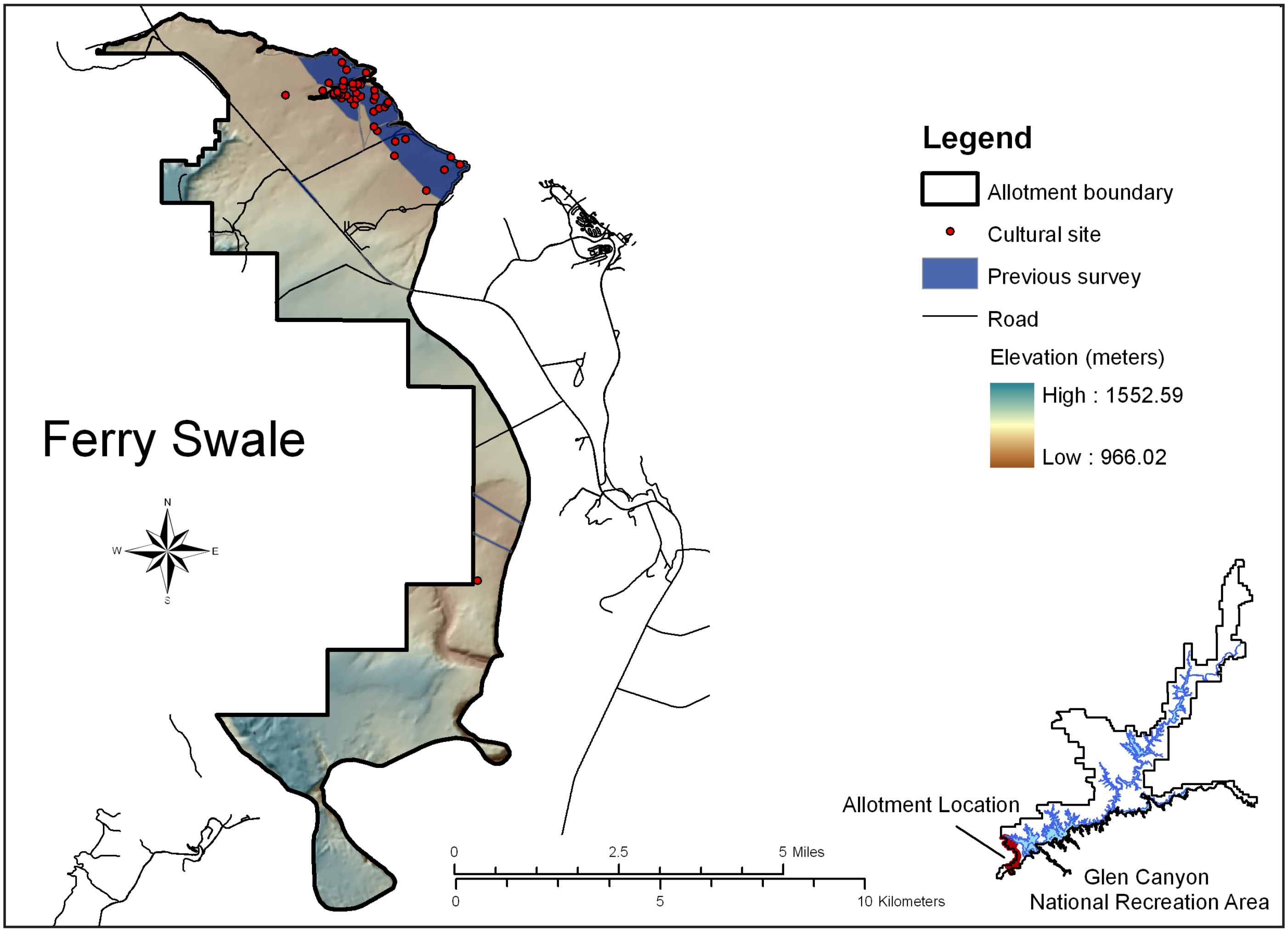
Geology	Acres	Percent	No. Cultural Sites
Not identified	21.79	0.23	0
Alluvial gravel (local sources)	819.13	8.68	0
Alluvium	336.31	3.56	0
Dakota Formation	1728.18	18.32	0
Entrada Sandstone	2477.56	26.26	0
Eolian sand	13.28	0.14	0
Mixed eolian and alluvial deposits	0.62	<0.00	0
Morrison Formation	494.93	5.25	0
Romana Sandstone	524.98	5.56	0
Slumps and land-slides	518.97	5.50	0
Straight Cliffs For-mation	521.19	5.52	0
Tropic Shale	1976.84	20.95	0
Total	**9433.78**	**99.97%**	**0**

Distribution of Cultural Sites by Geological Location:

No cultural sites are known for Clark Bench at this time.

Ferry Swale

Map Panels



Total Area: 14,763.11 acres

Sampling Fractions:
2 percent: 295.26 acres
5 percent: 738.16 acres
11 percent: 1623.94 acres
16 percent: 2362.10 acres
20 percent: 2952.62 acres

Elevation range amsl:
966.022 – 1552.59 meters (3169.36 - 5093.80 feet)

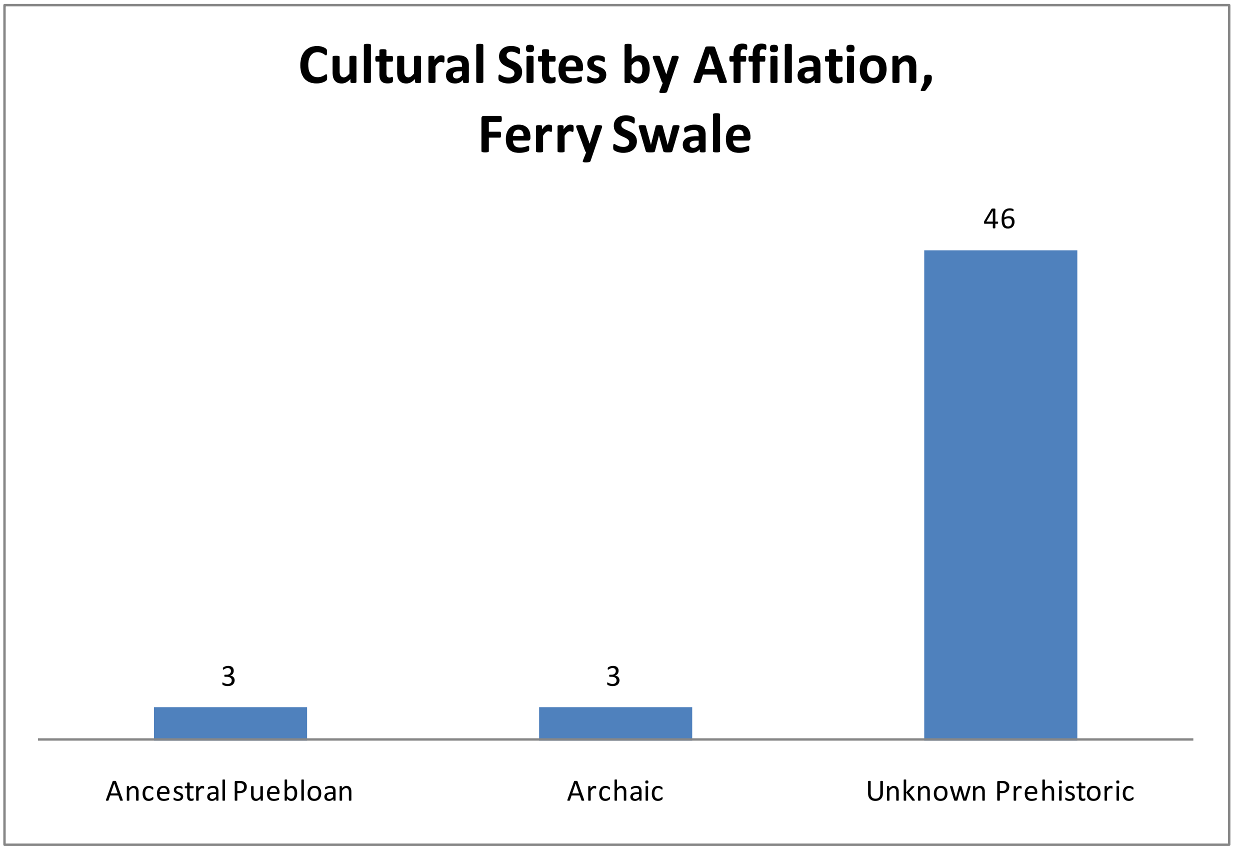
Rivers and Springs:
None known at this time.

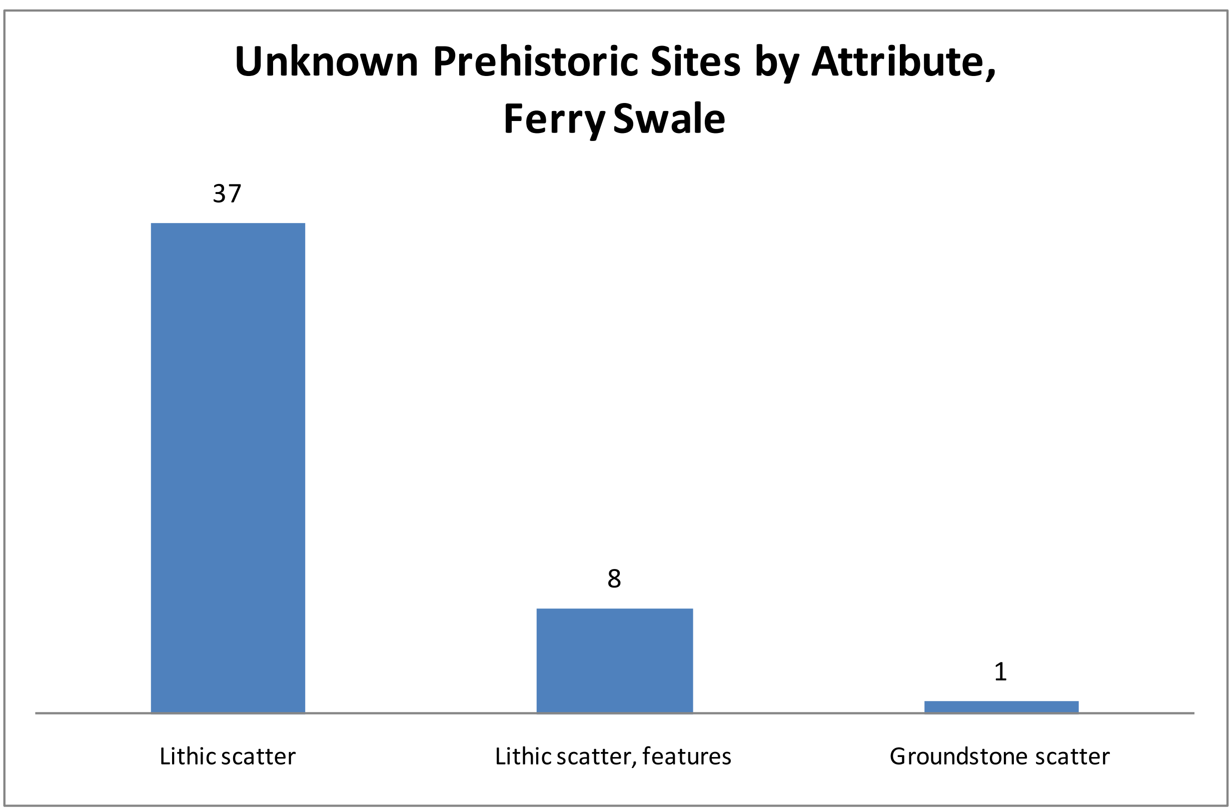
Accessibility:
Ferry Swale is accessible from Hwy 89 and Alt 89, and is located near Wahweap and Glen Canyon Dam. Lone Rock campground is located within the allotment boundaries, and Lee's Ferry offers resources to the southern portion of the allotment.

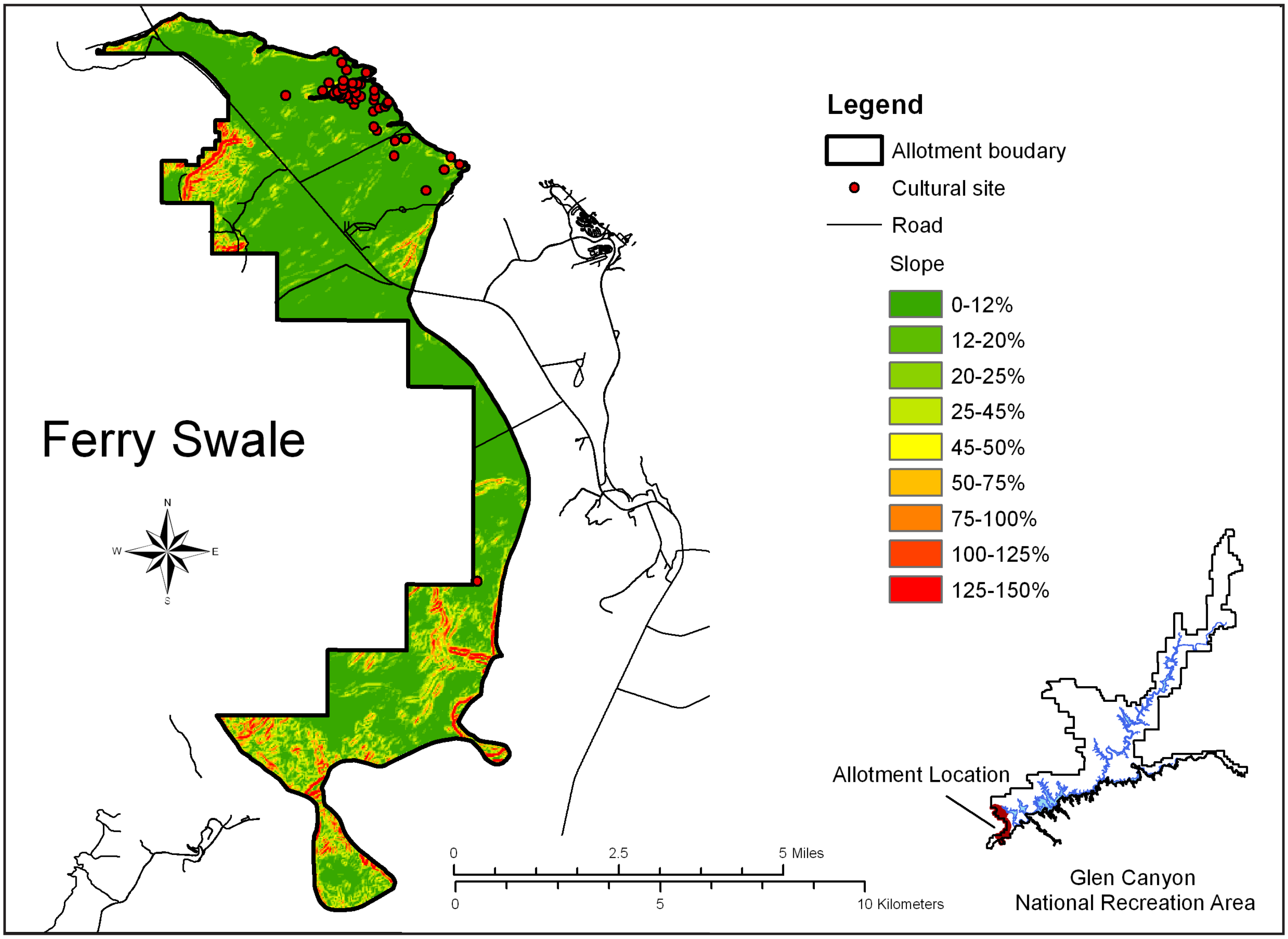
No. Cultural Sites: 52
Area surveyed: 1,017.63 acres

Survey References:
Bauman (1992): 5.68 acres
Berg 91993): 1.45 acres
Hagopian (2007): 11.84 acres
Kincaid (1988a): 0.95 acres
Moffitt et al. (1978): 15.64 acres
Montgomery (2002): 18.12 acres
Neilson (1989): 23.60 acres
Tipps (1987): 936.19 acres
Unknown (2005): 12.06 acres

The figures on the subsequent page depict the proportions of cultural sites by affiliation, and for those prehistoric sites for which affiliation is unknown, by attribute.


Cultural Sites by Affilation,
Ferry Swale
46
3
3
Ancestral Puebloan
Archaic
Unknown Prehistoric


Unknown Prehistoric Sites by Attribute,
Ferry Swale
37
8
1
Lithic scatter
Lithic scatter, features
Groundstone scatter



Slope Considerations:

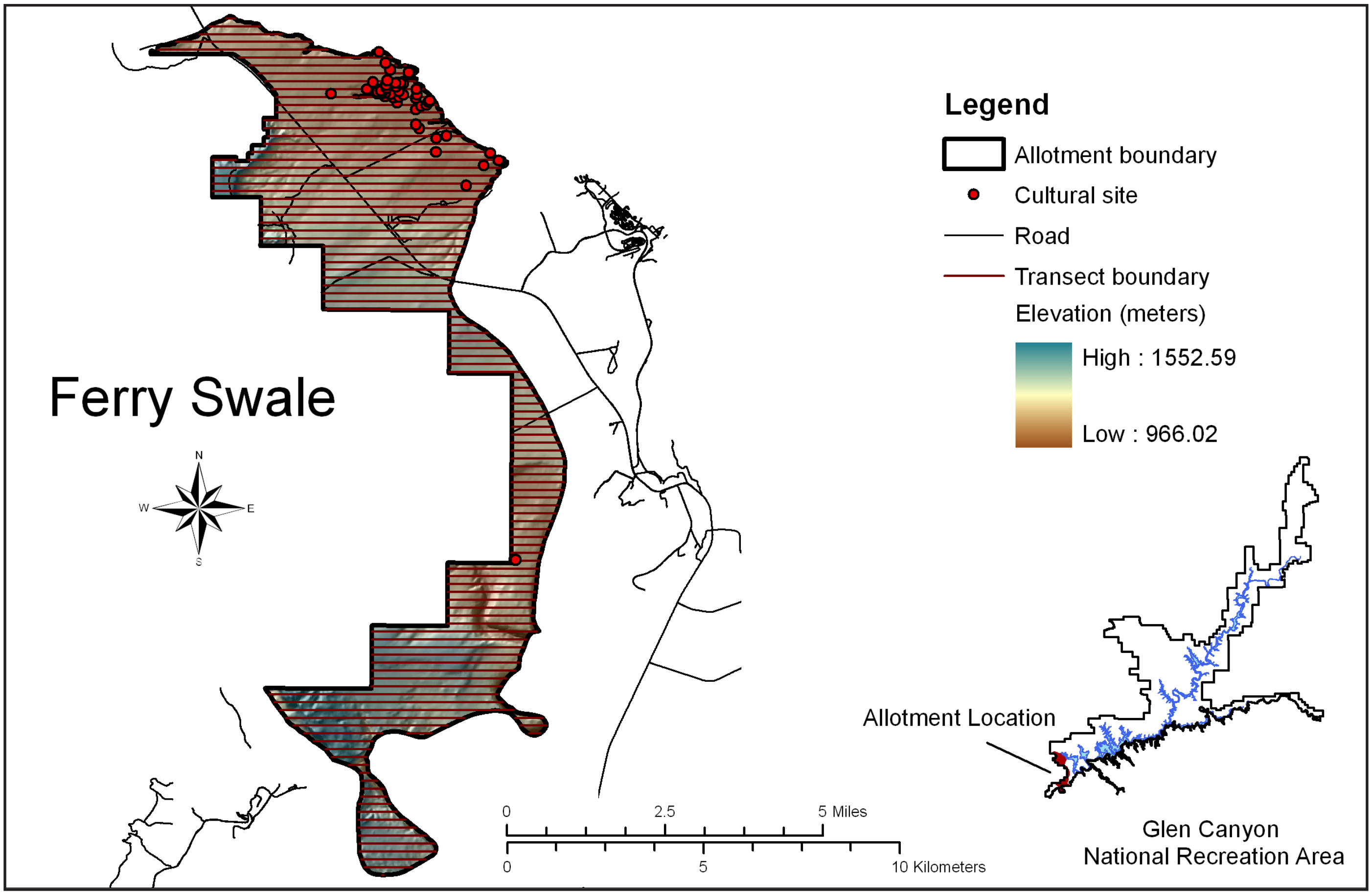
Slope plays a large role in terrain accessibility, and may be used in the stratification of survey areas. For example, GCNRA may wish to assign catagories such as low, moderate, and high to specific slope gradients. Such assignations are most often dependent on the factors guiding archaeological survey work, and as such, are not included in this document. Included herein, however, are suggestions for basic transect orientation based on the presence of topographical barriers identified by the presence of excessive slope gradients.

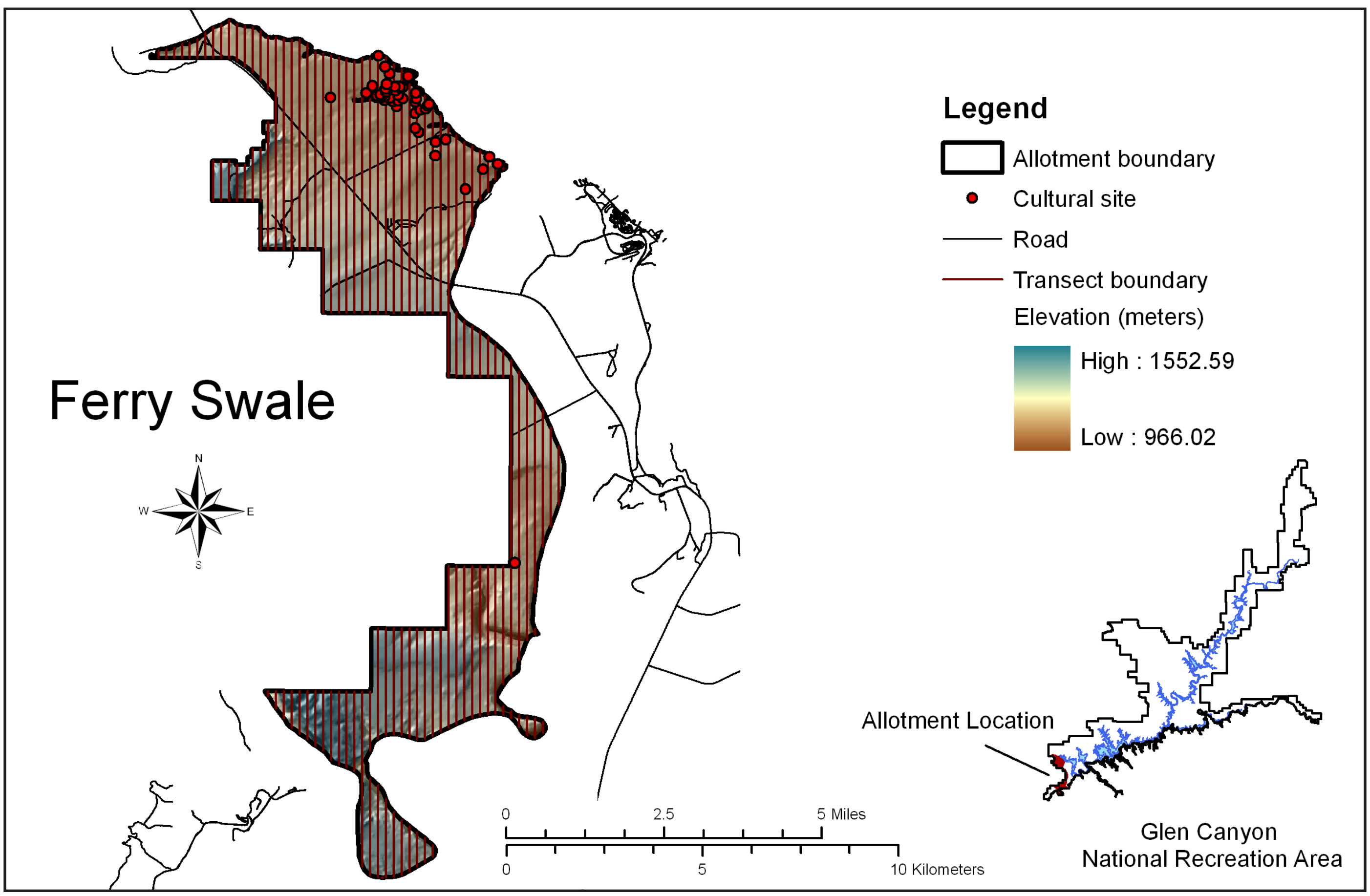
Survey Zones Dictated by Slope:

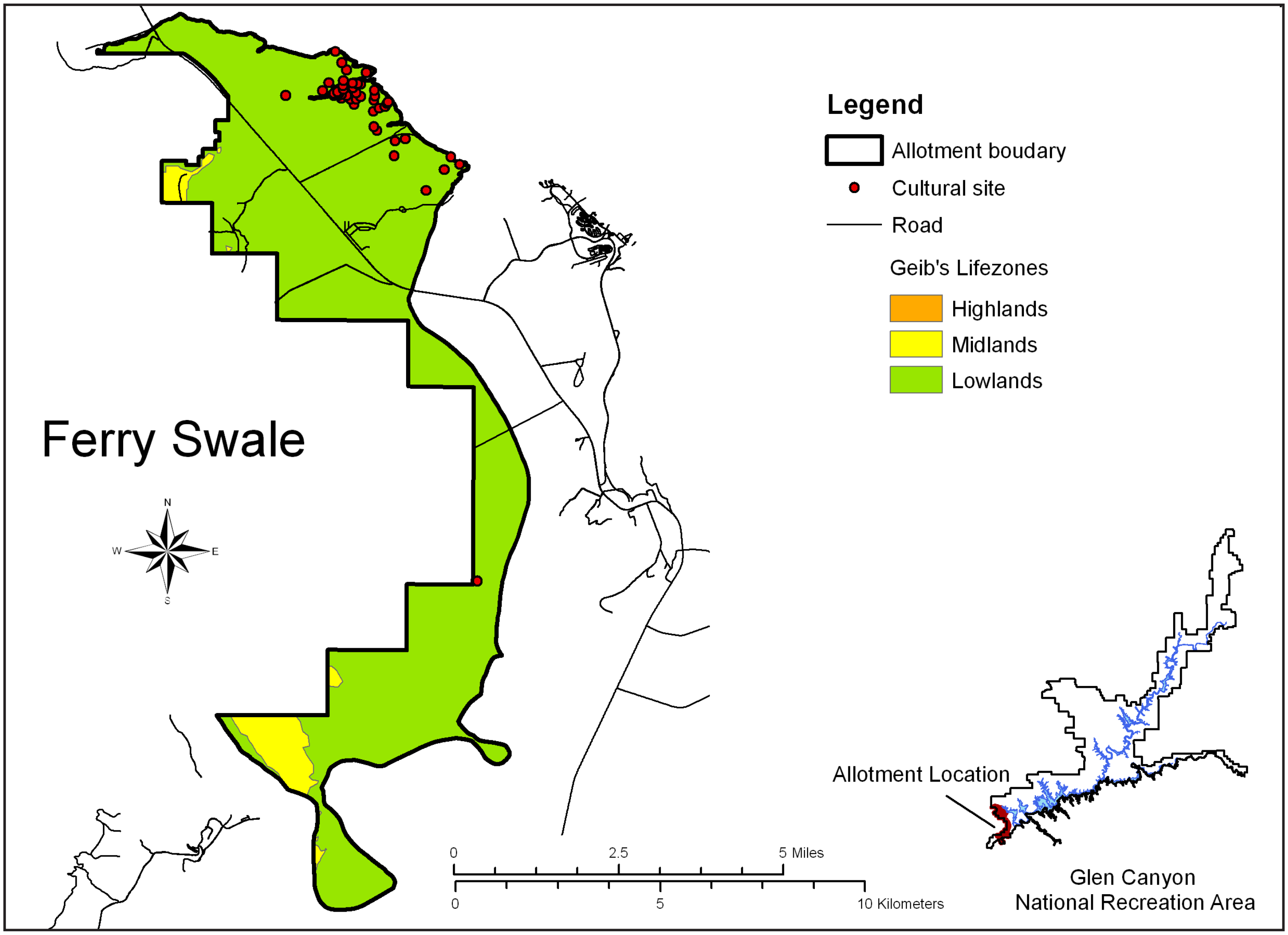
The majority of the northern half of Ferry Swale allotment is fairly level. With the exception of the steep escarpment along the northwest edge of the allotment, slope provides few accessibility problems. East-west transects may be set either perpendicular to Hwy 89 (se-nw), or north-south transects set perpendicular to lateral roads.

In contrast to the north, slope in the southern half of the allotment does interfere with survey access, with a steep canyon cutting from the se-nw. It may be possible to access the interior of the southern portion by road from Lee's Ferry; however, transect orientation should not be assigned to the south until access in established.

The 'fishnet' maps provided on the subsequent page provide transects spaced at 200 meter intervals for both east-west and north-south oriented pedestrian survey.


Ferry Swale
N
W
E
S
Legend
Allotment boundary
Cultural site
Road
Transect boundary
Elevation (meters)
High : 1552.59
Low : 966.02
Allotment Location
0
2.5
5 Miles
0
5
10 Kilometers
Glen Canyon
National Recreation Area


Ferry Swale
N
W
E
S
Legend
Allotment boundary
Cultural site
Road
Transect boundary
Elevation (meters)
High : 1552.59
Low : 966.02
Allotment Location
0
2.5
5 Miles
0
5
10 Kilometers
Glen Canyon
National Recreation Area



Area of Each Lifezone:

Highlands: 0.00 acres
Midlands: 770.31 acres
Lowlands: 13,939.67 acres

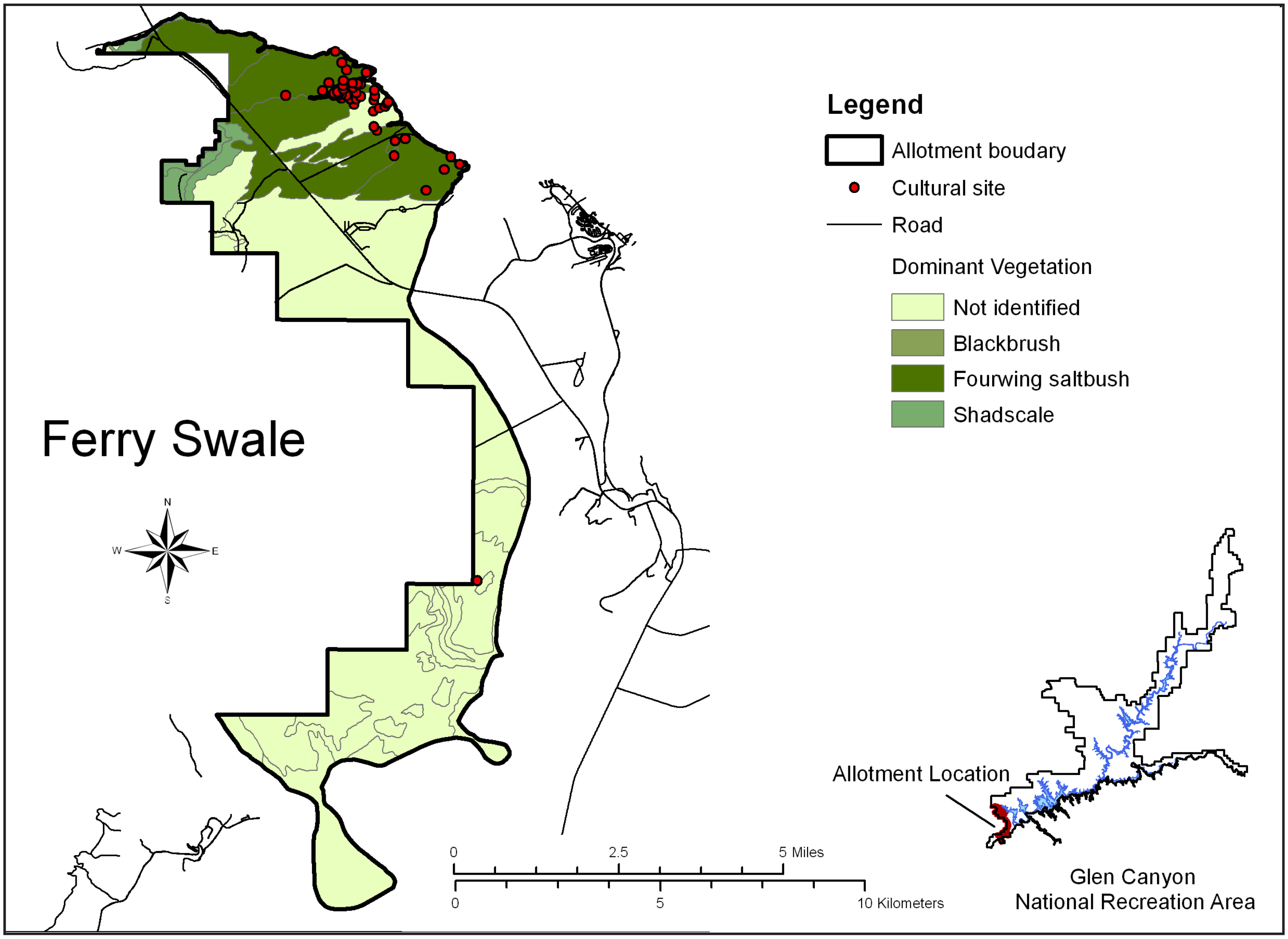
No. Cultural Sites in Each Lifezone:

Highlands: 0
Midlands: 0
Lowlands: 52

Lifezone Significance and Known Cultural Sites: Currently, all recorded sites (n = 52) in Ferry Swale occur in Geib's Lowland lifezone. Geib characterizes the lowlands as hot and arid, with permanent water, arable alluvium, and long growing seasons ideal for agriculturalists. In addition, Geib describes the lowlands as having diverse plant communities, natural shelters, and quality raw material for manufacturing stone tools.

	Elevation	Characteristics	Environment	Significance to Humans
Lowlands	1219-1372 m (4000-4500 ft)	Hot and arid steep-walled sandstone canyons.	Riparian plants; bighorn sheep	Permanent water, arable alluvium, long growing season, diverse plant communities, natural shelters, quality siliceous stone from river gravels
Midlands	1372-1676 m (4500-5500 ft)	Arid slickrock and dune fields on benchlands and low plateaus.	Blackbrush, shadscale, grasses; antelope.	Grasses, including dropseed and ricegrass, prickly pear and shadscale; good antelope habitat, quality siliceous stone in certain locations.
Highlands	Above 1676 m (Above 5500 ft)	High elevation mesas and plateaus with cooler temperatures and greater precipitation.	Pinyon-juniper woodlands; deer and rabbit.	Higher elevation plant foods (i.e. pinyon); later harvests; dry-farming; abundant fuel, deer and rabbit.

Shading indicates lifezones present in allotment.



Area of Individual Vegetation Zones:

Dominant Species	Acres Covered	No. Sites
Not identified	10,597.41	17
Blackbrush (*Coleogyne ramosissima)*	1.21	0
Fourwing saltbush (*Atriplex canescens*)	3671.09	35
Shadscale (*Atriplex confertifolia)*	493.40	0
Total	**14,763.11**	**52**

No. Cultural Sites in Each Vegetation Zone:
Currently, all known cultural sites occur in fourwing saltbush (n = 35), or in areas for which the dominant vegetation has not yet been identified (n=17).

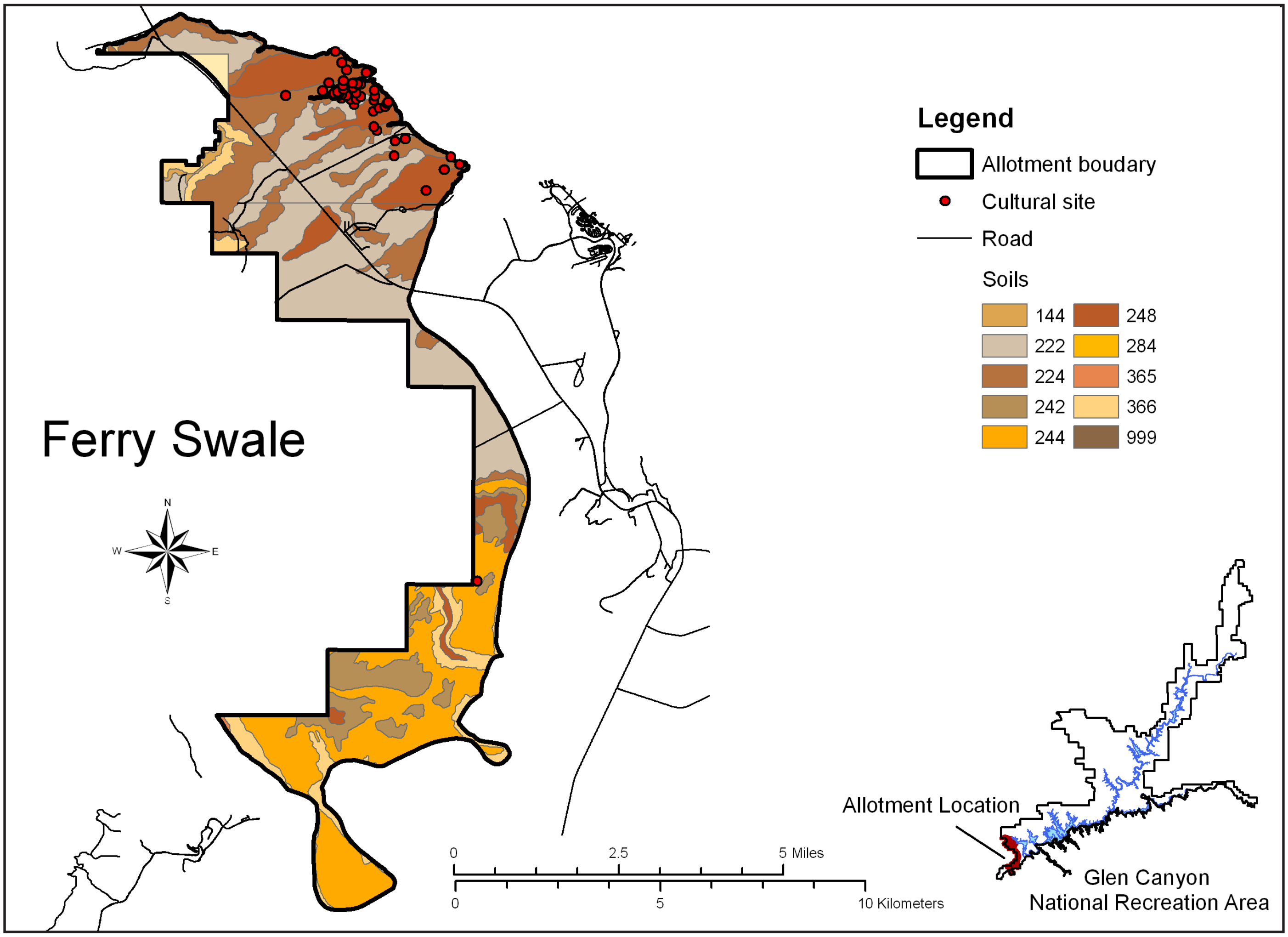
Visibility:
Although the dominant species known for Ferry Swale grow abundantly in their communities, they do not tend to crowd, thereby leaving bare ground highly visible between individual plants.

Summary:
The primary dominant vegetation zones within the Ferry Swale grazing allotment include fourwing saltbush (28.87 percent), shadscale (3.34 percent), and blackbrush-shadscale (<0.00 percent). The remainder of the allotment, which comprises most of the northern portion and all of the southern half, has not yet had the dominant species identified.

Dominant Species:
Blackbrush (*Coleogyne ramosissima)*
Fourwing saltbush (*Atriplex canescens)*
Shadscale (*Atriplex confertifolia*)

Secondary Dominant Species:
Fremont Cottonwood (*populus fremontii)*
Sand sagebrush (*Artemisia filifolia)*

Associated Soils:
Blackbrush, when present, dominates in shallow sandy loam. Fourwing saltbush occurs in both sandy bottoms, where it is associated with Fremont cottonwood in semi-wet saline streambanks, and in sandy loam, where it is as-

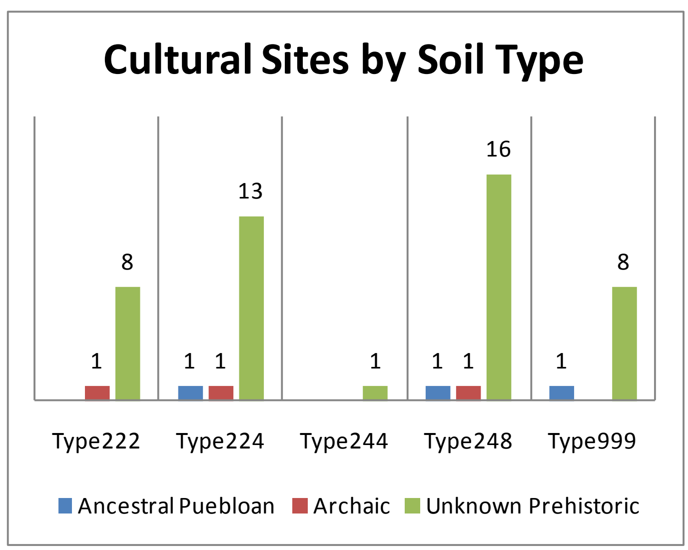


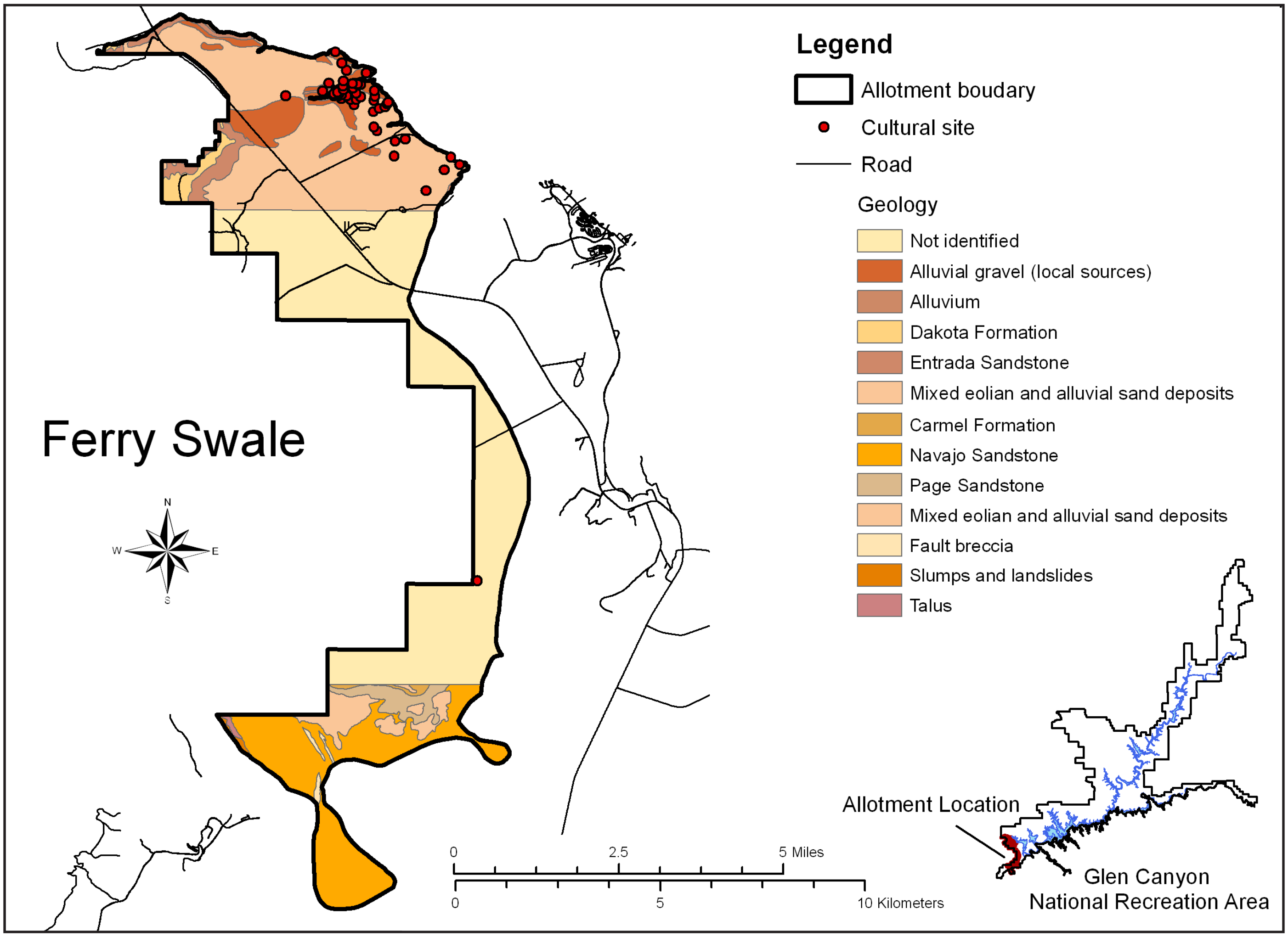
Allotment Divided by Soil Type (MUSYM):

Soil Type	Acres	Percent	No. Cultural Sites
Not Identified	124.97	0.85	0
144	75.16	0.51	0
222	4744.46	32.14	9
224	2432.28	16.48	15
242	1137.30	7.70	0
244	3310.14	22.42	1
248	1718.91	11.64	18
284	3.29	<0.00	0
365	14.17	<0.00	0
366	1131.75	7.67	0
999	70.68	0.48	9
Total	14,763.11	99.89%	52

Distribution of Cultural Sites by Soil Type:

Nine (n=9) sites occur in soil type 222, including one Archaic site, and 8 prehistoric sites of unknown affiliation. Of these unknown sites, all are lithic scatters, five of which contain features. Fifteen (n = 15) sites occur in soil type 224, including one Ancestral Puebloan site, one Archaic site, and 13 unaffiliated sites. The unaffiliated sites consist of 12 lithic scatters and a single groundstone scatter. A single (n = 1) unaffiliated lithic scatter is located in soil type 244. Soil type 248 contains one (n = 1) Ancestral Puebloan site, one (n = 1) Archaic site, and 16 unaffiliated lithic scatters, of which two contain features. The remaining sites (n = 9) occur in soil type 999, and include a single Ancestral Puebloan site, and 8 lithic scatters, of which one contains a possible hearth.



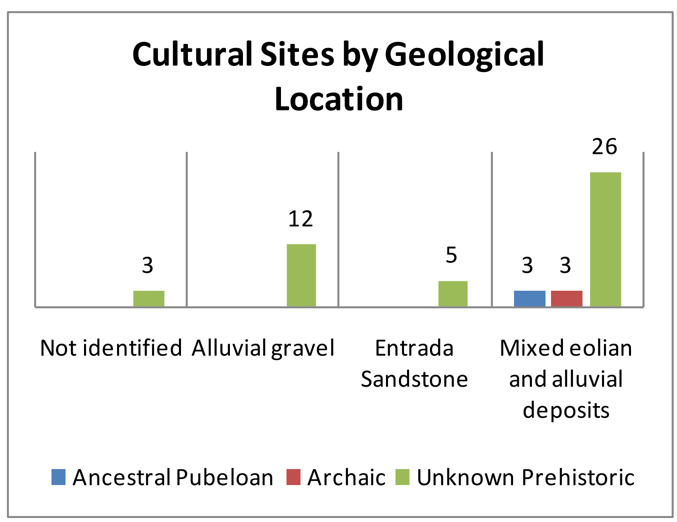


Allotment Divided by Geology:

Geology	Acres	Percent	No. Cultural Sites
Not identified	6172.72	41.81	3
Alluvial gravel (local sources)	724.20	4.51	12
Alluvium	7.52	<0.00	0
Dakota Formation	191.62	1.30	0
Entrada Sandstone	457.60	3.10	5
Mixed eolian and alluvial deposits	4528.46	30.67	32
Carmel Formation	50.58	0.34	0
Page Sandstone	288.04	1.95	0
Fault breccia	50.61	0.34	0
Slumps and land-slides	35.49	0.24	0
Talus	21.28	0.14	0
Navajo Sandstone	2234.99	15.14	0
Total	**14,763.11**	**99.54%**	**52**

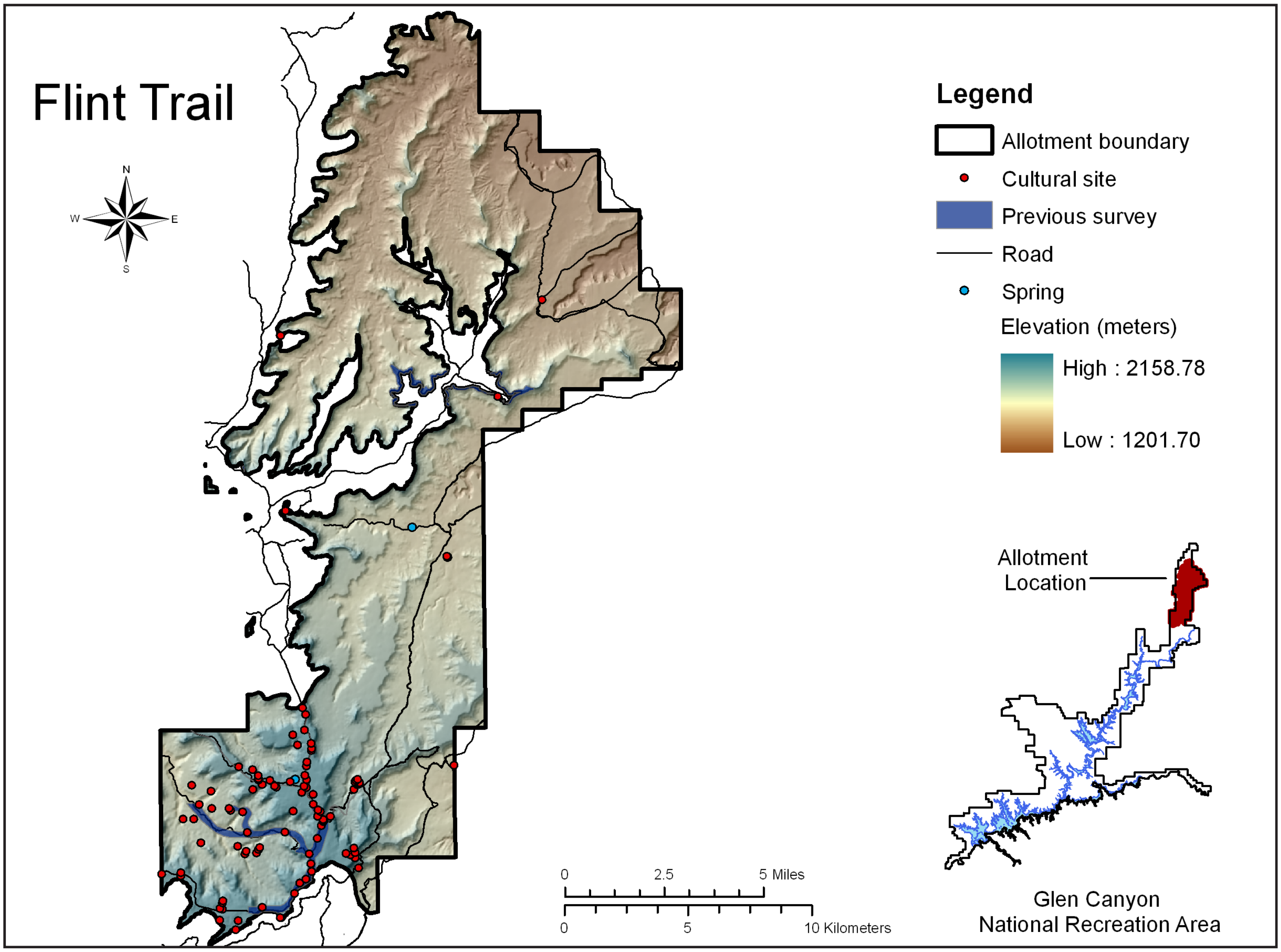
Distribution of Cultural Sites by Geological Location:

Three (n = 3) lithic scatters occur in unidentified geology. Twelve (n = 12) lithic scatters, one with a possible hearth, occur in alluvial gravels. Five (n = 5) lithic scatters occur on Entrada Sandstone. Mixed eolian and alluvial deposits contain the remaining sites, including three (n = 3) Ancestral Puebloan sites, three (n = 3) Archaic sites, 18 lithic scatters, 7 lithic scatters with features, and one (n = 1) groundstone scatter.



Flint Trail

Map Panels



Total Area: 80,276.71 acres

Sampling Fractions:
2 percent: 1605.53 acres
5 percent: 4013.84 acres
11 percent: 8830.44 acres
16 percent: 12,844.27 acres
20 percent: 16,055.34 acres

Elevation range amsl:
1201.70 – 2158.78 meters (3942.59 - 7082.61 feet)

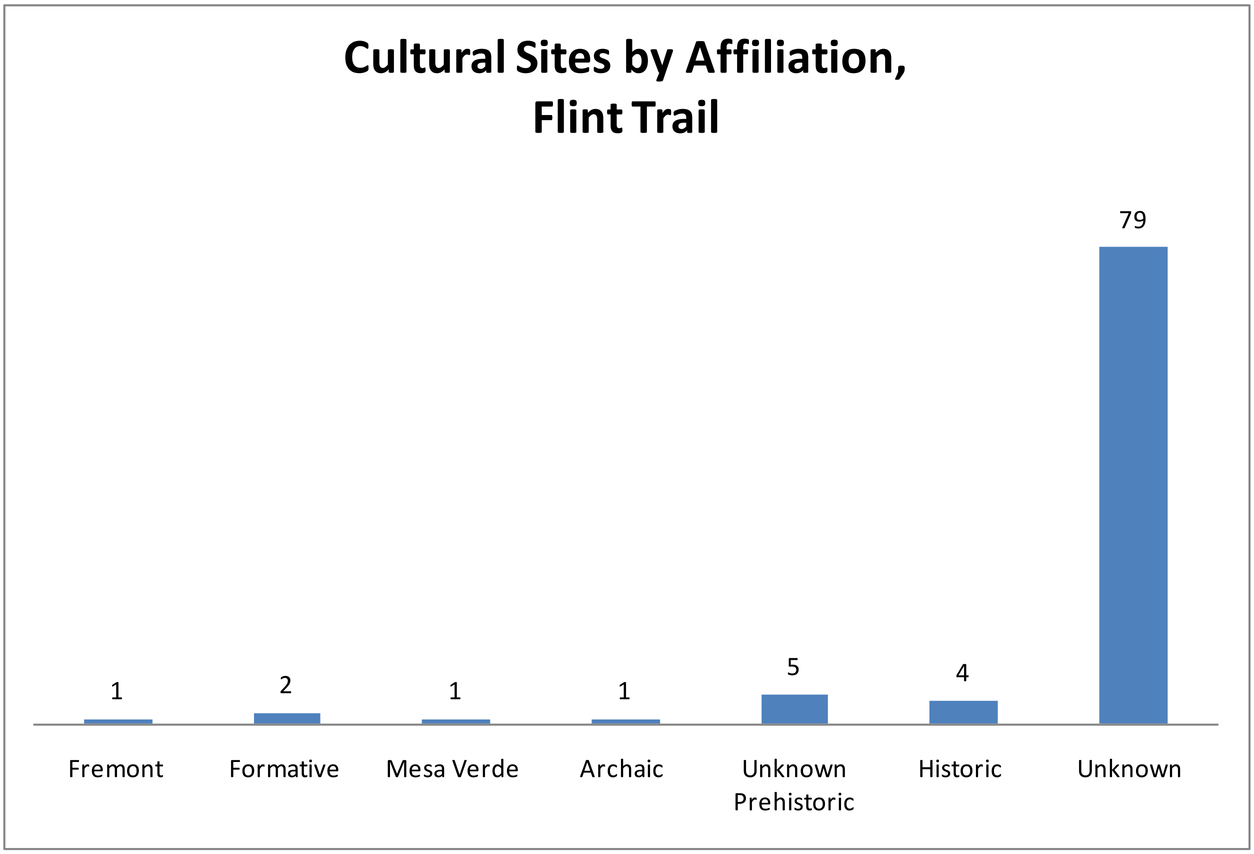
Rivers and Springs:
Three springs, including Flint and Big Water, are located within Flint Trail grazing allotment.

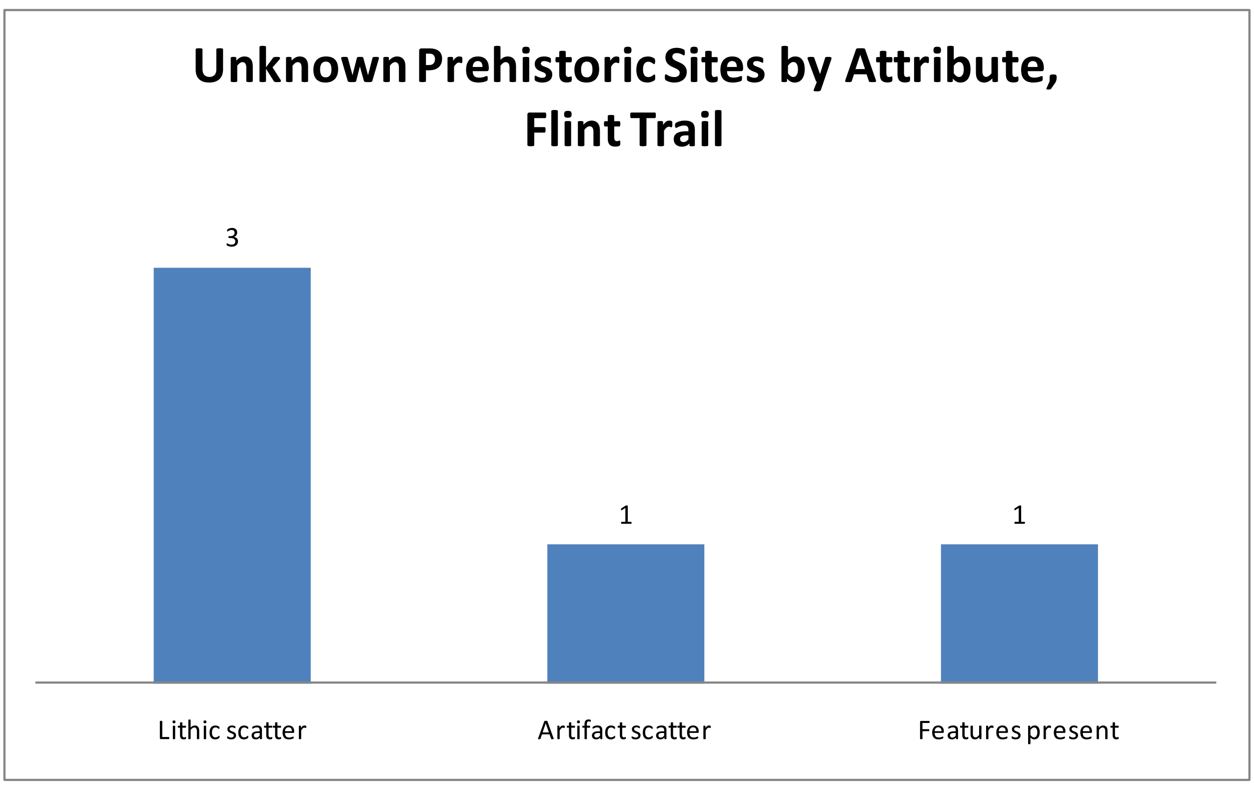
Accessibility:
Flint Trail is accessible by County Hwys 633, 730, 731, 756, 787, 765, 744, 775, and 777. Hans Flat Ranger Station is located on the western edge of the allotment at the junction of 777 and 633.

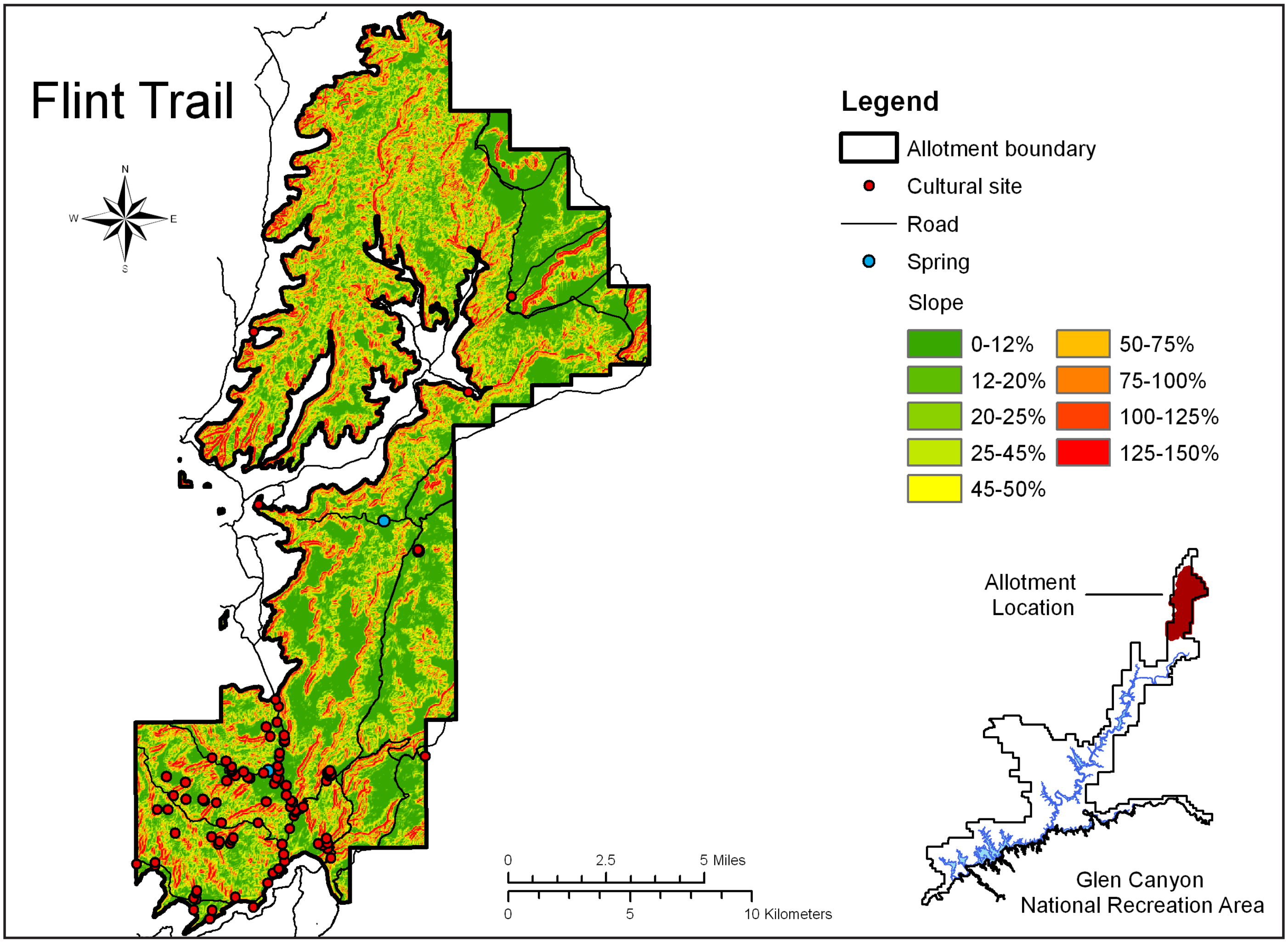
No. Cultural Sites: 93
Area surveyed: 1386.89 acres

Survey References:
Bungart and Geib (1986): 345.03 acres
Hauck (1982): 2.93
Kincaid (1988c): 3.34 acres
Kincaid (1989e): 29.35
Nickens (1981): 48.82 acres
Nickens (1986a): 959.56 acres

The figures on the subsequent page depict the proportions of cultural sites by affiliation, and for those prehistoric sites for which affiliation is unknown, by attribute.


Cultural Sites by Affiliation,
Flint Trail
1
2
1
1
5
4
79
Fremont
Formative
Mesa Verde
Archaic
Unknown Prehistoric
Historic
Unknown


Unknown Prehistoric Sites by Attribute,
Flint Trail
3
1
1
Lithic scatter
Artifact scatter
Features present



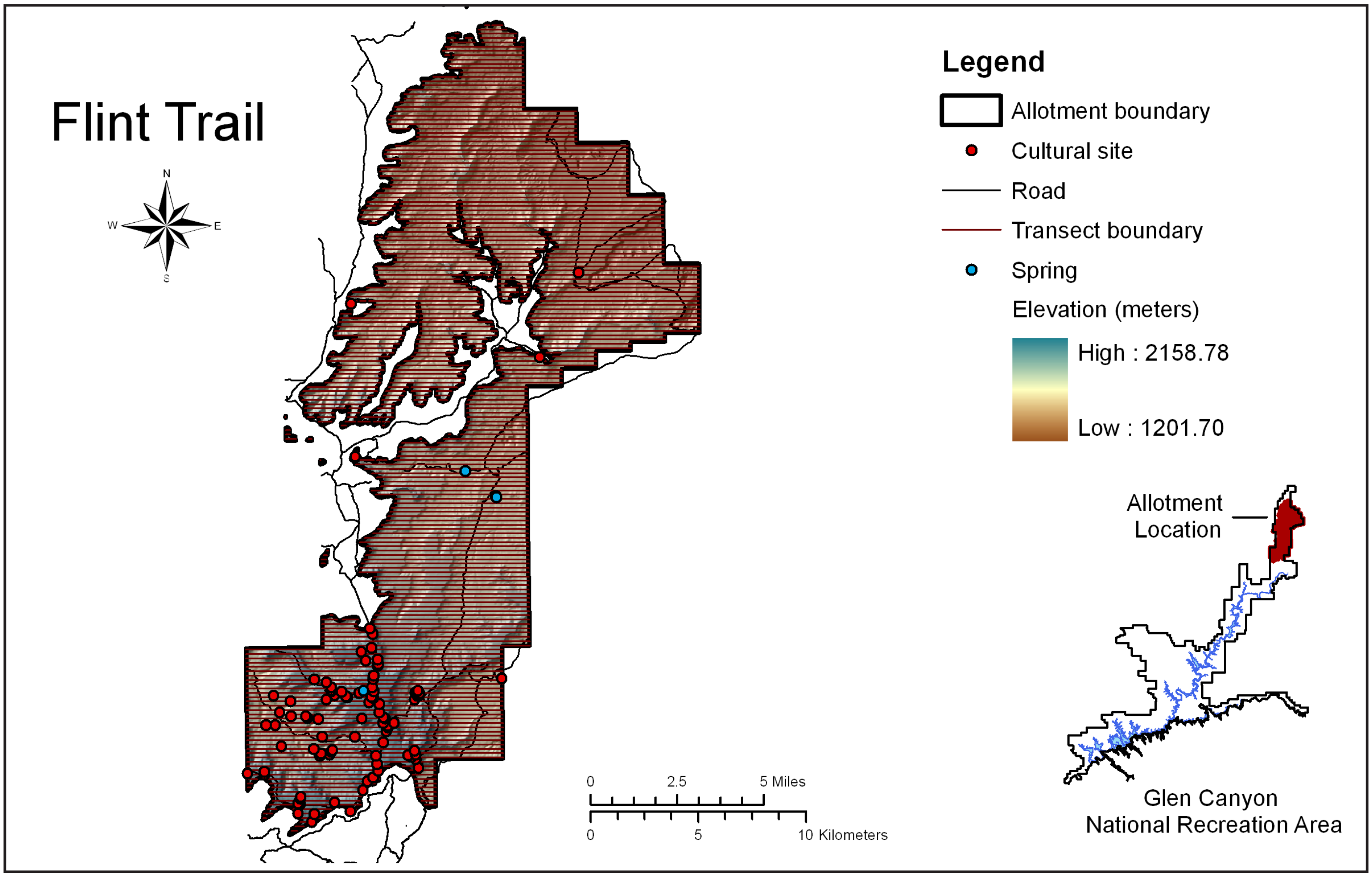
Slope Considerations:

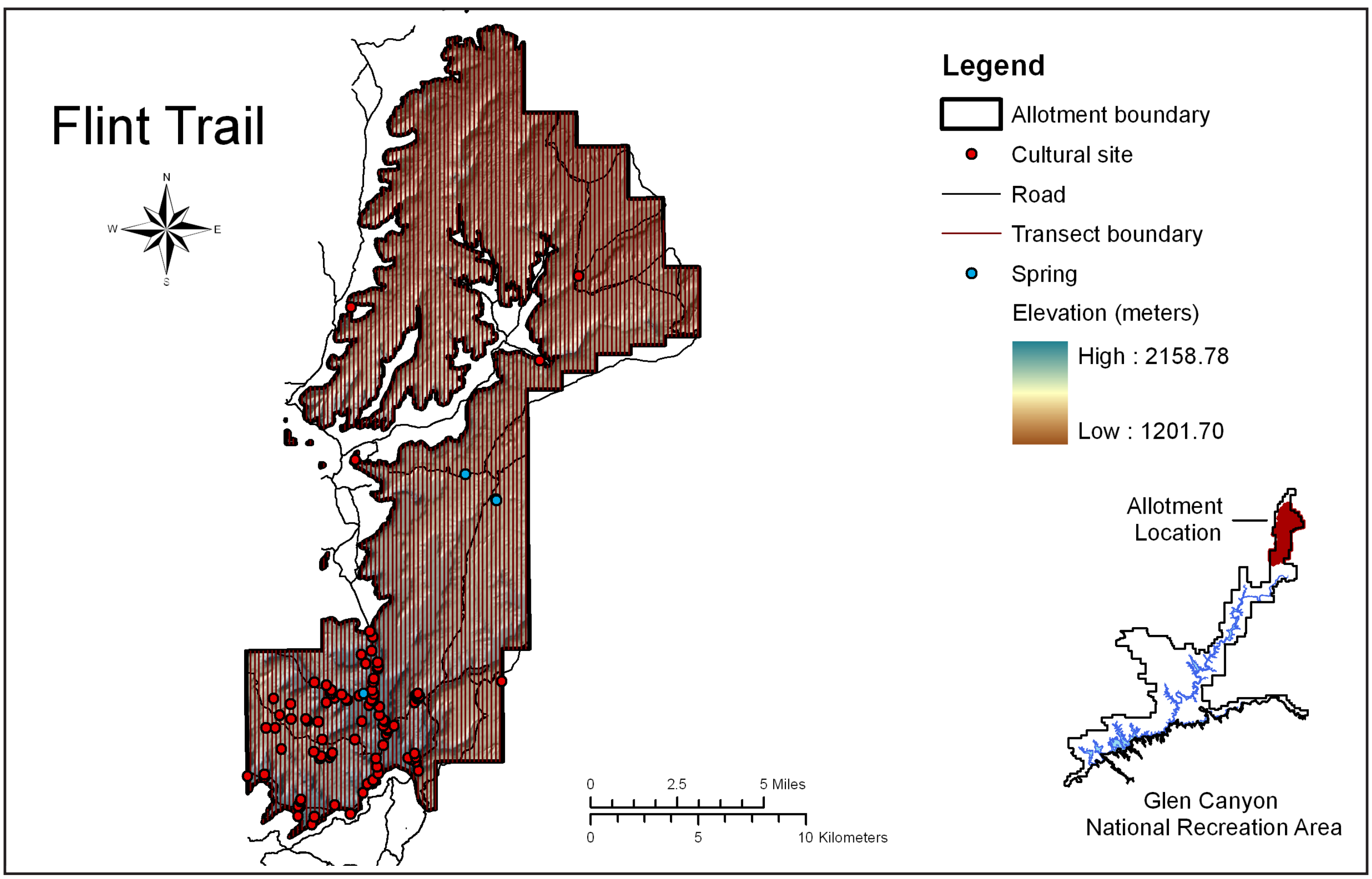
Slope plays a large role in terrain accessibility, and may be used in the stratification of survey areas. For example, GCNRA may wish to assign catagories such as low, moderate, and high to specific slope gradients. Such assignations are most often dependent on the factors guiding archaeological survey work, and as such, are not included in this document. Included herein, however, are suggestions for basic transect orientation based on the presence of topographical barriers identified by the presence of excessive slope gradients.

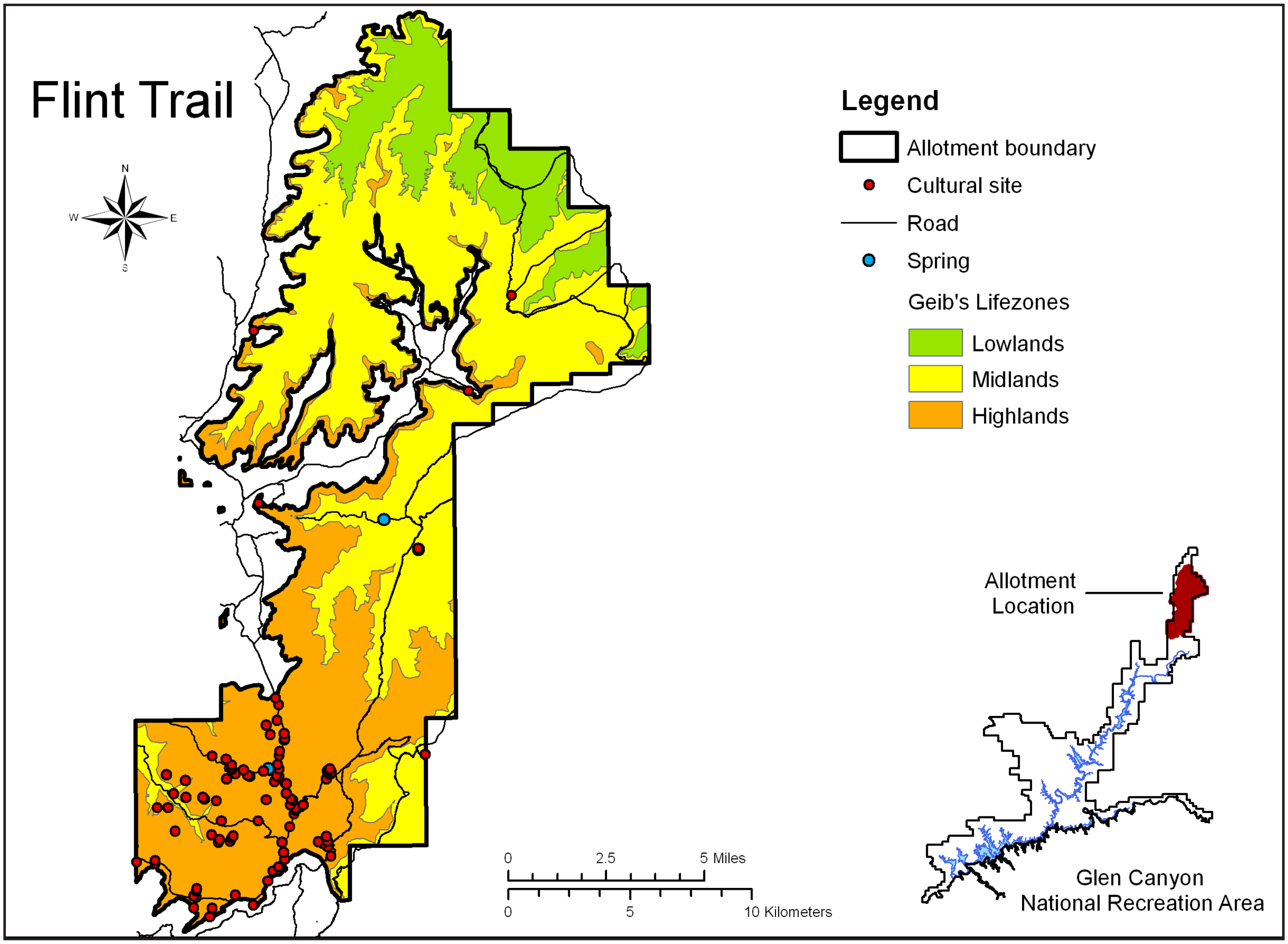
Survey Zones Dictated by Slope:

The majority of Flint Trail is comprised of difficult terrain. Field crews should expect to only survey small segments of the allotment at a time due to the numerous escarpments dividing the allotment. However, note that main roads provide reasonable access for surveyors, so transects placed perpendicular to roads will greatly facilitate survey in this allotment.

The 'fishnet' maps provided on the subsequent page provide transects spaced at 200 meter intervals for both east-west and north-south oriented pedestrian survey.


Flint Trail
N
W
E
S
Legend
Allotment boundary
Cultural site
Road
Transect boundary
Spring
Elevation (meters)
High : 2158.78
Low : 1201.70
0
2.5
5 Miles
0
5
10 Kilometers
Allotment Location
Glen Canyon National Recreation Area


Flint Trail
N
W
E
S
Legend
Allotment boundary
Cultural site
Road
Transect boundary
Spring
Elevation (meters)
High : 2158.78
Low : 1201.70
0
2.5
5 Miles
0
5
10 Kilometers
Allotment Location
Glen Canyon National Recreation Area



Area of Each Lifezone:

Highlands: 30,277.04 acres
Midlands: 39,899.12 acres
Lowlands: 10,038.11 acres

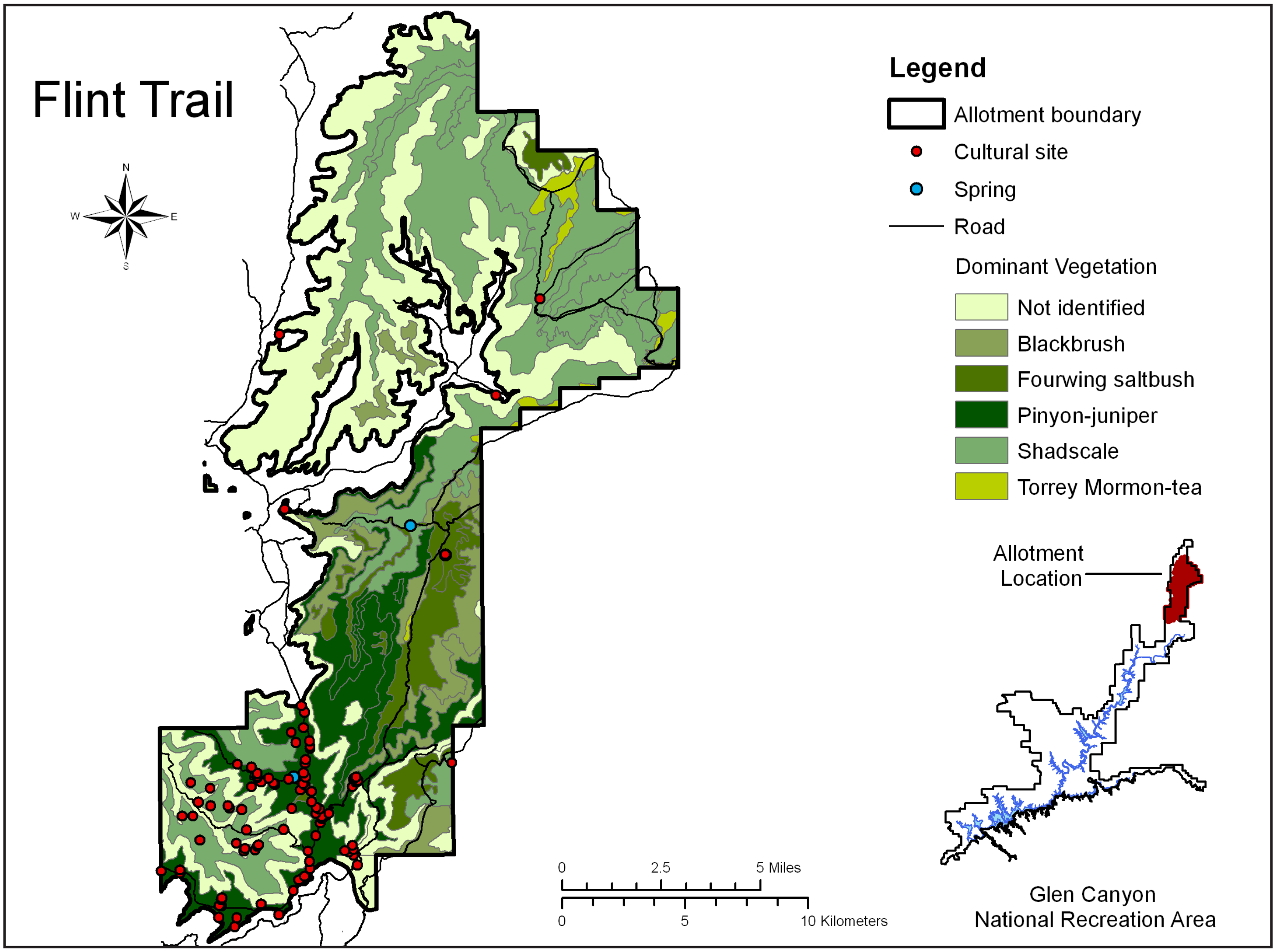
No. Cultural Sites in Each Lifezone:

Highlands: 88
Midlands: 5
Lowlands: 0

Lifezone Significance and Known Cultural Sites: Although all of Geib's lifezones are present within the Flint Trail allotment boundaries, cultural sites are currently known only for midlands (n = 5) and highlands (n = 88). Midland locations provide important grasses, cacti, and hunting opportunities, particularly of antelope. Highlands include pinyon-juniper forests, which provide important food sources, as well as game animals such as deer and rabbit. Highlands also receive enough annual precipitation to allow for dry farming of agricultural produces.

	Elevation	Characteristics	Environment	Significance to Humans
Lowlands	1219-1372 m (4000-4500 ft)	Hot and arid steep-walled sandstone canyons.	Riparian plants; bighorn sheep	Permanent water, arable alluvium, long growing season, diverse plant communities, natural shelters, quality siliceous stone from river gravels
Midlands	1372-1676 m (4500-5500 ft)	Arid slickrock and dune fields on benchlands and low plateaus.	Blackbrush, shadscale, grasses; antelope.	Grasses, including dropseed and ricegrass, prickly pear and shadscale; good antelope habitat, quality siliceous stone in certain locations.
Highlands	Above 1676 m (Above 5500 ft)	High elevation mesas and plateaus with cooler temperatures and greater precipitation.	Pinyon-juniper woodlands; deer and rabbit.	Higher elevation plant foods (i.e. pinyon); later harvests; dry-farming; abundant fuel, deer and rabbit.

Shading indicates lifezones present in allotment.



Area of Individual Vegetation Zones:

Dominant Species	Acres Covered	No. Sites
Not identified	28,268.84	13
Blackbrush (*Coleogyne ramosissima)*	6652.36	0
Fourwing saltbush (*Atriplex canescens)*	5399.26	1
Pinyon-Juniper *(Pinus edulis - Juniperus osteosperma)*	12,155.62	63
Shadscale *(Atriplex confertifolia)*	26,510.60	16
Torrey Mormon tea *(Ephedra torreyana)*	1290.03	0
Total	**80,276.71**	**93**

No. Cultural Sites in Each Vegetation Zone:
The majority (n = 63) of the known cultural sites within Flint Trail occur in the pinyon-juniper dominant vegetation regime. The remaining sites occur in shadscale (n = 16), fourwing saltbush (n = 1), and in regions for which the dominant vegetation remained unidentified (n = 13). Unfortunately, no information is available at this time for the majority of these sites, so correlating site function to vegetation zones is not feasible at this time.

Visibility:
In general, the dominant vegetation of Flint Trail provide moderate - excellent visibility with large portions of the ground between plants bare of vegetation. However, a build-up of duff in the pinyon juniper zones may impede the visibility of small sites and isolated artifacts.

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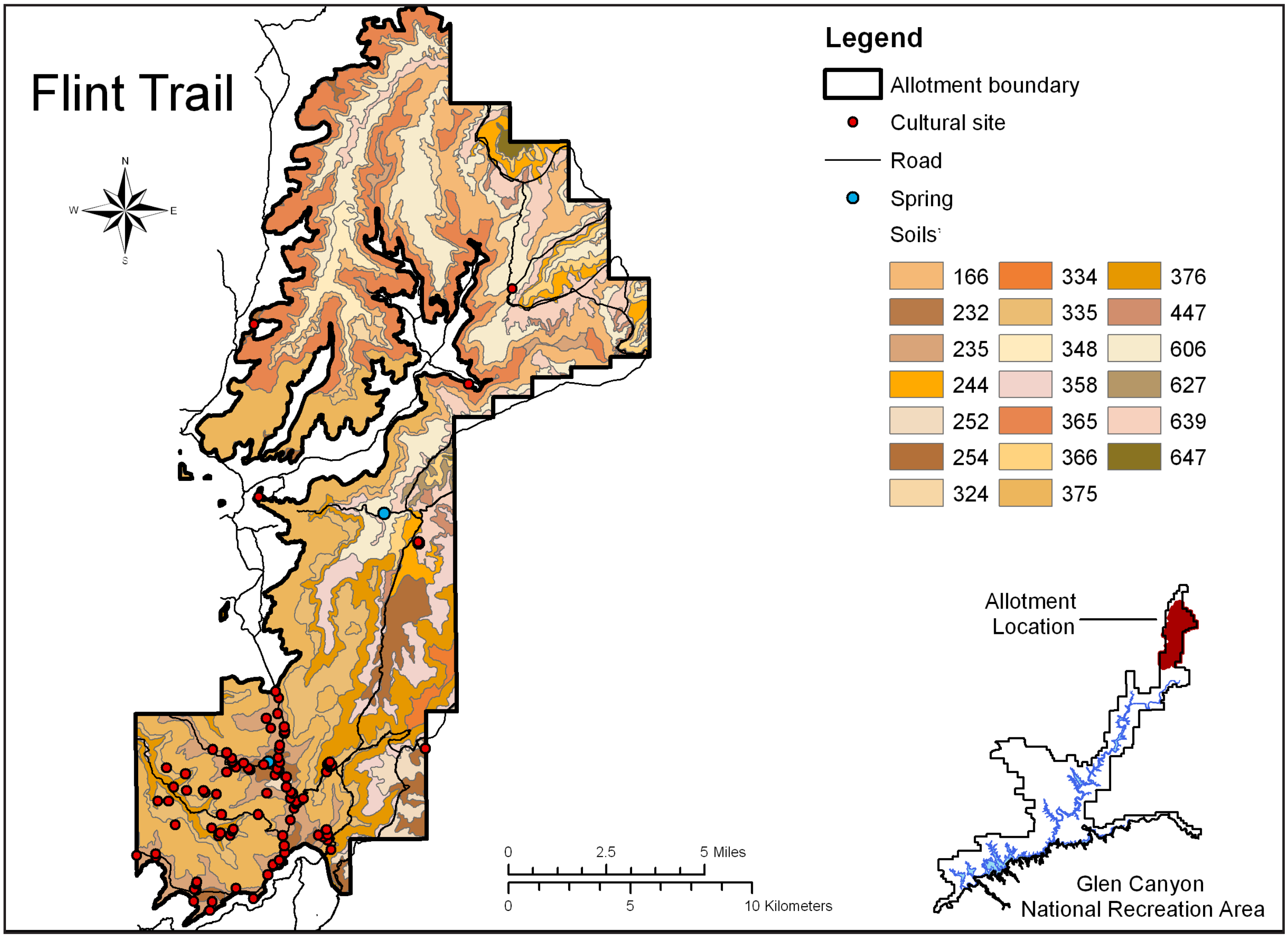
Summary:
Flint Trail is dominated by blackbrush (8.29 percent), fourwing saltbush (6.73 percent), pinyon-juniper (15.14 percent), shadscale (33.02 percent), and Torrey Mormon tea (1.61 percent). The remainder of the allotment's dominant vegetation remains unidentified.

Dominant Species:
Blackbrush (*Coleogyne ramosissima)*
Fourwing saltbush (*Atriplex canescens)*
Shadscale (*Atriplex confertifolia*)
Torrey Mormon tea (*Ephedra torreyana*)
Pinyon (*Pinus edulis*)
Juniper (*Juniperus osteosperma*)

Secondary Dominant Species:
Fremont Cottonwood (*populus fremontii)*
Sand sagebrush (*Artemisia filifolia)*
Mat saltbush (*Atriplex confertifolia*)
Castle Valley Saltbush (*Atriplex cuneata*)

Associated Soils:
Blackbrush grows in shallow sandy loam and sandy loam. Fourwing saltbush occurs in sandy loam and sandy bottoms, where it may be associated with Fremont cottonwood in semiwet saline streambanks. Pinyon-juniper occurs in shallow sandy loam and shallow sand. Shadscale grows in stony loam, where it may be associated with Castle Valley saltbush in alkali flats, in shallow sandy loam alongside blackbrush, and in shallow loam with mat saltbush in shallow clay and Torrey Mormon tea in very shallow gypsum. Finally, Torrey Mormon tea occurs in gypsum loam and very shallow gypsum.



Allotment Divided by Soil Type (MUSYM):

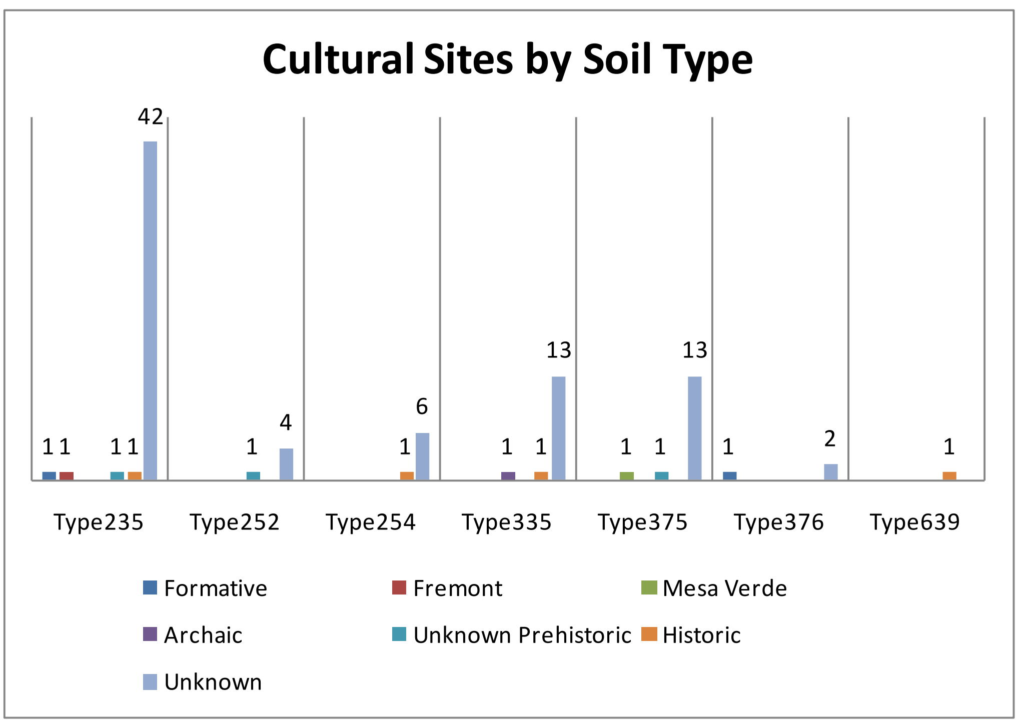
Soil types, acreage, and associated sites are included in the table on the subsequent page.

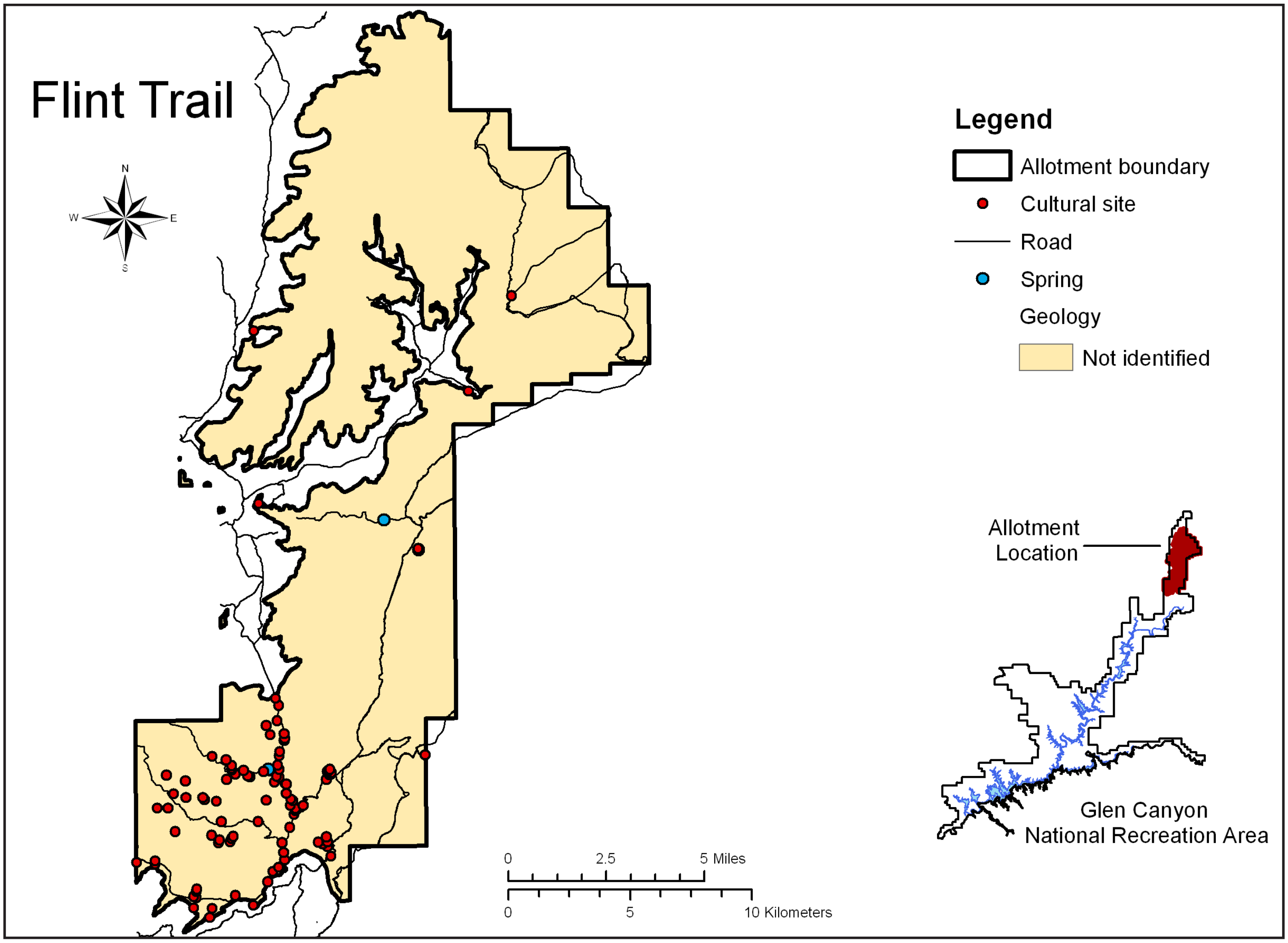
Distribution of Cultural Sites by Soil Type:

A total of 46 cultural sites occur in soil type 235, including a Formative site, a Fremont site, a historic site, a lithic scatter, and 42 sites with unknown affiliation and/or attribute information. Five (n = 5) sites occur in soil type 252, including one lithic scatter and four sites within unknown cultural affiliation and attribute information. Seven (n = 7) sites are located on soil type 254, including a historic site with prehistoric components, a prehistoric site of unknown affiliation, and five sites with no affiliation or attribute information. Fifteen (n = 15) sites are located in soil type 335, including one historic site, one Archaic site, and 13 sites with no known affiliation or attribute information. Fifteen (n = 15) sites occur in soil type 375, including one Mesa Verde site, a lithic scatter, and 13 sites with unknown affiliation or attributes. Three (n = 3) sites occur in soil type 376, including one Formative site and two sites with no known affiliation or attribute information. A single historic site (n = 1) is located in soil type 639.

The figure on the subsequent page depicts site affiliations as they relate to soil types.

Soil Type	Acres	Percent	No. Cultural Sites
166	9579.33	11.93	0
232	52.47	<0.00	0
235	4430.54	5.52	46
244	2059.55	2.57	0
252	1259.83	1.57	5
254	3369.33	4.20	7
324	1140.58	1.42	0
335	4906.64	6.11	15
348	1357.72	1.69	0
358	3358.38	4.18	0
365	10,732.14	13.69	0
366	1312.92	1.64	0
375	14,676.18	18.28	15
376	6115.65	7.62	3
447	864.41	1.08	0
606	9565.59	11.92	0
627	381.17	0.95	0
639	4878.31	6.08	1
647	235.96	0.29	0
Total	**80,276.70**	**100.74%**	**92**





Allotment Divided by Geology:

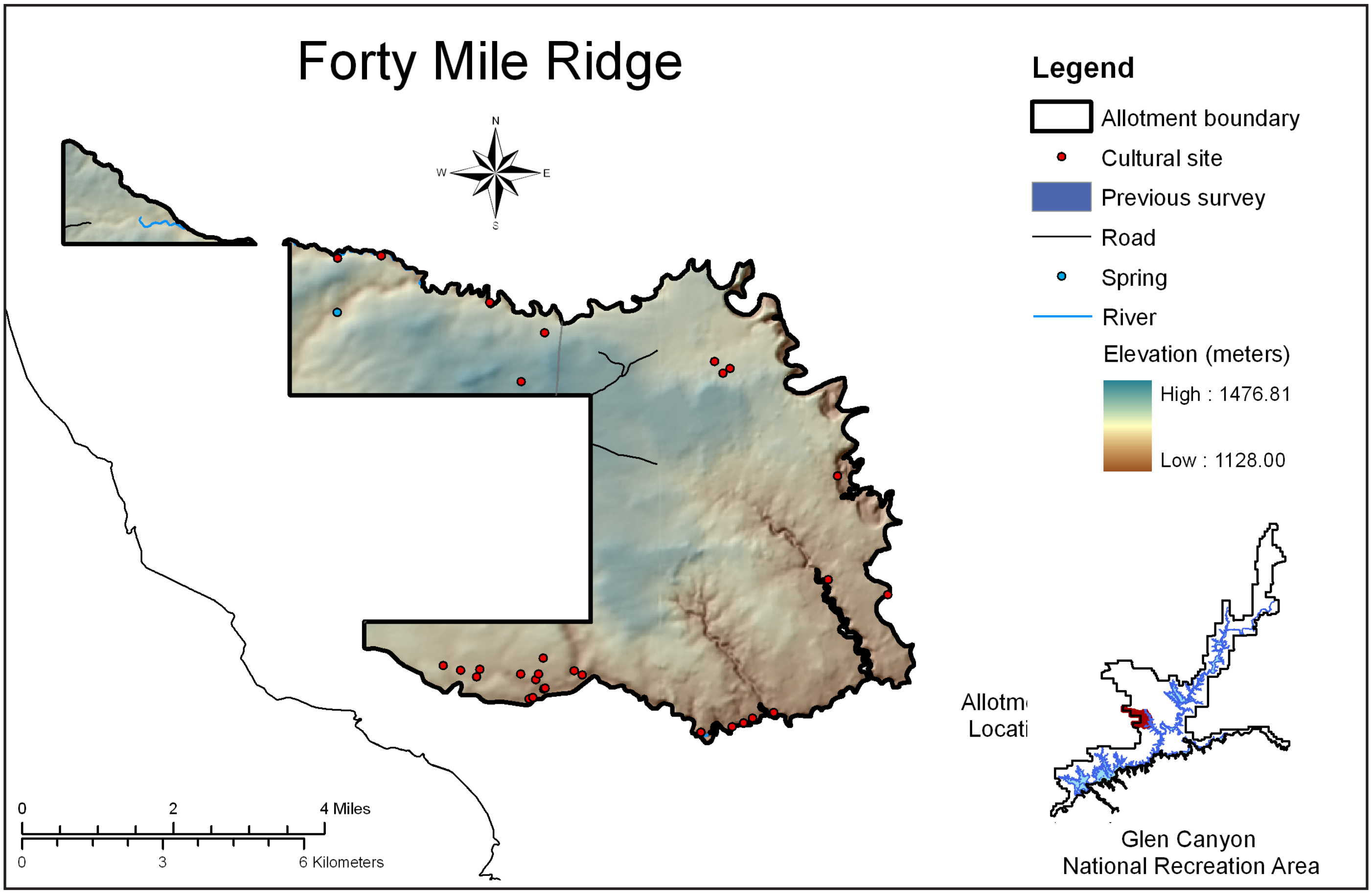
No geological information for Flint Trail grazing allotment is available at this time.

Distribution of Cultural Sites by Geological Location:

All known cultural sites (n = 93) in Flint Trail occur in contexts for which the geology has not been identified.

Forty Mile Ridge

Map Panels



Total Area: 18,707.15 acres

Sampling Fractions:
2 percent: 374.14 acres
5 percent: 935.36 acres
11 percent: 2057.79 acres
16 percent: 2993.14 acres
20 percent: 3741.43 acres

Elevation range amsl:
1128.00 – 1476.81 meters (3700.79 - 4845.18 feet)

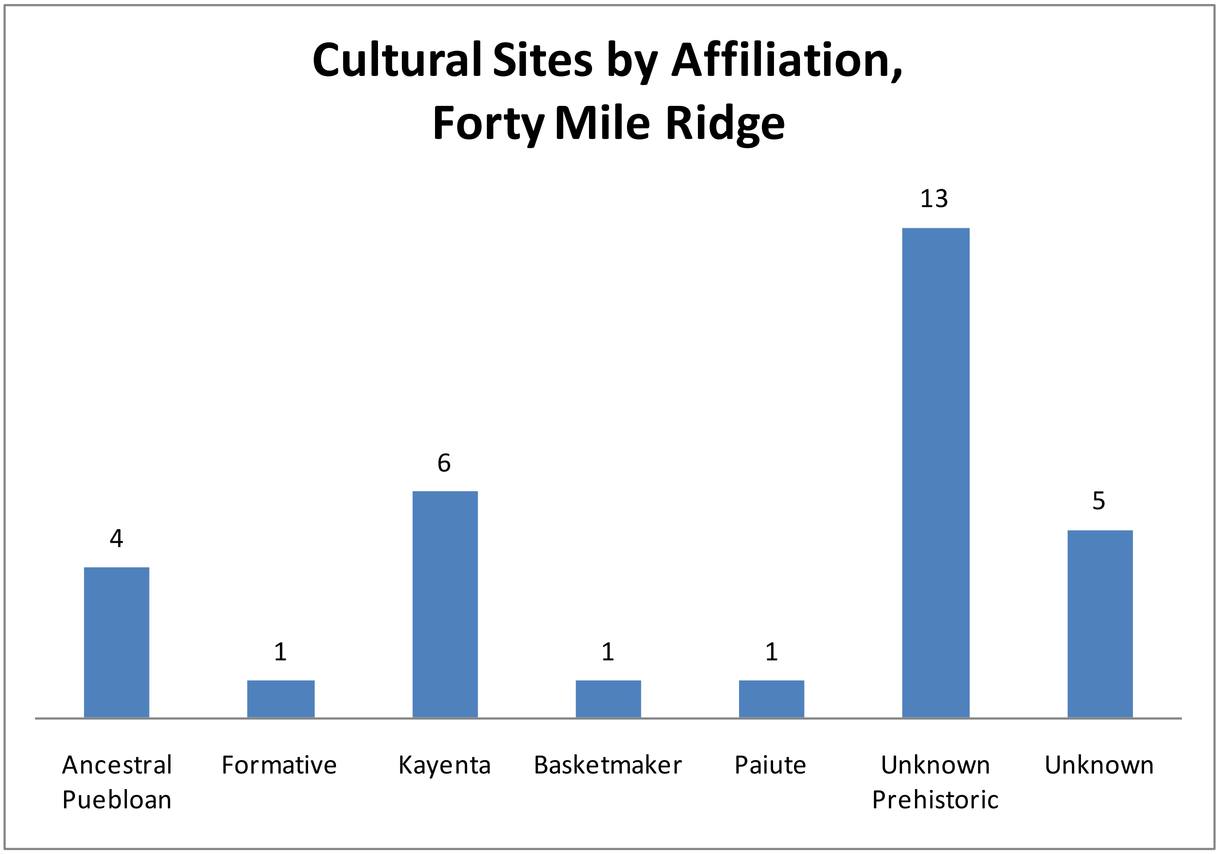
Rivers and Springs:
One unnamed spring is located within Forty Mile Ridge grazing allotment. Dry Fork Creek crosses the northernmost portion of the allotment, and Fortymile Creek crosses the southernmost tip of the allotment.

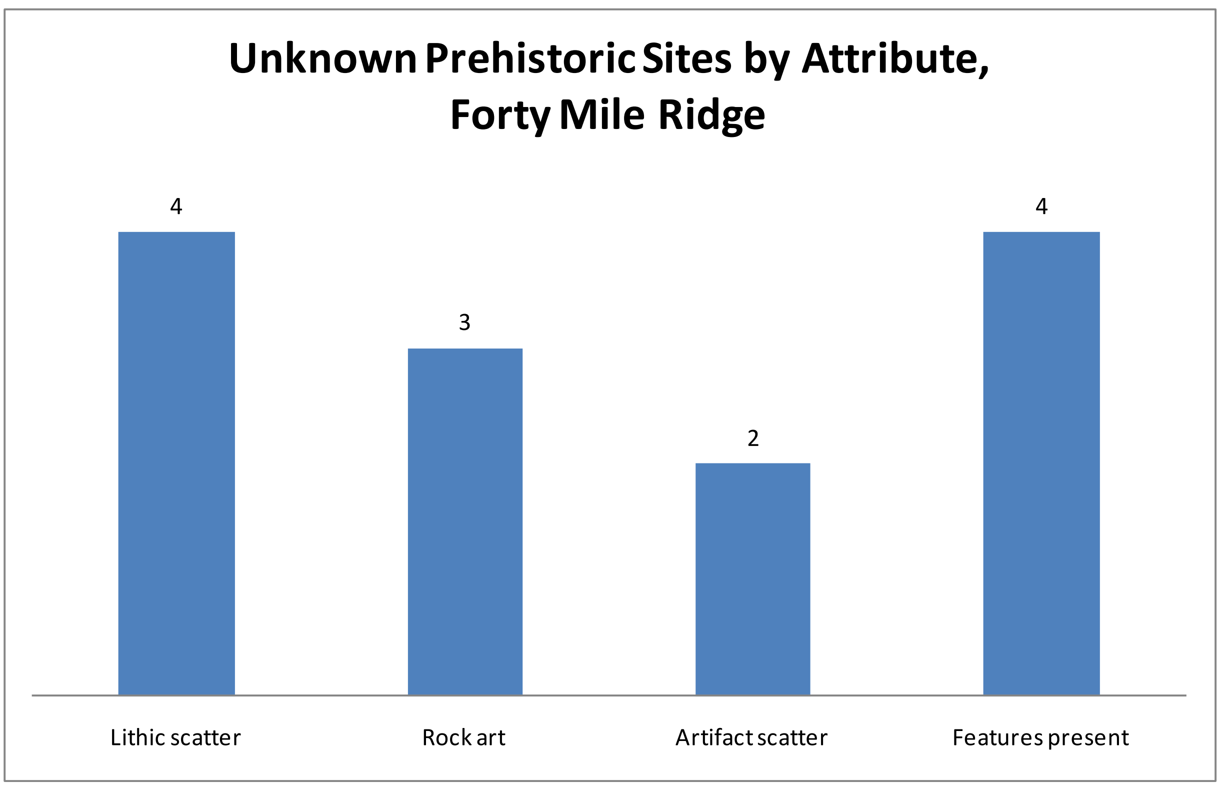
Accessibility:
Hole-in-the-Rock Road (County Hwy 330) parallels the allotment to the west. A lateral road extending from 330 across the topographic feature of Fortymile Ridge provides access to the center of the allotment.

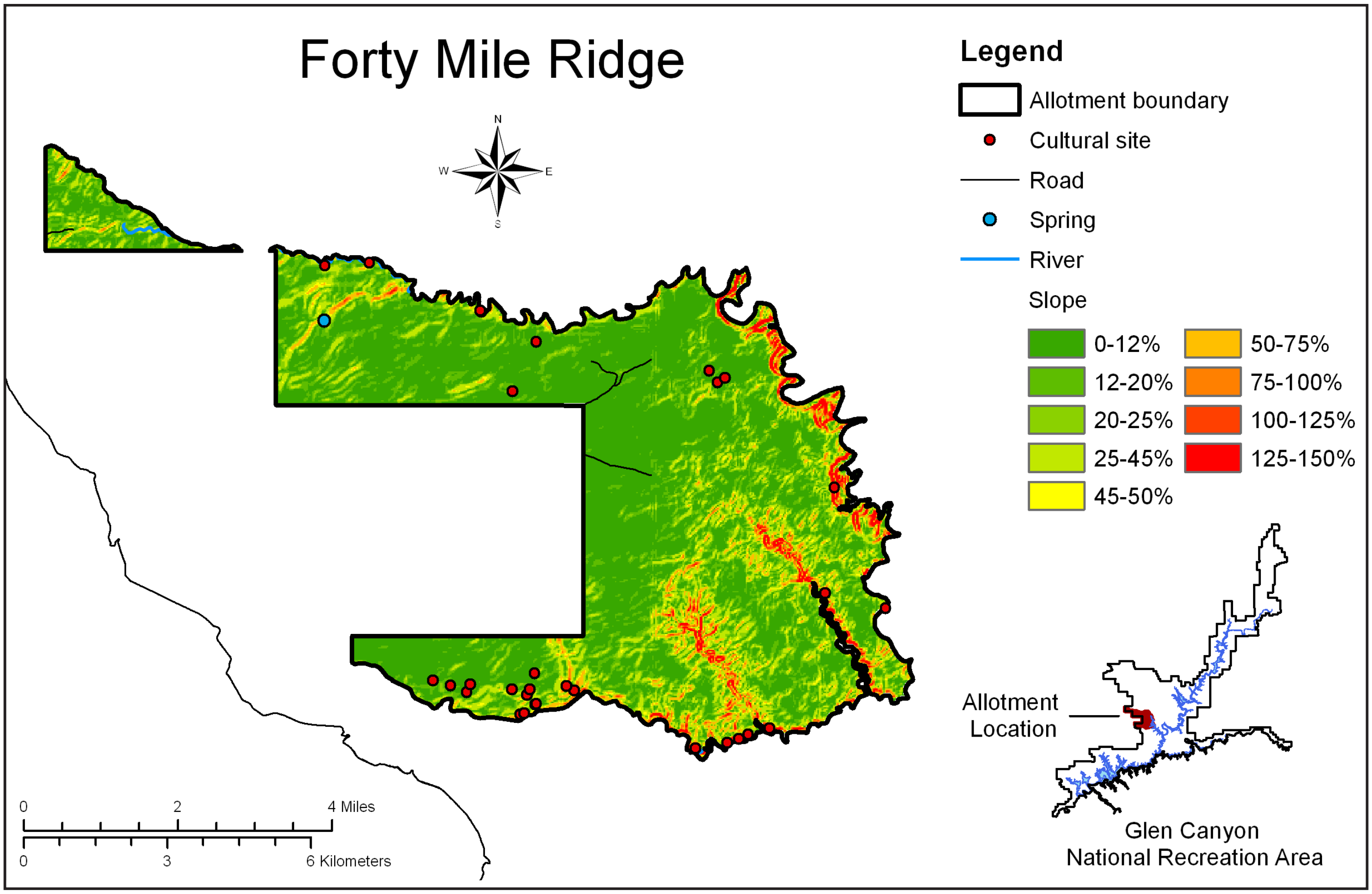
No. Cultural Sites: 31
Area surveyed: 6.03

Survey References:
Wells (1982): 6.03 acres

The figures on the subsequent page depict the proportions of cultural sites by affiliation, and for those prehistoric sites for which affiliation is unknown, by attribute.


Cultural Sites by Affiliation,
Forty Mile Ridge
4
1
6
1
1
13
5
Ancestral Puebloan
Formative
Kayenta
Basketmaker
Paiute
Unknown Prehistoric
Unknown


Unknown Prehistoric Sites by Attribute,
Forty Mile Ridge
4
3
2
4
Lithic scatter
Rock art
Artifact scatter
Features present



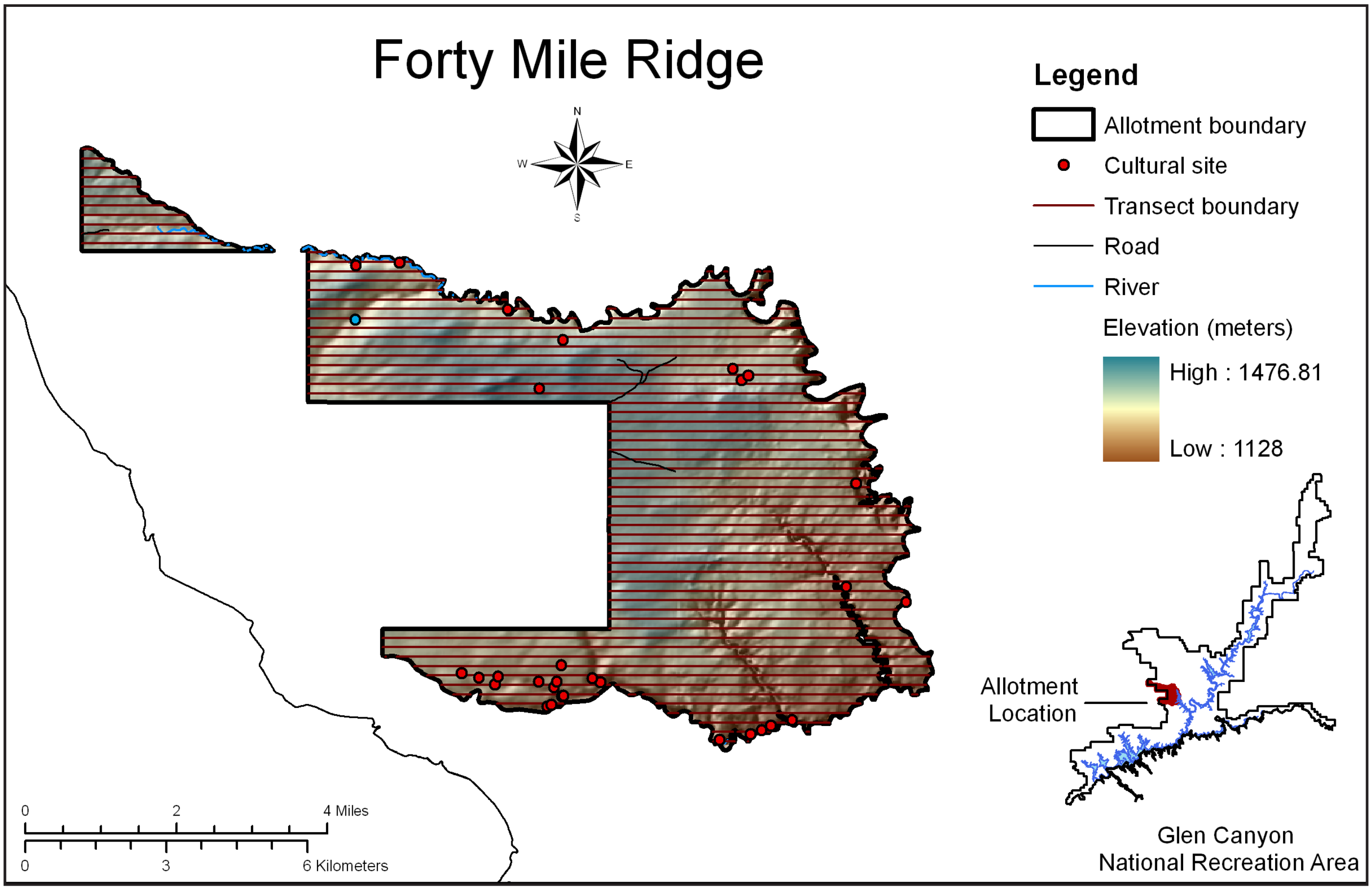
Slope Considerations:

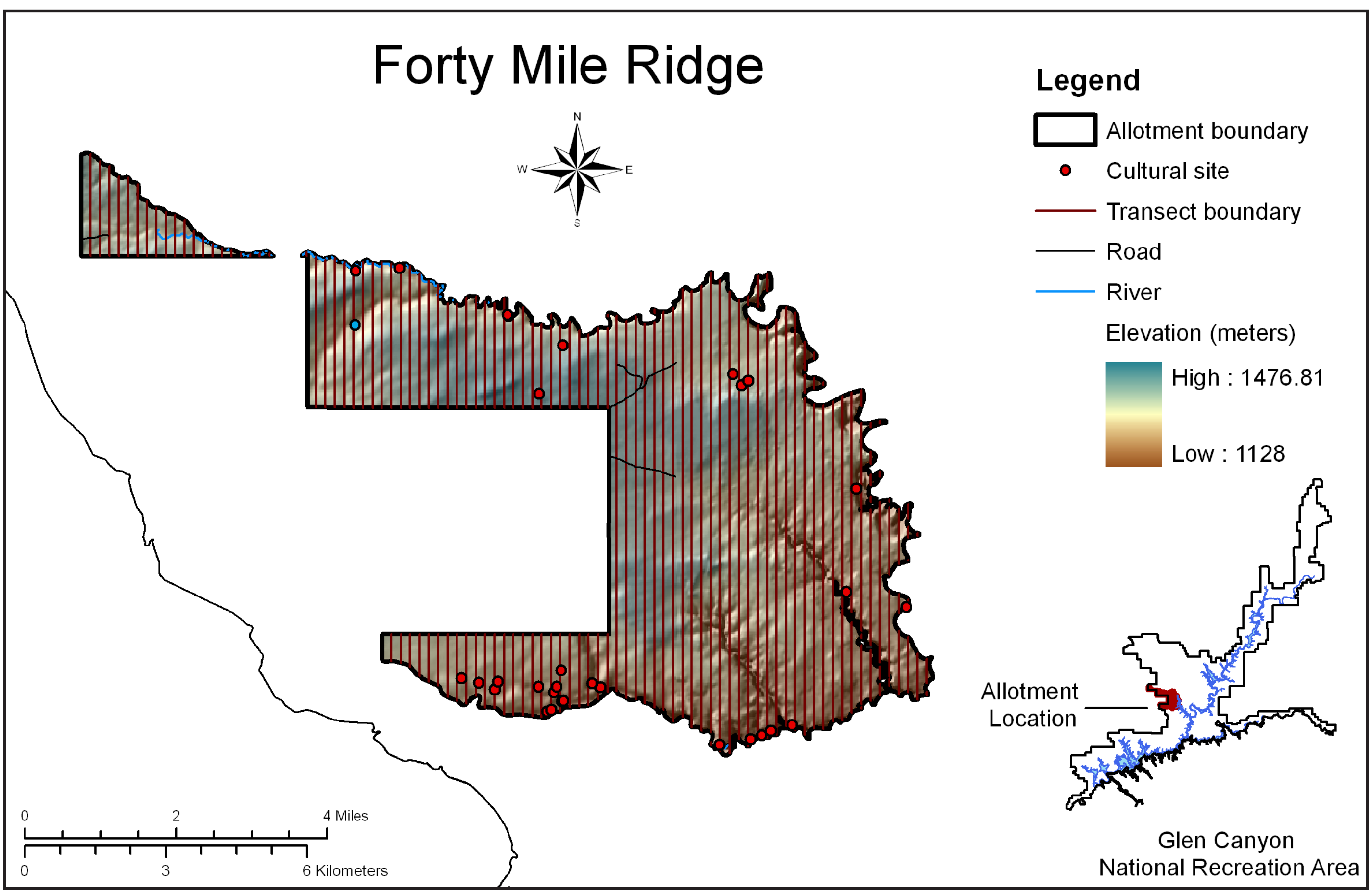
Slope plays a large role in terrain accessibility, and may be used in the stratification of survey areas. For example, GCNRA may wish to assign catagories such as low, moderate, and high to specific slope gradients. Such assignations are most often dependent on the factors guiding archaeological survey work, and as such, are not included in this document. Included herein, however, are suggestions for basic transect orientation based on the presence of topographical barriers identified by the presence of excessive slope gradients.

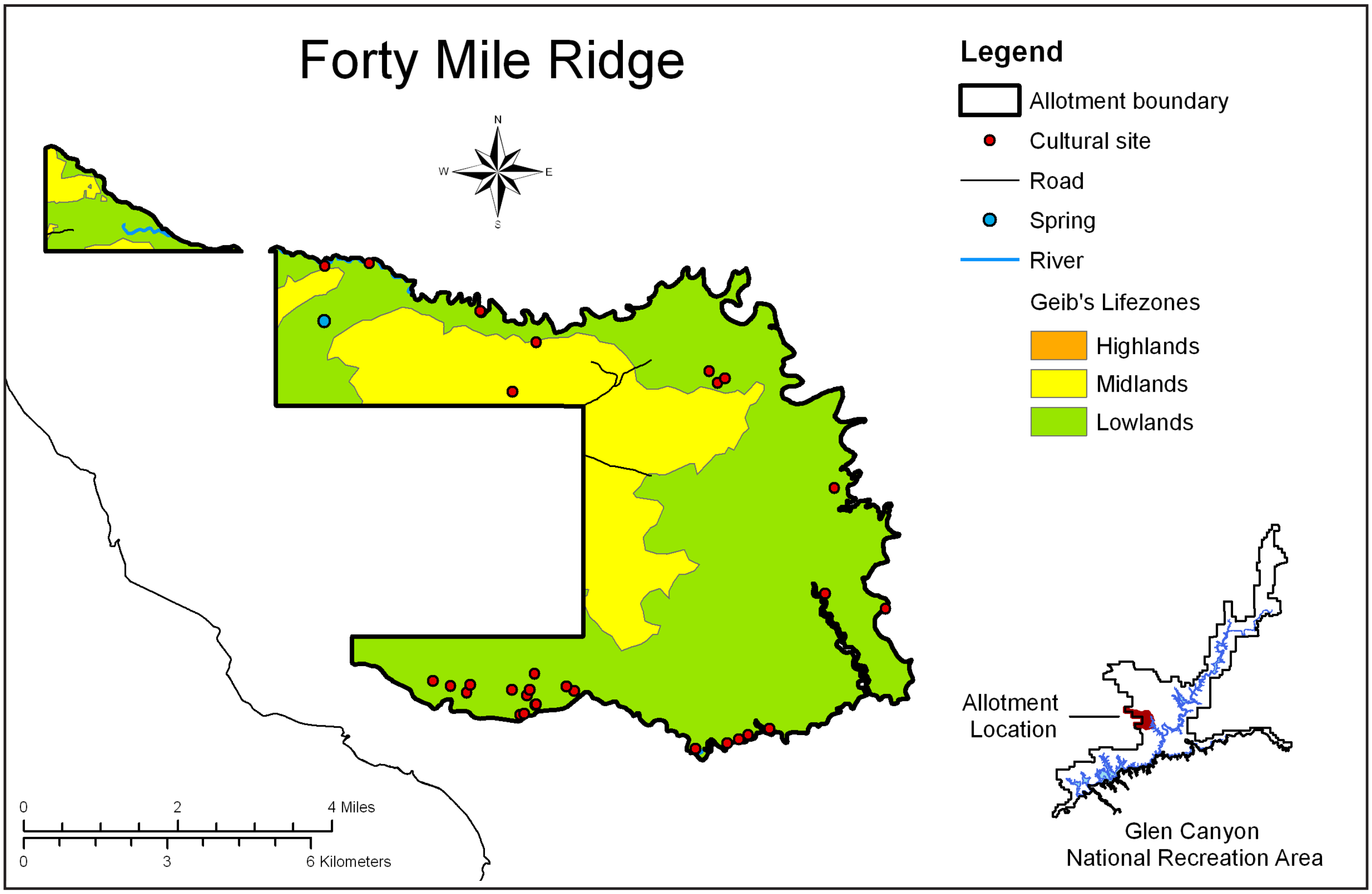
Survey Zones Dictated by Slope:

Given road orientation and slope, placement of north-south oriented transects perpendicular to available roads is recommended for the northern portion of Forty Mile Ridge. In the central portion of the allotment, north-south or east-west oriented transects should work equally well. In the southern portion of the allotment, however, steep canyons are present. The bottoms of these canyons will have to be surveyed separately. Given the orientation of these canyons, north-south oriented transects are recommended, so that longer transect lengths may be surveyed at a time.

The 'fishnet' maps provided on the subsequent page provide transects spaced at 200 meter intervals for both east-west and north-south oriented pedestrian survey.


Forty Mile Ridge
N
W
E
S
Legend
Allotment boundary
Cultural site
Transect boundary
Road
River
Elevation (meters)
High : 1476.81
Low : 1128
Allotment Location
Glen Canyon
National Recreation Area
0
2
4 Miles
0
3
6 Kilometers


Forty Mile Ridge
N
W
E
S
Legend
Allotment boundary
Cultural site
Transect boundary
Road
River
Elevation (meters)
High : 1476.81
Low : 1128
Allotment Location
Glen Canyon
National Recreation Area
0
2
4 Miles
0
3
6 Kilometers



Area of Each Lifezone:

Highlands: 0.0 acres
Midlands: 5335.79 acres
Lowlands: 13,277.50 acres

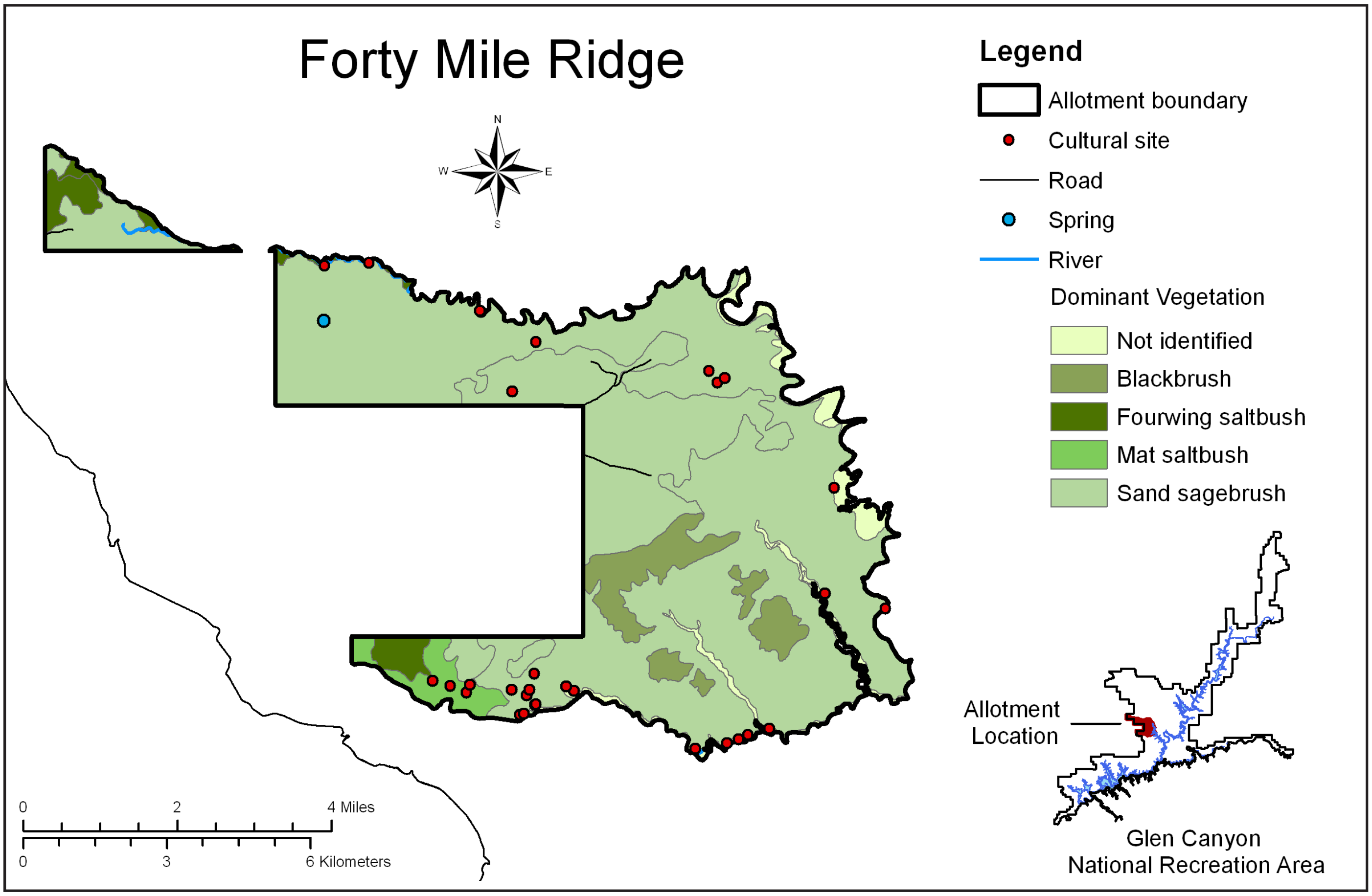
No. Cultural Sites in Each Lifezone:

Highlands: 0
Midlands: 3
Lowlands: 28

Lifezone Significance and Known Cultural Sites: The majority of sites known for Forty Mile Ridge occur in the lowlands (n = 28). Geib describes the lowlands as hot and arid, with permanent water, arable alluvium, and long growing seasons needed for agricultural pursuits. The remaining three (n = 3) sites are located in the midlands, described as Geib as rich in grass and cacti resources, in addition to providing good habitant for antelope.

	Elevation	Characteristics	Environment	Significance to Humans
Lowlands	1219-1372 m (4000-4500 ft)	Hot and arid steep-walled sandstone canyons.	Riparian plants; bighorn sheep	Permanent water, arable alluvium, long growing season, diverse plant communities, natural shelters, quality siliceous stone from river gravels
Midlands	1372-1676 m (4500-5500 ft)	Arid slickrock and dune fields on benchlands and low plateaus.	Blackbrush, shadscale, grasses; antelope.	Grasses, including dropseed and ricegrass, prickly pear and shadscale; good antelope habitat, quality siliceous stone in certain locations.
Highlands	Above 1676 m (Above 5500 ft)	High elevation mesas and plateaus with cooler temperatures and greater precipitation.	Pinyon-juniper woodlands; deer and rabbit.	Higher elevation plant foods (i.e. pinyon); later harvests; dry-farming; abundant fuel, deer and rabbit.

Shading indicates lifezones present in allotment.



Area of Individual Vegetation Zones:

Dominant Species	Acres Covered	No. Sites
Not identified	790.46	5
Blackbrush (*Coleogyne ramosissima)*	1176.39	0
Fourwing saltbush (*Atriplex canescens)*	628.96	1
Mat saltbush (*Atriplex canescens)*	478.00	4
Sand sagebrush *(Artemisia filifolia)*	15,633.34	21
Total	**18,707.15**	**31**

No. Cultural Sites in Each Vegetation Zone:
The majority of known sites (n = 21) in Forty Mile Ridge are located in sand sagebrush, the dominant vegetation of the allotment. The remainder are located in fourwing saltbush (n = 1), mat saltbush (n =4), and in areas for which the dominant vegetation has not yet been identified (n = 5).

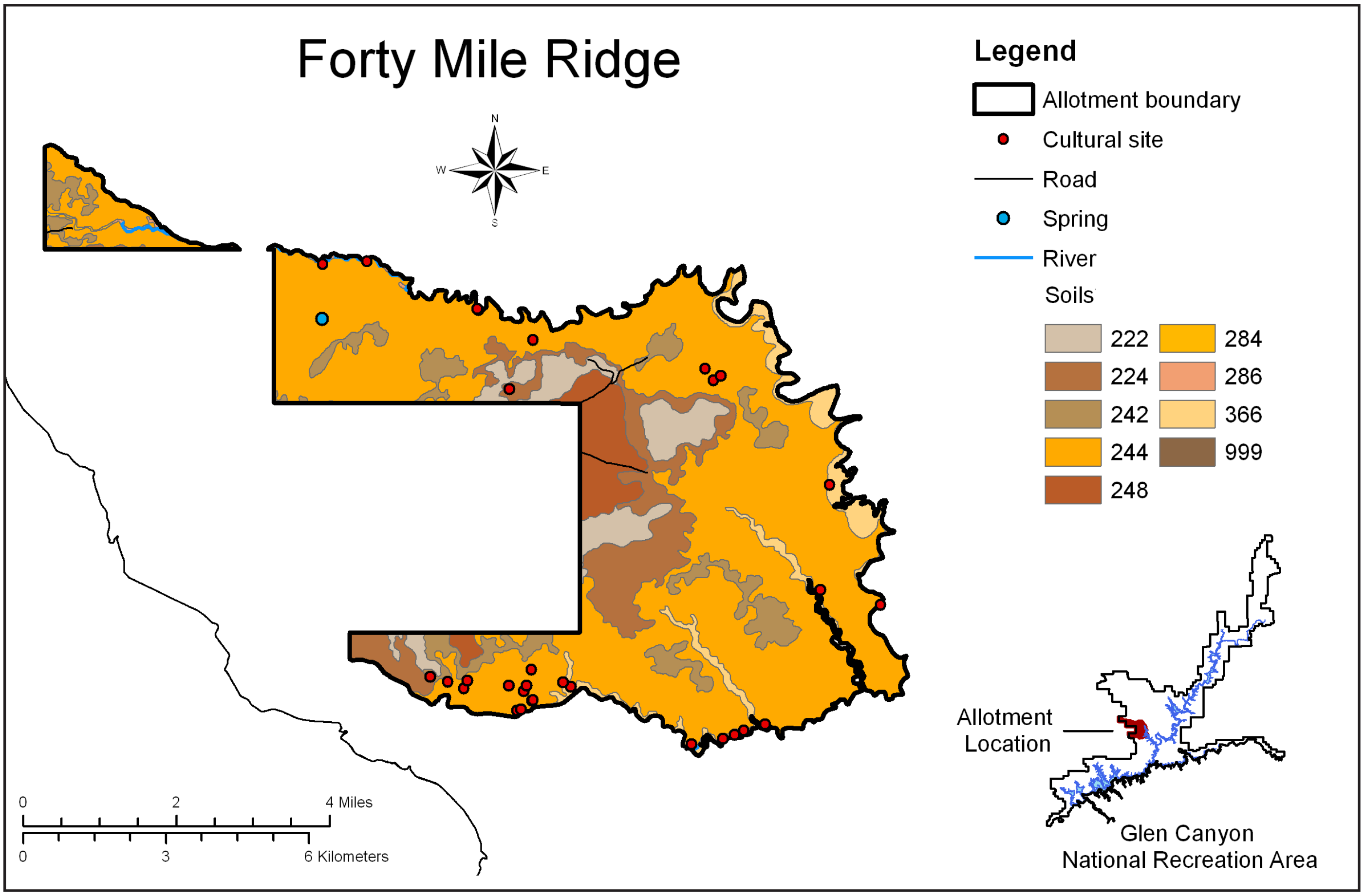
Visibility:
In general, the dominant vegetative communities of the allotment provide moderate - excellent visibility for the archaeologist, with large portions of the ground between plants bare of vegetation.

Summary:
The primary dominant vegetation zones within the Forty Mile Ridge grazing allotment include blackbrush (6.29 percent), fourwing saltbush (3.60 percent), mat saltbush (2.26 percent), and sand sagebrush (83.57 percent). Dominant vegetation for the remainder of the allotment is not currently known.

Dominant Species:
Fourwing saltbush *(Atriplex canescens*)
Mat saltbush (*Atriplex confertifolia*)
Sand Sagebrush (*Artemisia filifolia*)
Shadscale (*Atriplex confertifolia*)

Secondary Dominant Species:
Fremont cottonwood (*Populus fremontii*)

Associated Soils:
Blackbrush grows in shallow sandy loam, and may be associated with fourwing saltbush in sandy loam. Fourwing saltbush occurs in sandy bottoms, where it may be found with Fremont cottonwood in semiwet saline streambanks, and in sandy loam. Mat saltbush grows in shallow clay, where it may be found with fourwing saltbush in sandy loam. Finally, sand sagebrush occurs in sand, where it grows with blackbrush in shallow sandy loam.

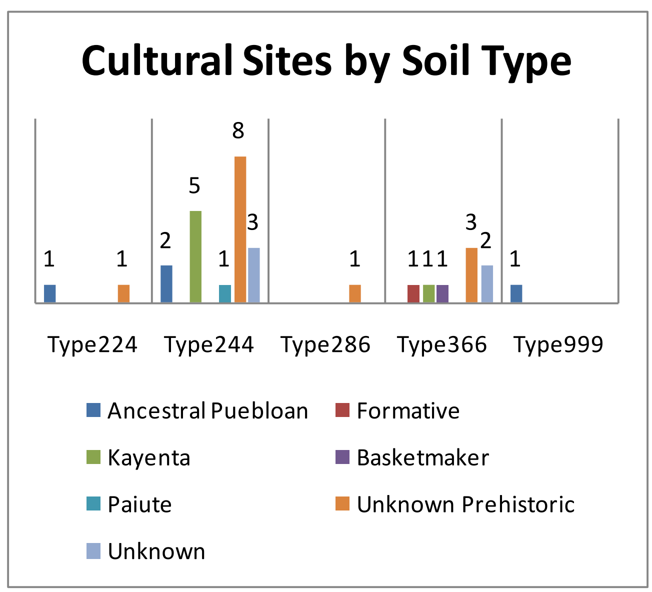


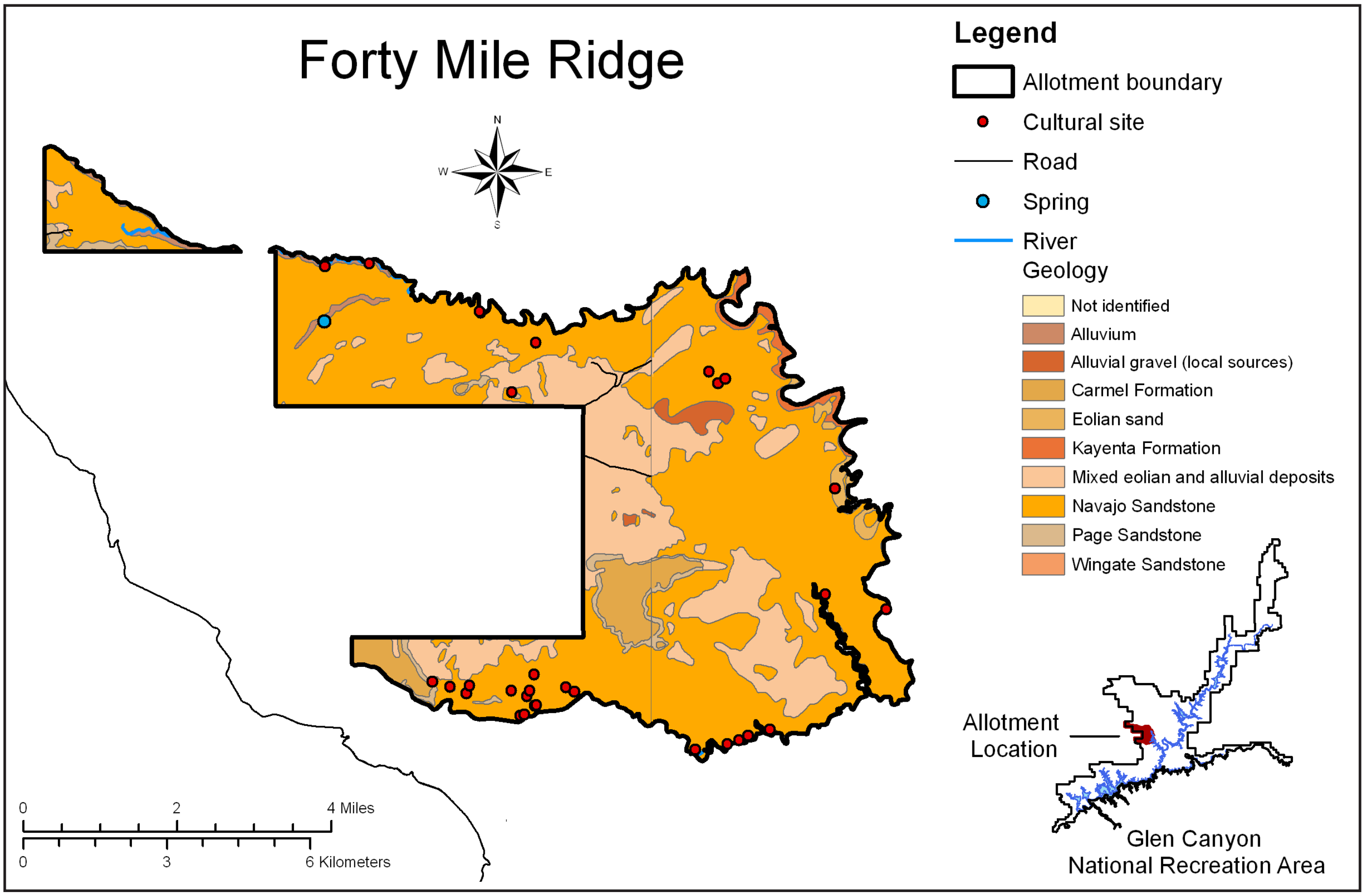
Allotment Divided by Soil Type (MUSYM):

Soil Type	Acres	Percent	No. Cultural Sites
222	1124.79	6.01	0
224	1867.68	9.98	2
242	1452.80	7.77	0
244	12,279.78	65.64	19
248	862.21	4.61	0
284	18.68	<0.00	0
286	87.08	0.47	1
366	979.37	5.24	8
999	34.77	0.19	1
Total	**18,707.16**	**99.91%**	**31**

Distribution of Cultural Sites by Soil Type:

Two (n = 2) sites occur on soil type 224, including one Ancestral Puebloan site, and one unaffiliated prehistoric site containing extensive cultural fill. Nineteen (n = 19) sites occur on soil type 244, which is often associated with Navajo Sandstone or slickrock. These sites include two Ancestral Puebloan sites, five Kayenta sites, one Paiute site, eight prehistoric sites for which affiliation is currently not known, and three sites for which no information is currently available. The unaffiliated prehistoric sites in 244 include four lithic scatters, one artifact scatter, two sites with features, and one rock art site. A single granary (n = 1) is located within soil type 286. Eight (n = 8) sites, including a Basketmaker site, a Formative site, a Kayenta site, two rock art sites, a single unaffiliated structural site, and two sites for which affiliation and/or attribute information is currently lacking. The final site (n = 1), an Ancestral Puebloan site, occurs in soil type 999.



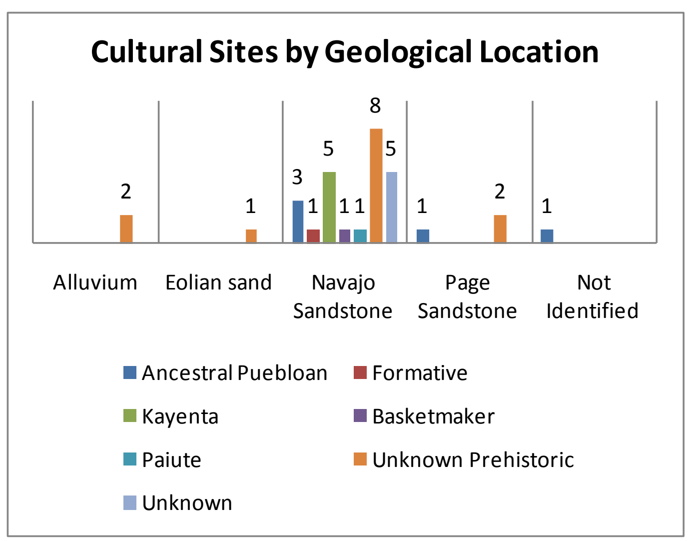


Allotment Divided by Geology:

Geology	Acres	Percent	No. Cultural Sites
Not identified	84.87	0.45	1
Alluvial gravels (local sources)	172.99	0.92	0
Alluvium	231.23	1.24	2
Carmel Formation	769.83	4.12	0
Eolian sand	176.45	0.94	1
Kayenta Formation	254.16	1.36	0
Mixed eolian and alluvial deposits	4214.41	22.53	0
Navajo Sandstone	12,449.34	66.55	24
Page Sandstone	353.71	1.89	3
Wingate Sandstone	0.16	<0.00	0
Total	**18,707.15**	**100%**	**31**

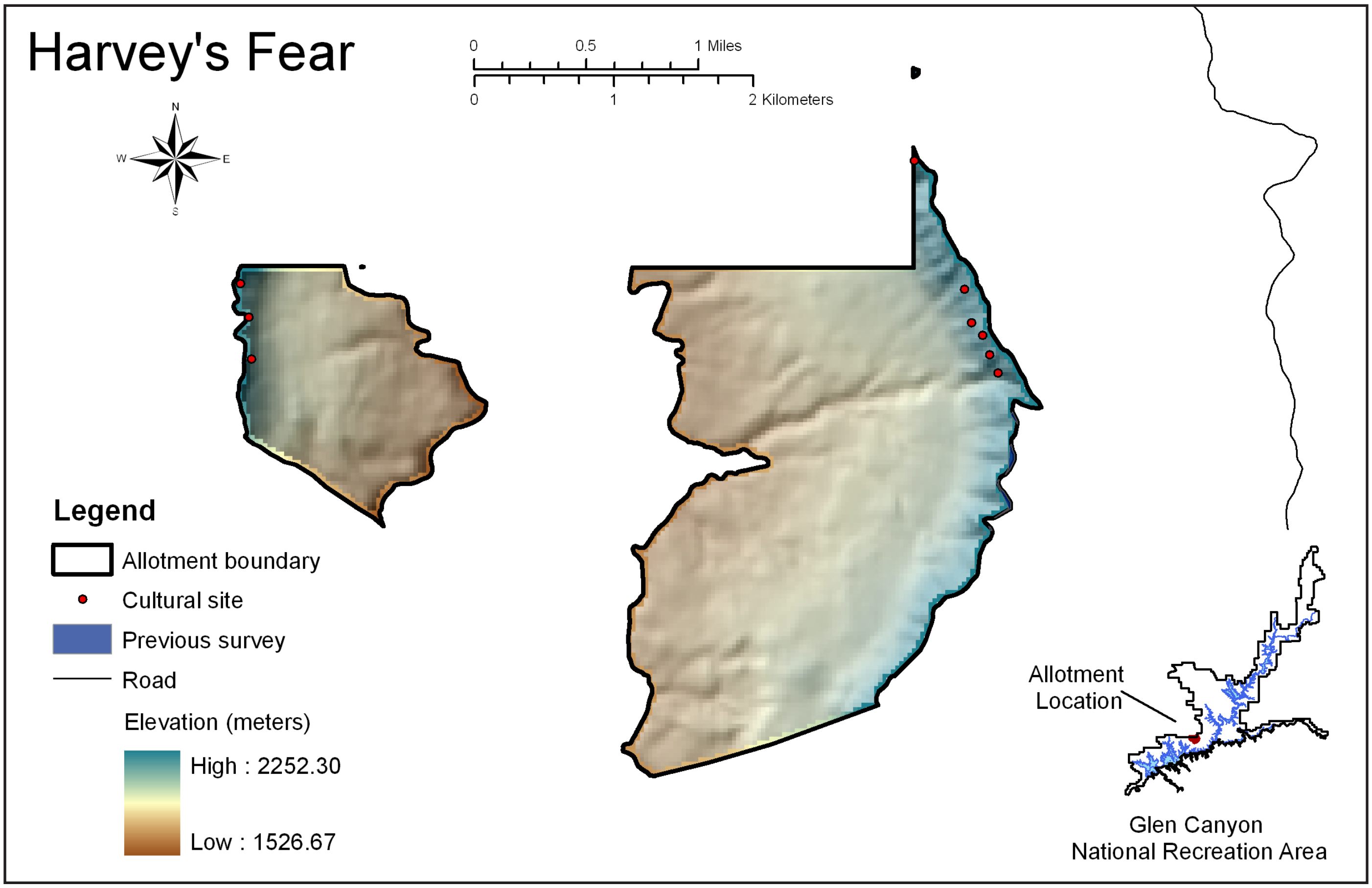
Distribution of Cultural Sites by Geological Location:

Two sites (n = 2), including a granary and a rock art site, occur in alluvium. One structural site (n = 1) for which the affiliation is not currently known occurs in eolian sand. Twenty-four (n = 24) sites occur in Navajo Sandstone, or slickrock. These sites include three Ancestral Puebloan sites, one Basketmaker site, one Formative site, five Kayenta sites, one Paiute site, eight prehistoric sites for which the cultural affiliation is not known, and five sites for which both attribute and affiliation information are currently unknown. The unknown prehistoric sites located in Navajo Sandstone include two rock art sites, four lithic scatters, an artifact scatter, and single site containing a stone circle at the site center. Three sites (n = 3), including one Ancestral Puebloan site and two currently unaffiliated prehistoric sites are located on Page Sandstone. The remaining site (n = 1) consists of an Ancestral Puebloan site located in an area for which the geology is not currently known.



Harvey's Fear

Map Panels



Total Area: 2415.96 acres

Sampling Fractions:
2 percent: 48.32 acres
5 percent: 120.80 acres
11 percent: 265.76 acres
16 percent: 393.80 acres
20 percent: 483.19 acres

Elevation range amsl:
1526.67 – 2252.30 meters (5008.76 - 7389.44 feet)

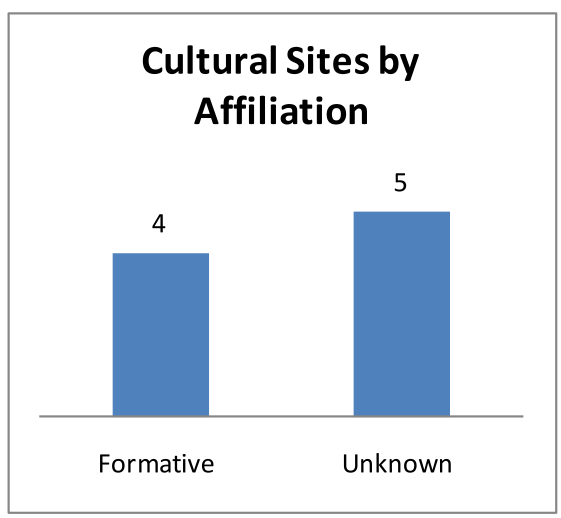
Rivers and Springs:
None known.

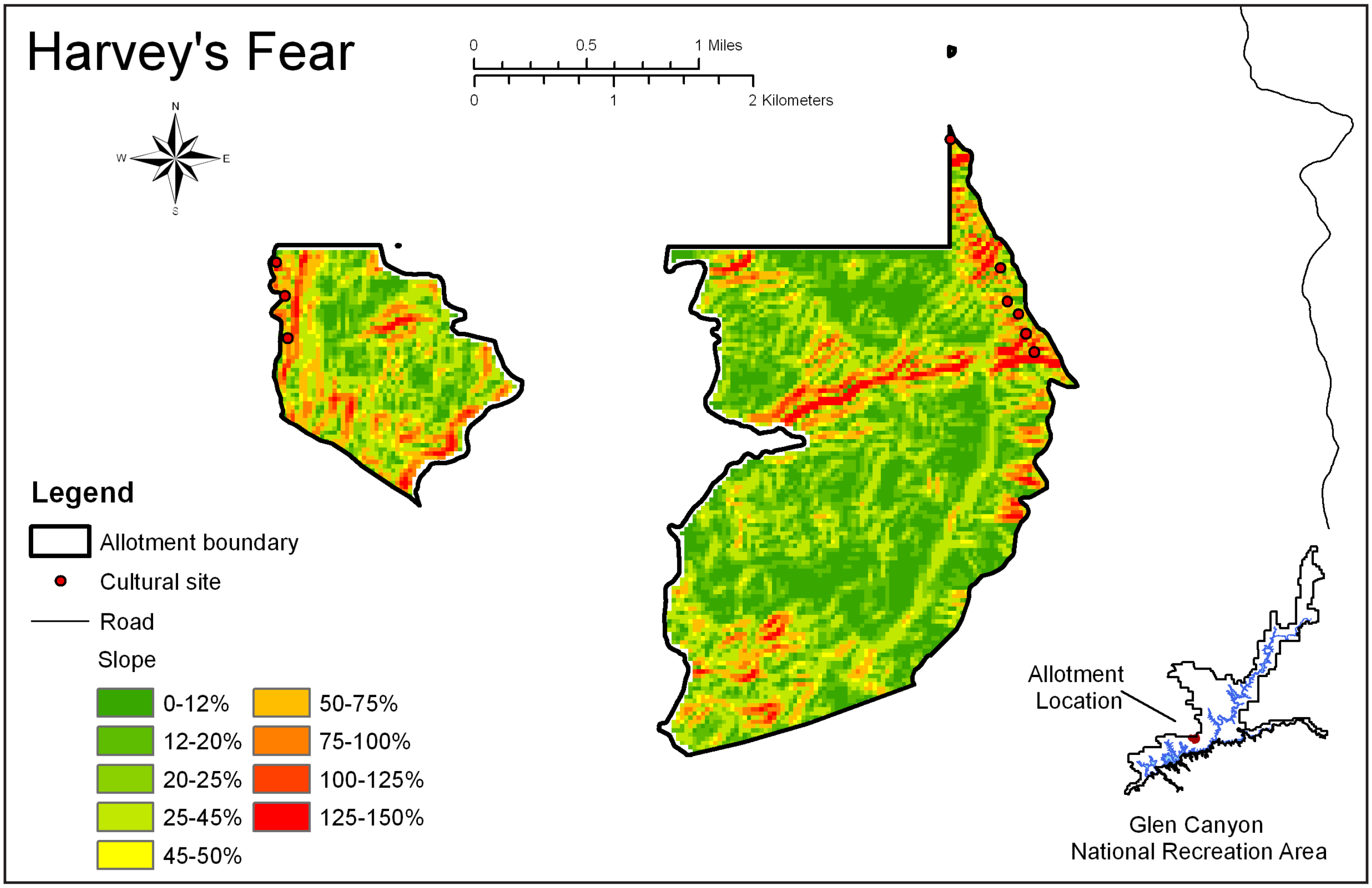
Accessibility:
Harvey's Fear is accessible by an unnamed road extending south from County Hwy 330 (Hole-in-the-Rock Road) along the east side of the allotment. Given that the allotment is divided by Dry Rock Creek and Lake Canyon, access from the lake may be more feasible than attempting road access. Dangling Rope Marina is located directly south of the allotment.

No. Cultural Sites: 9
Area surveyed: 2.81 acres

Survey References:
GLCA (1996): 2.81 acres

The figure below depicts known cultural sites by affiliation. As the information available is minimal, only one figure is included for this allotment.





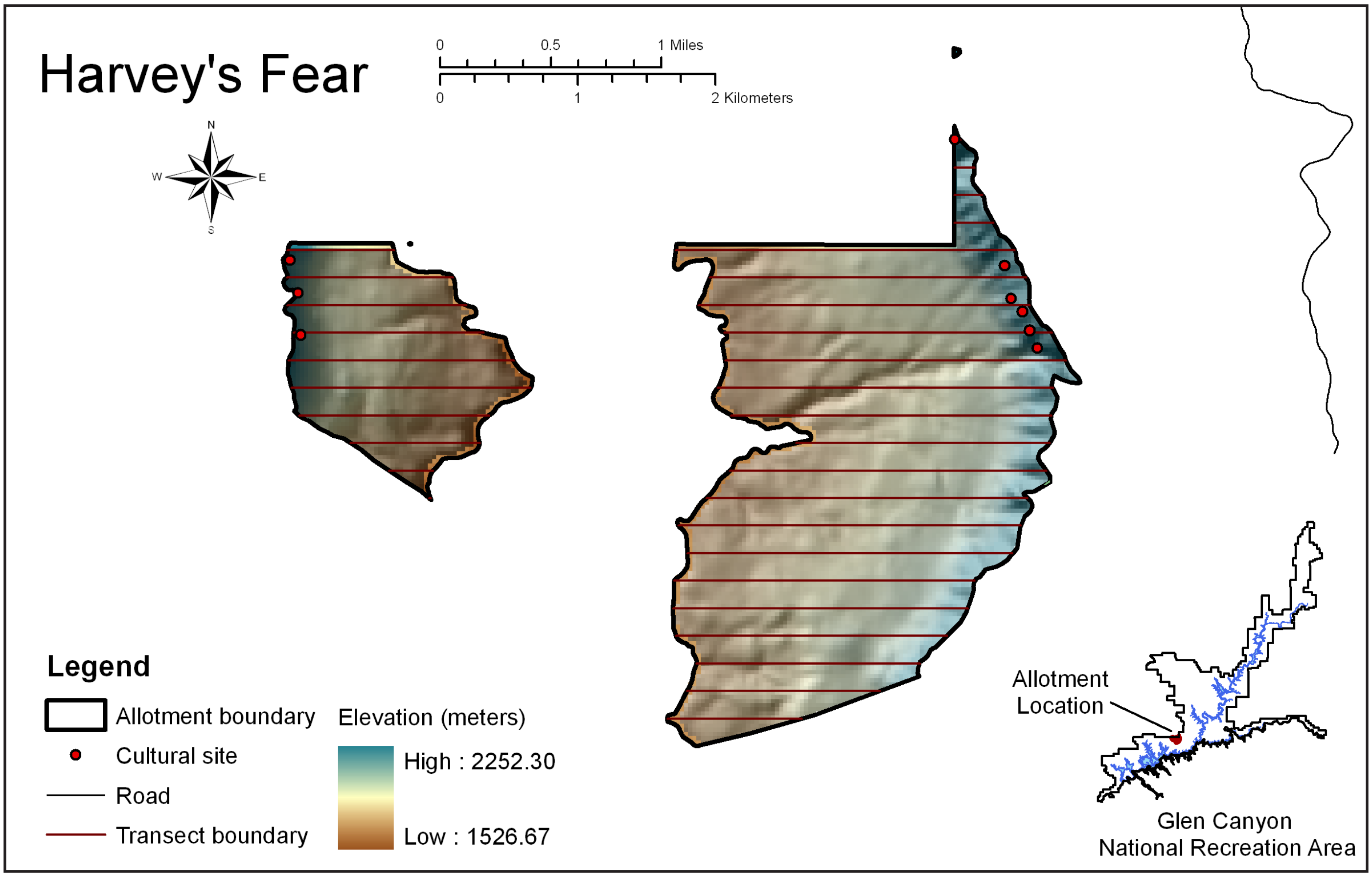
Slope Considerations:

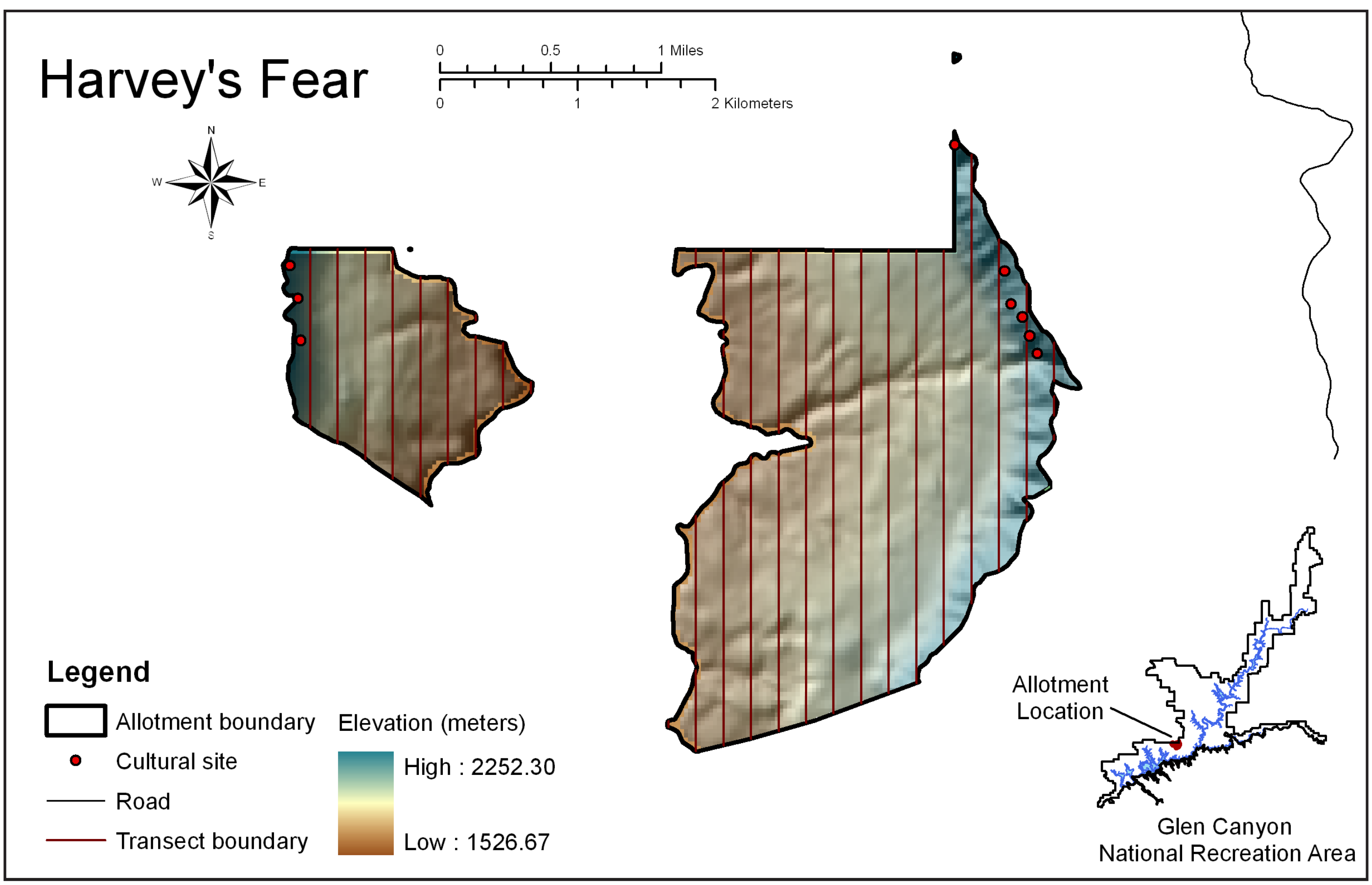
Slope plays a large role in terrain accessibility, and may be used in the stratification of survey areas. For example, GCNRA may wish to assign catagories such as low, moderate, and high to specific slope gradients. Such assignations are most often dependent on the factors guiding archaeological survey work, and as such, are not included in this document. Included herein, however, are suggestions for basic transect orientation based on the presence of topographical barriers identified by the presence of excessive slope gradients.

Survey Zones Dictated by Slope:

Harvey's Fear consists of two separate pieces of land, with the eastern section divided into north and south by a lateral canyon. Steep slopes mark much of the outer boundary of the western section, and the eastern edge of the east section. Moreover, no roads are currently recorded for the interior of Harvey's Fear. Given the current information, east-west orientation of transects is recommended; however, if access roads are identified, transects should be set perpendicular to roadways when possible.

The 'fishnet' maps provided on the subsequent page provide transects spaced at 200 meter intervals for both east-west and north-south oriented pedestrian survey.


Harvey's Fear
0
0.5
1 Miles
0
1
2 Kilometers
N
W
E
S
Legend
Allotment boundary
Cultural site
Road
Transect boundary
Elevation (meters)
High : 2252.30
Low : 1526.67
Allotment
Location
Glen Canyon
National Recreation Area


Harvey's Fear
0
0.5
1 Miles
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2 Kilometers
N
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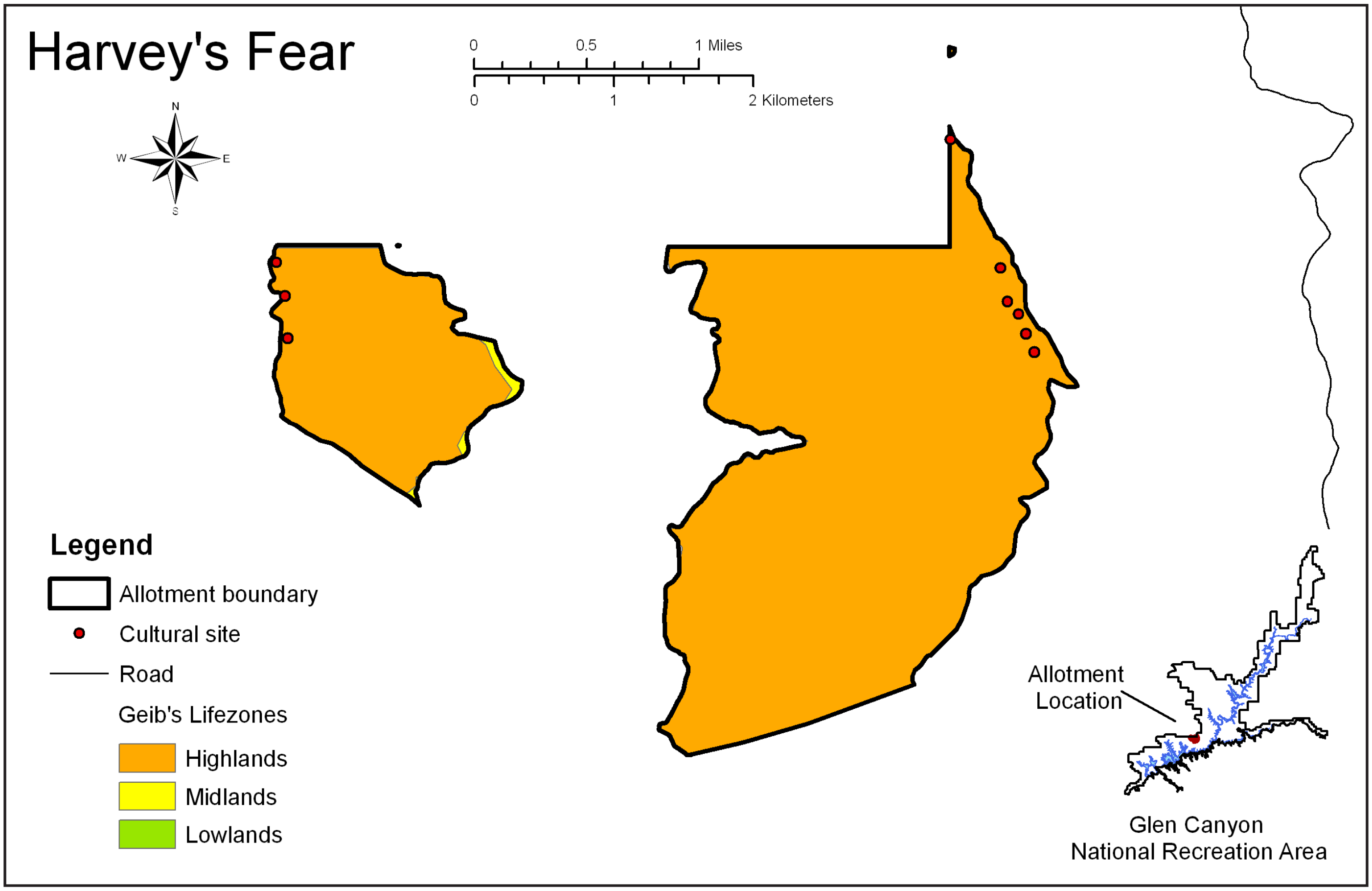
Legend
Allotment boundary
Cultural site
Road
Transect boundary
Elevation (meters)
High : 2252.30
Low : 1526.67
Allotment
Location
Glen Canyon
National Recreation Area



Area of Each Lifezone:

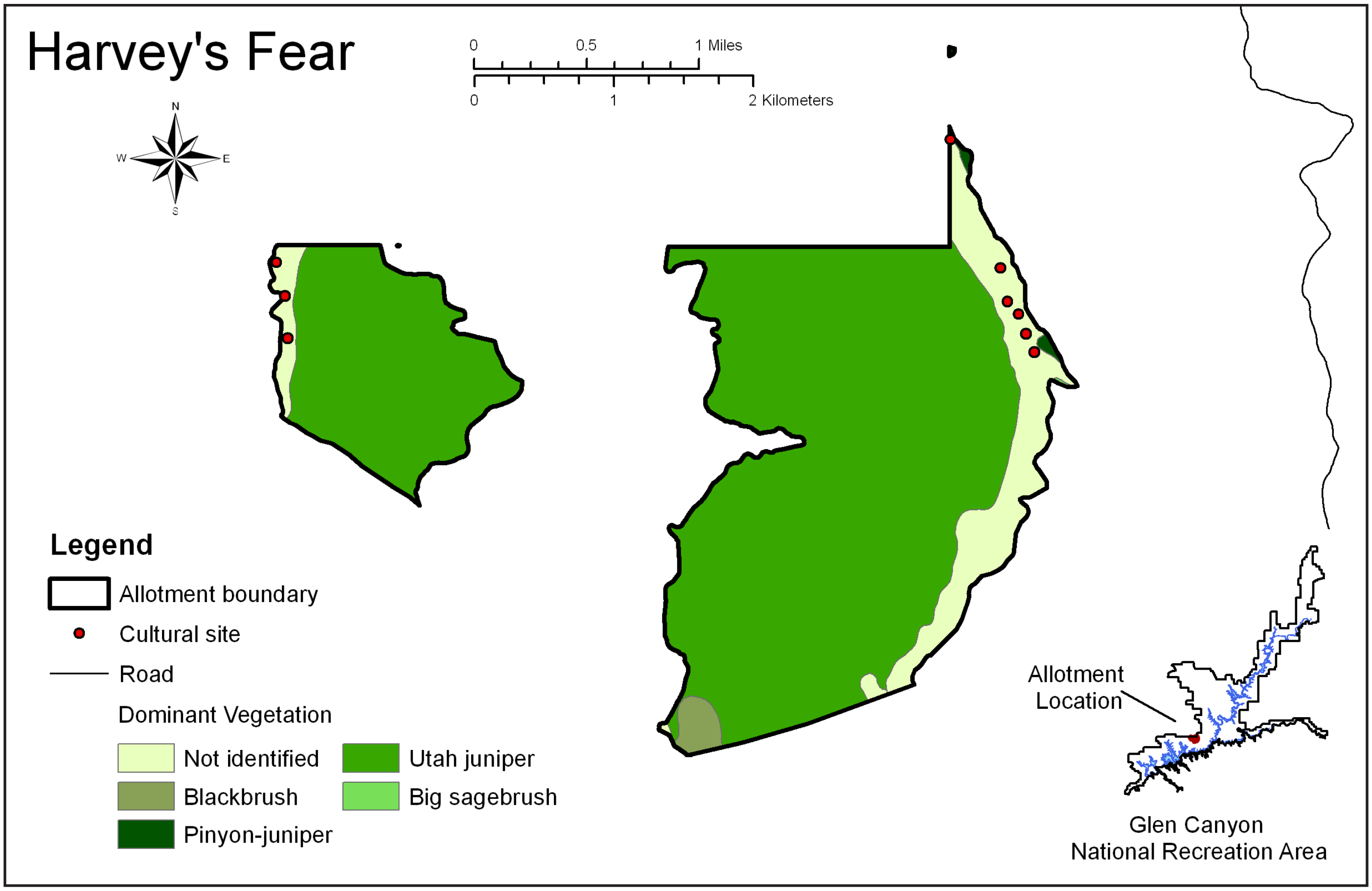
Highlands: 2393.39 acres
Midlands: 11.01 acres
Lowlands: 0.00 acres

No. Cultural Sites in Each Lifezone:

Highlands: 9
Midlands: 0
Lowlands: 0

Lifezone Significance and Known Cultural Sites: All known cultural sites (n = 9) in Harvey's Fear are located in Geib's highland region. As described by Geib, the highlands have lower temperatures and higher precipitation than other lifezones in GCNRA. In addition, the highlands allow for dry-framing, contain abundant fuel, and animal and plant resources not available at lower elevations.

	Elevation	Characteristics	Environment	Significance to Humans
Lowlands	1219-1372 m (4000-4500 ft)	Hot and arid steep-walled sandstone canyons.	Riparian plants; big-horn sheep	Permanent water, arable alluvium, long growing season, diverse plant communities, natural shelters, quality siliceous stone from river gravels
Midlands	1372-1676 m (4500-5500 ft)	Arid slickrock and dune fields on benchlands and low plateaus.	Blackbrush, shadscale, grasses; antelope.	Grasses, including dropseed and ricegrass, prickly pear and shadscale; good antelope habitat, quality siliceous stone in certain locations.
Highlands	Above 1676 m (Above 5500 ft)	High elevation mesas and plateaus with cooler temperatures and greater precipitation.	Pinyon-juniper woodlands; deer and rabbit.	Higher elevation plant foods (i.e. pinyon); later harvests; dry-farming; abundant fuel, deer and rabbit.
Shading indicates lifezones present in allotment.				



Area of Individual Vegetation Zones:

Dominant Species	Acres Covered	No. Sites
Not identified	297.71	9
Blackbrush (*Coleogyne ramosissima*)	27.16	0
Pinyon-juniper *(Pinus edulis - Juniperus osteosperma)*	7.57	0
Utah juniper *(Juniperus osteosperma)*	2082.52	0
Big sagebrush *(Artemisia tridentata)*	1.00	0
Total	**2415.96**	**9**

No. Cultural Sites in Each Vegetation Zone:
All known cultural sites (n = 9) in Harvey's Fear occur in vegetation zones for which the dominant regime has not been identified.

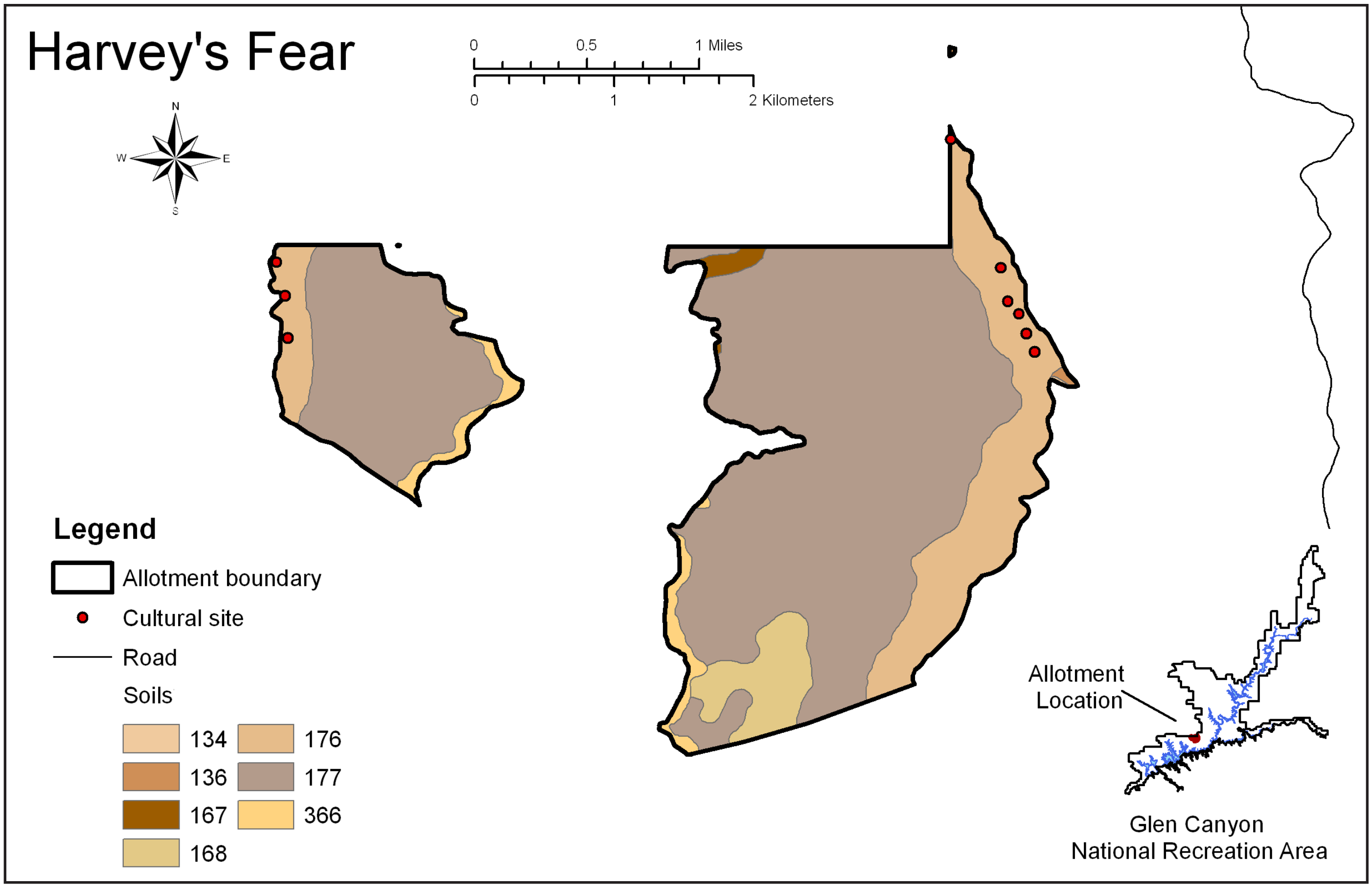
Visibility:
The Utah juniper coverage of Harvey's Fear may decrease visibility, particularly for small sites and isolated artifacts which may be lost in built-up duff beneath the trees.

Summary:
The dominant species in Harvey's Fear is Utah juniper, which covers 86.20 percent of the allotment. Other dominant species include blackbrush (1.12 percent), pinyon-juniper (0.31 percent), and big sagebrush (<0.00 percent).

Dominant Species:
Big sagebrush *(Artemisia tridentata)*
Blackbrush (*Coleogyne ramosissima*)
Pinyon (*Pinus edulis*)
Juniper, Utah Juniper (*Juniperus osteosperma*)

Secondary Dominant Species:
None currently known.

Associated Soils:
Big sagebrush grows primarily in loam, where it may be associated with pinyon-juniper in stony loam. Blackbrush occurs in shallow sandy loam. Pinyon-juniper growth occurs in shallow loam and stony loam. Finally, Utah juniper dominates in stony loam, and is often associated with pinyon-juniper stands in gravelly loam.

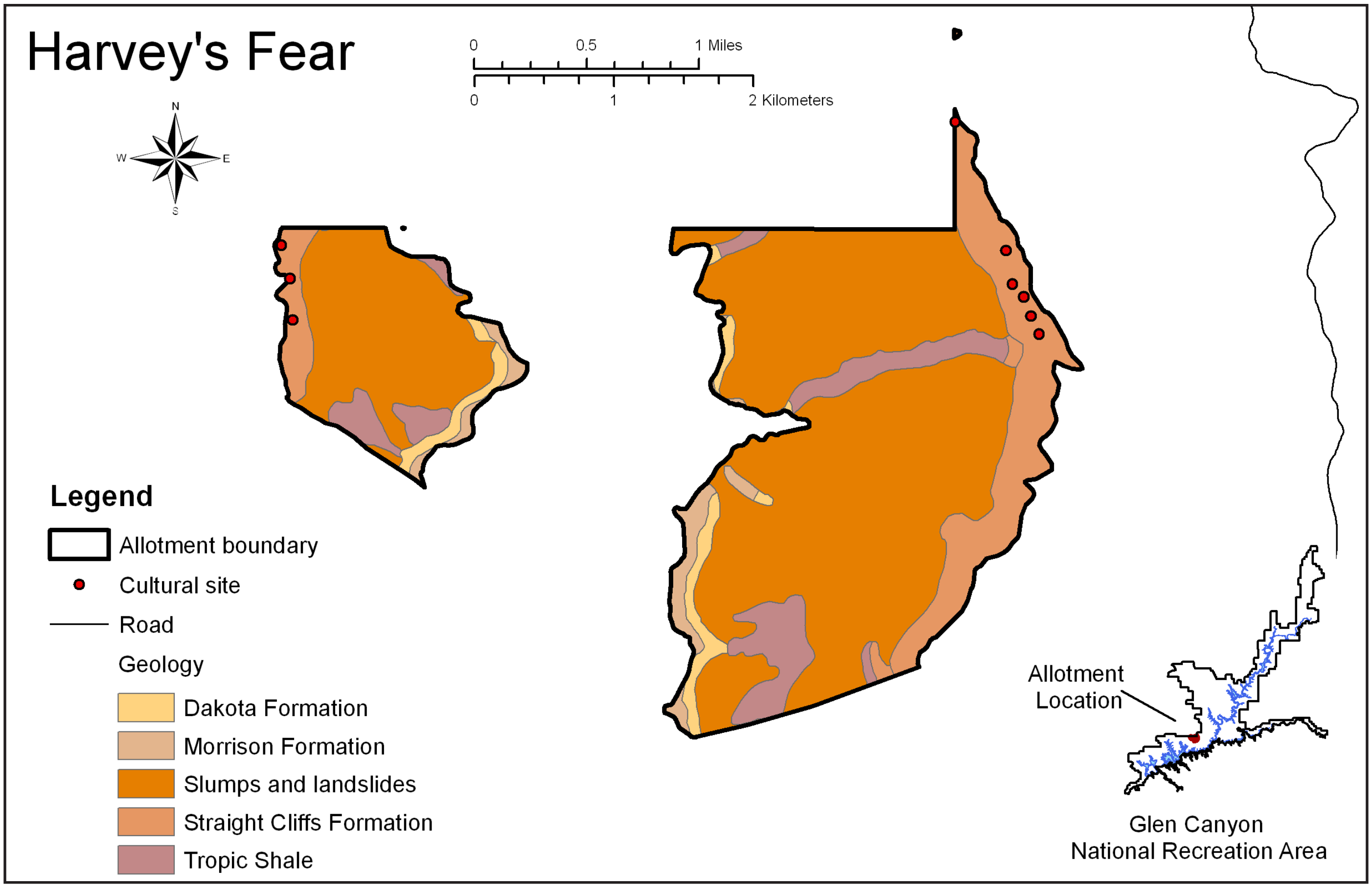


Allotment Divided by Soil Type (MUSYM):

Soil Type	Acres	Percent	No. Cultural Sites
134	2.15	<0.00	0
136	3.92	<0.00	0
167	16.75	0.69	0
168	110.99	4.59	0
176	430.49	17.82	9
177	1779.14	73.64	0
366	72.52	3.01	0
Total	**2415.96**	**99.75%**	**9**

Distribution of Cultural Sites by Soil Type:

All known cultural sites (n = 9) within Harvey's Fear occur in soil type 176.



Allotment Divided by Geology:

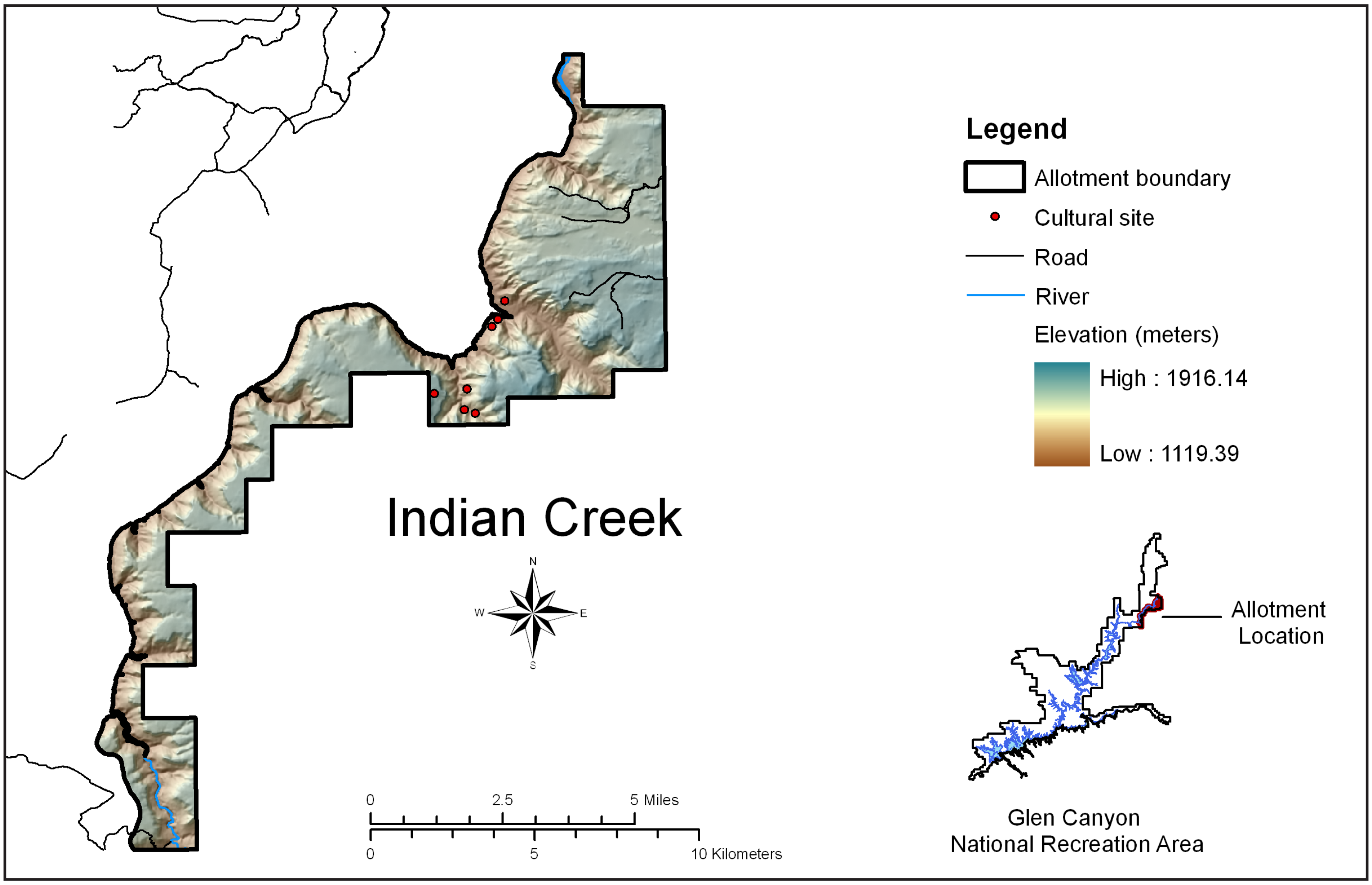
Geology	Acres	Percent	No. Cultural Sites
Dakota Formation	8300	3.44	0
Morrison Formation	72.25	3.11	0
Slumps and land-slides	1697.55	70.26	0
Straight Cliffs For-mation	355.80	14.73	9
Tropic Shale	204.35	8.33	0
Total	**2415.95**	**99.87%**	**9**

Distribution of Cultural Sites by Geological Location:

All known cultural sites (n = 9) in Harvey's Fear occur in Straight Cliffs Formation geological contexts.

Indian Creek

Map Panels



Total Area: 20,725.77 acres

Sampling Fractions:
2 percent: 414.52 acres
5 percent: 1036.29 acres
11 percent: 2279.83 acres
16 percent: 3316.12 acres
20 percent: 4145.15 acres

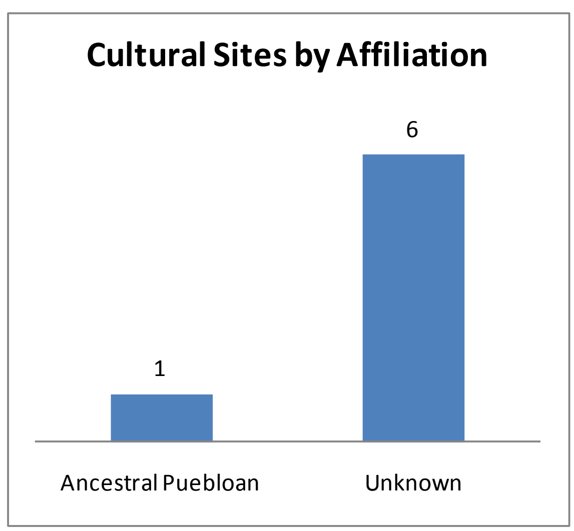
Elevation range amsl:
1119.39 – 1916.14 meters (3672.54 - 6286.55 feet)

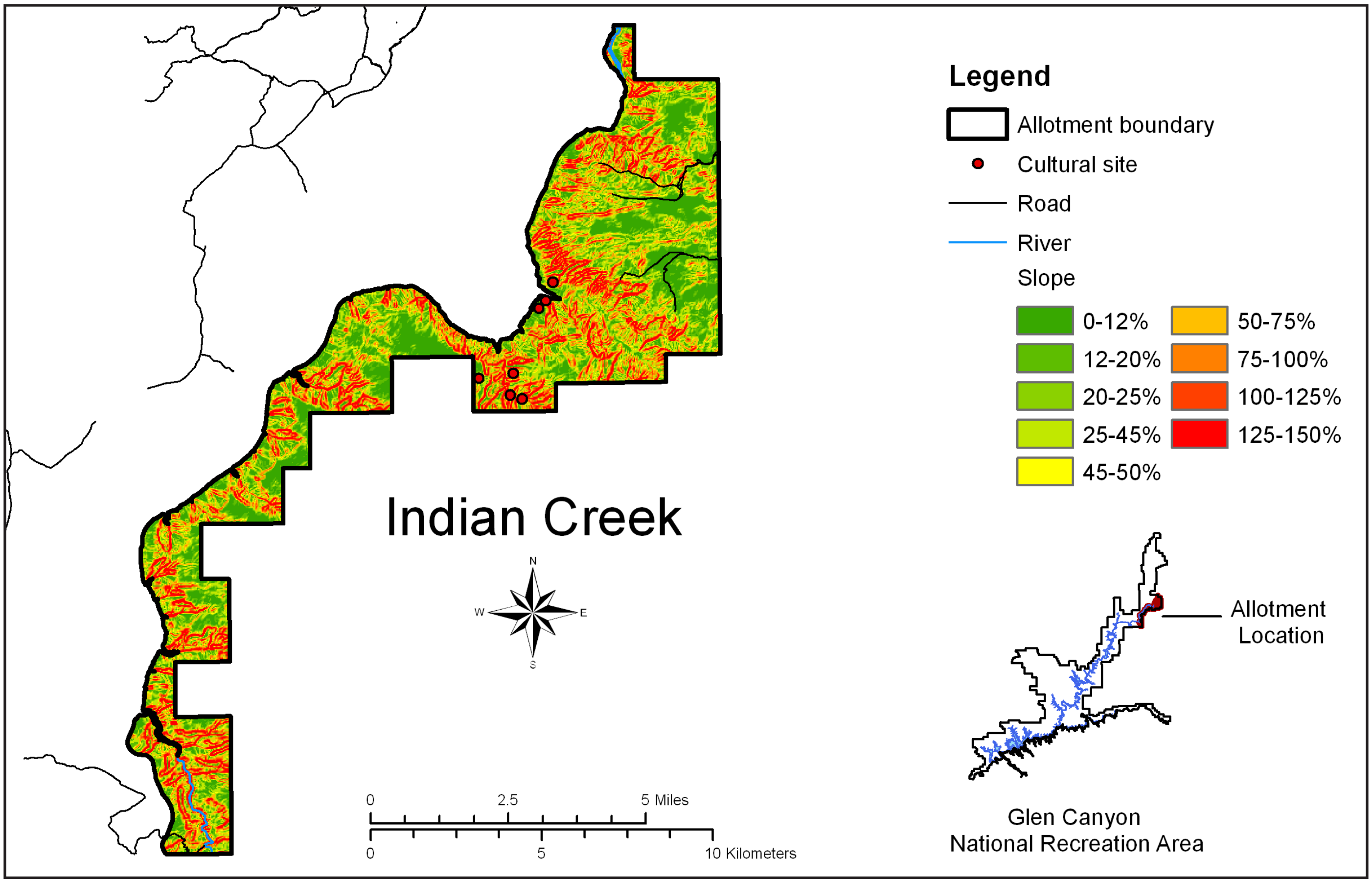
Rivers and Springs:
Two creeks, one in Dark Canyon and one in Gypsum Canyon (the second of which is not depicted; see Appendix A), cross Indian Creek Grazing allotment.

Accessibility:
County Hwy 633 parallels the allotment to the west. Lateral roads enter the northern portion of the allotment from the east, and the southernmost portion from the west. Cataract Canyon of Lake Powell forms the western boundary of the allotment, which may allow for boat access as well.

No. Cultural Sites: 7
Area surveyed: 0.00 acres

The figure below depicts known cultural sites by affiliation. As the information available is minimal, only one figure is included for this allotment.





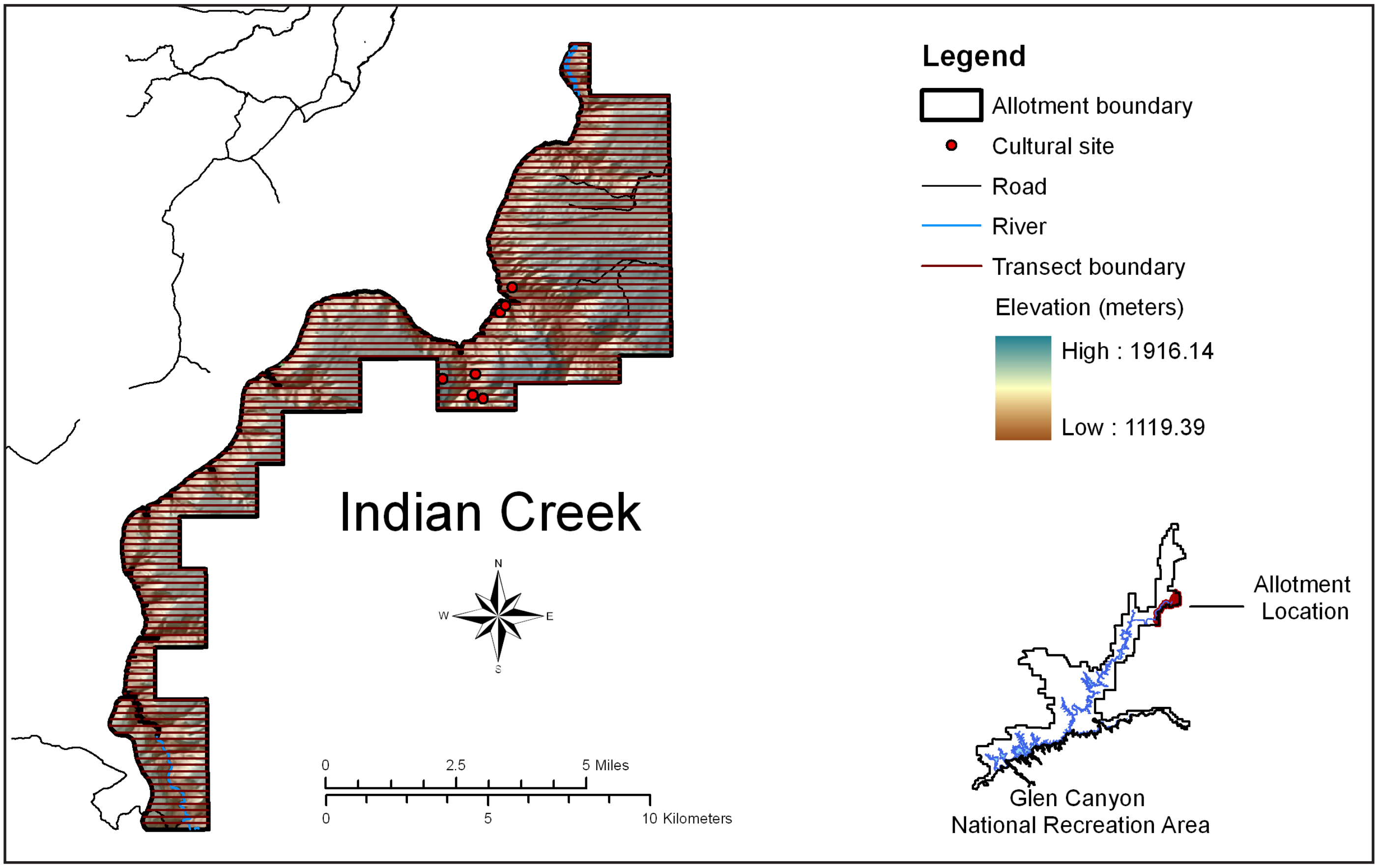
Slope Considerations:

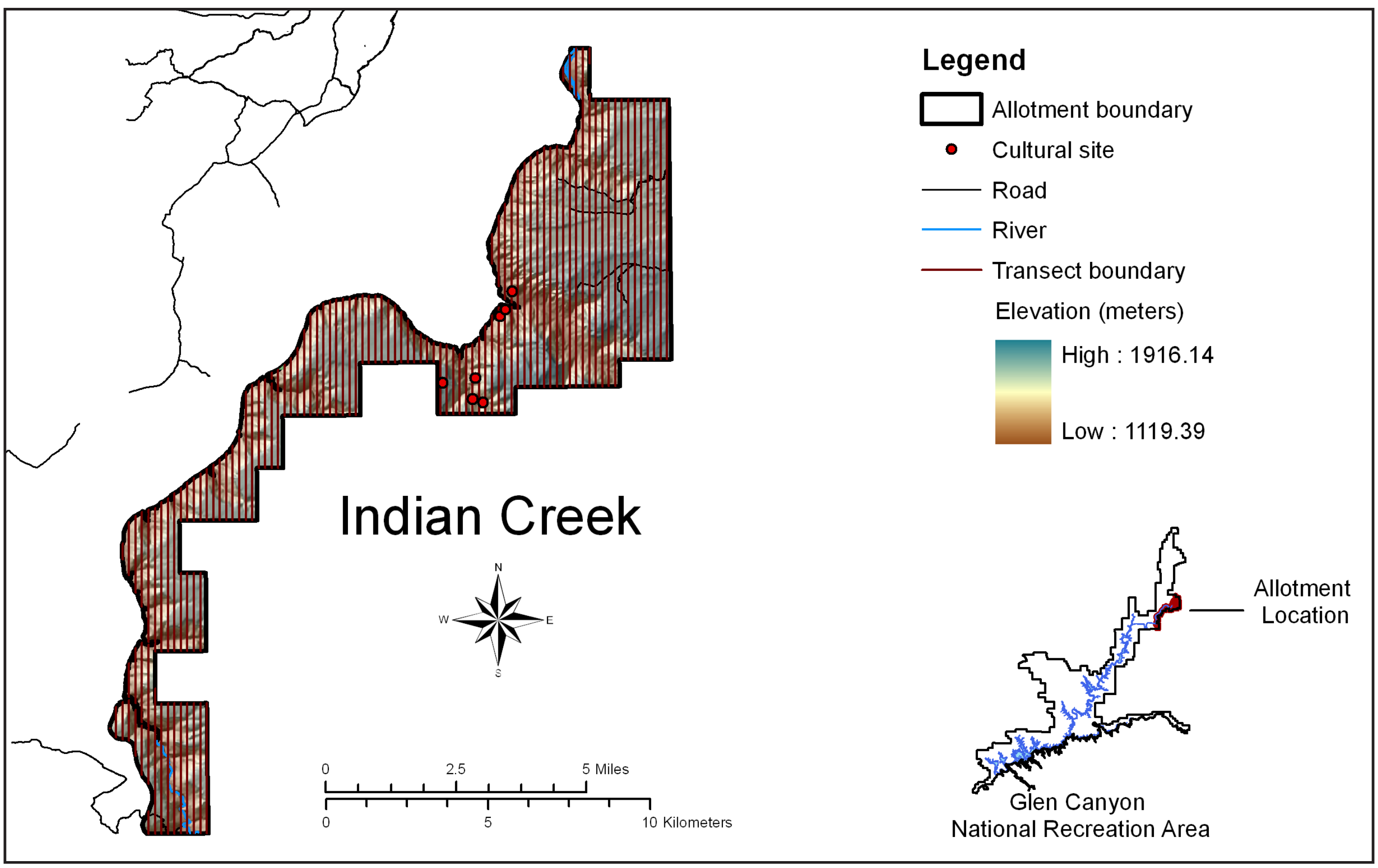
Slope plays a large role in terrain accessibility, and may be used in the stratification of survey areas. For example, GCNRA may wish to assign catagories such as low, moderate, and high to specific slope gradients. Such assignations are most often dependent on the factors guiding archaeological survey work, and as such, are not included in this document. Included herein, however, are suggestions for basic transect orientation based on the presence of topographical barriers identified by the presence of excessive slope gradients.

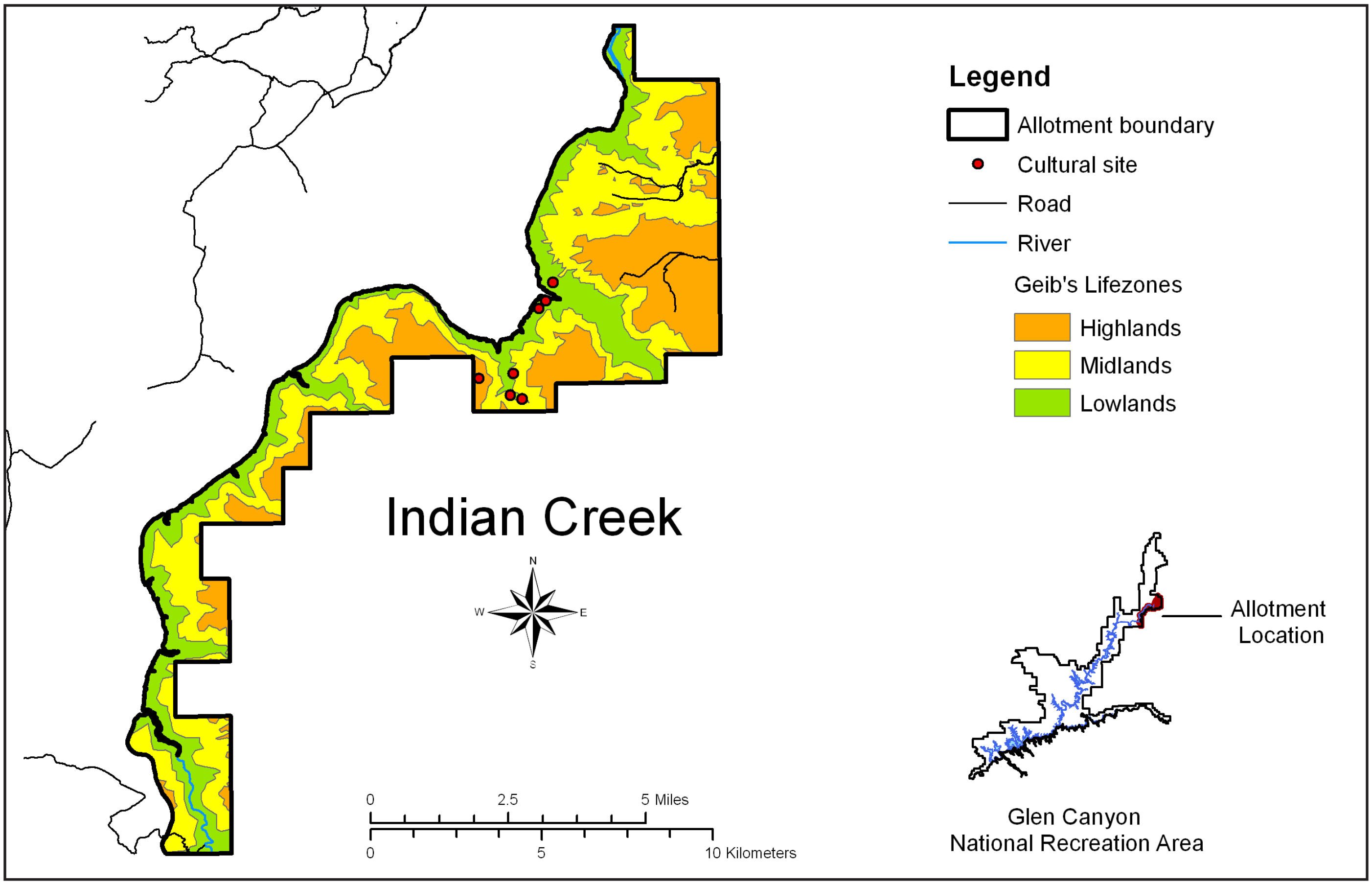
Survey Zones Dictated by Slope:

Indian Creek allotment is cross-cut by numerous canyons and steep slopes. Whenever possible, transect orientation should be perpendicular to access roads and set to avoid canyons and rises.

The 'fishnet' maps provided on the subsequent page display transects spaced at 200 meter intervals for both east-west and north-south oriented pedestrian survey.


Legend
Allotment boundary
Cultural site
Road
River
Transect boundary
Elevation (meters)
High : 1916.14
Low : 1119.39
Indian Creek
N
W
E
S
0
2.5
5 Miles
0
5
10 Kilometers
Allotment Location
Glen Canyon National Recreation Area


Legend
Allotment boundary
Cultural site
Road
River
Transect boundary
Elevation (meters)
High : 1916.14
Low : 1119.39
Indian Creek
N
W
E
S
0
2.5
5 Miles
0
5
10 Kilometers
Allotment Location
Glen Canyon National Recreation Area



Area of Each Lifezone:

Highlands: 6234.38 acres
Midlands: 8896.24 acres
Lowlands: 5529.44 acres

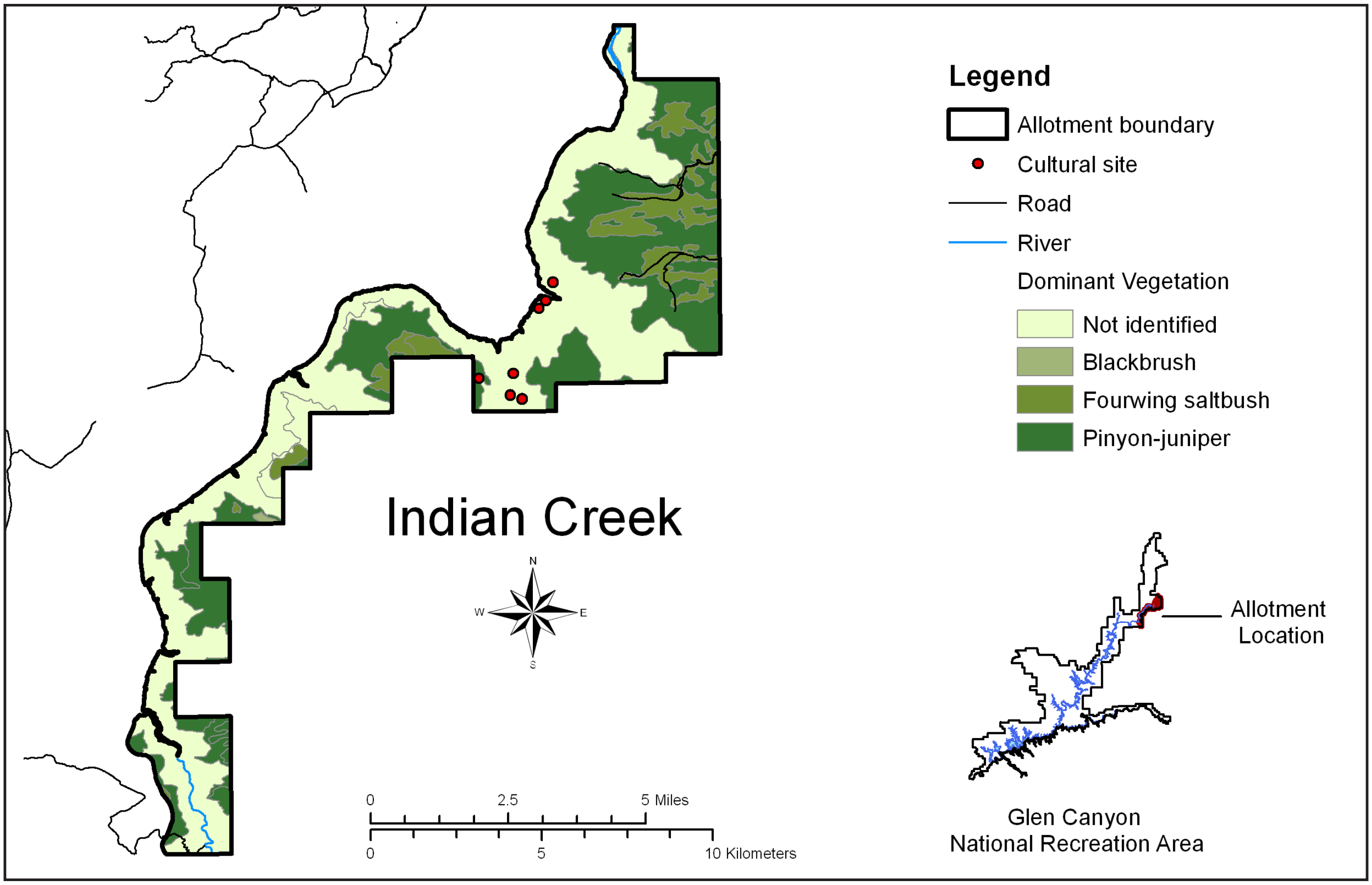
No. Cultural Sites in Each Lifezone:

Highlands: 1
Midlands: 1
Lowlands: 5

Lifezone Significance and Known Cultural Sites:
A single site (n = 1) is located in Geib's Highland zone. Geib describes the highlands as providing important foods, such as pinyon, deer, and rabbit, and suggests that the lower temperatures and increased precipitation of the highlands allowed for dry farming and later harvests than lower elevations. Likewise, a single site (n = 1) with no known attribute/affiliation information is located in the Midland zone, described as providing important grasses, cacti, and game such as antelope to prehistoric populations. The remaining sites (n = 5) occur in the lowlands, described by Geib as hot and arid, with permanent water, arable alluvium, and long growing seasons suited to agriculture.

	Elevation	Characteristics	Environment	Significance to Humans
Lowlands	1219-1372 m (4000-4500 ft)	Hot and arid steep-walled sandstone canyons.	Riparian plants; bighorn sheep	Permanent water, arable alluvium, long growing season, diverse plant communities, natural shelters, quality siliceous stone from river gravels
Midlands	1372-1676 m (4500-5500 ft)	Arid slickrock and dune fields on benchlands and low plateaus.	Blackbrush, shadscale, grasses; antelope.	Grasses, including dropseed and ricegrass, prickly pear and shadscale; good antelope habitat, quality siliceous stone in certain locations.
Highlands	Above 1676 m (Above 5500 ft)	High elevation mesas and plateaus with cooler temperatures and greater precipitation.	Pinyon-juniper woodlands; deer and rabbit.	Higher elevation plant foods (i.e. pinyon); later harvests; dry-farming; abundant fuel, deer and rabbit.

Shading indicates lifezones present in allotment.



Area of Individual Vegetation Zones:

Dominant Species	Acres Covered	No. Sites
Not identified	11,222.21	6
Blackbrush *(Coleogyne ramosissima)*	33.71	0
Fourwing saltbush *(Atriplex canescens)*	2082.62	0
Pinyon-juniper *(Pinus edulis - Juniperus osteosperma)*	7387.23	1
Total	20725.77	7

No. Cultural Sites in Each Vegetation Zone:
Six (n = 6) known sites occur in zones where the dominant vegetation has not yet been identified. The remaining site (n = 1) occurs in pinyon-juniper vegetation.

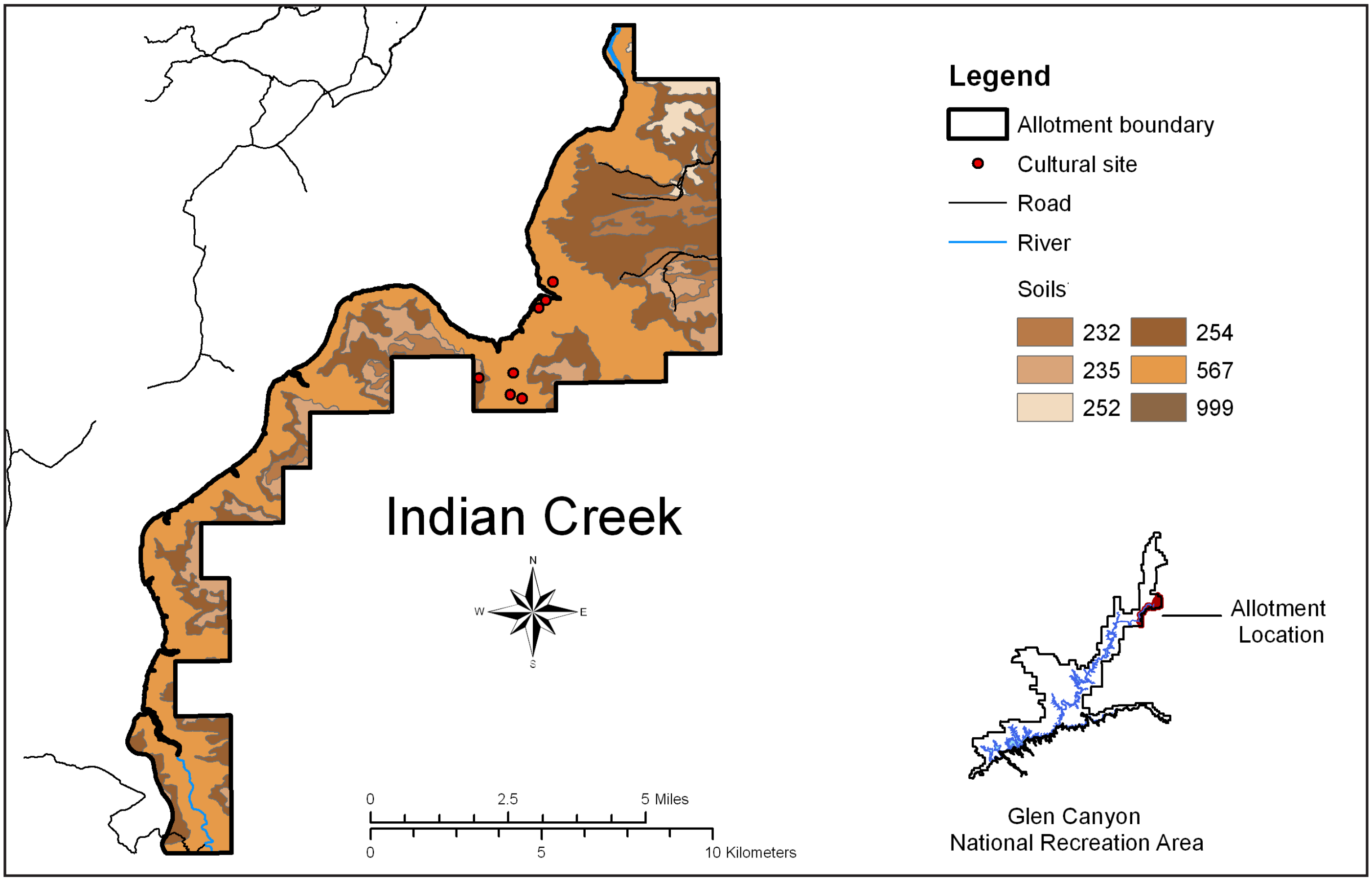
Visibility:
Blackbrush and fourwing saltbush both provide moderate - excellent visibility, with large portions of ground bare between plants. In pinyon-juniper stands, however, ground visibility may be impeded by a build-up of organic matter beneath the trees. Finally, the dominant vegetation for the majority (54.15 percent) of Indian Creek has not been identified.

Summary:
Blackbrush accounts for 0.16 percent of dominant vegetation in the allotment. Fourwing saltbush is also present (10.05 percent), as is pinyon-juniper (35.64 percent). Dominant vegetation for the remainder of the allotment remainder unidentified.

Dominant Species:
Blackbrush (*Coleogyne ramosissima*)
Fourwing saltbush (*Atriplex canescens*)
Pinyon (*Pinus edulis*)
Juniper (*Juniperus osteosperma*)

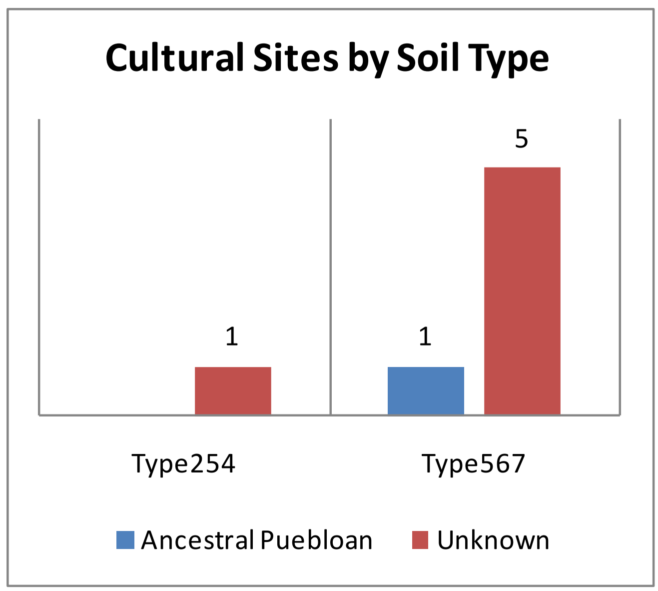
Secondary Dominant Species:
Cutler Mormon-tea (*Ephedra cutleri*)
Sand Sagebrush (*Artemisia filifolia*)

Associated Soils:
Blackbrush grows primarily in shallow sandy loam and talus, whereas fourwing saltbush occurs in sandy loam, in sand with sand sagebrush, and in shallow sand with Cutler Mormon tea. Finally, pinyon-juniper dominates in shallow sandy loam, shallow loam, and stony loam.



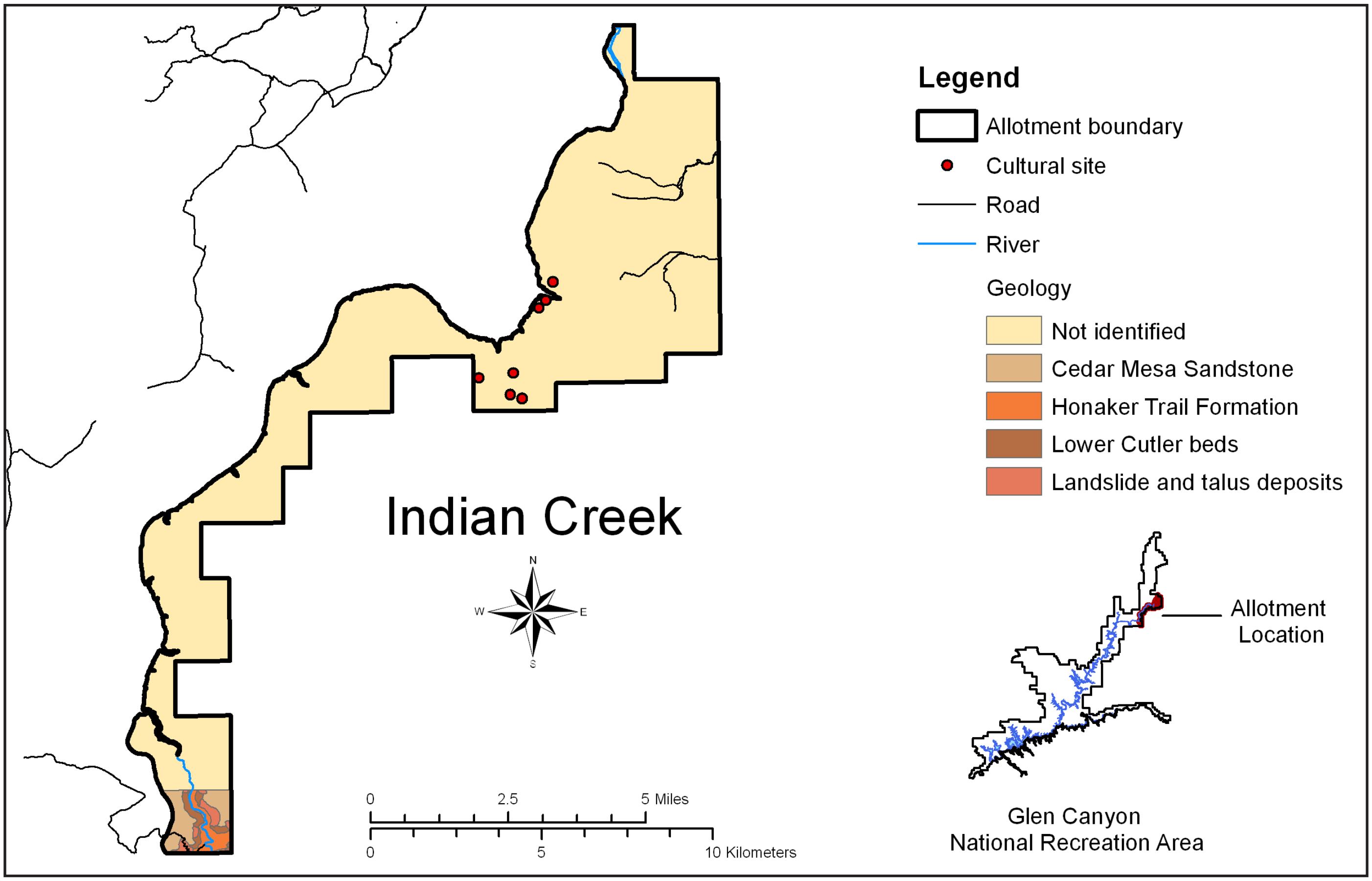
Allotment Divided by Soil Type (MUSYM):

Soil Type	Acres	Percent	No. Cultural Sites
232	1511.00	7.29	0
235	2062.72	9.95	0
252	556.43	2.68	0
254	6128.26	29.57	1
567	10,392.77	50.14	6
999	74.59	0.36	0
Total	**20725.77**	**99.99**	**7**



Distribution of Cultural Sites by Soil Type:

A single site (n = 1) of unknown affiliation for which attribute information is currently lacking, is located in soil type 254. The remaining sites (n = 6), including an Ancestral Puebloan site and five sites for which affiliation/attribute information is unavailable are located in soil type 567.



Allotment Divided by Geology:

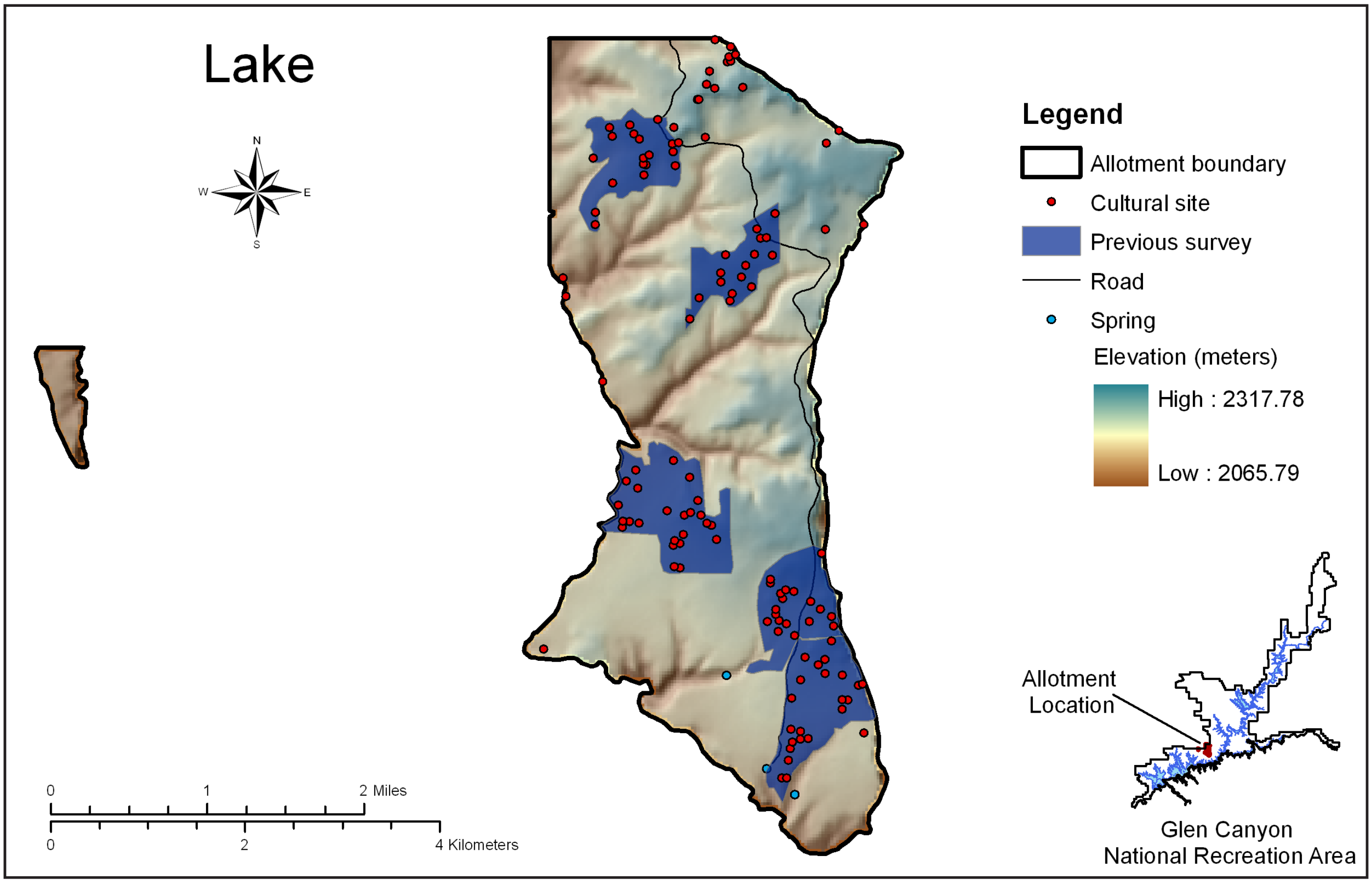
Geology	Acres	Percent	No. Cultural Sites
Not identified	19878.33	95.59	7
Cedar Mesa Sandstone	393.55	1.90	0
Honaker Trail Formation	214.42	1.03	0
Lower Cutler Beds	128.33	0.62	0
Landslide and talus deposits	111.14	0.54	0
Total	**20,725.77**	**99.68%**	**7**

Distribution of Cultural Sites by Geological Location:

All known cultural sites (n = 7) in Indian Creek occur in contexts for which the geology has not been identified.

Lake

Map Panels



Total Area: 5107.81 acres

Sampling Fractions:
2 percent: 102.16 acres
5 percent: 255.39 acres
11 percent: 561.86 acres
16 percent: 817.25 acres
20 percent: 1021.56 acres

Elevation range amsl:
2065.79 – 2317.78 meters (6777.53 - 7604.27 feet)

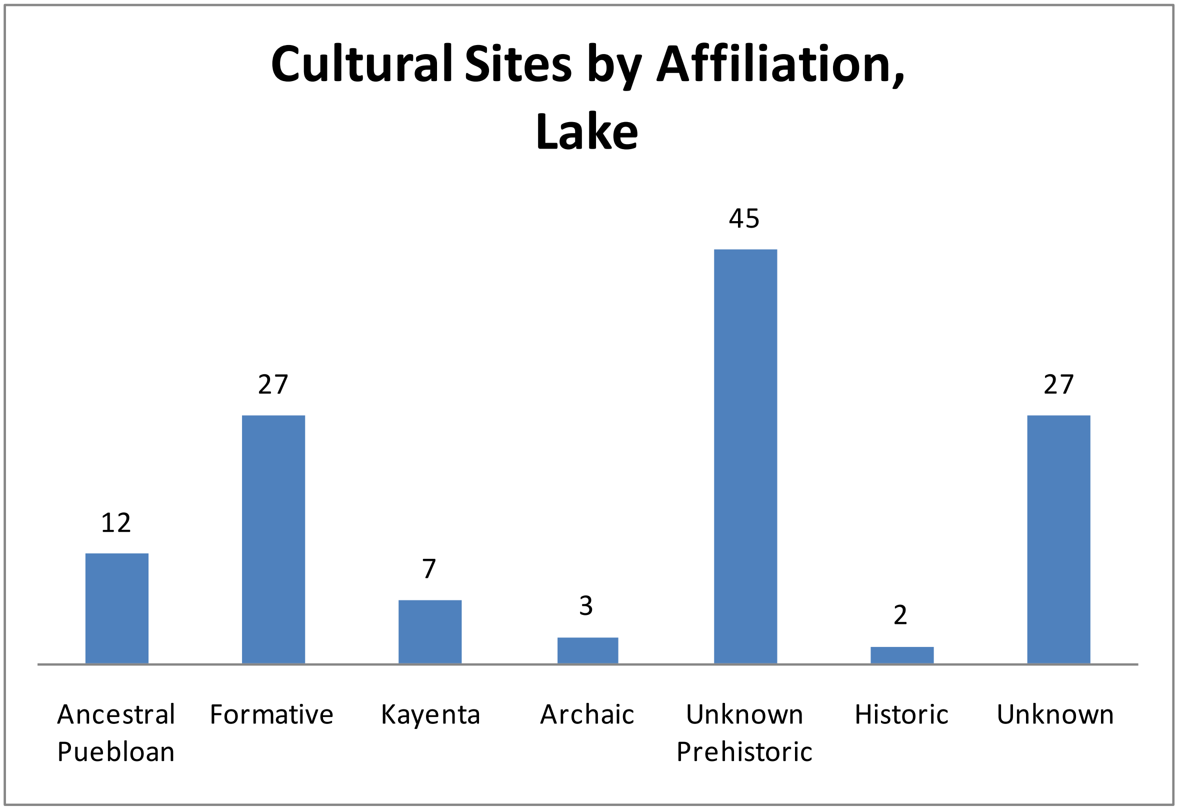
Rivers and Springs:
Three (n = 3) springs, including East Spring, are located in Lake grazing allotment.

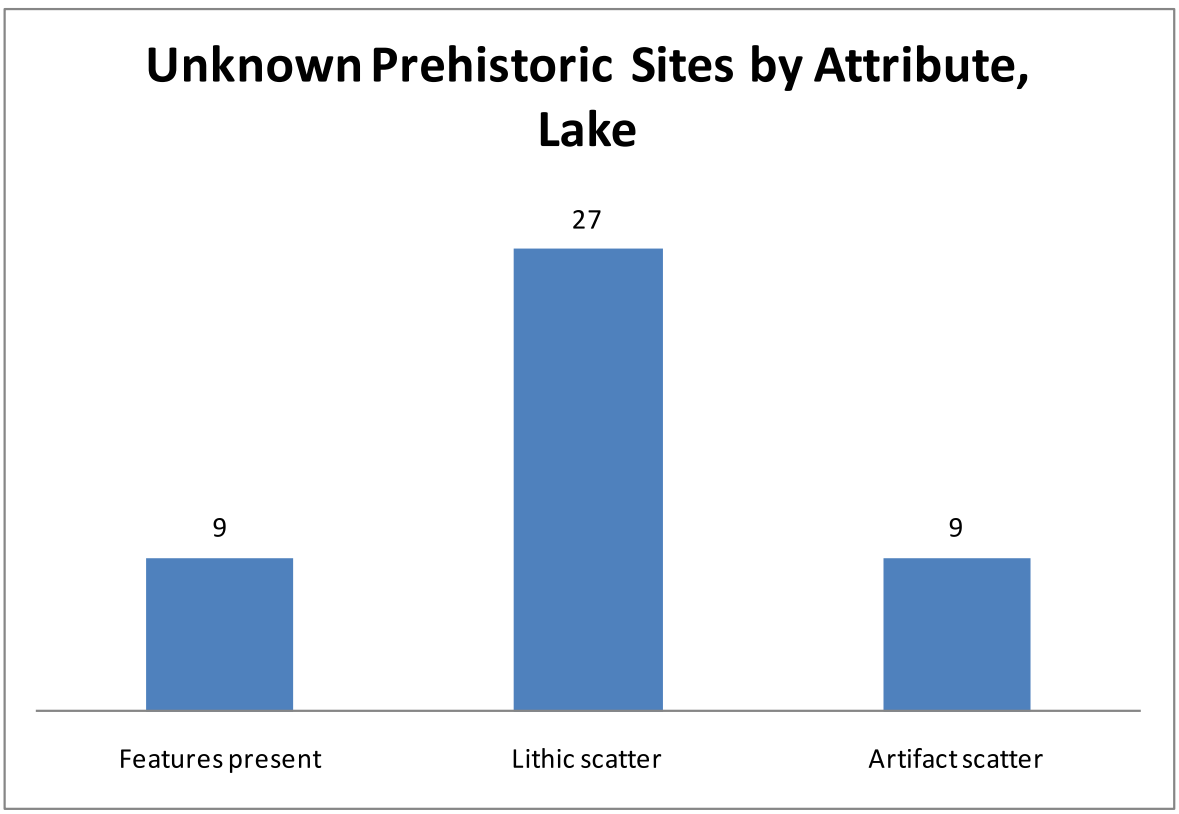
Accessibility:
A north-south oriented road extends south from County Hwy 330 (Hole-in-the-Rock Road) through the eastern (larger) portion of the allotment, traveling along the eastern side. Harvey's Fear allotment and Dry Creek separate the east and west portions of Lake grazing allotment, and the western portion may necessitate access from Lake Powell, or perhaps from Middle Rock Creek. Dangling Rope Marina is located southwest of the allotment.

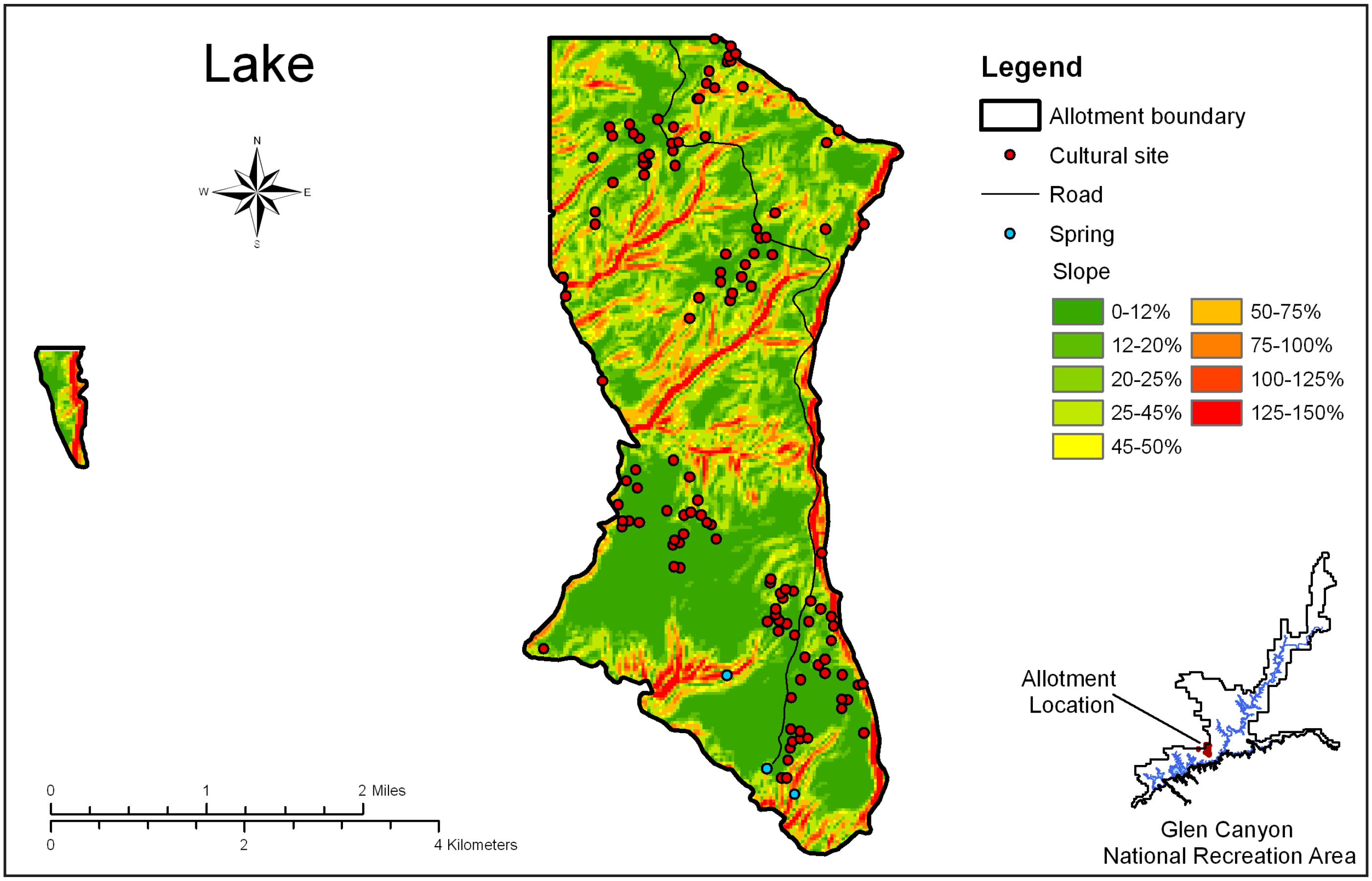
No. Cultural Sites: 123
Area surveyed: 1022.16 acres

Survey References:
GLCA (1994): 233.83 acres
GLCA (1995): 185.37 acres
GLCA (1996): 282.45 acres
GLCA (1997): 138.79 acres
GLCA (1999): 181.72 acres

The figures on the subsequent page depict the proportions of cultural sites by affiliation, and for those prehistoric sites for which affiliation is unknown, by attribute.


Cultural Sites by Affiliation, Lake
12
27
7
3
45
2
27
Ancestral Puebloan
Formative
Kayenta
Archaic
Unknown Prehistoric
Historic
Unknown


Unknown Prehistoric Sites by Attribute, Lake
9
27
9
Features present
Lithic scatter
Artifact scatter



Slope Considerations:

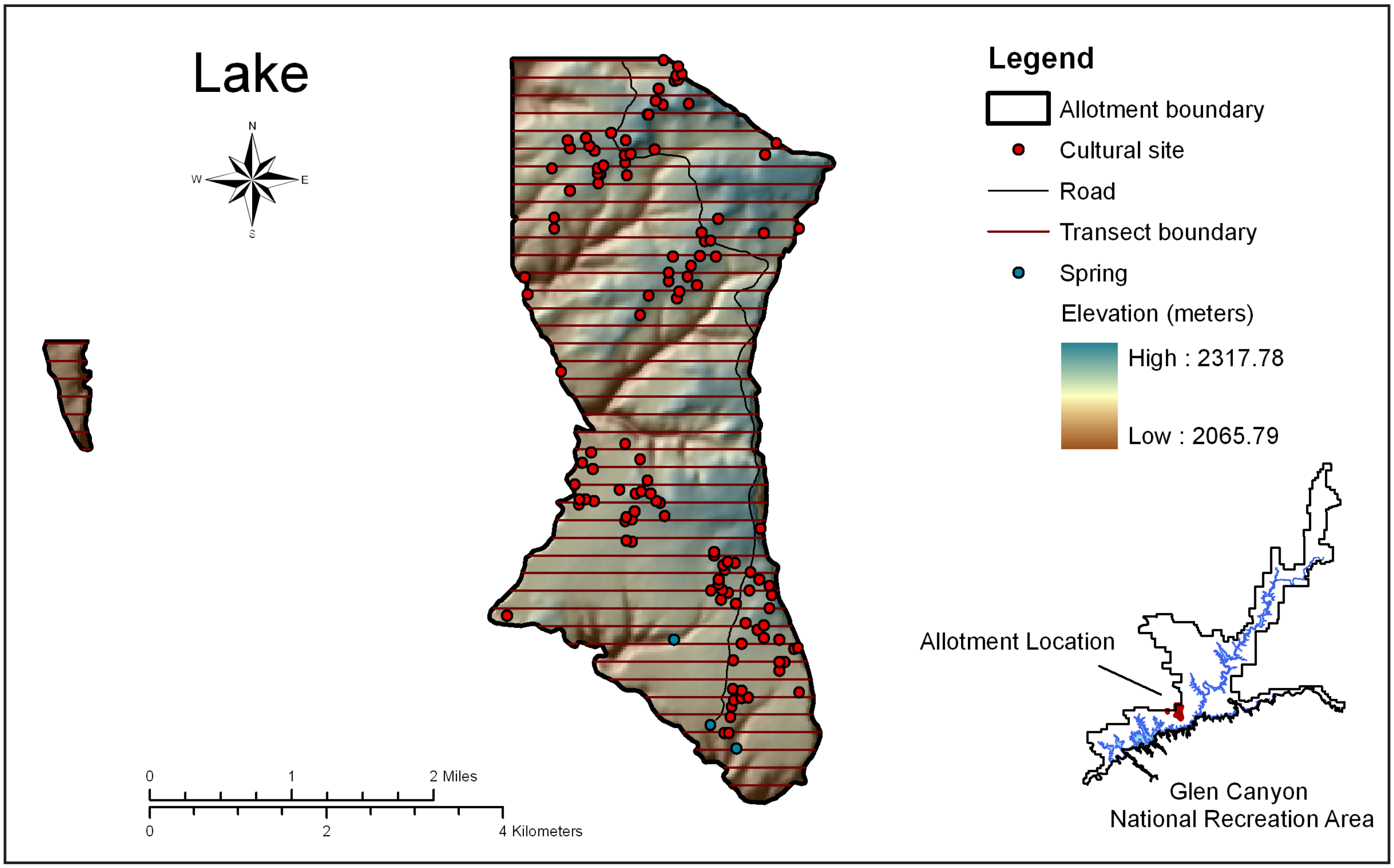
Slope plays a large role in terrain accessibility, and may be used in the stratification of survey areas. For example, GCNRA may wish to assign catagories such as low, moderate, and high to specific slope gradients. Such assignations are most often dependent on the factors guiding archaeological survey work, and as such, are not included in this document. Included herein, however, are suggestions for basic transect orientation based on the presence of topographical barriers identified by the presence of excessive slope gradients.

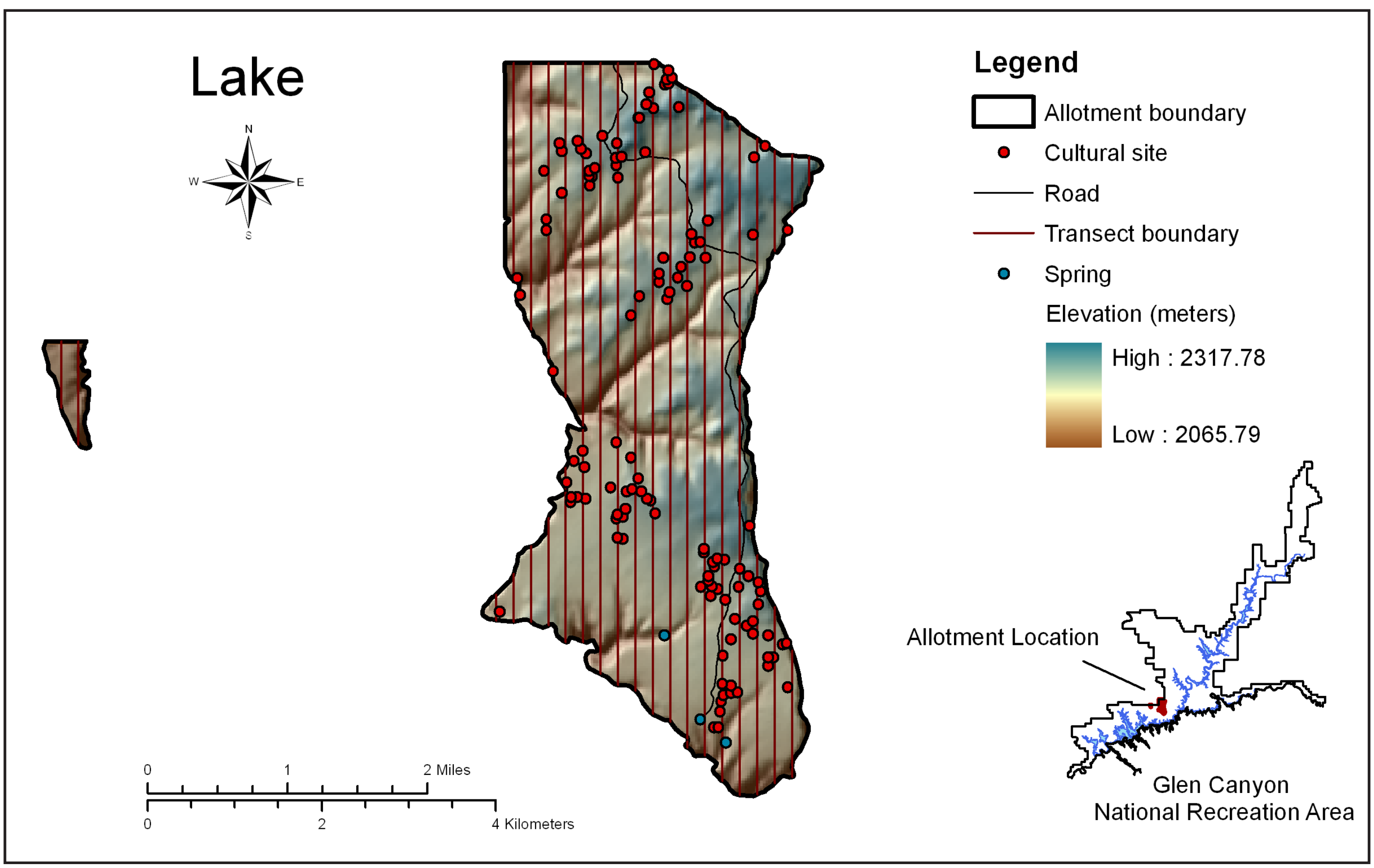
Survey Zones Dictated by Slope:

Steep canyons account for the majority of high-percentage slope in Lake grazing allotment. However, these canyons should pose few problems for higher-elevation survey, as east-west oriented transects set perpendicular to the main road should provide access to most areas. Canyon bottoms will necessitate separate survey.

Note: The western-most portion of the allotment may be difficult to reach, given the lack of roads and the location of a steep slope on the lake-side.

The 'fishnet' maps provided on the subsequent page display transects spaced at 200 meter intervals for both east-west and north-south oriented pedestrian survey.


Lake
N
W
E
S
Legend
Allotment boundary
Cultural site
Road
Transect boundary
Spring
Elevation (meters)
High : 2317.78
Low : 2065.79
Allotment Location
Glen Canyon
National Recreation Area
0
1
2 Miles
0
2
4 Kilometers


Lake
N
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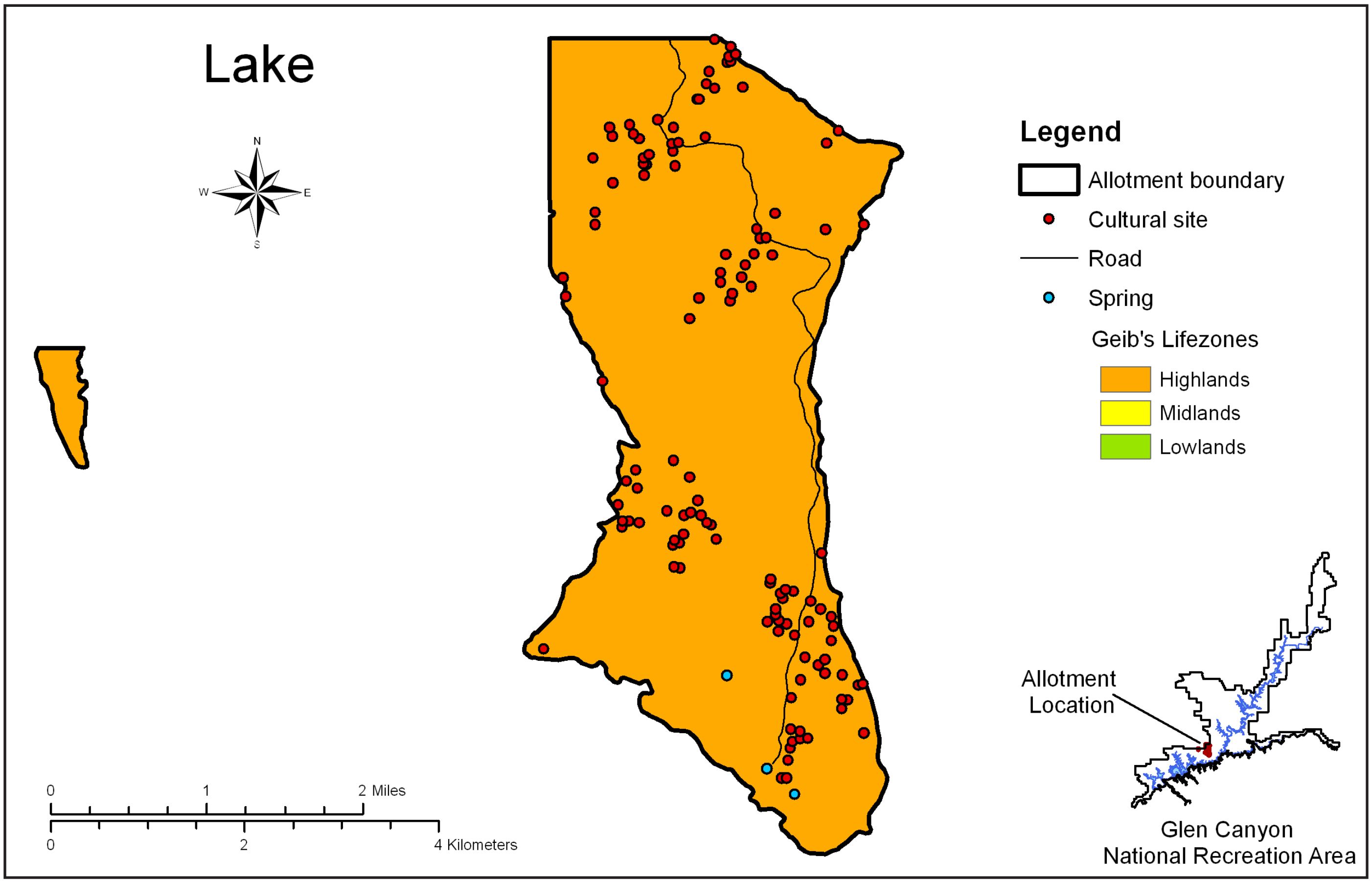
Legend
Allotment boundary
Cultural site
Road
Transect boundary
Spring
Elevation (meters)
High : 2317.78
Low : 2065.79
Allotment Location
Glen Canyon
National Recreation Area
0
1
2 Miles
0
2
4 Kilometers



Area of Each Lifezone:

Highlands:5107.81 acres
Midlands: 0.0 acres
Lowlands:0.0 acres

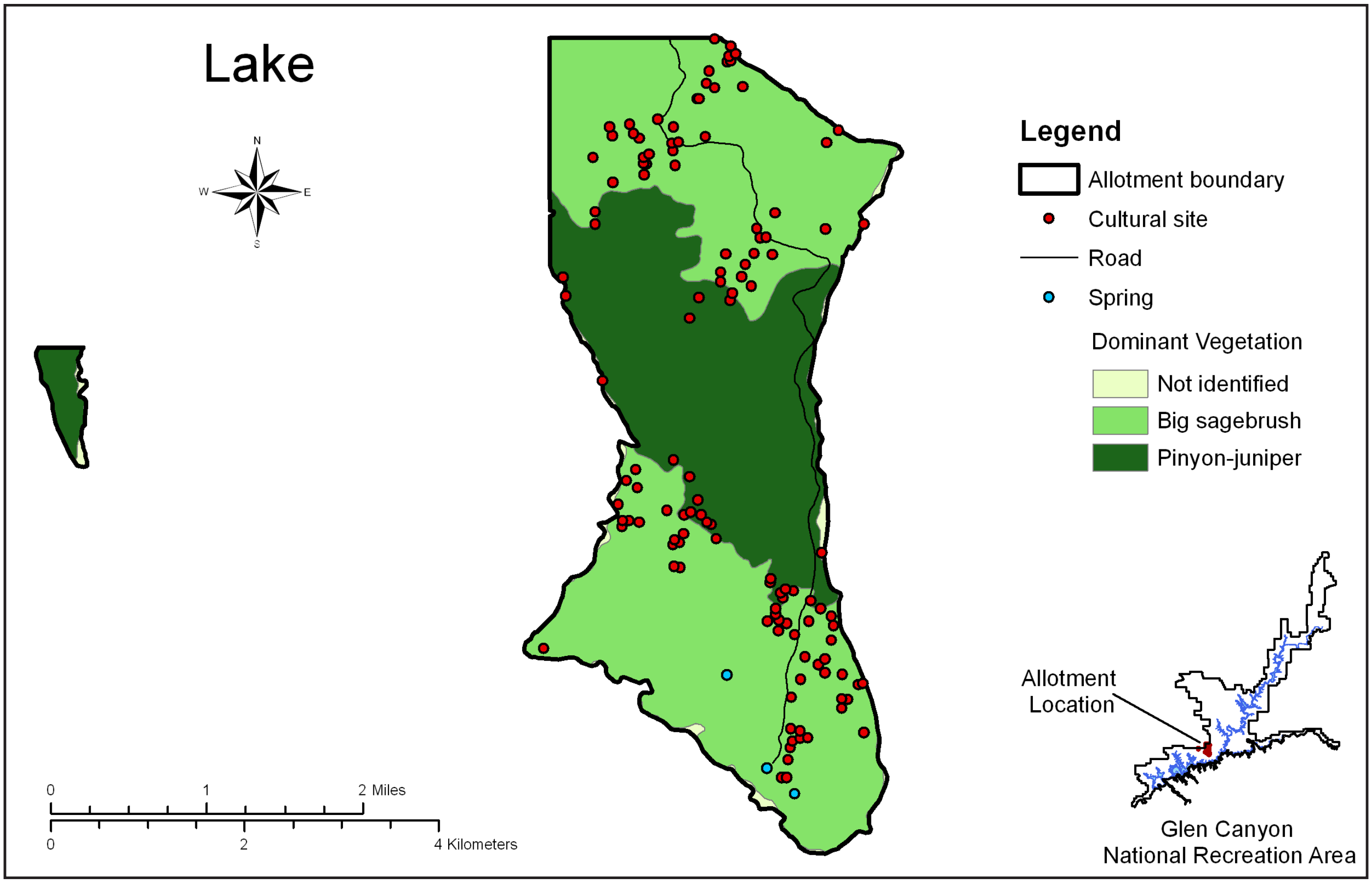
No. Cultural Sites in Each Lifezone:

Highlands: 123
Midlands: 0
Lowlands: 0

Lifezone Significance and Known Cultural Sites: The entire Lake allotment is located in Geib's Highland zone. Geib describes the highlands has having cooler temperatures and higher precipitation than lower elevations, allowing for dry farming and later harvests. In addition, Geib notes that the highlands provide important natural foods, including pinyon, deer, and rabbit. A total of 123 cultural sites are currently known for this allotment.

	Elevation	Characteristics	Environment	Significance to Humans
Lowlands	1219-1372 m (4000-4500 ft)	Hot and arid steep-walled sandstone canyons.	Riparian plants; big-horn sheep	Permanent water, arable alluvium, long growing season, diverse plant communities, natural shelters, quality siliceous stone from river gravels
Midlands	1372-1676 m (4500-5500 ft)	Arid slickrock and dune fields on benchlands and low plateaus.	Blackbrush, shadscale, grasses; antelope.	Grasses, including dropseed and ricegrass, prickly pear and shadscale; good antelope habitat, quality siliceous stone in certain locations.
Highlands	Above 1676 m (Above 5500 ft)	High elevation mesas and plateaus with cooler temperatures and greater precipitation.	Pinyon-juniper woodlands; deer and rabbit.	Higher elevation plant foods (i.e. pinyon); later harvests; dry-farming; abundant fuel, deer and rabbit.

Shading indicates lifezones present in allotment.



Area of Individual Vegetation Zones:

Dominant Species	Acres Covered	No. Sites
Not identified	89.76	2
Big sagebrush (*Artemisia tridentata*)	3221.95	99
Pinyon-juniper (*Pinus edulis - Juniperus osteosperma*)	1796.10	22
Total	5107.81	123

No. Cultural Sites in Each Vegetation Zone:
Two sites (n = 2) are located in zones for which the dominant vegetation has not been identified. Ninety-nine (n = 99) sites are located within the big sagebrush, and the remainder (n = 22) are located in pinyon-juniper.

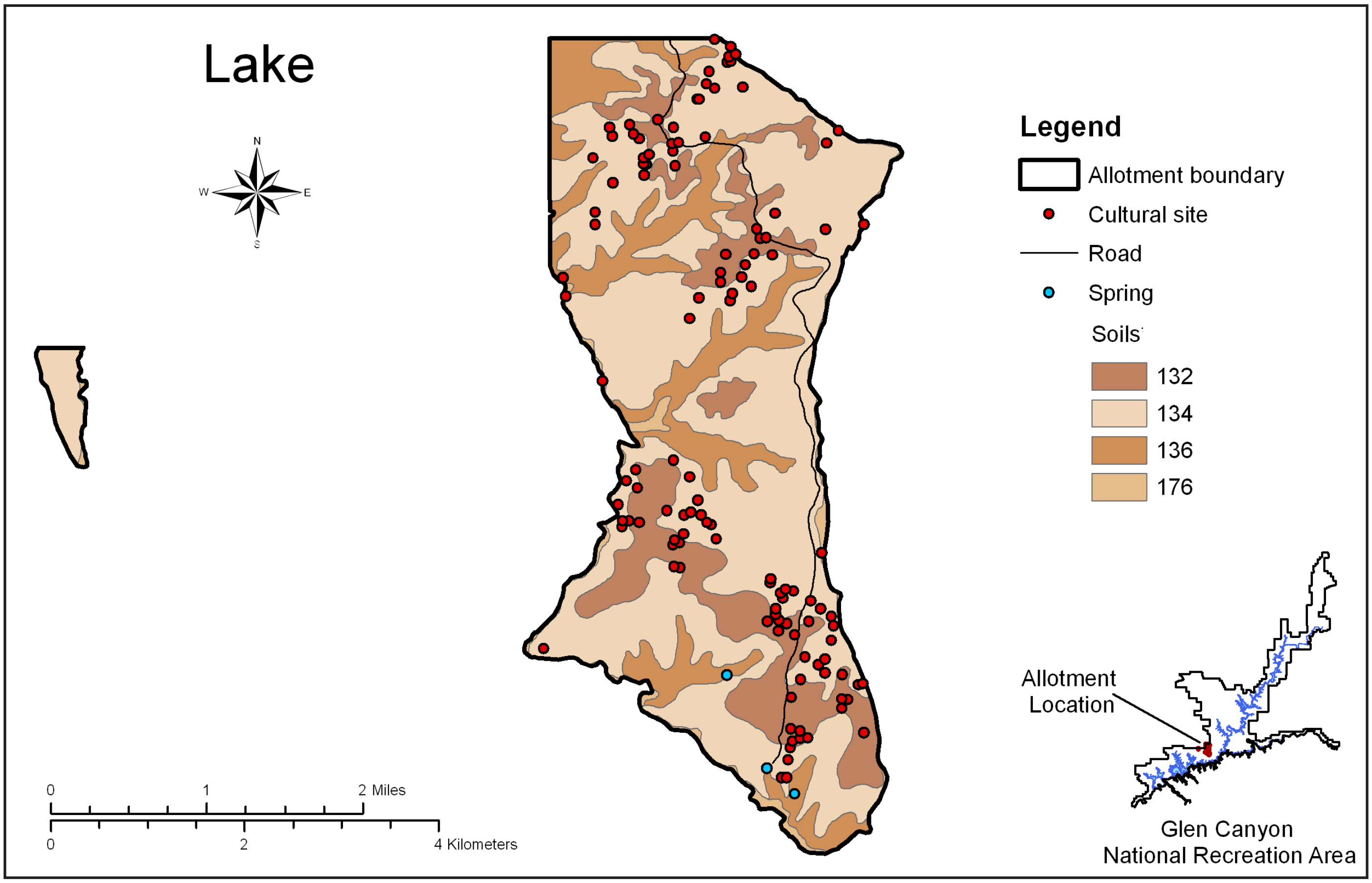
Visibility:
Big sagebrush provides moderate-excellent ground visibility. However, ground visibility may be impeded in the pinyon-juniper zones due to built-up organic material.

Summary:
The primary dominant vegetation zones within the Lake grazing allotment include big sagebrush (63.08 percent) and pinyon-juniper (35.16 percent). Dominant vegetation for the remainder of the allotment is not currently known.

Dominant Species:
Big sagebrush (*Artemisia tridentata*)
Pinyon (*Pinus edulis*)
Juniper (*Juniperus osteosperma*)

Secondary Dominant Species:
None known.

Associated Soils:
Big sagebrush grows primarily in loam, and may be associated with pinyon-juniper in stony loam. Pinyon-juniper dominates in very steep stony loam, stony loam, and shallow loam.

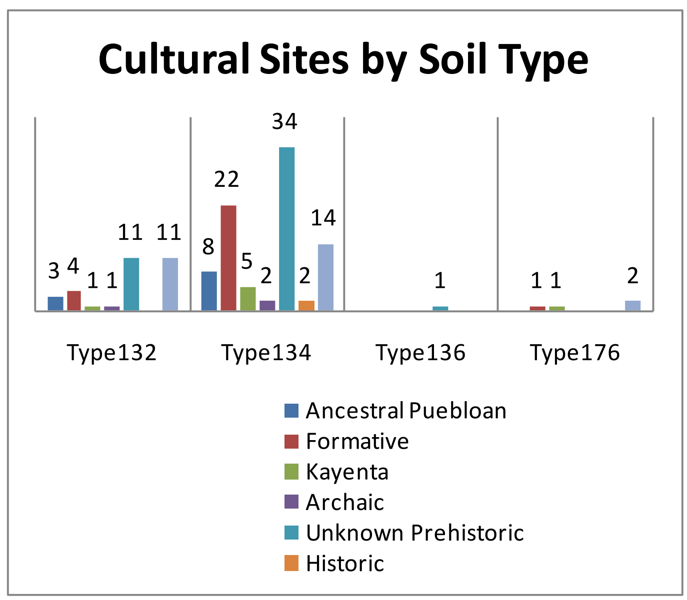


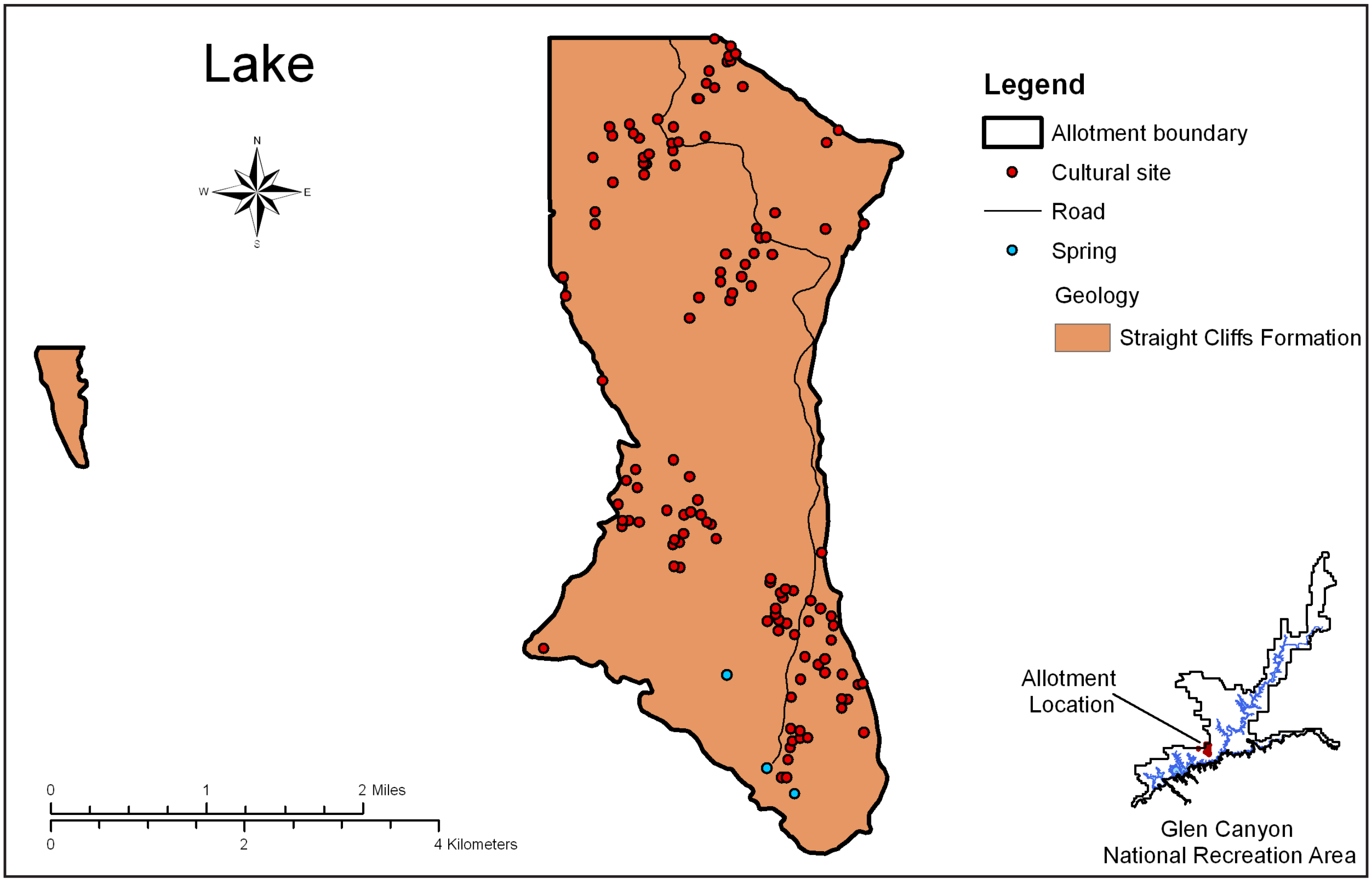
Allotment Divided by Soil Type (MUSYM):

Soil Type	Acres	Percent	No. Cultural Sites
132	865.07	16.94	31
134	3251.78	63.66	87
136	861.20	17.25	1
176	129.75	2.54	4
Total	**5107.80**	**100.39%**	**123**

Distribution of Cultural Sites by Soil Type:

Thirty-one (n = 31) sites occur within soil type 132, including three Ancestral Puebloan sites, four Formative sites, one Kayenta site, one Archaic site, eleven unaffiliated lithic/artifact scatters, two of which have features present, and 11 sites for which affiliation and attribute information are currently not available. Eighty-seven (n = 87) sites occur in soil type 134, including eight Ancestral Puebloan sites, 22 Formative sites, five Kayenta sites, two (n = 2) Archaic sites, 34 prehistoric sites of unknown affiliation including seven sites with features, seven artifact scatters, and 20 lithic scatters, two historic sites, and finally, 14 sites for which affiliation/attribute information is not currently available. A single (n =1) artifact scatter is located in soil type 136. The remaining sites (n = 4) are located in soil type 176, and include a Kayenta site, a Formative site, and two sites for which attribute and affiliation information are not currently available.





Allotment Divided by Geology:

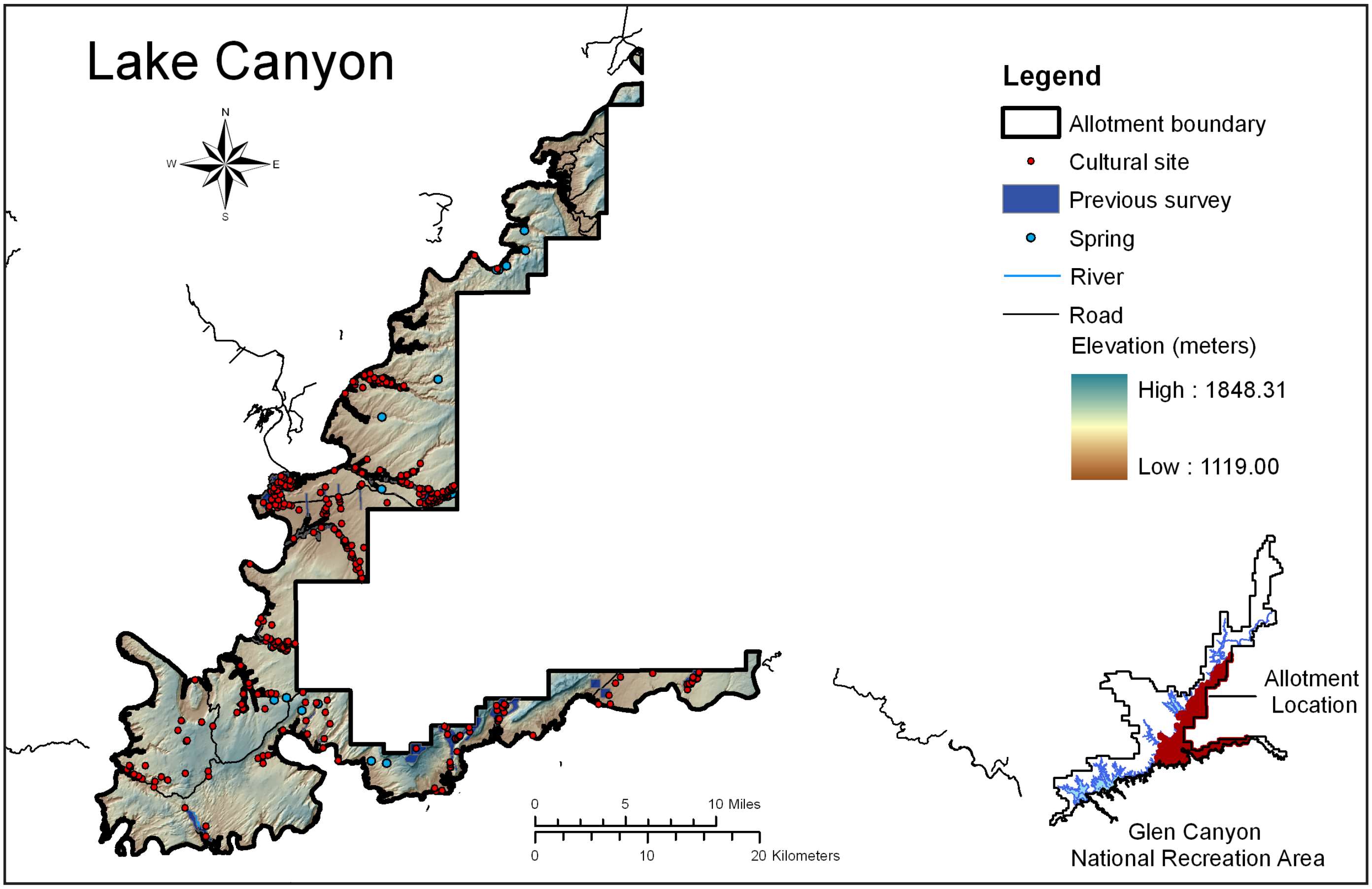
The Straight Cliffs Formation accounts for all geological context in Lake grazing allotment.

Distribution of Cultural Sites by Geological Location:

All known cultural sites (n = 123) in Lake grazing allotment occur in Straight Cliffs Formation geological contexts.

Lake Canyon

Map Panels



Total Area: 186,075.68 acres

Sampling Fractions:
2 percent: 3721.51 acres
5 percent: 9303.78 acres
11 percent: 20,468.32 acres
16 percent: 29,772.11 acres
20 percent: 37,215.14 acres

Elevation range amsl:
1119.00 – 1848.31 meters (3671.26 - 6064.01 feet)

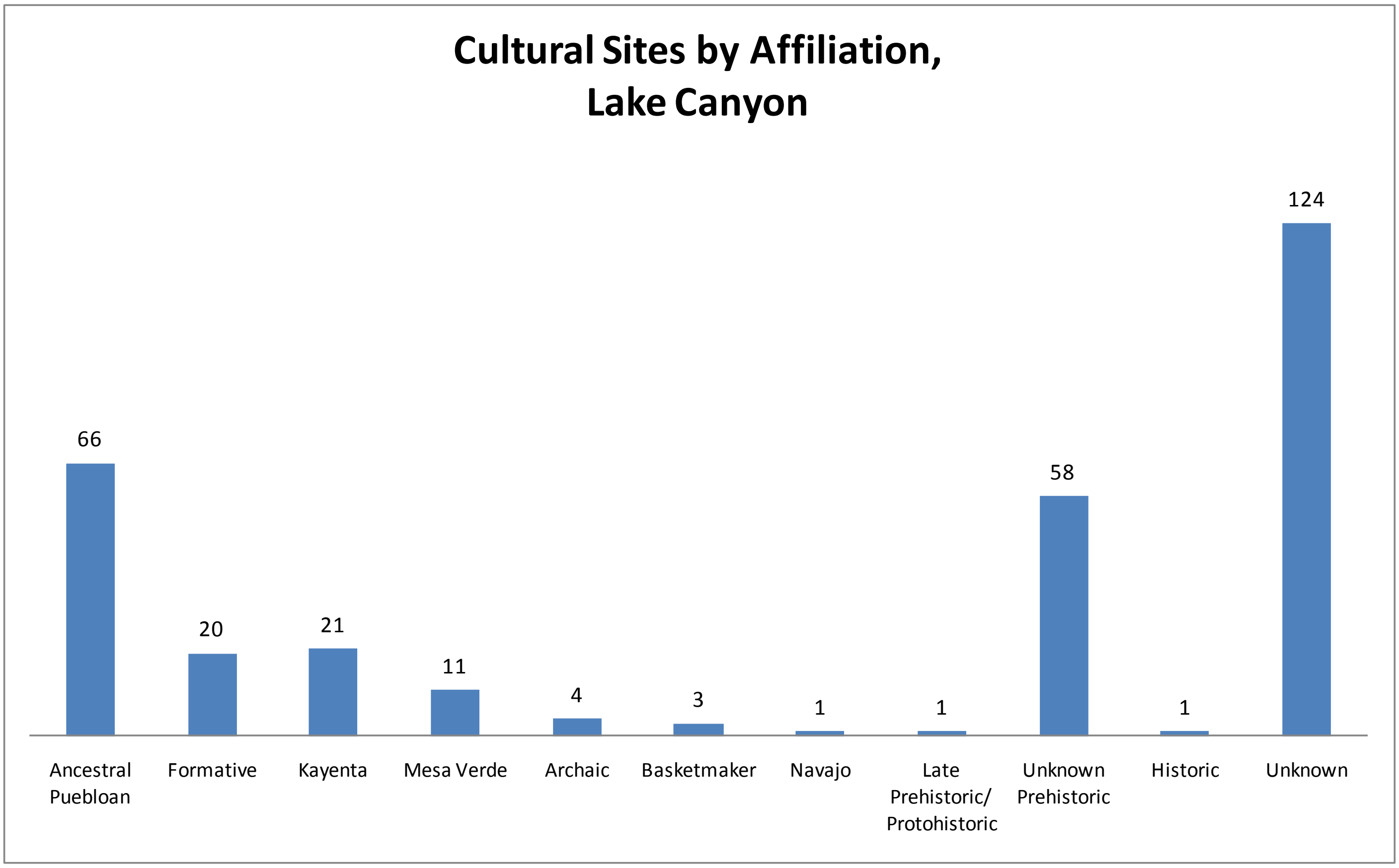
Rivers and Springs:
A total of 21 springs are located in Lake Canyon grazing allotment, in addition to Castle Creek (not depicted), Wilson Creek, and the creeks of Lake Canyon and Moqui Canyon.

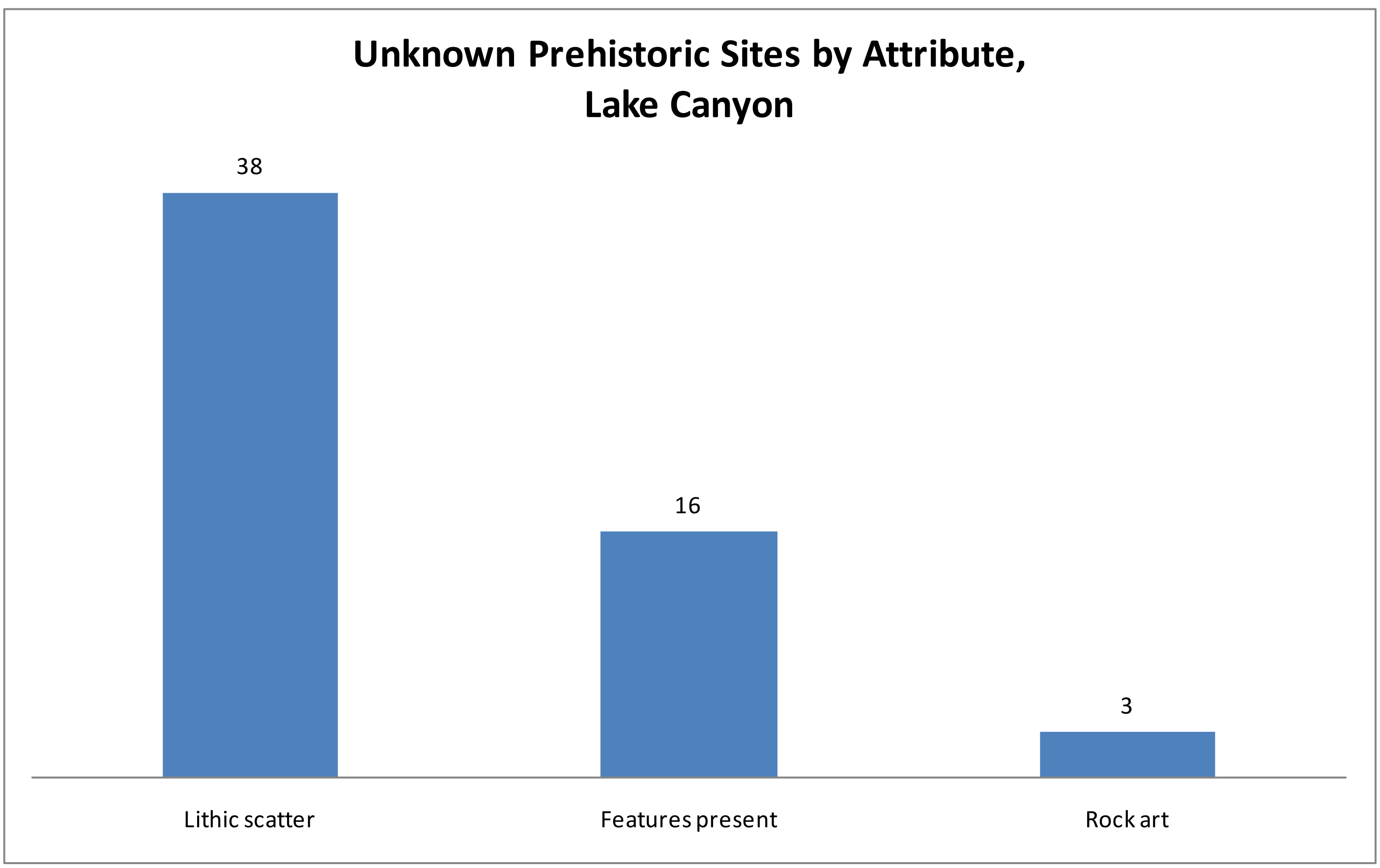
Accessibility:
County Hwy 450 crosses the southwestern portion of the allotment from east-west. State Hwy 276 provides east-west access through the center of the allotment and hall's Crossing. State Hwy 95 passes across the north from southeast-northwest through Hite. County Hwys 430 and 450 provide access to the San Juan arm of the allotment. Numerous County Hwys, including 630, 657, 656, 632, 651, and 650, and lateral roadways provide access to the interior of the allotment. Finally, Lake Powell bounds both the west and south sides of the allotment, allowing for boat access if necessary.

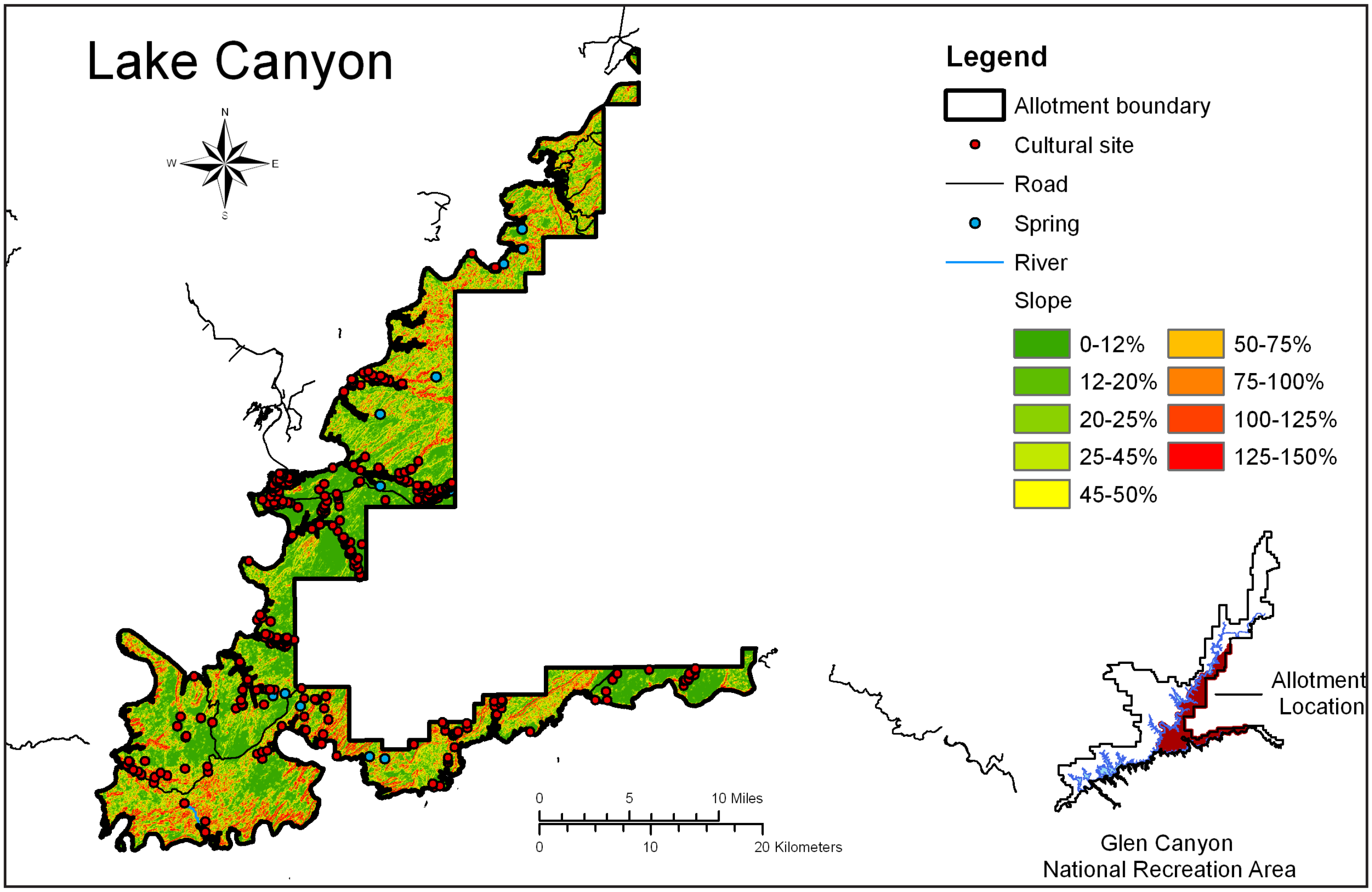
No. Cultural Sites: 310
Area surveyed: 6514.09 acres

Survey References:
Baker (2004): 521.70 acres
Burchett (1996): 6.19 acres
Geib and Bungart (1988): 2781.56 acres
Kincaid (1986h): 3.14 acres
Kincaid (1986j): 1.88 acres
Kincaid (1987): 679.41 acres
Kincaid (1989d): 0.18 acres
Kincaid (2006): 8.68 acres
Neal and Wenker (1997): 1015.20
Schroedl (1981a): 2471.86 acres
Vetter (1985): 17.58

The figures on the subsequent page depict the proportions of cultural sites by affiliation, and for those prehistoric sites for which affiliation is unknown, by attribute. Note: most surveys, and therefore recorded sites, in Lake Canyon occur in and along canyons.


Cultural Sites by Affiliation, Lake Canyon
66
20
21
11
4
3
1
1
58
1
124
Ancestral Puebloan
Formative
Kayenta
Mesa Verde
Archaic
Basketmaker
Navajo
Late Prehistoric/ Protohistoric
Unknown Prehistoric
Historic
Unknown


Unknown Prehistoric Sites by Attribute, Lake Canyon
38
16
3
Lithic scatter
Features present
Rock art



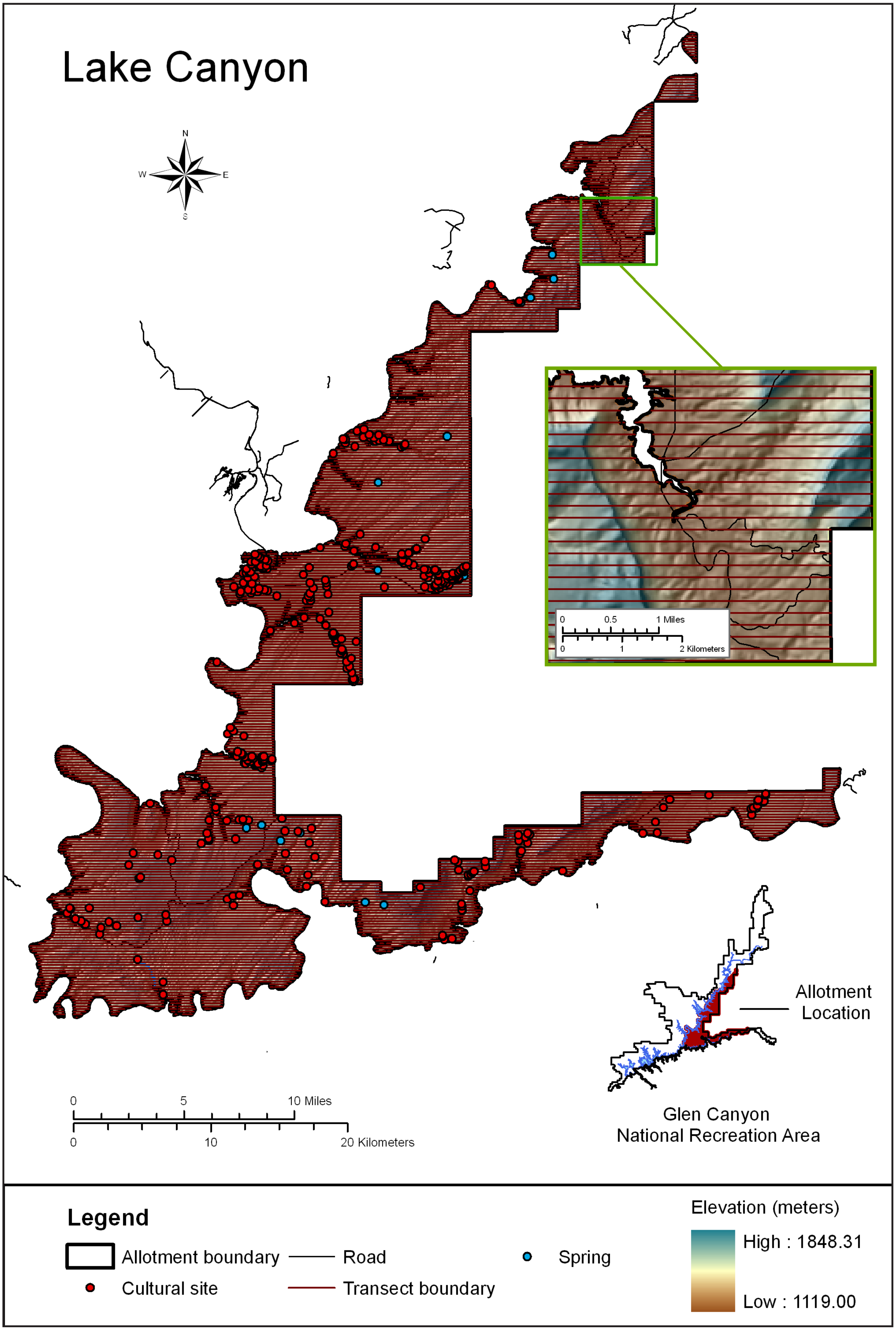
Slope Considerations:

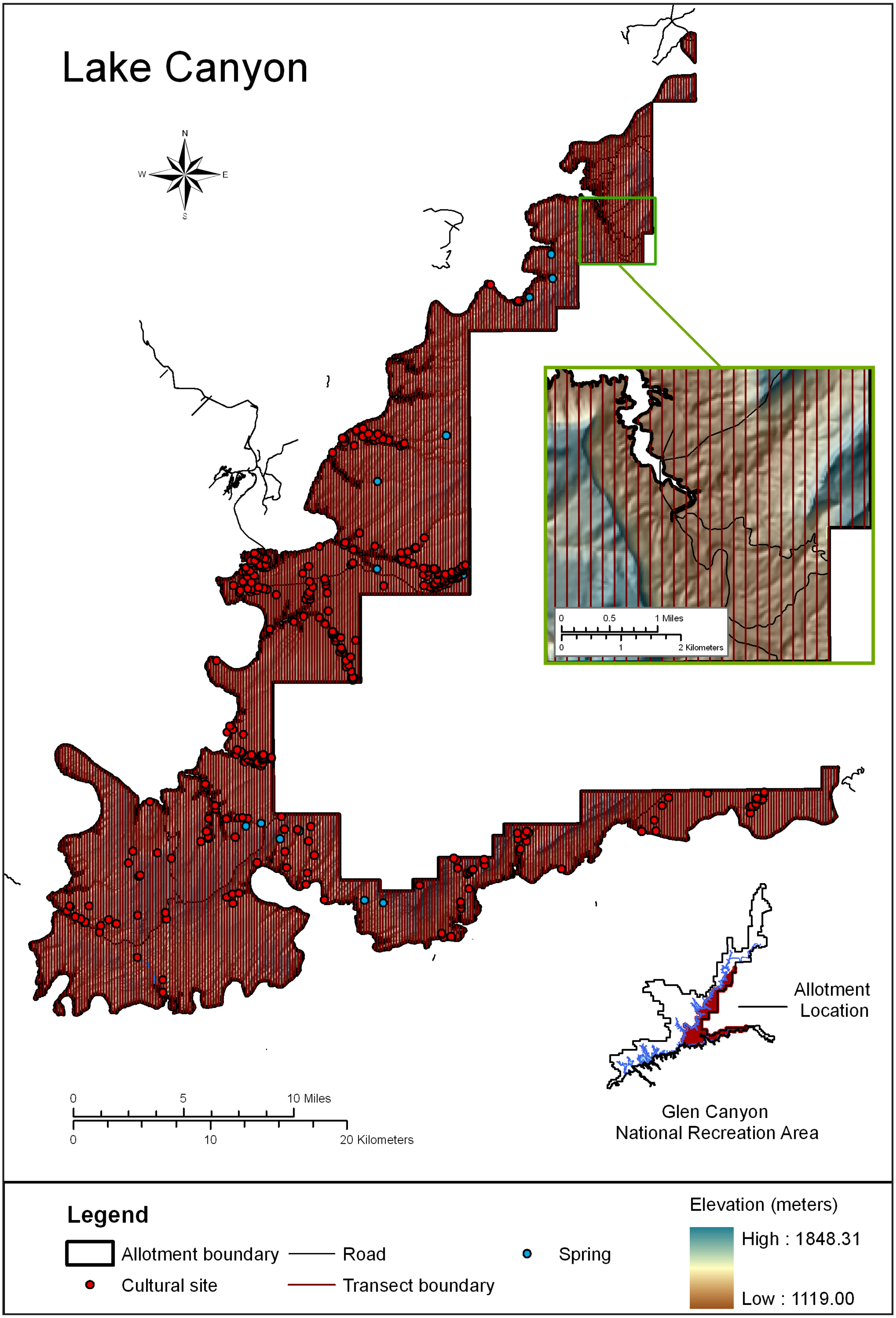
Slope plays a large role in terrain accessibility, and may be used in the stratification of survey areas. For example, GCNRA may wish to assign catagories such as low, moderate, and high to specific slope gradients. Such assignations are most often dependent on the factors guiding archaeological survey work, and as such, are not included in this document. Included herein, however, are suggestions for basic transect orientation based on the presence of topographical barriers identified by the presence of excessive slope gradients.

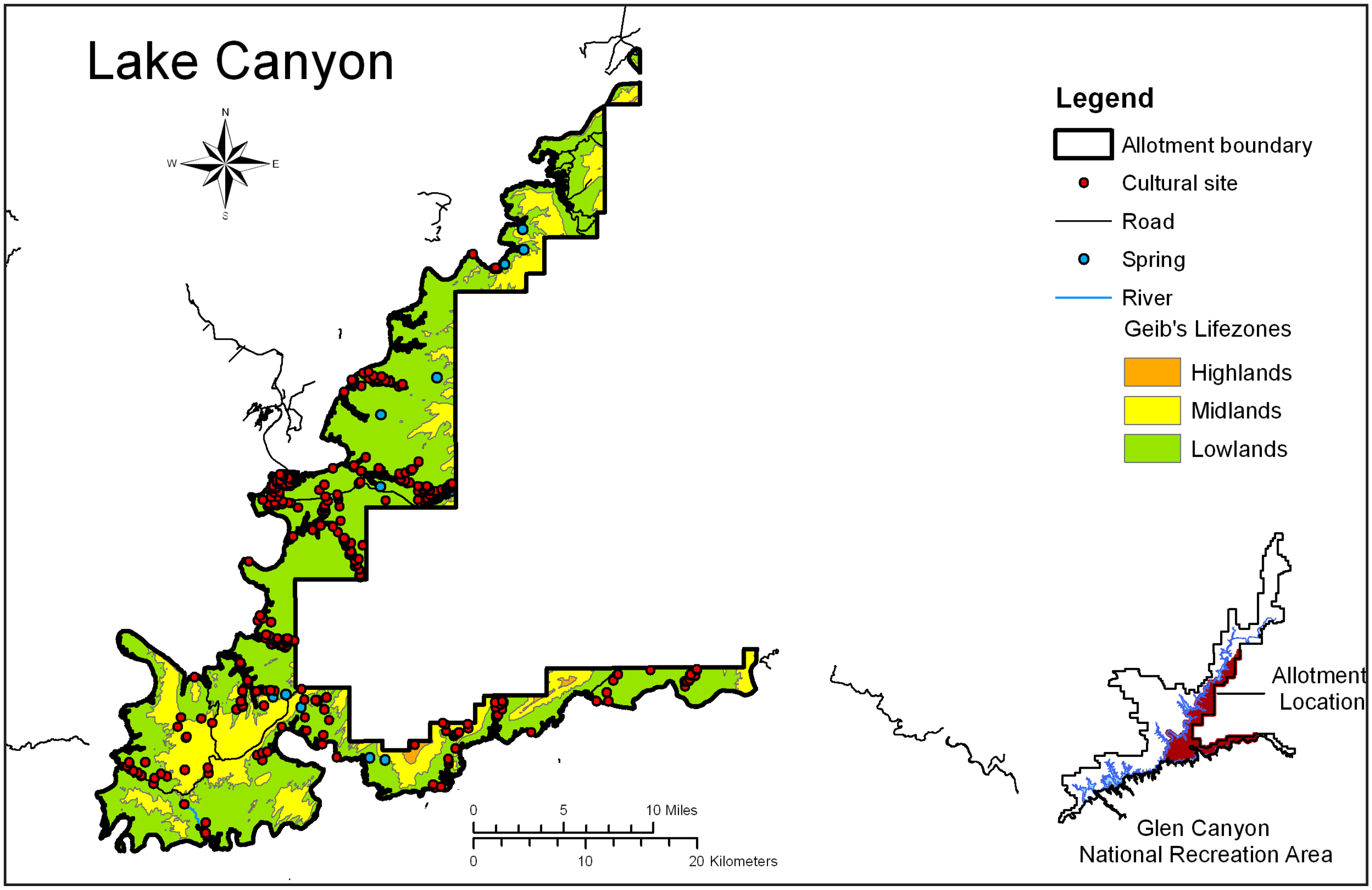
Survey Zones Dictated by Slope:

Numerous canyons and steep slopes cross-cut Lake Canyon allotment. Given the overall size of the allotment, transect orientation should be situationally selected, with preferred orientation perpendicular to roadways and the shoreline of Lake Powell.

The 'fishnet' maps provided on the subsequent pages display transects spaced at 200 meter intervals for both east-west and north-south oriented pedestrian survey.


Lake Canyon
N
W
E
S
0
0.5
1 Miles
0
1
2 Kilometers
Allotment Location
Glen Canyon National Recreation Area
0
5
10 Miles
0
10
20 Kilometers
Legend
Allotment boundary
Cultural site
Road
Transect boundary
Spring
Elevation (meters)
High : 1848.31
Low : 1119.00


Lake Canyon
N
W
E
S
0
0.5
1 Miles
0
1
2 Kilometers
0
5
10 Miles
0
10
20 Kilometers
Allotment Location
Glen Canyon
National Recreation Area
Legend
Allotment boundary
Road
Spring
Cultural site
Transect boundary
Elevation (meters)
High : 1848.31
Low : 1119.00



Area of Each Lifezone:

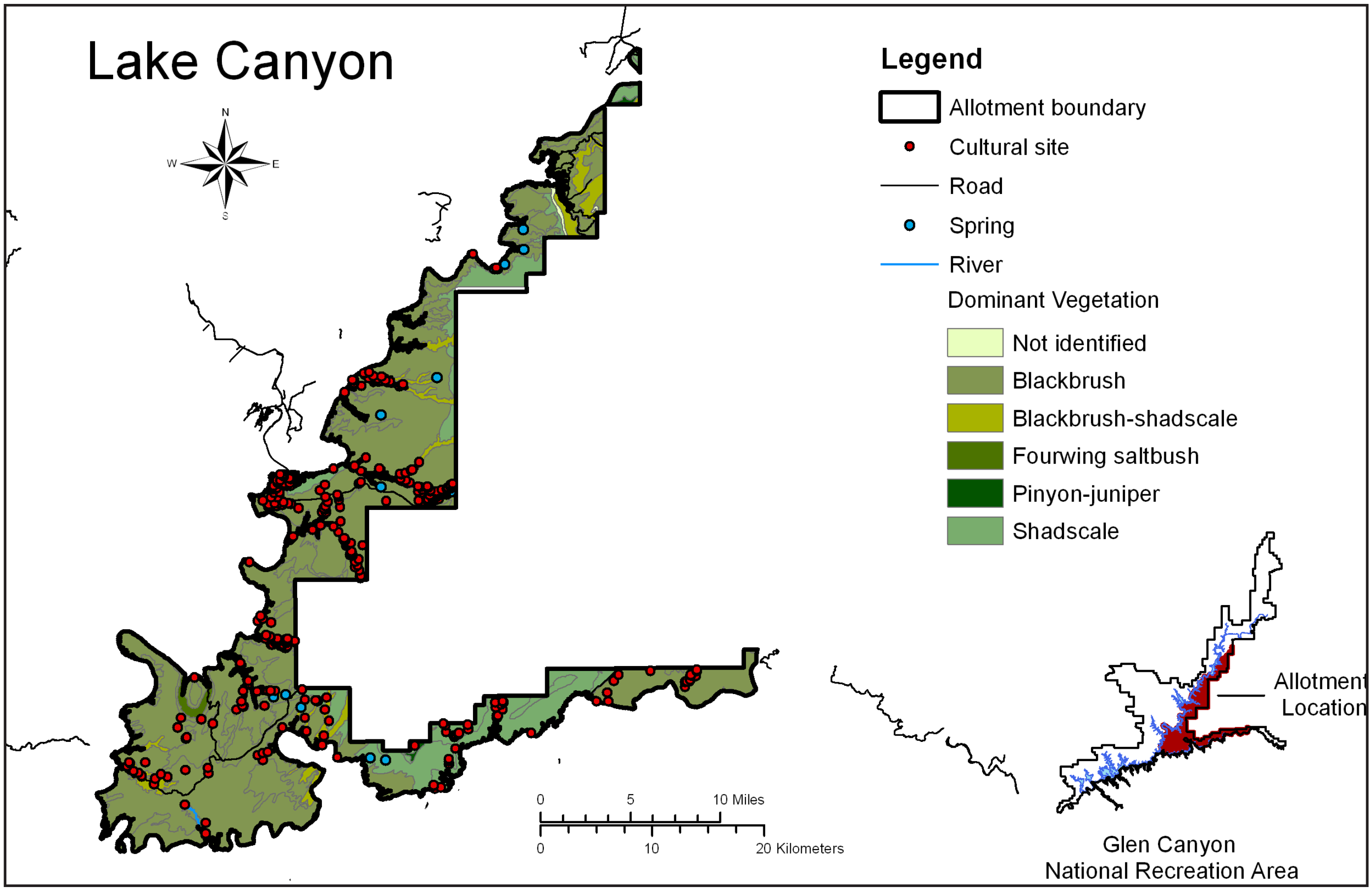
Highlands:1073.16 acres
Midlands: 42,976.01 acres
Lowlands:141,488.23 acres

No. Cultural Sites in Each Lifezone:

Highlands: 1
Midlands: 19
Lowlands: 285

Lifezone Significance and Known Cultural Sites: A single site (n = 1) is located in Geib's Highland zone. Geib describes the highlands as providing important foods, such as pinyon, deer, and rabbit, and suggests that the lower temperatures and increased precipitation of the highlands allowed for dry farming and later harvests than lower elevations. Nineteen (n = 19) sites are located in the Midland zone, described as providing important grasses, cacti, and game such as antelope to prehistoric populations. The remaining sites (n = 285) occur in the lowlands, described by Geib as hot and arid, with permanent water, arable alluvium, and long growing seasons suited to agriculture.

	Elevation	Characteristics	Environment	Significance to Humans
Lowlands	1219-1372 m (4000-4500 ft)	Hot and arid steep-walled sandstone canyons.	Riparian plants; bighorn sheep	Permanent water, arable alluvium, long growing season, diverse plant communities, natural shelters, quality siliceous stone from river gravels
Midlands	1372-1676 m (4500-5500 ft)	Arid slickrock and dune fields on benchlands and low plateaus.	Blackbrush, shadscale, grasses; antelope.	Grasses, including dropseed and ricegrass, prickly pear and shadscale; good antelope habitat, quality siliceous stone in certain locations.
Highlands	Above 1676 m (Above 5500 ft)	High elevation mesas and plateaus with cooler temperatures and greater precipitation.	Pinyon-juniper woodlands; deer and rabbit.	Higher elevation plant foods (i.e. pinyon); later harvests; dry-farming; abundant fuel, deer and rabbit.
Shading indicates lifezones present in allotment.				



Area of Individual Vegetation Zones:

Dominant Species	Acres Covered	No. Sites
Not identified	1954.79	15
Blackbrush (*Coleogyne ramosissima*)	141,001.07	156
Blackbrush-shadscale (*Coleogyne ramosissima - Atriplex confertifolia*)	12,497.32	86
Fourwing saltbush (*Atriplex canescens*)	1357.77	0
Pinyon-juniper (*Pinus edulis - Juniperus osteosperma*)	423.62	
Shadscale (*Atriplex confertifolia*)	28,841.11	
Total	**186,075.68**	

No. Cultural Sites in Each Vegetation Zone:
Fifteen sites (n = 15) are located in zones for which the dominant vegetation has not been identified. 156 sites occur in blackbrush. 86 sites occur in blackbrush-shadscale. One (n = 1) site occurs in pinyon-juniper. The remaining sites (n = 52) are located in shadscale.

Visibility:
In general, the dominant vegetation of Lake Canyon provide moderate - excellent visibility with large portions of the ground between plants bare of vegetation. However, a build-up of duff in the pinyon juniper zones may impede the visibility of small sites and isolated artifacts.

Continued on subsequent page...

Continued from previous page...

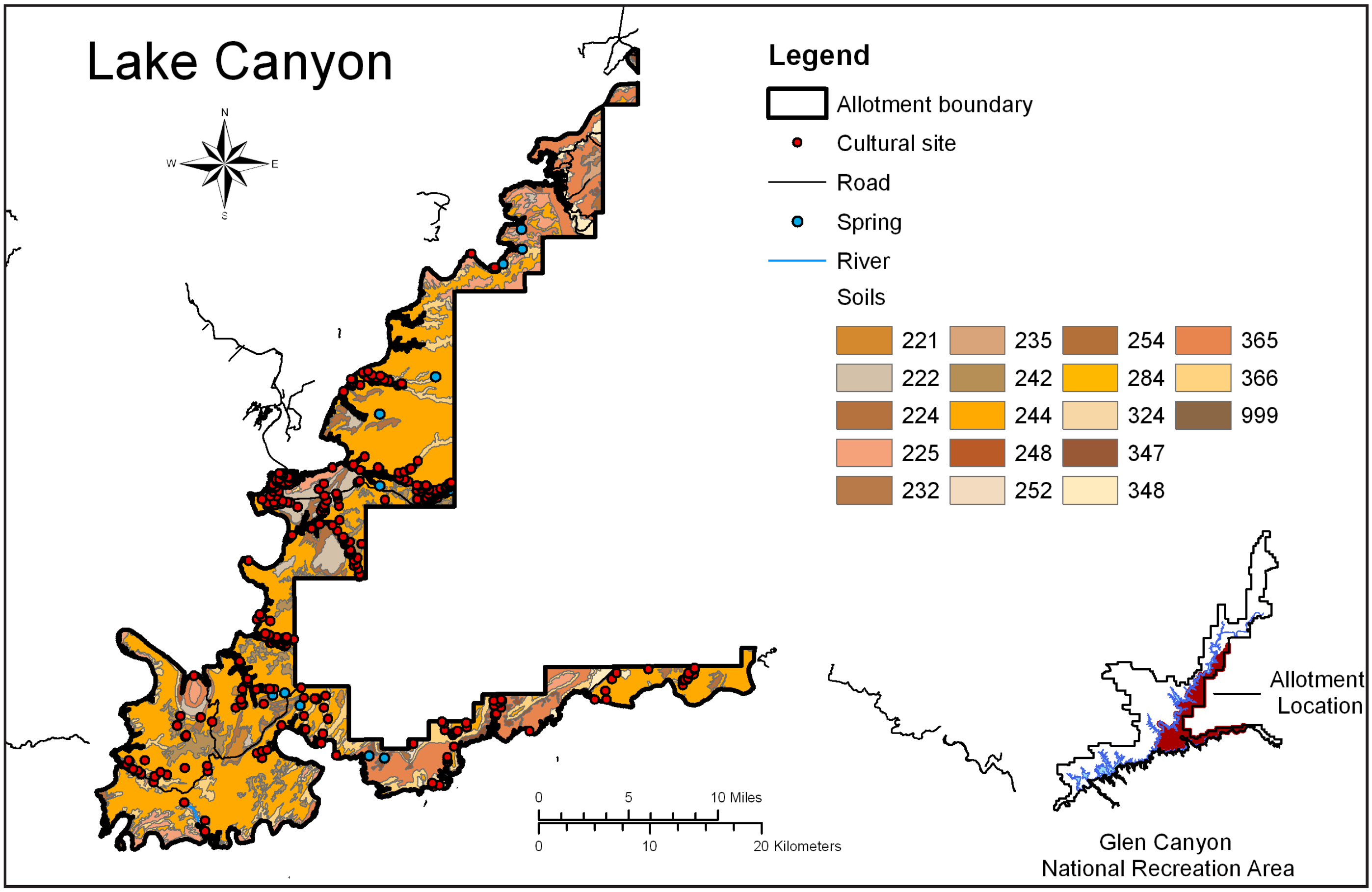
Summary:
The primary dominant vegetation zones within the Lake grazing allotment include blackbrush (75.78 percent), blackbrush-shadscale (6.72 percent), fourwing saltbush (0.73 percent), pinyon-juniper (0.23 percent), and shadscale (15.50 percent). Dominant vegetation for the remainder of the allotment is not currently known.

Dominant Species:
Blackbrush (*Coleogyne ramosissima*)
Fourwing saltbush (*Atriplex canescens*)
Pinyon (*Pinus edulis*)
Juniper (*Juniperus osteosperma*)
Shadscale (*Atriplex confertifolia*)

Secondary Dominant Species:
Fremont Cottonwood (*populus fremontii)*
Sand sagebrush (*Artemisia filifolia)*

Associated Soils:

Blackbrush grows in shallow sandy loam and sandy loam, where it is often associated with sand sagebrush in shady loam and sand. Blackbrush-shadscale occurs in talus, and may be associated with shadscale in shallow clay. Fourwing saltbush grows in sandy loam, often in association with blackbrush in shallow sandy loam. Pinyon-juniper occurs in shallow sandy loam with blackbrush. Shadscale grows in stony loam in association with blackbrush growing in sandy loam, and in shallow loam, loam, and stony loam, where fourwing saltbush may also grow in sandy loam



Allotment Divided by Soil Type (MUSYM):

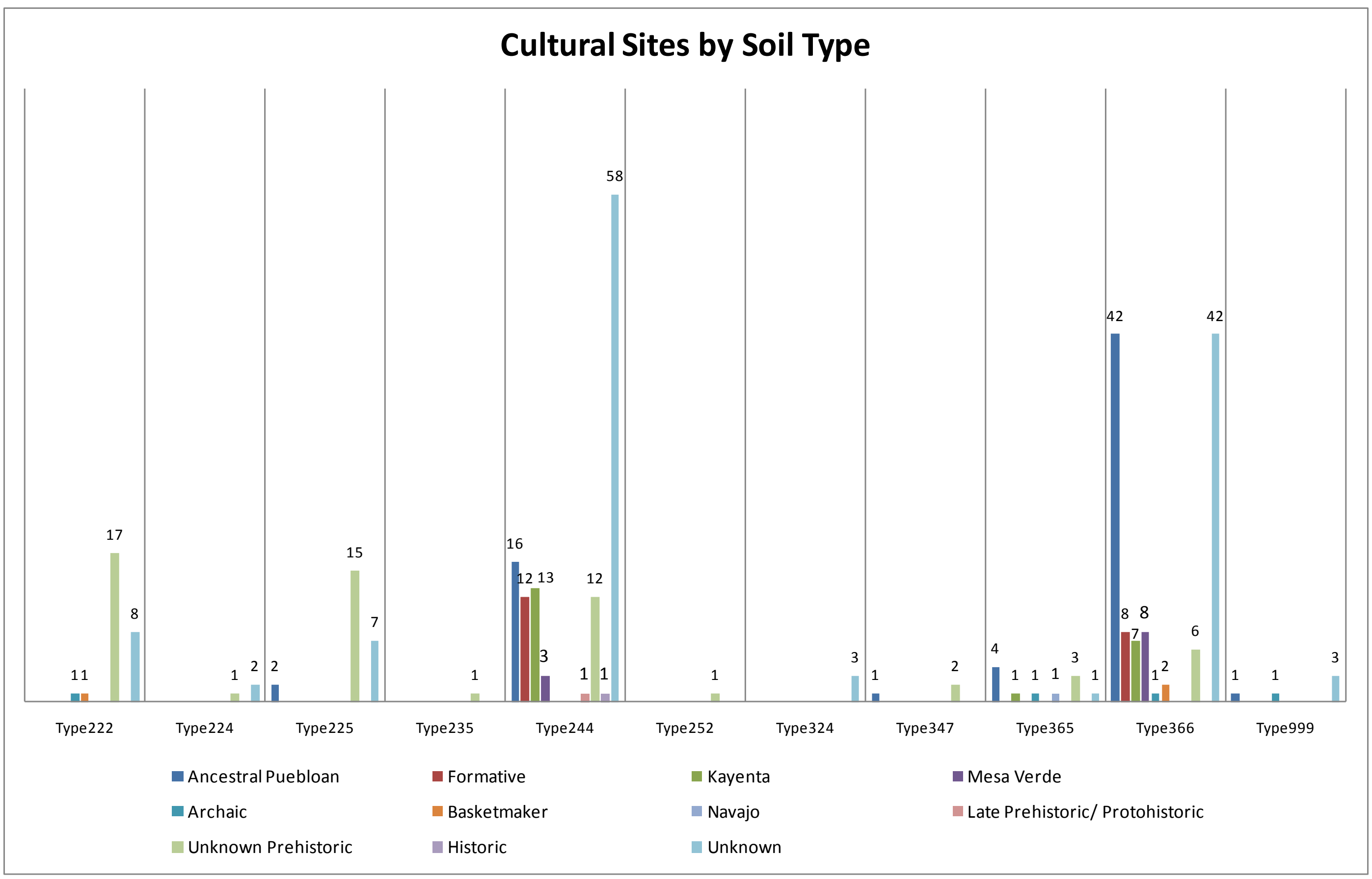
Soil types, acreage, and associated sites are included in the table on the subsequent page.

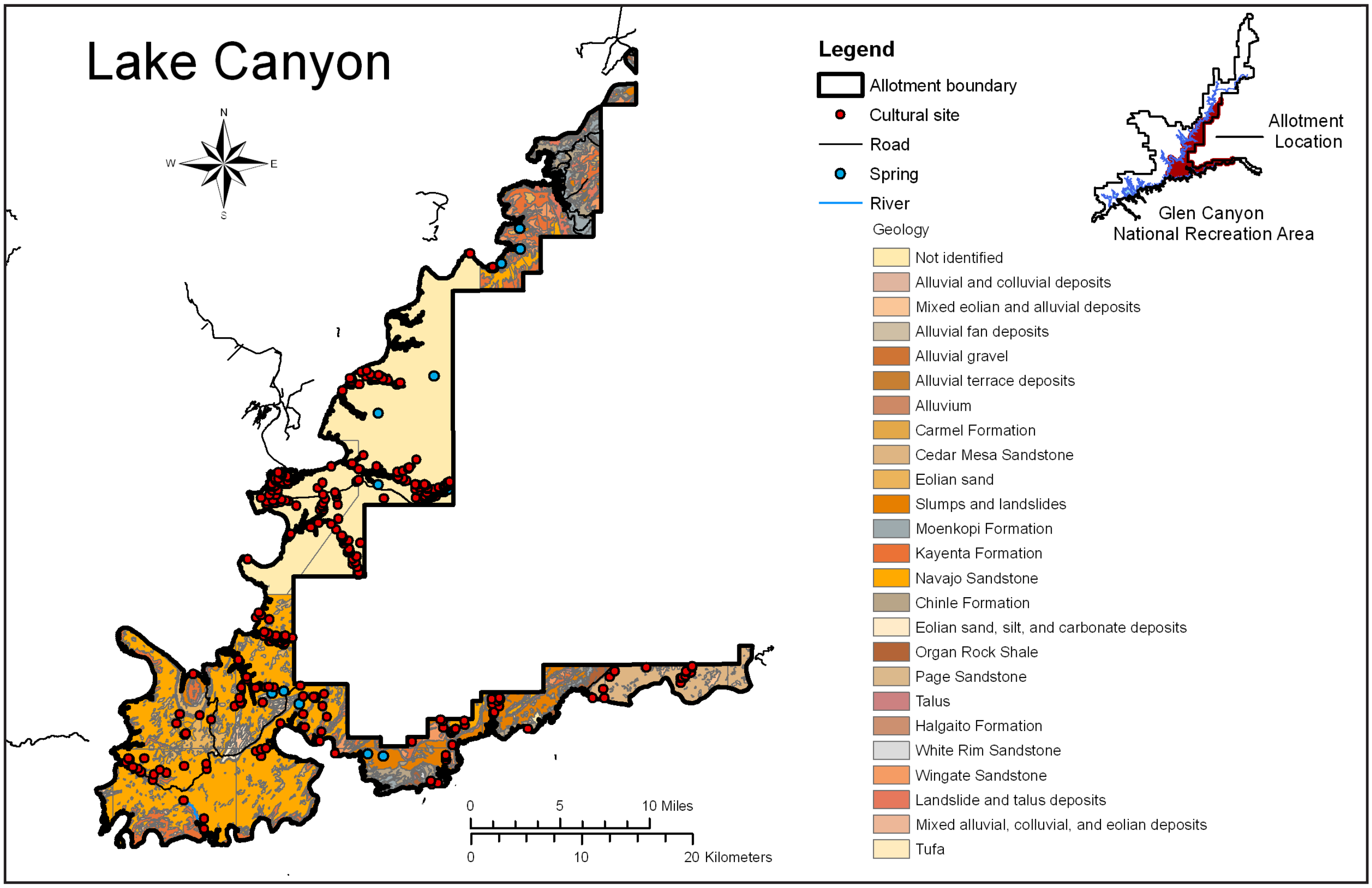
Distribution of Cultural Sites by Soil Type:

Twenty-seven (n = 27) sites occur in soil type 222, including an Archaic site, a Basketmaker site, 17 lithic scatters with unknown affiliations, and eight sites for which attribute/affiliation information is currently unavailable. Three (n = 3) sites are located in soil type 224, including a lithic scatter of unknown affiliation, and two sites for which affiliation/attribute information is not available. Twenty-four (n = 24) sites are located in soil type 225, including two Ancestral Puebloan sites, 15 lithic scatters with no known affiliation, and seven sites for which attribute/affiliation information is not available. A single (n = 1) lithic scatter is located in soil type 235. One hundred sixteen (n = 116) sites are located within soil type 244, which is often associated with Navajo Sandstone, or slickrock. These sites include 16 Ancestral Puebloan sites, 12 Formative sites, 13 Kayenta sites, three Mesa Verde sites,11 prehistoric sites for which affiliation is not known, including seven sites with features, three lithic scatters, and two rock art sites, one protohistoric sites, one historic site, and 58 sites for which affiliation/attribute data is not currently available. A single (n = 1) slab hearth is located in soil type 252. Three sites (n = 3) for which attribute/affiliation information is not available are located in soil type 324. Three sites (n = 3), including one Ancestral Puebloan site, a lithic scatter, and a lithic scatter with a slab hearth are located in soil type 347. Eleven (n = 11) sites occur in soil type 365, including four Ancestral Puebloan sites, one Kayenta site, one Archaic site, one Navajo site, and three unaffiliated prehistoric sites, including two with features and one rock art site, and one site with no known attribute/affiliation information. One hundred sixteen (n = 116) sites are located in soil type 366. These include 42 Ancestral Puebloan sites, two Basketmaker sites, eight Formative sites, seven Formative sites, eight Mesa Verde sites, one Archaic site, six prehistoric sites with features for which affiliation is not known, and 42 sites for which attribute/affiliation information is currently not known. The remaining sites (n = 5) occur in soil type 999, and include one Ancestral Puebloan site, an Archaic site, and three sites for which attribute/affiliation information is not currently available.

The figure on the subsequent page depicts site affiliations as they relate to soil types.

Soil Type	Acres	Percent	No. Cultural Sites
221	1927.47	1.04	0
222	7434.18	4.00	27
224	6188.04	3.33	3
225	11,133.75	5.98	24
234	97.31	<0.00	0
235	696.14	0.37	0
242	7062.16	3.80	1
244	97,333.67	52.31	116
248	247.87	0.13	0
252	250.28	0.13	1
254	831.97	0.45	0
284	103.99	<0.00	0
324	705.85	0.38	3
347	2063.46	1.11	3
348	3618.10	1.94	0
365	20,713.68	11.13	11
366	25,053.10	13.46	116
999	614.66	0.33	5
Total	**186,075.7**	**99.89**	**310**





Allotment Divided by Geology:

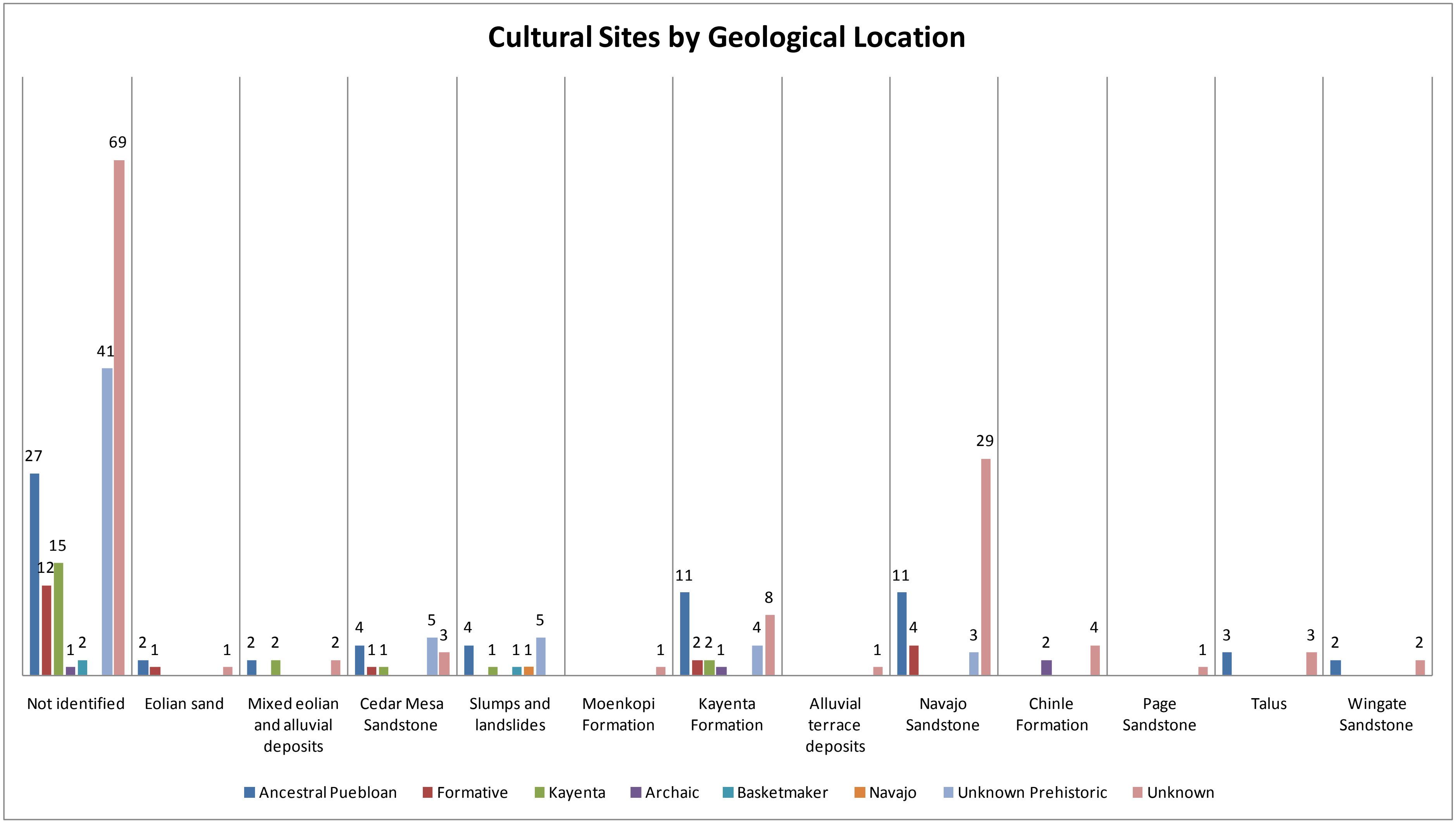
Geology, acreage, and associated sites are included in the table on the subsequent page.

Distribution of Cultural Sites by Geological Location:

A total of four (n = 4) sites are located on eolian sand, including two Ancestral Puebloan sites, one Formative site, and one site for which attribute/affiliation information is not available. Six (n = 6) sites are located on mixed eolian and alluvial deposits, including two Ancestral Puebloan sites, two Kayenta sites, and two sites for which affiliation/attribute information is currently not available. Fourteen (n = 14) sites are located on Cedar Mesa Sandstone, including four Ancestral Puebloan sites, one Formative site, one Kayenta site, five prehistoric sites, including three with features and two with rock art, for which affiliation is not known, and three for which both attribute and affiliation information is lacking at this time. Twelve (n = 12) sites occur on slumps and landslides, including four Ancestral Puebloan sites, one Basketmaker site, one Kayenta site, one Navajo site, and five prehistoric sites for which affiliation is currently unknown, including three with features, and two with rock art. A single site (n = 1) for which attribute and affiliation information is not available is located on Moenkopi Formation. Twenty-eight (n = 28) sites are located on Kayenta Formation, including 11 Ancestral Puebloan sites, two Formative sites, two Kayenta sites, one Archaic site, four currently unaffiliated prehistoric sites containing features, and eight sites for which attribute/affiliation information is not available. A single site (n = 1) for which attribute/affiliation information is currently not known occurs on alluvial terrace deposits. Forty-seven (n = 47) sites occur on Navajo Sandstone, or slickrock. These sites include 11 Ancestral Puebloan sites, four Formative sites, three currently unaffiliated prehistoric sites with features, and 29 sites for which attribute/affiliation information is not available. Two (n = 2) Archaic sites and four (n = 4) sites lacking affiliation/attribute information are located on Chinle Formation. A single site (n = 1) lacking attribute/affiliation information occurs on Page Sandstone. Three (n = 3) Ancestral Puebloan sites and three (n = 3) sites lacking attribute/affiliation information occur on talus. Likewise, two (n = 2) Ancestral Puebloan sites and two (n = 2) sites lacking attribute/affiliation information occur on Wingate Sandstone. The remaining sites (n = 167) are located in areas where the geology has not been identified.

The figure on page depicts site affiliations as they relate to soil types.

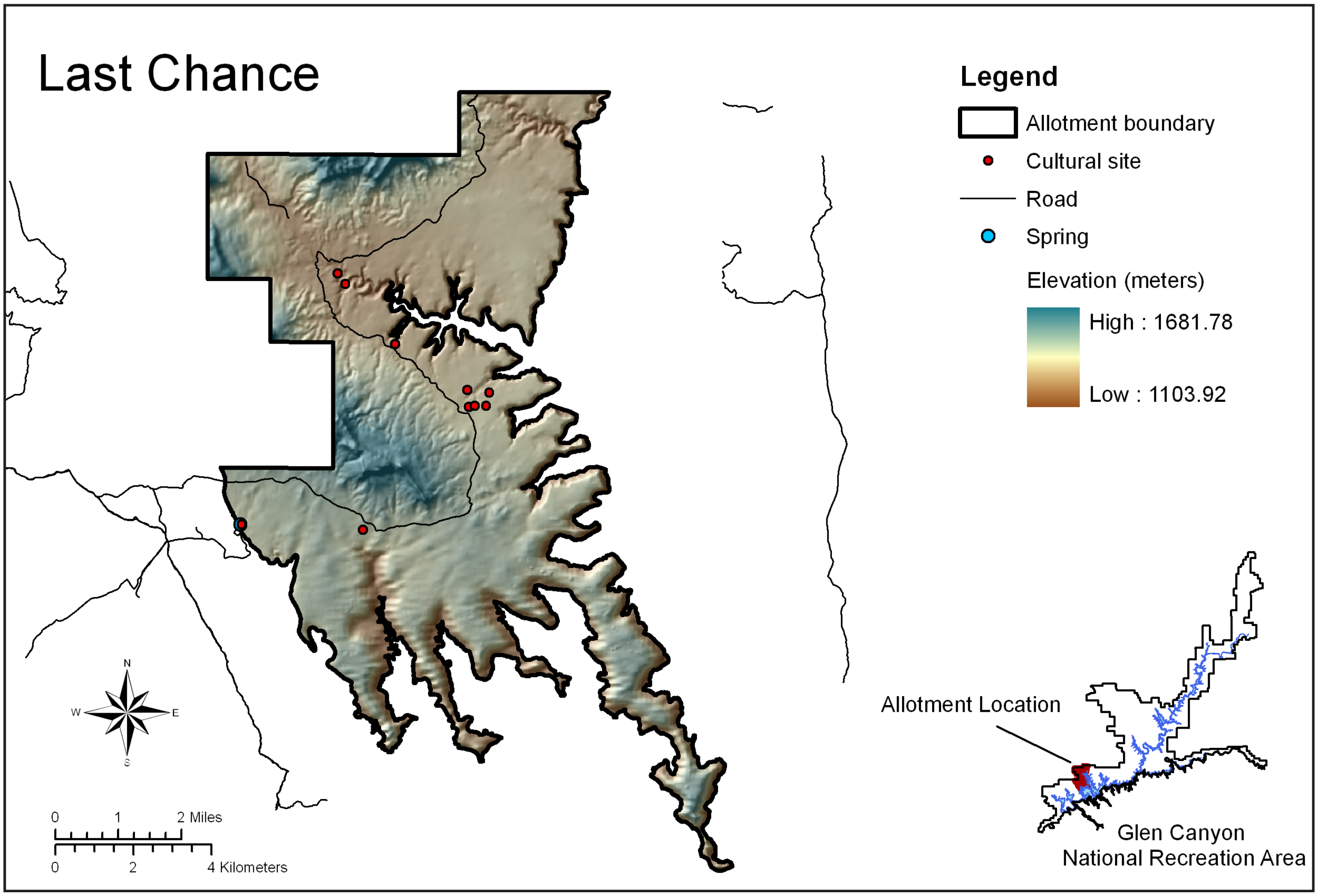
Geology	Acres	Percent	No. Cultural Sites
Not identified	42,063.12	22.61	180
Alluvial and colluvial deposits	28.27	<0.00	0
Alluvial fan	230.48	0.12	0
Alluvial gravel	35.55	<0.00	0
Alluvial terrace deposits	167.85	0.09	1
Alluvium	32.31	<0.00	0
Carmel Formation	237.23	0.13	0
Cedar Mesa Sandstone	8276.84	4.45	14
Chinle Formation	8357.53	4.50	6
Eolian sand	6422.85	3.45	4
Eolian sand, silt, and carbonates	1471.91	0.79	0
Halgaito Formation	12.73	<0.00	0
Kayenta Formation	14,701.60	7.90	28
Landslide and talus deposits	22,759.88	12.23	0
Mixed alluvial, colluvial, and eolian deposits	399.42	0.22	0
Mixed eolian and alluvial deposits	2681.85	1.44	6
Moenkopi Formation	4457.69	2.40	1
Navajo Sandstone	53,620.28	28.82	47
Organ Rock Shale	1445.22	0.78	0
Page Sandstone	506.74	0.27	1
Slumps and landslides	9960.91	5.35	12
Talus	2433.51	1.31	6
Tufa	22.61	<0.00	0
White Rim Sandstone	251.16	0.13	0
Wingate Sandstone	5498.14	2.95	4
Total	**186075.68**	**99.94%**	**310**



Geology figure for Lake Canyon grazing allotment.

Last Chance

Map Panels



Total Area: 27,068.36 acres

Sampling Fractions:
2 percent: 541.37 acres
5 percent: 1353.42 acres
11 percent: 2977.52 acres
16 percent: 4330.94 acres
20 percent: 5413.67 acres

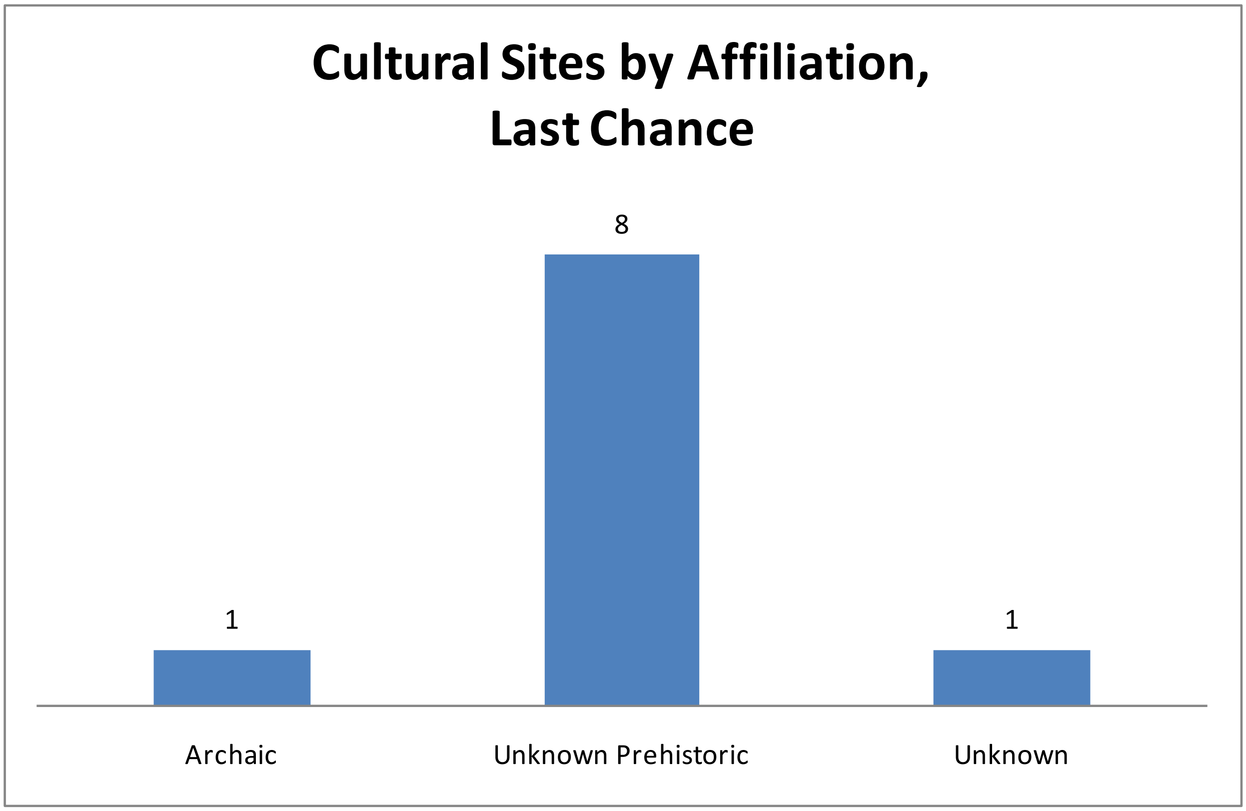
Elevation range amsl:
1103.92 – 1681.78 meters (3621.78 - 5517.65 feet)

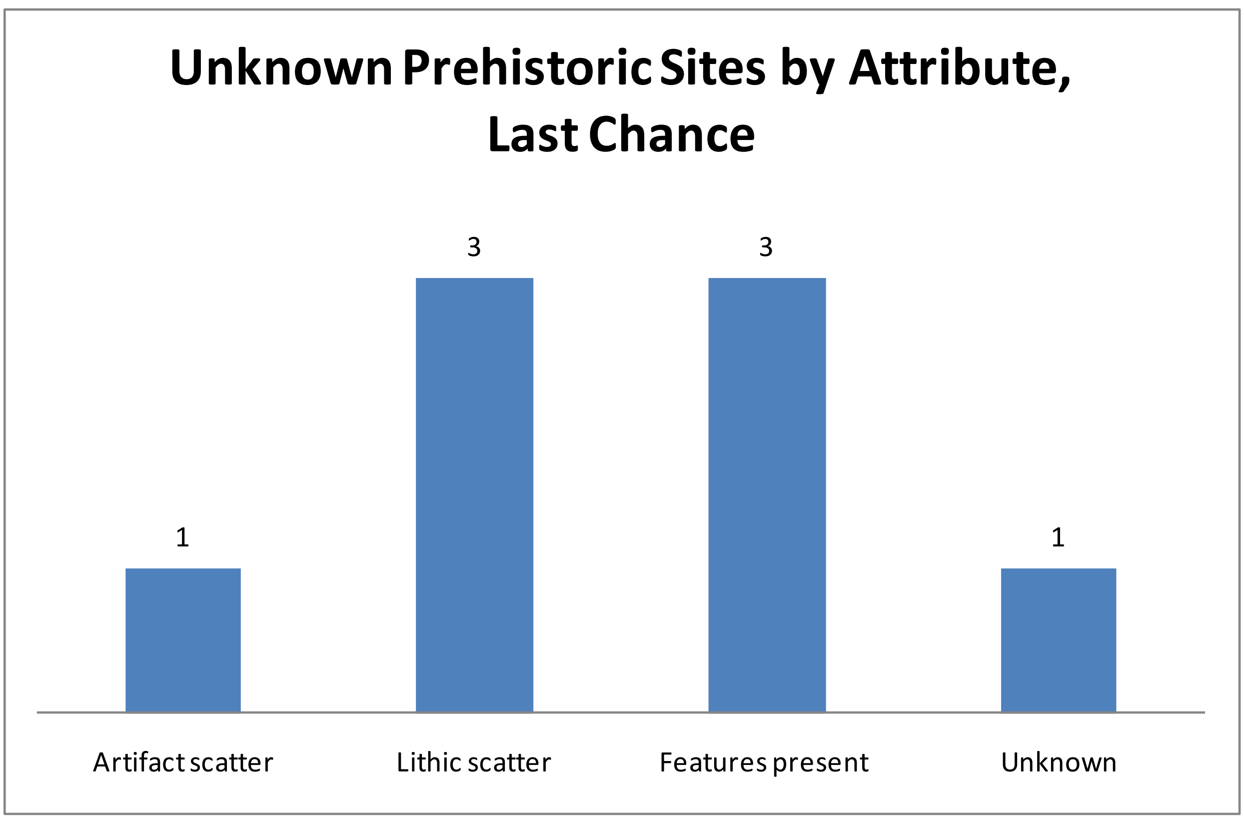
Rivers and Springs:
The Gunsight spring occurs in Last Chance grazing allotment, as do several creeks (not depicted). The creeks include Last Chance Creek and the waterways of Little Valley Canyon.

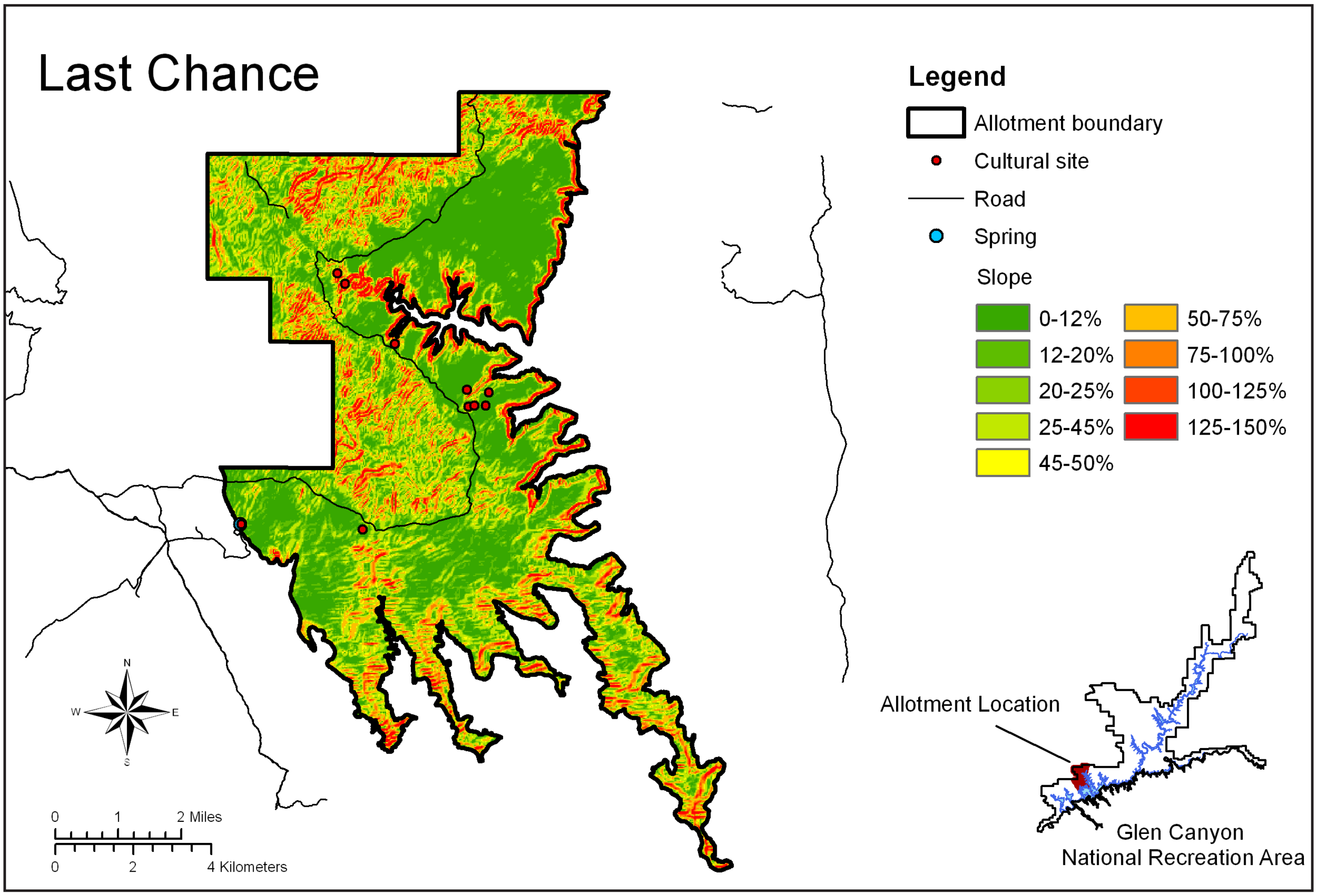
Accessibility:
County Hwy 230 provides access to the entire allotment. Lake Powell borders the south and east sides, as well, providing lake access if necessary.

No. Cultural Sites: 10
Area surveyed: 0.00 acres

The figures on the subsequent page depict cultural sites by affiliation, and for those prehistoric sites for which affiliation is not known, site attributes.


Cultural Sites by Affiliation,
Last Chance
8
1
1
Archaic
Unknown Prehistoric
Unknown


Unknown Prehistoric Sites by Attribute,
Last Chance
3
3
1
1
Artifact scatter
Lithic scatter
Features present
Unknown



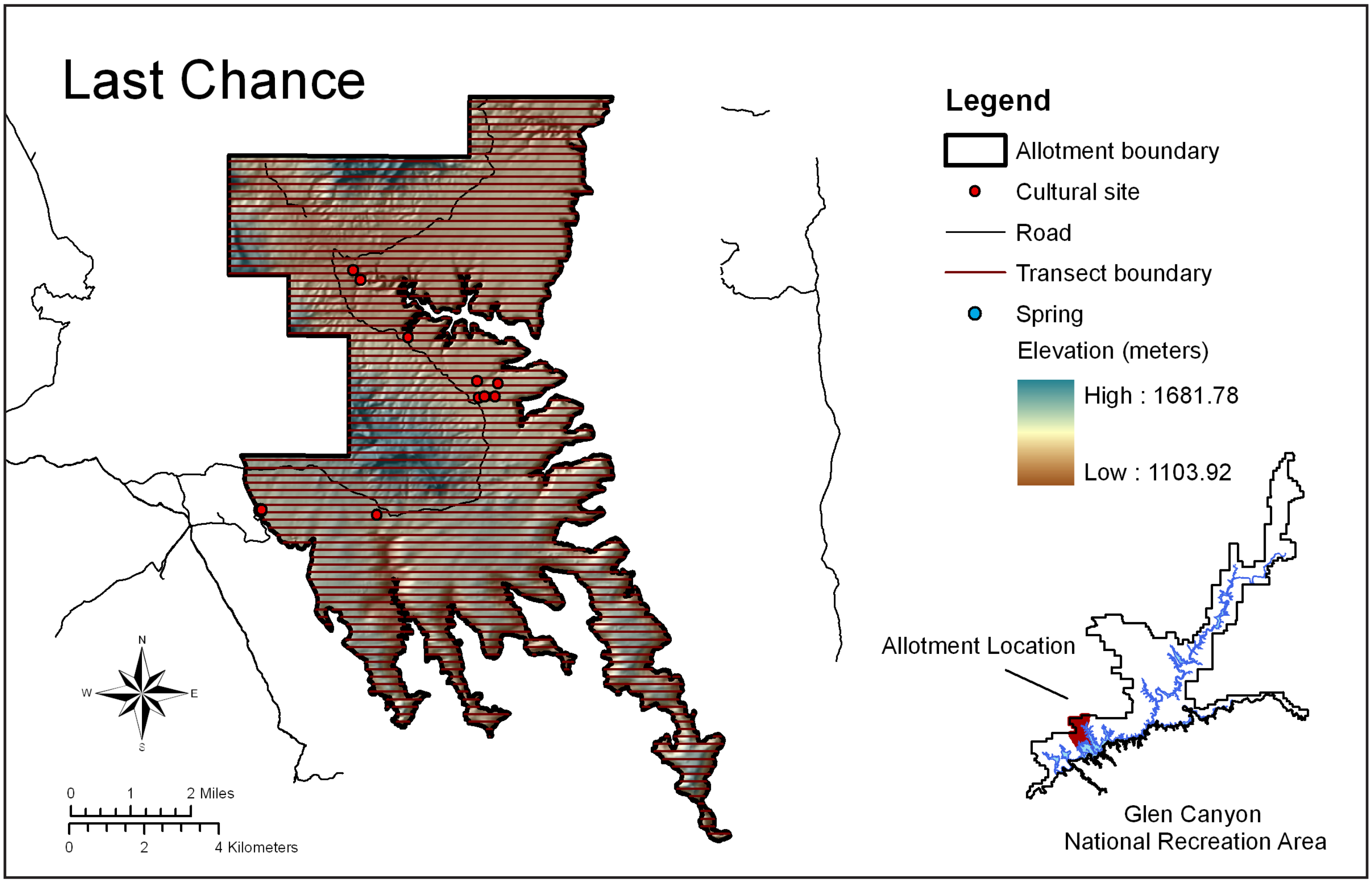
Slope Considerations:

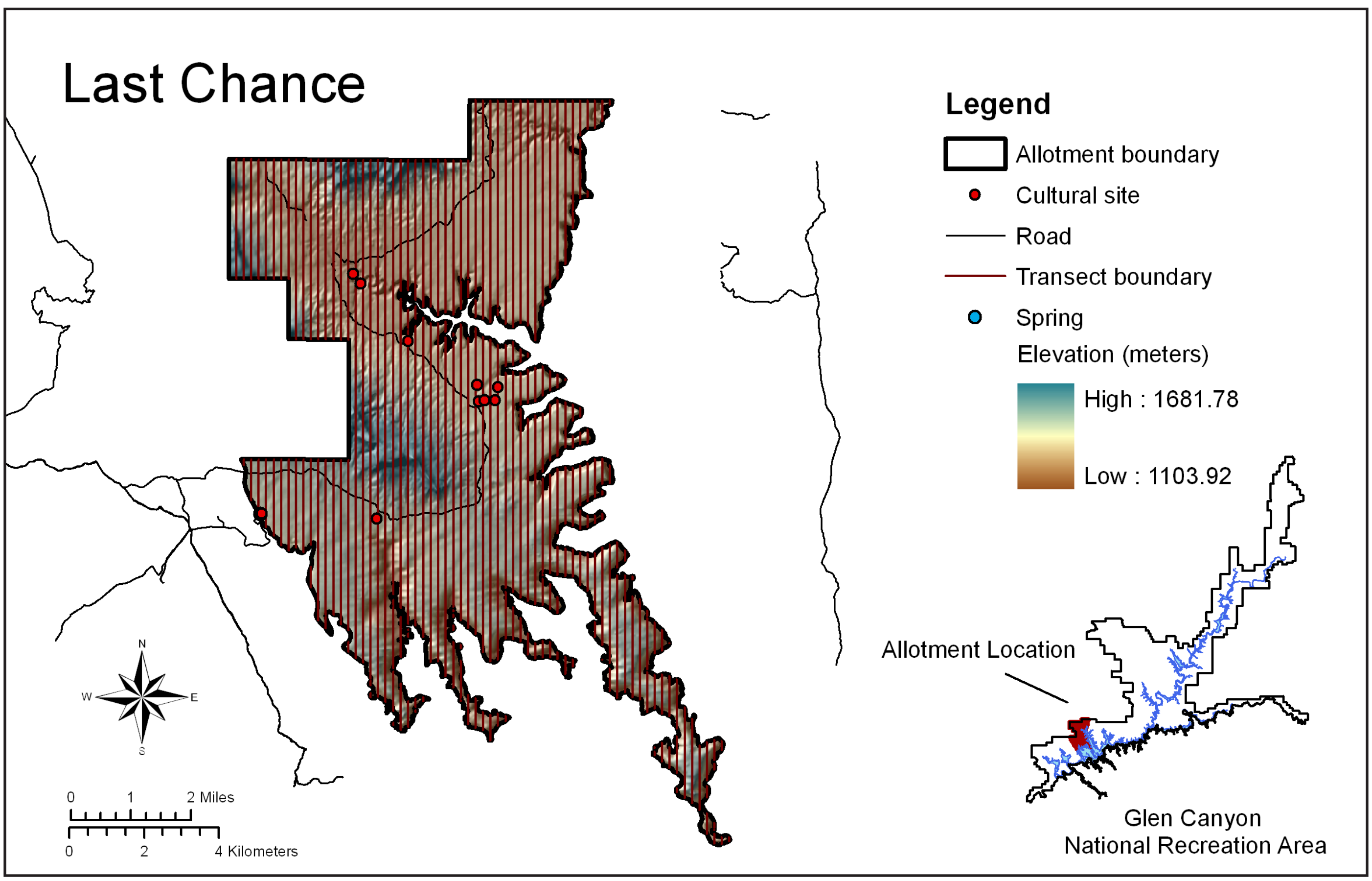
Slope plays a large role in terrain accessibility, and may be used in the stratification of survey areas. For example, GCNRA may wish to assign catagories such as low, moderate, and high to specific slope gradients. Such assignations are most often dependent on the factors guiding archaeological survey work, and as such, are not included in this document. Included herein, however, are suggestions for basic transect orientation based on the presence of topographical barriers identified by the presence of excessive slope gradients.

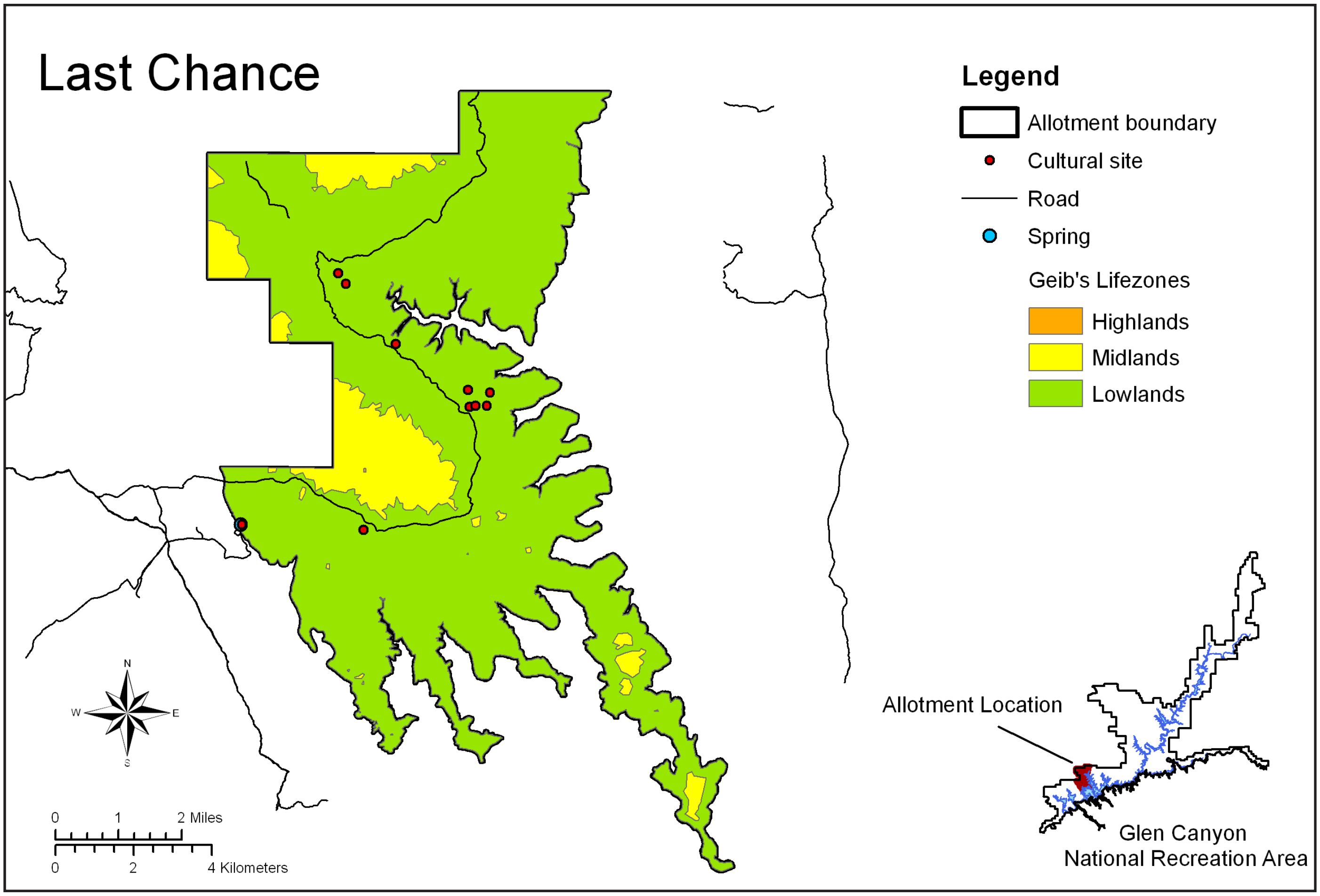
Survey Zones Dictated by Slope:

Excessive slope, particularly west of County Hwy 230 and along the eastern edge of the allotment, may prohibit pedestrian survey in those areas. However, areas within Last Chance allotment should be easily accessible from the highway. Transects placed perpendicular to the road are recommended whenever possible.

The 'fishnet' maps provided on the subsequent page display transects spaced at 200 meter intervals for both east-west and north-south oriented pedestrian survey.


Last Chance
Legend
Allotment boundary
Cultural site
Road
Transect boundary
Spring
Elevation (meters)
High : 1681.78
Low : 1103.92
Allotment Location
Glen Canyon
National Recreation Area
N
W
E
S
0
1
2 Miles
0
2
4 Kilometers


Last Chance
Legend
Allotment boundary
Cultural site
Road
Transect boundary
Spring
Elevation (meters)
High : 1681.78
Low : 1103.92
Allotment Location
Glen Canyon
National Recreation Area
N
W
E
S
0
1
2 Miles
0
2
4 Kilometers



Area of Each Lifezone:

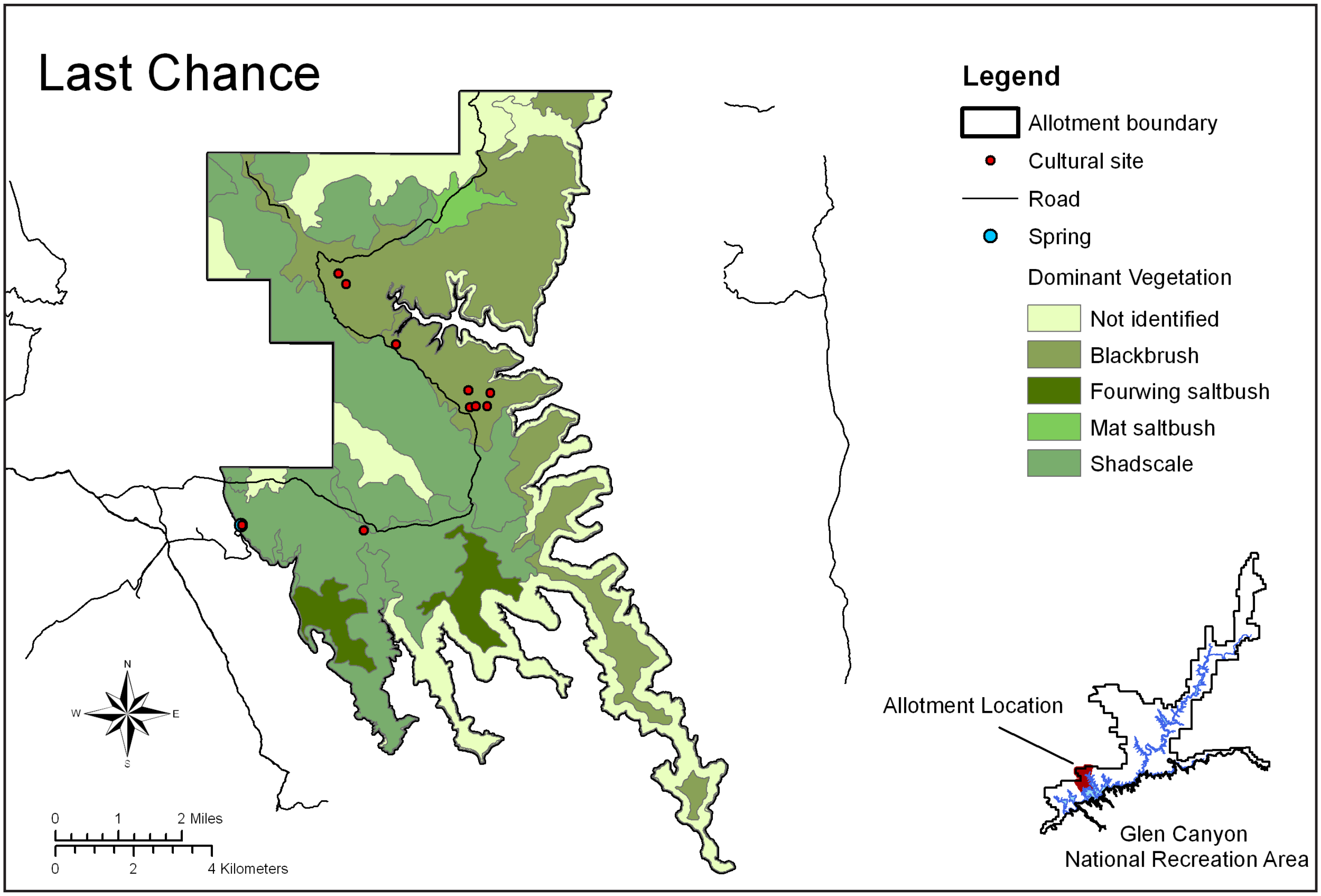
Highlands: 1.33 acres
Midlands: 3048.28 acres
Lowlands: 23,916.54 acres

No. Cultural Sites in Each Lifezone:

Highlands: 0
Midlands: 0
Lowlands: 10

Lifezone Significance and Known Cultural Sites: Although all of Geib's lifezones are present in Last Chance grazing allotment, all known cultural sites (n = 10) occur in the Lowlands. Geib describes the lowlands as hot and arid, but containing permanent water sources, arable alluvium, and long growing seasons suitable to agriculture. In addition, diverse plant communities, natural shelters, and raw materials suitable to the manufacture of stone tools were also available to prehistoric people in the lowlands.

	Elevation	Characteristics	Environment	Significance to Humans
Lowlands	1219-1372 m (4000-4500 ft)	Hot and arid steep-walled sandstone canyons.	Riparian plants; big-horn sheep	Permanent water, arable alluvium, long growing season, diverse plant communities, natural shelters, quality siliceous stone from river gravels
Midlands	1372-1676 m (4500-5500 ft)	Arid slickrock and dune fields on benchlands and low plateaus.	Blackbrush, shadscale, grasses; antelope.	Grasses, including dropseed and ricegrass, prickly pear and shadscale; good antelope habitat, quality siliceous stone in certain locations.
Highlands	Above 1676 m (Above 5500 ft)	High elevation mesas and plateaus with cooler temperatures and greater precipitation.	Pinyon-juniper woodlands; deer and rabbit.	Higher elevation plant foods (i.e. pinyon); later harvests; dry-farming; abundant fuel, deer and rabbit.
Shading indicates lifezones present in allotment.				



Area of Individual Vegetation Zones:

Dominant Species	Acres Covered	No. Sites
Not identified	6950.85	0
Blackbrush (*Coleogyne ramosissima*)	7810.90	8
Fourwing saltbush (*Atriplex canescens*)	1265.68	0
Mat saltbush (*Atriplex corrugata*)	348.74	0
Shadscale (*Atriplex confertifolia*)	10,692.19	2
Total	**27,068.36**	**10**

No. Cultural Sites in Each Vegetation Zone:
Eight sites (n =8) sites are located in blackbrush. The remaining two (n = 2) sites are located in shadscale..

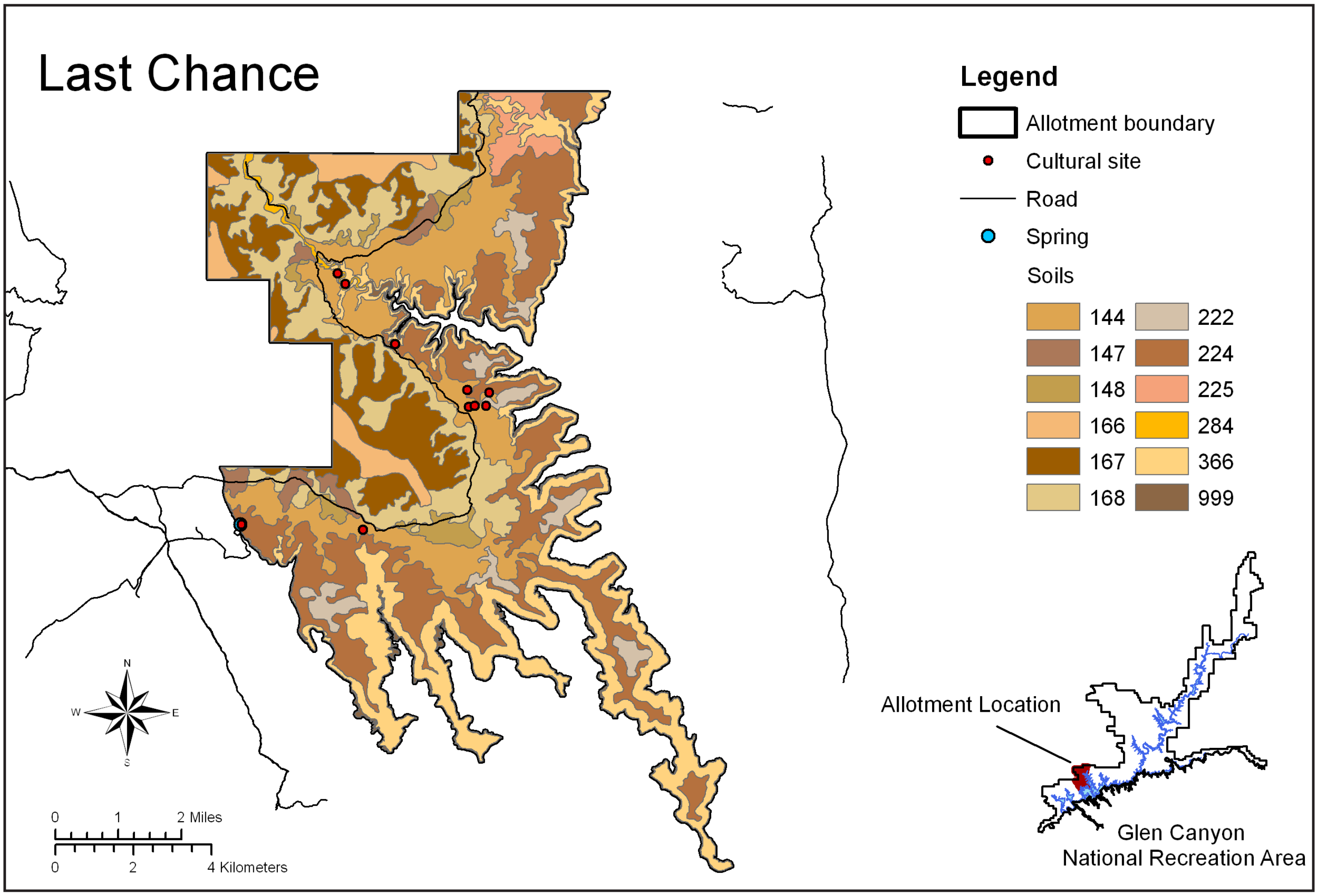
Visibility:
In general, the dominant vegetative communities of the allotment provide moderate - excellent ground visibility, with large portions of the ground between plants bare of vegetation.

Summary:
The primary dominant vegetation zones within the Last Chance grazing allotment include blackbrush (28.56 percent), fourwing saltbush (4.68 percent), mat saltbush (1.29 percent), and shadscale (39.50 percent). Dominant vegetation for the remainder of the allotment is not currently known.

Dominant Species:
Fourwing saltbush (*Atriplex canescens*)
Blackbrush (*Coleogyne ramosissima*)
Shadscale (*Atriplex confertifolia*)
Mat saltbush (*Atriplex corrugata*)

Secondary Dominant Species:
Torrey Mormon tea (*Ephedra torreyana*)

Associated Soils:
Blackbrush grows primarily in shallow sandy loam. Fourwing saltbush occurs in rocky sandy loam, where it may be associated with blackbrush in shallow sandy loam. Mat saltbush grows in shallow clay. Finally, shadscale occurs in stony loam, and in shallow loam, where it occurs with mat saltbush in shallow clay Torrey Mormon tea in very shallow gypsum.

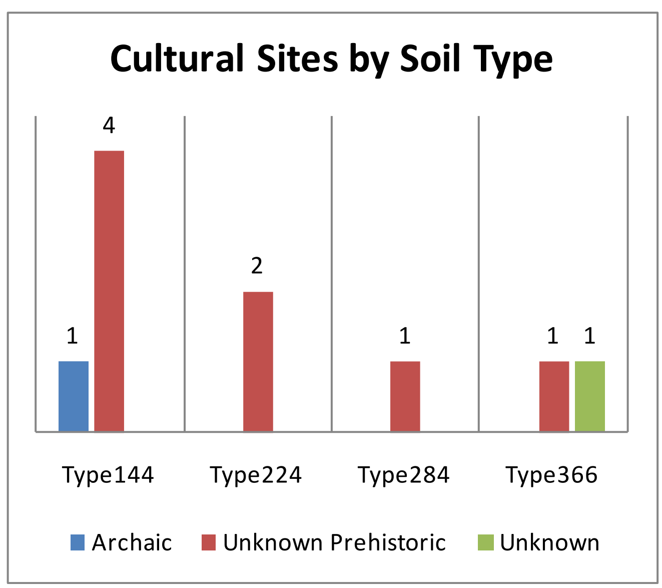


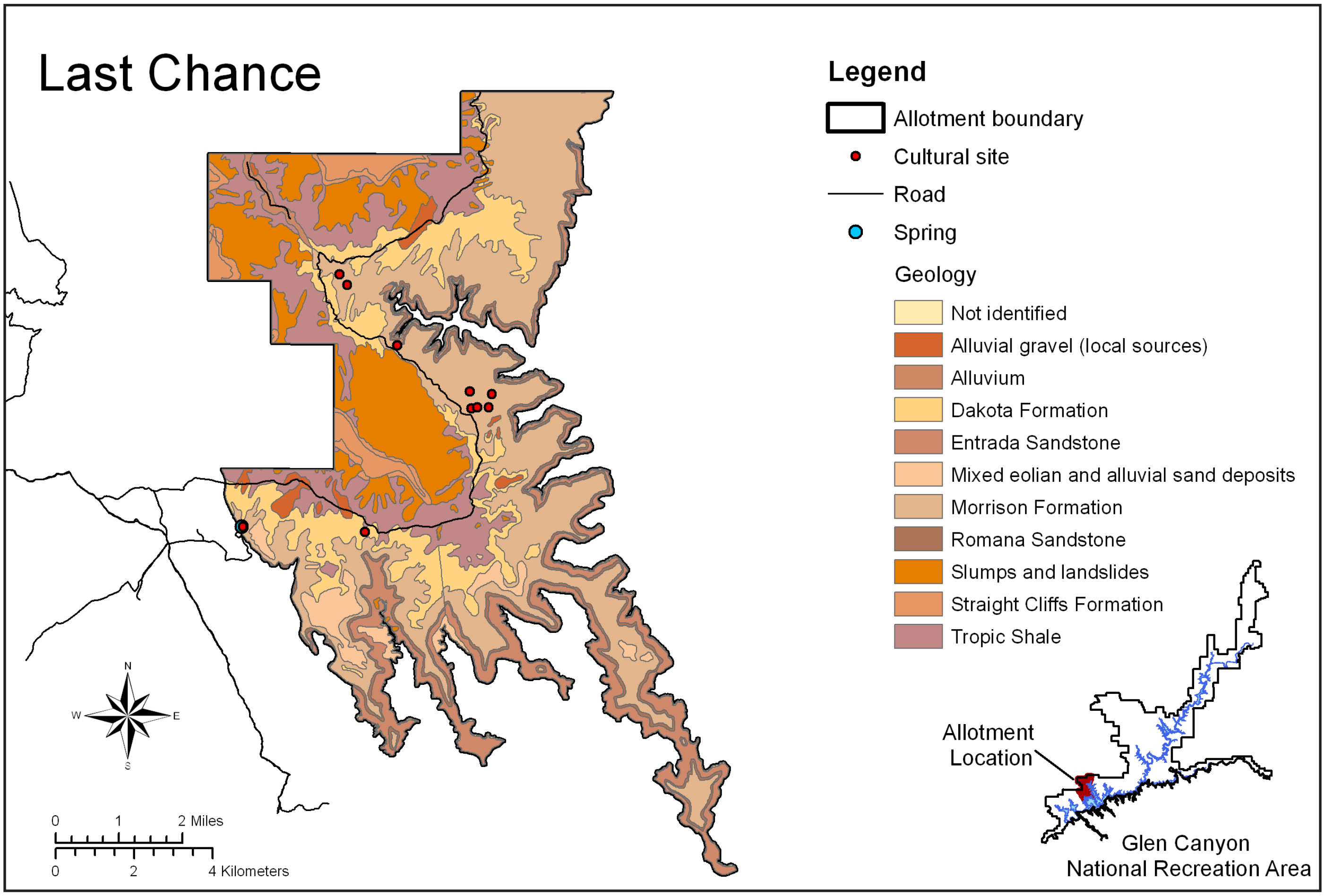
Allotment Divided by Soil Type (MUSYM):

Soil Type	Acres	Percent	No. Cultural Sites
144	4407.54	16.28	5
147	494.22	1.83	0
148	660.11	2.44	0
166	1030.21	3.81	0
167	3320.32	12.27	0
168	4089.81	15.11	0
222	1030.47	3.81	0
224	5701.64	20.64	2
225	456.99	1.69	0
284	143.47	0.53	1
366	5387.93	19.90	2
999	345.65	1.96	0
Total	**27,068.36**	**100.27%**	**10**

Distribution of Cultural Sites by Soil Type:

Five sites (n = 5), including one Archaic site, and four currently unaffiliated prehistoric sites, including one site with a hearth, a lithic scatter, and two artifact scatters occur in soil type 144. Two (n = 2) currently unaffiliated prehistoric sites, including one with features, and one lithic scatter, occur in soil type 224. One (n = 1) currently unaffiliated prehistoric site with features is located in soil type 284. The remaining two (n = 2) sites include a prehistoric site for which affiliation/attribute information is not known, and a site for which no information is currently available, occur in soil type 366.



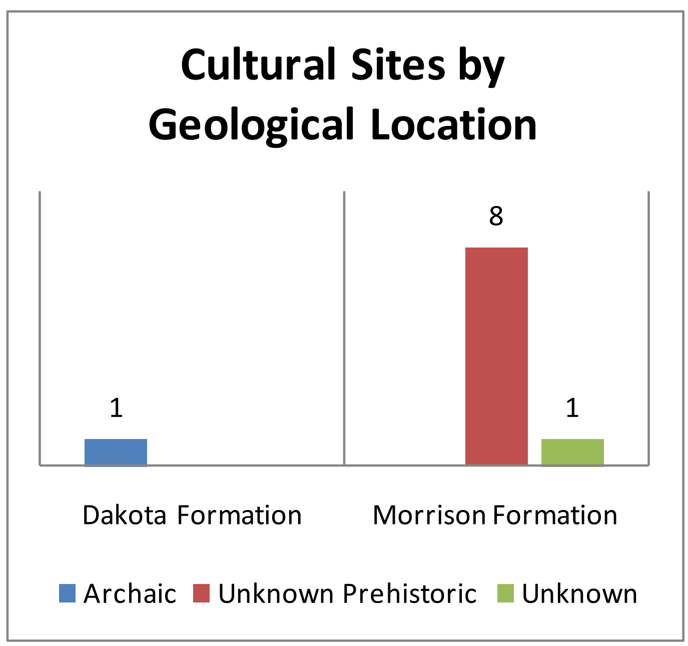


Allotment Divided by Geology:

Geology	Acres	Percent	No. Cultural Sites
Not identified	196.67	0.73	0
Alluvial gravel (local sources)	380.94	1.41	0
Alluvium	157.51	0.58	0
Dakota Formation	3519.75	13.00	1
Entrada Sandstone	3075.84	11.36	0
Mixed eolian and alluvial sand deposits	826.11	3.05	0
Morrison Formation	8944.49	33.04	9
Romana Sandstone	1236.22	4.57	0
Slumps and landslides	3930.31	14.52	0
Straight Cliffs Formation	1010.82	3.73	0
Tropic Shale	3789.70	14.00	0
Total	**27,068.36**	**99.99%**	**10**

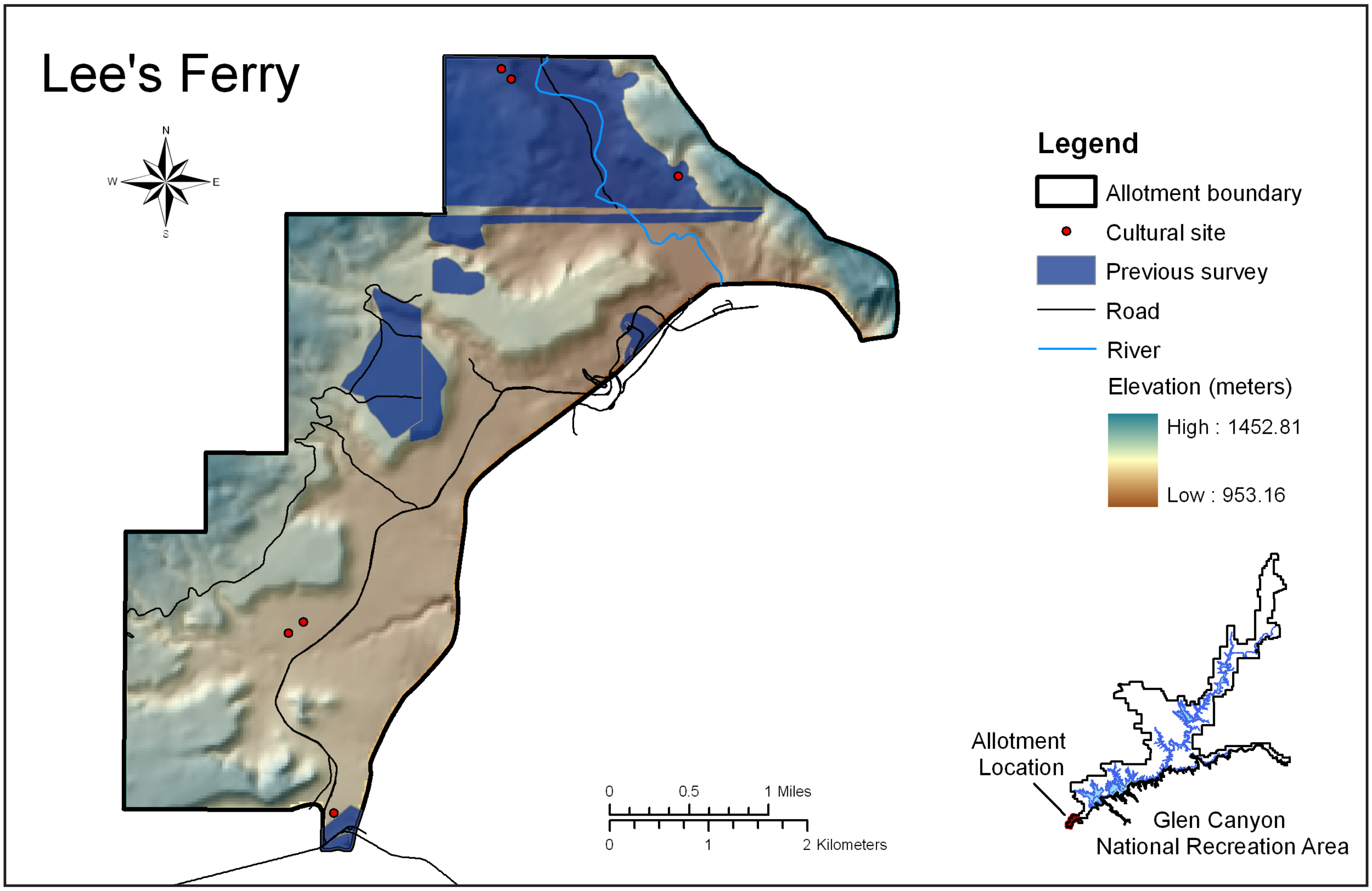
Distribution of Cultural Sites by Geological Location:

A single Archaic site (n =1) is located on Dakota Formation geology. The remaining sites (n = 9) are located on Morrison Formation geology. These sites include three lithic scatters, one artifact scatter, three sites with features, one prehistoric site with no additional information, and one site for which affiliation/attribute information is not currently available.



Lee's Ferry

Map Panels



Total Area: 6231.48 acres

Sampling Fractions:
2 percent: 124.63 acres
5 percent: 311.57 acres
11 percent: 685.46 acres
16 percent: 997.04 acres
20 percent: 1246.30 acres

Elevation range amsl:
953.16 – 1452.81 meters (3127.17 - 4766.44 feet)

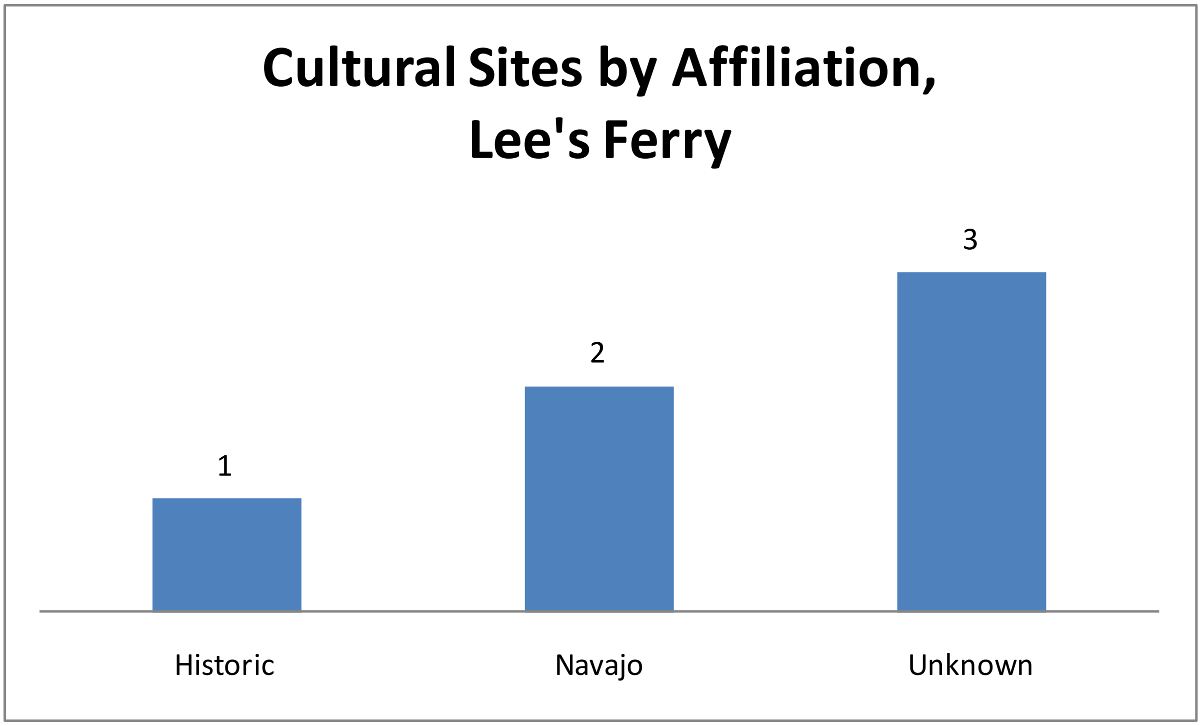
Rivers and Springs:
Paria River crosses from southeast to northwest through the northern portion of the allotment.

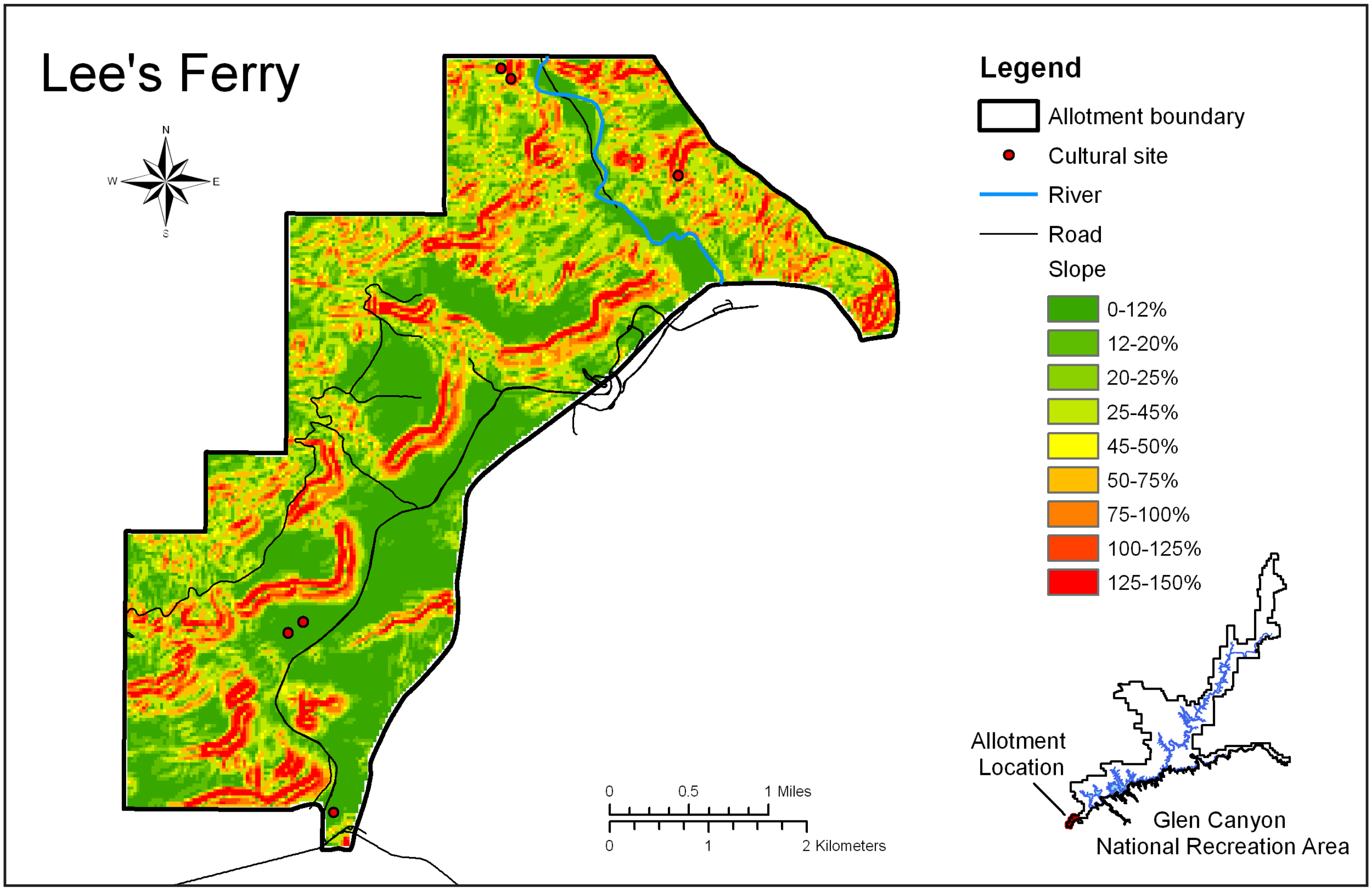
Accessibility:
State Alt Hwy 89 provides access to both the allotment and the location of Lee's Ferry, where a ranger station and camping are both located. Navajo Bridge Interpretive Center and Marble Canyon are both located at the southern tip of the allotment. Finally, lateral roadways provide access the interior of the allotment.

No. Cultural Sites: 6
Area surveyed: 1223.37 acres

Survey References:
Geib (n.d.): 221.24 acres
Geib (1986): 974.63 acres
Janus & Assoc. (1987): 0.59 acres
Janus & Assoc. (1988): 29.13 acres
Kincaid (n.d.): 26.13 acres
Kincaid (1988e): 0.05 acres
Kincaid (1988g): 0.04 acres
Kincaid (2003): 0.53 acres
Leap and Neal (1992): 0.34 acres
Stone (1988): 7.18 acres
Succec (2008): 0.11 acres

The figure on the subsequent page depicts known cultural sites by affiliation. As the information available is minimal, only one figure is included for this allotment.


Cultural Sites by Affiliation, Lee's Ferry
1
2
3
Historic
Navajo
Unknown



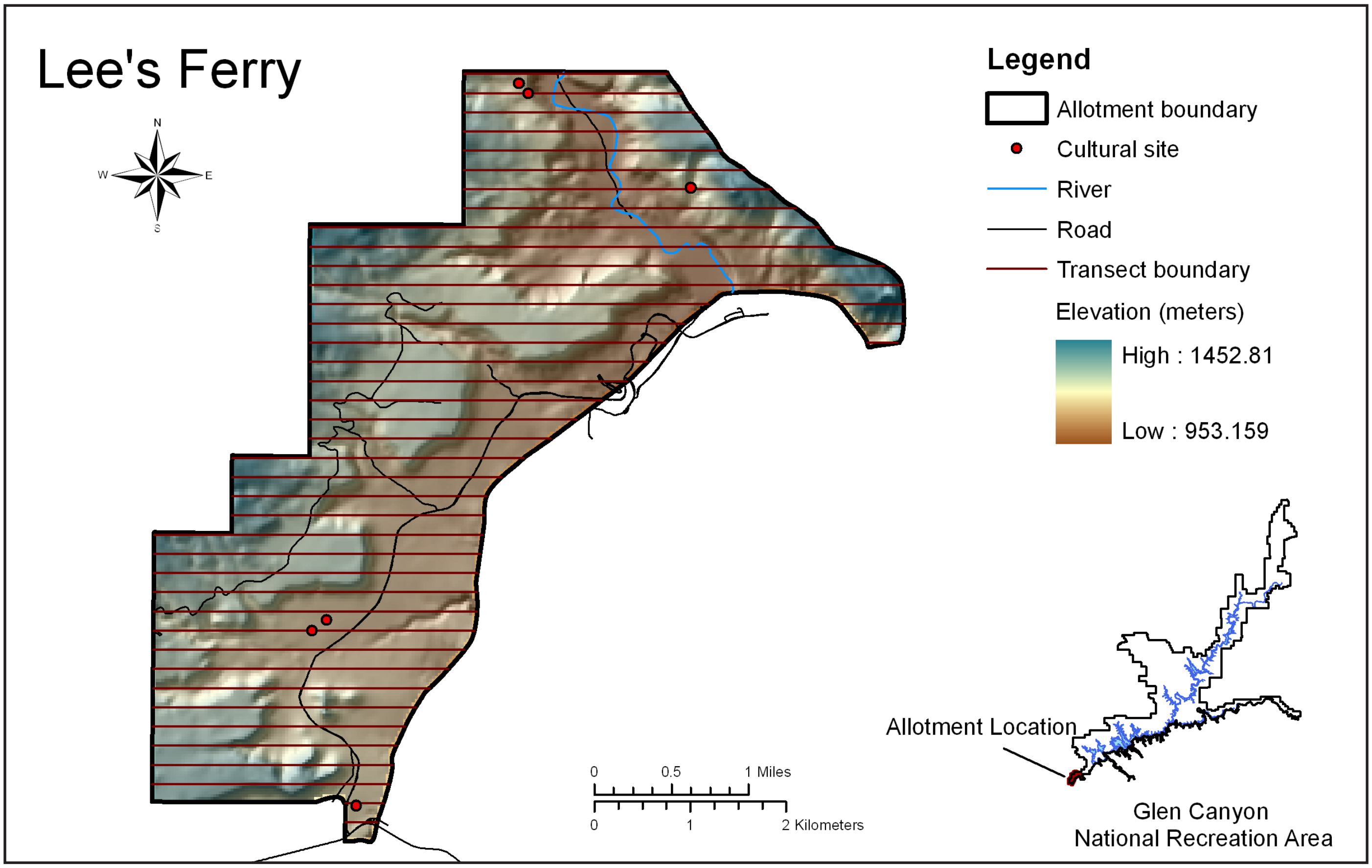
Slope Considerations:

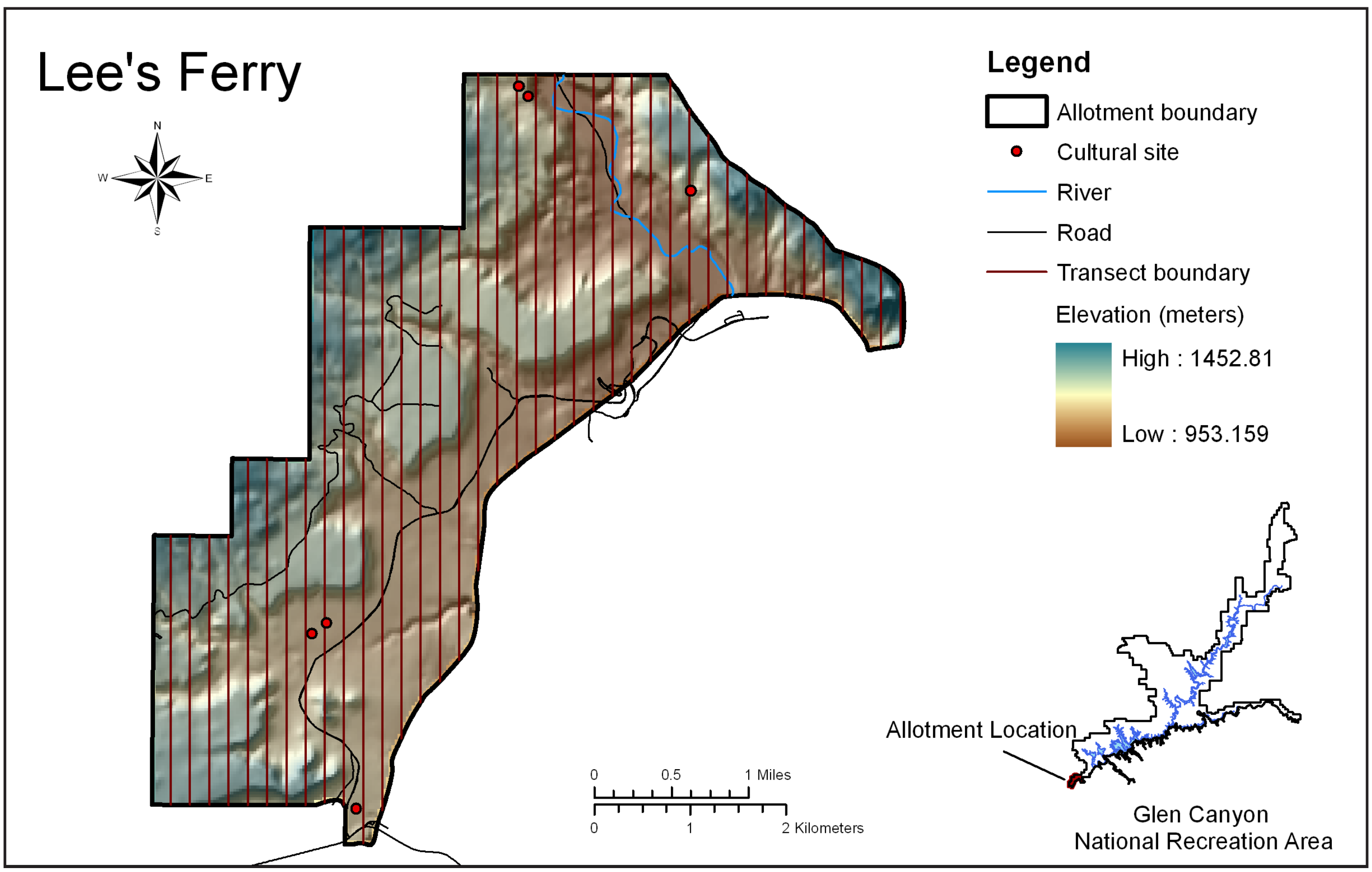
Slope plays a large role in terrain accessibility, and may be used in the stratification of survey areas. For example, GCNRA may wish to assign catagories such as low, moderate, and high to specific slope gradients. Such assignations are most often dependent on the factors guiding archaeological survey work, and as such, are not included in this document. Included herein, however, are suggestions for basic transect orientation based on the presence of topographical barriers identified by the presence of excessive slope gradients.

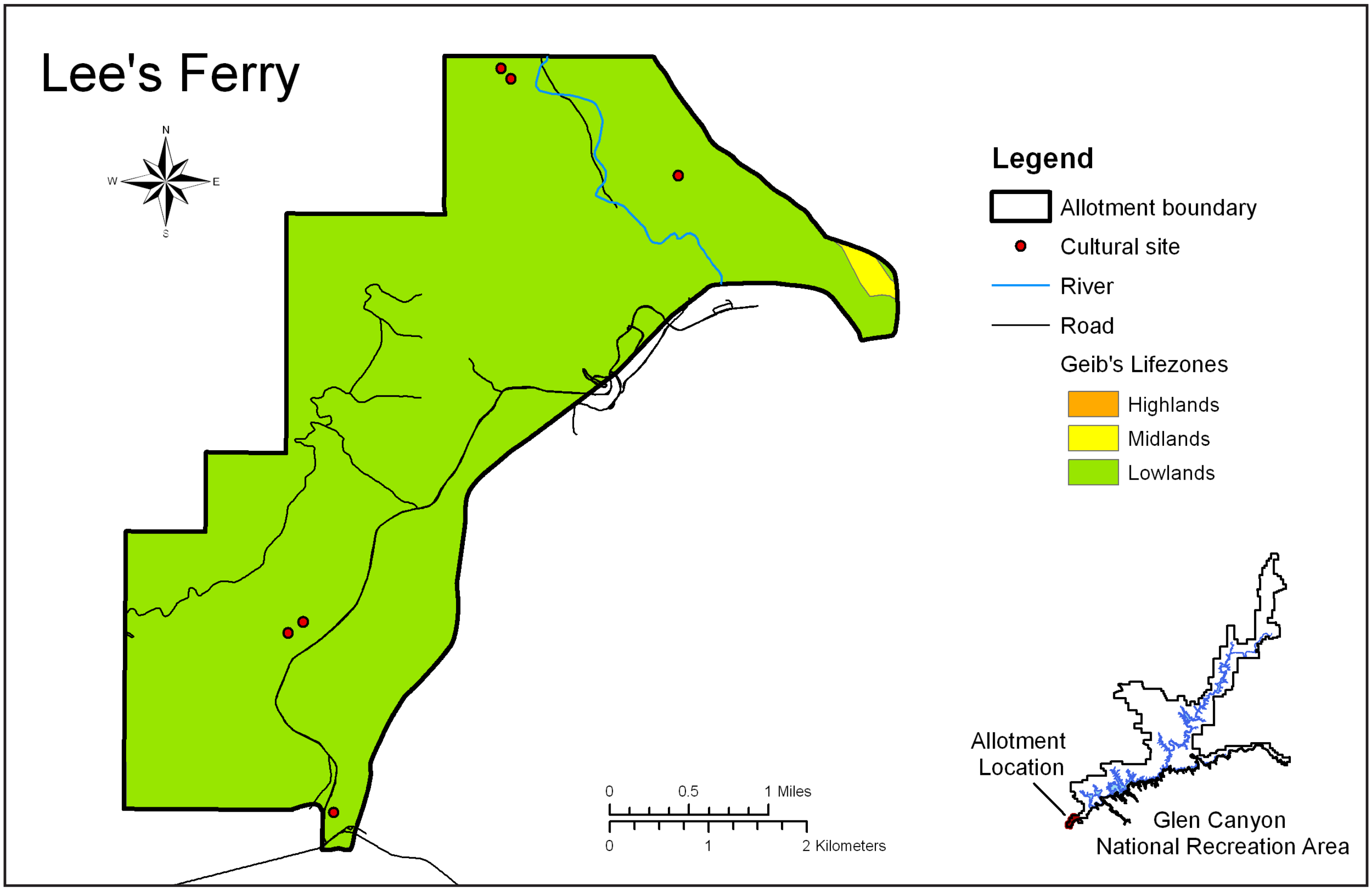
Survey Zones Dictated by Slope:

Although the eastern side of Lee's Ferry grazing allotment is relatively level, the western side is comprised of a series of uplifted mesas, the escarpments of which may provide some accessibility problems, particularly when lateral roadways are not present. However, main roads provide access to much of the allotment, and whenever possible, it is recommended that transects be set perpendicular to these roads.

The 'fishnet' maps provided on the subsequent page display transects spaced at 200 meter intervals for both east-west and north-south oriented pedestrian survey.


Lee's Ferry
N
W
E
S
Legend
Allotment boundary
Cultural site
River
Road
Transect boundary
Elevation (meters)
High : 1452.81
Low : 953.159
0
0.5
1 Miles
0
1
2 Kilometers
Allotment Location
Glen Canyon
National Recreation Area


Lee's Ferry
N
W
E
S
Legend
Allotment boundary
Cultural site
River
Road
Transect boundary
Elevation (meters)
High : 1452.81
Low : 953.159
0
0.5
1 Miles
0
1
2 Kilometers
Allotment Location
Glen Canyon
National Recreation Area



Area of Each Lifezone:

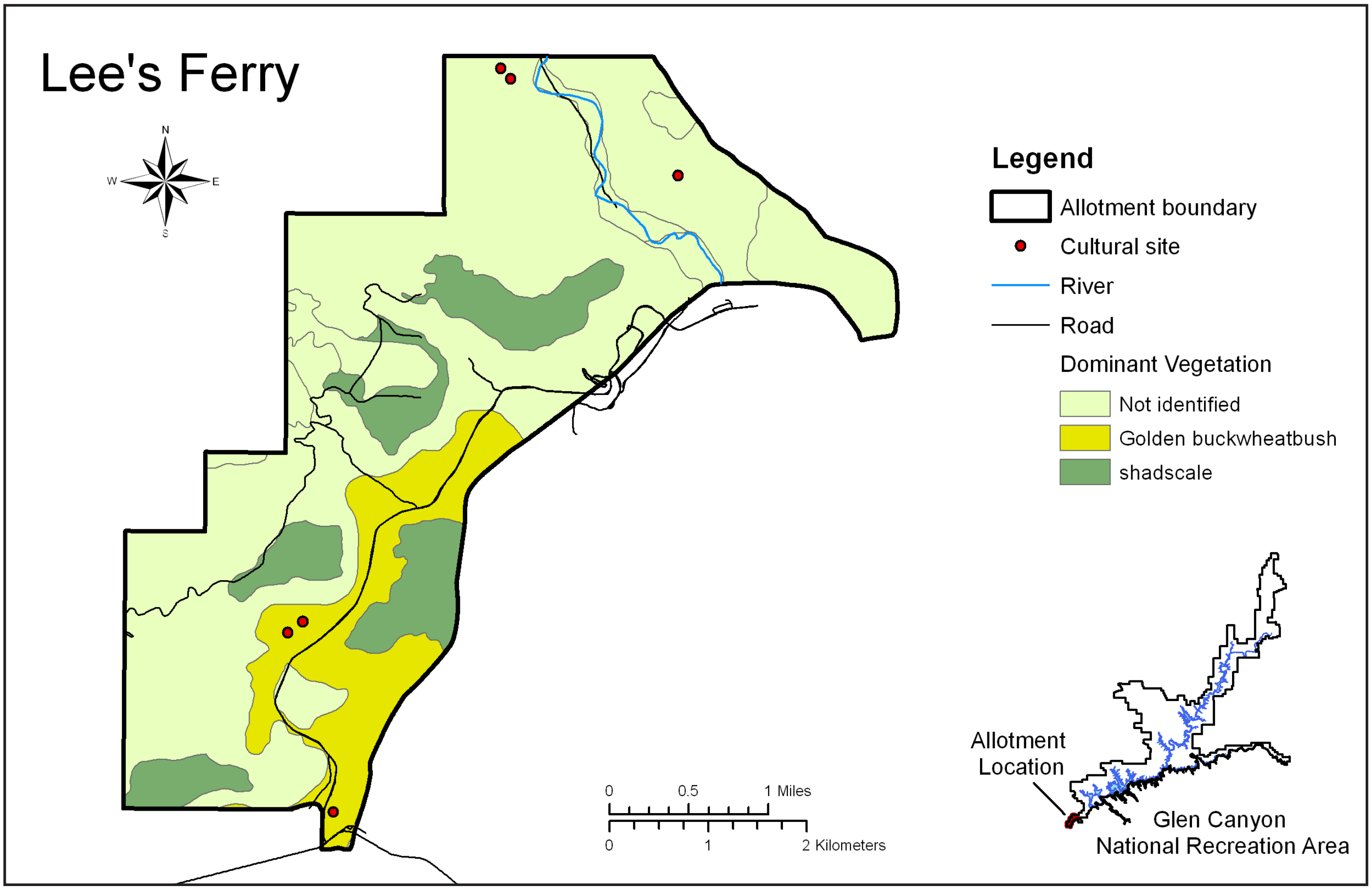
Highlands: 0.00 acres
Midlands: 38.50 acres
Lowlands: 6174.44 acres

No. Cultural Sites in Each Lifezone:

Highlands: 0
Midlands: 0
Lowlands: 6

Lifezone Significance and Known Cultural Sites: Although both Geib's Midland and Lowland zones are present in Lee's Ferry grazing allotment, all known cultural sites (n = 6) occur in the lowlands. Geib describes the lowlands as hot and arid, but containing permanent water sources, arable alluvium, and long growing seasons suitable to agriculture. In addition, diverse plant communities, natural shelters, and raw materials suitable to the manufacture of stone tools were also available to prehistoric people in the lowlands.

	Elevation	Characteristics	Environment	Significance to Humans
Lowlands	1219-1372 m (4000-4500 ft)	Hot and arid steep-walled sandstone canyons.	Riparian plants; bighorn sheep	Permanent water, arable alluvium, long growing season, diverse plant communities, natural shelters, quality siliceous stone from river gravels
Midlands	1372-1676 m (4500-5500 ft)	Arid slickrock and dune fields on benchlands and low plateaus.	Blackbrush, shadscale, grasses; antelope.	Grasses, including dropseed and ricegrass, prickly pear and shadscale; good antelope habitat, quality siliceous stone in certain locations.
Highlands	Above 1676 m (Above 5500 ft)	High elevation mesas and plateaus with cooler temperatures and greater precipitation.	Pinyon-juniper woodlands; deer and rabbit.	Higher elevation plant foods (i.e. pinyon); later harvests; dry-farming; abundant fuel, deer and rabbit.
Shading indicates lifezones present in allotment.				



Area of Individual Vegetation Zones:

Dominant Species	Acres Covered	No. Sites
Not identified	4470.76	3
Golden buckwheatbush (*Eriogonum corymbosum)*	884.22	3
Shadscale (*Atriplex confertifolia)*	876.50	0
Total	**6231.48**	**6**

No. Cultural Sites in Each Vegetation Zone:
Three (n = 3) sites occur in golden buckwheatbush, including the historic site (n = 1) and both Navajo sites (n = 2). The remaining sites (n = 3) are located in areas where the dominant vegetation has not yet been identified.

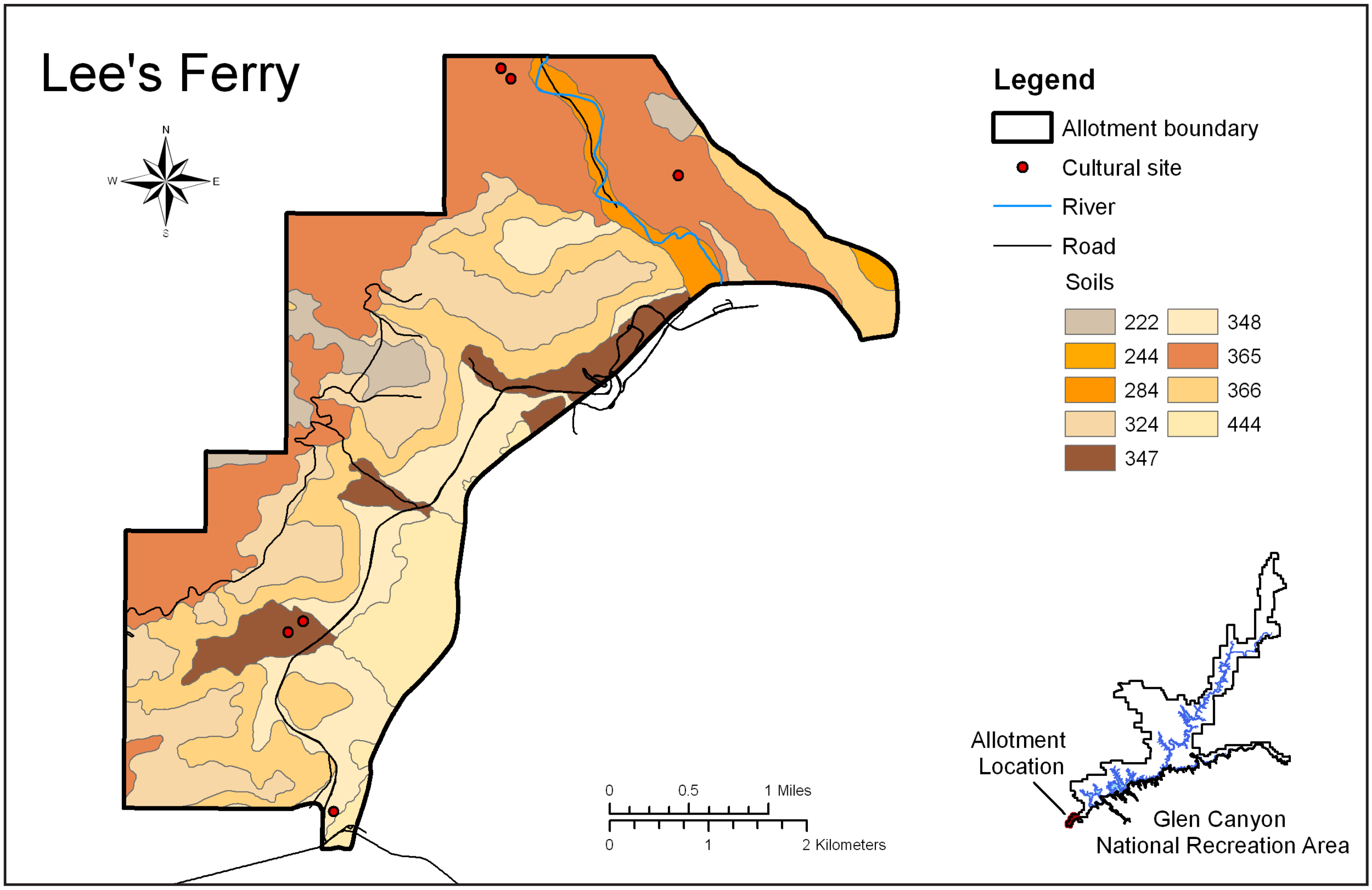
Visibility:
In general, the dominant vegetative communities of the allotment provide moderate - excellent ground visibility, with large portions of the ground between plants bare of vegetation. However, dominant vegetation for the majority of the allotment has not yet been identified, and visibility for those areas is not currently known.

Summary:
Golden buckwheatbush accounts for the dominant vegetation in 14.19 percent of the allotment, and shadscale for 14.07 percent. Dominant vegetation for the majority (71.66 percent) of the allotment remains unidentified.

Dominant Species:
Golden buckwheatbush (*Eriogonum corymbosum*)
Shadscale (*Atriplex confertifolia*)

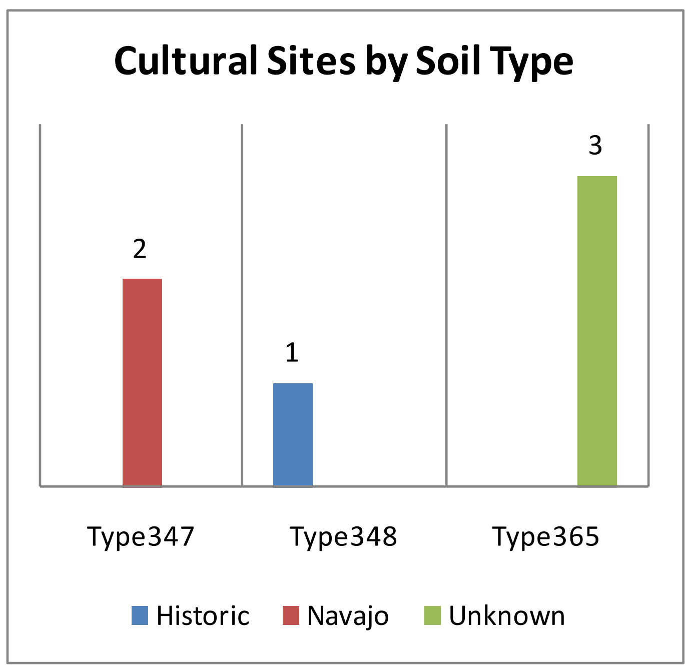
Secondary Dominant Species:
None known.

Associated Soils:
Golden buckwheatbush, which has limited distribution in GCNRA, grows primarily in gypsum hills. Shadscale in Lee's Ferry occurs in lime, rather than the loam it typically grows in.



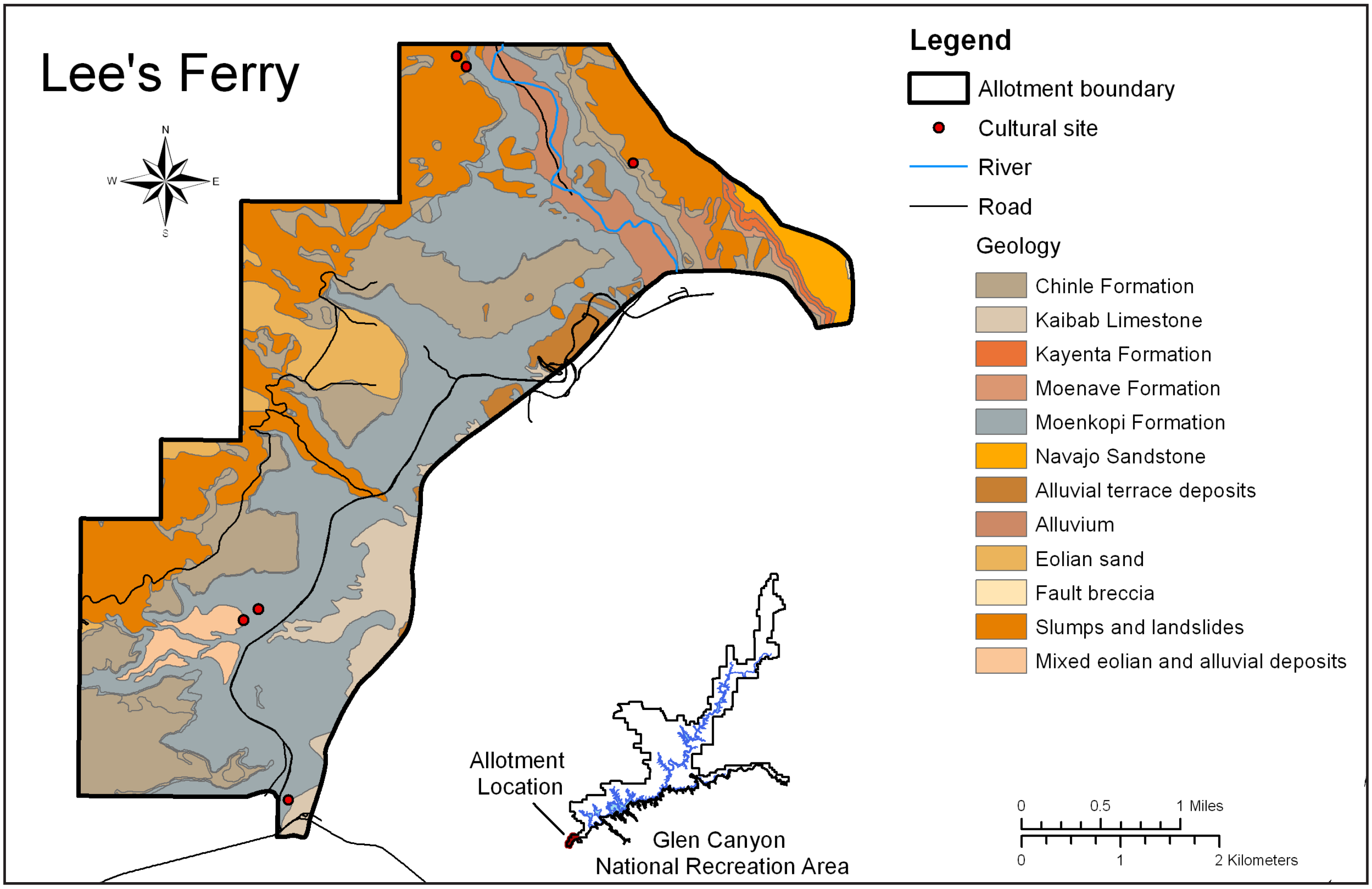
Allotment Divided by Soil Type (MUSYM):

Soil Type	Acres	Percent	No. Cultural Sites
Not identified	40.09	0.64	0
222	220.45	3.54	0
244	27.28	0.44	0
284	173.77	2.79	0
324	1139.56	18.29	0
347	383.74	6.52	2
348	728.28	11.69	1
365	1808.94	29.03	3
366	1313.35	21.08	0
444	396.02	6.36	0
Total	6231.48	100.38%	6



Distribution of Cultural Sites by Soil Type:

Both Navajo (n = 2) sites occur in soil type 347. The single historic site occurs in soil type 348. The remaining sites (n = 3), for which attribute/affiliation information is currently unavailable, occur in soil type 365.

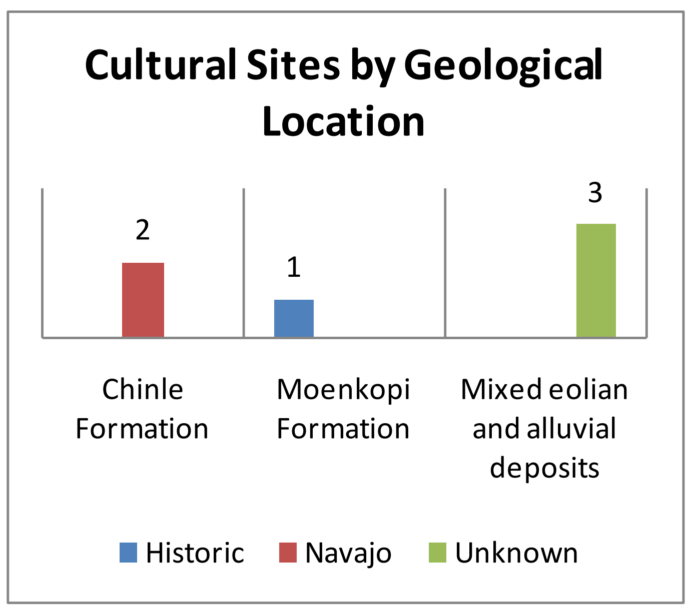


Allotment Divided by Geology:

Geology	Acres	Percent	No. Cultural Sites
Chinle Formation	1349.16	21.65	1
Kaibab Limestone	274.75	4.41	0
Kayenta Formation	45.49	0.73	0
Moenave Formation	19.75	0.32	0
Moenkopi Formation	2260.39	36.27	2
Navajo Sandstone	118.63	1.90	0
Alluvial terrace deposits	124.62	2.00	0
Alluvium	269.51	4.33	0
Eolian sand	279.03	4.48	0
Fault breccia	2.18	<0.00	0
Slumps and landslides	1382.70	22.19	2
Mixed eolian and alluvial deposits	105.08	1.68	1
Total	**6231.29**	**99.96**	**6**

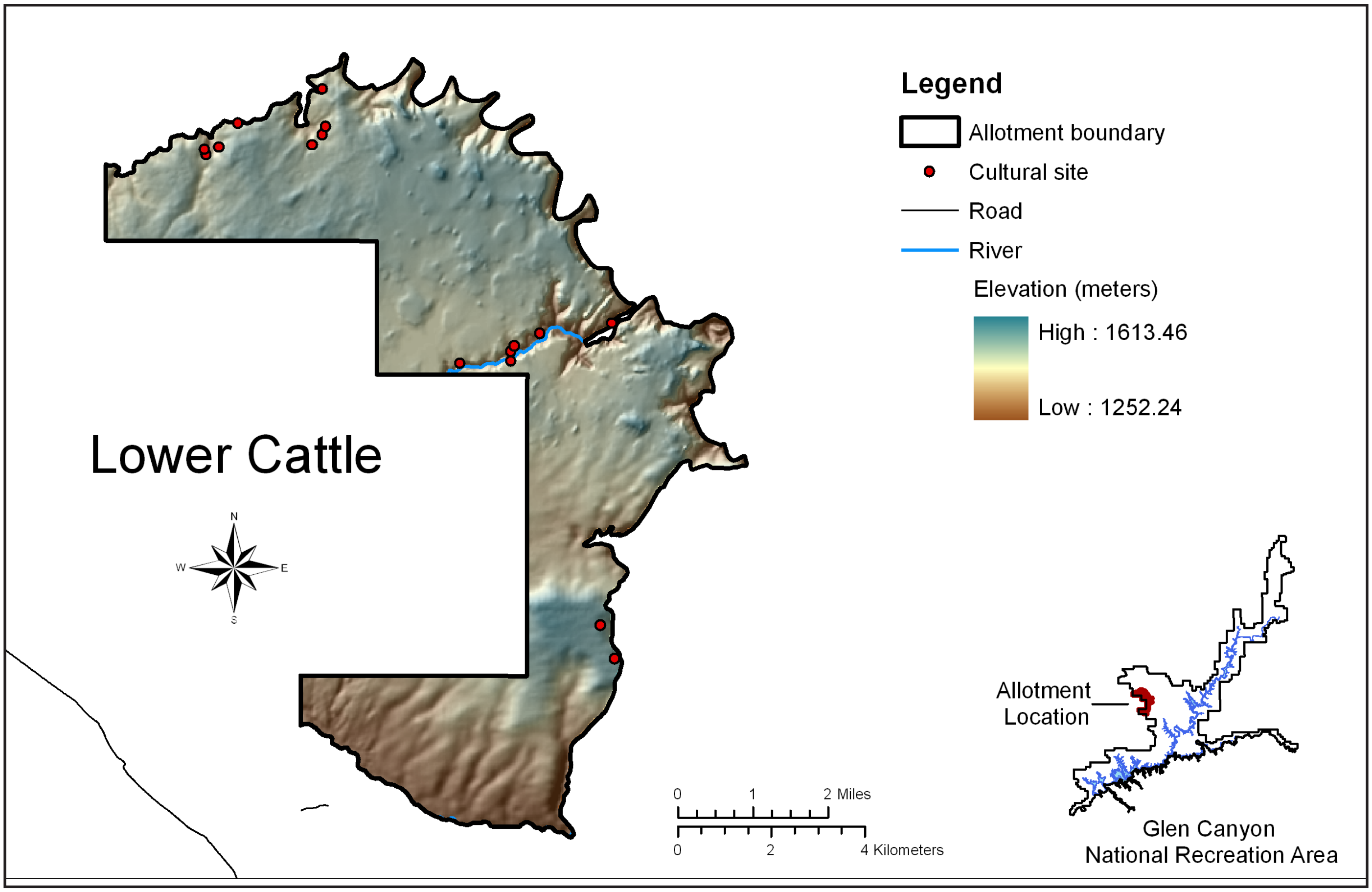
Distribution of Cultural Sites by Geological Location:

A single site (n = 1) for which attribute/affiliation information is not currently available is located on the Chinle Formation. Two (n = 2) sites, including a historic site and a Navajo hogan occur on Moenkopi Formation geology. Two sites (n = 2) for which affiliation/attribute information is not currently available occur on slumps and landslide deposits. The remaining site (n = 1) is located on mixed eolian and alluvial deposits, and consists of a Navajo structure and artifacts.



Lower Cattle

Map Panels



Total Area: 18,740.22 acres

Sampling Fractions:
2 percent: 374.80 acres
5 percent: 937.01 acres
11 percent: 2061.42 acres
16 percent: 2998.44 acres
20 percent: 3748.04 acres

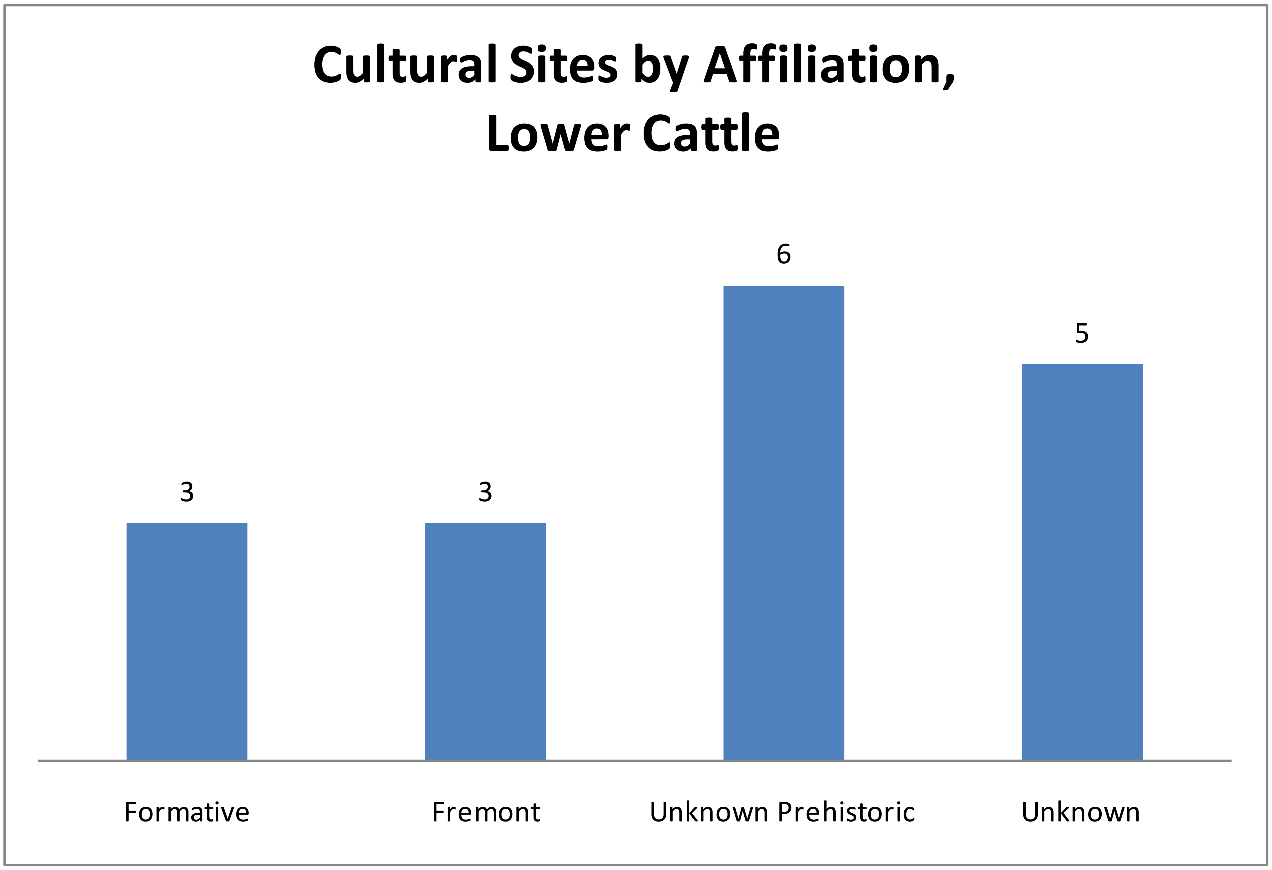
Elevation range amsl:
1252.24 – 1613.46 meters (4108.40 - 5293.50 feet)

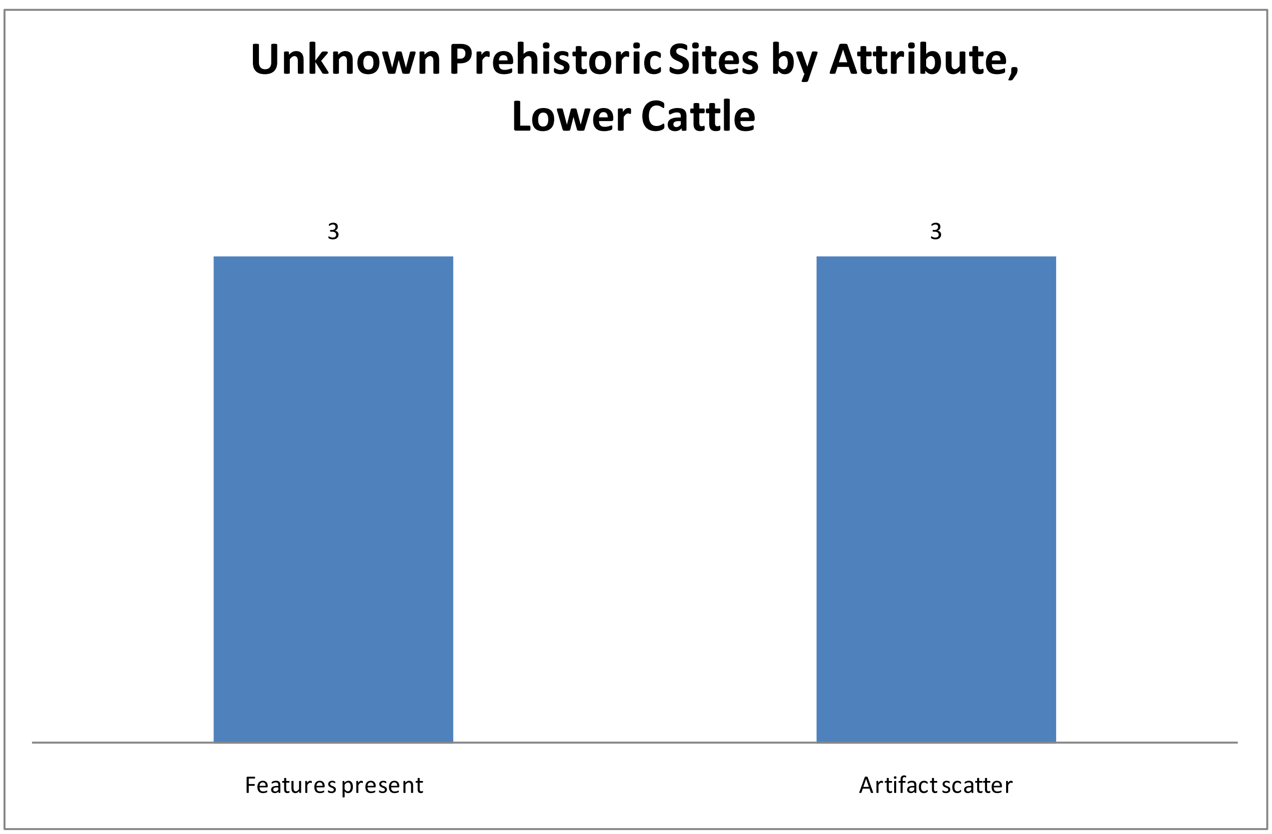
Rivers and Springs:
An ephemeral stream or creek runs through Scorpion Gulch. Twentyfivemile Wash (not depicted) forms the northern boundary of the allotment, and the Escalante River (not depicted) forms the eastern boundary.

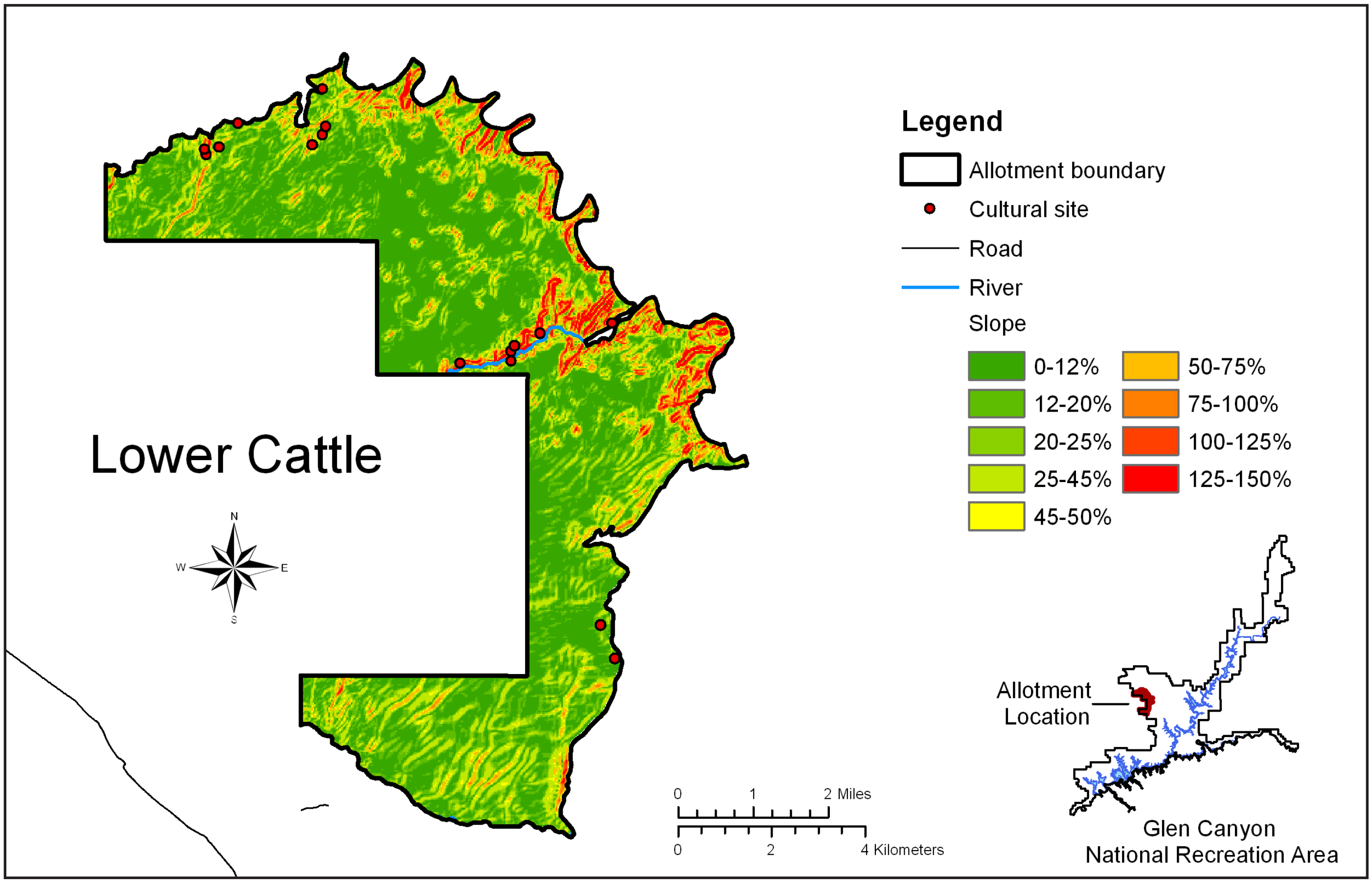
Accessibility:
Hole-in-the-Rock Road (County Hwy 330) is located to the west of the allotment, and although none are depicted, laterals likely provide access to the allotment interior.

No. Cultural Sites: 17
Area surveyed: 0.00 acres

The figures on the subsequent page depict cultural sites by affiliation, and for those prehistoric sites for which affiliation is not known, site attributes.


Cultural Sites by Affiliation,
Lower Cattle
3
3
6
5
Formative
Fremont
Unknown Prehistoric
Unknown


Unknown Prehistoric Sites by Attribute,
Lower Cattle
3
3
Features present
Artifact scatter



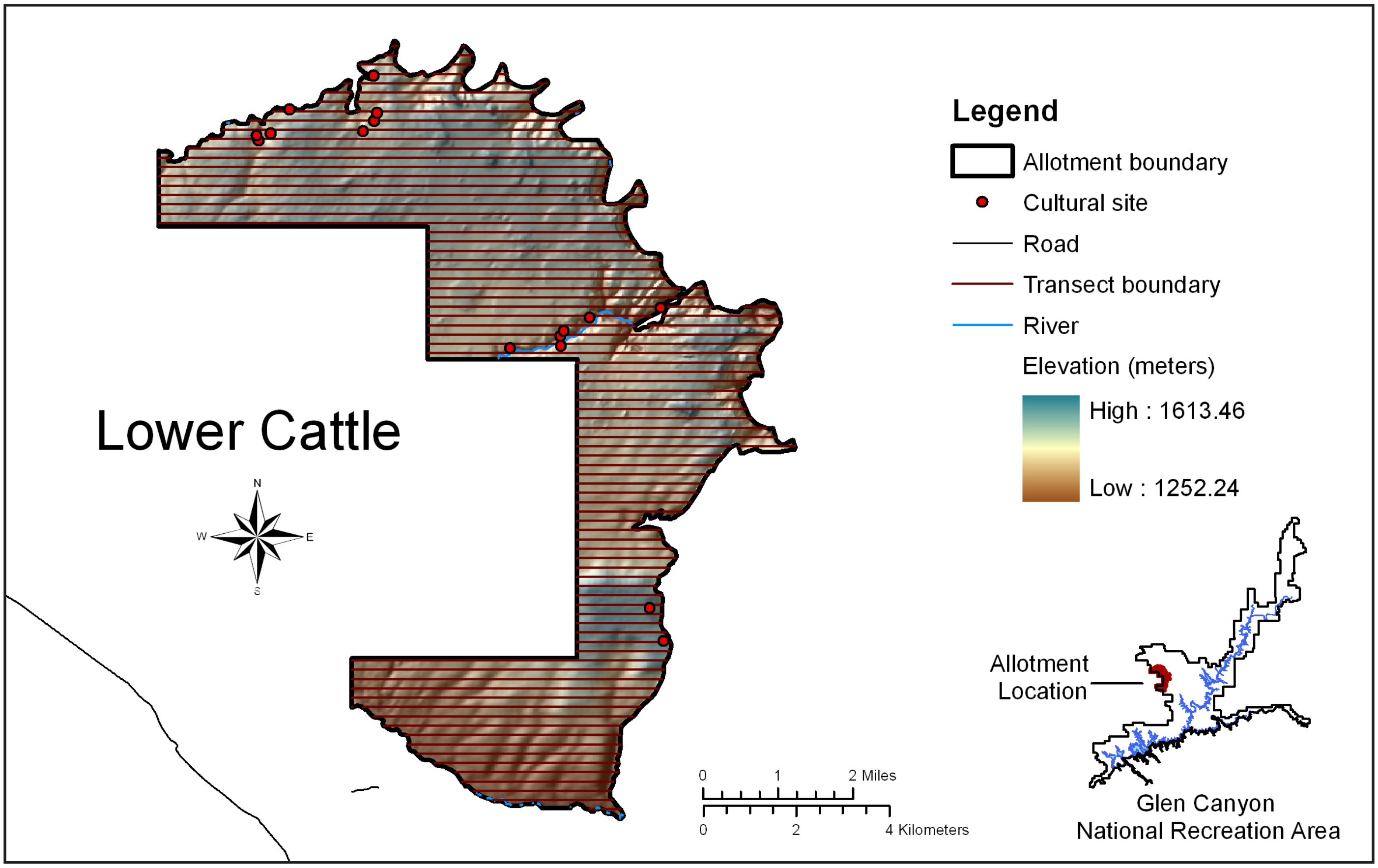
Slope Considerations:

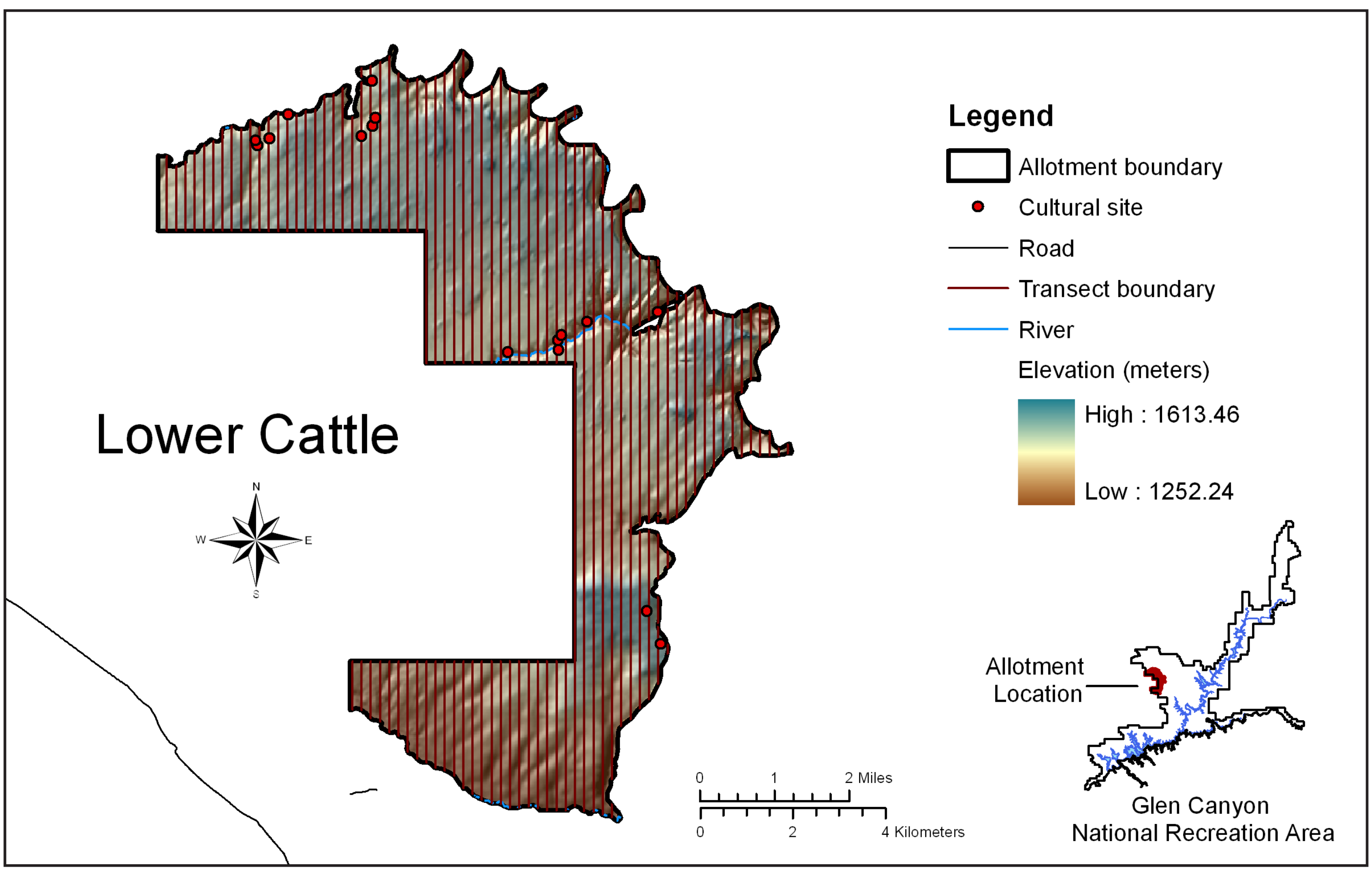
Slope plays a large role in terrain accessibility, and may be used in the stratification of survey areas. For example, GCNRA may wish to assign catagories such as low, moderate, and high to specific slope gradients. Such assignations are most often dependent on the factors guiding archaeological survey work, and as such, are not included in this document. Included herein, however, are suggestions for basic transect orientation based on the presence of topographical barriers identified by the presence of excessive slope gradients.

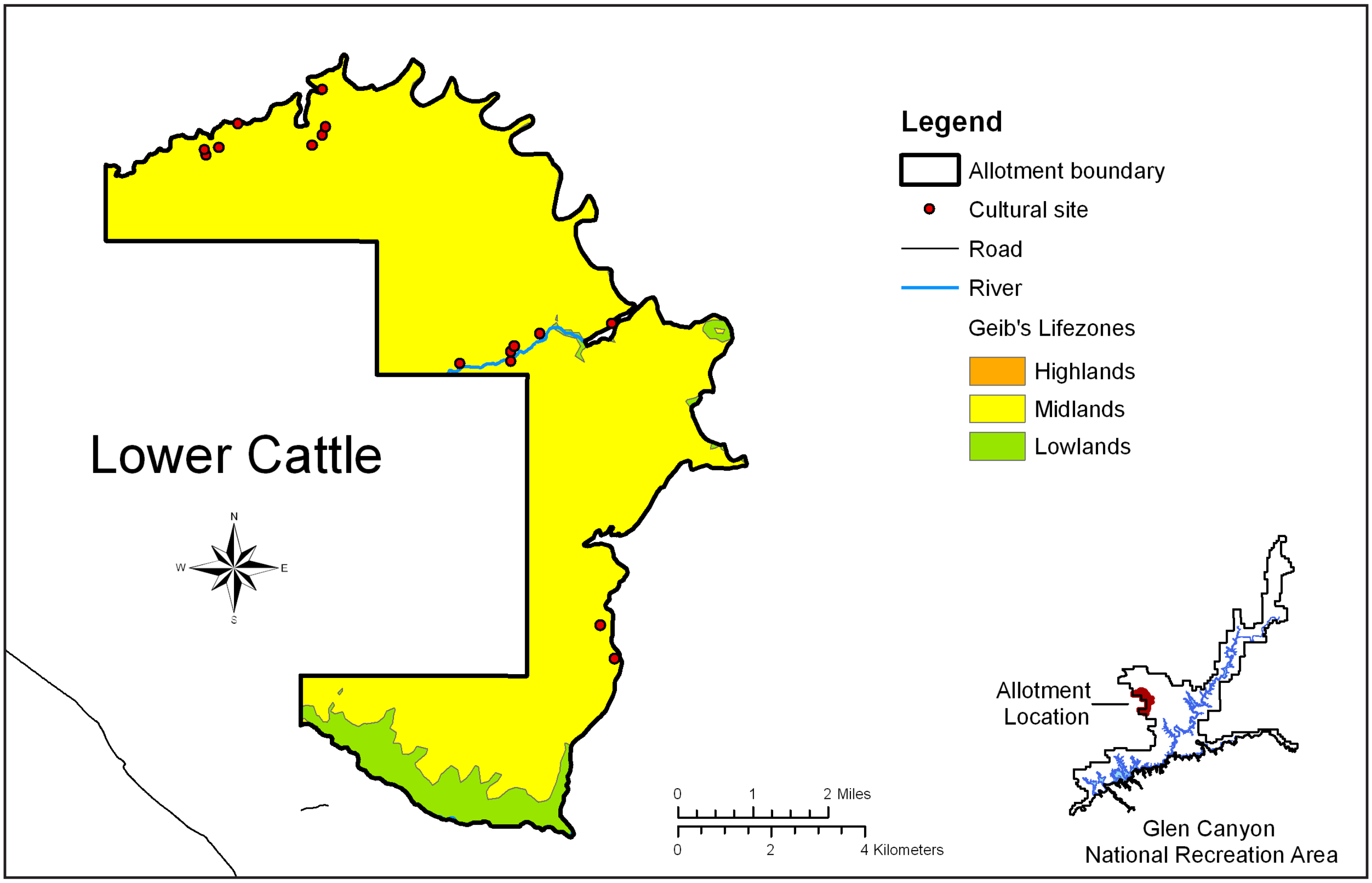
Survey Zones Dictated by Slope:

Scorpion Gulch divides the north portion of Lower Cattle grazing allotment from the south. Access to both north and south will necessitate locating lateral roads from County Hwy 330 (Hole-in-the-Rock Road). The south may be accessible from the Escalante River, but the northeastern edge of the allotment is bounded by steep slopes that most likely will prevent access from that direction. Finally, once access points are determined, recommended transects should be oriented east-west, at least in the southern portion of the allotment, in order to minimize the amount of pedestrian travel over southwest-northeast oriented hills/slopes.

The 'fishnet' maps provided on the subsequent page display transects spaced at 200 meter intervals for both east-west and north-south oriented pedestrian survey.


Lower Cattle
N
W
E
S
Legend
Allotment boundary
Cultural site
Road
Transect boundary
River
Elevation (meters)
High : 1613.46
Low : 1252.24
Allotment Location
Glen Canyon National Recreation Area
0 1 2 Miles
0 2 4 Kilometers


Lower Cattle
N
W
E
S
Legend
Allotment boundary
Cultural site
Road
Transect boundary
River
Elevation (meters)
High : 1613.46
Low : 1252.24
Allotment Location
Glen Canyon National Recreation Area
0 1 2 Miles
0 2 4 Kilometers

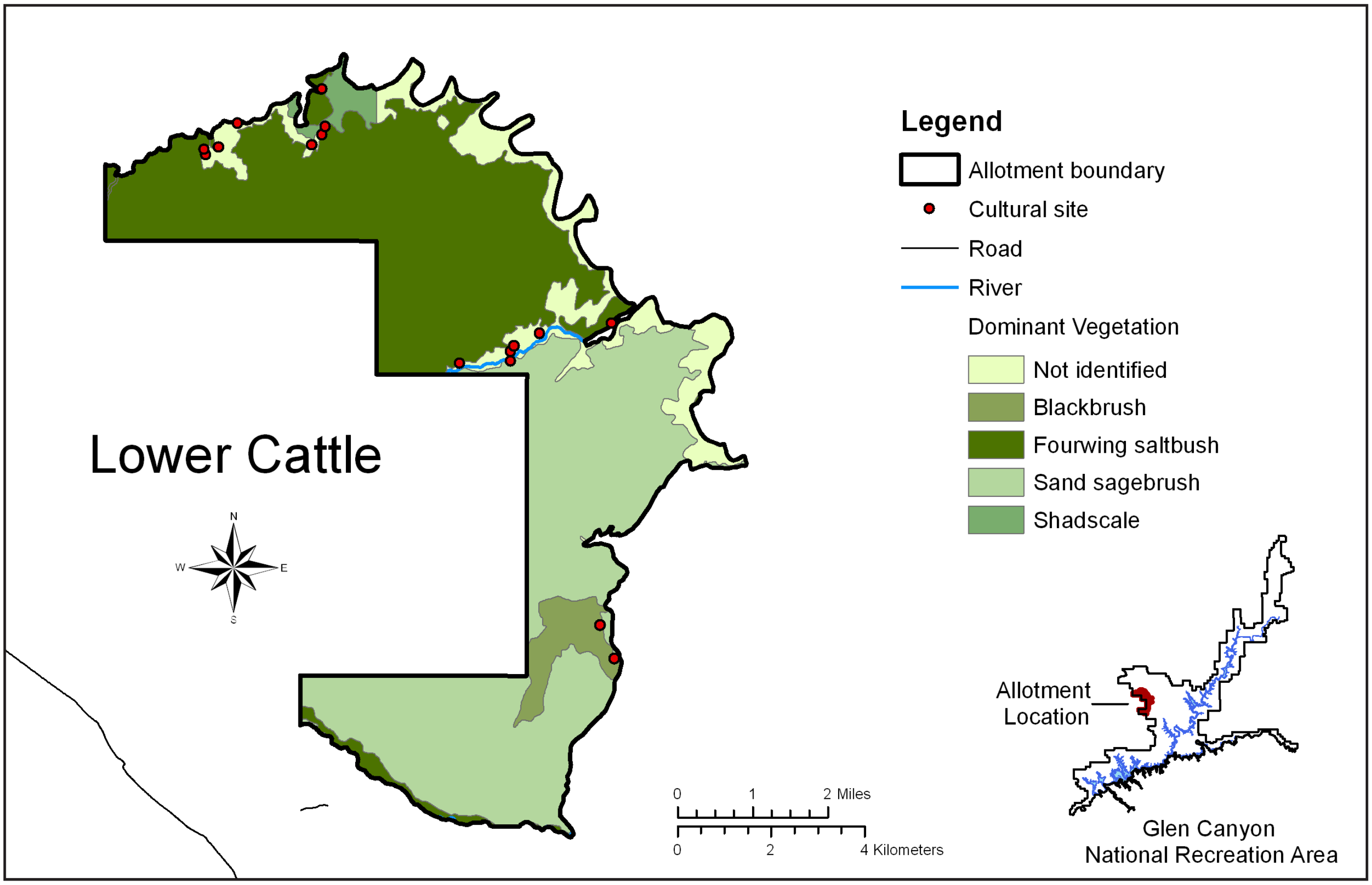


Area of Each Lifezone:
Highlands: 0.00 acres
Midlands: 17,328.25acres
Lowlands: 1344.45 acres

No. Cultural Sites in Each Lifezone:
Highlands: 0
Midlands: 17
Lowlands: 0

Lifezone Significance and Known Cultural Sites:
Although both the midlands and lowlands are present in Lower Cattle grazing allotment, all known cultural sites (n = 17) occur in the midlands. Geib describes the Midland zone as containing grasses, such as dropseed and ricegrass, cacti, and game, including antelope, important to prehistoric people in GCNRA.

	Elevation	Characteristics	Environment	Significance to Humans
Lowlands	1219-1372 m (4000-4500 ft)	Hot and arid steep-walled sandstone canyons.	Riparian plants; bighorn sheep	Permanent water, arable alluvium, long growing season, diverse plant communities, natural shelters, quality siliceous stone from river gravels
Midlands	1372-1676 m (4500-5500 ft)	Arid slickrock and dune fields on benchlands and low plateaus.	Blackbrush, shadscale, grasses; antelope.	Grasses, including dropseed and ricegrass, prickly pear and shadscale; good antelope habitat, quality siliceous stone in certain locations.
Highlands	Above 1676 m (Above 5500 ft)	High elevation mesas and plateaus with cooler temperatures and greater precipitation.	Pinyon-juniper woodlands; deer and rabbit.	Higher elevation plant foods (i.e. pinyon); later harvests; dry-farming; abundant fuel, deer and rabbit.
Shading indicates lifezones present in allotment.				



Area of Individual Vegetation Zones:

Dominant Species	Acres Covered	No. Sites
Not identified	2130.49	11
Blackbrush (*Coleogyne ramosissima)*	614.03	1
Fourwing saltbush *(Atriplex canescens)*	8015.92	2
Sand sagebrush (*Artemisia filifolia)*	7678.87	1
Shadscale (*Atriplex confertifolia)*	300.91	2
Total	**18,740.22**	**17**

No. Cultural Sites in Each Vegetation Zone:
A single site (n = 1) is located in blackbrush. Two (n = 2) sites are located in fourwing saltbush. A single site (n = 1) is located in sand sagebrush. Two (n = 2) Fremont sites are located in shadscale, and the remainder of sites (n = 11) are located in areas where the dominant vegetation has not yet been identified.

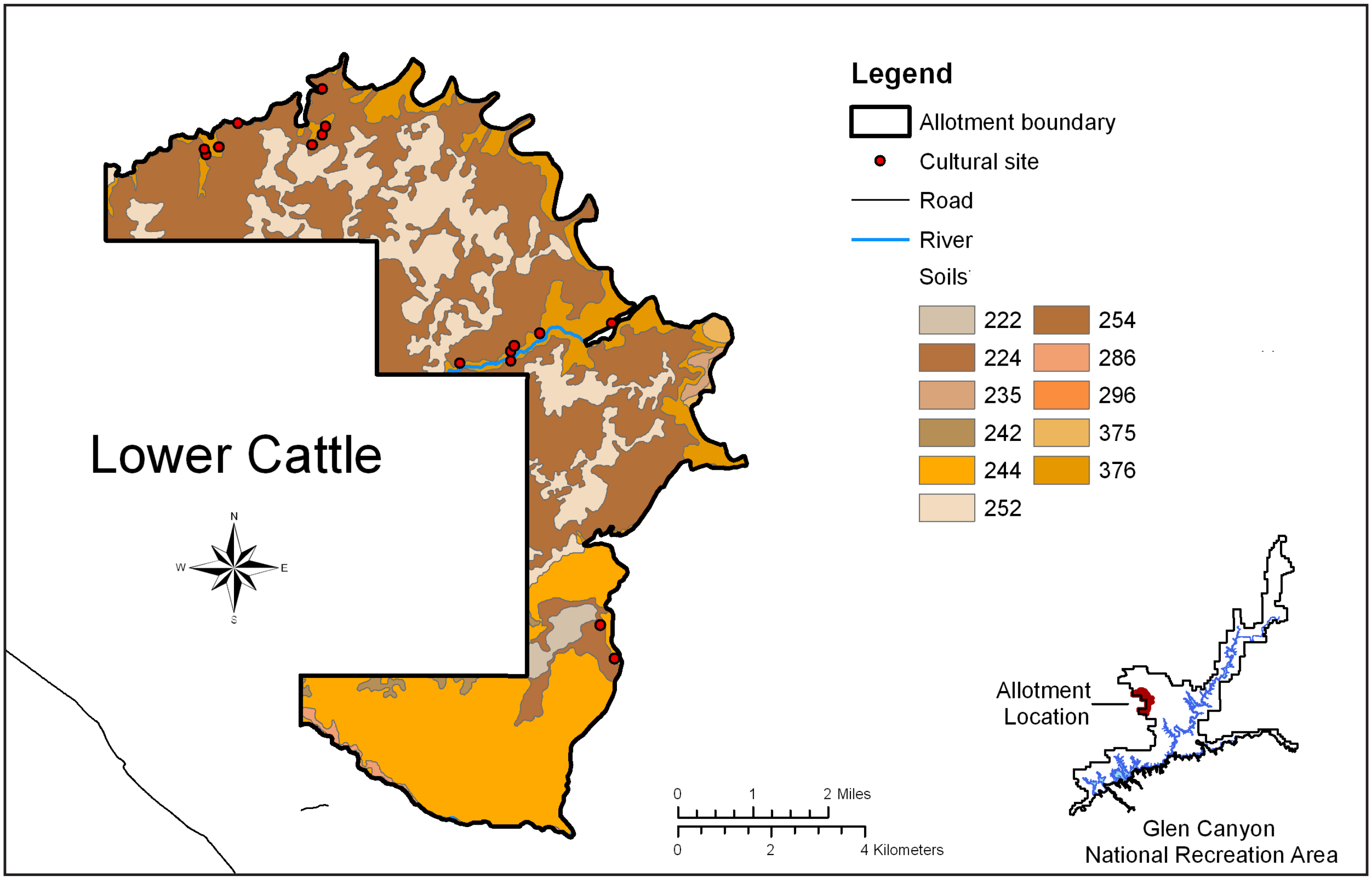
Visibility:
In general, the dominant vegetative communities of the allotment provide moderate - excellent ground visibility, with large portions of the ground between plants bare of vegetation.

Summary:
The primary dominant vegetation zones within the Lower Cattle grazing allotment include blackbrush (3.28 percent), fourwing saltbush (42.77 percent), sand sagebrush (40.98 percent), and shadscale (1.61 percent). Dominant vegetation for the remainder of the allotment is not currently known.

Dominant Species:
Fourwing saltbush (*Atriplex canescens*)
Blackbrush (*Coleogyne ramosissima*)
Sand sagebrush (*Artemisia filifolia)*
Shadscale (*Atriplex confertifolia*)

Secondary Dominant Species:
Fremont cottonwood (*Populus fremontii*)
Cutler Mormon tea (*Ephedra cutleri*)

Associated Soils:
Blackbrush grows primarily in shallow sandy loam. Fourwing saltbush grows in sandy bottom and sandy loam, often in association with Fremont cottonwood in semiwet saline streambanks, and in sand, where it may be associated with Cutler Mormon tea in shallow sand. Sand sagebrush grows in sand alongside blackbrush in sandy loam, and shadscale dominates in shallow sandy loam.

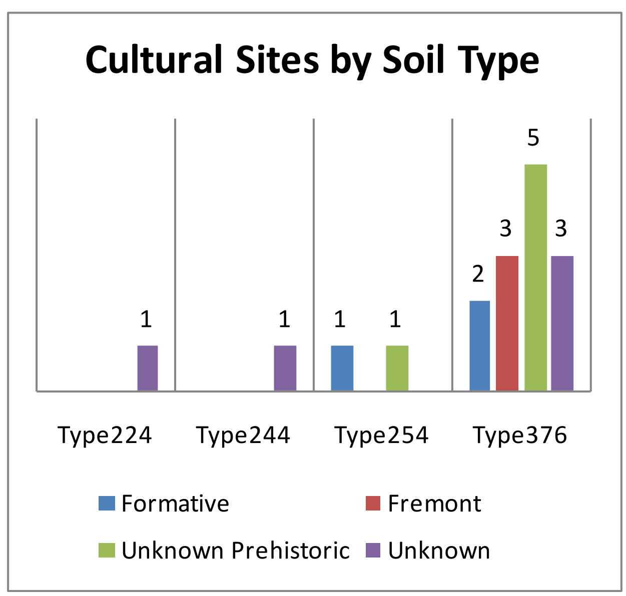


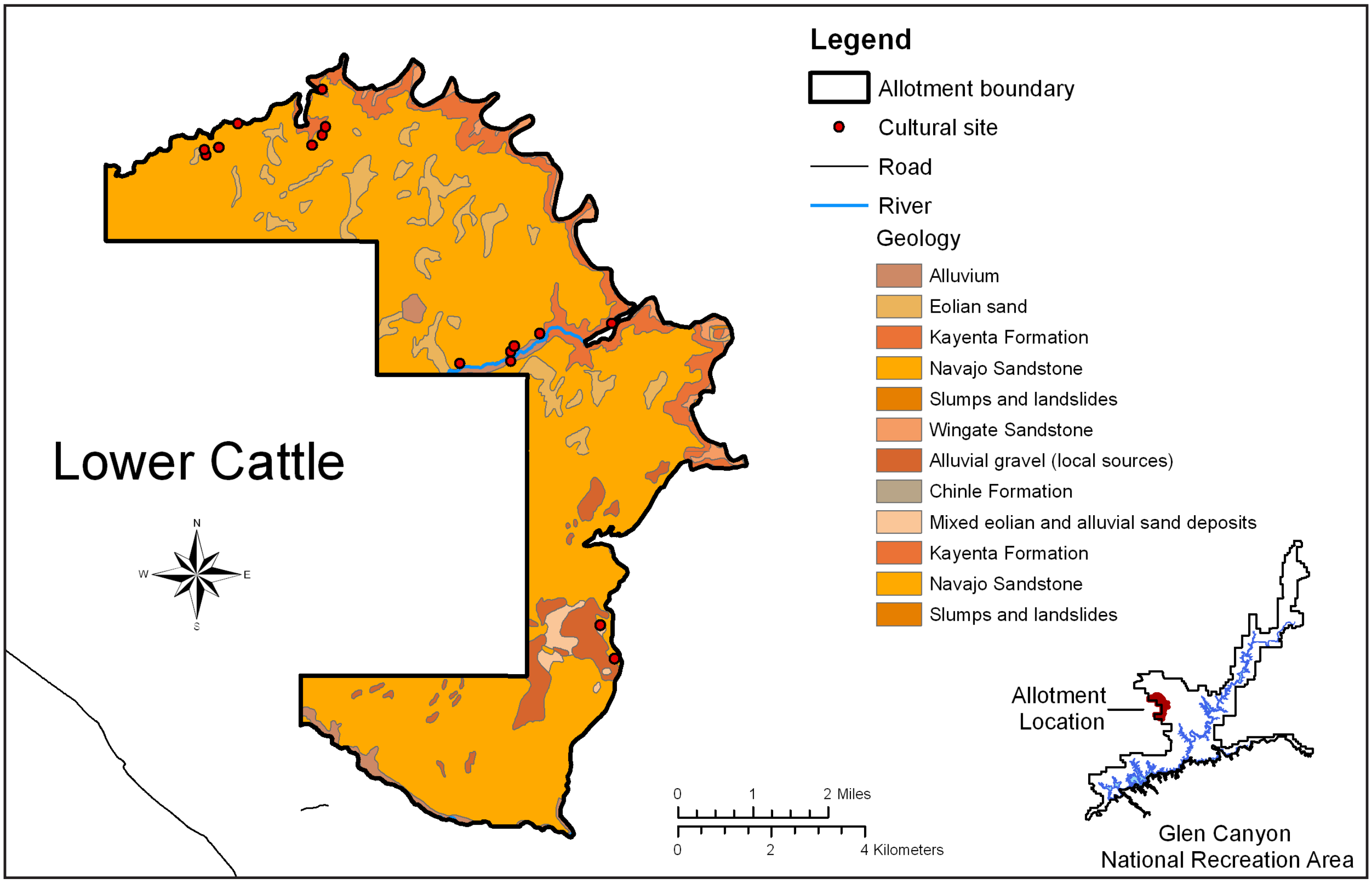
Allotment Divided by Soil Type (MUSYM):

Soil Type	Acres	Percent	No. Cultural Sites
222	238.68	1.27	0
224	377.31	2.01	1
235	79.66	0.43	0
242	118.97	0.63	0
244	4212.74	22.48	1
252	3622.46	19.33	0
254	7960.66	42.48	2
286	114.11	0.61	0
296	5.26	<0.00	0
375	117.95	0.63	0
376	1892.42	10.10	13
Total	**18,740.22**	**99.97%**	**17**

Distribution of Cultural Sites by Soil Type:

One site (n = 1) for which attribute/affiliation information is not available at this time occurs in soil type 224. One site (n = 1) for which attribute/affiliation information are is not available at this time occurs in soil type 244, which is often associated with Navajo Sandstone, or slickrock. Two sites (n = 2), including a Formative site and a currently unaffiliated artifact scatter occur in soil type 254. The remaining sites (n = 13), including two Formative sites, three Fremont sites, five currently unaffiliated prehistoric sites, including three with features, and three consisting of artifact scatters, and one site for which attribute/affiliation information is not currently available occur in soil type 376.



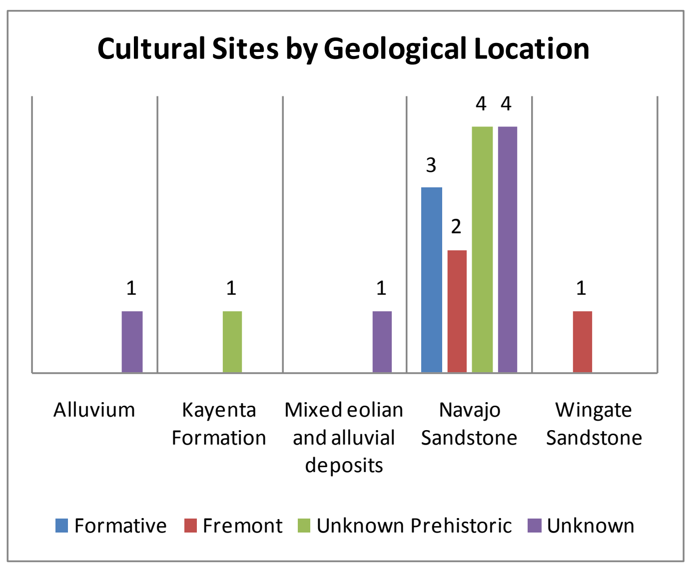


Allotment Divided by Geology:

Geology	Acres	Percent	No. Cultural Sites
Alluvium	356.97	1.90	1
Alluvial gravel (local sources)	697.55	3.72	0
Eolian sand	1088.46	5.81	0
Chinle Formation	3.46	<0.00	0
Kayenta Formation	1321.39	7.05	1
Mixed eolian and alluvial sand deposits	164.87	0.88	1
Navajo Sandstone	14,717.45	78.53	13
Slumps and landslides	15.68	<0.00	0
Wingate Sandstone	373.85	1.99	1
Total	**18,739.68**	**99.88**	**17**

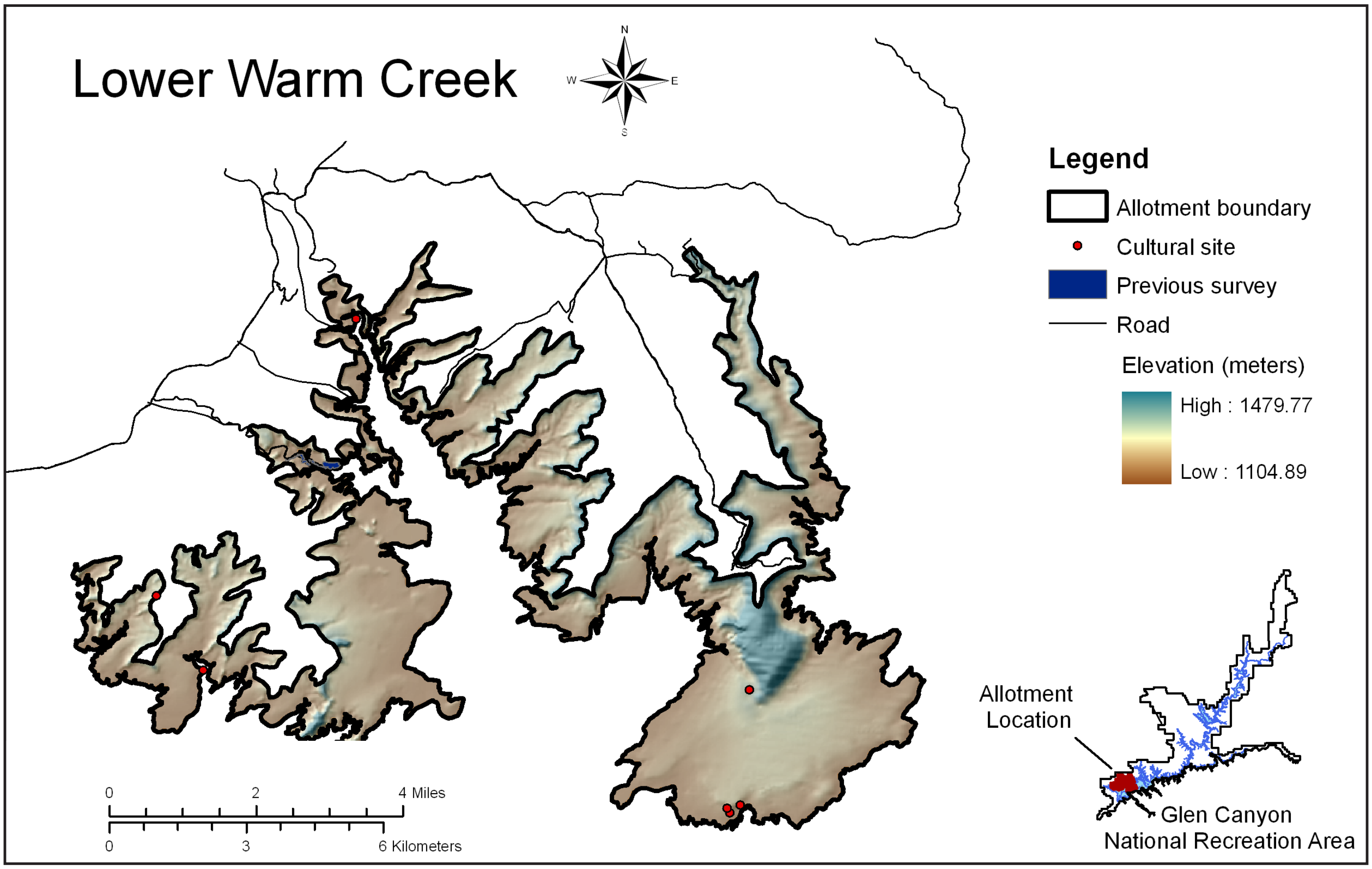
Distribution of Cultural Sites by Geological Location:

A single site (n = 1) for which attribute/affiliation information is not currently available is located on alluvium. A single artifact scatter (n = 1) for which affiliation is not currently known is located on the Kayenta Formation. A single site (n = 1) for which attribute/affiliation information is not available is located on mixed eolian and alluvial deposits. Finally, thirteen (n = 13) sites, including three Formative sites, two Fremont sites, four unaffiliated prehistoric sites, including two with features and two artifact scatters, and four sites for which attribute/affiliation information is not available. One Fremont site (n = 1) is located on Wingate Sandstone.



Lower Warm Creek

Map Panels



Total Area: 18,369.15 acres

Sampling Fractions:
2 percent: 367.383 acres
5 percent: 918.46 acres
11 percent: 2020.61 acres
16 percent: 2939.06 acres
20 percent: 3673.83 acres

Elevation range amsl:
1104.89 – 1479.77 meters (3624.97 - 4854.89 feet)

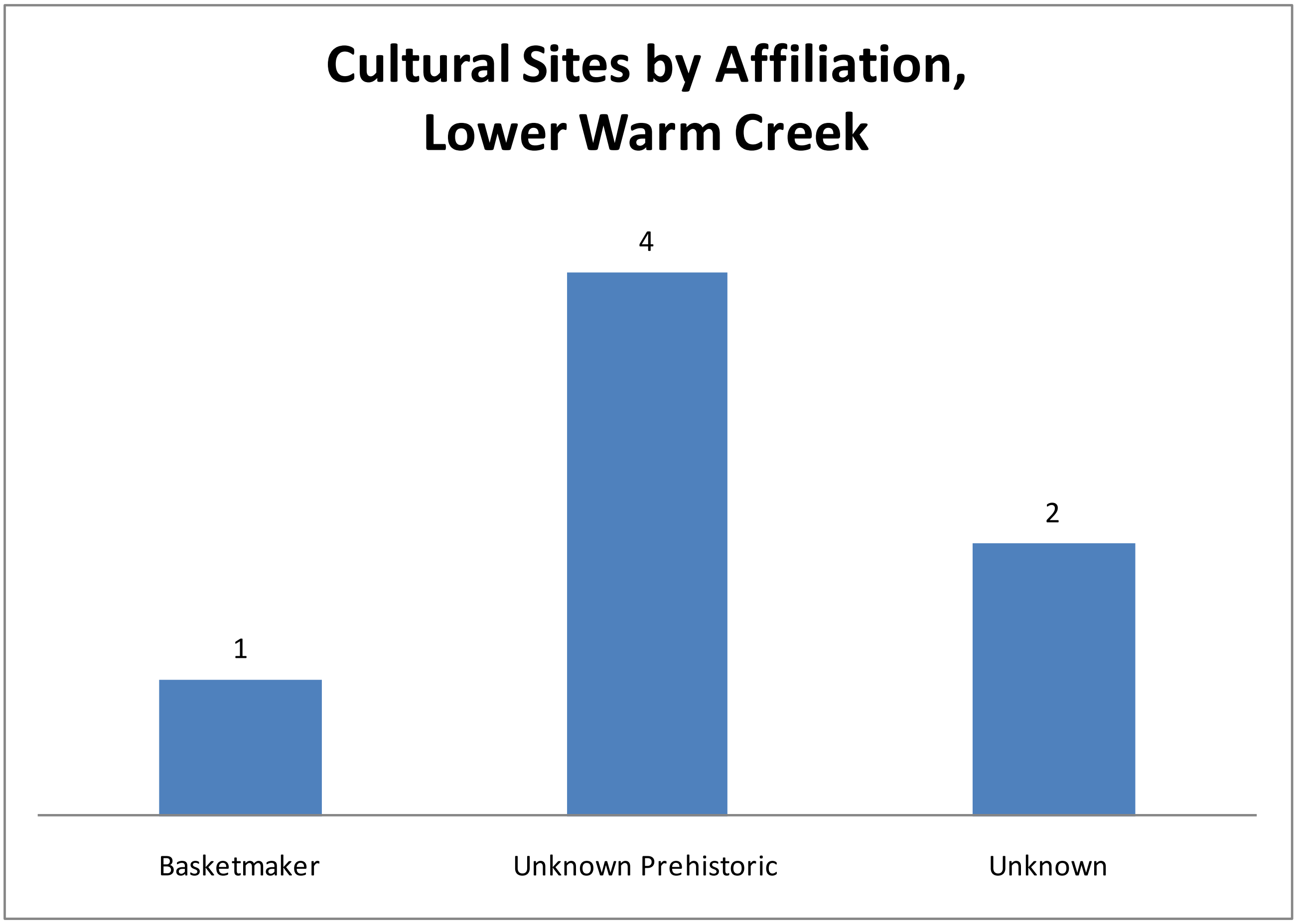
Rivers and Springs:
Warm Creek (not depicted) is located in Lower Warm Creek grazing allotment.

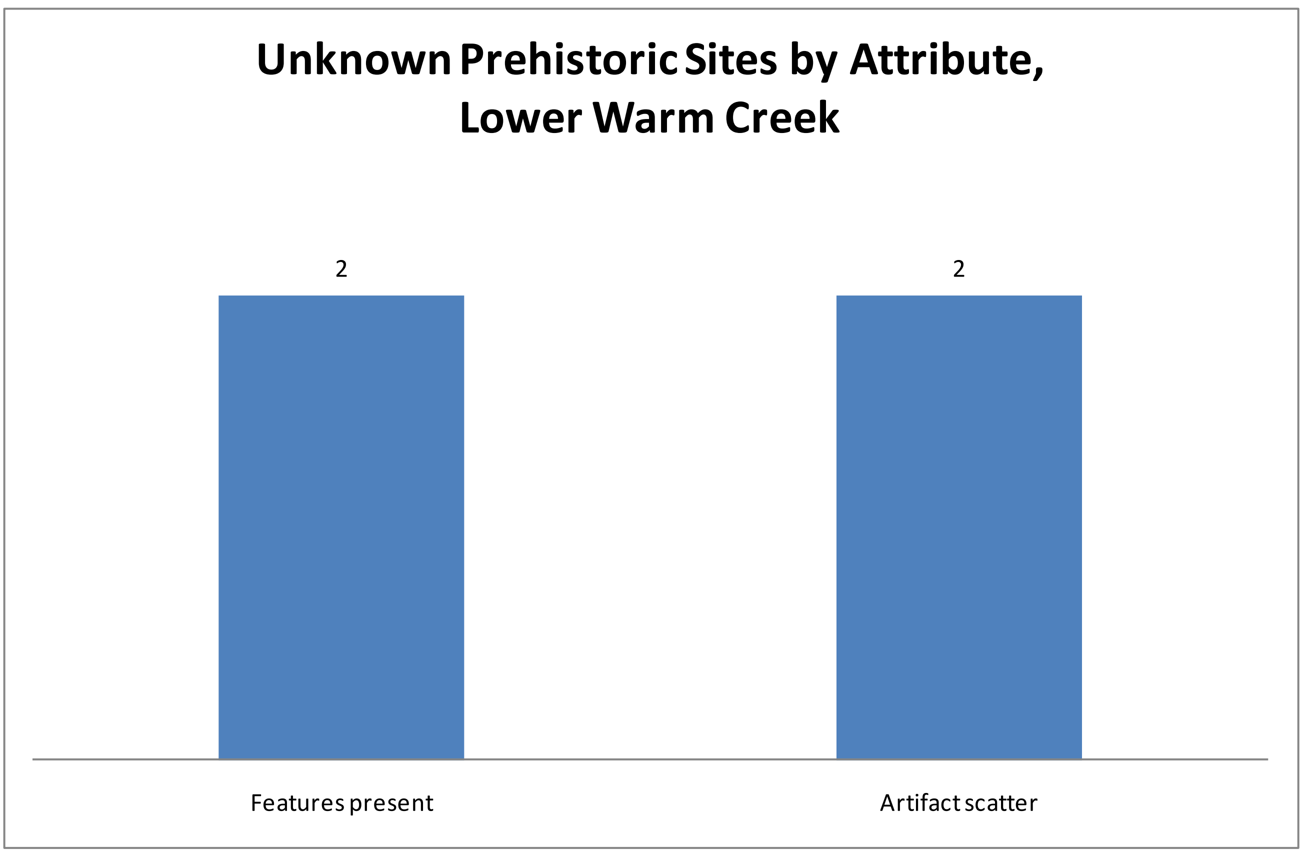
Accessibility:
County Hwy 230 crosses from east to west just north of the allotment. County Hwy 231 provides access from west of Warm Creek Bay, and County Hwy 265 provides access from east of the bay. Country Hwy 264 extends from 230 south into the southwestern portion of the allotment. Warm Creek Bay divides the southwest and southeast portion of the allotment, providing excellent access to the allotment from Lake Powell.

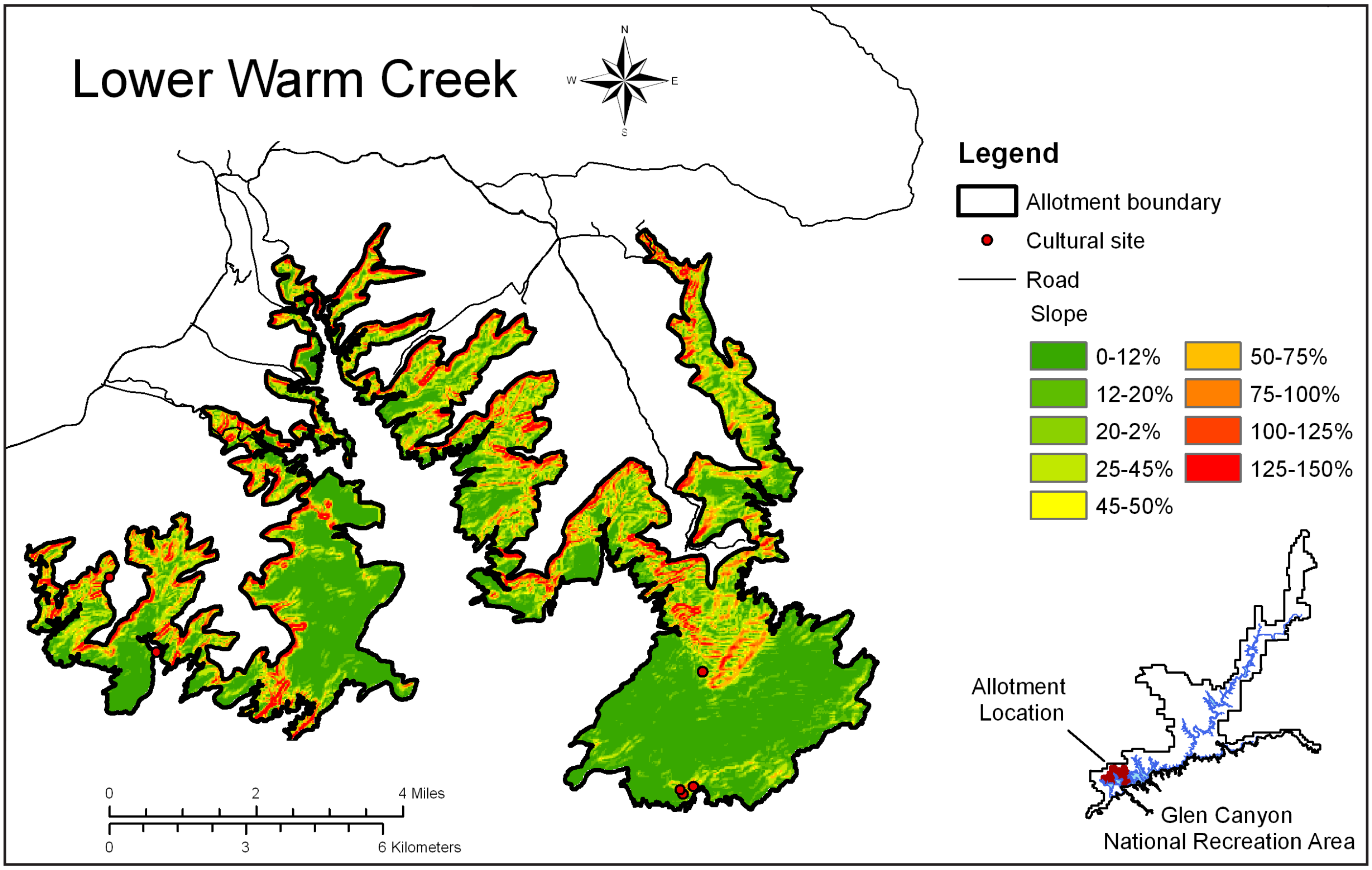
No. Cultural Sites: 7
Area surveyed: 16.59 acres

Survey References:
Kincaid (1993b): 10.04 acres
Kincaid (1993c): 6.72 acres

The figures on the subsequent page depict cultural sites by affiliation, and for those prehistoric sites for which affiliation is not known, site attributes.


Cultural Sites by Affiliation,
Lower Warm Creek
4
2
1
Basketmaker
Unknown Prehistoric
Unknown


Unknown Prehistoric Sites by Attribute,
Lower Warm Creek
2
2
Features present
Artifact scatter



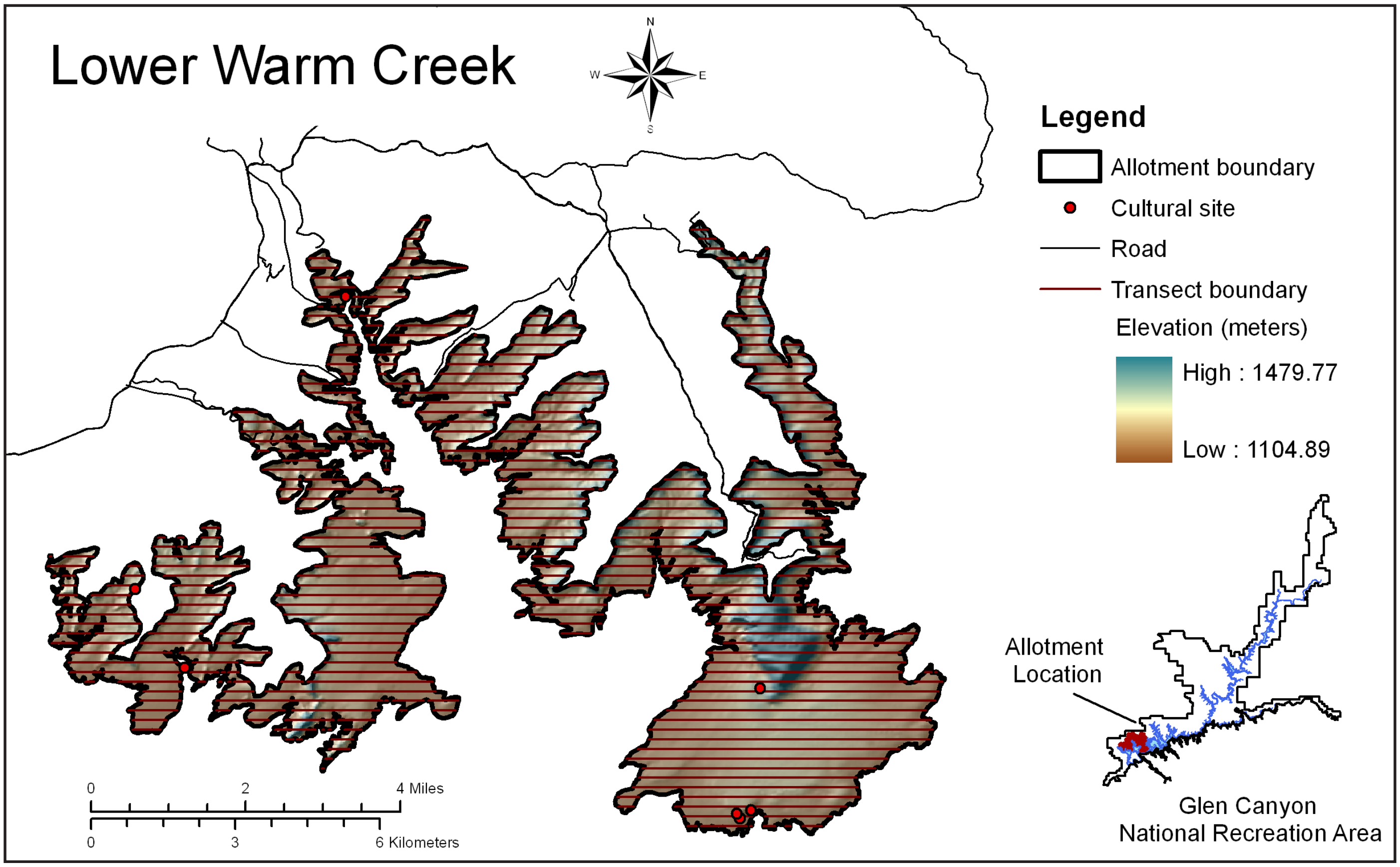
Slope Considerations:

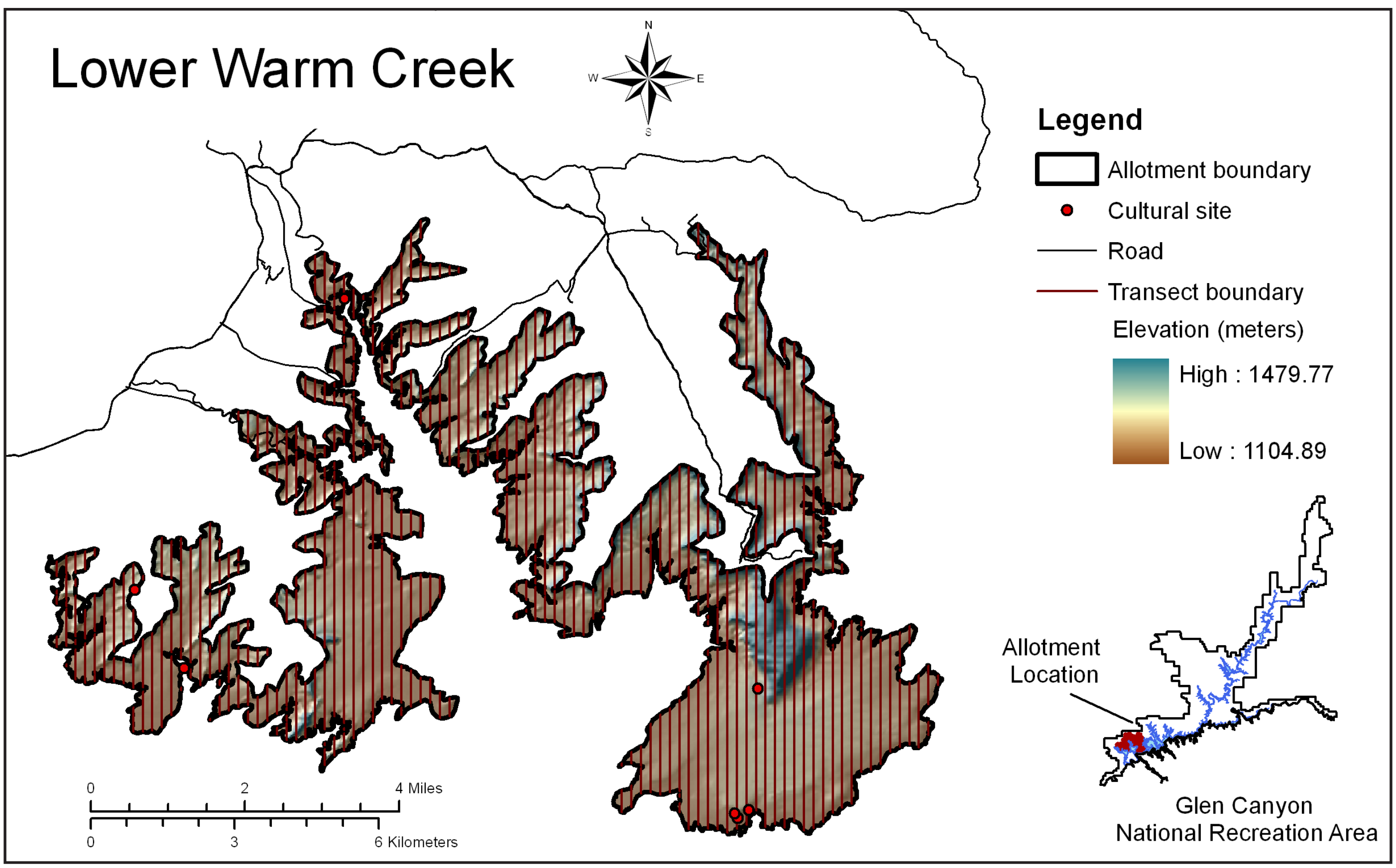
Slope plays a large role in terrain accessibility, and may be used in the stratification of survey areas. For example, GCNRA may wish to assign catagories such as low, moderate, and high to specific slope gradients. Such assignations are most often dependent on the factors guiding archaeological survey work, and as such, are not included in this document. Included herein, however, are suggestions for basic transect orientation based on the presence of topographical barriers identified by the presence of excessive slope gradients.

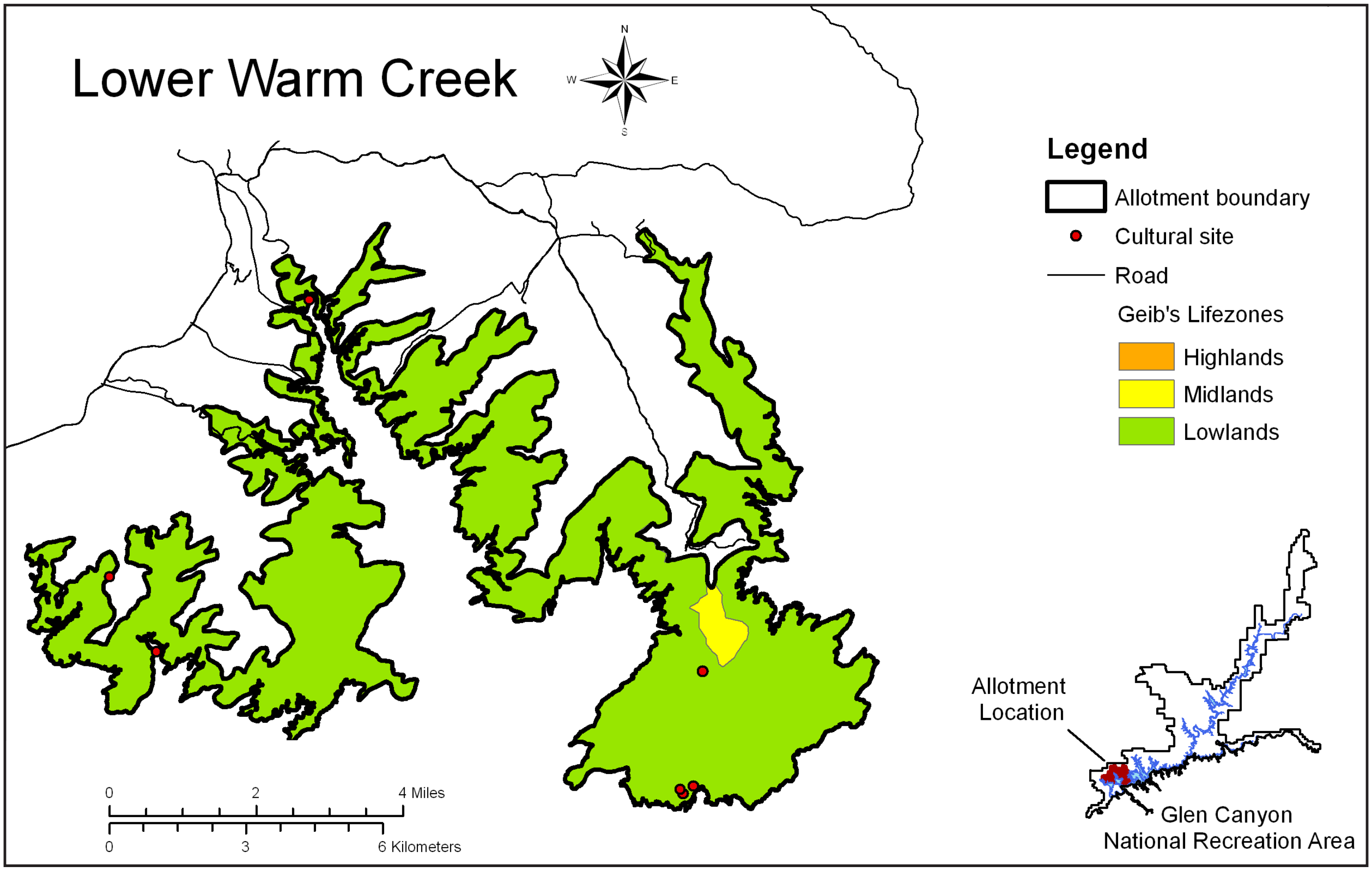
Survey Zones Dictated by Slope:

Steep escarpments/canyons form the boundaries of the much of Lower Warm Creek grazing allotment, particularly on the north and central outer edges. Slope, however, decreases toward the lake. Therefore, it is recommended that transects be placed perpendicular to Lake Powell when possible.

The 'fishnet' maps provided on the subsequent page display transects spaced at 200 meter intervals for both east-west and north-south oriented pedestrian survey.


Lower Warm Creek
N
W
E
S
Legend
Allotment boundary
Cultural site
Road
Transect boundary
Elevation (meters)
High : 1479.77
Low : 1104.89
Allotment Location
Glen Canyon National Recreation Area
0
2
4 Miles
0
3
6 Kilometers


Lower Warm Creek
N
W
E
S
Legend
Allotment boundary
Cultural site
Road
Transect boundary
Elevation (meters)
High : 1479.77
Low : 1104.89
Allotment Location
Glen Canyon National Recreation Area
0
2
4 Miles
0
3
6 Kilometers

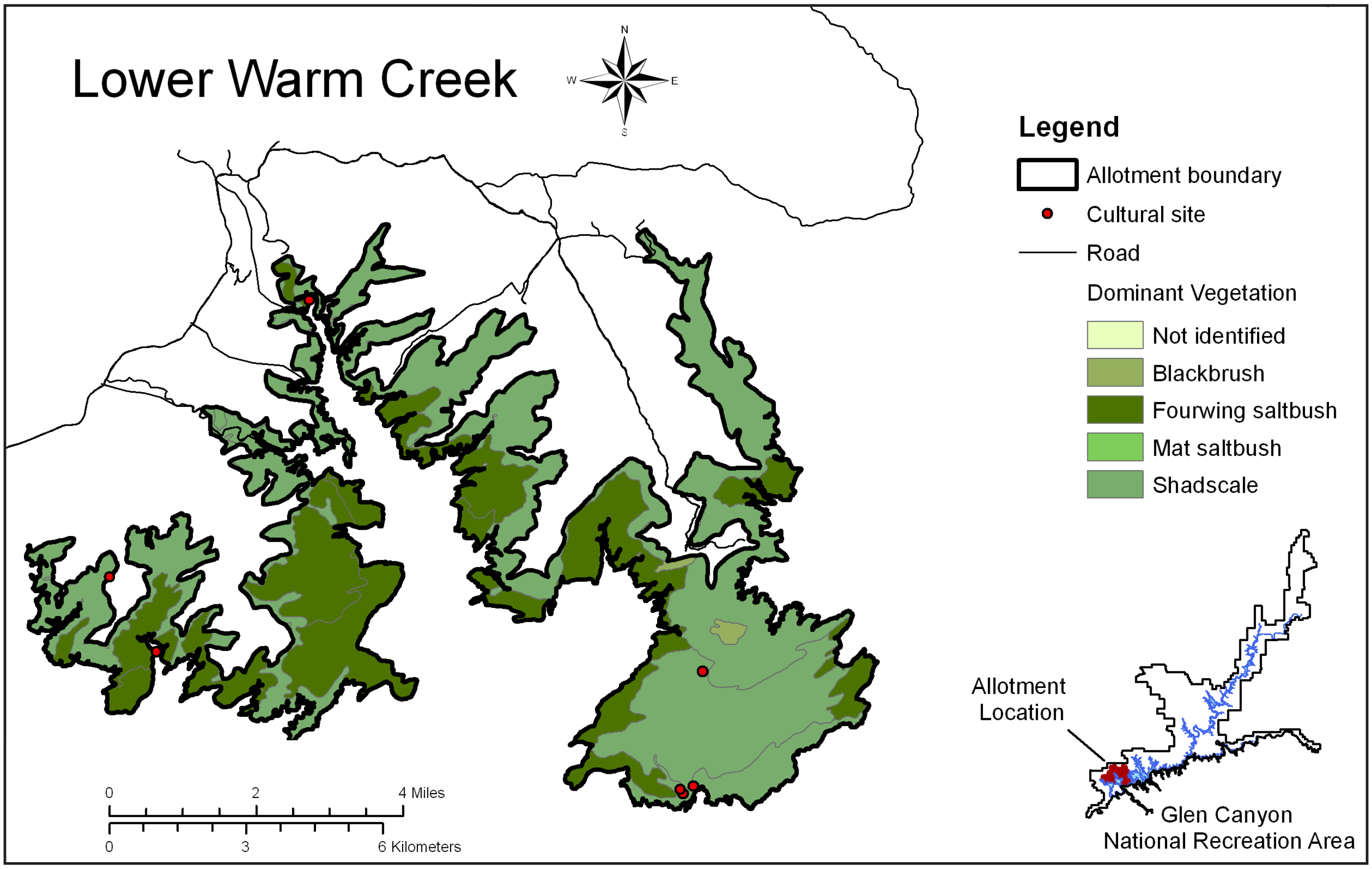


Area of Each Lifezone:
Highlands: 0.00 acres
Midlands: 301.94 acres
Lowlands: 17,940.32 acres

No. Cultural Sites in Each Lifezone:
Highlands: 0
Midlands: 0
Lowlands: 7

Lifezone Significance and Known Cultural Sites:
Although both the midlands and lowlands are present in Lower Cattle grazing allotment, all known cultural sites (n = 7) are located in the lowlands. Geib describes the lowlands as hot and arid, but containing permanent water sources, arable alluvium, and long growing seasons suitable to agriculture. In addition, diverse plant communities, natural shelters, and raw materials suitable to the manufacture of stone tools were also available to prehistoric people in the lowlands.

	Elevation	Characteristics	Environment	Significance to Humans
Lowlands	1219-1372 m (4000-4500 ft)	Hot and arid steep-walled sandstone canyons.	Riparian plants; big-horn sheep	Permanent water, arable alluvium, long growing season, diverse plant communities, natural shelters, quality siliceous stone from river gravels
Midlands	1372-1676 m (4500-5500 ft)	Arid slickrock and dune fields on benchlands and low plateaus.	Blackbrush, shadscale, grasses; antelope.	Grasses, including dropseed and ricegrass, prickly pear and shadscale; good antelope habitat, quality siliceous stone in certain locations.
Highlands	Above 1676 m (Above 5500 ft)	High elevation mesas and plateaus with cooler temperatures and greater precipitation.	Pinyon-juniper woodlands; deer and rabbit.	Higher elevation plant foods (i.e. pinyon); later harvests; dry-farming; abundant fuel, deer and rabbit.
Shading indicates lifezones present in allotment.				



Area of Individual Vegetation Zones:

Dominant Species	Acres Covered	No. Sites
Not identified	175.83	
Blackbrush (*Coleogyne ramosissima*)	267.62	0
Fourwing saltbush (*Atriplex canescens*)	6321.77	2
Mat saltbush (*Atriplex corrugata*)	0.08	0
Shadscale (*Atriplex confertifolia*)	11,603.85	5
Total	**18,369.15**	**7**

No. Cultural Sites in Each Vegetation Zone:
Two (n = 2) sites are located in fourwing saltbush. The remaining sites (n = 5) are located in shadscale.

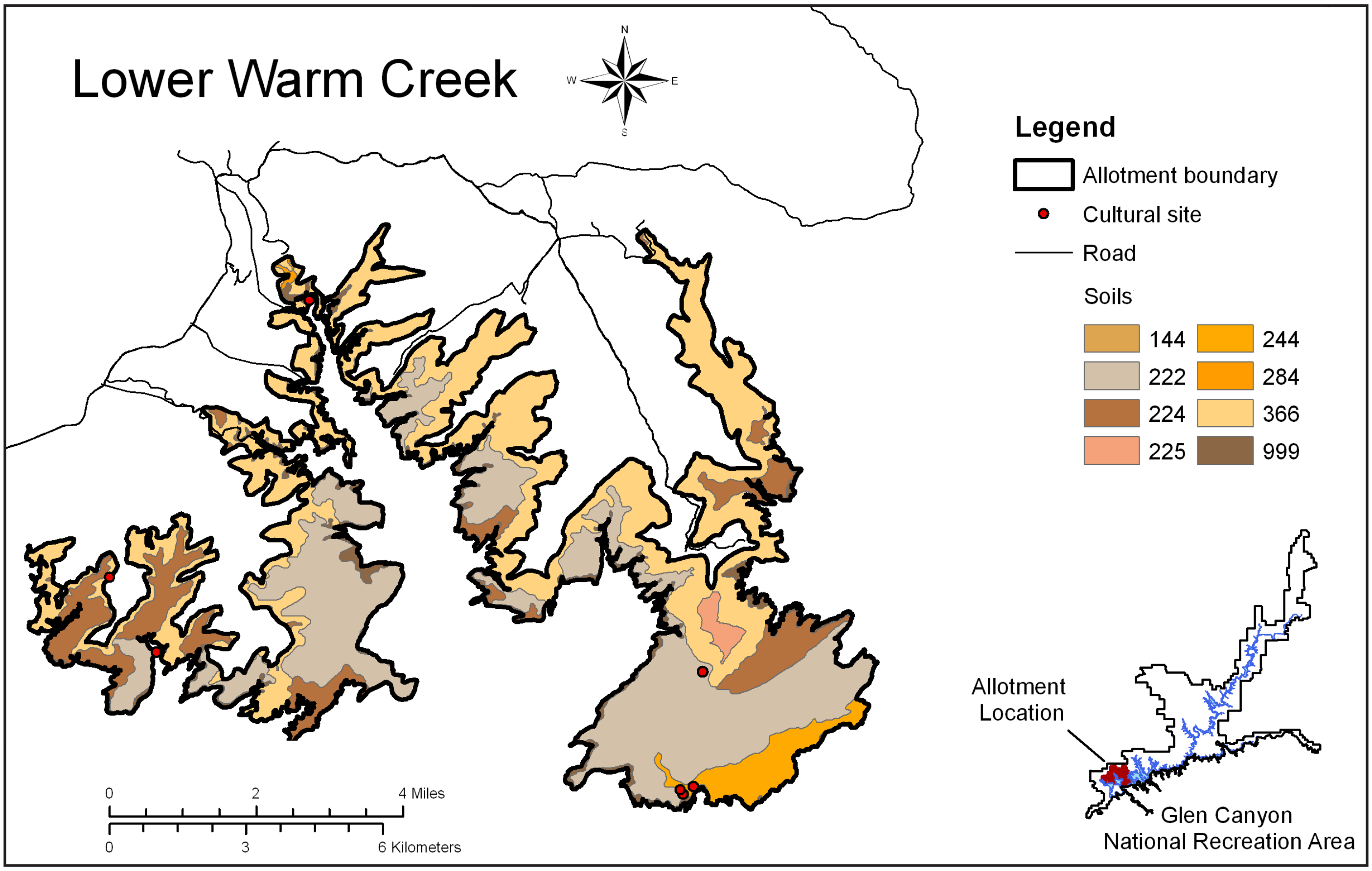
Visibility:
In general, the dominant vegetative communities of the allotment provide moderate - excellent ground visibility, with large portions of the ground bare of vegetation.

Summary:
The primary dominant vegetation zones within the Lower Cattle grazing allotment include blackbrush (1.46 percent), fourwing saltbush (34.42 percent), mat saltbush (<0.00 per cent), and shadscale (63.17 percent). Dominant vegetation for the remainder of the allotment is not currently known.

Dominant Species:
Fourwing saltbush (*Atriplex canescens*)
Blackbrush (*Coleogyne ramosissima*)
Mat saltbush (*Atriplex corrugata)*
Shadscale (*Atriplex confertifolia*)

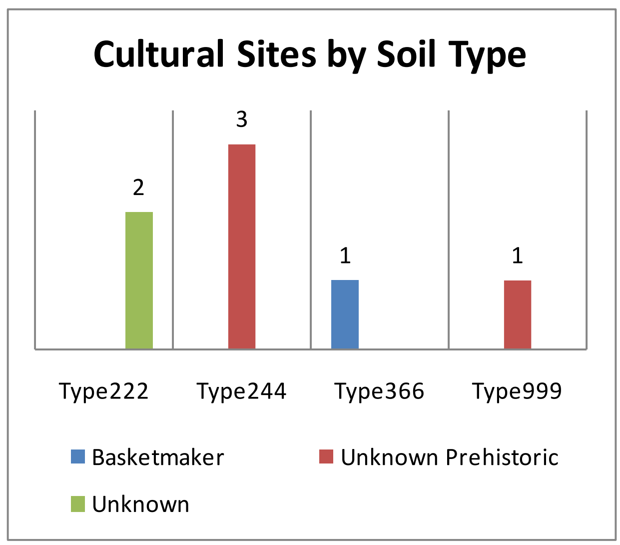
Secondary Dominant Species:
Fremont cottonwood (*Populus fremontii*)
Torrey Mormon tea (*Ephedra torreyana*)
Sand sagebrush (*Artemisia filifolia)*

Associated Soils:
Blackbrush grows in shallow sandy loam, often in association with fourwing saltbush in sandy loam. Fourwing saltbush occurs in sandy bottom alongside Fremont cottonwood in semiwet saline streambanks, and in sandy loam, where it grows with sand sagebrush. Mat saltbush grows in shallow clay. Finally, shadscale occurs in shallow loam with mat saltbush growing in shallow clay, and with Torrey Mormon tea in very shallow gypsum.



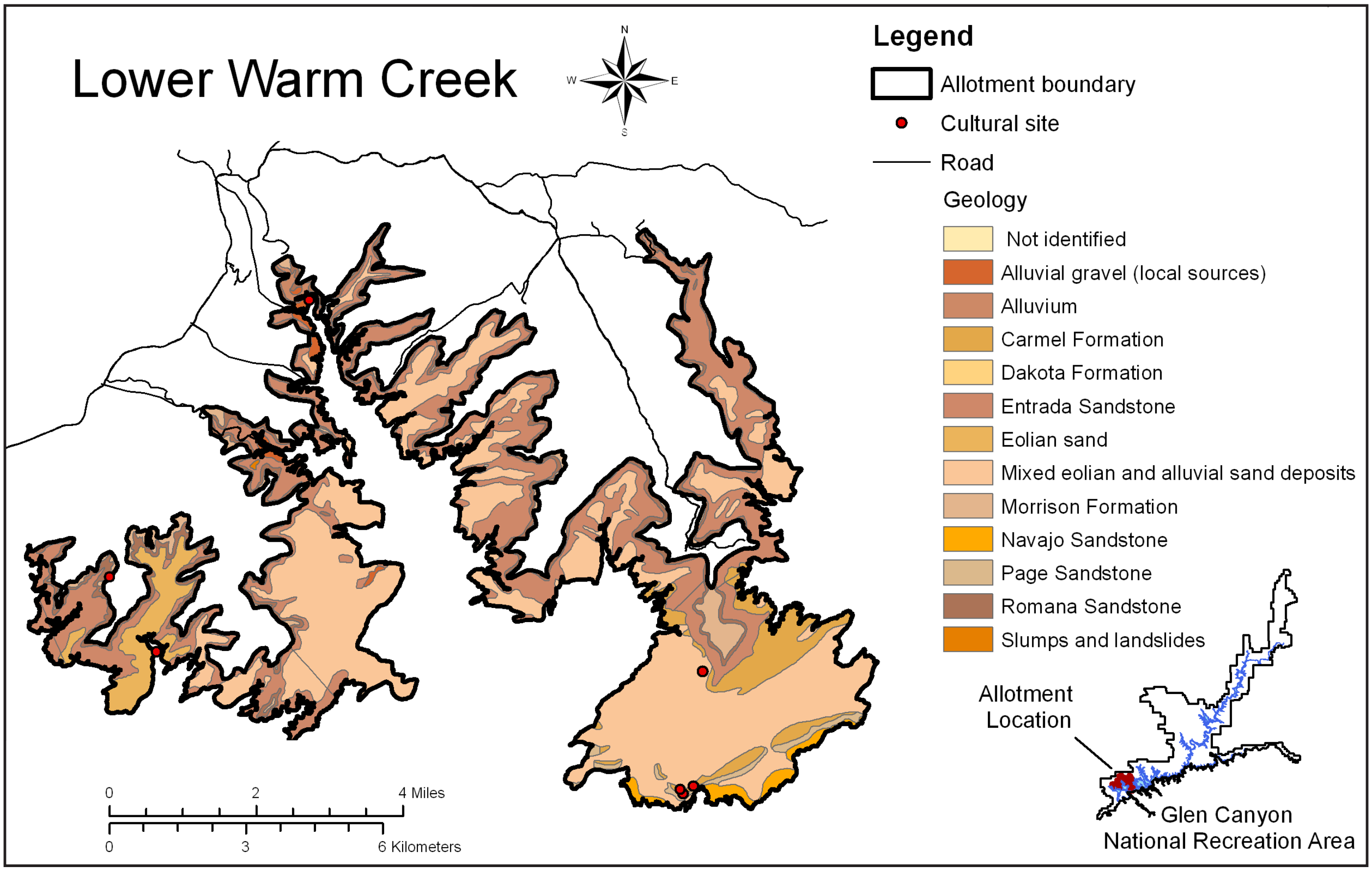
Allotment Divided by Soil Type (MUSYM):

Soil Type	Acres	Percent	No. Cultural Sites
144	3.22	<0.00	0
222	6273.28	34.15	2
224	2242.05	12.06	0
225	160.40	0.87	0
244	678.82	3.70	3
284	25.56	0.14	0
366	7604.88	41.40	1
999	1380.95	7.52	1
Total	**18,369.16**	**99.84**	**7**



Distribution of Cultural Sites by Soil Type:

Two sites (n = 2) for which attribute/affiliation information is not available at this time occurs in soil type 222. Three sites (n = 3), including two artifact scatters, and a lithic scatter with a hearth, are located in soil type 244, which is often associated with Navajo Sandstone, or slickrock. A single (n = 1) Basketmaker site is located in soil type 366. The remaining site (n = 1) consists of a possible hearth, and is located in soil type 999.

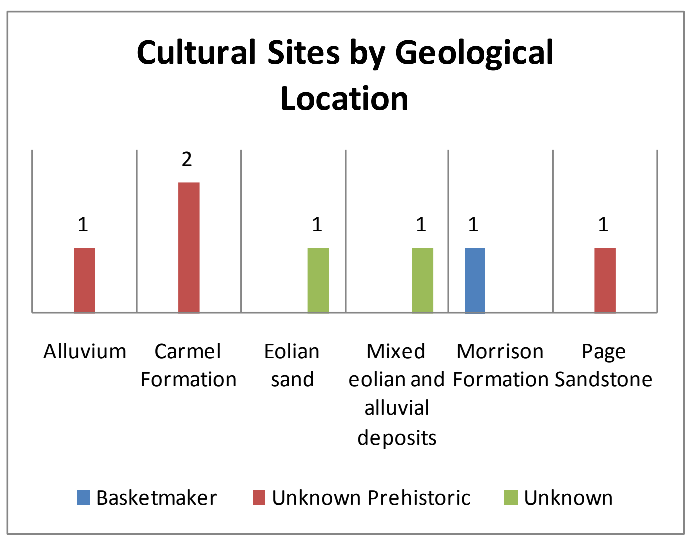


Allotment Divided by Geology:

Geology	Acres	Percent	No. Cultural Sites
Not identified	212.53	1.16	0
Alluvial gravels (local sources)	122.94	0.67	0
Alluvium	57.57	0.31	1
Carmel Formation	930.90	5.07	2
Dakota Formation	0.05	<0.00	0
Entrada Formation	5671.88	30.88	0
Eolian sand	681.61	3.71	1
Mixed eolian and alluvial sand deposits	7575.71	41.24	1
Morrison Formation	840.56	4.58	1
Navajo Sandstone	263.26	1.43	0
Page Sandstone	175.75	0.96	1
Romana Sandstone	1830.50	9.97	0
Slumps and landslides	5.89	<0.00	0
Total	**18,369.15**	**99.98**	**7**

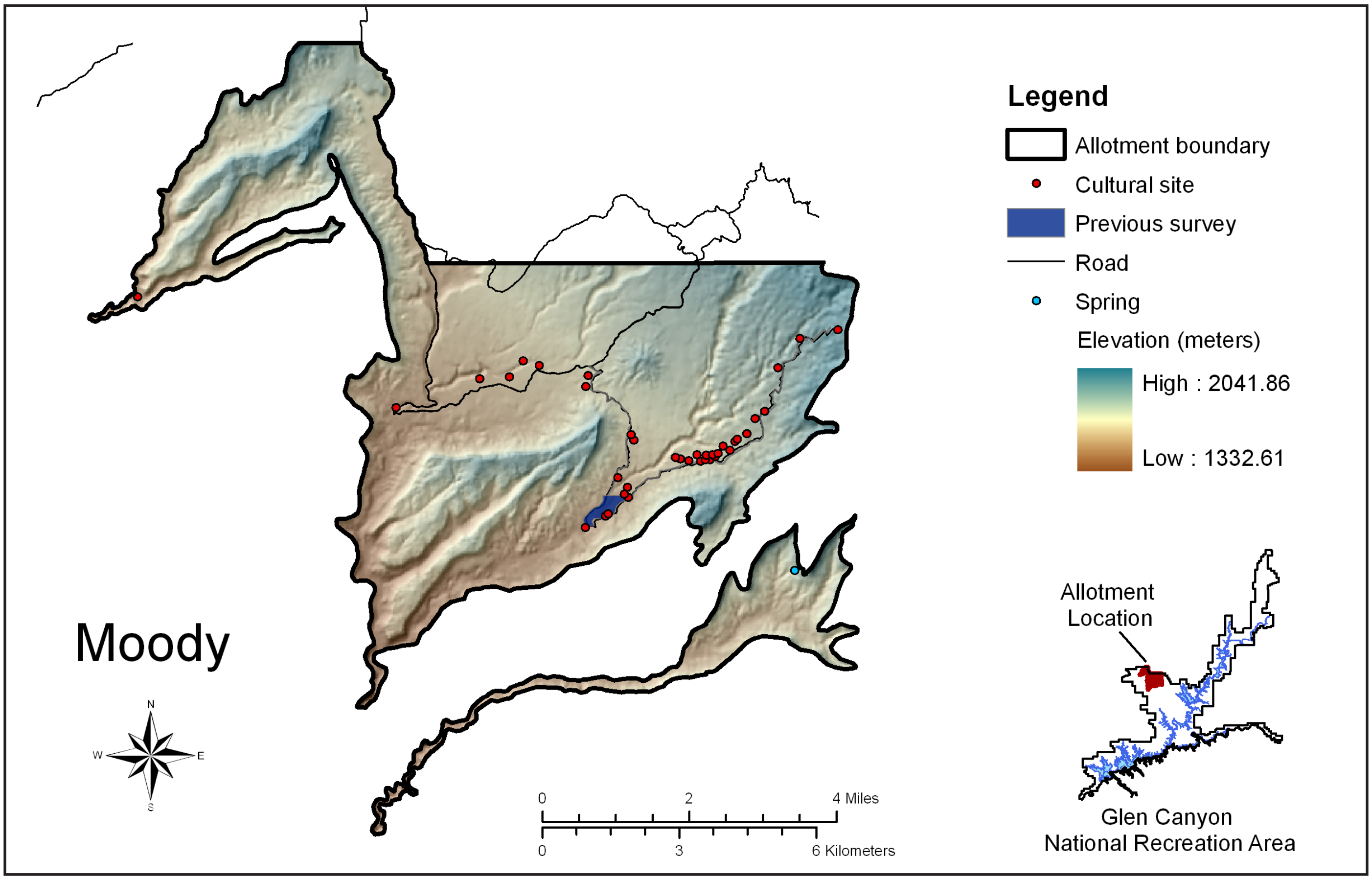
Distribution of Cultural Sites by Geological Location:

One currently unaffiliated site (n = 1) containing a possible hearth is located on alluvium. Two sites (n = 2), both artifact scatters for which affiliation is not currently known, are located on Carmel Formation geology. One site (n = 1) for which attribute/affiliation information is not currently available is located on eolian sand. One site (n = 1) for which attribute/affiliation information is not currently available is located on mixed eolian and alluvial sand deposits. A single (n = 1) Basketmaker site in located on Morrison Formation geology. The remaining site (n = 1), which consists of a lithic scatter with hearth, is located on Page Sandstone.



Moody

Map Panels



Total Area: 22,449.48 acres

Sampling Fractions:
2 percent: 448.99 acres
5 percent: 1122.47 acres
11 percent: 2469.44 acres
16 percent: 3591.92 acres
20 percent: 4489.90 acres

Elevation range amsl:
1332.61 – 2041.86 meters (4372.08 - 6699.02 feet)

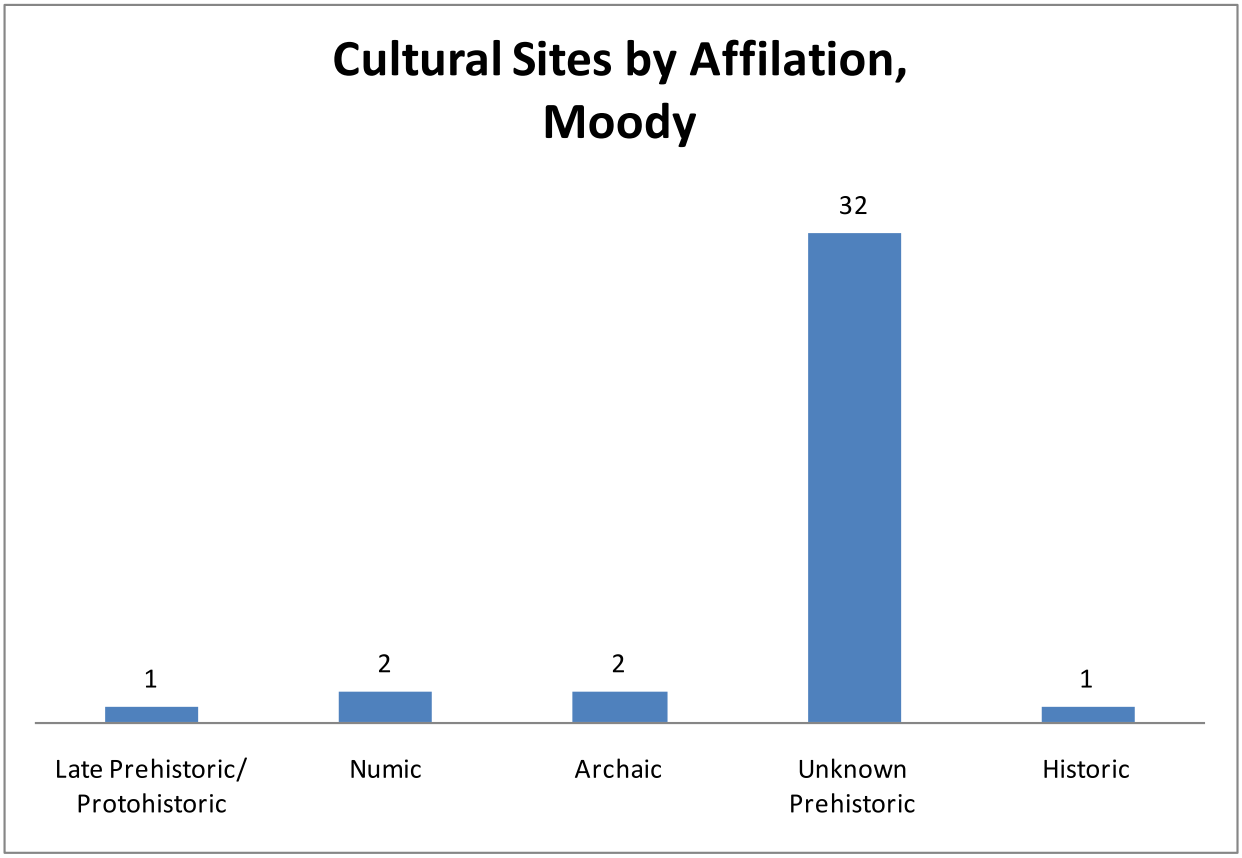
Rivers and Springs:
A single unnamed spring is located in Moody grazing allotment.

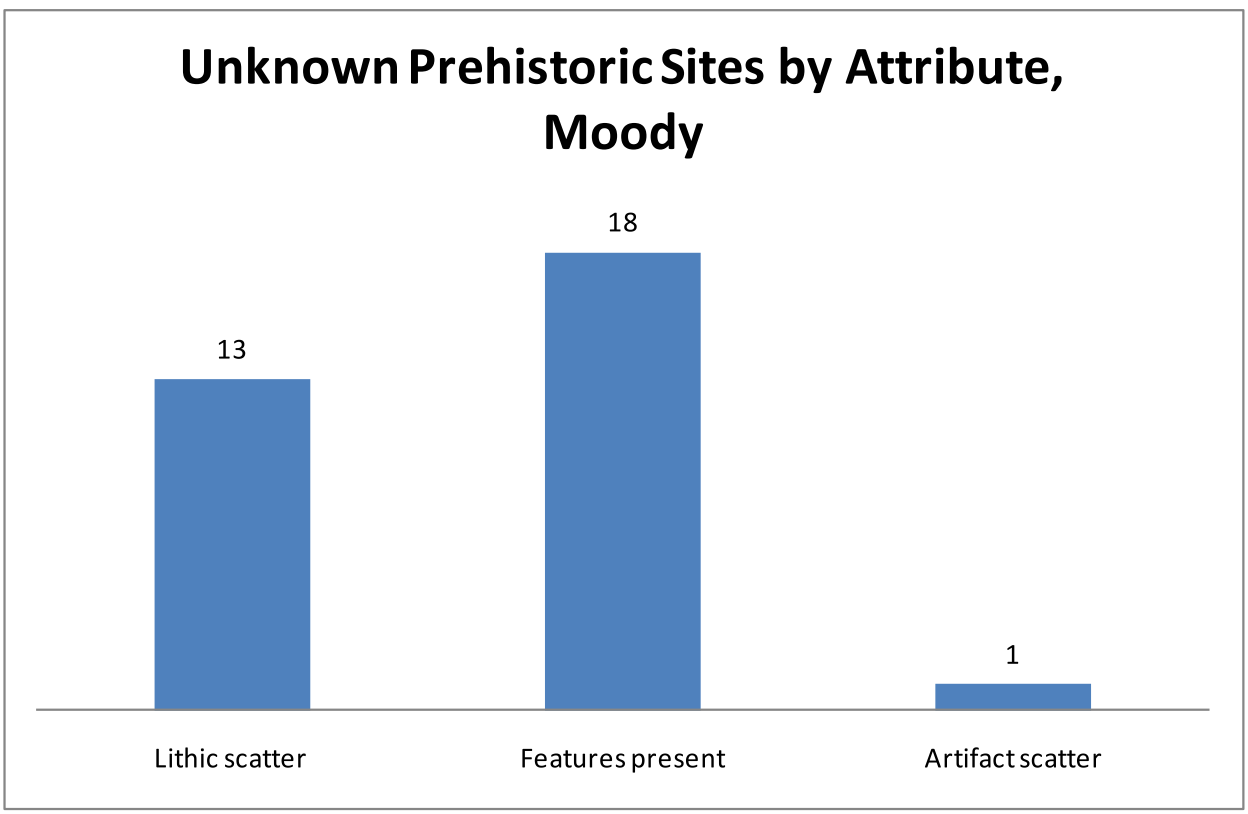
Accessibility:
County Hwy 332 (Moody Canyon Road) crosses the northern half of the allotment, and laterals likely provide access to the south, which is separated from the rest of the allotment by a canyon. Access from the east, using the Escalante River may also be possible.

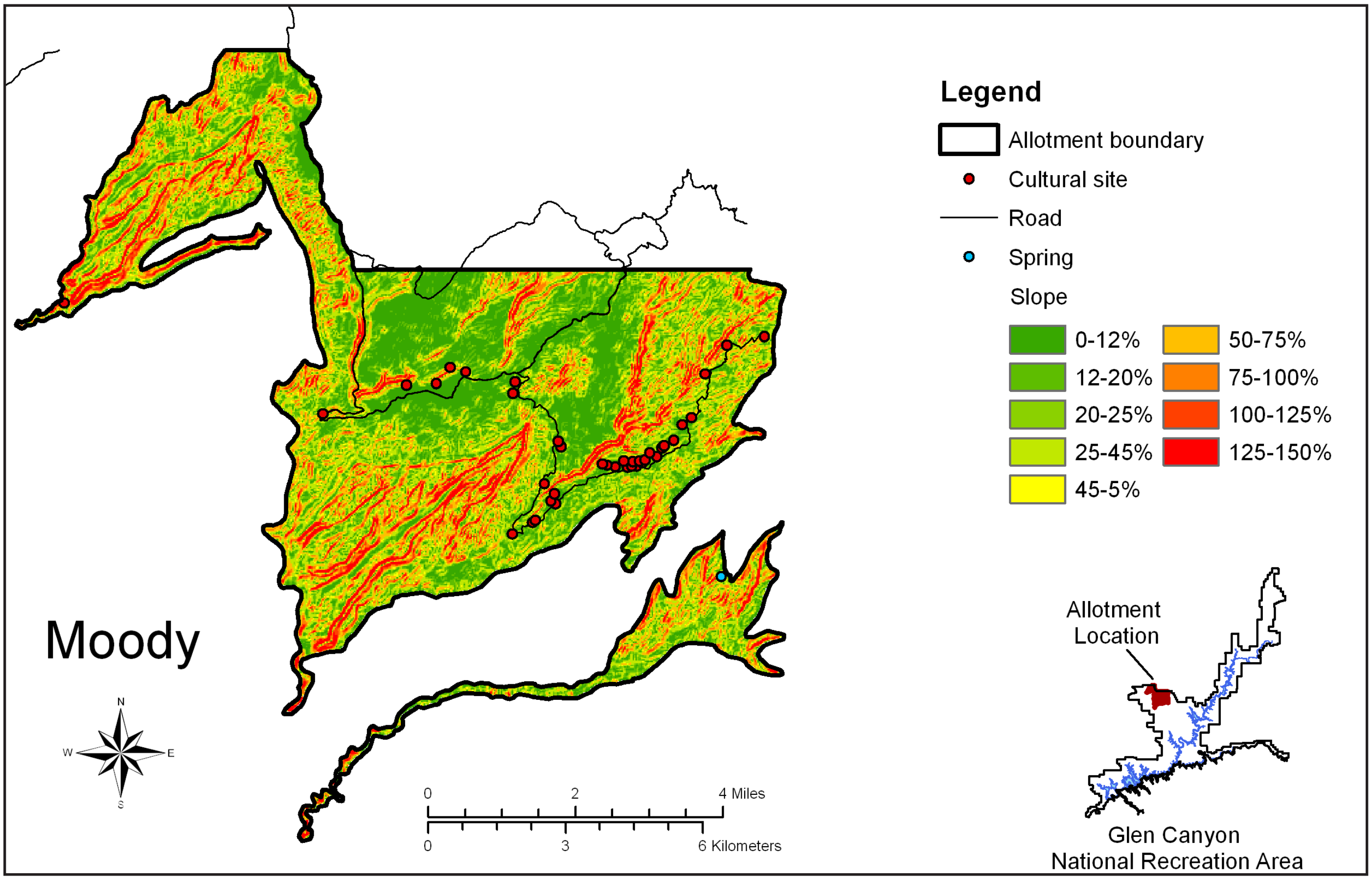
No. Cultural Sites: 38
Area surveyed: 128.04 acres

Survey References:
Horne et al. (1995): 128.44 acres

The figures on the subsequent page depict cultural sites by affiliation, and for those prehistoric sites for which affiliation is not known, site attributes.


Cultural Sites by Affilation, Moody
32
1
2
2
1
Late Prehistoric/ Protohistoric
Numic
Archaic
Unknown Prehistoric
Historic


Unknown Prehistoric Sites by Attribute, Moody
18
13
1
Lithic scatter
Features present
Artifact scatter



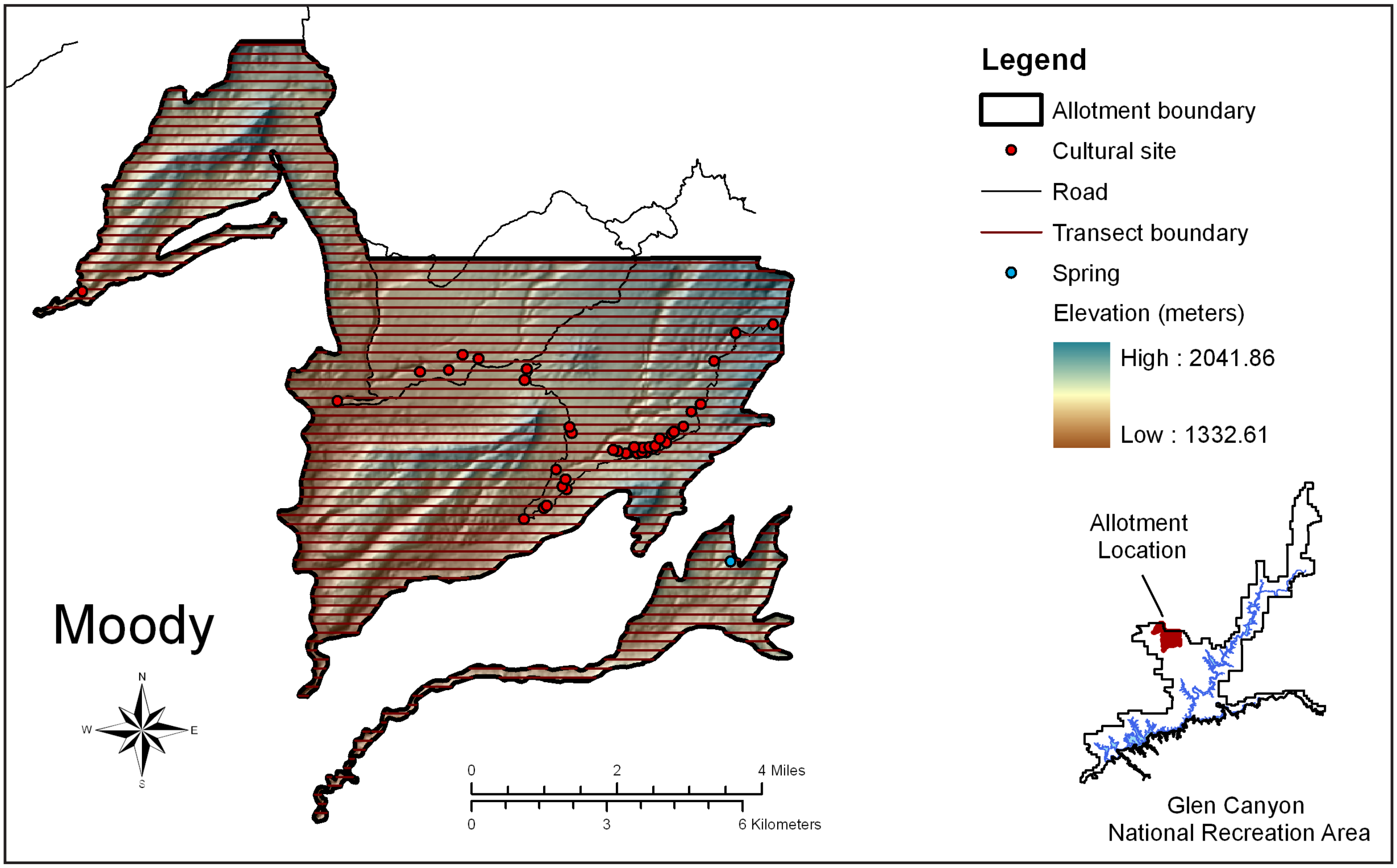
Slope Considerations:

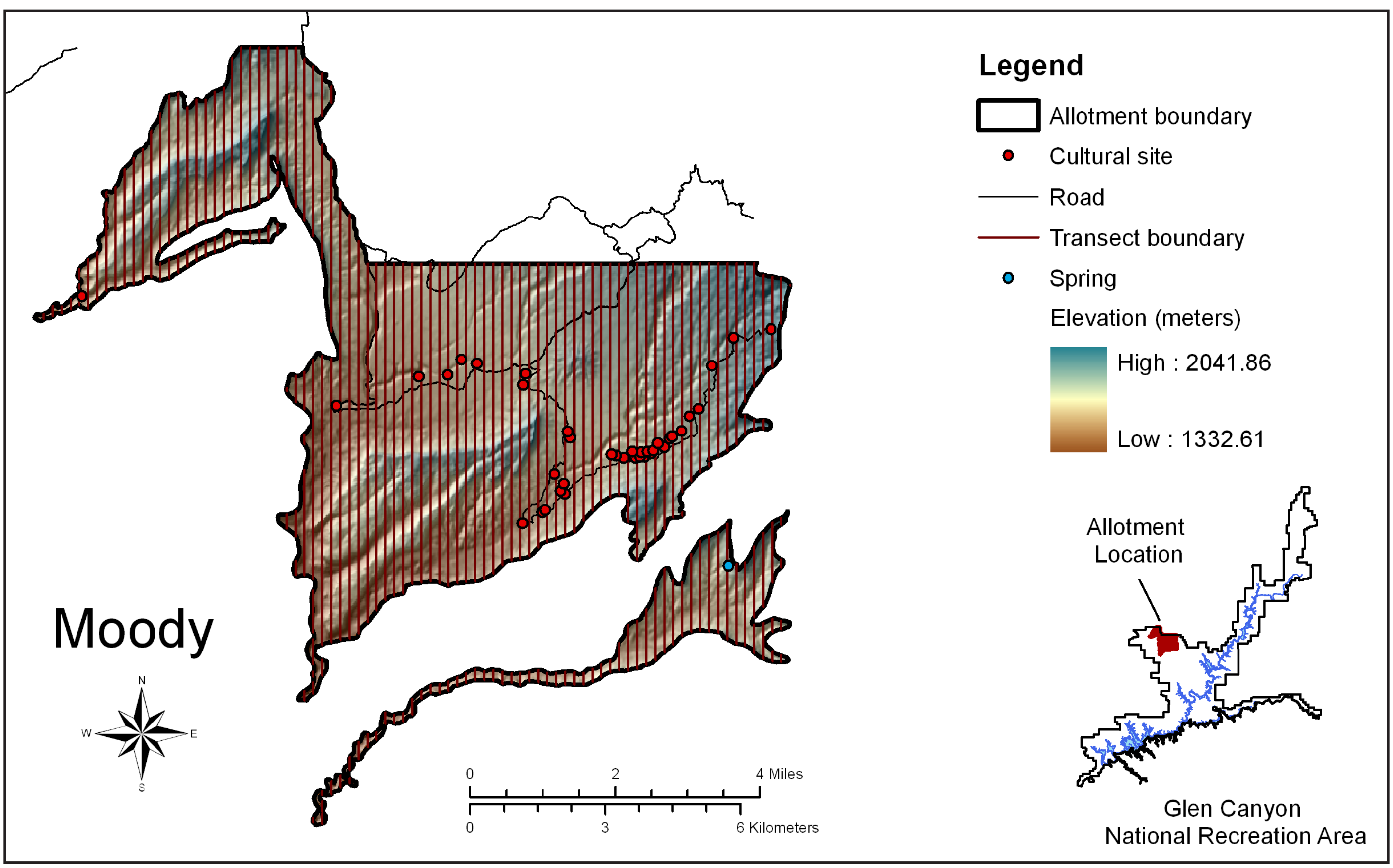
Slope plays a large role in terrain accessibility, and may be used in the stratification of survey areas. For example, GCNRA may wish to assign catagories such as low, moderate, and high to specific slope gradients. Such assignations are most often dependent on the factors guiding archaeological survey work, and as such, are not included in this document. Included herein, however, are suggestions for basic transect orientation based on the presence of topographical barriers identified by the presence of excessive slope gradients.

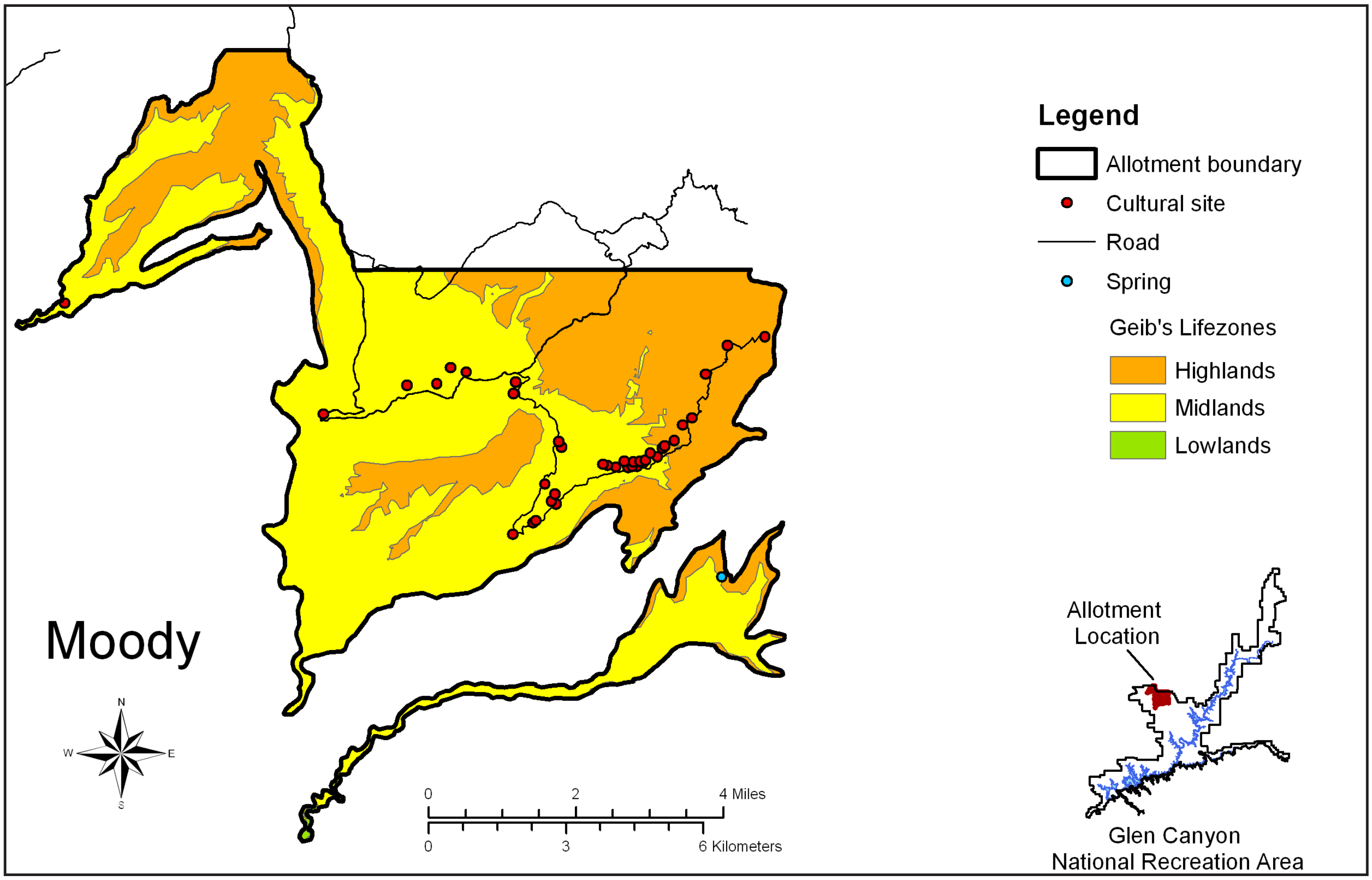
Survey Zones Dictated by Slope:

Canyons and steep slopes comprise most of the east, west, and south portions of Moody grazing allotment. The north-central portion of the allotment is fairly level, and accessible from County Hwy 332 and a southern lateral roadway. Recommended transects should be placed perpendicular to the roadways.

The 'fishnet' maps provided on the subsequent page display transects spaced at 200 meter intervals for both east-west and north-south oriented pedestrian survey.


Legend
Allotment boundary
Cultural site
Road
Transect boundary
Spring
Elevation (meters)
High : 2041.86
Low : 1332.61
Allotment Location
Glen Canyon National Recreation Area
Moody
N
W
E
S
0
2
4 Miles
0
3
6 Kilometers


Legend
Allotment boundary
Cultural site
Road
Transect boundary
Spring
Elevation (meters)
High : 2041.86
Low : 1332.61
Allotment Location
Glen Canyon National Recreation Area
Moody
N
W
E
S
0
2
4 Miles
0
3
6 Kilometers



Area of Each Lifezone:

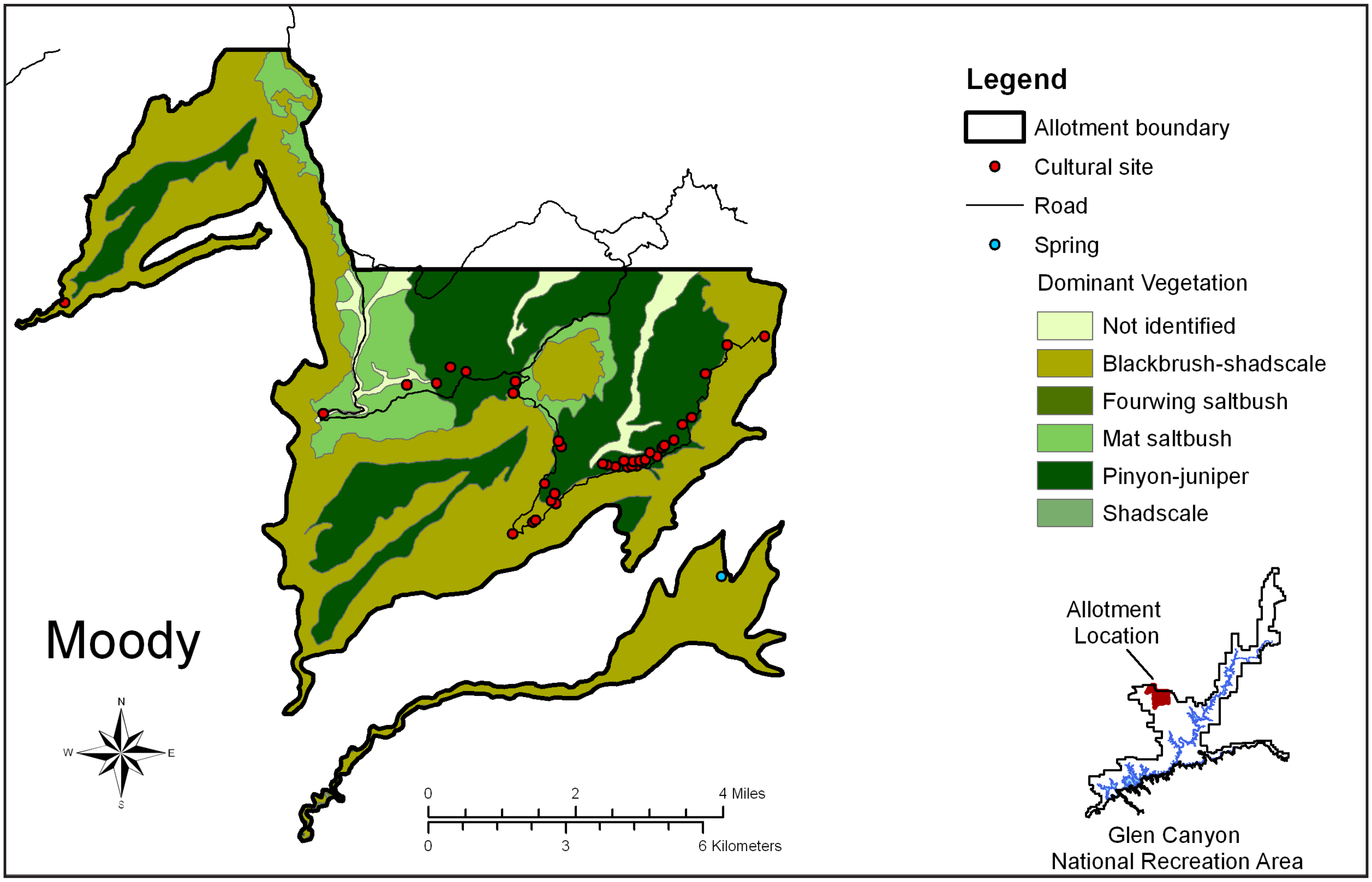
Highlands: 8734.53 acres
Midlands: 13,618.17 acres
Lowlands:17.96 acres

No. Cultural Sites in Each Lifezone:

Highlands: 8
Midlands: 30
Lowlands: 0

Lifezone Significance and Known Cultural Sites:
Although all of Geib's lifezones are present in Moody grazing allotment, known cultural sites (n = 38) are limited to the midlands and highlands. Midland locations provide important grasses, cacti, and hunting opportunities, particularly of antelope. Highlands include pinyon-juniper forests, which provide important food sources, as well as game animals such as deer and rabbit. Highlands also receive enough annual precipitation to allow for dry farming of agricultural products.

	Elevation	Characteristics	Environment	Significance to Humans
Lowlands	1219-1372 m (4000-4500 ft)	Hot and arid steep-walled sandstone canyons.	Riparian plants; big-horn sheep	Permanent water, arable alluvium, long growing season, diverse plant communities, natural shelters, quality siliceous stone from river gravels
Midlands	1372-1676 m (4500-5500 ft)	Arid slickrock and dune fields on benchlands and low plateaus.	Blackbrush, shadscale, grasses; antelope.	Grasses, including dropseed and ricegrass, prickly pear and shadscale; good antelope habitat, quality siliceous stone in certain locations.
Highlands	Above 1676 m (Above 5500 ft)	High elevation mesas and plateaus with cooler temperatures and greater precipitation.	Pinyon-juniper woodlands; deer and rabbit.	Higher elevation plant foods (i.e. pinyon); later harvests; dry-farming; abundant fuel, deer and rabbit.
Shading indicates lifezones present in allotment.				



Area of Individual Vegetation Zones:

Dominant Species	Acres Covered	No. Sites
Not identified	840.09	
Blackbrush-shadscale (*Coleogyne ramosissima - Atriplex confertifolia*)	12,449.53	7
Fourwing saltbush (*Atriplex canescens*)	0.24	0
Mat saltbush (*Atriplex corrugata*)	2247.32	1
Pinyon-juniper (*Pinus edulis - Juniperus osteosperma*)	6888.94	29
Shadscale (*Atriplex confertifolia*)	23.36	0
Total	**22,449.48**	**38**

No. Cultural Sites in Each Vegetation Zone:
Seven (n = 7) sites are located in blackbrush-shadscale. One site (n = 1) is located in mat saltbush. Twenty-nine (n = 29) sites are located in pinyon-juniper. The remaining site (n = 1) is located in an area where the dominant vegetation has not yet been identified.

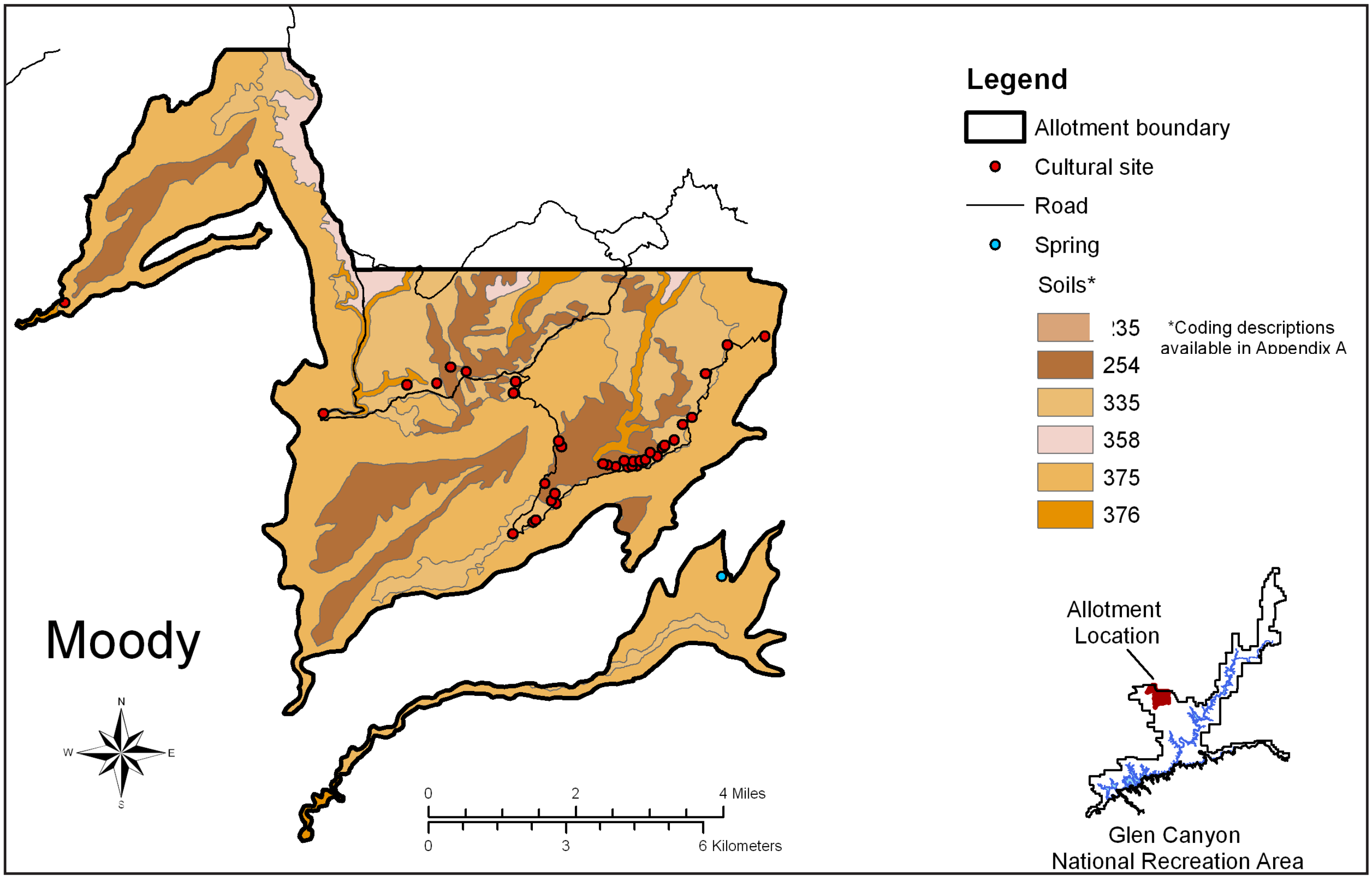
Visibility:
In general, the dominant vegetative communities of the allotment provide moderate - excellent ground visibility. However, in pinyon-juniper, ground visibility may be lessened by built-up organic matter.

Summary:
The primary dominant vegetation zones within Moody grazing allotment include blackbrush-shadscale (55.46 percent), fourwing saltbush (<0.00 percent), mat saltbush (10.01 per cent), pinyon-juniper (30.69 percent), and shadscale (0.10 percent). Dominant vegetation for the remainder of the allotment is not currently known.

Dominant Species:
Shadscale (*Atriplex confertifolia*)
Fourwing saltbush (*Atriplex canescens*)
Blackbrush (*Coleogyne ramosissima*)
Mat saltbush (*Atriplex corrugata*)
Pinyon (*Pinus edulis*)
Juniper (*Juniperus osteosperma*)

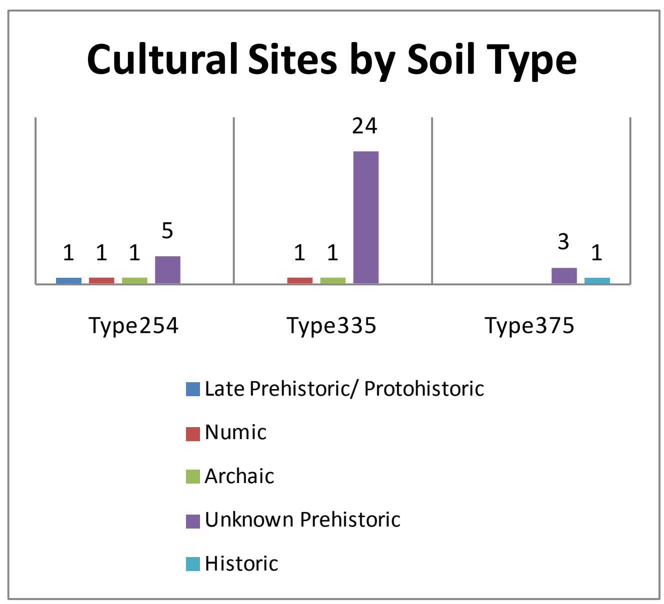
Secondary Dominant Species:
Fremont cottonwood (*Populus fremontii*)

Associated Soils:
Blackbrush-shadscale grows in shallow clay, where it grows with mat saltbush. Fourwing saltbush grows in sandy bottoms, sometimes in association with Fremont cottonwood in semiwet saline streambanks. Mat saltbush occurs in sandy loam, often with shadscale growing in shallow sandy loam. Both pinyon-juniper and shadscale dominate in shallow sandy loam.



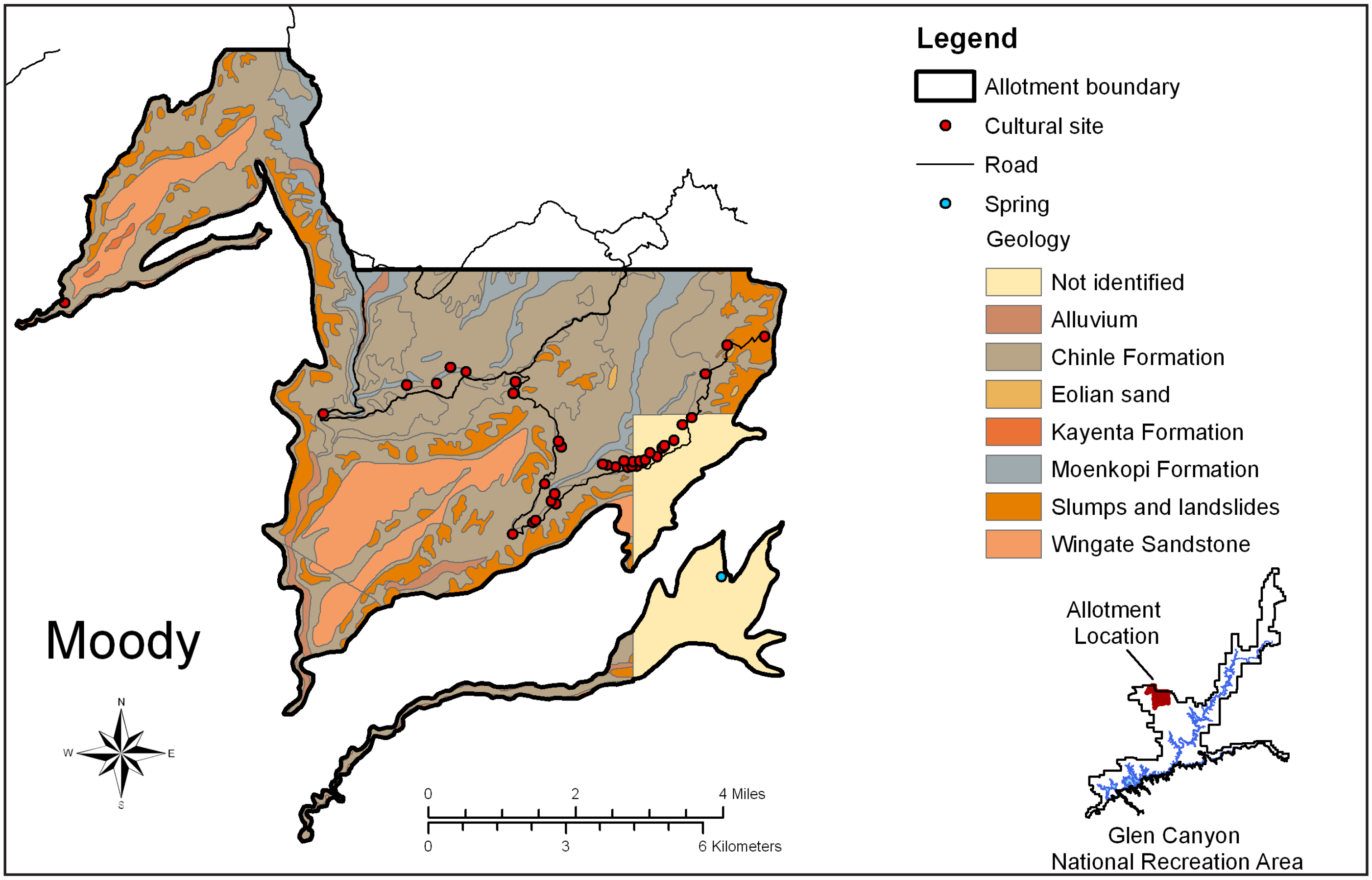
Allotment Divided by Soil Type (MUSYM):

Soil Type	Acres	Percent	No. Cultural Sites
235	1.71	<0.00	0
254	4126.62	18.38	8
335	4317.95	19.23	26
358	734.85	3.27	0
375	12,435.92	55.40	4
376	832.44	3.71	0
Total	**22,449.49**	**99.99%**	**38**



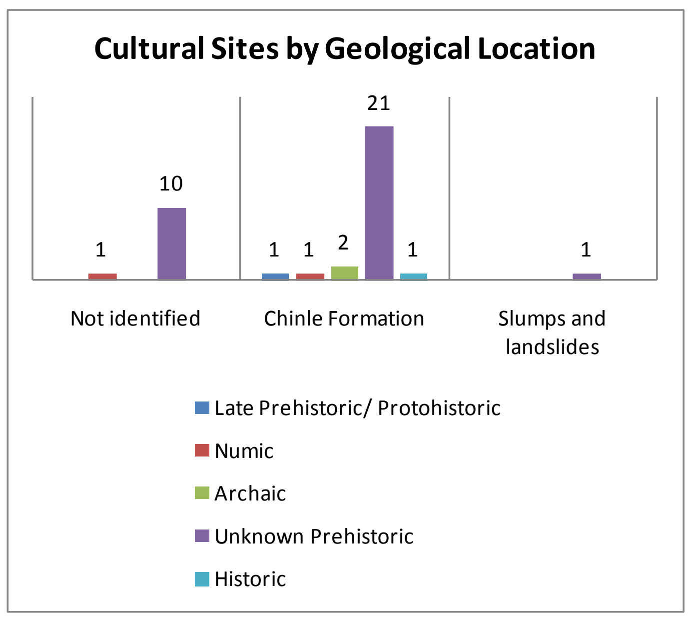
Distribution of Cultural Sites by Soil Type:

Eight sites (n = 8), including a Late Prehistoric site, a Numic site, an Archaic site, two lithic scatters, one artifact scatter, and two sites with features, are located in soil type 254. Twenty-six (n = 26) sites are located in soil type 335. These sites include an Archaic site, a Numic site, and 24 currently unaffiliated prehistoric sites, including 14 sites with features, one artifact scatter, and nine lithic scatters. The remaining four (n = 4) sites, including one historic site and three prehistoric sites, of which one is a lithic scatter, and two contain features, are located in soil type 375.



Allotment Divided by Geology:

Geology	Acres	Percent	No. Cultural Sites
Not identified	2502.75	11.12	11
Alluvium	464.65	2.07	0
Chinle Formation	12,483.46	55.61	26
Eolian sand	28.56	0.13	0
Kayenta Formation	34.05	0.15	0
Moenkopi Formation	1454.14	6.48	0
Slumps and landslides	2719.78	12.12	1
Wingate Sandstone	2762.09	12.31	0
Total	**22,449.48**	**99.99%**	**38**

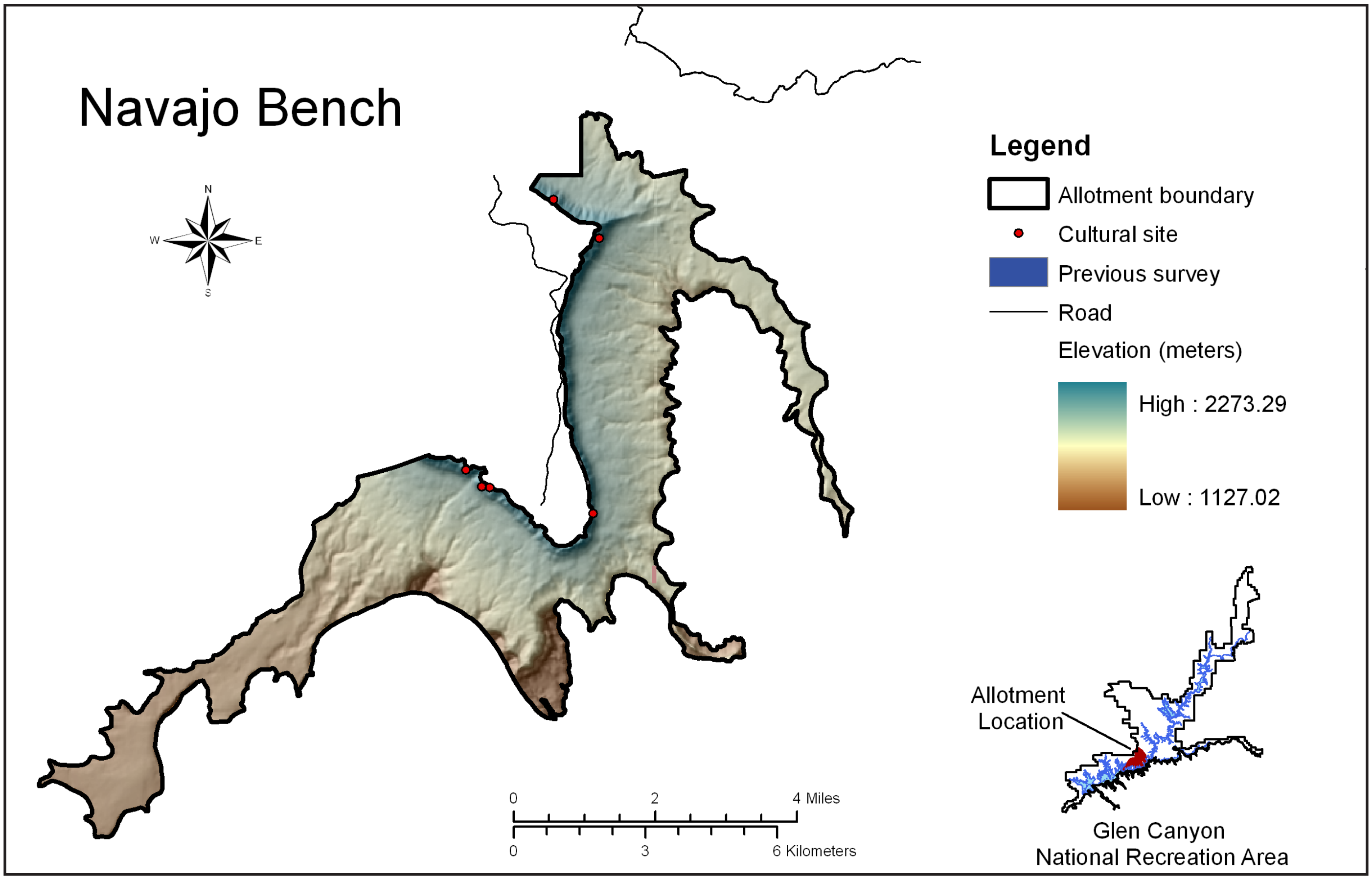


Distribution of Cultural Sites by Geological Location:

Twenty-six (n = 26) sites are located on Chinle Formation geology. These sites include a historic site, two Archaic sites, a Late Prehistoric site, a Numic site, and 21 currently unaffiliated prehistoric sites, of which 13 have features, two are artifact scatters, and six are lithic scatters. An isolated hearth (n = 1) is located on slump and landslide deposits. The remaining sites (n = 11) are located in areas for which the geological context is not currently available.

Navajo Bench

Map Panels



Total Area: 13,966.00 acres

Sampling Fractions:
2 percent: 279.32 acres
5 percent: 698.30 acres
11 percent: 1536.26 acres
16 percent: 2234.56 acres
20 percent: 2793.20 acres

Elevation range amsl:
1127.02 – 2273.29 meters (3697.57 - 7458.30 feet)

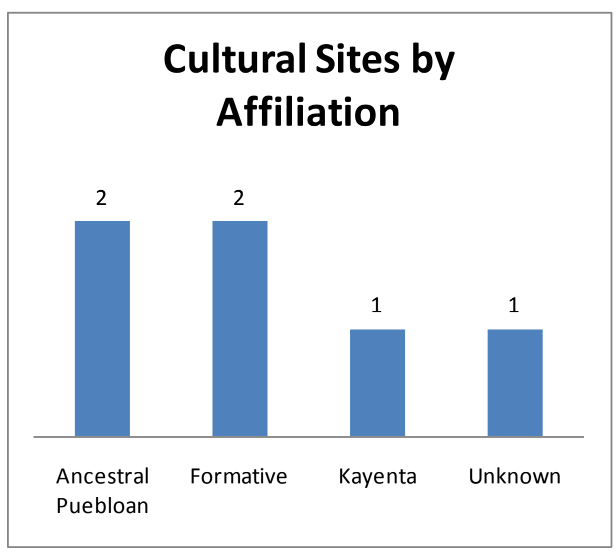
Rivers and Springs:
None known.

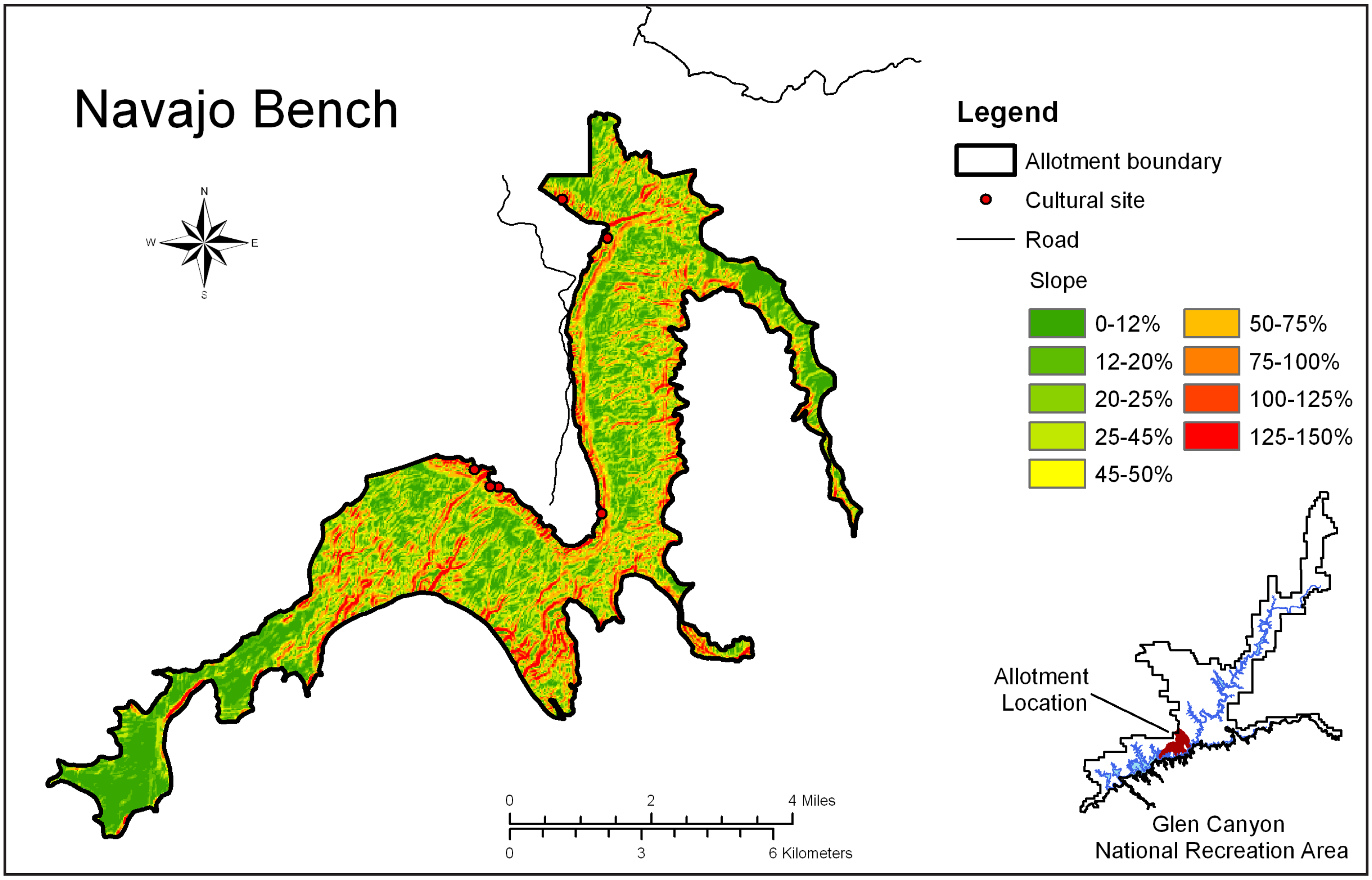
Accessibility:
Hole-in-the-Rock Road (County Hwy 330) provides access to the allotment. Dangling Rope Marina may also prove a resource for boat access to Navajo Bench allotment.

No. Cultural Sites: 6
Area surveyed: 0.84 acres

Survey References:
GLCA (1994): 0.38 acres
GLCA (1995): 0.46 acres

The figure below depicts known cultural sites by affiliation. As the information available is minimal, only one figure is included for this allotment.





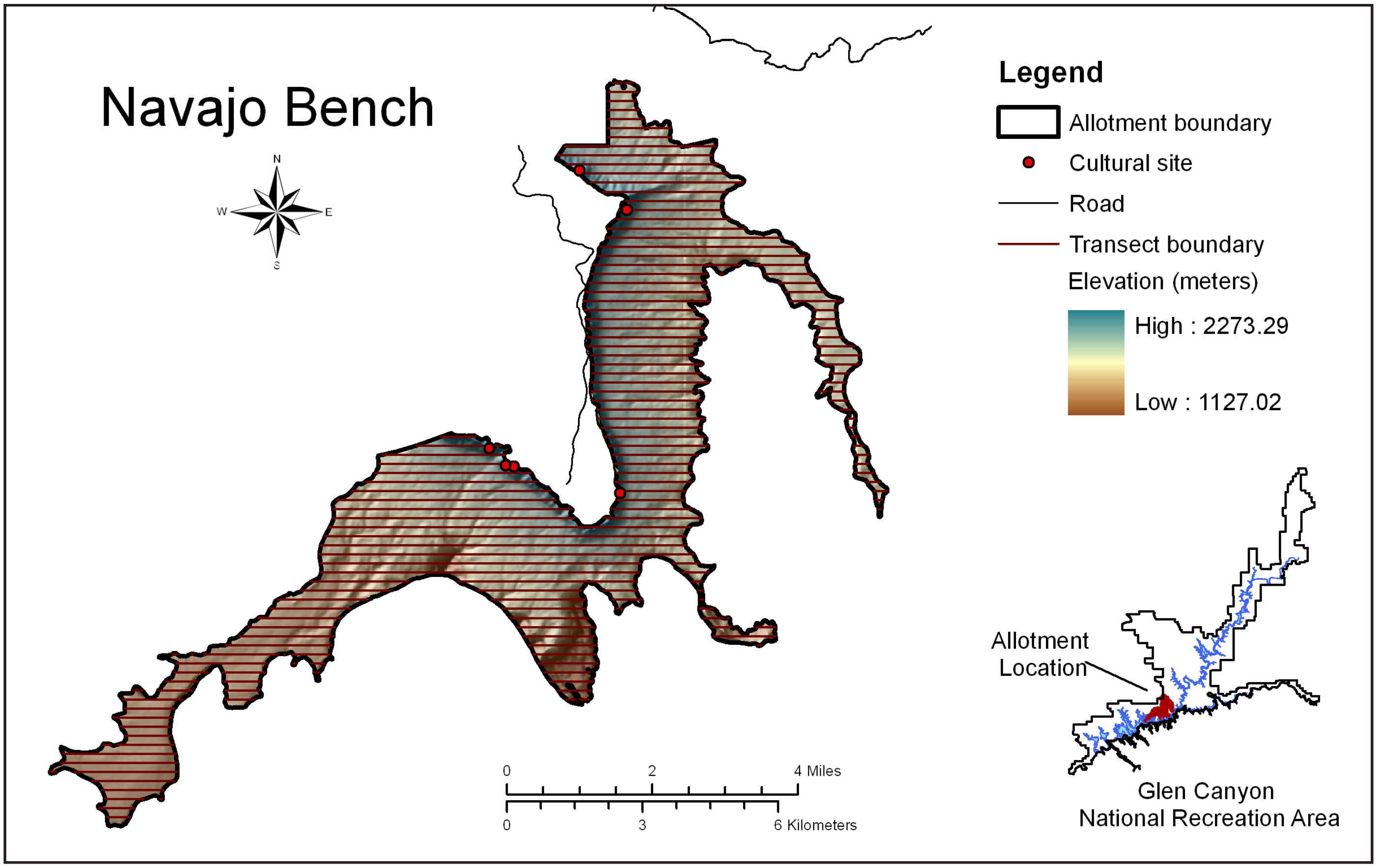
Slope Considerations:

Slope plays a large role in terrain accessibility, and may be used in the stratification of survey areas. For example, GCNRA may wish to assign catagories such as low, moderate, and high to specific slope gradients. Such assignations are most often dependent on the factors guiding archaeological survey work, and as such, are not included in this document. Included herein, however, are suggestions for basic transect orientation based on the presence of topographical barriers identified by the presence of excessive slope gradients.

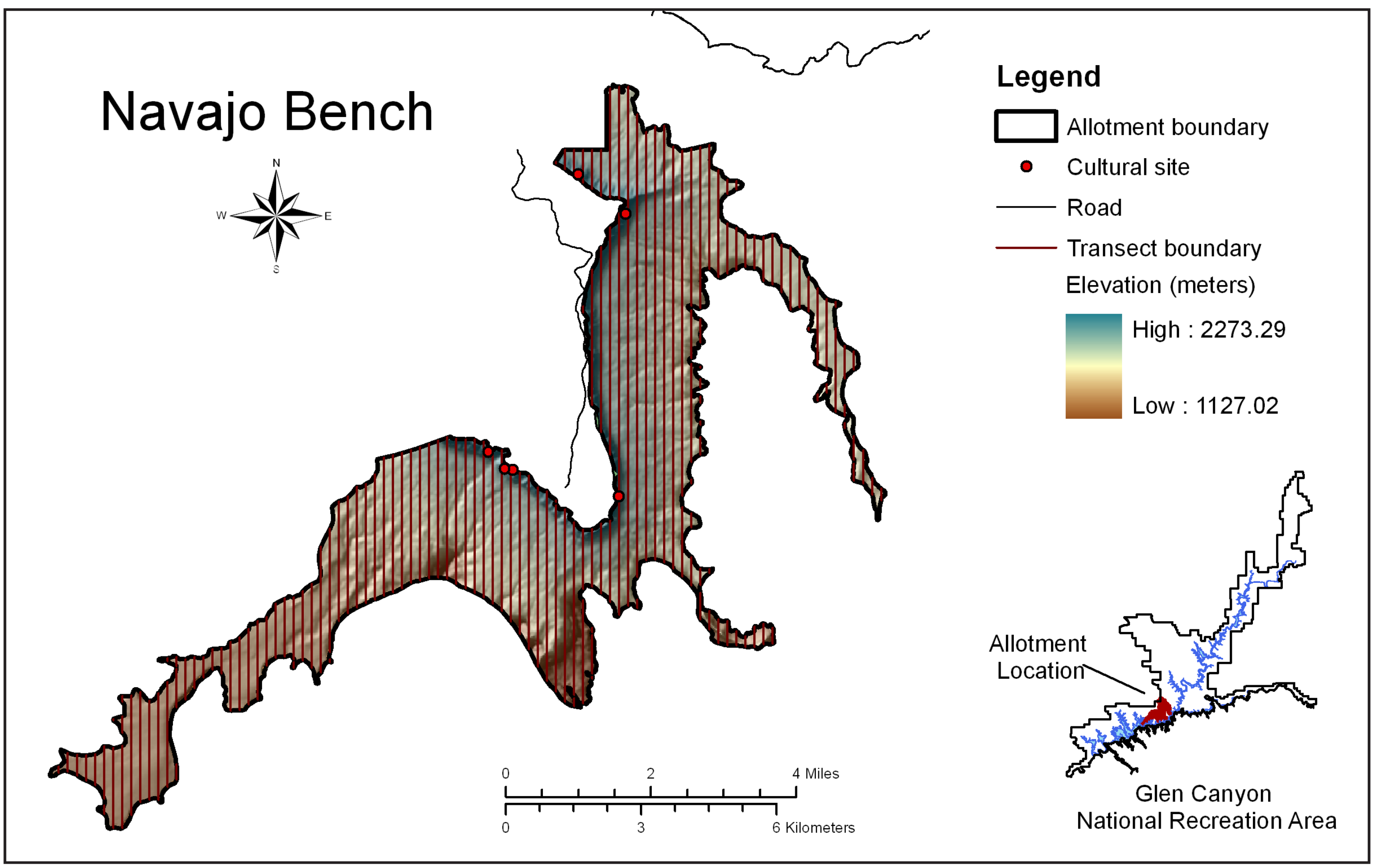
Survey Zones Dictated by Slope:

In the southern half of the allotment, north-south transects are recommended where possible, and in the north, east-west transects should allow for avoidance of east-west trending slopes. However, canyons and escarpments will likely provide access problems in much of the allotment.

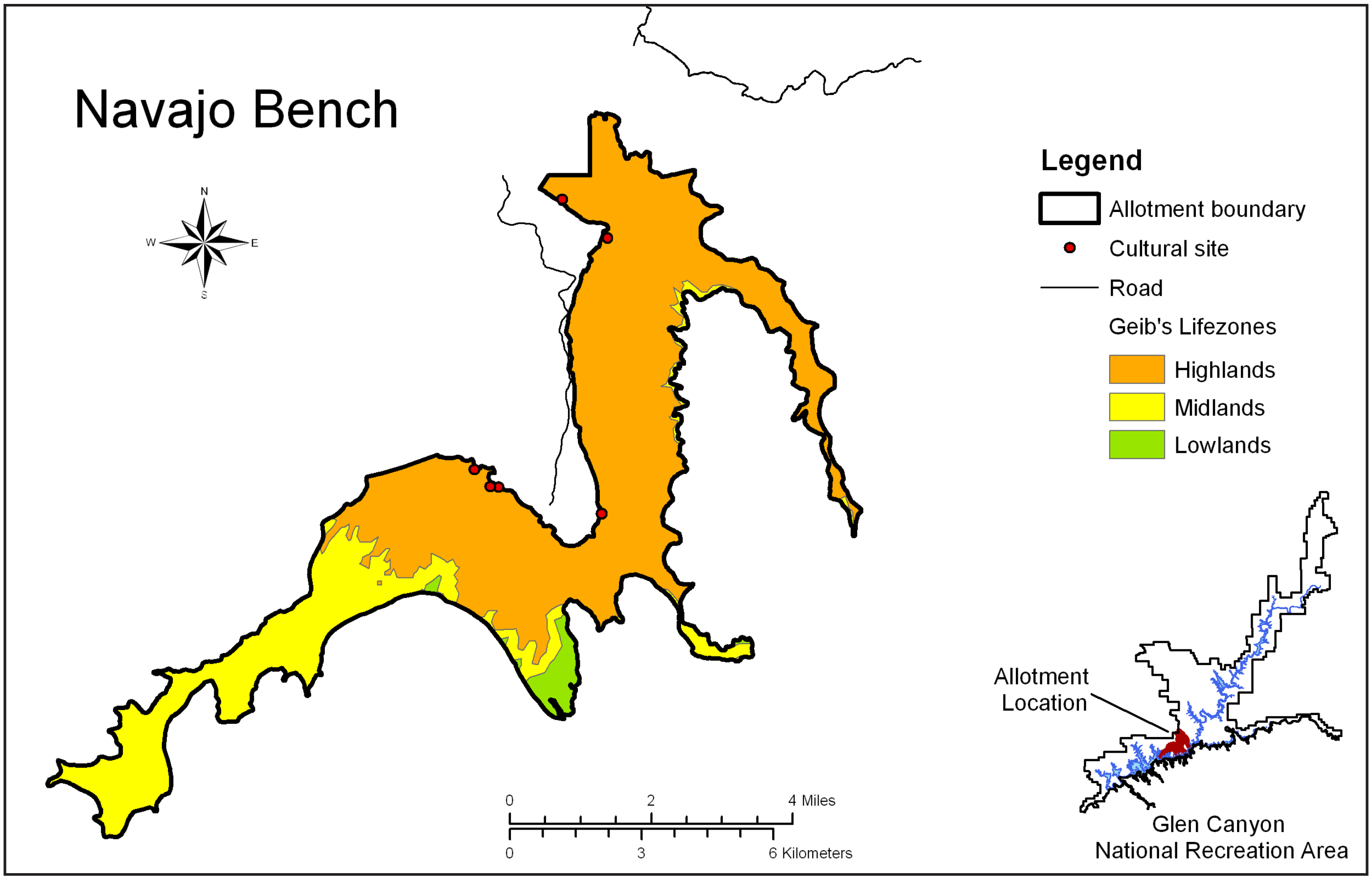
The 'fishnet' maps provided on the subsequent page display transects spaced at 200 meter intervals for both east-west and north-south oriented pedestrian survey.



Navajo Bench
N
W
E
S
Legend
Allotment boundary
Cultural site
Road
Transect boundary
Elevation (meters)
High : 2273.29
Low : 1127.02
0
2
4 Miles
0
3
6 Kilometers
Allotment Location
Glen Canyon National Recreation Area



Navajo Bench
N
W
E
S
Legend
Allotment boundary
Cultural site
Road
Transect boundary
Elevation (meters)
High : 2273.29
Low : 1127.02
0
2
4 Miles
0
3
6 Kilometers
Allotment Location
Glen Canyon National Recreation Area



Area of Each Lifezone:

Highlands: 9884.24acres
Midlands: 3662.42 acres
Lowlands: 396.20 acres

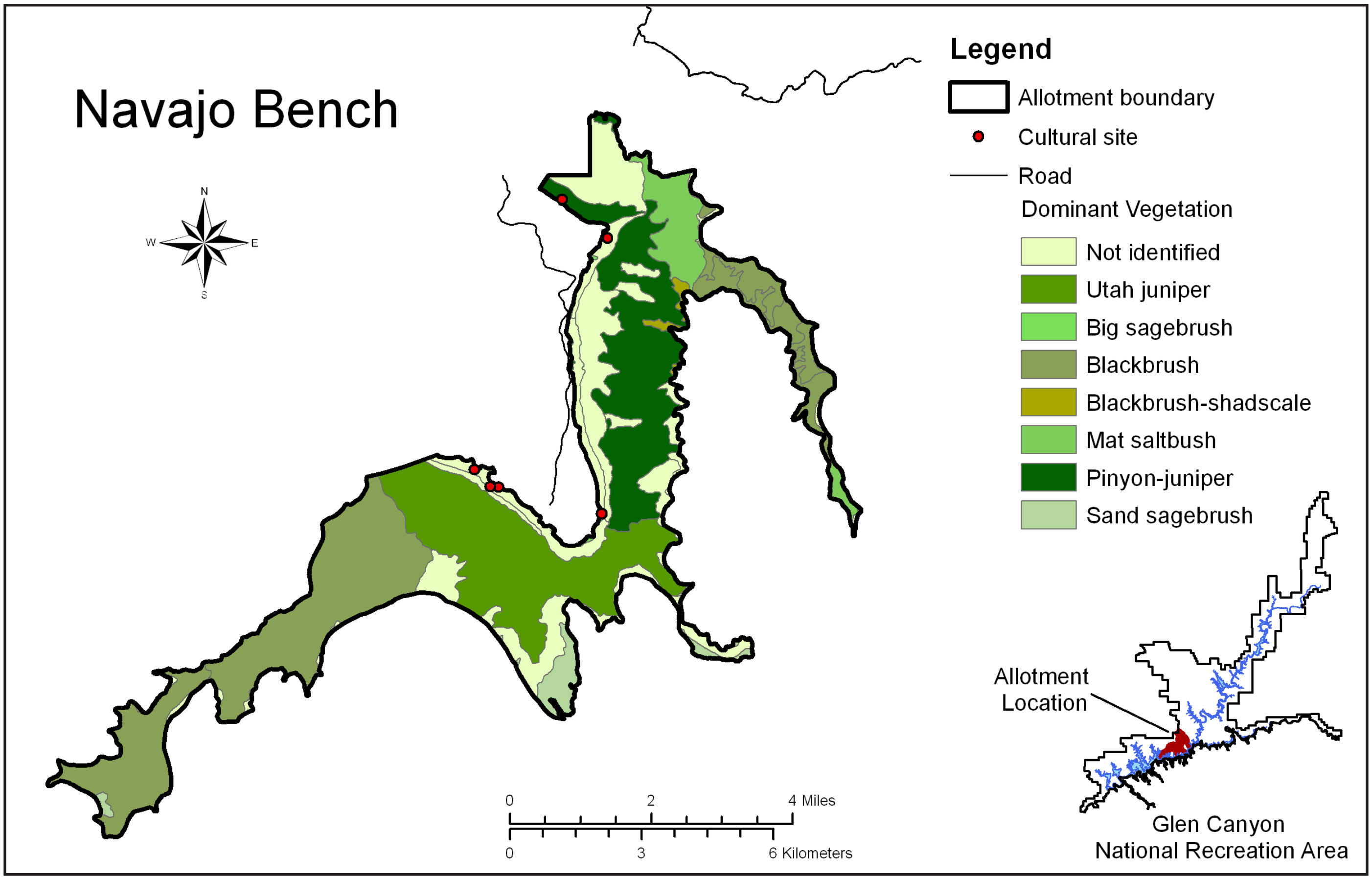
No. Cultural Sites in Each Lifezone:

Highlands: 6
Midlands: 0
Lowlands: 0

Lifezone Significance and Known Cultural Sites:
Although all of Geib's lifezones are present in Navajo Bench allotment, all known cultural sites (n =6) are located in the highlands. Geib describes the highlands as having cooler temperatures and higher precipitation than lower elevations, allowing for dry farming and later harvests. In addition, Geib notes that the highlands provide important natural foods, including pinyon, deer, and rabbit.

	Elevation	Characteristics	Environment	Significance to Humans
Lowlands	1219-1372 m (4000-4500 ft)	Hot and arid steep-walled sandstone canyons.	Riparian plants; big-horn sheep	Permanent water, arable alluvium, long growing season, diverse plant communities, natural shelters, quality siliceous stone from river gravels
Midlands	1372-1676 m (4500-5500 ft)	Arid slickrock and dune fields on benchlands and low plateaus.	Blackbrush, shadscale, grasses; antelope.	Grasses, including dropseed and ricegrass, prickly pear and shadscale; good antelope habitat, quality siliceous stone in certain locations.
Highlands	Above 1676 m (Above 5500 ft)	High elevation mesas and plateaus with cooler temperatures and greater precipitation.	Pinyon-juniper woodlands; deer and rabbit.	Higher elevation plant foods (i.e. pinyon); later harvests; dry-farming; abundant fuel, deer and rabbit.

Shading indicates lifezones present in allotment.



Area of Individual Vegetation Zones:

Dominant Species	Acres Covered	No. Sites
Not identified	3278.72	6
Utah juniper ***(Juniperus osteosperma)***	2867.19	0
Big sagebrush (*Artemisia tridentata*)	24.70	0
Blackbrush (*Coleogyne ramosissima*)	4216.45	**0**
Blackbrush-shadscale (*Coleogyne ramosissima - Atriplex confertifolia*)	86.18	0
Mat saltbush (*Atriplex corrugata*)	707.69	0
Pinyon-juniper (*Pinus edulis - Juniperus osteosperma*)	2399.25	0
Sand sagebrush (*Artemisia filifolia*)	385.82	0
Total	**13,966.00**	**6**

No. Cultural Sites in Each Vegetation Zone:
One site (n = 1) is located in pinyon-juniper. The remainder (n = 5) occur in areas where dominant vegetation has not yet been identified.

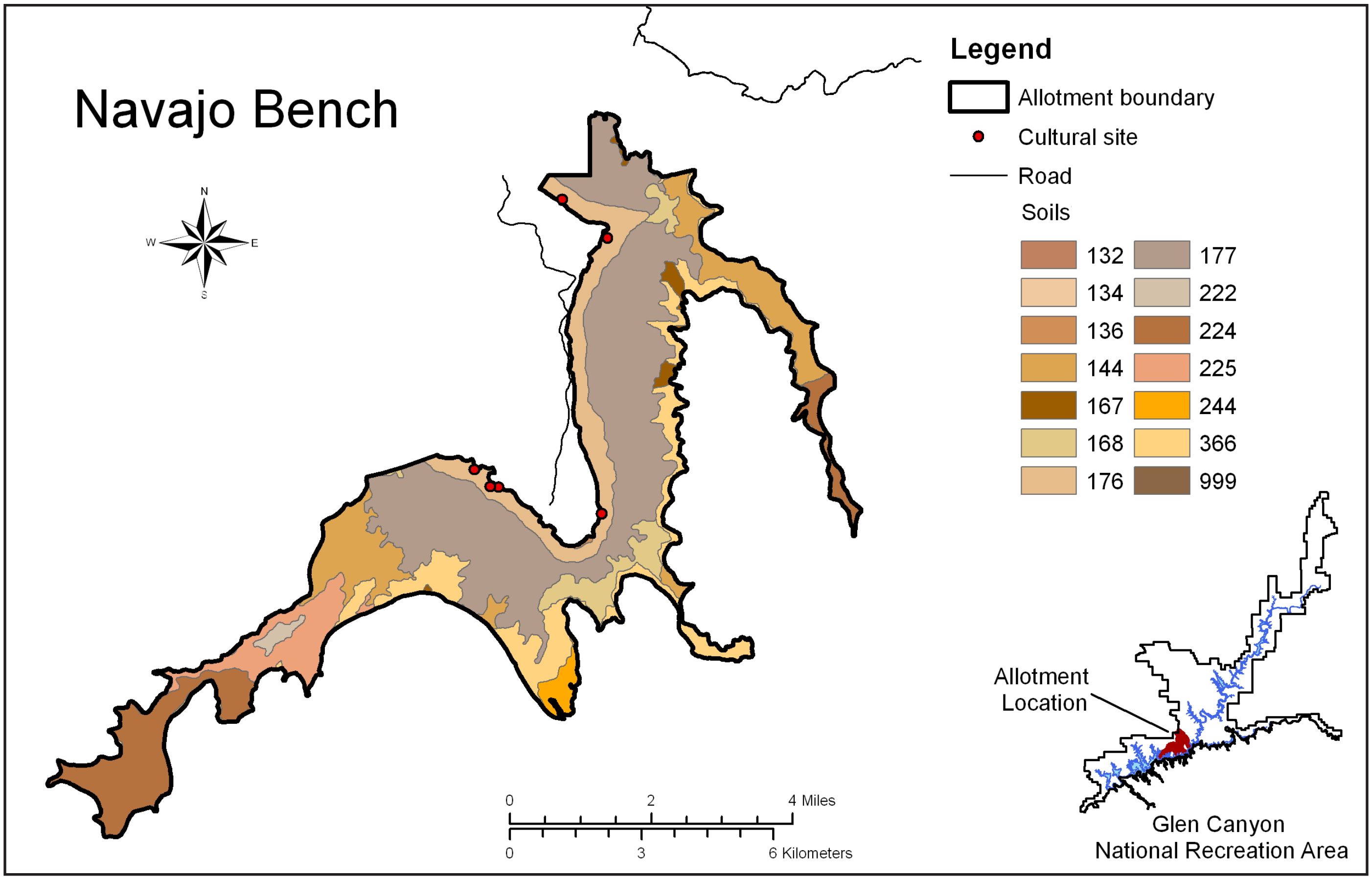
Visibility:
In areas dominated by shrubby vegetation, visibility should be moderate - excellent. However, in Utah juniper and pinyon-juniper, ground visibility may be hindered by built-up organic material beneath the trees.

Summary:
Utah juniper accounts for 20.53 percent of the dominant vegetation in Navajo Bench. Also present are big sagebrush (0.18 percent), blackbrush (30.19 percent), blackbrush-shadscale (0.62 percent), mat saltbush (5.07 percent, and sand sagebrush (2.77 percent).

Dominant Species:
Big sagebrush (*Artemisia tridentata*)
Blackbrush (*Coleogyne ramosissima*)
Pinyon (*Pinus edulis*)
Juniper, Utah Juniper *(Juniperus osteosperma*)
Shadscale (*Atriplex confertifolia*)
Sand sagebrush (*Artemisia filifolia*)
Mat saltbush (*Atriplex corrugata*)

Secondary Dominant Species:
Fourwing saltbush (*Atriplex canescens*)

Associated Soils:
Big sagebrush grows in loam, alongside pinyon-juniper in stony loam. Blackbrush occurs in sandy loam, and in shallow loam with fourwing saltbush in sandy loam. Blackbrush-shadscale dominates in talus, and mat saltbush in shallow clay. Pinyon-juniper grow in shallow loam, gravelly loam, and very steep stony loam. Sand sagebrush occurs in sand, often alongside blackbrush in shallow sandy loam. Finally, Utah juniper occurs in stony loam alongside pinyon-juniper in gravelly loam.

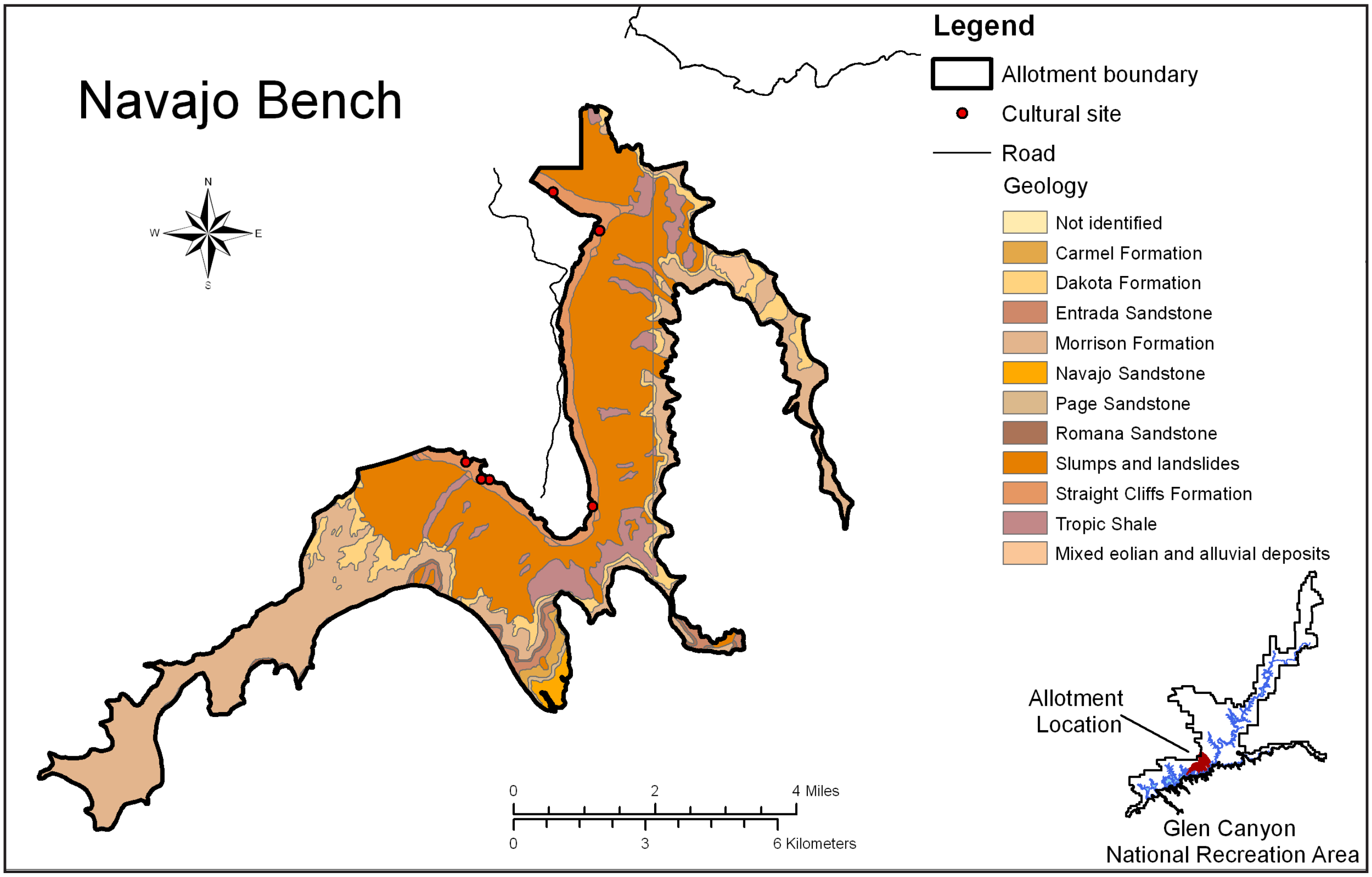


Allotment Divided by Soil Type (MUSYM):

Soil Type	Acres	Percent	No. Cultural Sites
132	2.30	<0.00	0
134	9.90	<0.00	0
136	11.94	<0.00	0
144	1673.34	11.98	0
167	153.08	1.20	0
168	584.10	4.18	0
176	1400.13	10.03	6
177	5589.25	40.02	0
222	86.84	0.62	0
224	1479.08	10.59	0
225	787.64	5.64	0
244	202.80	1.45	0
366	1984.93	14.21	0
999	0.65	<0.00	0
Total	**13,965.98**	**99.92%**	**6**

Distribution of Cultural Sites by Soil Type:

All known cultural sites (n = 6) are located in soil type 176.



Allotment Divided by Geology:

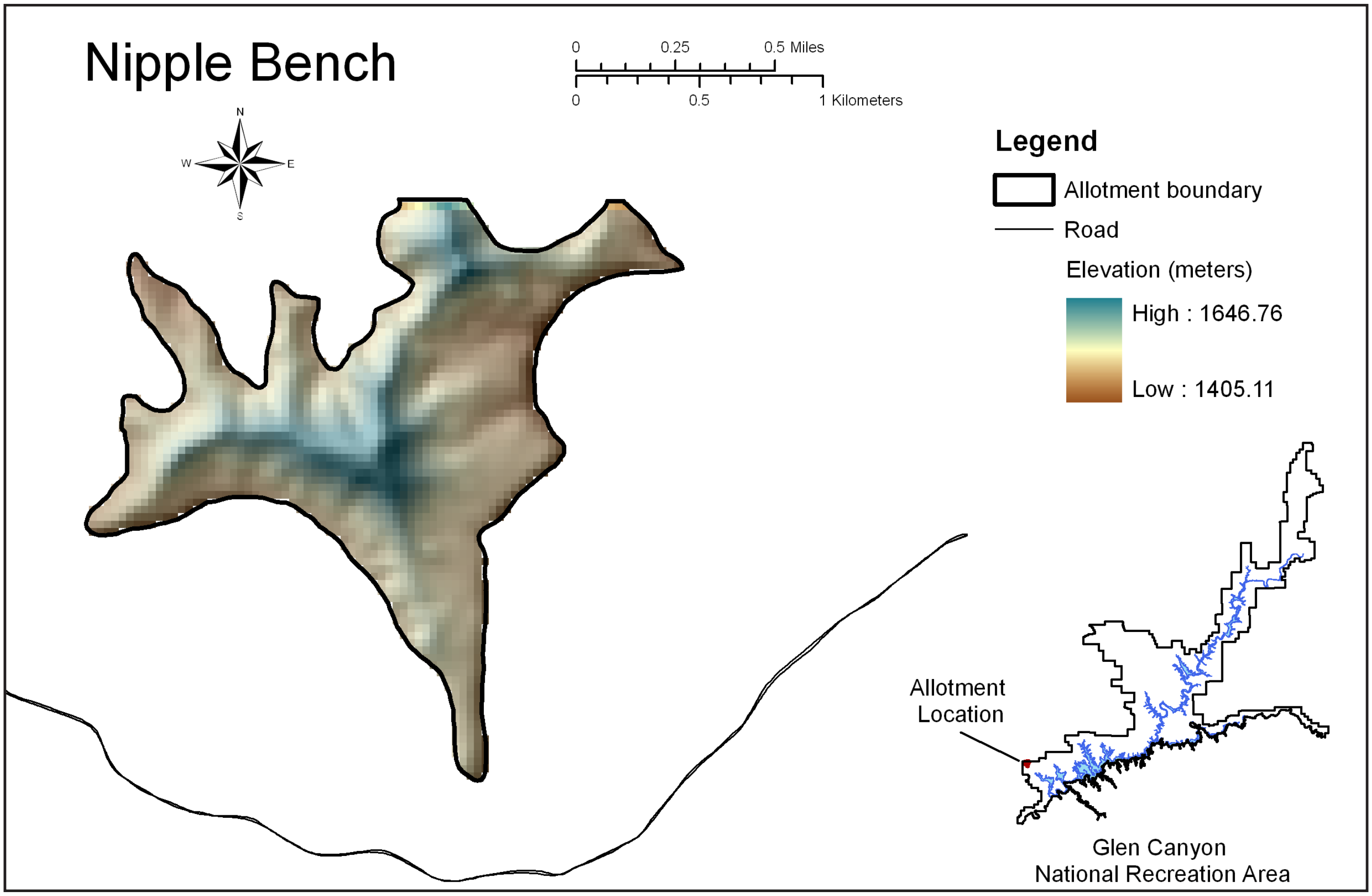
Geology	Acres	Percent	No. Cultural Sites
Not identified	1.14	<0.00	0
Carmel Formation	118.69	0.85	0
Dakota Formation	1130.35	8.09	0
Entrada Sandstone	225.63	1.62	0
Morrison Formation	4349.80	31.46	0
Navajo Sandstone	140.34	1.00	0
Page Sandstone	51.64	0.37	0
Romana Sandstone	172.21	1.23	0
Slumps and landslides	5777.69	41.37	0
Straight Cliffs Formation	862.87	6.18	6
Tropic Shale	1026.84	7.35	0
Mixed eolian and alluvial deposits	108.87	0.78	0
Total	**13,965.65**	**100.03%**	**6**

Distribution of Cultural Sites by Geological Location:

All known cultural sites (n = 6) occur on Straight Cliffs Formation geology.

Nipple Bench

Map Panels



Total Area: 486.22 acres

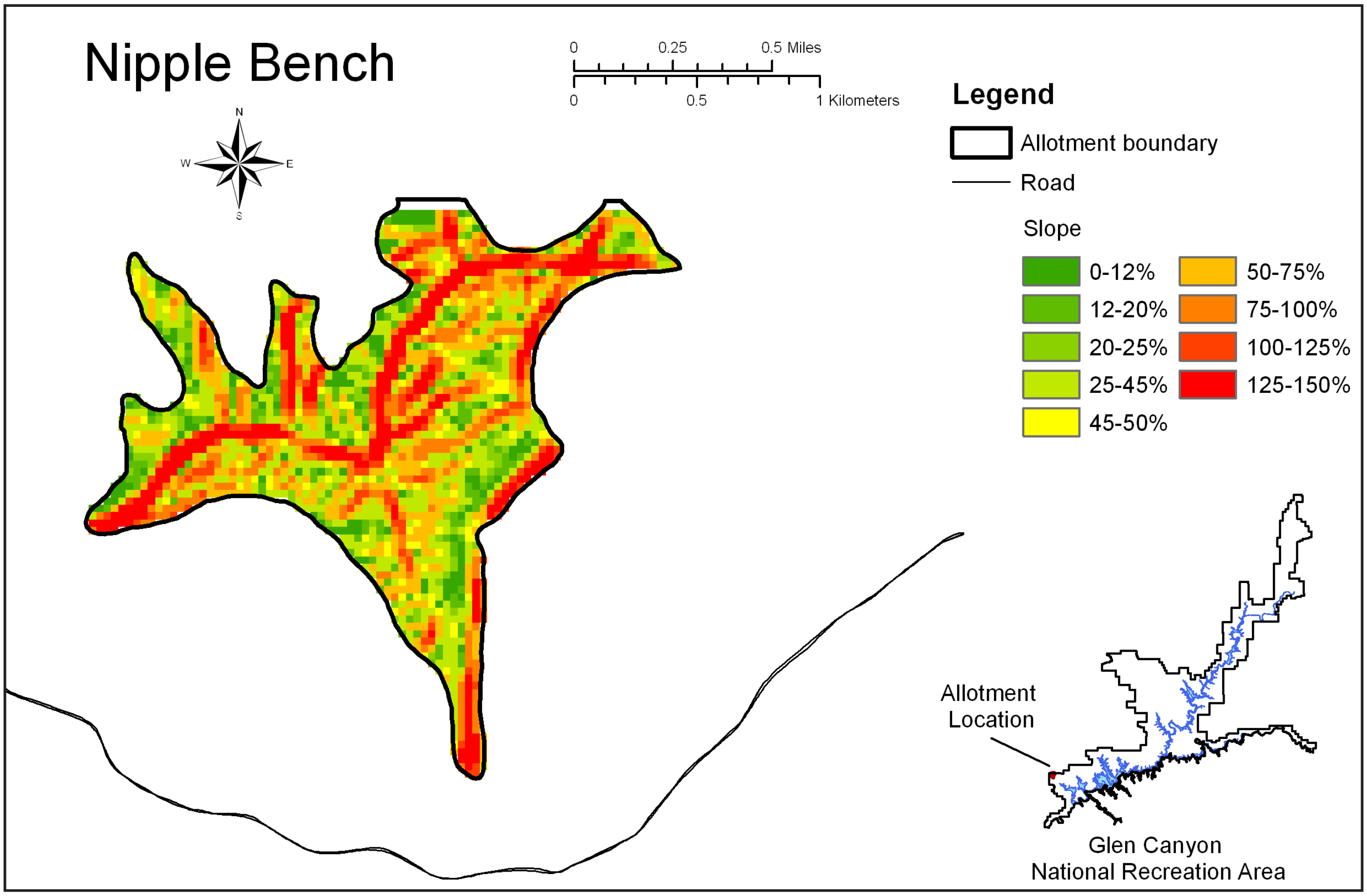
Sampling Fractions:
2 percent: 9.72 acres
5 percent: 24.31 acres
11 percent: 168.99 acres
16 percent: 77.80 acres
20 percent: 97.24 acres

Elevation range amsl:
1505.11 – 1646.76 meters (4938.02 - 5402.76 feet)

Rivers and Springs:
None known.

Accessibility:
County Hwy 230 runs east-west south of Nipple Bench allotment.

No. Cultural Sites: 0
Area surveyed: 0.00 acres



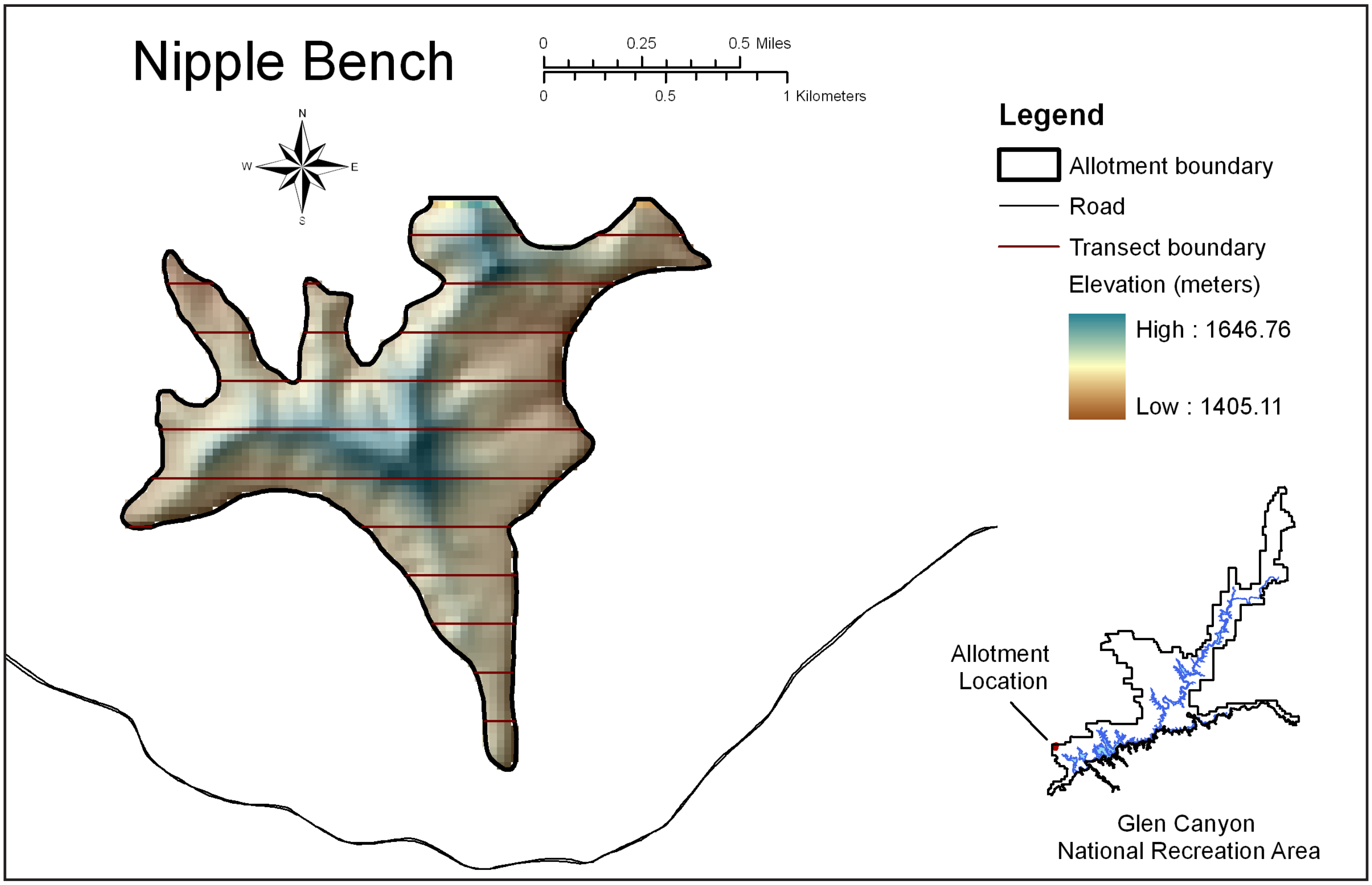
Slope Considerations:

Slope plays a large role in terrain accessibility, and may be used in the stratification of survey areas. For example, GCNRA may wish to assign catagories such as low, moderate, and high to specific slope gradients. Such assignations are most often dependent on the factors guiding archaeological survey work, and as such, are not included in this document. Included herein, however, are suggestions for basic transect orientation based on the presence of topographical barriers identified by the presence of excessive slope gradients.

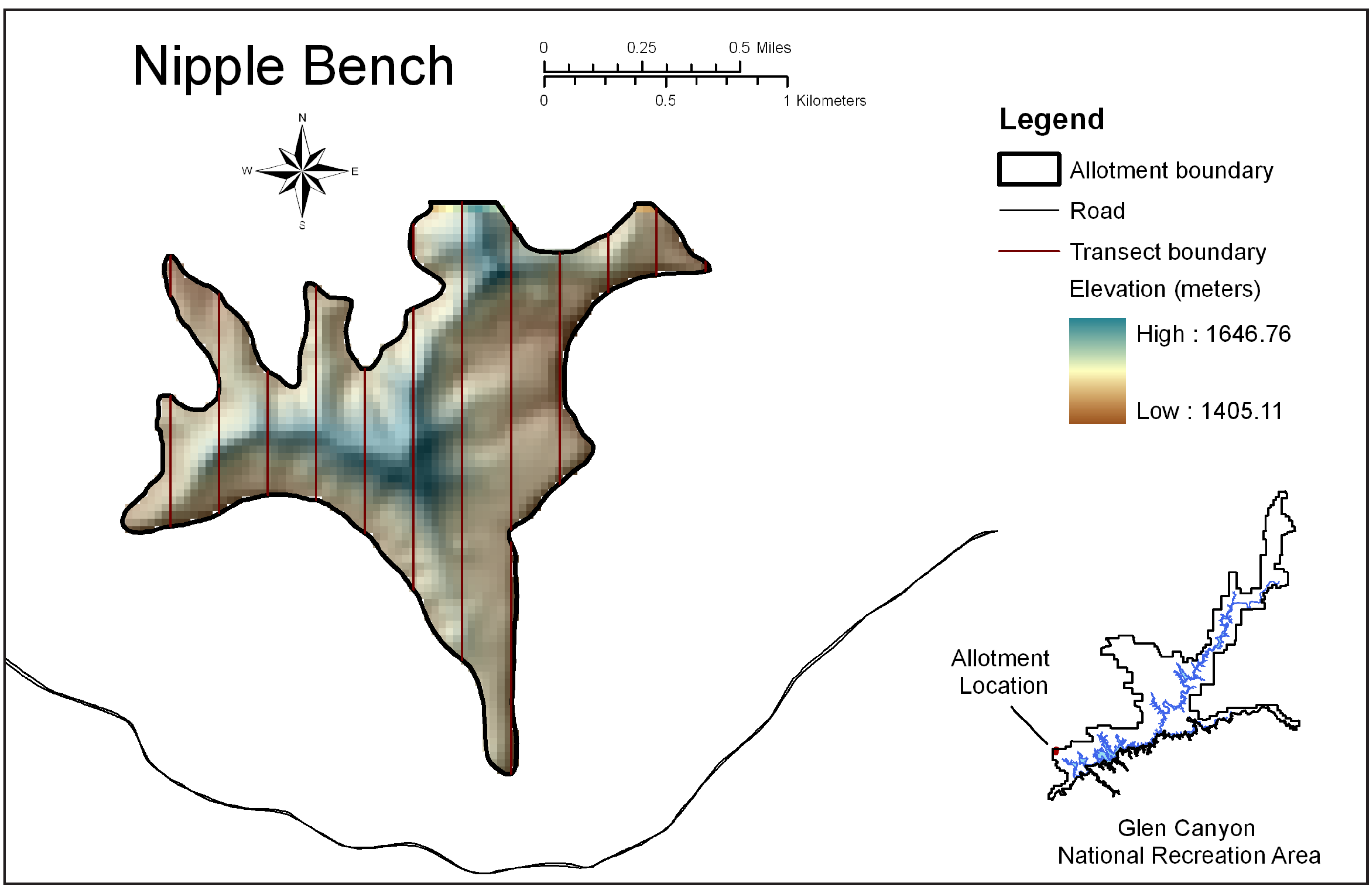
Survey Zones Dictated by Slope:

Steep slopes characterize most of Nipple Bench allotment. County Hwy 230 provides near access to the allotment, and north-south oriented transects set perpendicular to the road and roughly parallel to the eastern edge of the allotment are recommended when possible.

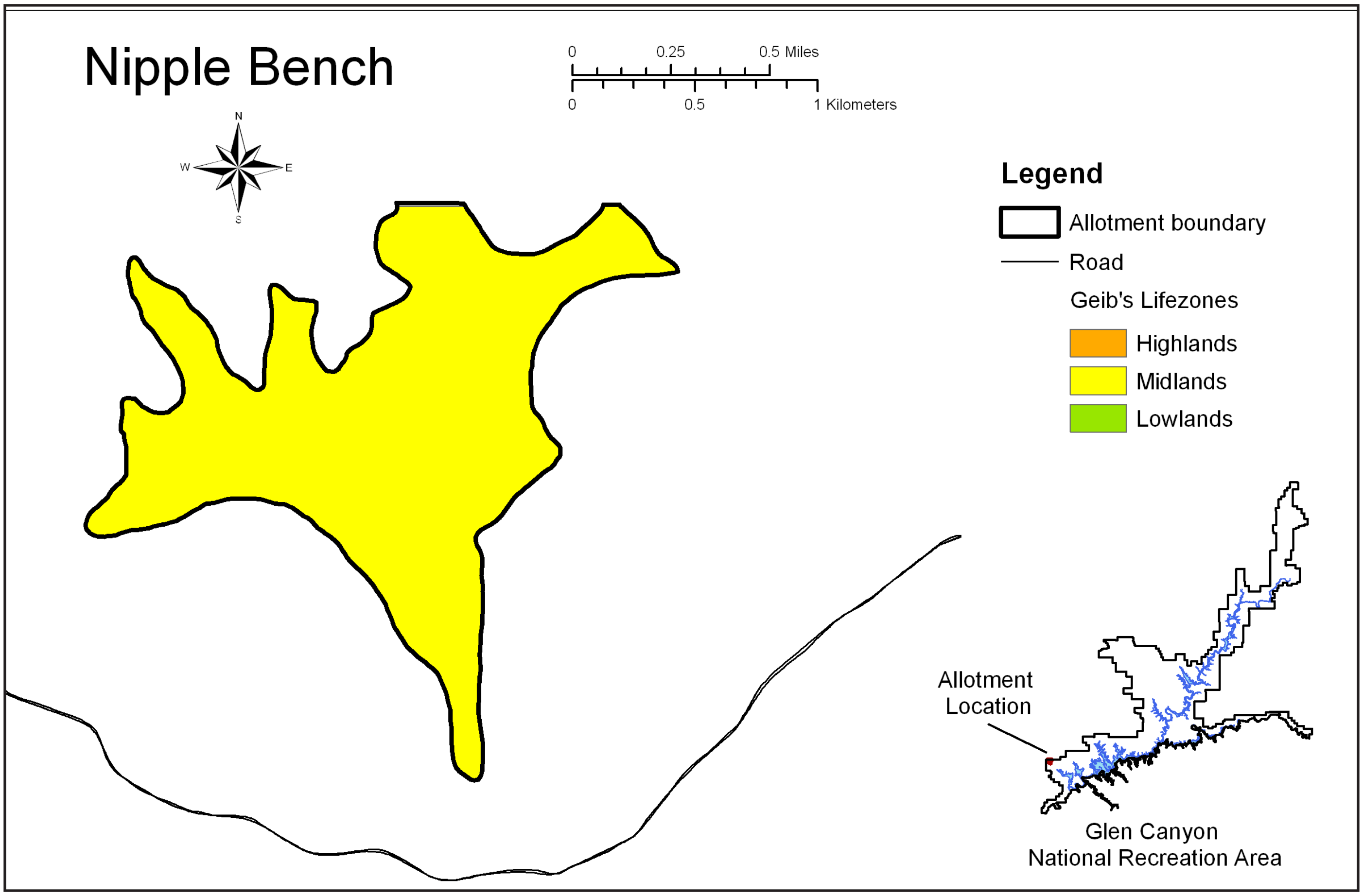
The 'fishnet' maps provided on the subsequent page display transects spaced at 200 meter intervals for both east-west and north-south oriented pedestrian survey.



Nipple Bench
0
0.25
0.5 Miles
0
0.5
1 Kilometers
N
W
E
S
Legend
Allotment boundary
Road
Transect boundary
Elevation (meters)
High : 1646.76
Low : 1405.11
Allotment Location
Glen Canyon National Recreation Area



Nipple Bench
0
0.25
0.5 Miles
0
0.5
1 Kilometers
N
W
E
S
Legend
Allotment boundary
Road
Transect boundary
Elevation (meters)
High : 1646.76
Low : 1405.11
Allotment Location
Glen Canyon National Recreation Area



Area of Each Lifezone:

Highlands: 0.00 acres
Midlands: 486.22 acres
Lowlands: 0.00 acres

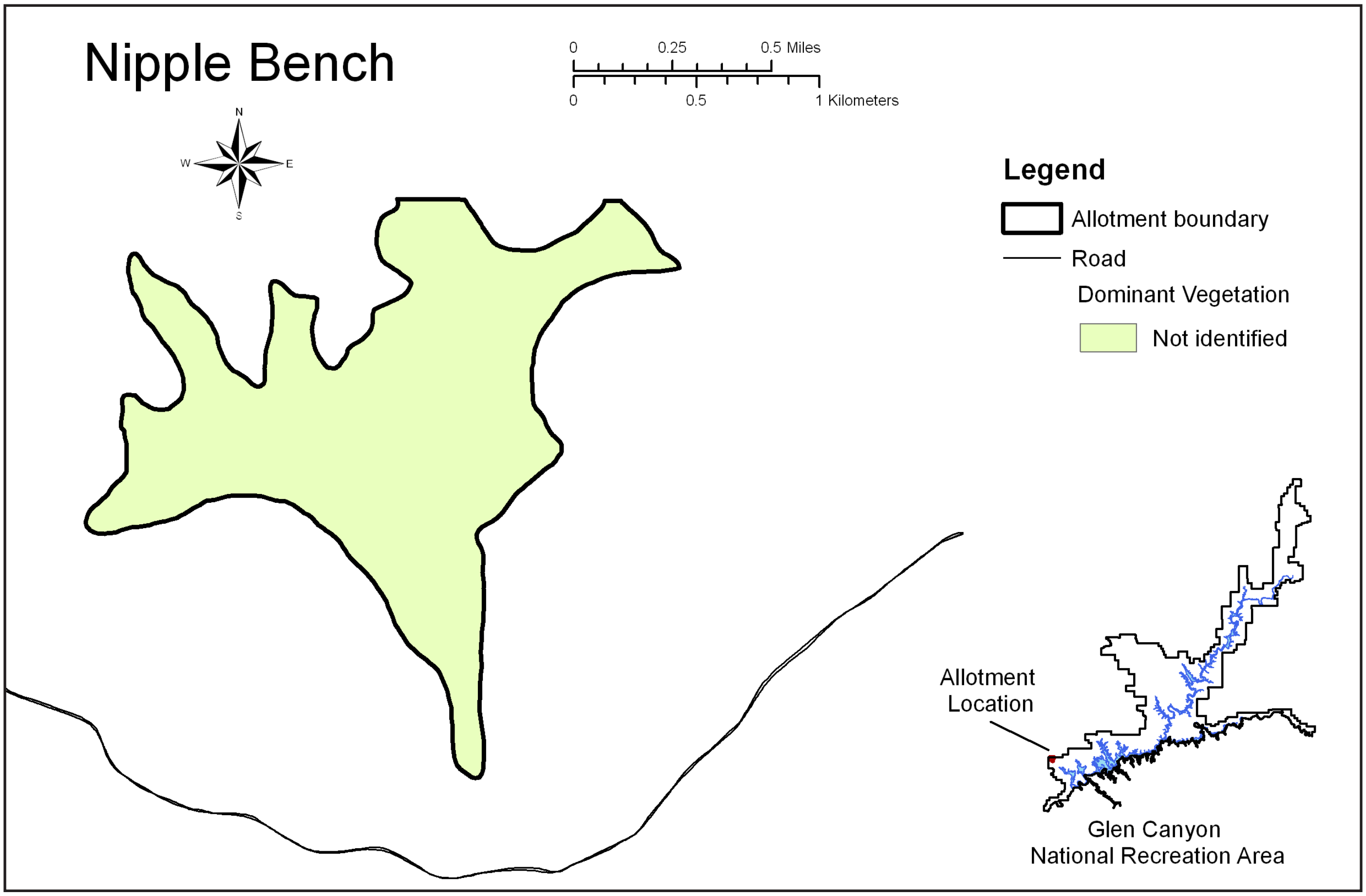
No. Cultural Sites in Each Lifezone:

Highlands: 0
Midlands: 0
Lowlands: 0

Lifezone Significance and Known Cultural Sites:

No cultural sites are currently known for Nipple Bench grazing allotment.

	Elevation	Characteristics	Environment	Significance to Humans
Lowlands	1219-1372 m (4000-4500 ft)	Hot and arid steep-walled sandstone canyons.	Riparian plants; big-horn sheep	Permanent water, arable alluvium, long growing season, diverse plant communities, natural shelters, quality siliceous stone from river gravels
Midlands	1372-1676 m (4500-5500 ft)	Arid slickrock and dune fields on benchlands and low plateaus.	Blackbrush, shadscale, grasses; antelope.	Grasses, including dropseed and ricegrass, prickly pear and shadscale; good antelope habitat, quality siliceous stone in certain locations.
Highlands	Above 1676 m (Above 5500 ft)	High elevation mesas and plateaus with cooler temperatures and greater precipitation.	Pinyon-juniper woodlands; deer and rabbit.	Higher elevation plant foods (i.e. pinyon); later harvests; dry-farming; abundant fuel, deer and rabbit.
Shading indicates lifezones present in allotment.				



Area of Individual Vegetation Zones:

Dominant Species	Acres Covered	No. Sites
Not identified	786.22	0
Total	**486.22**	**0**

No. Cultural Sites in Each Vegetation Zone:
No cultural sites are currently known for Nipple Bench grazing allotment.

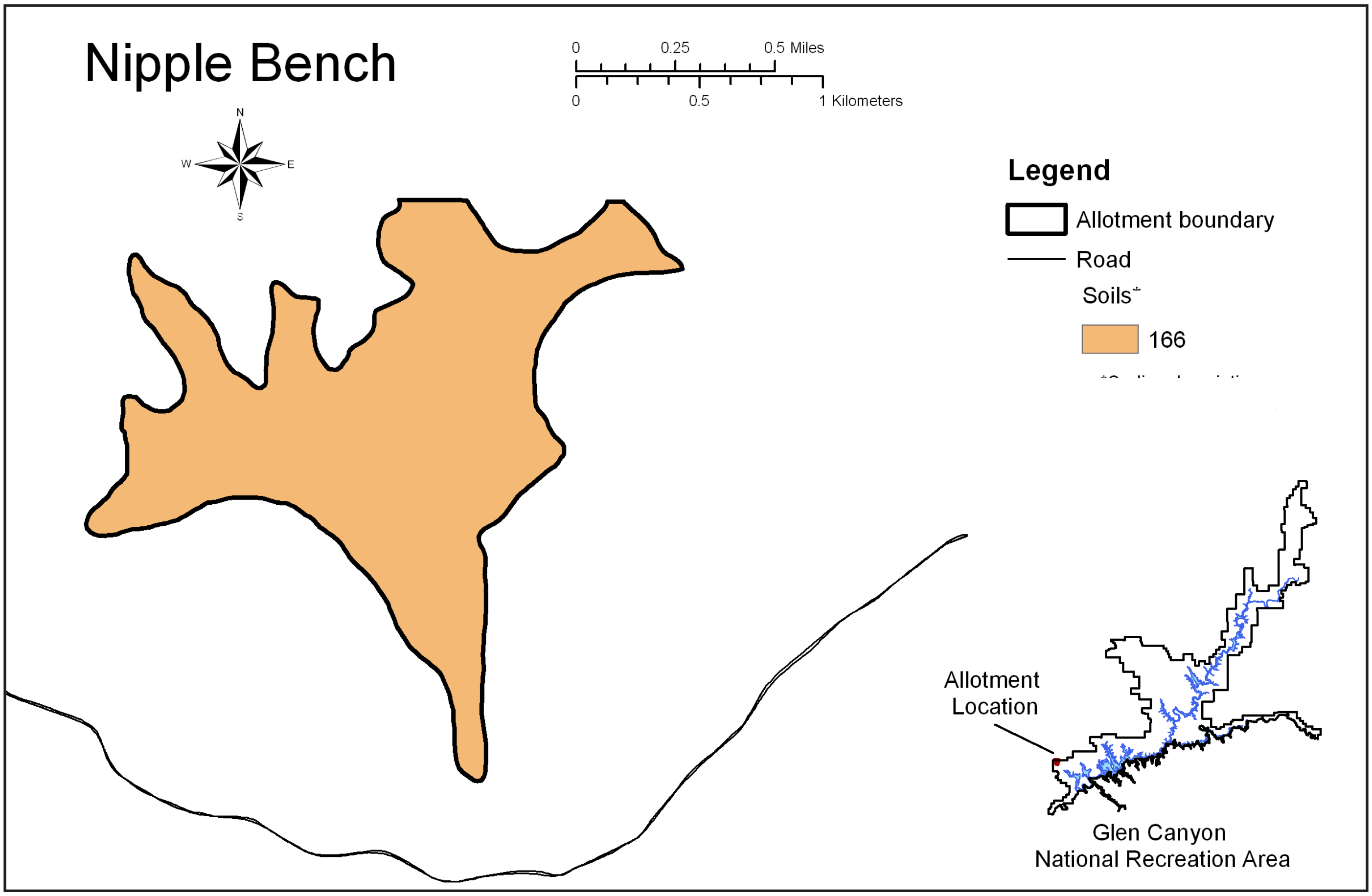
Visibility:
Unknown.

Summary:
Dominant vegetation for Nipple Bench is currently unknown.

Dominant Species:
Unknown.

Secondary Dominant Species:
Unknown.

Associated Soils:
Unknown.

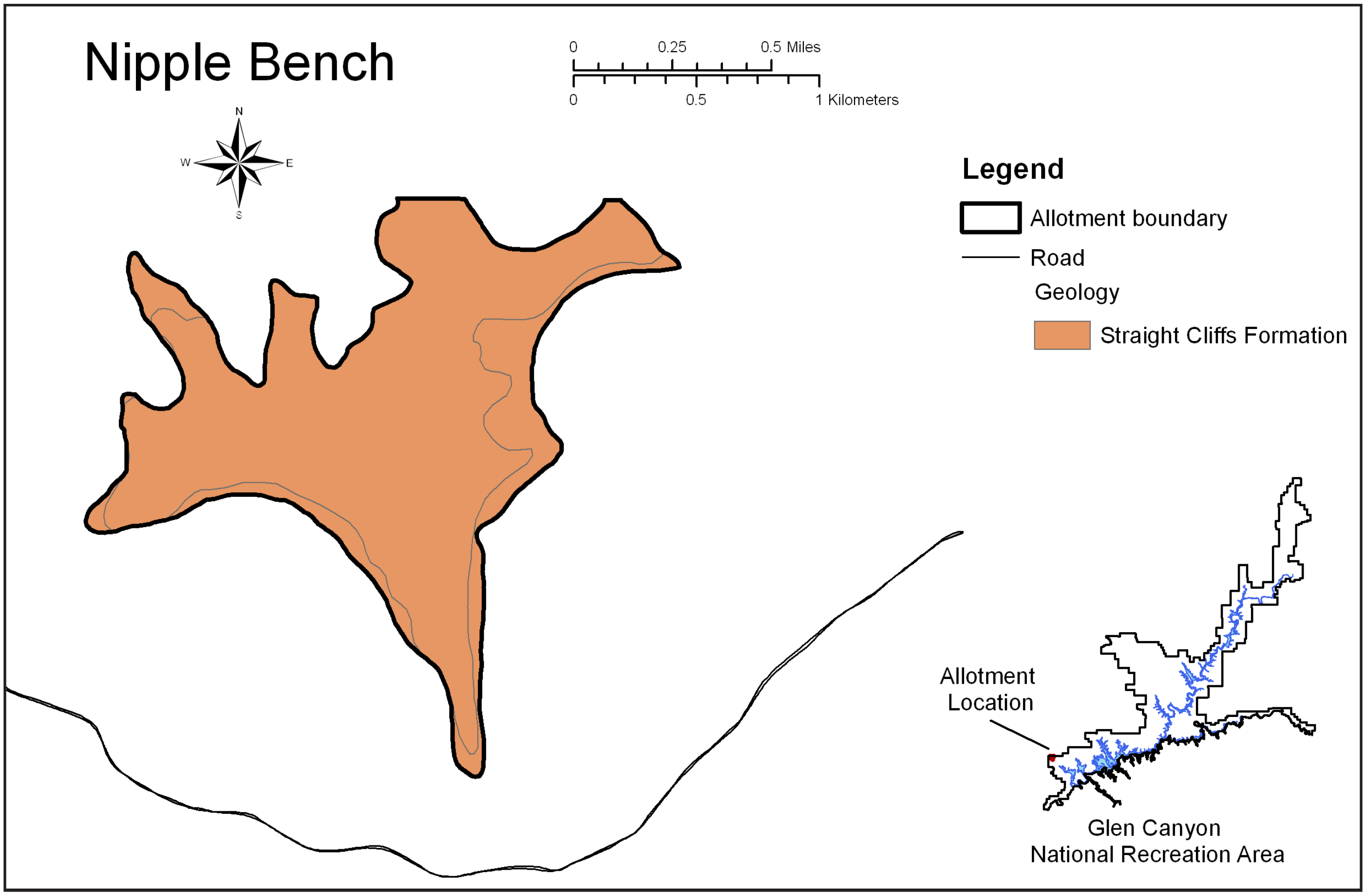


Allotment Divided by Soil Type (MUSYM):

Nipple Bench allotment is comprised entirely of soil type 166.

Distribution of Cultural Sites by Soil Type:

No cultural sites are known for Nipple Bench allotment at this time.



Allotment Divided by Geology:

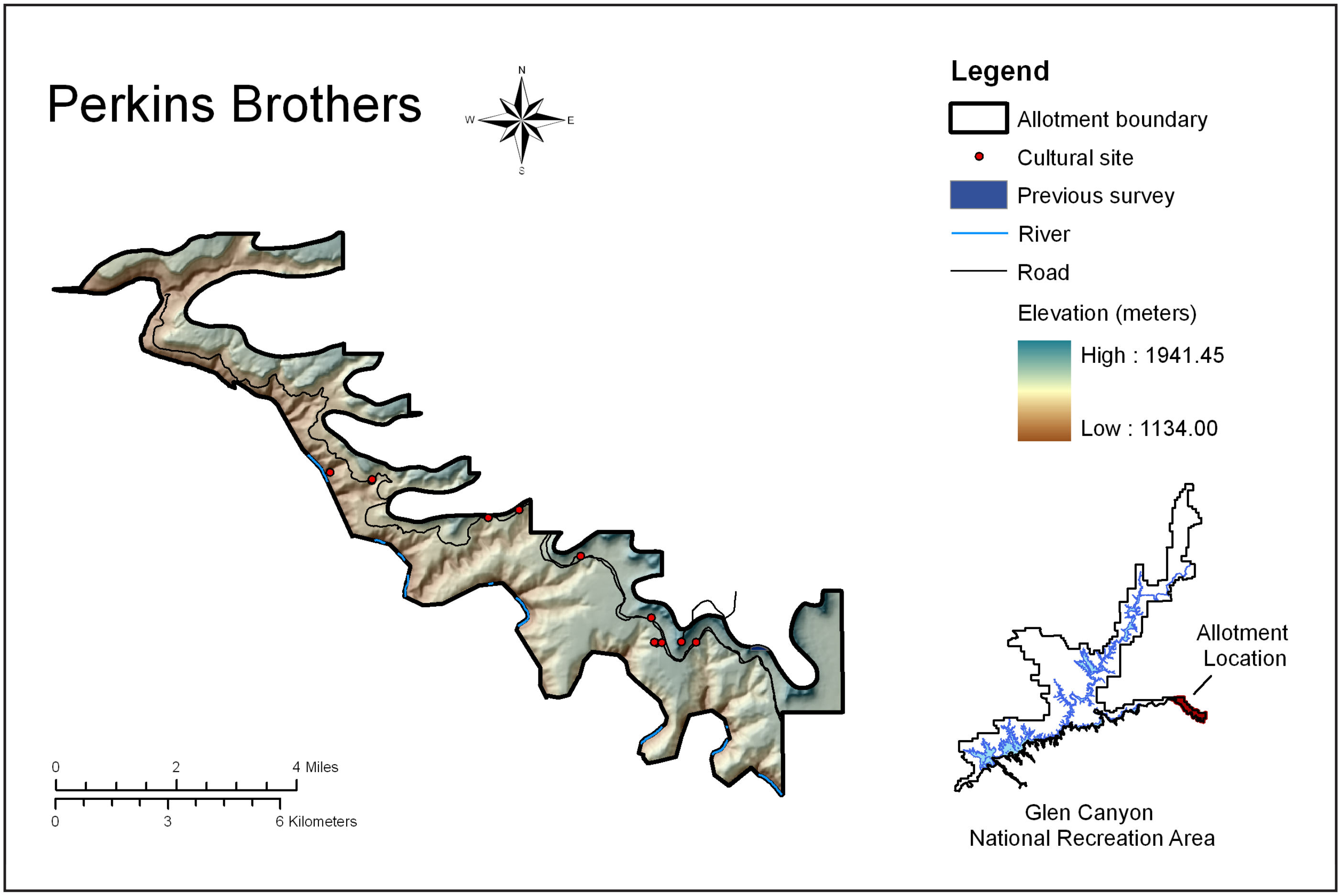
Nipple Bench grazing allotment occurs entirely upon Straight Cliffs Formation geology.

Distribution of Cultural Sites by Geological Location:

No cultural sites are known for Nipple Bench at this time.

Perkins Brothers

Map Panels



Total Area: 13,767.95 acres

Sampling Fractions:
2 percent: 275.36 acres
5 percent: 688.40 acres
11 percent: 1514.47 acres
16 percent: 2202.87 acres
20 percent: 2753.59 acres

Elevation range amsl:
1134.00 – 1941.45 meters (3720.47 - 6369.59 feet)

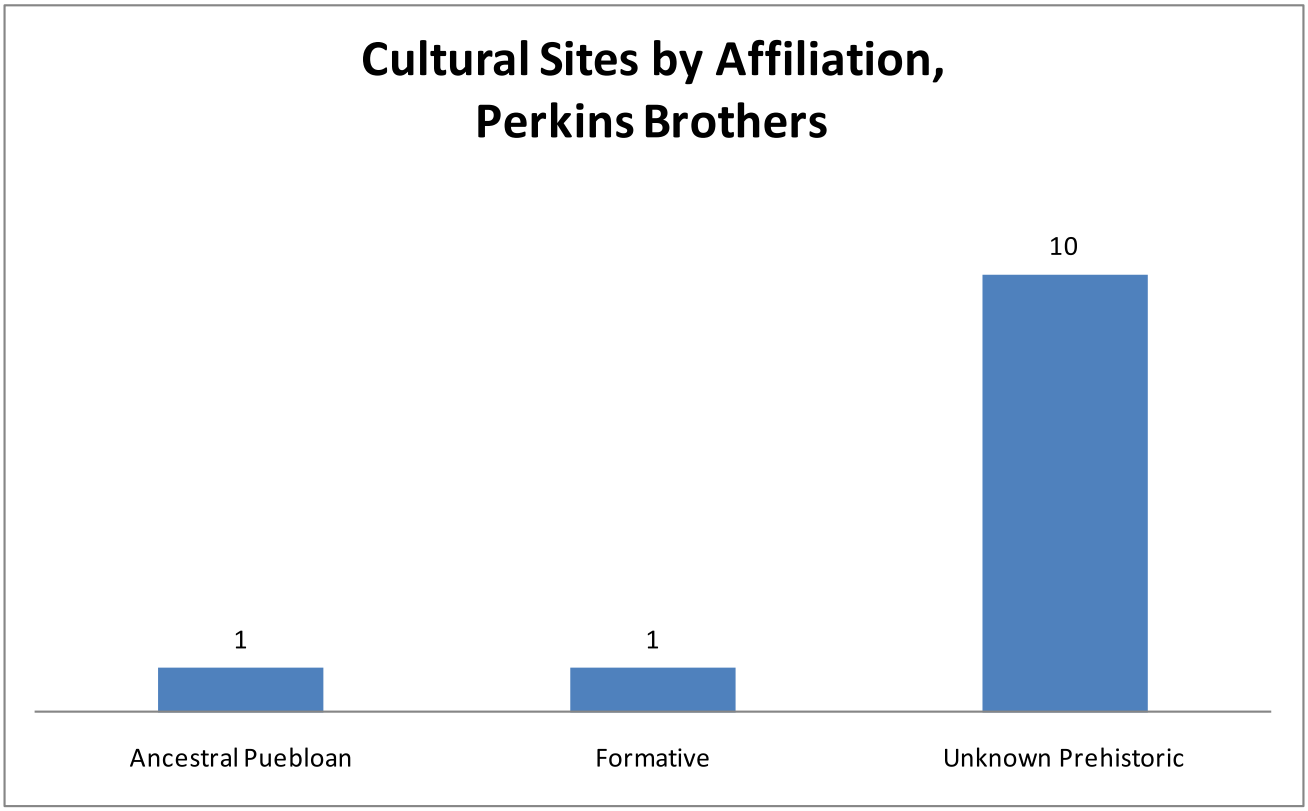
Rivers and Springs:
The San Juan River forms the southern boundary of Perkins Brothers grazing allotment.

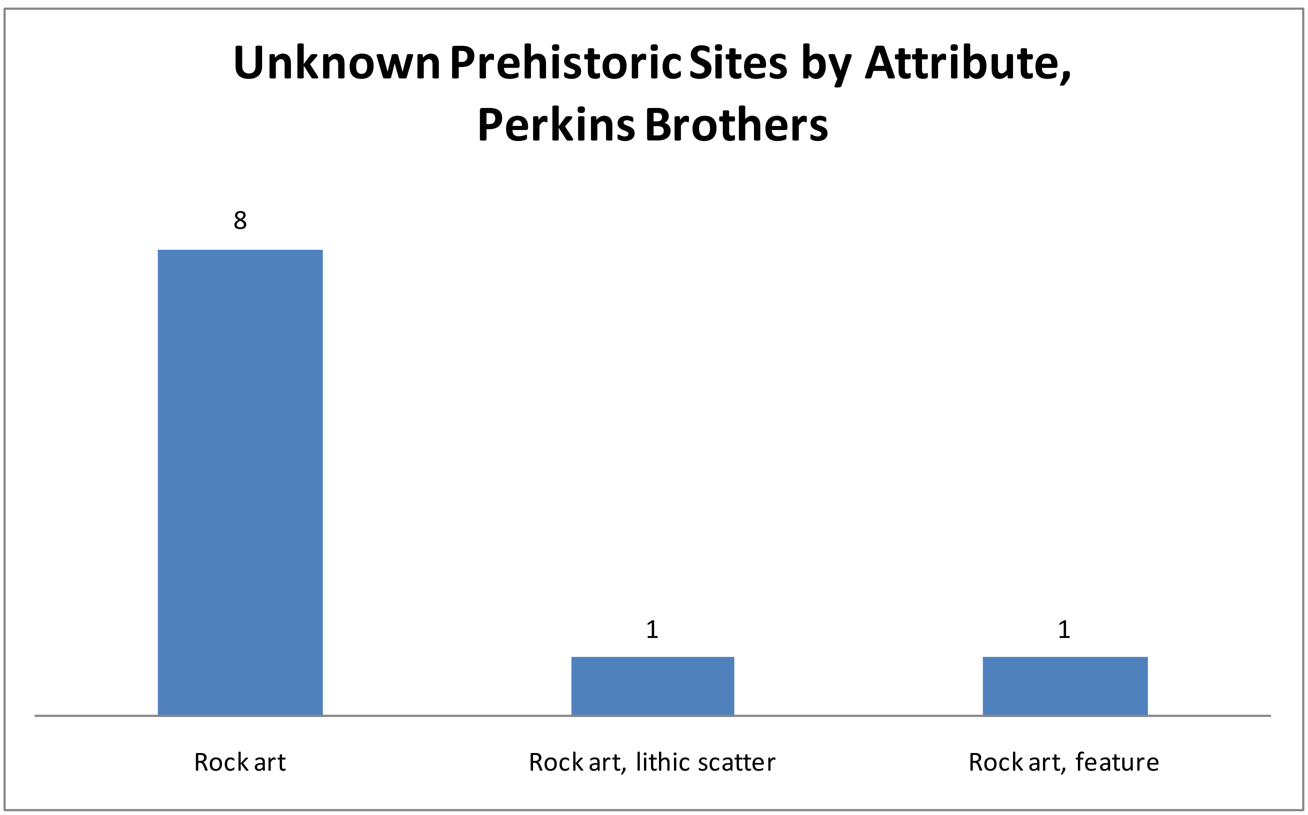
Accessibility:
County Hwy 431 enters the eastern end of the allotment from the north, and a lateral runs east-west through the center of the allotment.

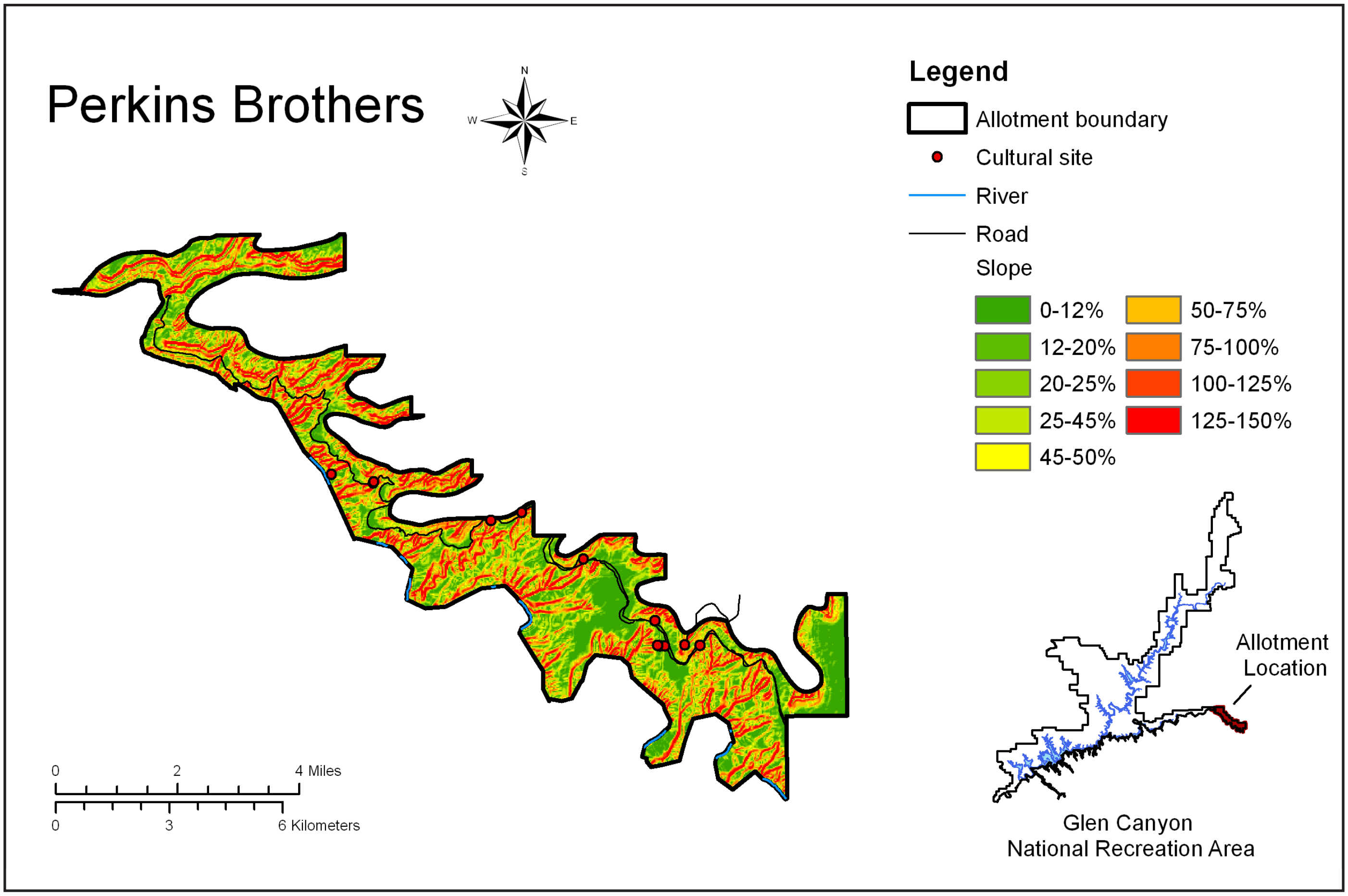
No. Cultural Sites: 12
Area surveyed: 10.11 acres

Survey References:
Geib and Fairley (1986): 10.11 acres

The figures on the subsequent page depict cultural sites by affiliation, and for those prehistoric sites for which affiliation is not known, site attributes.


Cultural Sites by Affiliation,
Perkins Brothers
10
1
1
Ancestral Puebloan
Formative
Unknown Prehistoric


Unknown Prehistoric Sites by Attribute,
Perkins Brothers
8
1
1
Rock art
Rock art, lithic scatter
Rock art, feature



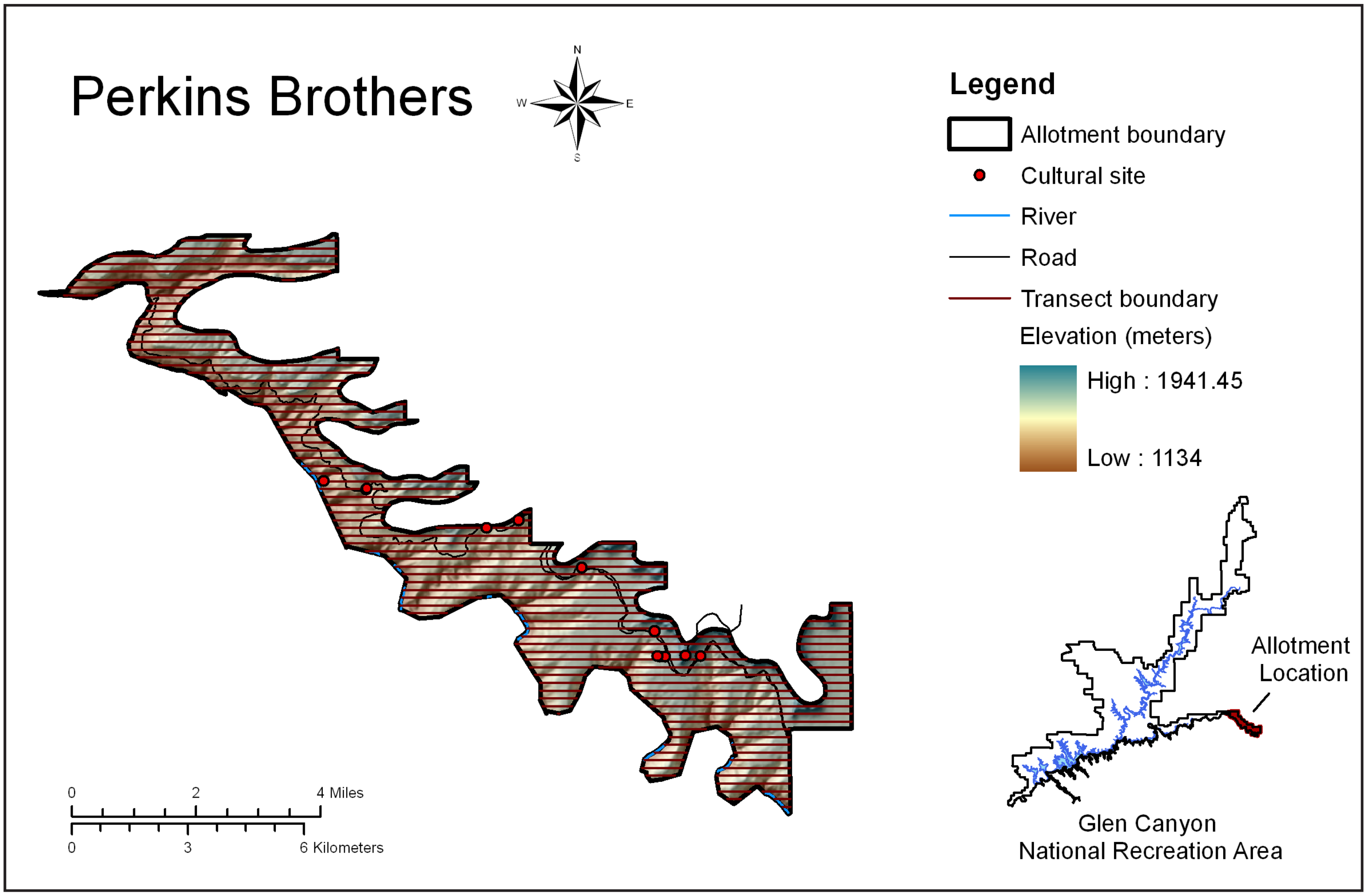
Slope Considerations:

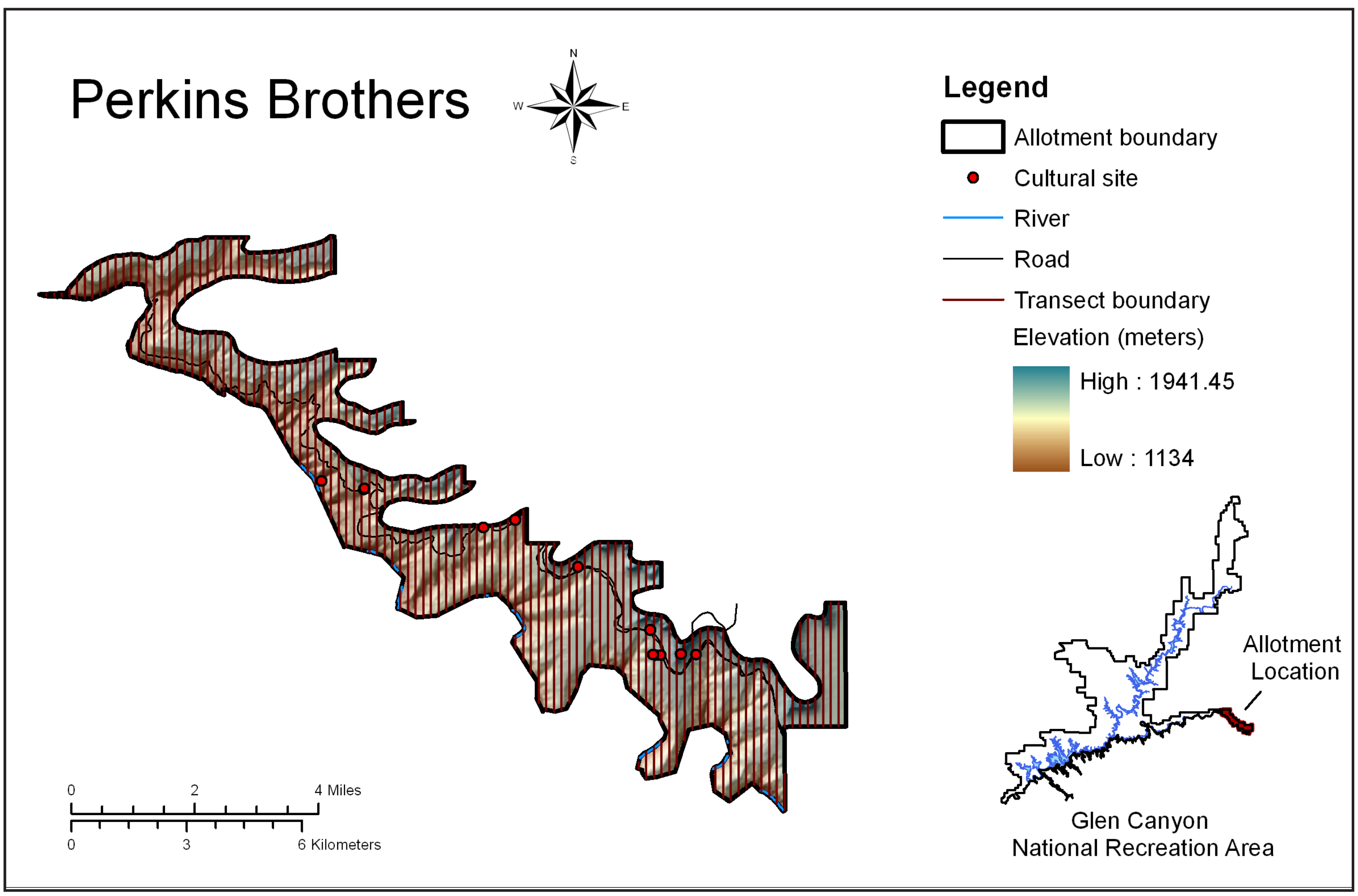
Slope plays a large role in terrain accessibility, and may be used in the stratification of survey areas. For example, GCNRA may wish to assign catagories such as low, moderate, and high to specific slope gradients. Such assignations are most often dependent on the factors guiding archaeological survey work, and as such, are not included in this document. Included herein, however, are suggestions for basic transect orientation based on the presence of topographical barriers identified by the presence of excessive slope gradients.

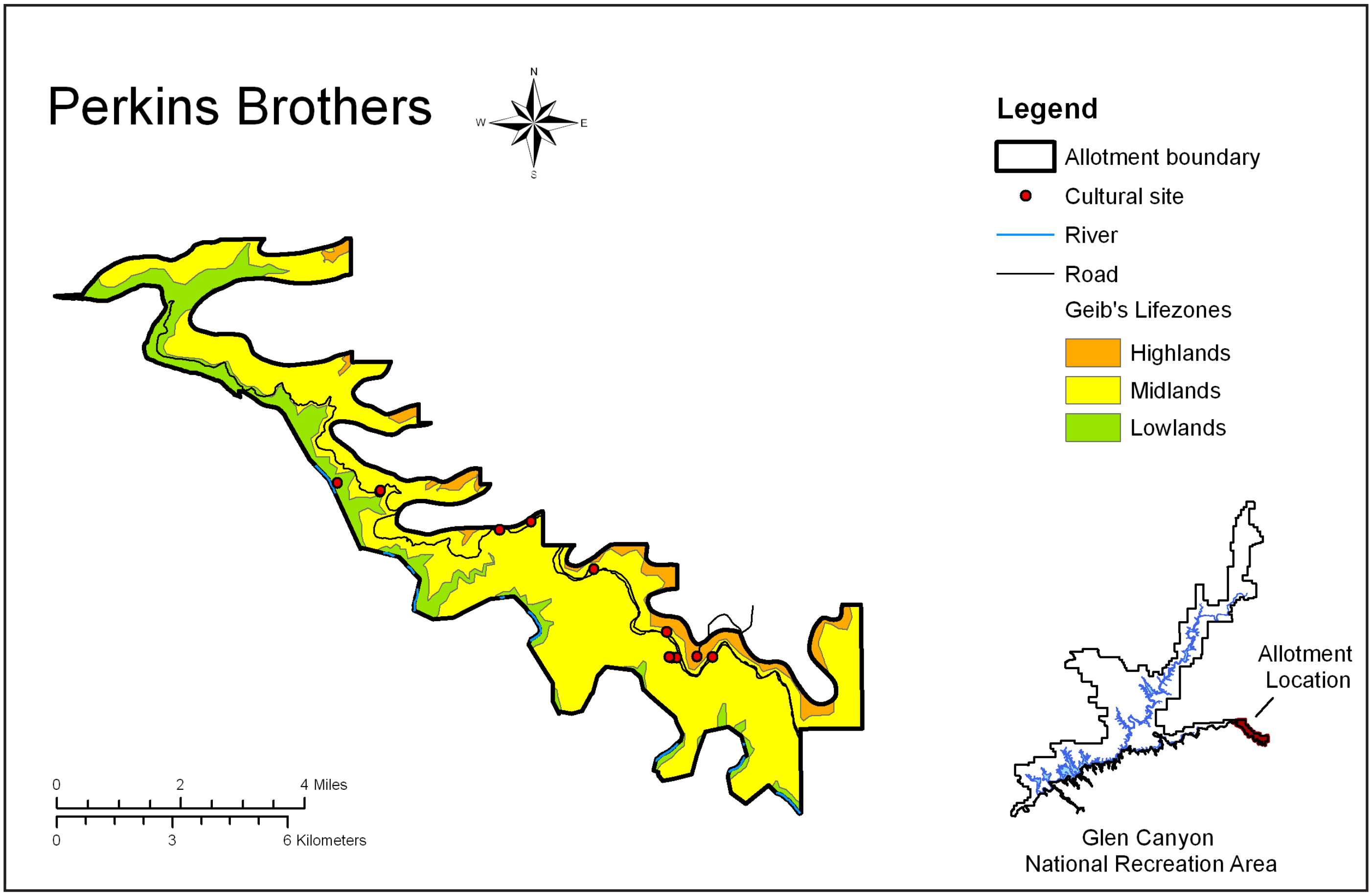
Survey Zones Dictated by Slope:

Transects set perpendicular to the lateral roadway present in the center of the allotment are recommended whenever possible. However, excessive slope will likely offer access problems in much of the allotment, and transects should be assigned on situational bases.

The 'fishnet' maps provided on the subsequent page display transects spaced at 200 meter intervals for both east-west and north-south oriented pedestrian survey.


Perkins Brothers
N
W
E
S
Legend
Allotment boundary
Cultural site
River
Road
Transect boundary
Elevation (meters)
High : 1941.45
Low : 1134
Allotment Location
Glen Canyon National Recreation Area
0 2 4 Miles
0 3 6 Kilometers


Perkins Brothers
N
W
E
S
Legend
Allotment boundary
Cultural site
River
Road
Transect boundary
Elevation (meters)
High : 1941.45
Low : 1134
Allotment Location
Glen Canyon National Recreation Area
0 2 4 Miles
0 3 6 Kilometers



Area of Each Lifezone:

Highlands: 1030.90 acres
Midlands: 10,398.37 acres
Lowlands:2308.31 acres

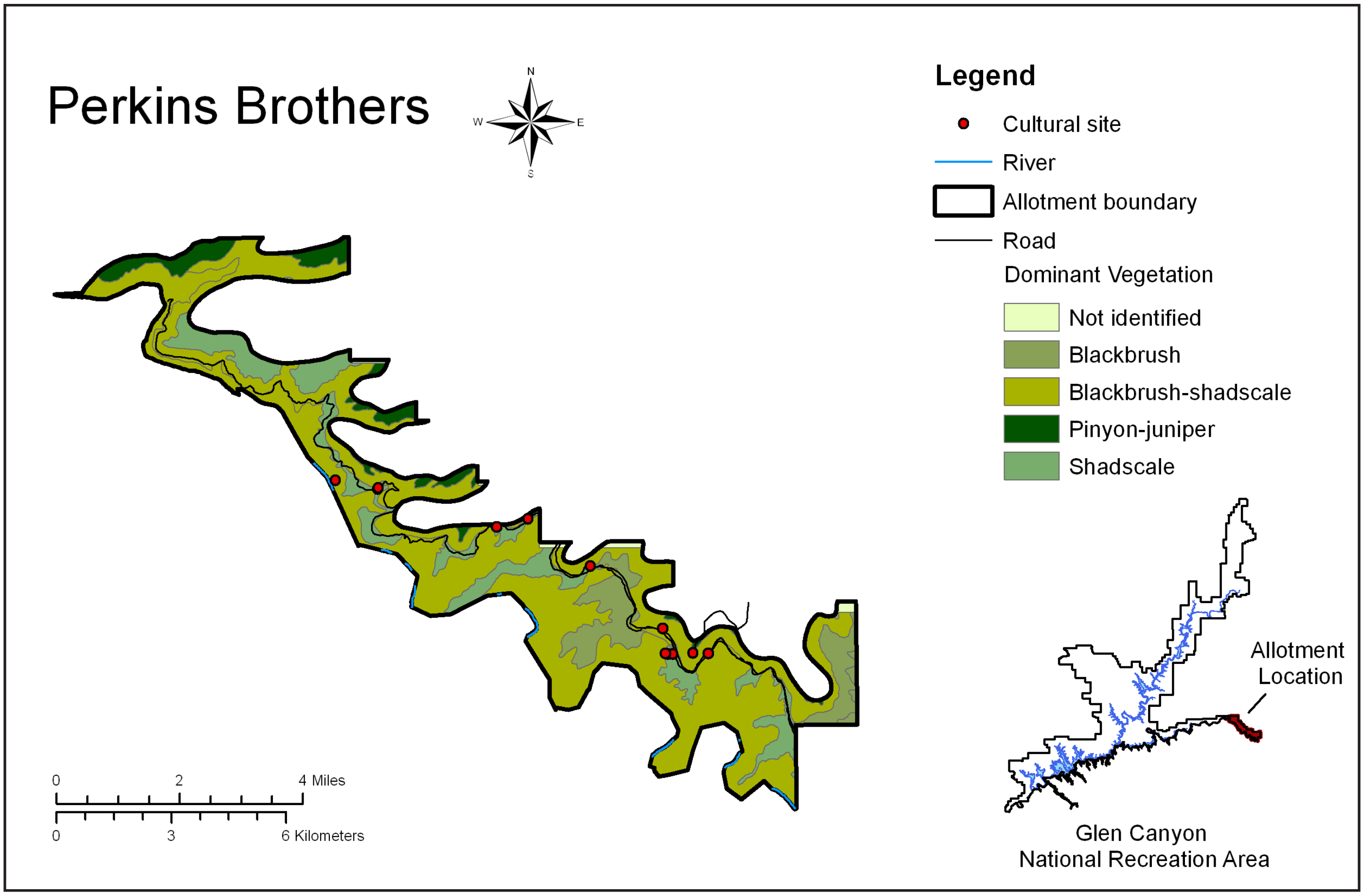
No. Cultural Sites in Each Lifezone:

Highlands: 1
Midlands: 10
Lowlands: 1

Lifezone Significance and Known Cultural Sites:
A single site (n = 1) is located in Geib's Highland zone. Geib describes the highlands as providing important foods, such as pinyon, deer, and rabbit, and suggests that the lower temperatures and increased precipitation of the highlands allowed for dry farming and later harvests than lower elevations. Ten (n = 10) sites are located in the Midland zone, described as providing important grasses, cacti, and game such as antelope to prehistoric populations. The remaining site (n = 1) occurs in the lowlands, described by Geib as hot and arid, with permanent water, arable alluvium, and long growing seasons suited to agriculture.

	Elevation	Characteristics	Environment	Significance to Humans
Lowlands	1219-1372 m (4000-4500 ft)	Hot and arid steep-walled sandstone canyons.	Riparian plants; bighorn sheep	Permanent water, arable alluvium, long growing season, diverse plant communities, natural shelters, quality siliceous stone from river gravels
Midlands	1372-1676 m (4500-5500 ft)	Arid slickrock and dune fields on benchlands and low plateaus.	Blackbrush, shadscale, grasses; antelope.	Grasses, including dropseed and ricegrass, prickly pear and shadscale; good antelope habitat, quality siliceous stone in certain locations.
Highlands	Above 1676 m (Above 5500 ft)	High elevation mesas and plateaus with cooler temperatures and greater precipitation.	Pinyon-juniper woodlands; deer and rabbit.	Higher elevation plant foods (i.e. pinyon); later harvests; dry-farming; abundant fuel, deer and rabbit.

Shading indicates lifezones present in allotment.



Area of Individual Vegetation Zones:

Dominant Species	Acres Covered	No. Sites
Not identified	187.41	0
Blackbrush (*Coleogyne ramosissima)*	1211.71	0
Blackbrush-shadscale (*Coleogyne ramosissima - Atriplex confertifolia)*	9368.16	5
Pinyon-juniper (*Pinus edulis - Juniperus osteosperma)*	913.56	0
Shadscale (*Atriplex confertifolia)*	2087.11	7
Total	**13,767.95**	**12**

No. Cultural Sites in Each Vegetation Zone:
Five (n = 5) sites are located in blackbrush-shadscale. The remaining seven (n = 7) sites are located in shadscale dominant vegetation.

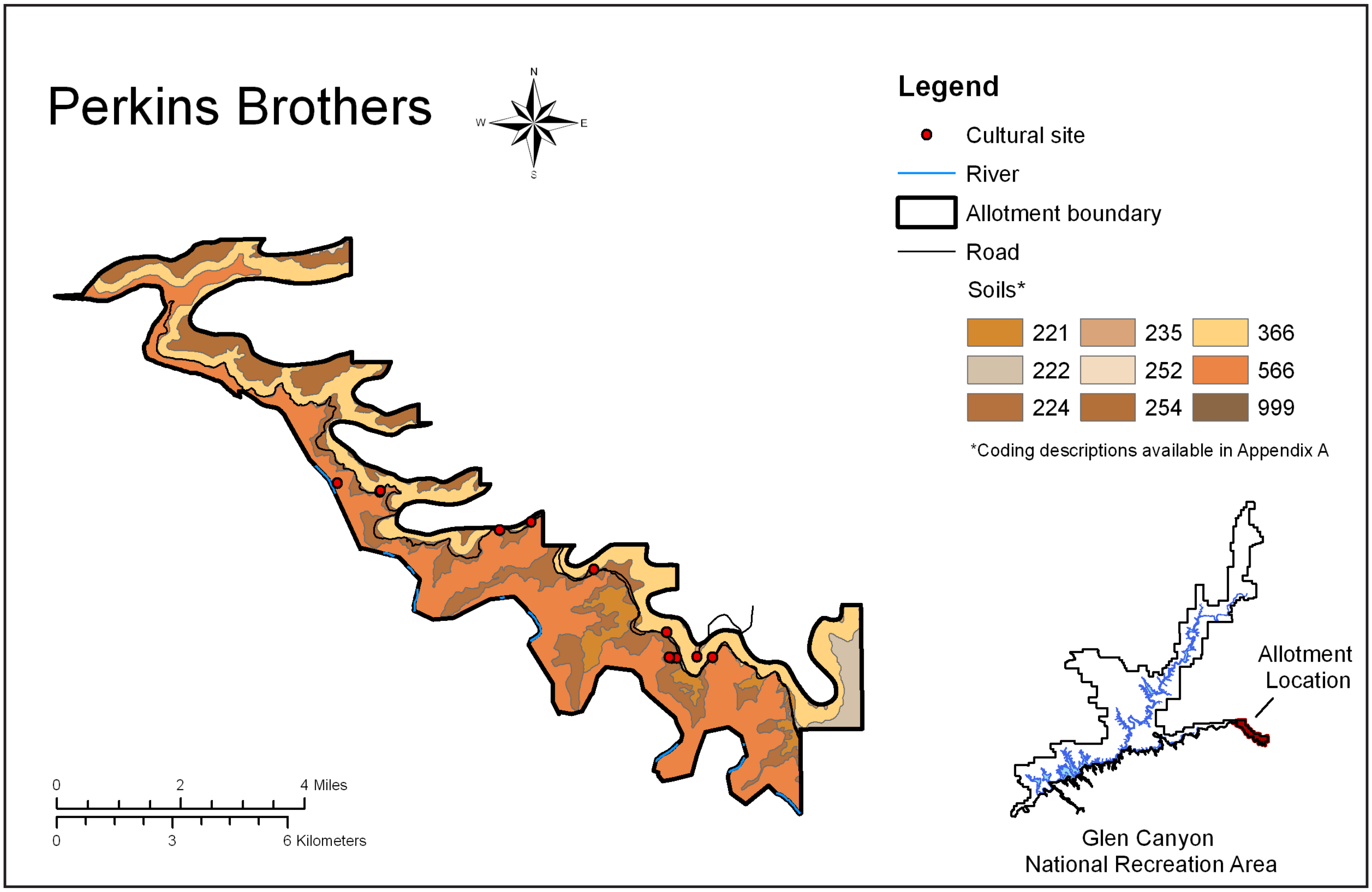
Visibility:
In general, the dominant vegetative communities of the allotment provide moderate - excellent ground visibility. However, in pinyon-juniper, ground visibility may be lessened by built-up organic matter.

Summary:
The primary dominant vegetation zones within Perkins Brothers grazing allotment include blackbrush (8.80 percent), blackbrush-shadscale (68.04 percent), pinyon-juniper (6.64 percent), and shadscale (15.16 percent). Dominant vegetation for the remainder of the allotment is not currently known.

Dominant Species:
Shadscale (*Atriplex confertifolia*)
Blackbrush *(Coleogyne ramosissima*)
Pinyon (*Pinus edulis*)
Juniper (*Juniperus osteosperma*)

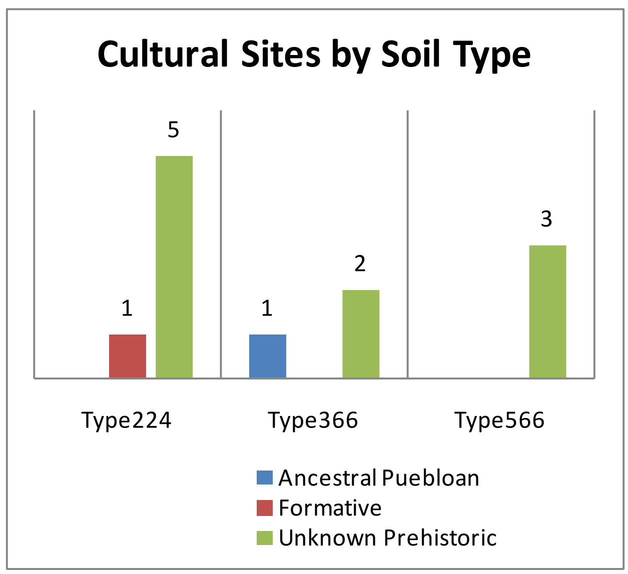
Secondary Dominant Species:
Fourwing saltbush (*Atriplex canescens*)

Associated Soils:
Blackbrush grows in sand, shallow sandy, and in sandy loam, where fourwing saltbush may also occur. Blackbrush-shadscale dominates in talus. Pinyon-juniper grows in sandy loam alongside blackbrush, and in shallow loam and stony loam. Finally, shadscale occurs in shallow loam and shallow sandy loam.



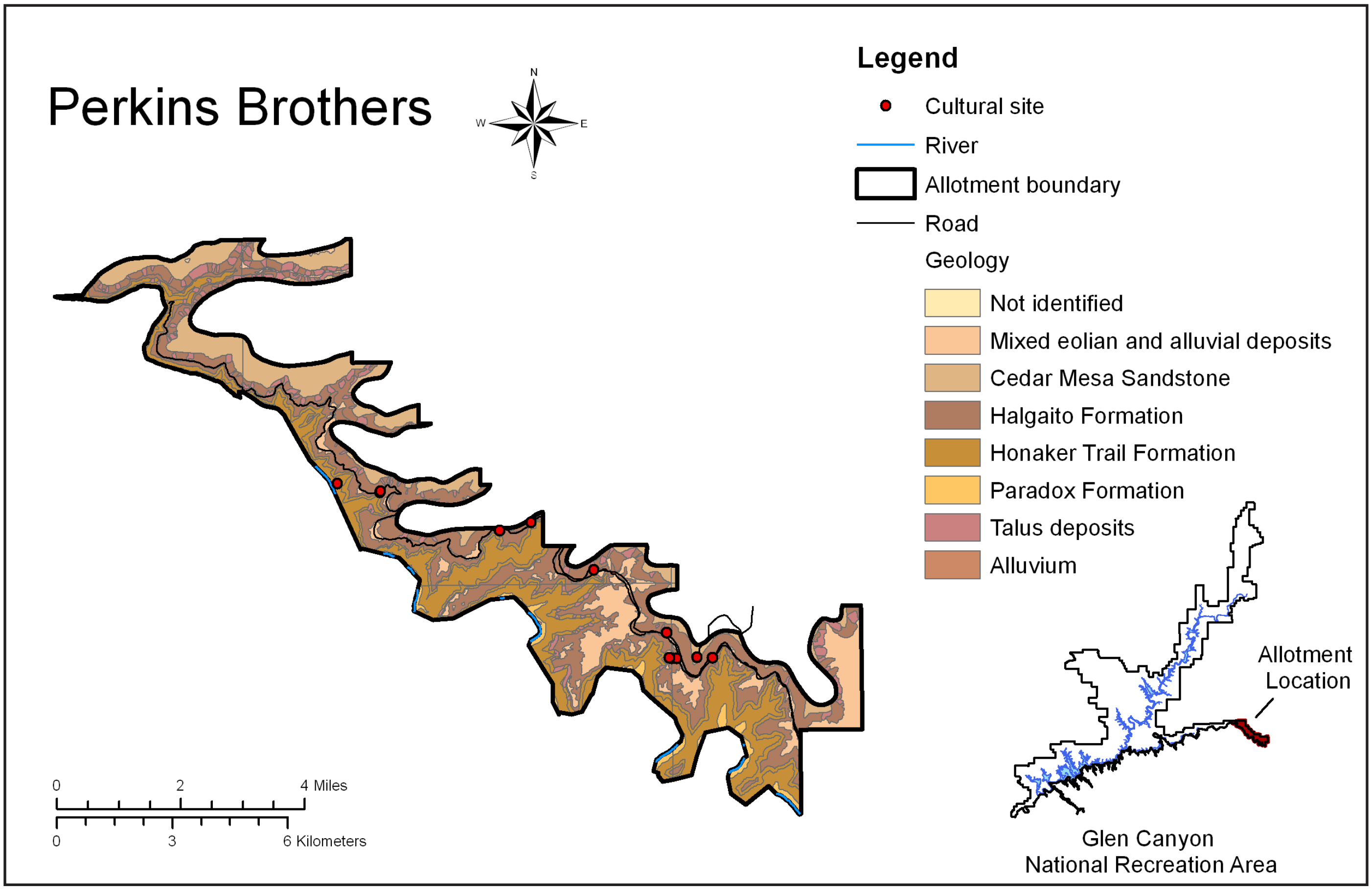
Allotment Divided by Soil Type (MUSYM):

Soil Type	Acres	Percent	No. Cultural Sites
221	594.33	4.32	0
222	411.76	2.99	0
224	2015.05	14.64	6
235	49.97	0.36	0
252	31.96	0.23	0
254	1497.63	10.66	0
366	3797.99	27.59	3
566	5287.36	38.40	3
999	81.90	0.59	0
Total	**13,767.95**	**99.78**	**12**



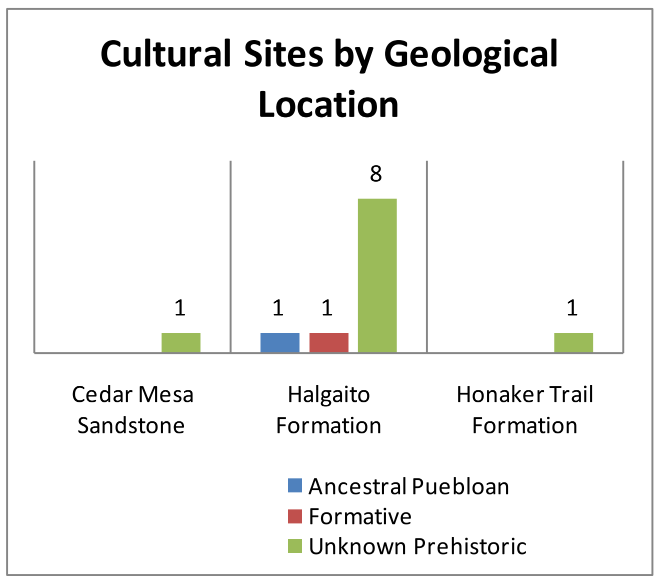
Distribution of Cultural Sites by Soil Type:

Six (n = 6) sites, including one Formative site and five rock art sites, one of which has an associated lithic scatter, occur in soil type 224. Three (n = 3) sites, including one Ancestral Puebloan site and two rock art sites, one of which may have associated features, occur in soil type 366. The remaining sites (n = 3) are all rock art sites located in soil type 566.



Allotment Divided by Geology:

Geology	Acres	Percent	No. Cultural Sites
Not identified	31.91	0.23	0
Mixed eolian and alluvial deposits	1613.39	11.72	0
Cedar Mesa Sandstone	2284.84	16.60	1
Halgaito Formation	4663.85	33.87	10
Honaker Trail Formation	4066.81	29.54	1
Paradox Formation	352.71	2.56	0
Talus	743.37	5.40	0
Alluvium	11.22	<0.00	0
Total	**13,768.10**	**99.92**	**12**

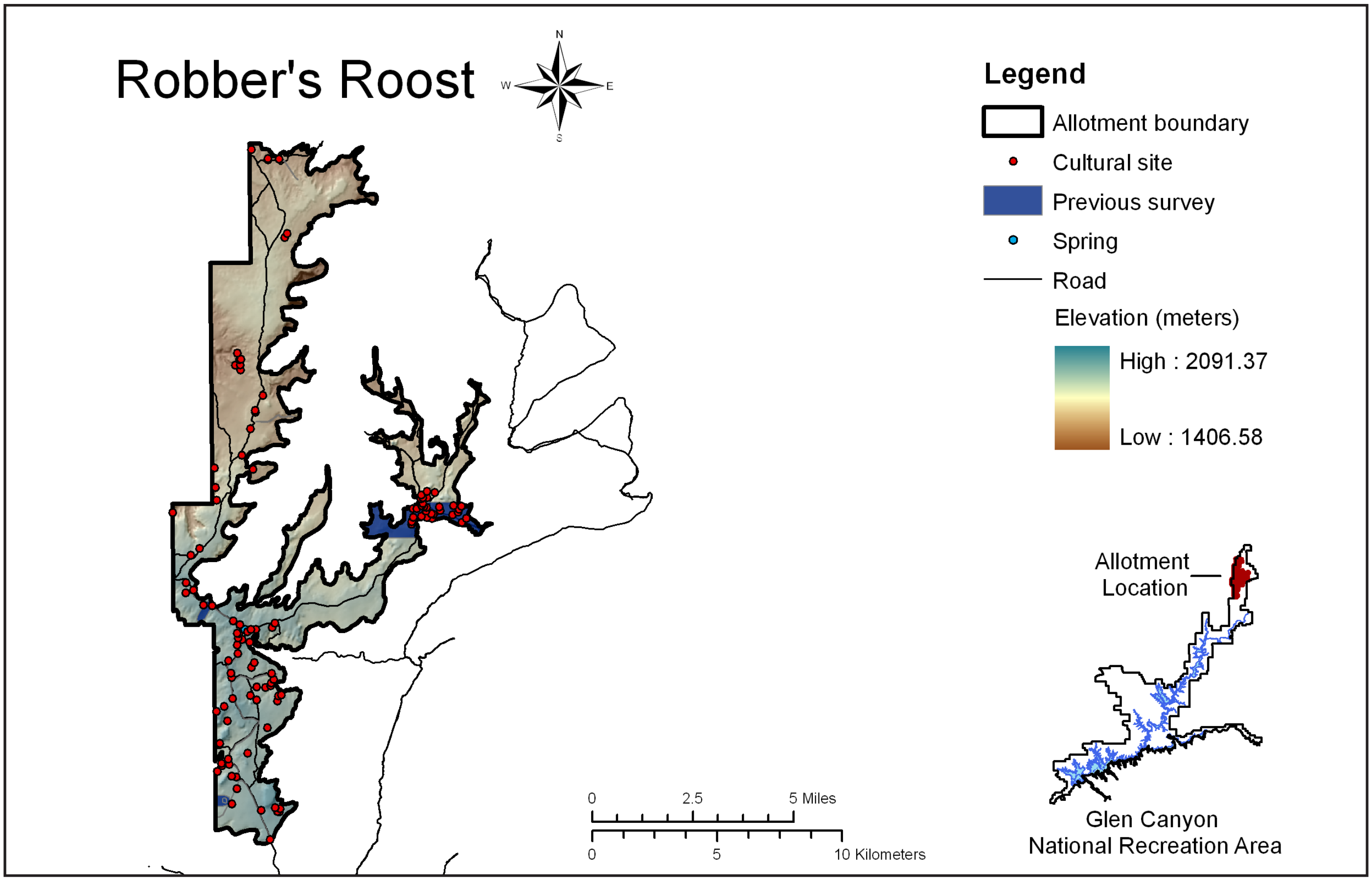


Distribution of Cultural Sites by Geological Location:

One (n = 1) rock art site with features is located on Cedar Mesa Sandstone. Ten (n = 10) sites, including one Ancestral Puebloan site, one Formative site, and eight rock art sites, one of which has an associated lithic scatter, are located on Halgaito Formation geology. The remaining site (n = 1) consists of a rock art site located on Honaker Trail Formation geology.

Robber’s Roost

Map Panels



Total Area: 23,954.31 acres

Sampling Fractions:
2 percent: 479.09 acres
5 percent: 1197.72 acres
11 percent: 2634.97 acres
16 percent: 3832.69 acres
20 percent: 4790.86 acres

Elevation range amsl:
1406.58 – 2091.37 meters (4614.76 - 6861.45 feet)

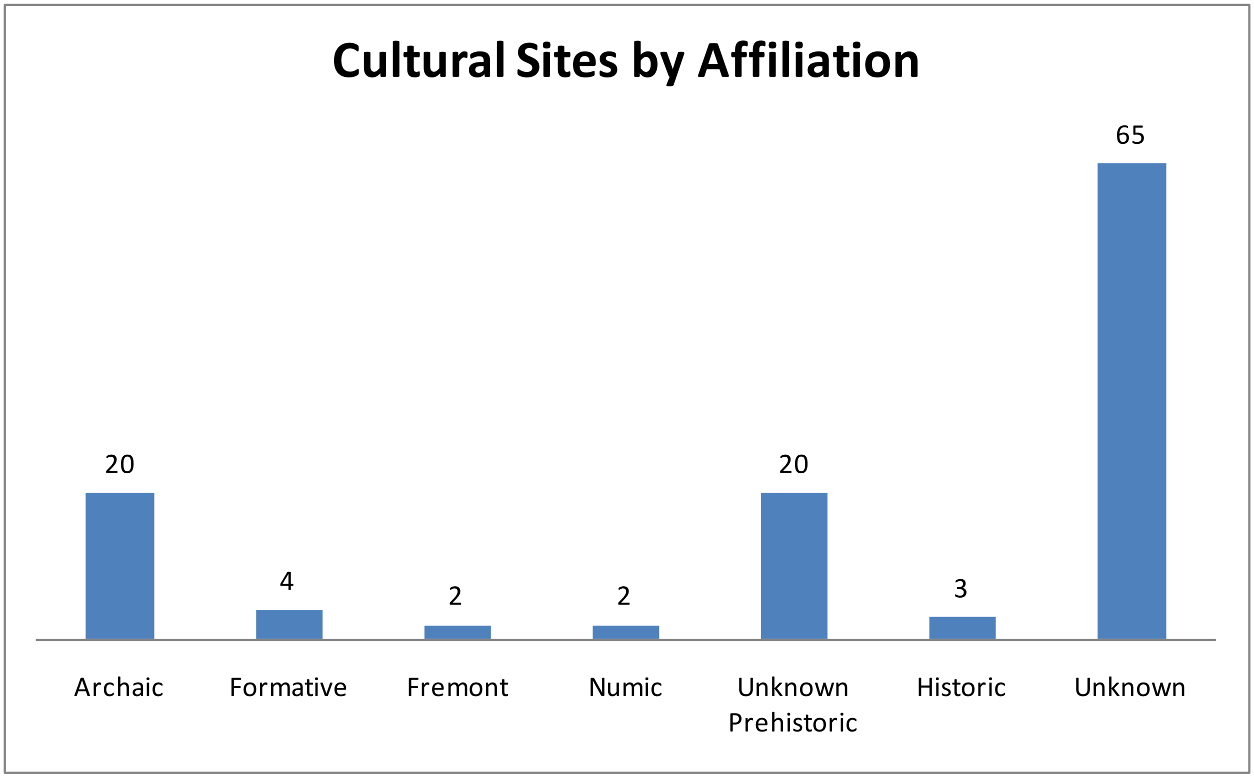
Rivers and Springs:
French spring is located in Robber's Roost grazing allotment.

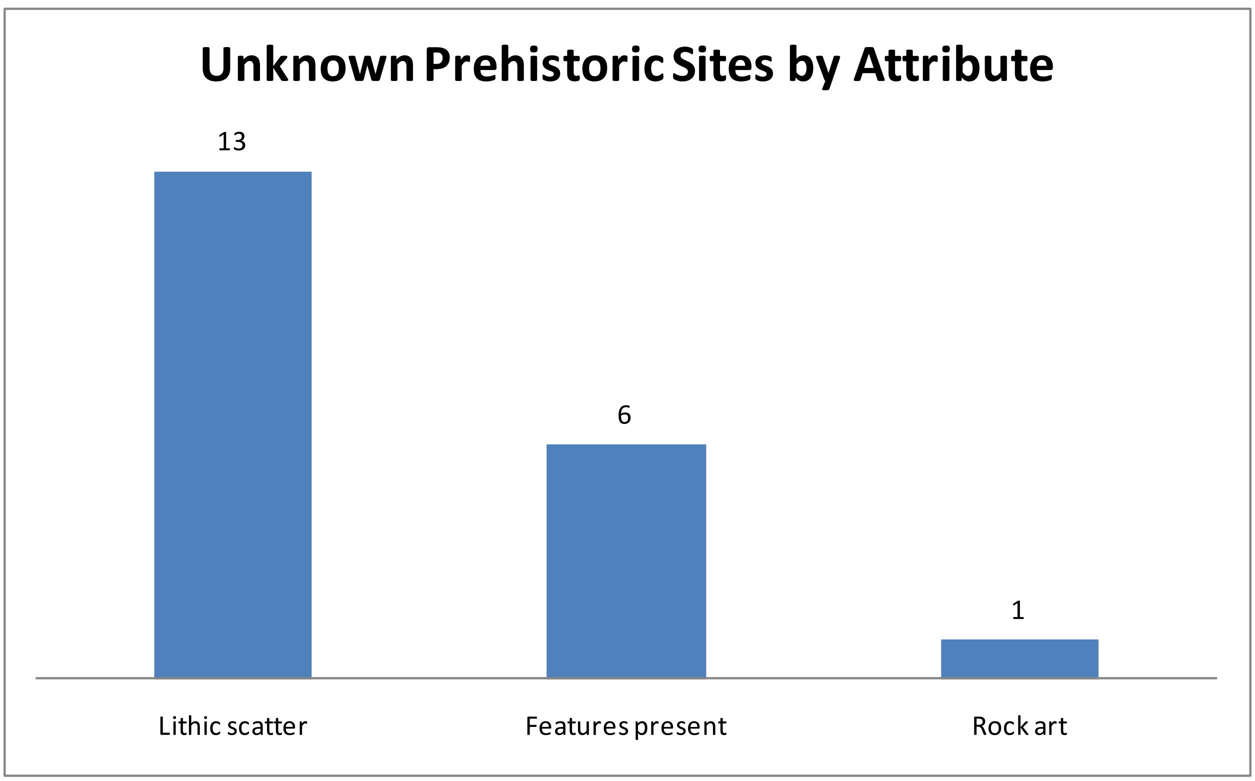
Accessibility:
County Hwy 777 and County Hwy 633 travel north-south through Robber's Roost, and County Hwy 763 parallels the allotment on the east. County Hwys 744 and 755 also cross the center of the allotment. Hans Flat Ranger Station is located on the central west boundary of the allotment.

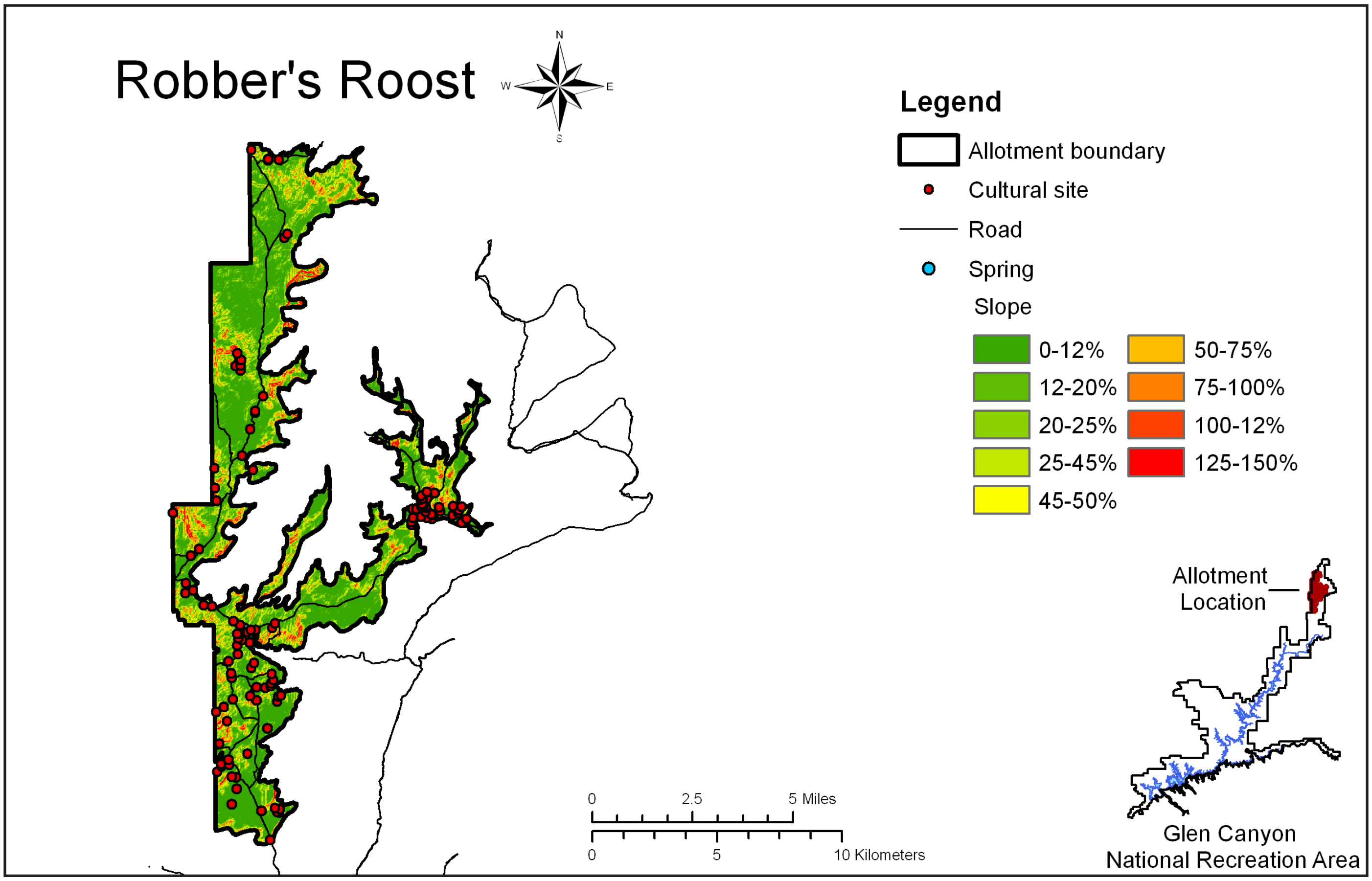
No. Cultural Sites: 116
Area surveyed: 1126.50 acres

Survey References:
Bungart and Geib (1986): 900.61 acres
Hauck (1982): 15.79 acres
Kincaid (1986): 55.21 acres
Kincaid (1988c): 73.52 acres
Kincaid (1993e): 6.12 acres
Nickens (1981): 82.53 acres

The figures on the subsequent page depict cultural sites by affiliation, and for those prehistoric sites for which affiliation is not known, site attributes.


Cultural Sites by Affiliation
20
4
2
2
20
3
65
Archaic
Formative
Fremont
Numic
Unknown Prehistoric
Historic
Unknown


Unknown Prehistoric Sites by Attribute
13
6
1
Lithic scatter
Features present
Rock art



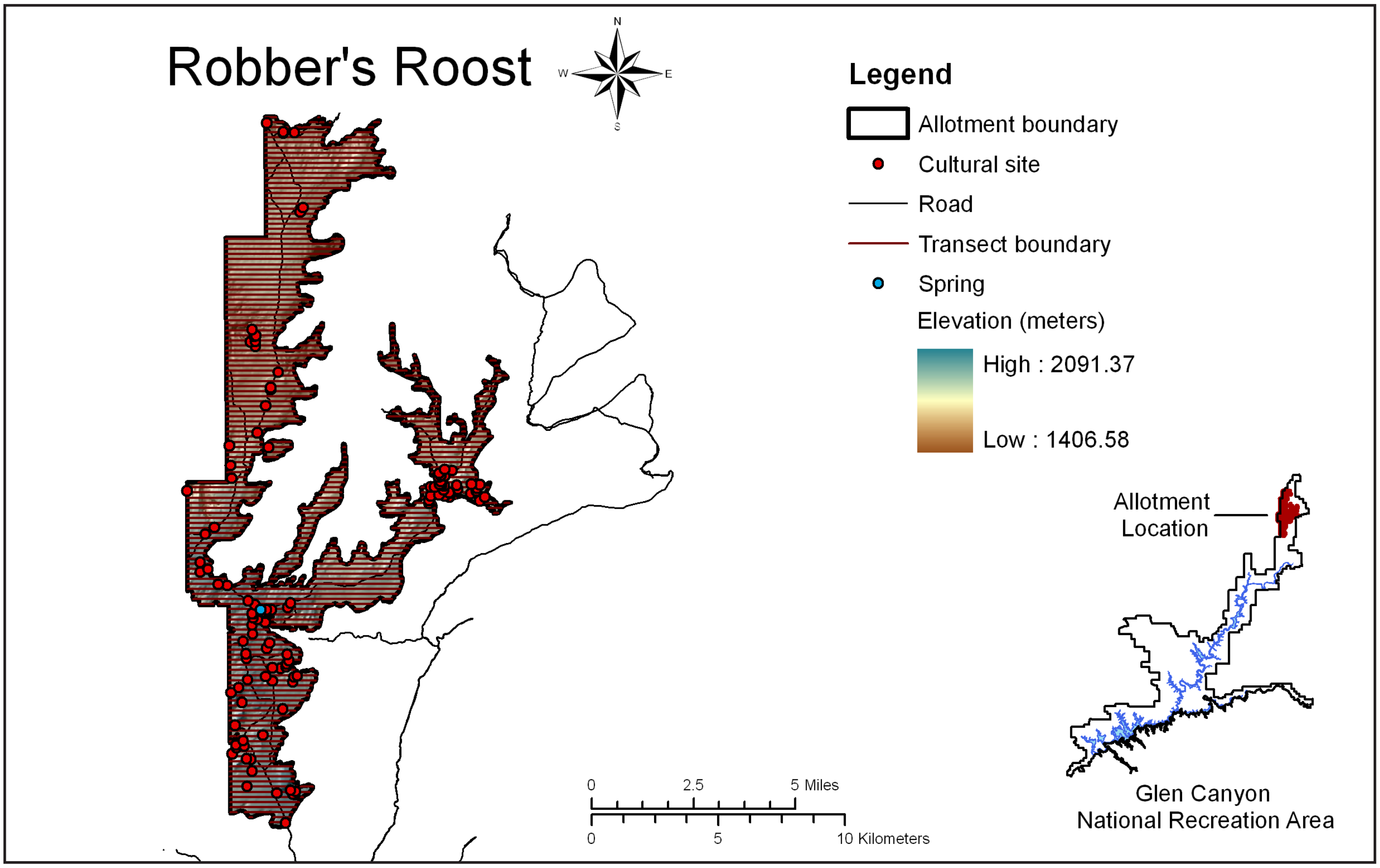
Slope Considerations:

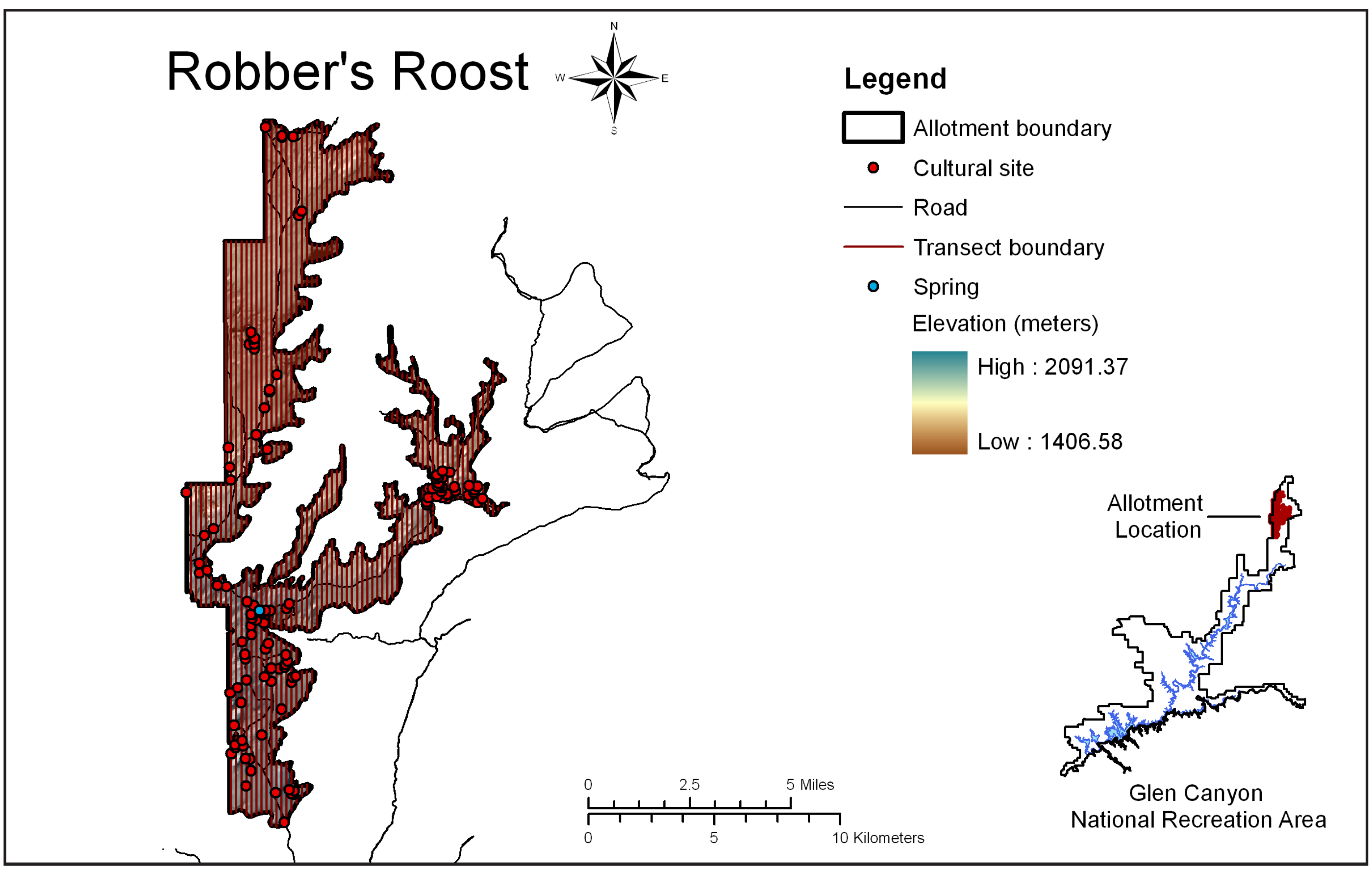
Slope plays a large role in terrain accessibility, and may be used in the stratification of survey areas. For example, GCNRA may wish to assign catagories such as low, moderate, and high to specific slope gradients. Such assignations are most often dependent on the factors guiding archaeological survey work, and as such, are not included in this document. Included herein, however, are suggestions for basic transect orientation based on the presence of topographical barriers identified by the presence of excessive slope gradients.

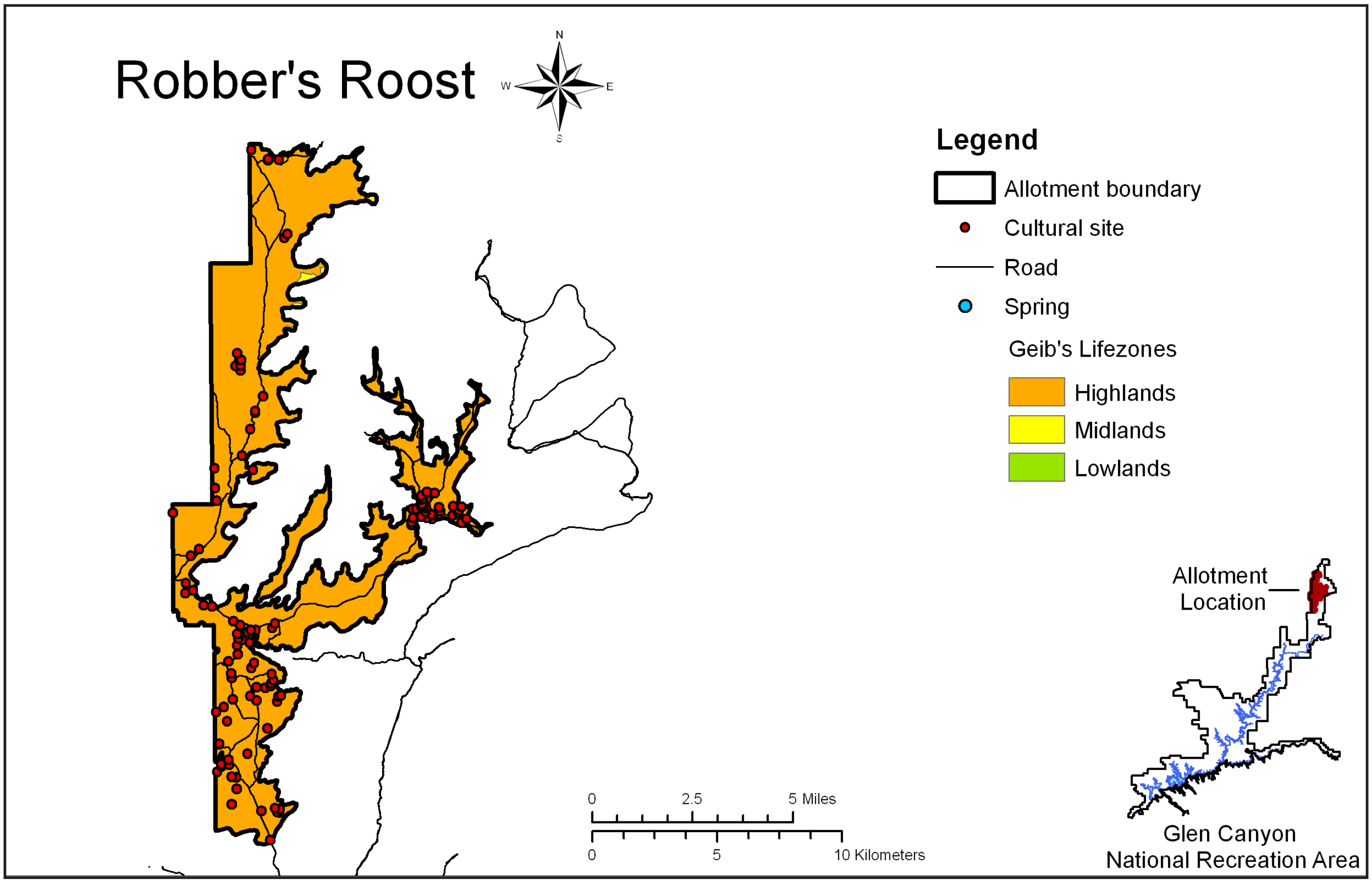
Survey Zones Dictated by Slope:

Primary and lateral roadways provide access to most of Robber's Roost allotment. Recommended transects should therefore be placed perpendicular to available roadways wherever possible.

The 'fishnet' maps provided on the subsequent page display transects spaced at 200 meter intervals for both east-west and north-south oriented pedestrian survey.


Robber's Roost
N
W
E
S
Legend
Allotment boundary
Cultural site
Road
Transect boundary
Spring
Elevation (meters)
High : 2091.37
Low : 1406.58
Allotment Location
Glen Canyon National Recreation Area
0
2.5
5 Miles
0
5
10 Kilometers


Robber's Roost
N
W
E
S
Legend
Allotment boundary
Cultural site
Road
Transect boundary
Spring
Elevation (meters)
High : 2091.37
Low : 1406.58
Allotment Location
Glen Canyon National Recreation Area
0
2.5
5 Miles
0
5
10 Kilometers



Area of Each Lifezone:

Highlands: 23,728.79 acres
Midlands: 210.630 acres
Lowlands: 0.00 acres

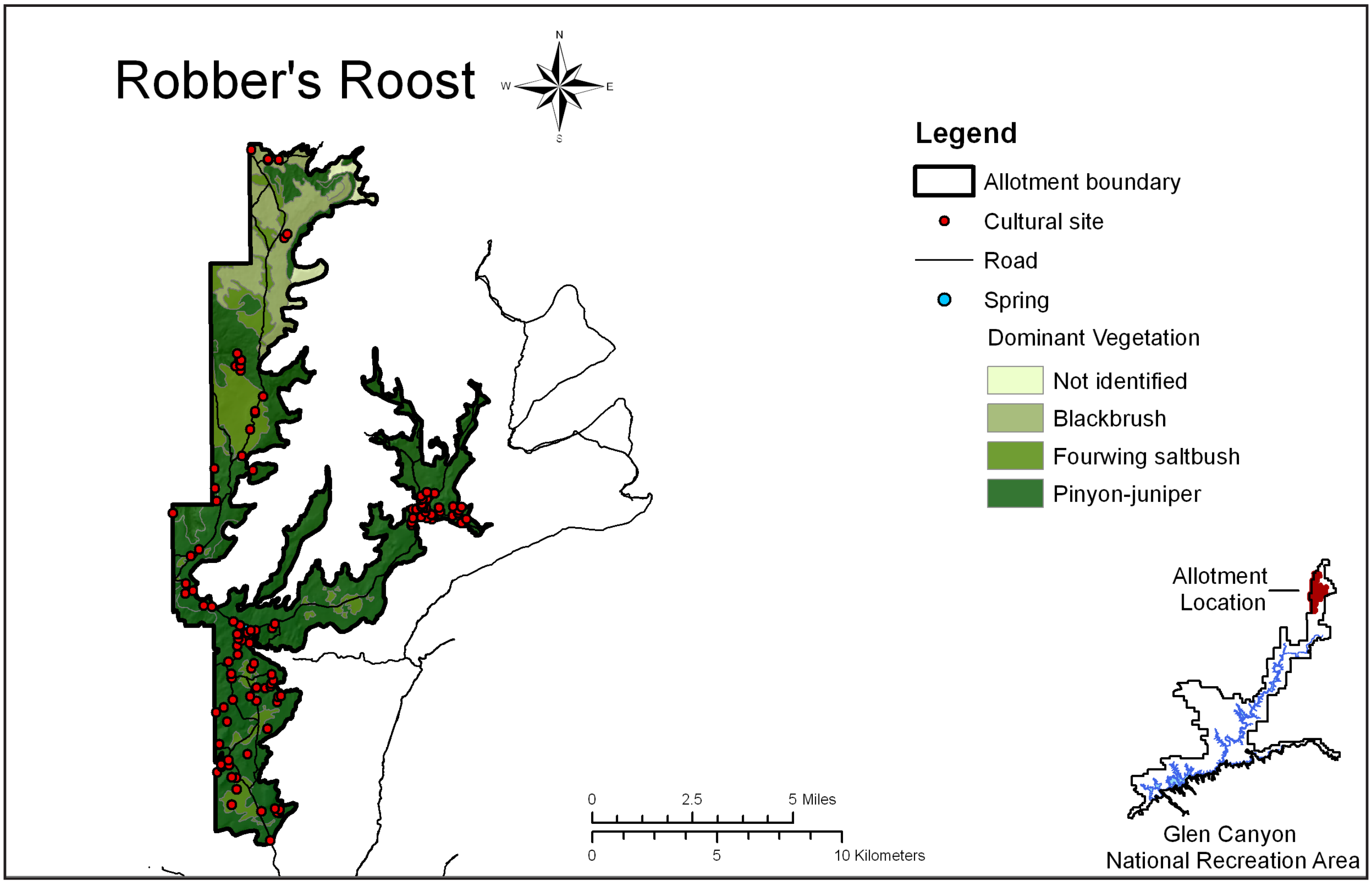
No. Cultural Sites in Each Lifezone:

Highlands: 116
Midlands: 0
Lowlands: 0

Lifezone Significance and Known Cultural Sites: Although both Midland and Highland zones are present within Robber's Roost grazing allotment, all known cultural sites (n = 116) occur in the highlands. Geib describes the highlands has having cooler temperatures and higher precipitation than lower elevations, allowing for dry farming and later harvests. In addition, Geib notes that the highlands provide important natural foods, including pinyon, deer, and rabbit.

	Elevation	Characteristics	Environment	Significance to Humans
Lowlands	1219-1372 m (4000-4500 ft)	Hot and arid steep-walled sandstone canyons.	Riparian plants; big-horn sheep	Permanent water, arable alluvium, long growing season, diverse plant communities, natural shelters, quality siliceous stone from river gravels
Midlands	1372-1676 m (4500-5500 ft)	Arid slickrock and dune fields on benchlands and low plateaus.	Blackbrush, shadscale, grasses; antelope.	Grasses, including dropseed and ricegrass, prickly pear and shadscale; good antelope habitat, quality siliceous stone in certain locations.
Highlands	Above 1676 m (Above 5500 ft)	High elevation mesas and plateaus with cooler temperatures and greater precipitation.	Pinyon-juniper woodlands; deer and rabbit.	Higher elevation plant foods (i.e. pinyon); later harvests; dry-farming; abundant fuel, deer and rabbit.

Shading indicates lifezones present in allotment.



Area of Individual Vegetation Zones:

Dominant Species	Acres Covered	No. Sites
Not identified	939.74	1
Blackbrush (*Coleogyne ramosissima)*	2980.82	5
Fourwing saltbush *(Atriplex canescens)*	3506.22	9
Pinyon-juniper (*Pinus edulis - Juniperus osteosperma)*	16,527.53	101
Total	**23,954.31**	**116**

No. Cultural Sites in Each Vegetation Zone:
Five (n = 5) sites are located in blackbrush. Nine (n = 9) sites are located in fourwing saltbush. 101 sites are located in pinyon-juniper, and the remaining site (n = 1) is located in an area for which the dominant vegetation has not been identified.

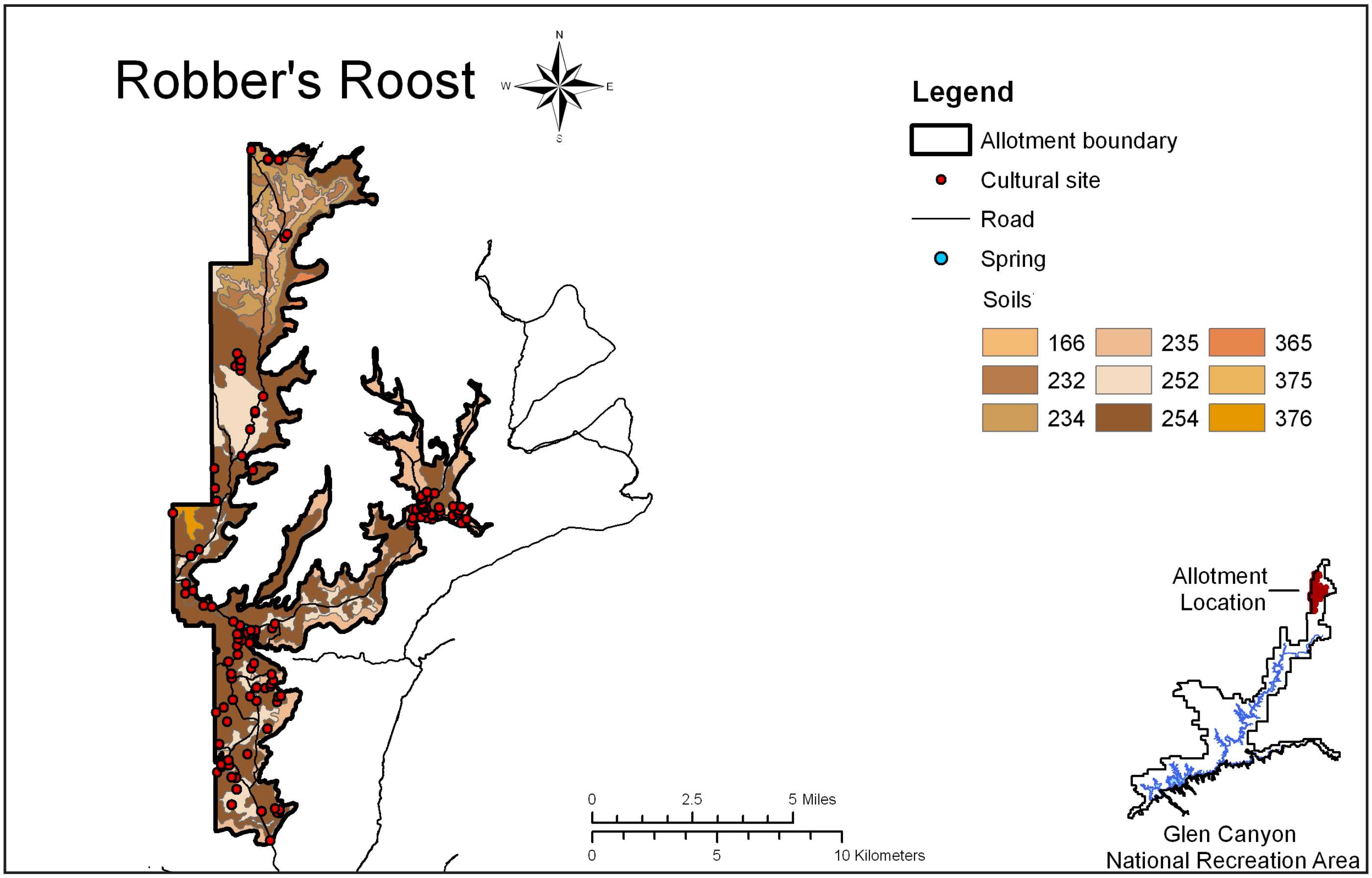
Visibility:
Pinyon-juniper dominants Robber's Roost grazing allotment, and in these areas, ground visibility may be reduced by the presence of duff beneath the trees. In shrubby communities, however, the ground visibility should be moderate - excellent, with large portions of the ground bare between plants.

Summary:
The primary dominant vegetation zones within Robber's Roost grazing allotment include blackbrush (12.44 percent), fourwing saltbush (14.64 percent), and pinyon-juniper (69.00 percent). Dominant vegetation for the remainder of the allotment is not currently known.

Dominant Species:
Fourwing saltbush (*Atriplex canescens*)
Blackbrush *(Coleogyne ramosissima*)
Pinyon (*Pinus edulis*)
Juniper (*Juniperus osteosperma*)

Secondary Dominant Species:
None known.

Associated Soils:
Blackbrush occurs in shallow sandy loam. Fourwing saltbush grows in sandy loam, and pinyon-juniper dominates in both sandy loam and shallow sand.

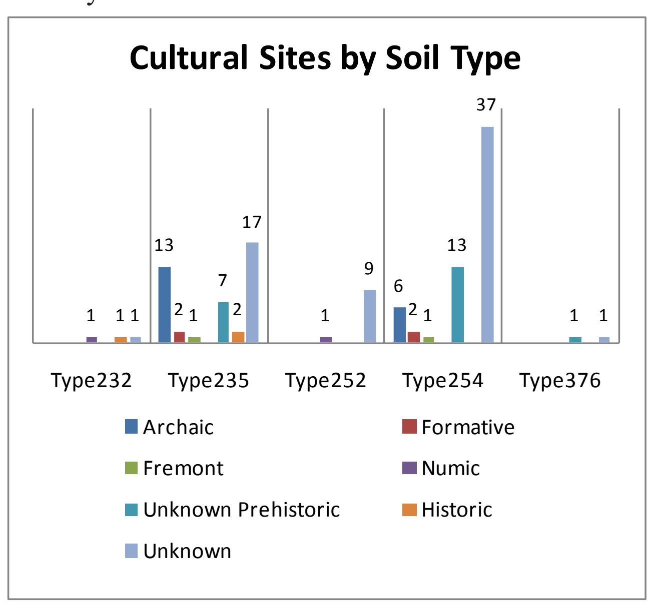


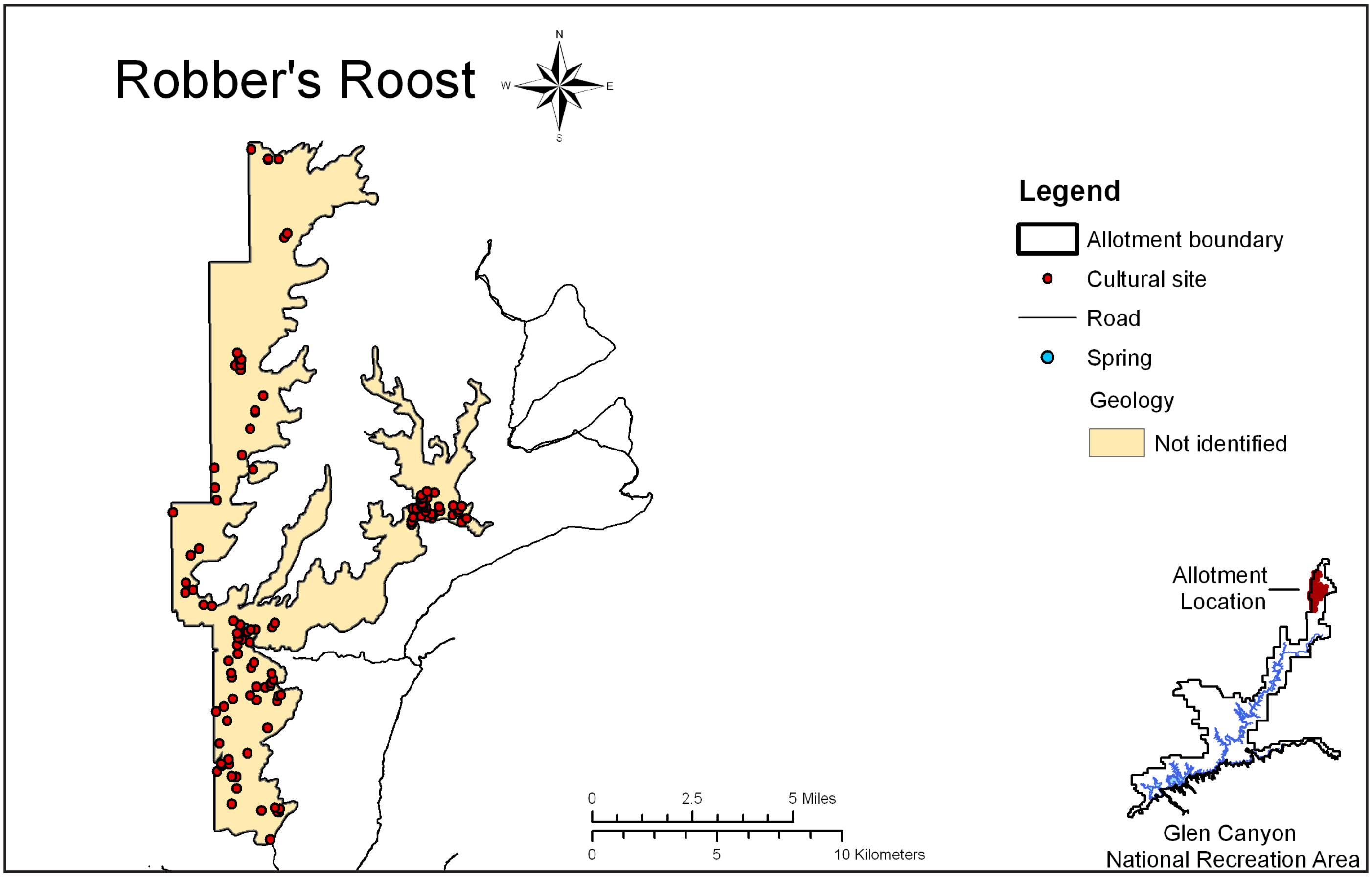
Allotment Divided by Soil Type (MUSYM):

Soil Type	Acres	Percent	No. Cultural Sites
166	0.39	<0.00	0
232	1339.24	5.59	3
234	1780.54	7.43	0
235	5138.88	21.45	42
252	3208.60	13.39	10
254	11,735.35	48.99	59
365	348.76	1.46	0
375	165.61	0.69	0
376	236.94	0.99	2
Total	**23,954.31**	**99.99%**	**116**

Distribution of Cultural Sites by Soil Type:

Three (n = 3) sites, including one historic site, one Numic site, and one site for which attribute/affiliation information is not available occur in soil type 232. Forty-two (n = 42) sites are located on soil type 235. These sites include 13 Archaic sites, two historic sites, two Formative sites, one Fremont site, seven currently unaffiliated prehistoric sites including three lithic scatters, three sites with features, and one rock art site, and 17 sites for which affiliation/attribute information is not available. Ten (n =10) sites, including one Numic site and nine sites for which affiliation/attribute information is not currently available, occur in soil type 252. Fifty-nine (n = 59) sites occur on soil type 254. These sites include five Archaic sites, one Fremont site, two Formative sites, 13 currently unaffiliated prehistoric sites including 11 lithic scatters and two sites with features, and 37 sites for which affiliation/attribute information is lacking at this time. The remaining two (n = 2) sites are located on soil type 376, and include one prehistoric site with features, and one site for which information is currently unavailable.





Allotment Divided by Geology:

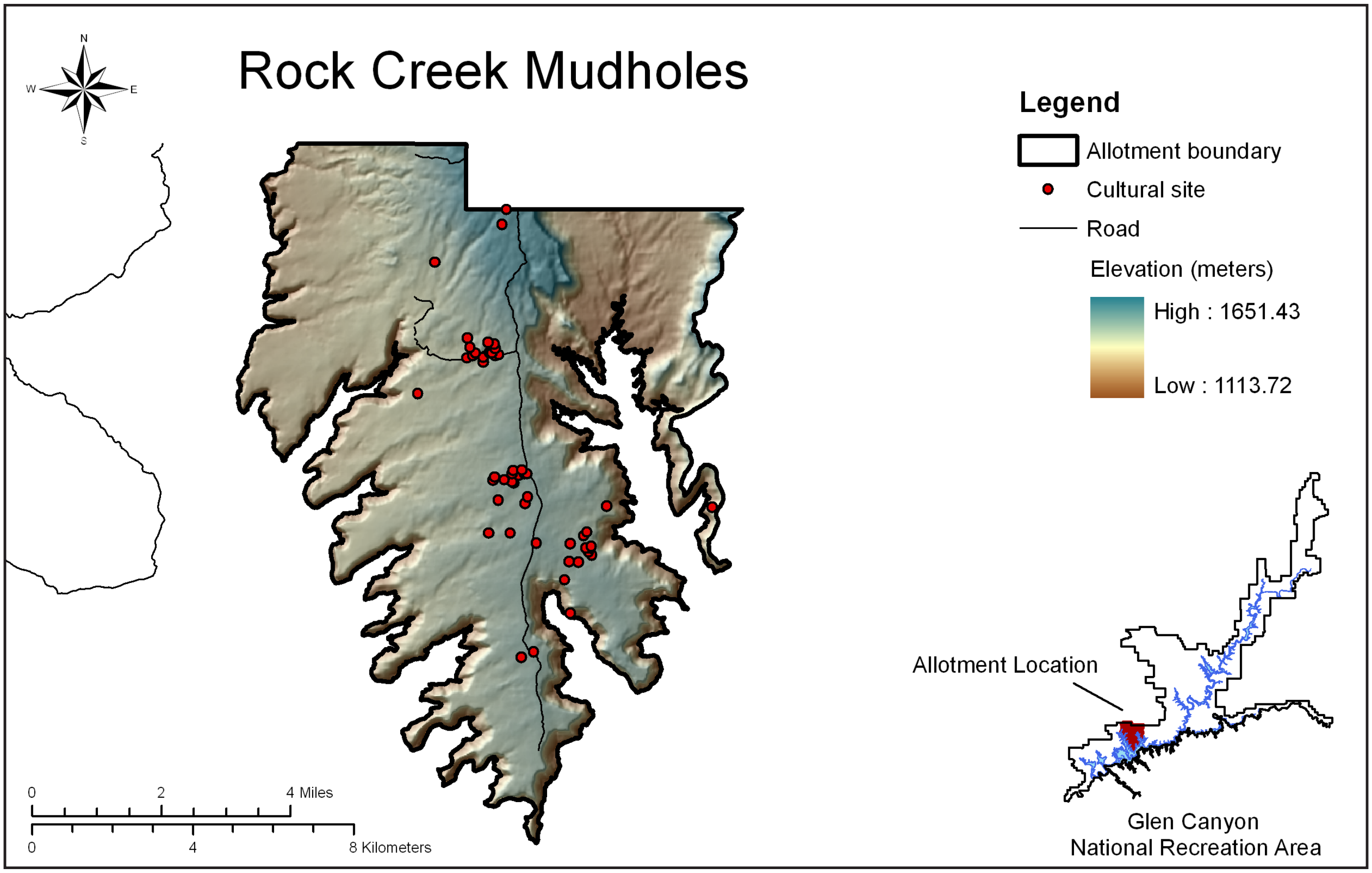
No geological information for Robber's Roost grazing allotment is available at this time.

Distribution of Cultural Sites by Geological Location:

All known cultural sites (n = 116) are located in areas for which information on the geological context is not currently available.

Rock Creek Mudholes

Map Panels



Total Area: 29,133.991 acres

No. Cultural Sites: 52
Area surveyed: 0.00 acres

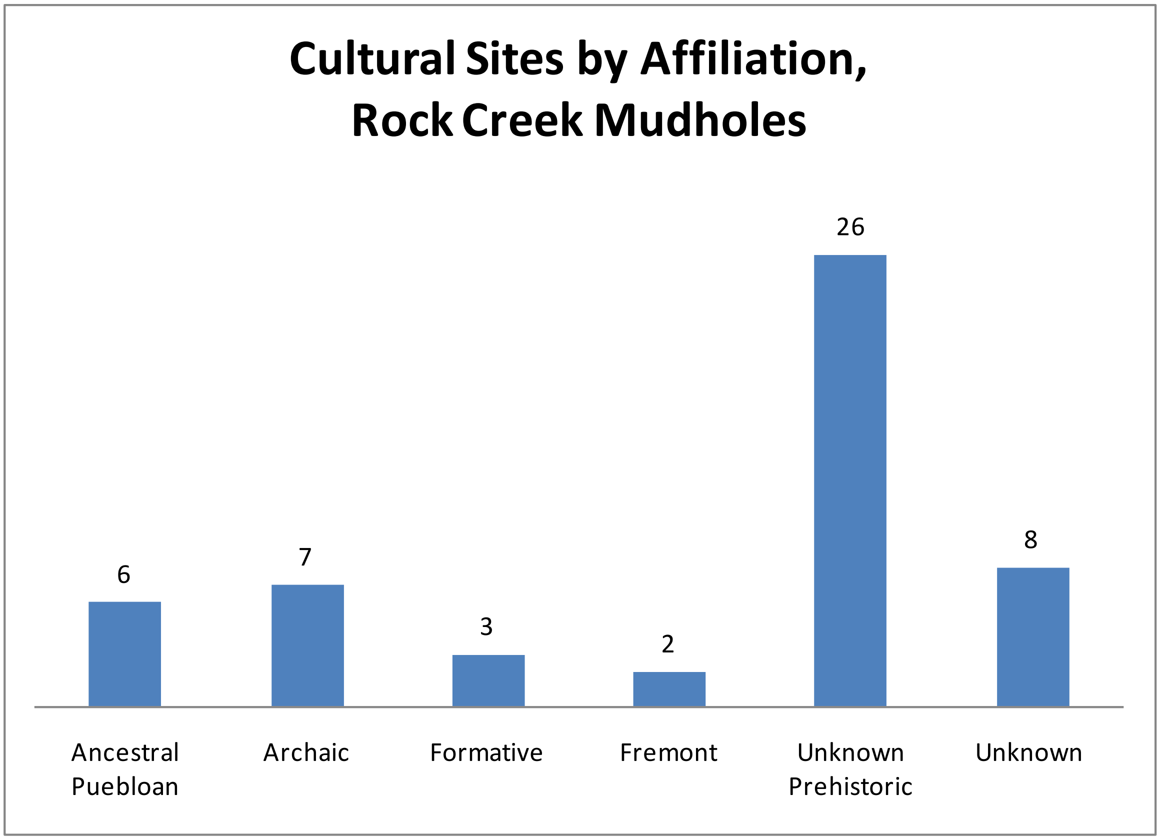
Sampling Fractions:
2 percent: 582.68 acres
5 percent: 1456.70 acres
11 percent: 3204.74 acres
16 percent: 4661.44 acres
20 percent: 5826.80 acres

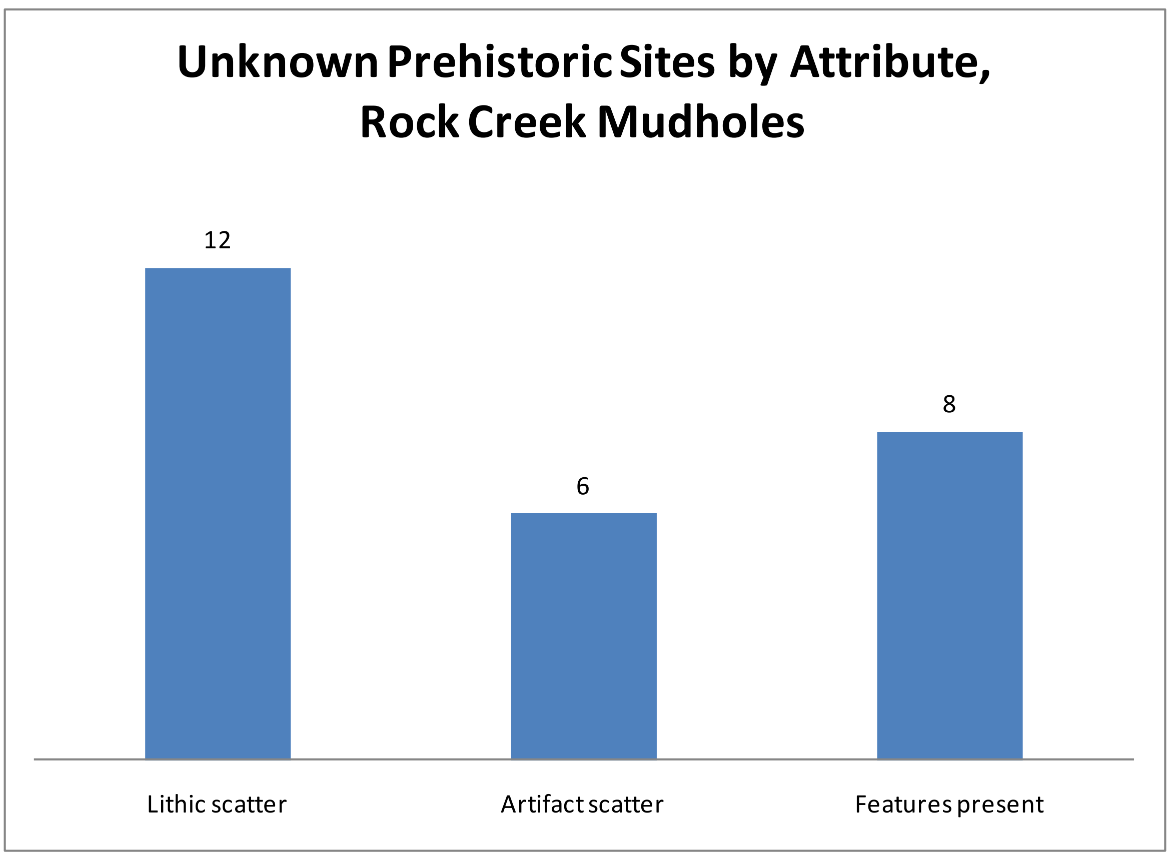
Elevation range amsl:
1113.72 – 1651.43 meters (3653.94 - 5418.08 feet)

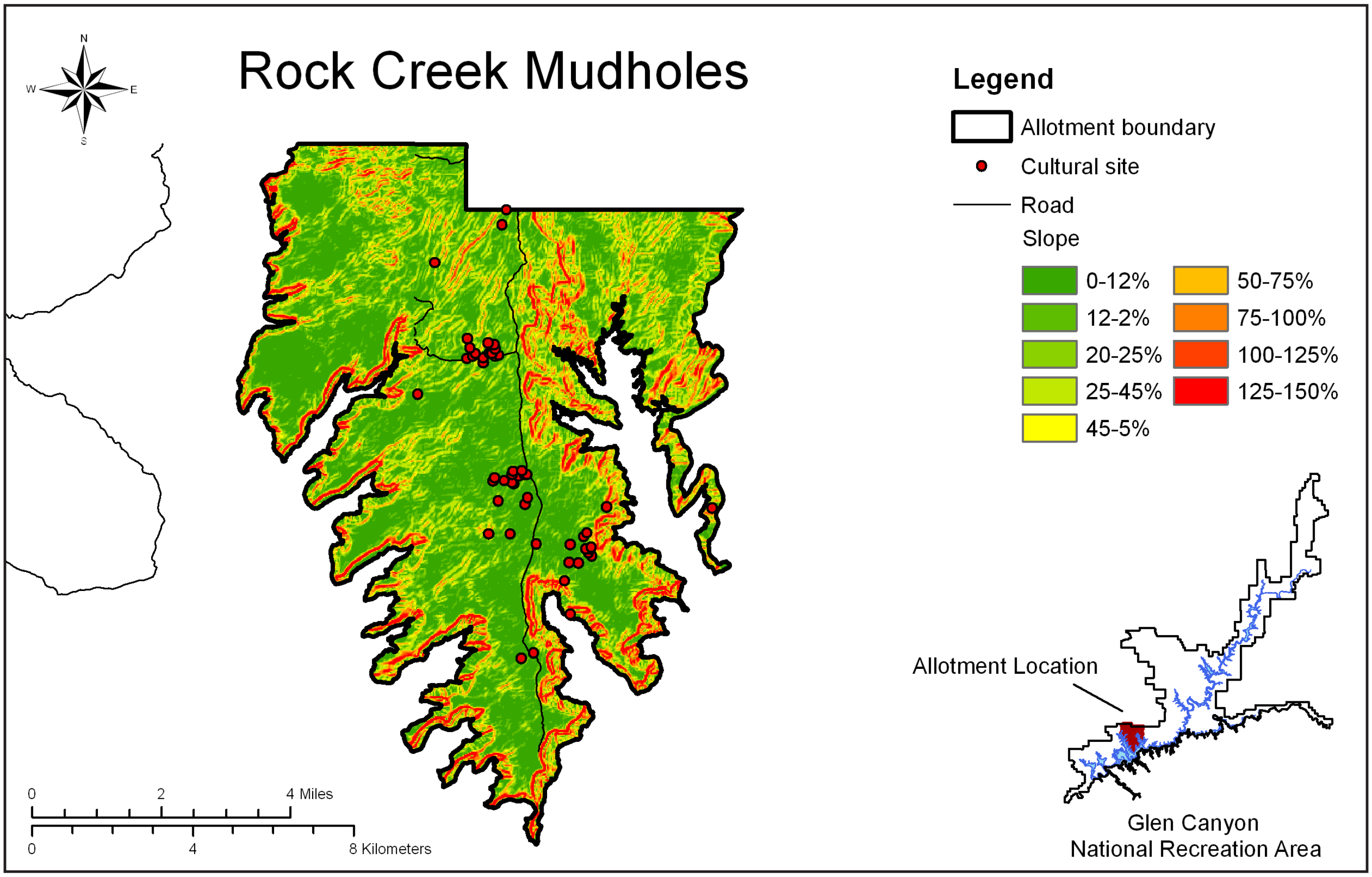
Rivers and Springs:
Rock Creek (not depicted) is located in Rock Creek Mudholes grazing allotment.

Accessibility:
County Hwy 262 runs north-south through the allotment, and County Hwy 279 crosses through the allotment from east-west. County Hwy 230 also parallels the allotment on the western side. Lake Powell forms the southern boundary of the allotment and Rock Creek Bay cuts into the southeast. Last Chance Bay forms the west boundary. Given that most of Rock Creek Mudholes is surrounded by Lake Powell, boat access may also be possible

The figures on the subsequent page depict cultural sites by affiliation, and for those prehistoric sites for which affiliation is not known, site attributes.


Cultural Sites by Affiliation,
Rock Creek Mudholes
6
7
3
2
26
8
Ancestral Puebloan
Archaic
Formative
Fremont
Unknown Prehistoric
Unknown


Unknown Prehistoric Sites by Attribute,
Rock Creek Mudholes
12
6
8
Lithic scatter
Artifact scatter
Features present



Slope Considerations:

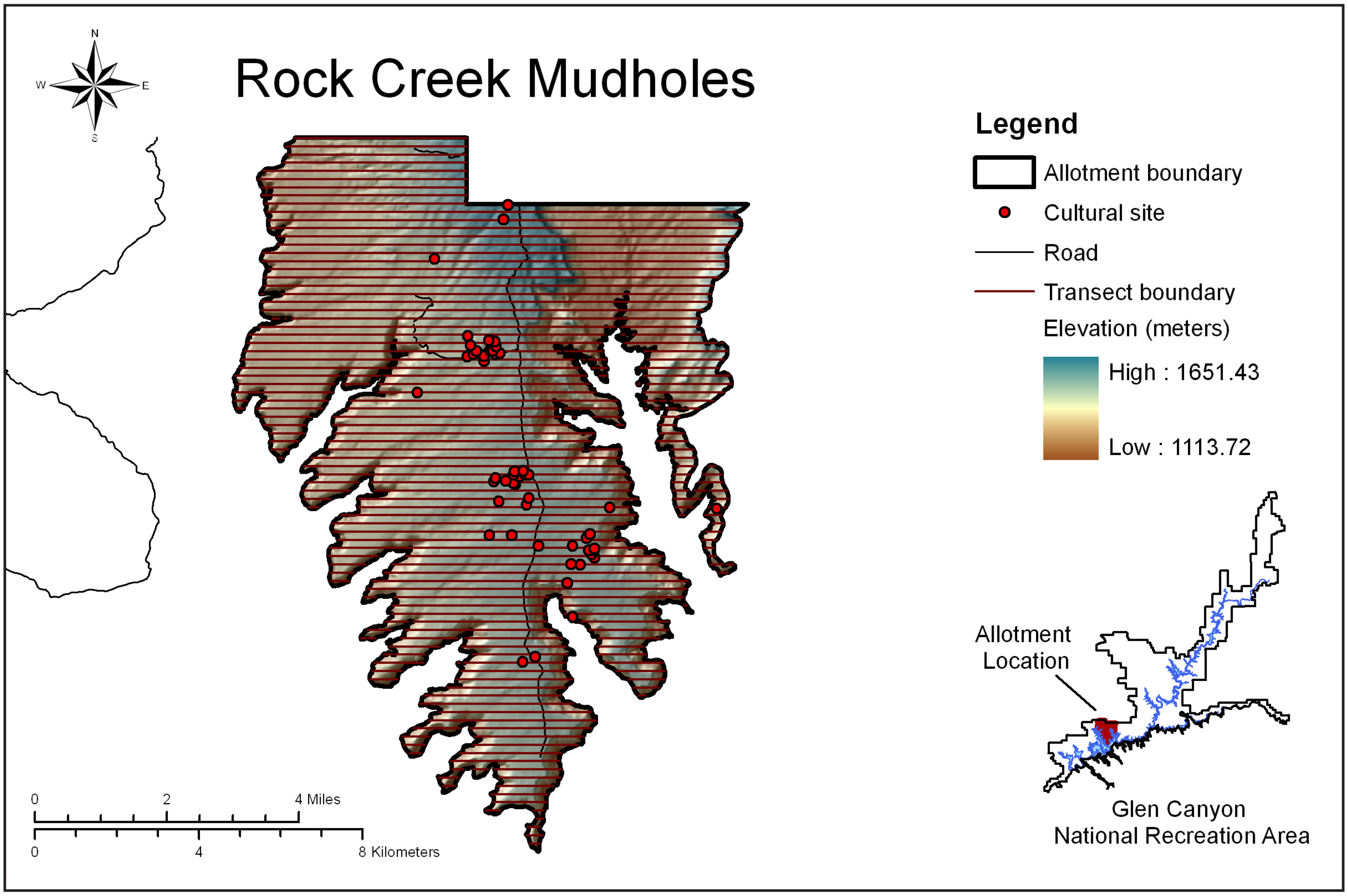
Slope plays a large role in terrain accessibility, and may be used in the stratification of survey areas. For example, GCNRA may wish to assign catagories such as low, moderate, and high to specific slope gradients. Such assignations are most often dependent on the factors guiding archaeological survey work, and as such, are not included in this document. Included herein, however, are suggestions for basic transect orientation based on the presence of topographical barriers identified by the presence of excessive slope gradients.

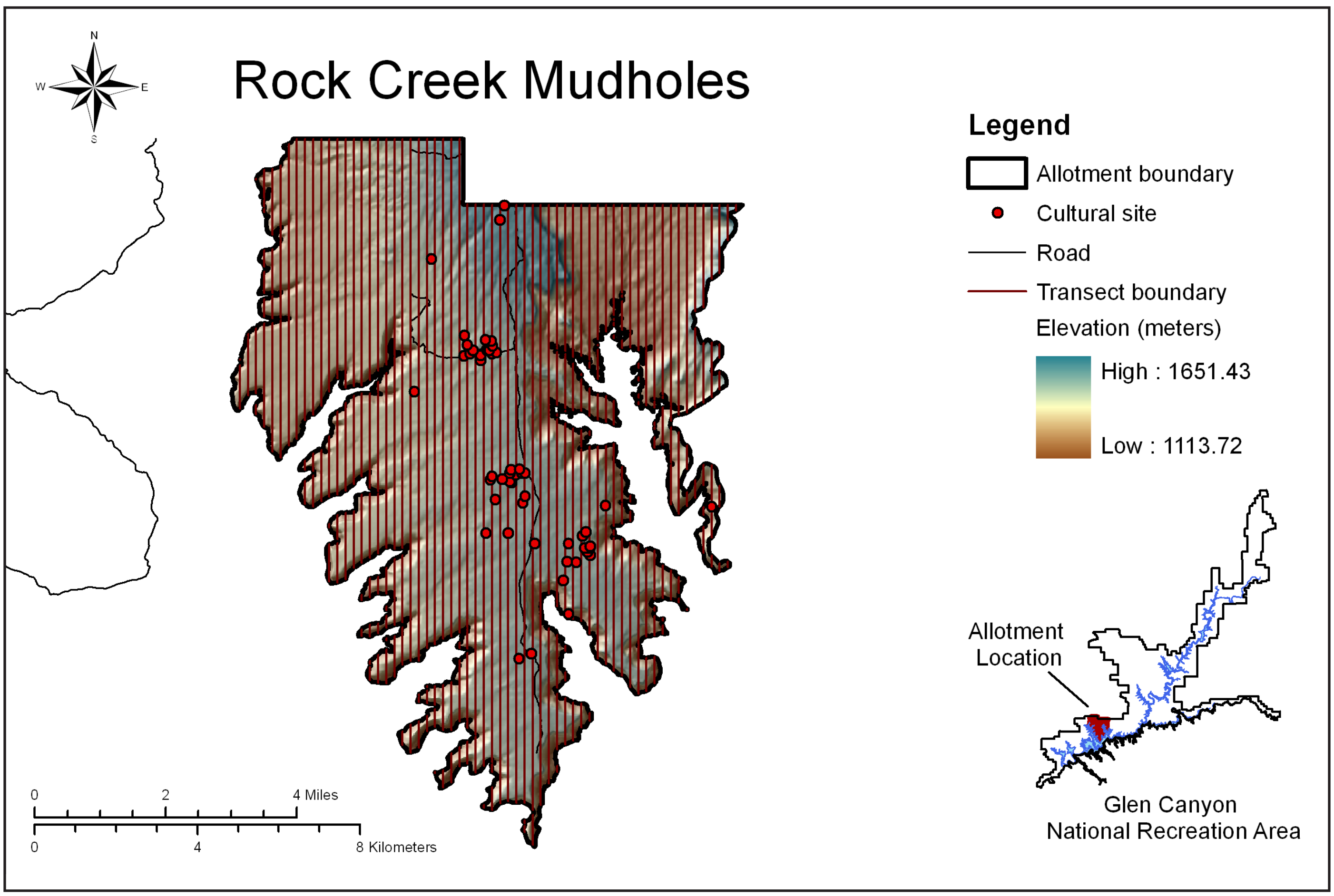
Survey Zones Dictated by Slope:

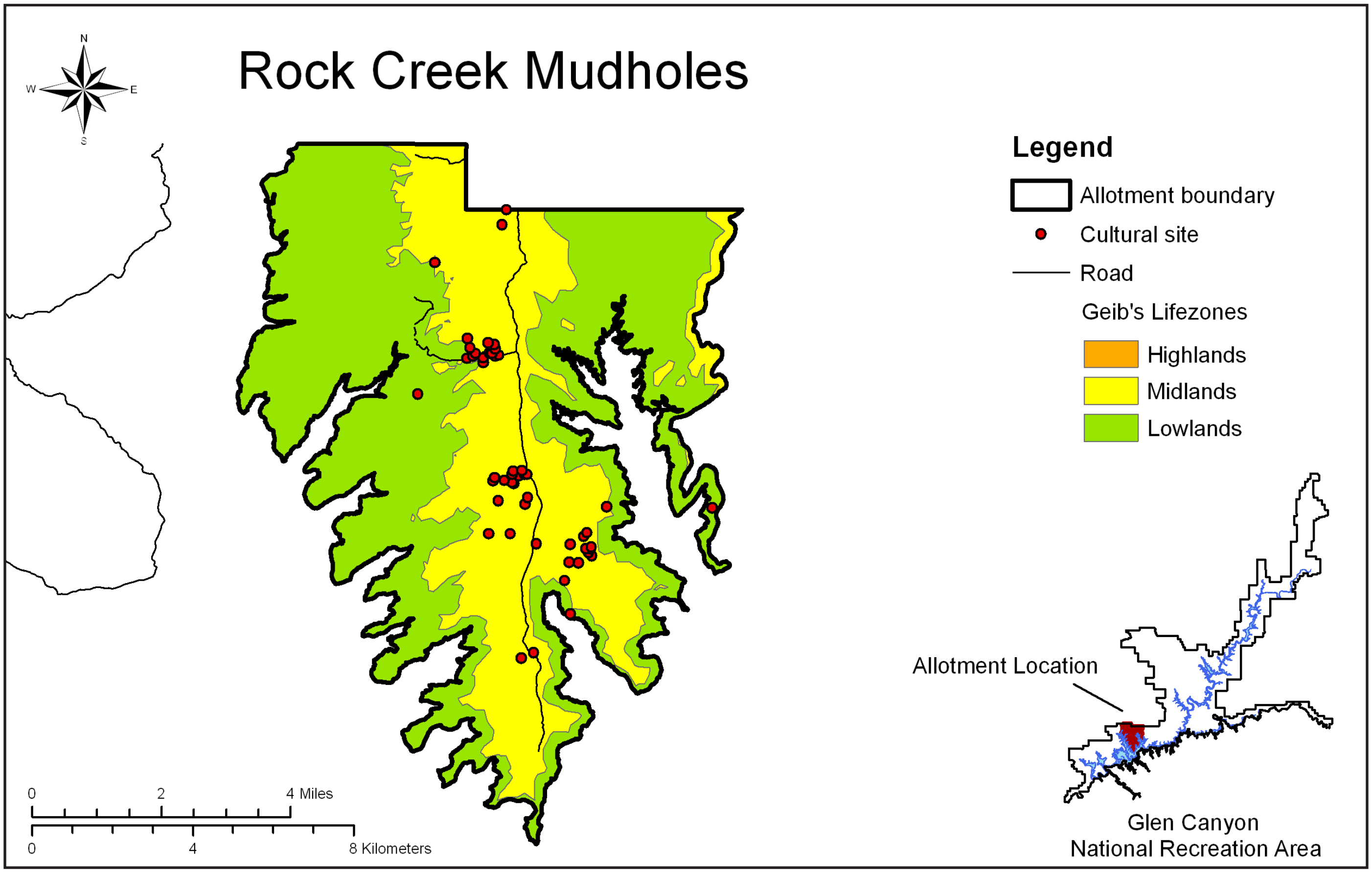
Primary and lateral roadways provide access to most Rock Creek Mudholes allotment, particullarly through the center. Recommended transects should therefore be placed perpendicular to available roadways wherever possible.

Note: Excessive slope will make lake access to the allotment difficult, as steep escarpments rise from the lake edge to form the boundary of the allotment.

The 'fishnet' maps provided on the subsequent page display transects spaced at 200 meter intervals for both east-west and north-south oriented pedestrian survey.


N
W
E
S
Rock Creek Mudholes
Legend
Allotment boundary
Cultural site
Road
Transect boundary
Elevation (meters)
High : 1651.43
Low : 1113.72
Allotment Location
Glen Canyon National Recreation Area
0
2
4 Miles
0
4
8 Kilometers


N
W
E
S
Rock Creek Mudholes
Legend
Allotment boundary
Cultural site
Road
Transect boundary
Elevation (meters)
High : 1651.43
Low : 1113.72
Allotment Location
Glen Canyon National Recreation Area
0
2
4 Miles
0
4
8 Kilometers



Area of Each Lifezone:

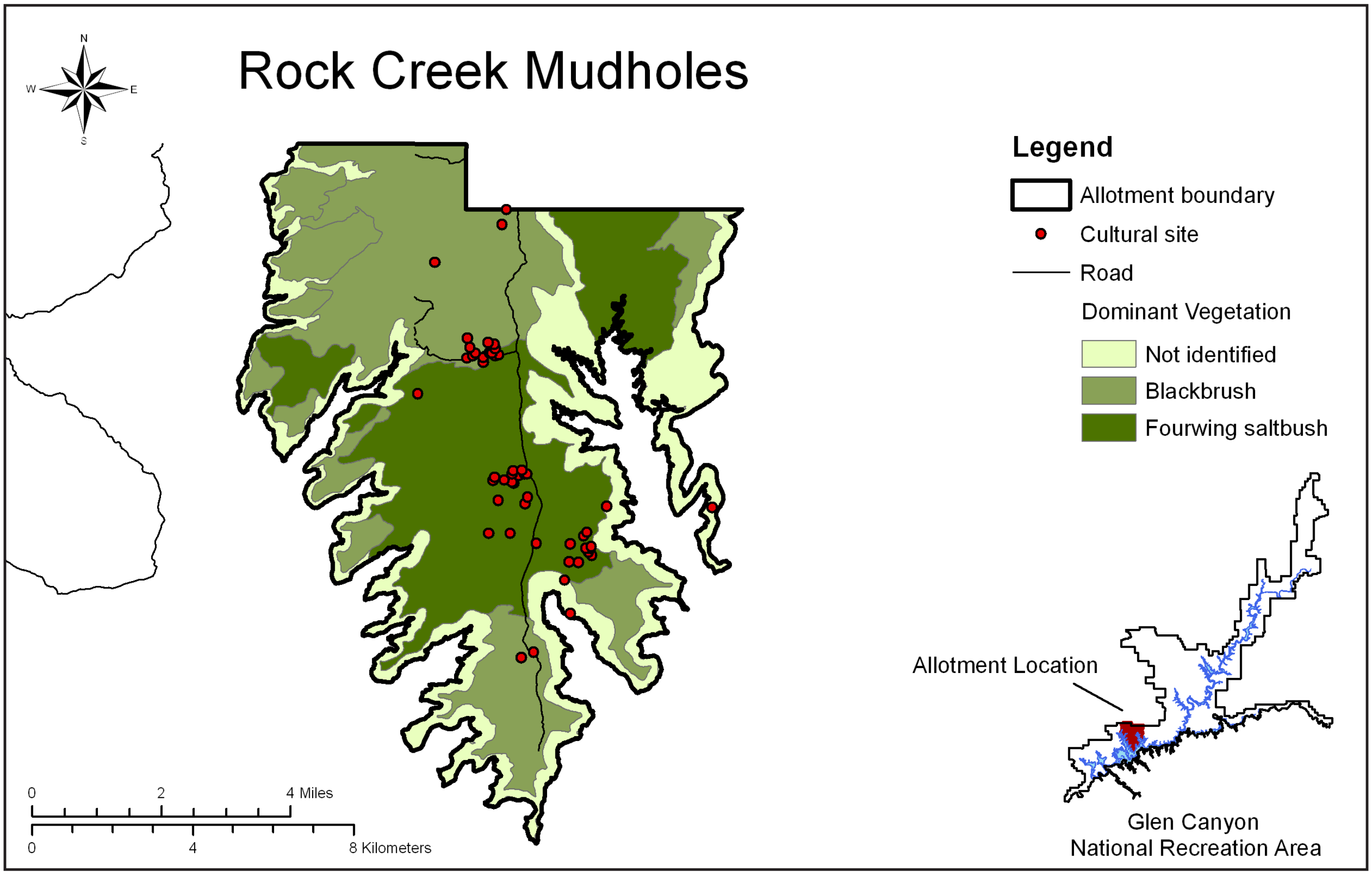
Highlands: 0.00 acres
Midlands: 11,057.20 acres
Lowlands: 17,981.14 acres

No. Cultural Sites in Each Lifezone:

Highlands: 0
Midlands: 48
Lowlands: 4

Lifezone Significance and Known Cultural Sites:
The majority of sites known for Rock Creek Mudholes occur in the midlands (n = 48). Geib describes the midlands as rich in grass and cacti resources, in addition to providing good habitant for antelope. The remaining sites (n = 4) are located in lowlands, described by Geib as hot and arid, with permanent water, arable alluvium, and long growing seasons needed for agricultural pursuits.

	Elevation	Characteristics	Environment	Significance to Humans
Lowlands	1219-1372 m (4000-4500 ft)	Hot and arid steep-walled sandstone canyons.	Riparian plants; bighorn sheep	Permanent water, arable alluvium, long growing season, diverse plant communities, natural shelters, quality siliceous stone from river gravels
Midlands	1372-1676 m (4500-5500 ft)	Arid slickrock and dune fields on benchlands and low plateaus.	Blackbrush, shadscale, grasses; antelope.	Grasses, including dropseed and ricegrass, prickly pear and shadscale; good antelope habitat, quality siliceous stone in certain locations.
Highlands	Above 1676 m (Above 5500 ft)	High elevation mesas and plateaus with cooler temperatures and greater precipitation.	Pinyon-juniper woodlands; deer and rabbit.	Higher elevation plant foods (i.e. pinyon); later harvests; dry-farming; abundant fuel, deer and rabbit.
Shading indicates lifezones present in allotment.				



Area of Individual Vegetation Zones:

Dominant Species	Acres Covered	No. Sites
Not identified	8373.65	4
Blackbrush (*Coleogyne ramosissima)*	11,013.57	14
Fourwing saltbush *(Atriplex canescens)*	9746.77	34
Total	**29,133.99**	**52**

No. Cultural Sites in Each Vegetation Zone:
Fourteen (n = 14) sites are located in blackbrush. Thirty-four sites (n = 34) are located in fourwing saltbush. The remaining sites (n = 4) are located in areas for which the dominant vegetation has not been identified.

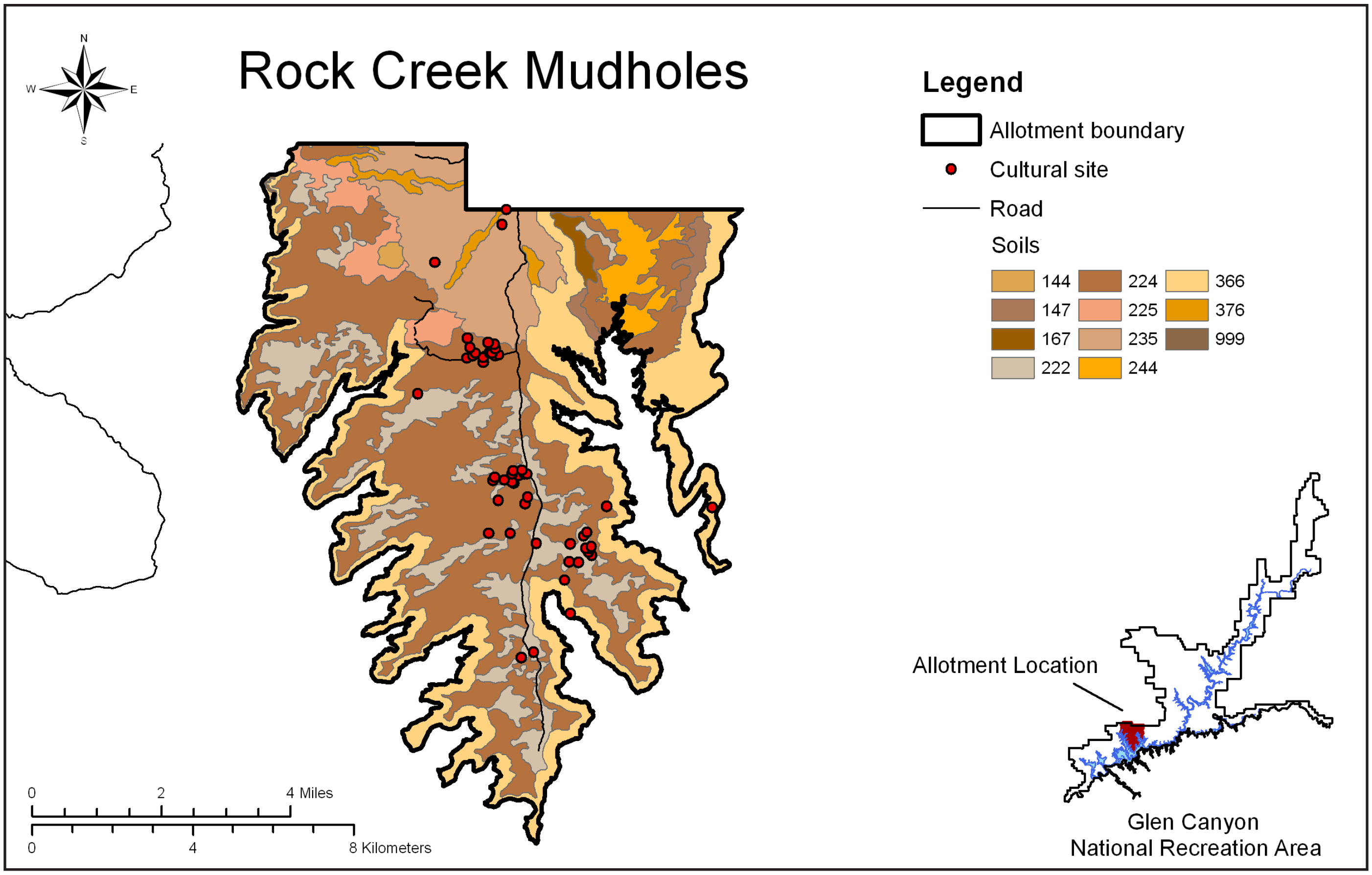
Visibility:
In general, the dominant vegetative communities of the allotment provide moderate - excellent ground visibility, with large portions of the ground bare of vegetation.

Summary:
The primary dominant vegetation zones within Rock Creek Mudholes grazing allotment include blackbrush (37.80 percent) and fourwing saltbush (33.45 percent,. Dominant vegetation for the remainder of the allotment is not currently known.

Dominant Species:
Fourwing saltbush (*Atriplex canescens*)
Blackbrush *(Coleogyne ramosissima*)

Secondary Dominant Species:
None known.

Associated Soils:
Blackbrush grows in shallow sandy loam, and in sandy loam where it may be associated with fourwing saltbush. Fourwing saltbush grows in sandy loam, and in rocky sandy loam alongside blackbrush in shallow sandy loam.

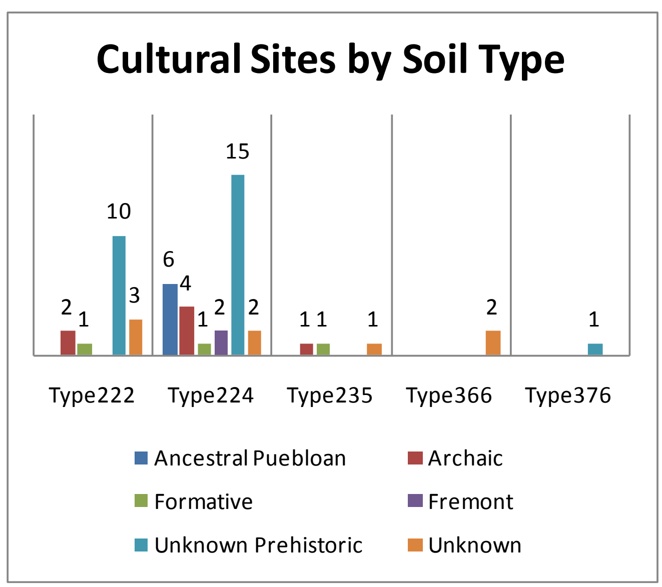


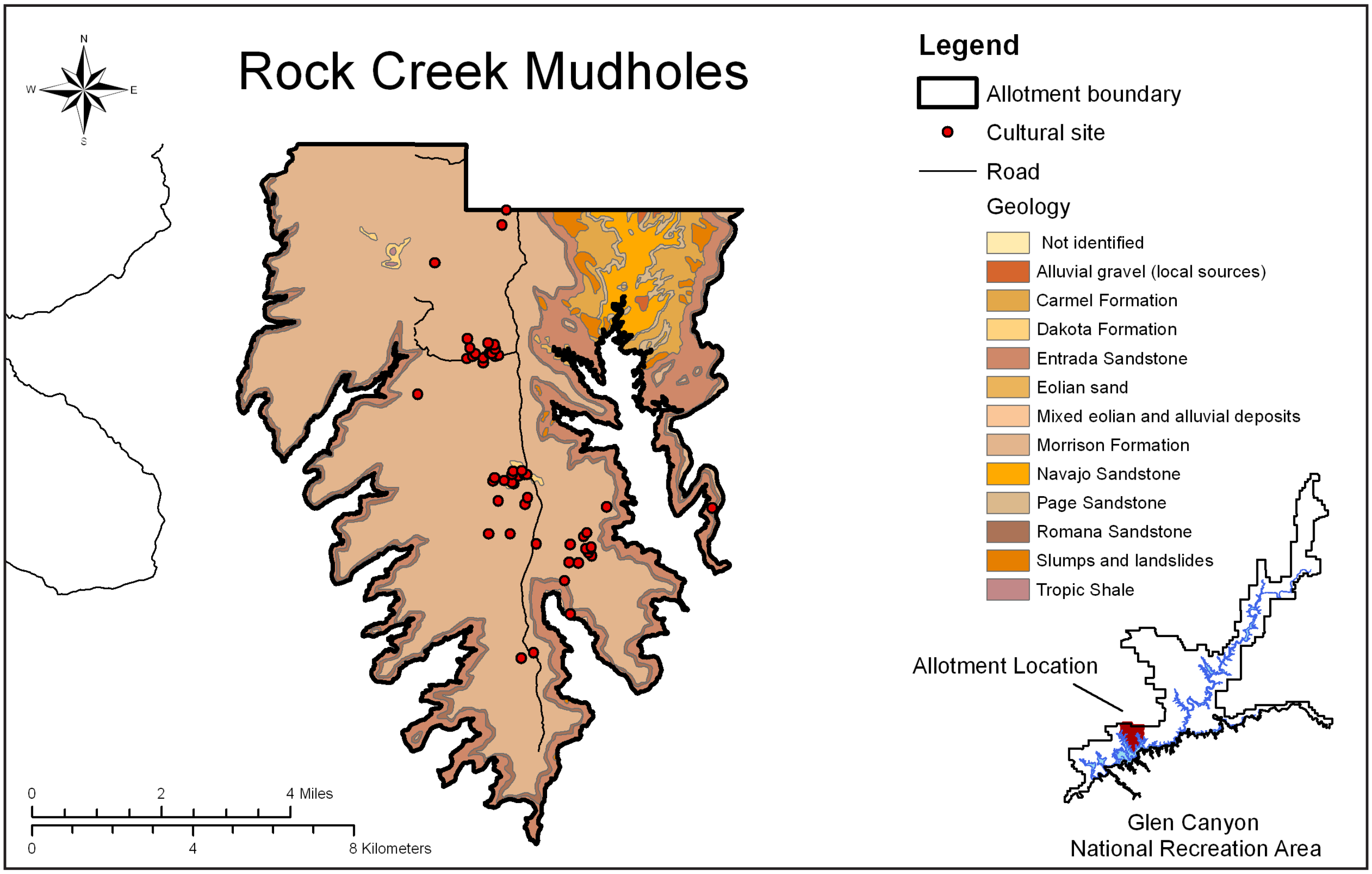
Allotment Divided by Soil Type (MUSYM):

Soil Type	Acres	Percent	No. Cultural Sites
144	82.66	0.28	0
147	328.68	1.13	0
167	178.95	0.61	0
222	3840.33	13.18	16
224	11,504.99	39.49	30
225	880.88	3.02	0
235	3112.73	10.68	3
244	808.37	2.77	0
366	7789.62	26.74	2
376	406.01	1.39	1
999	200.78	0.69	0
Total	**29,134.00**	**99.98%**	**52**

Distribution of Cultural Sites by Soil Type:

Sixteen (n = 16) sites, including two Archaic sites, one Formative site, ten currently unaffiliated prehistoric sites including two with features, five artifact scatters, and three lithic scatters, and three sites for which attribute/affiliation information is not currently available, occur in soil type 222. Thirty (n = 30) sites are located in soil type 224. These sites include six Ancestral Puebloan sites, four Archaic sites, one Formative site, two Fremont sites, 15 prehistoric sites, including nine lithic scatters, one artifact scatter, and five sites with features, and two sites for which attribute/affiliation information is currently lacking. Three (n = 3) sites, including one Archaic site, one Formative site, and one site for which attribute/affiliation information is currently unknown, are located on soil type 235. Two sites (n = 2) for which attribute/affiliation information is currently not known occur on soil type 366. The remaining site (n = 1) consists of five hearths, and is located on soil type 376.



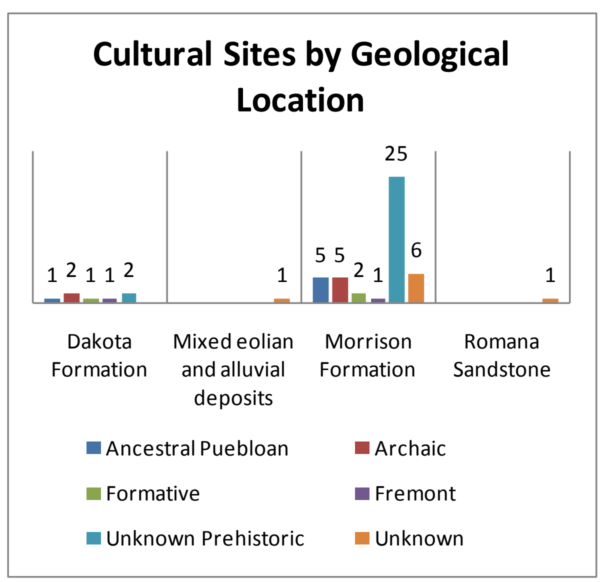


Allotment Divided by Geology:

Geology	Acres	Percent	No. Cultural Sites
Not identified	190.81	0.65	0
Alluvial gravel (local sources)	43.36	0.15	0
Carmel Formation	971.41	3.33	0
Dakota Formation	124.73	0.43	7
Entrada Sandstone	4811.26	16.51	0
Eolian sand	35.25	0.12	0
Mixed eolian and alluvial deposits	34.38	0.12	1
Morrison Formation	19,517.62	66.99	43
Navajo Sandstone	774.47	2.66	0
Page Sandstone	382.18	1.31	0
Romana Sandstone	1808.68	6.21	1
Slumps and landslides	428.66	1.47	0
Tropic Shale	10.88	<0.00	0
Total	**29,133.69**	**99.95%**	**52**

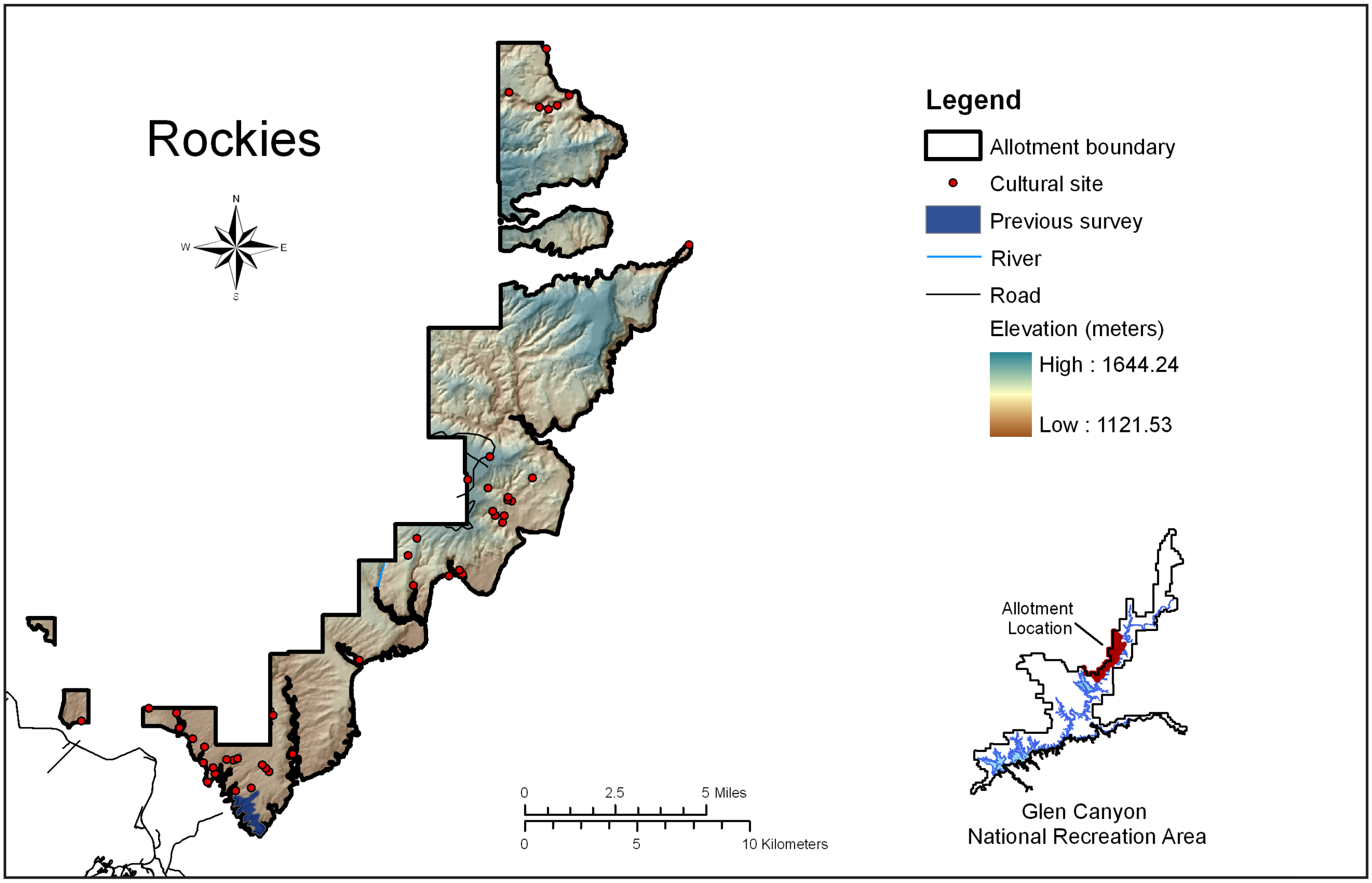
Distribution of Cultural Sites by Geological Location:

Seven (n = 7) sites, including one Ancestral Puebloan site, two Archaic sites, one Formative site, one Fremont site, and two unaffiliated prehistoric sites, one of which is an artifact scatter and the other containing a hearth, are located on Dakota Formation geology. A single site (n =1) for which attribute/affiliation information is unknown is located on mixed eolian and alluvial deposits. Forty-three (n = 43) sites are located on Morrison Formation geology, including five Ancestral Puebloan sites, five Archaic sites, two Formative sites, one Fremont site, 25 currently unaffiliated prehistoric sites, including 12 lithic scatters, five artifact scatters, and eight sites with features, and six sites for which attribute/affiliation information is not currently known. The remaining site (n = 1), for which information is currently not available, is located on Romana Sandstone.



Rockies

Map Panels



Total Area: 40,460.21 acres

Sampling Fractions:
2 percent: 809.20 acres
5 percent: 2023.01 acres
11 percent: 4450.62 acres
16 percent: 6473.63 acres
20 percent: 8092.04 acres

Elevation range amsl:
1121.53 – 1644.24 meters (3679.56 - 5394.49 feet)

Rivers and Springs:
Sevenmile Creek is located within Rockies grazing allotment, as are the following creeks (not depicted): Hanson, Smith Fork, Warm Springs, and Trachyte.

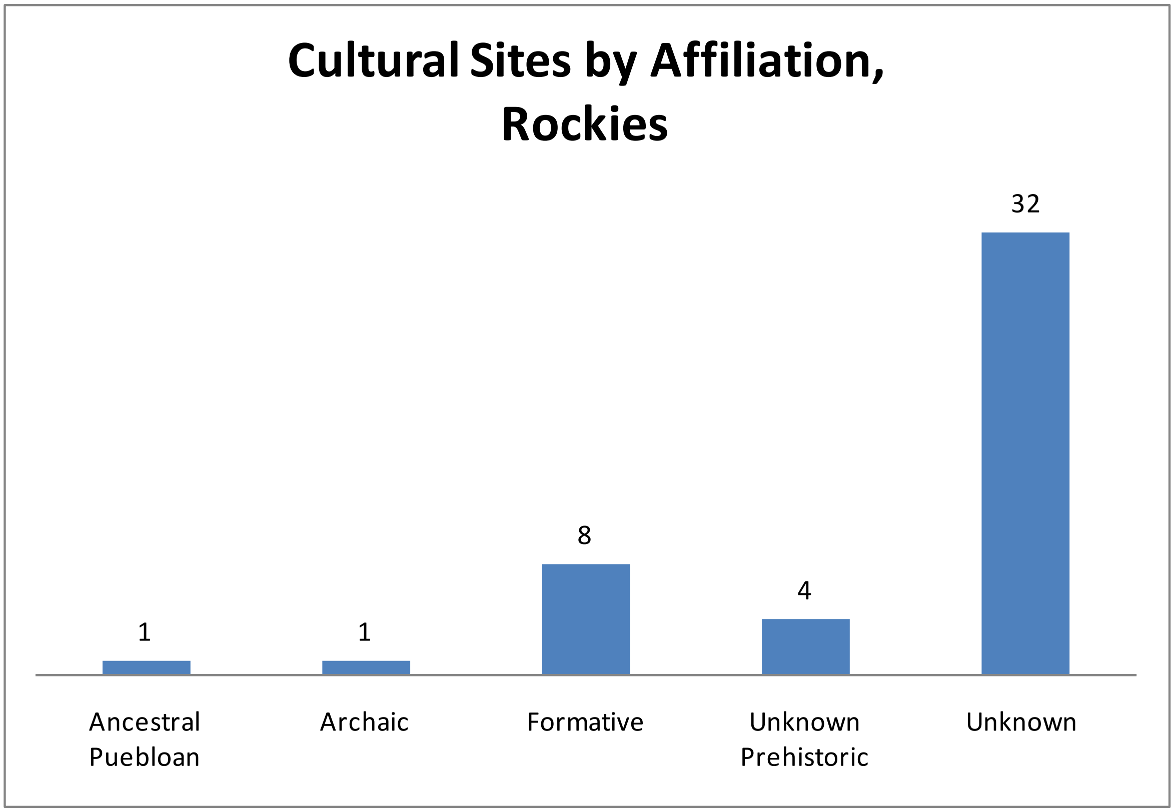
Accessibility:
County Hwys 531, 276, 533, 532, and 530 provide access to southwest portion of the allotment, and to Bullfrog North campground, Bullfrog South campground, Bullfrog campground, and Stanton Creek campground. Lake Powell bounds the eastern edge of the allotment, allowing for potential boat access.

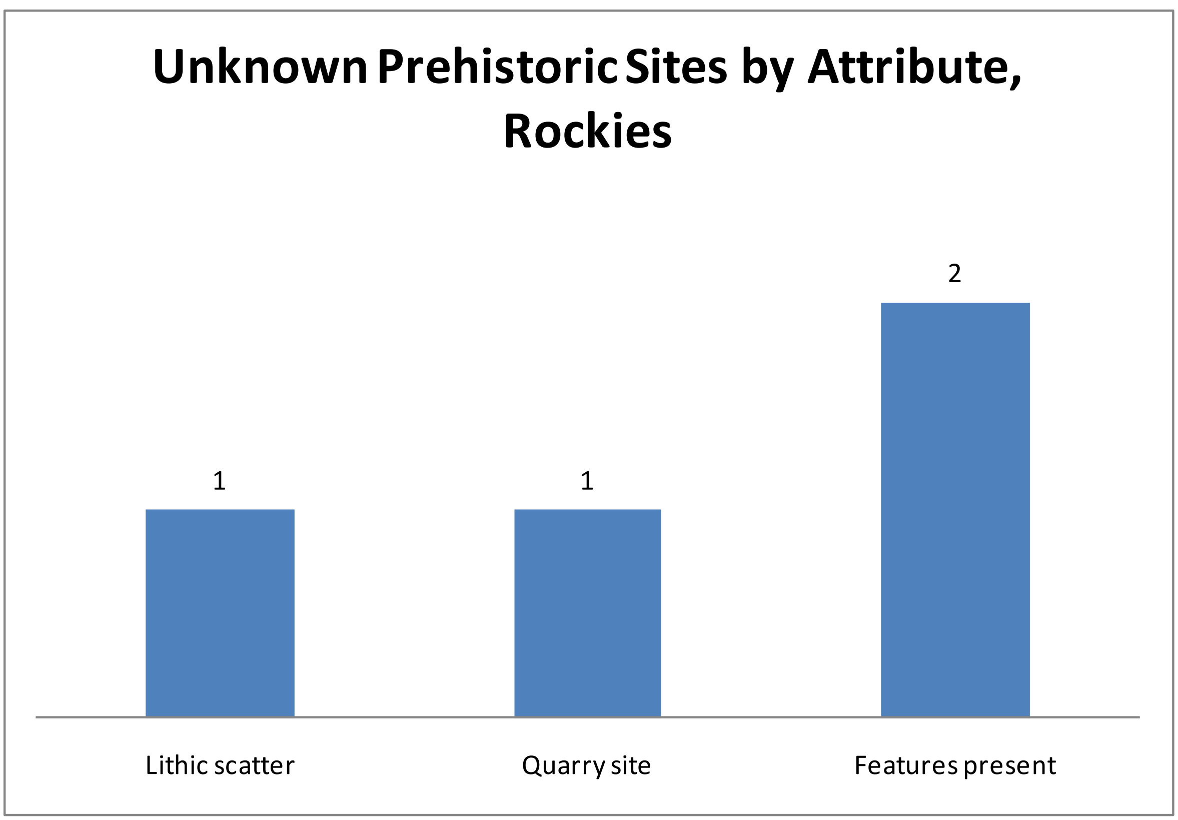
Fourmile Canyon and Twomile Canyon divide the north portion of the allotment from the south.

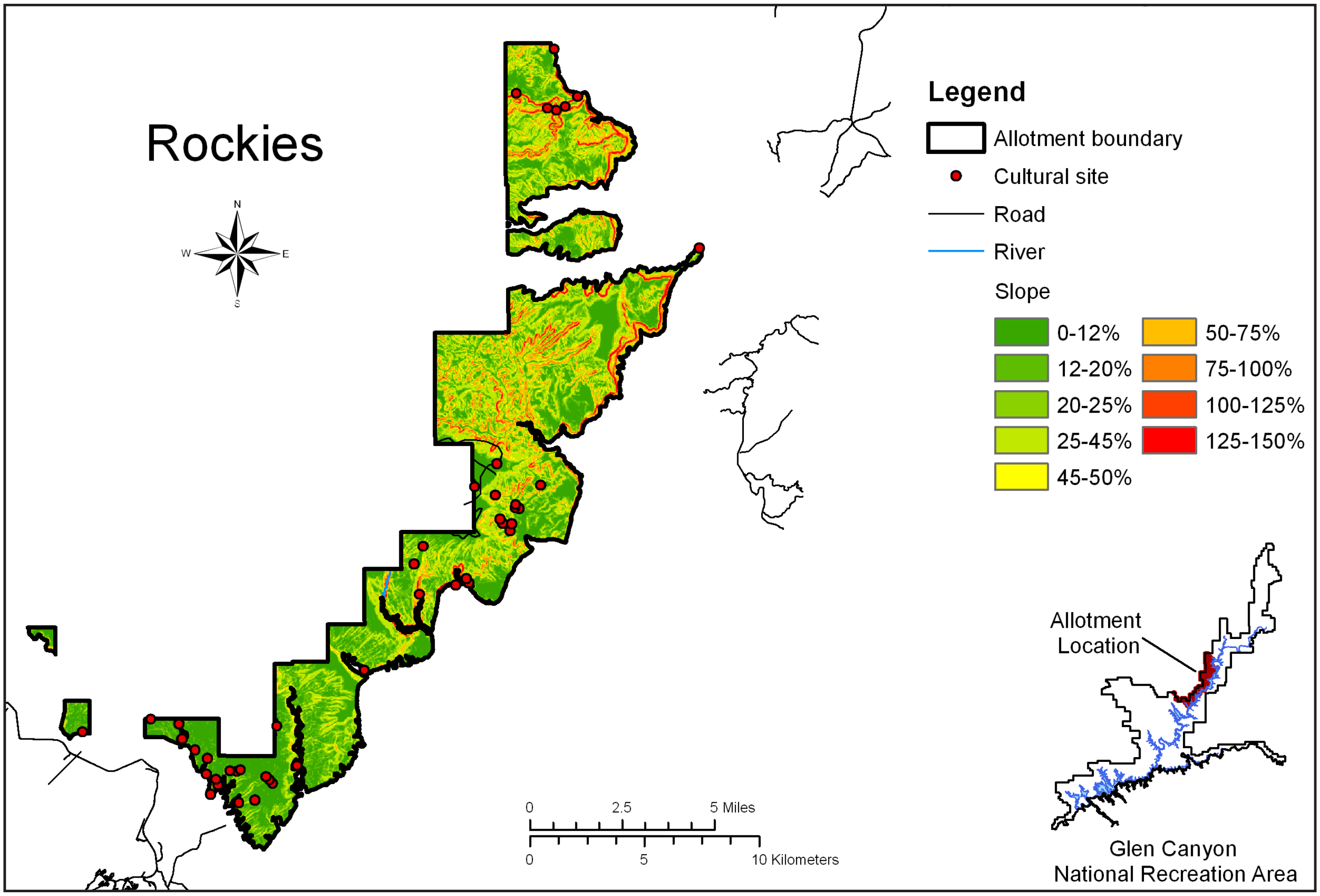
No. Cultural Sites: 46
Area surveyed: 314.03 acres

Survey References:
Tipps (1980): 14.63 acres
Kincaid (1989a): 299.40 acres

The figures on the subsequent page depict cultural sites by affiliation, and for those prehistoric sites for which affiliation is not known, site attributes.


Cultural Sites by Affiliation, Rockies
32
8
4
1
1
Ancestral Puebloan
Archaic
Formative
Unknown Prehistoric
Unknown


Unknown Prehistoric Sites by Attribute, Rockies
2
1
1
Lithic scatter
Quarry site
Features present



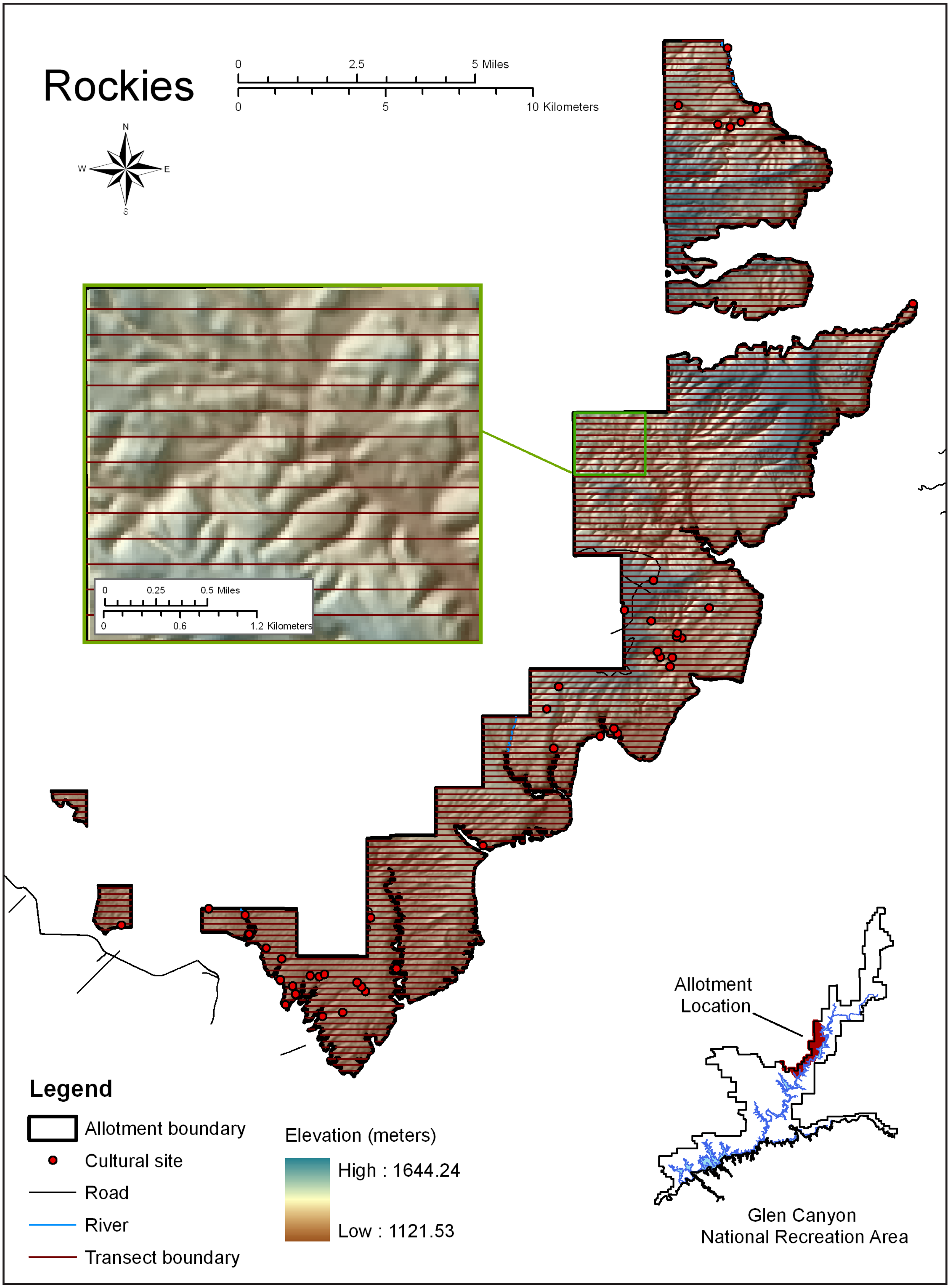
Slope Considerations:

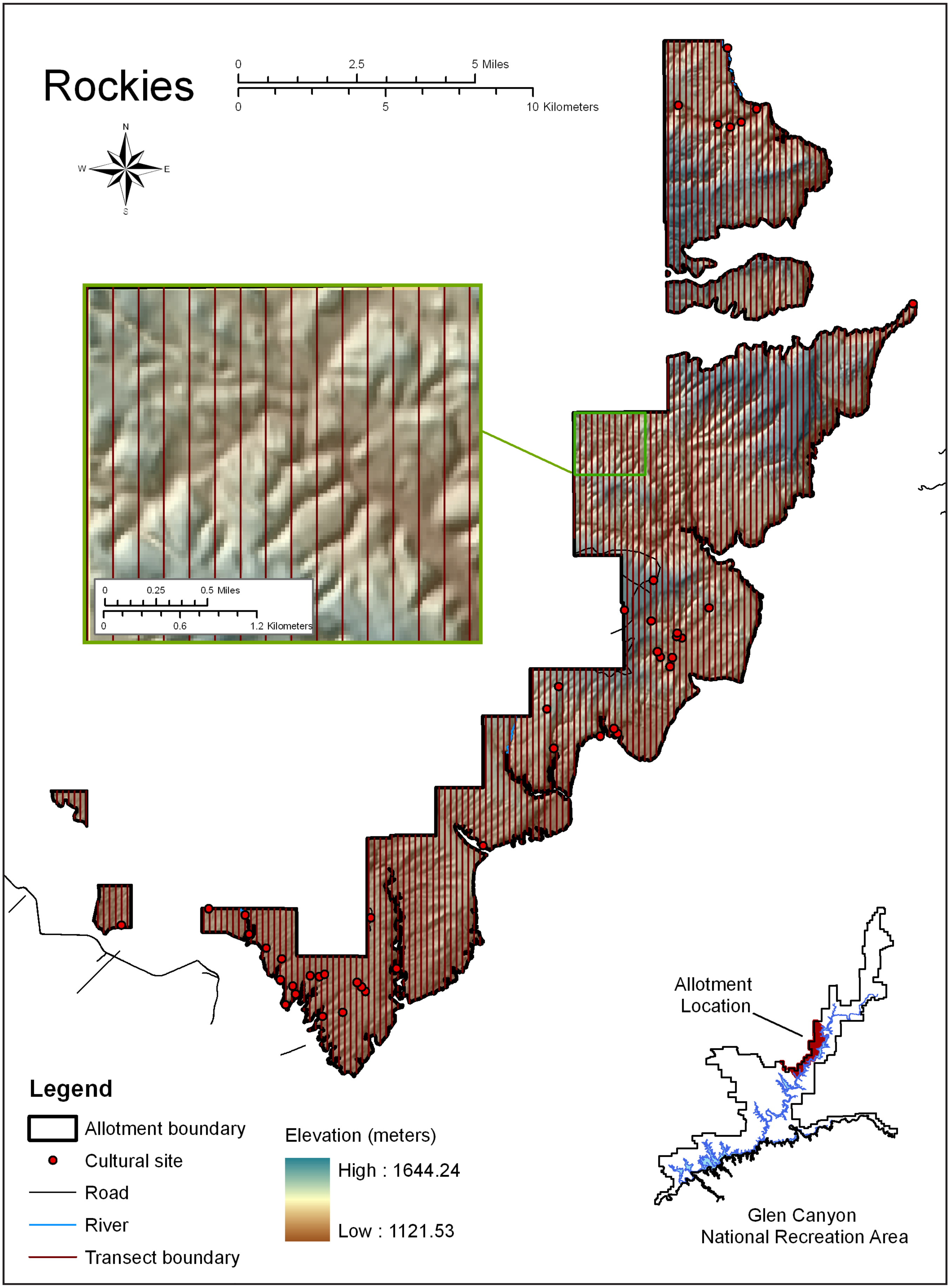
Slope plays a large role in terrain accessibility, and may be used in the stratification of survey areas. For example, GCNRA may wish to assign catagories such as low, moderate, and high to specific slope gradients. Such assignations are most often dependent on the factors guiding archaeological survey work, and as such, are not included in this document. Included herein, however, are suggestions for basic transect orientation based on the presence of topographical barriers identified by the presence of excessive slope gradients.

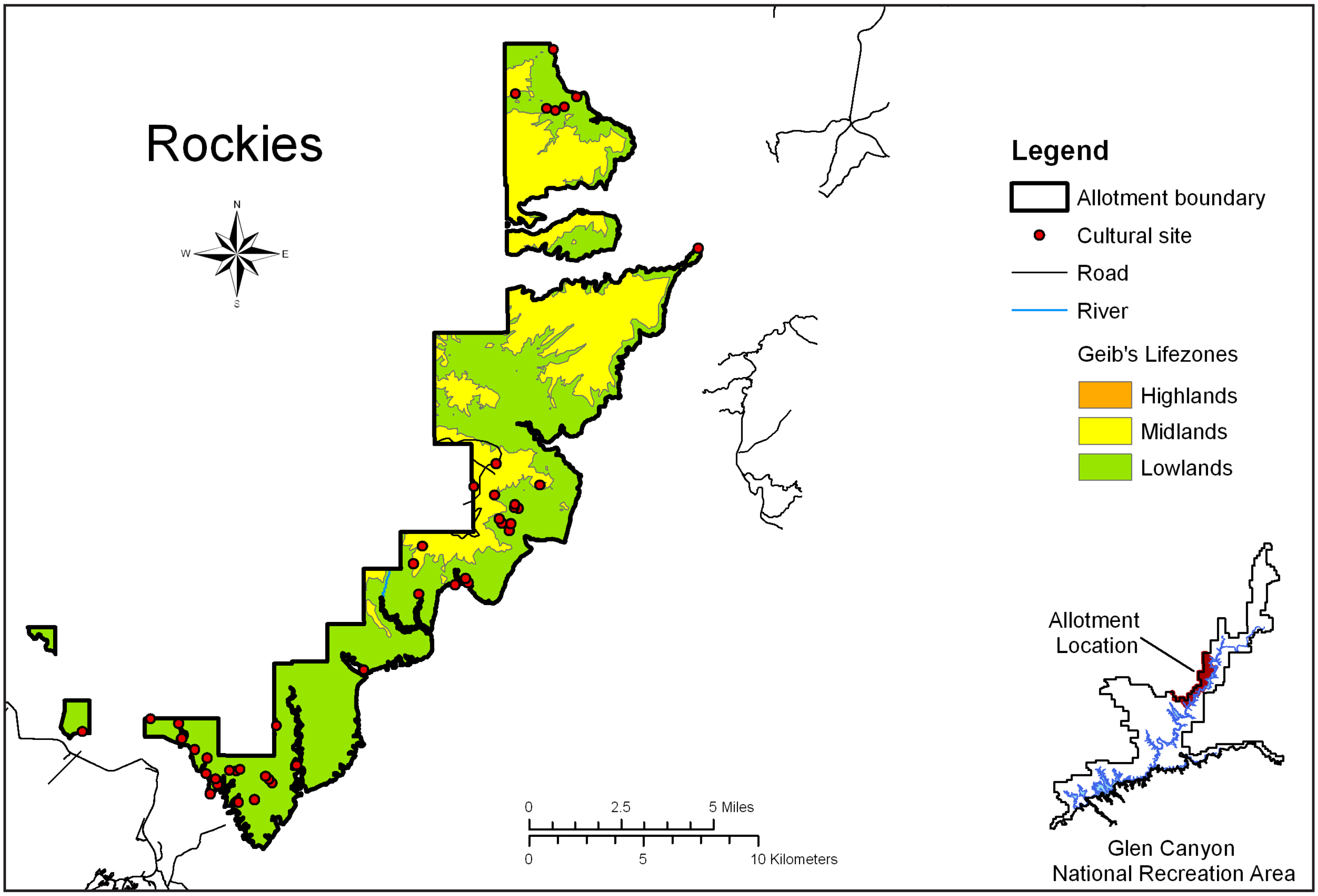
Survey Zones Dictated by Slope:

Access via road or boat may be possible for much of Rockies allotment, particularly in the south and along the eastern boundary. Transects should be set perpendicular to the point of access whenever possible, be it road or lake that provides the best access to a particular survey location.

The 'fishnet' maps provided on the subsequent pages display transects spaced at 200 meter intervals for both east-west and north-south oriented pedestrian survey.


Rockies
0
2.5
5 Miles
0
5
10 Kilometers
N
W
E
S
0
0.25
0.5 Miles
0
0.6
1.2 Kilometers
Legend
Allotment boundary
Cultural site
Road
River
Transect boundary
Elevation (meters)
High : 1644.24
Low : 1121.53
Allotment Location
Glen Canyon
National Recreation Area


Rockies
0
2.5
5 Miles
0
5
10 Kilometers
N
W
E
S
0
0.25
0.5 Miles
0
0.6
1.2 Kilometers
Allotment
Location
Glen Canyon
National Recreation Area
Legend
Allotment boundary
Cultural site
Road
River
Transect boundary
Elevation (meters)
High : 1644.24
Low : 1121.53



Area of Each Lifezone:

Highlands: 0.00 acres
Midlands: 13,737.14 acres
Lowlands: 26,534.91 acres

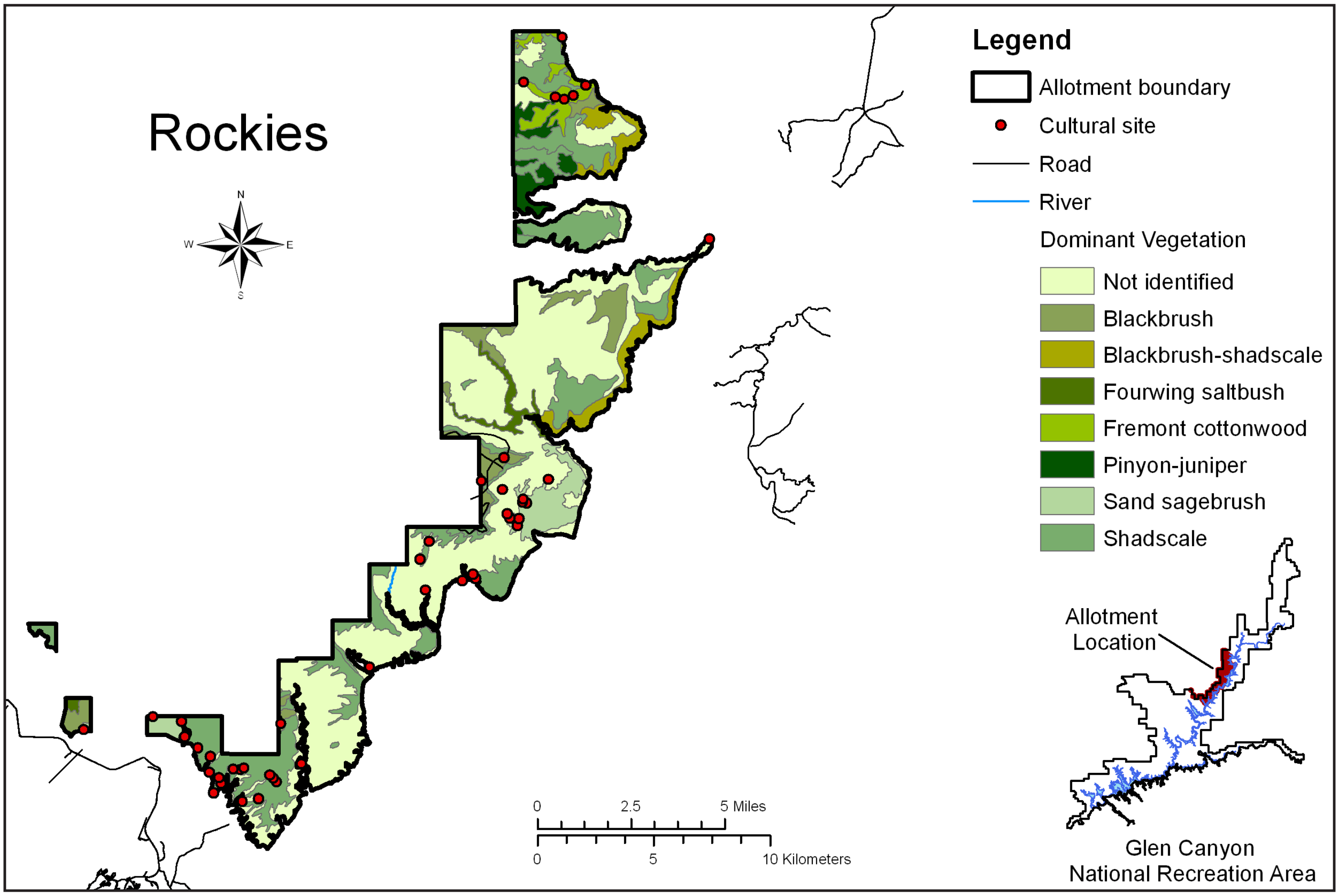
No. Cultural Sites in Each Lifezone:

Highlands: 0
Midlands: 4
Lowlands: 42

Lifezone Significance and Known Cultural Sites:
The majority of sites known for Rockies grazing allotment occur in the lowlands (n = 42). Geib describes the lowlands as hot and arid, with permanent water, arable alluvium, and long growing seasons needed for agricultural pursuits. The remaining four (n = 4) sites are located in the midlands, described as Geib as rich in grass and cacti resources, in addition to providing good habitant for antelope.

	Elevation	Characteristics	Environment	Significance to Humans
Lowlands	1219-1372 m (4000-4500 ft)	Hot and arid steep-walled sandstone canyons.	Riparian plants; big-horn sheep	Permanent water, arable alluvium, long growing season, diverse plant communities, natural shelters, quality siliceous stone from river gravels
Midlands	1372-1676 m (4500-5500 ft)	Arid slickrock and dune fields on benchlands and low plateaus.	Blackbrush, shadscale, grasses; antelope.	Grasses, including dropseed and ricegrass, prickly pear and shadscale; good antelope habitat, quality siliceous stone in certain locations.
Highlands	Above 1676 m (Above 5500 ft)	High elevation mesas and plateaus with cooler temperatures and greater precipitation.	Pinyon-juniper woodlands; deer and rabbit.	Higher elevation plant foods (i.e. pinyon); later harvests; dry-farming; abundant fuel, deer and rabbit.

Shading indicates lifezones present in allotment.



Area of Individual Vegetation Zones:

Dominant Species	Acres Covered	No. Sites
Not identified	20,794.64	15
Blackbrush ***(Coleogyne ramosissima)***	2495.00	2
Blackbrush-shadscale ***(Coleogyne ramosissima - Atriplex confertifolia)***	2030.69	0
Fourwing saltbush ***(Atriplex canescens)***	730.72	1
Fremont cottonwood ***(Populus fremontii)***	1062.97	5
Pinyon-juniper ***(Pinus edulis - Juniperus osteosperma)***	1214.35	0
Sand sagebrush ***(Artemisia filifolia)***	1824.60	11
Shadscale ***(Atriplex confertifolia)***	10,307.24	12
Total	**40,460.21**	**46**

No. Cultural Sites in Each Vegetation Zone:
Two (n = 2) sites are located in blackbrush. One (n = 1) site is located in fourwing saltbush. Five (n = 5) sites are located in Fremont cottonwood. Eleven (n = 11) sites occur in sand sagebrush, and 12 sites occur in shadscale. The remaining sites (n = 15) are located in areas for which the dominant vegetation is currently not identified.

Visibility:
In general, the dominant vegetation of Lake Canyon provide moderate - excellent visibility with large portions of the ground between plants bare of vegetation. However, a build-up of duff in the pinyon juniper zones may impede the visibility of small sites and isolated artifacts.

Continued on subsequent page...

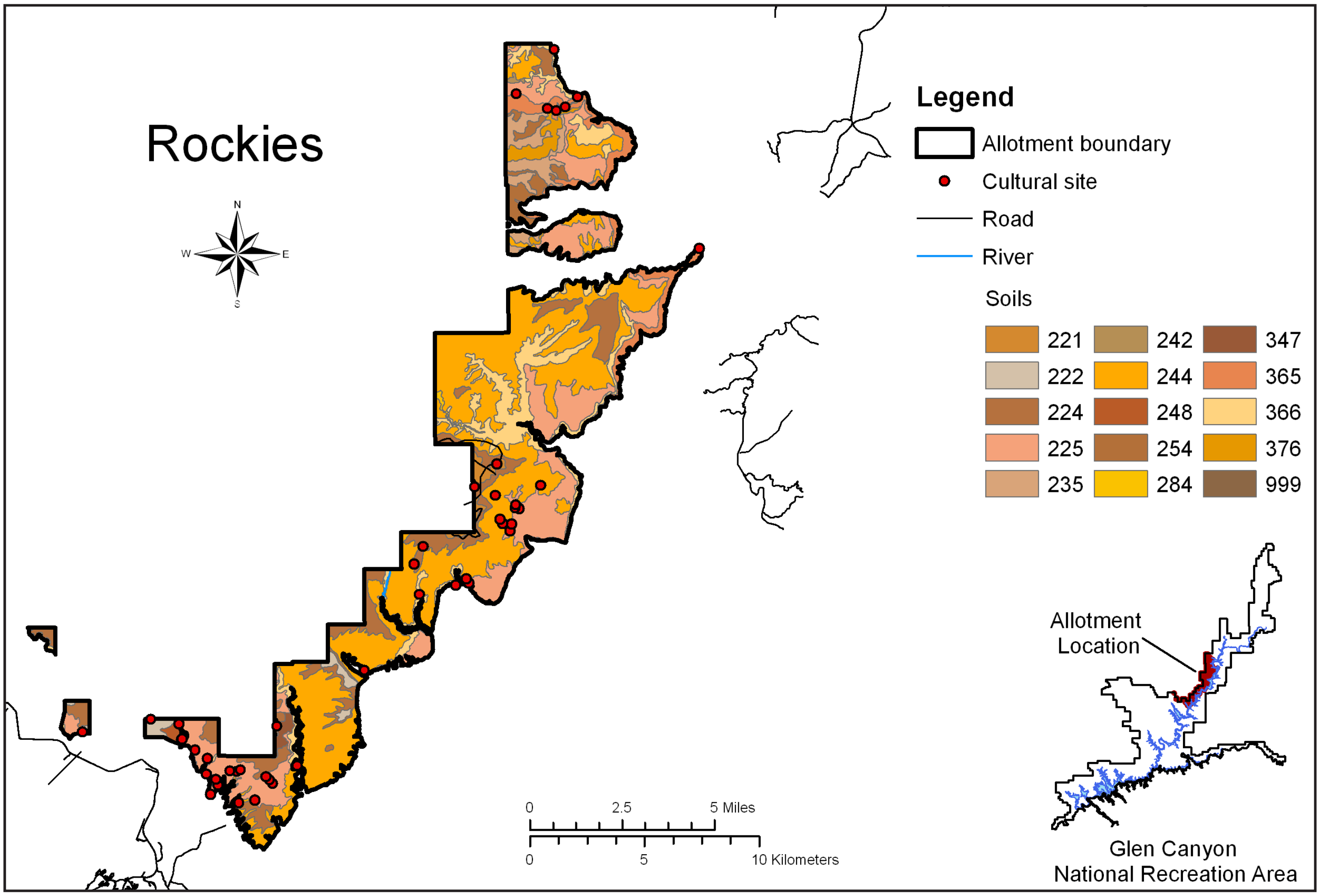
Continued from previous page...

Summary:
The primary dominant vegetation zones within Rockies grazing allotment includes blackbrush (6.17 percent), blackbrush-shadscale (5.02 percent), fourwing saltbush (1.81 percent), Fremont cottonwood (2.63 percent), pinyon-juniper (3.00 percent), sand sagebrush (4.51 percent), and shadscale (25.48 percent). Dominant vegetation for the remainder of the allotment is not currently known.

Dominant Species:
Shadscale *(Atriplex confertifolia*)
Fourwing saltbush (*Atriplex canescens*)
Fremont Cottonwood (*Populus fremontii*)
Sand Sagebrush (*Artemisia filifolia*)
Pinyon *(Pinus edulis*)
Juniper (*Juniperus osteosperma*)

Secondary Dominant Species:
None known.

Associated Soils:
Blackbrush grows in shallow sandy loam, stony loam, and sandy loam. Blackbrush-shadscale occurs in talus, and may be associated with shadscale in stony loam. Fourwing saltbush grows in sandy loam, and in sandy bottom alongside Fremont cottonwood in semiwet saline streambanks. Fremont cottonwood grows in semiwet saline streambanks in association with shadscale in stony loam. Pinyon-juniper grows in shallow loam, stony loam and shallow sand. Sand sagebrush grows in sand alongside blackbrush in shallow sandy loam. Finally, shadscale grows in shallow sandy loam, often with blackbrush.



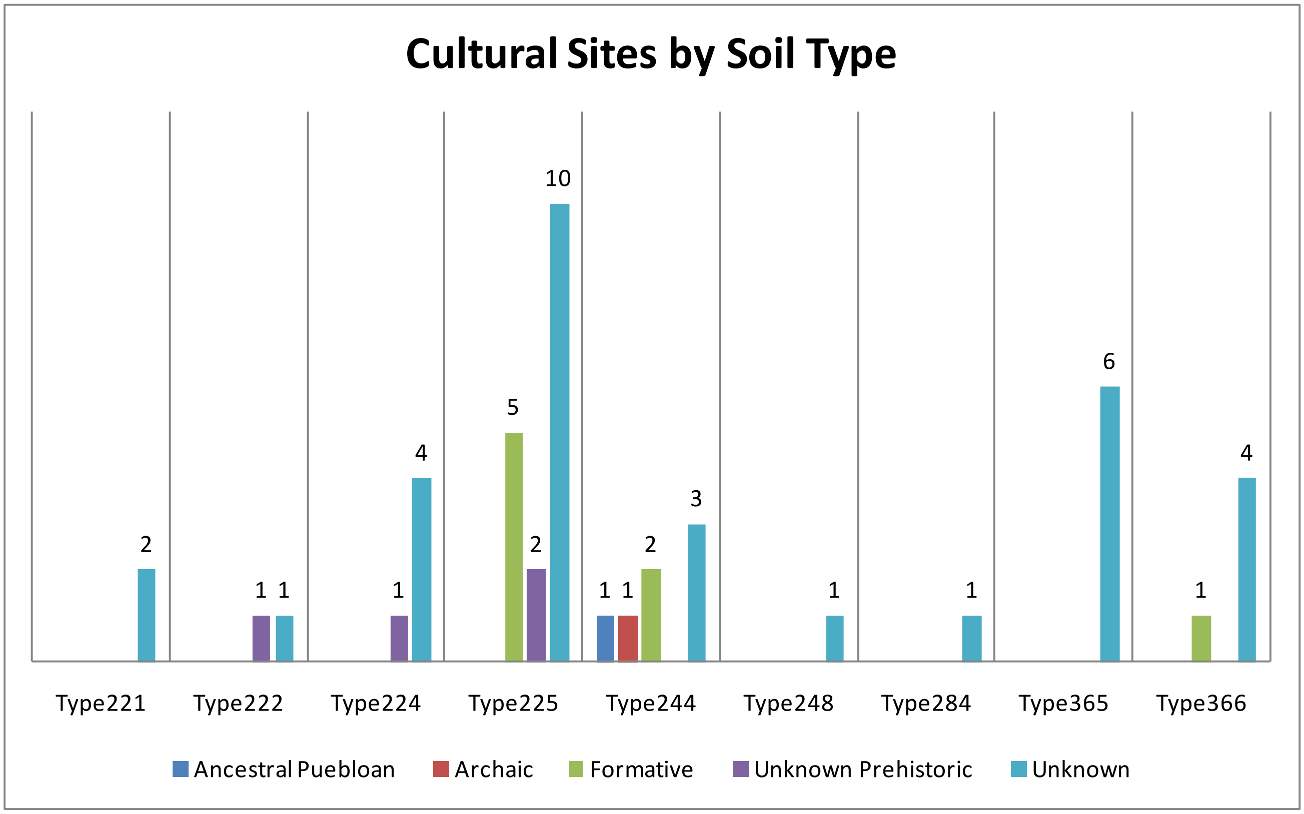
Allotment Divided by Soil Type (MUSYM):

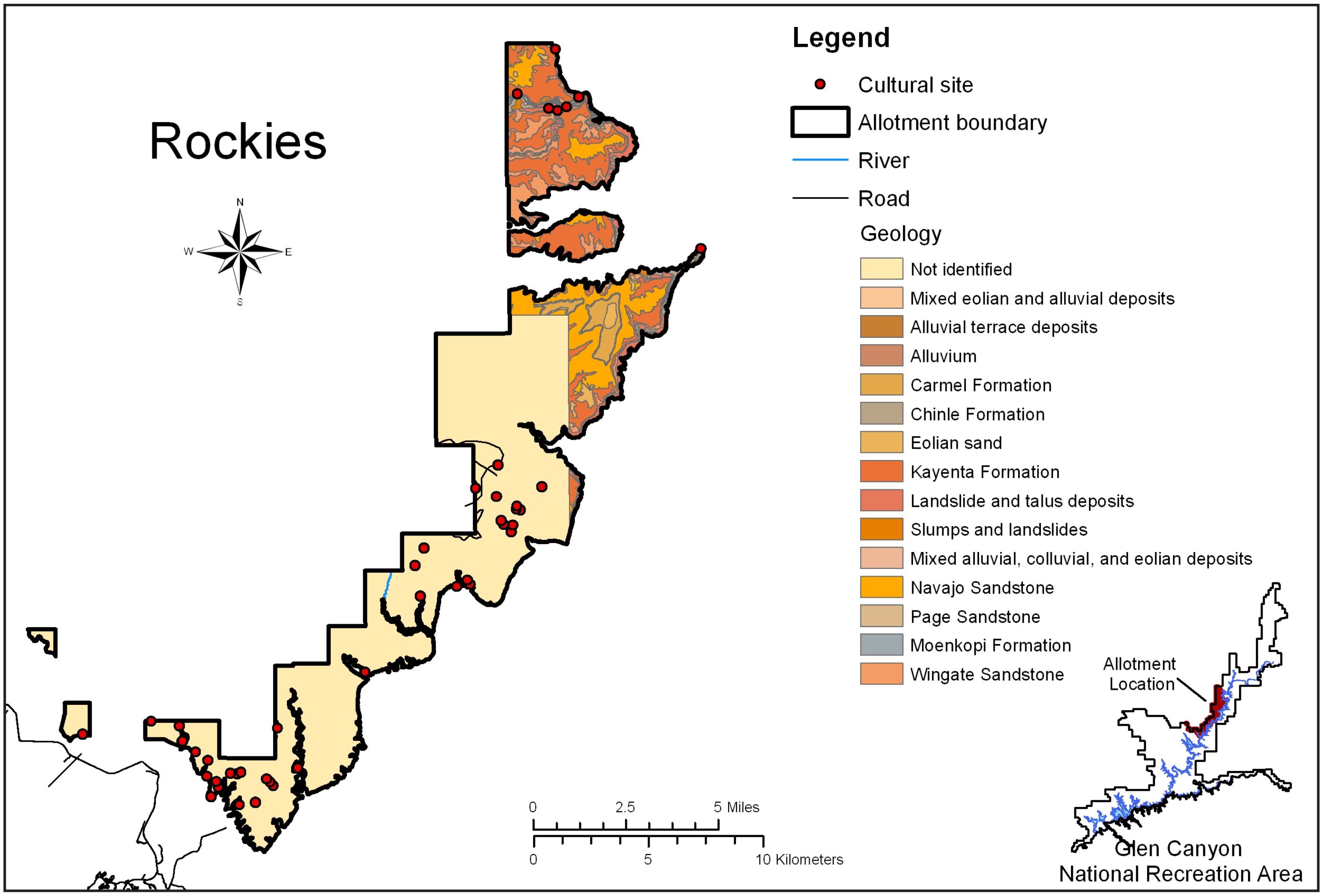
Soil Type	Acres	Percent	No. Cultural Sites
221	402.51	0.99	2
222	488.20	1.21	2
224	4452.34	11.00	5
225	8015.73	19.81	17
235	1273.77	3.15	0
242	41.67	0.10	0
244	16,948.71	41.89	7
248	116.60	0.29	1
254	800.62	1.98	0
284	110.98	0.27	1
347	199.82	0.49	0
365	2204.43	5.45	6
366	4709.49	11.64	5
376	560.10	1.14	0
999	135.23	0.33	0
Total	40,460.20	99.74%	46

Distribution of Cultural Sites by Soil Type:

Two sites (n = 2) for which attribute/affiliation information is not currently available, occur in soil type 221. Two sites (n = 2), including one lithic scatter and one site for which information is currently not available, are located in soil type 222. Five (n = 5) sites, including one prehistoric quarry and four sites currently lacking affiliation/attribute information, are located on soil type 224. Seventeen (n = 17) sites occur in soil type 225. These sites include five Formative sites, two prehistoric sites with hearths, and ten sites for which attribute/affiliation information is not currently available. Seven (n = 7) sites, including one Ancestral Puebloan site, one Archaic site, two Formative sites, and three sites for which affiliation/attribute information is currently lacking, occur in soil type 244, which is often associated with Navajo Sandstone, or slickrock. One site (n = 1) of unknown attributes/affiliation is located in soil type 248. One site (n = 1) of unknown attributes/affiliation is located on soil type 284. Six (n = 6) sites for which attribute/affiliation information is not currently available are located in soil type 365. The remaining (sites = 5), include one Formative site and four sites for which attribute/affiliation information is not available, and are located on soil type 366.

The figure on the subsequent page displays known cultural sites by affiliation and soil type.


Cultural Sites by Soil Type
2
1 1
1
4
5
2
10
1 1
2
3
1
1
6
1
4
Type221
Type222
Type224
Type225
Type244
Type248
Type284
Type365
Type366
Ancestral Puebloan
Archaic
Formative
Unknown Prehistoric
Unknown

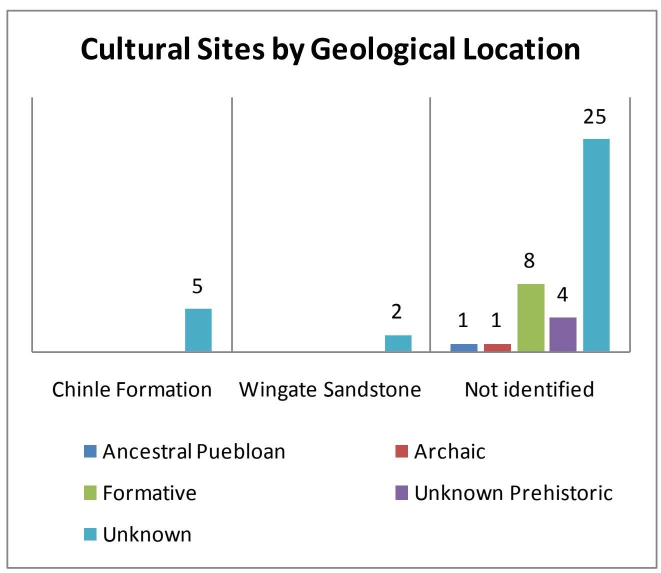


Allotment Divided by Geology:

Geology	Acres	Percent	No. Cultural Sites
Not identified	26,374.02	65.19	39
Mixed eolian and alluvial deposits	0.05	<0.00	0
Alluvial terrace deposits	21.35	<0.00	0
Alluvium	64.53	0.16	0
Carmel Formation	680.07	1.68	0
Chinle Formation	871.57	2.15	5
Eolian sand	338.84	0.84	0
Kayenta Formation	5238.34	12.95	0
Landslide and talus deposits	1076.73	2.66	0
Slumps and landslides	88.50	0.22	0
Mixed alluvial, colluvial, and eolian deposits	13.16	<0.00	0
Navajo Sandstone	3376.94	8.35	0
Page Sandstone	149.68	0.37	0
Moenkopi Formation	15.13	<0.00	0
Wingate Sandstone	2151.30	5.32	2
Total	**40,460.21**	**99.89%**	**46**

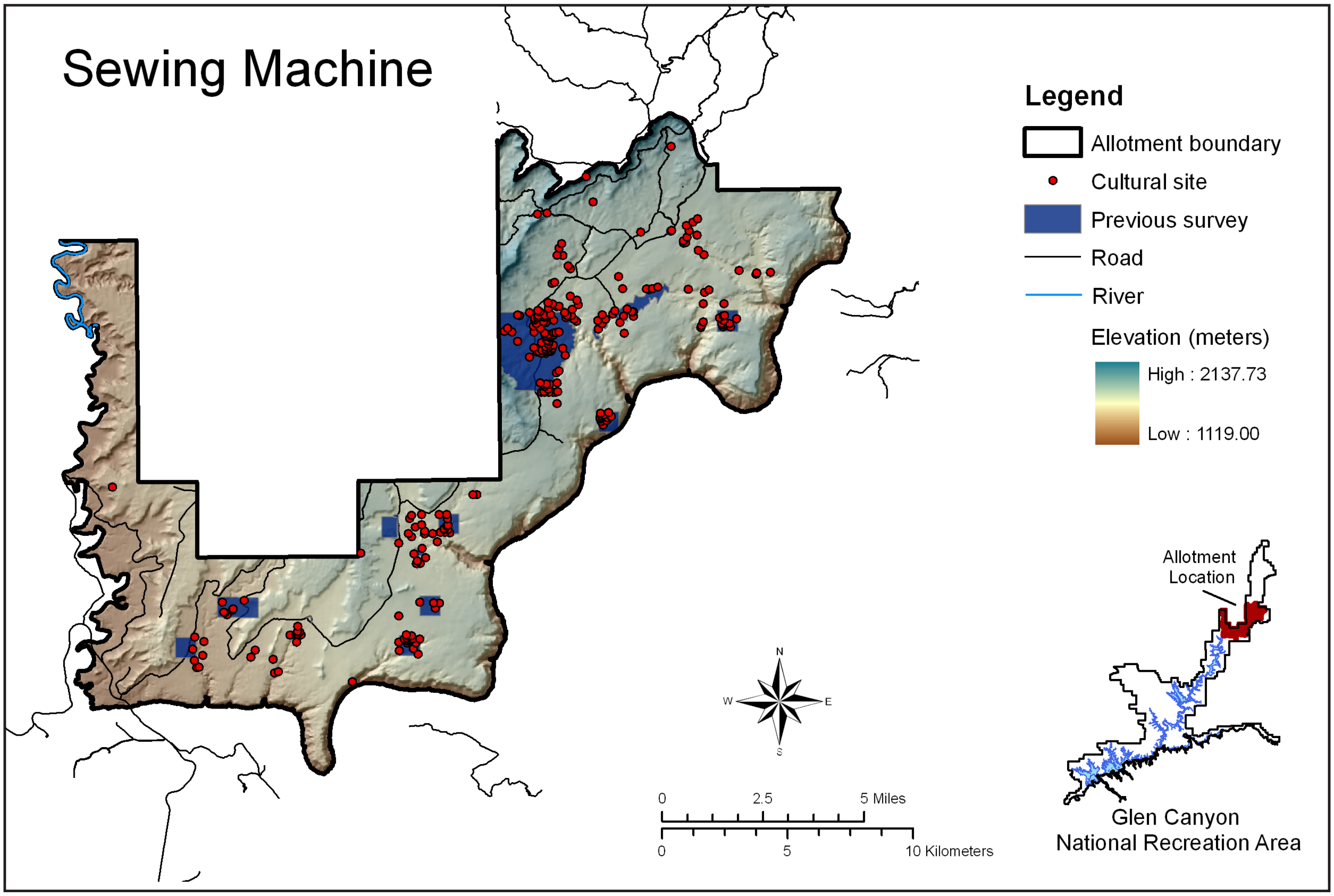
Distribution of Cultural Sites by Geological Location:

Five (n = 5) sites for which affiliation/attribute information is not available, are located on Chinle Formation geology. Two sites (n = 2) for which affiliation/attribute information is not currently available are located on Wingate Sandstone. The remaining sites (n = 39) are located in areas where the geology has not yet been identified.



Sewing Machine

Map Panels



Total Area: 68,264.32 acres

Sampling Fractions:
2 percent: 1365.29 acres
5 percent: 3413.22 acres
11 percent: 7509.08 acres
16 percent: 10922.29 acres
20 percent: 13652.86 acres

Elevation range amsl:
1119.00 – 2137.73 meters (3671.26 - 7013.55 feet)

Rivers and Springs:
Dirty Devil River forms the northwest boundary of Sewing Machine grazing allotment.

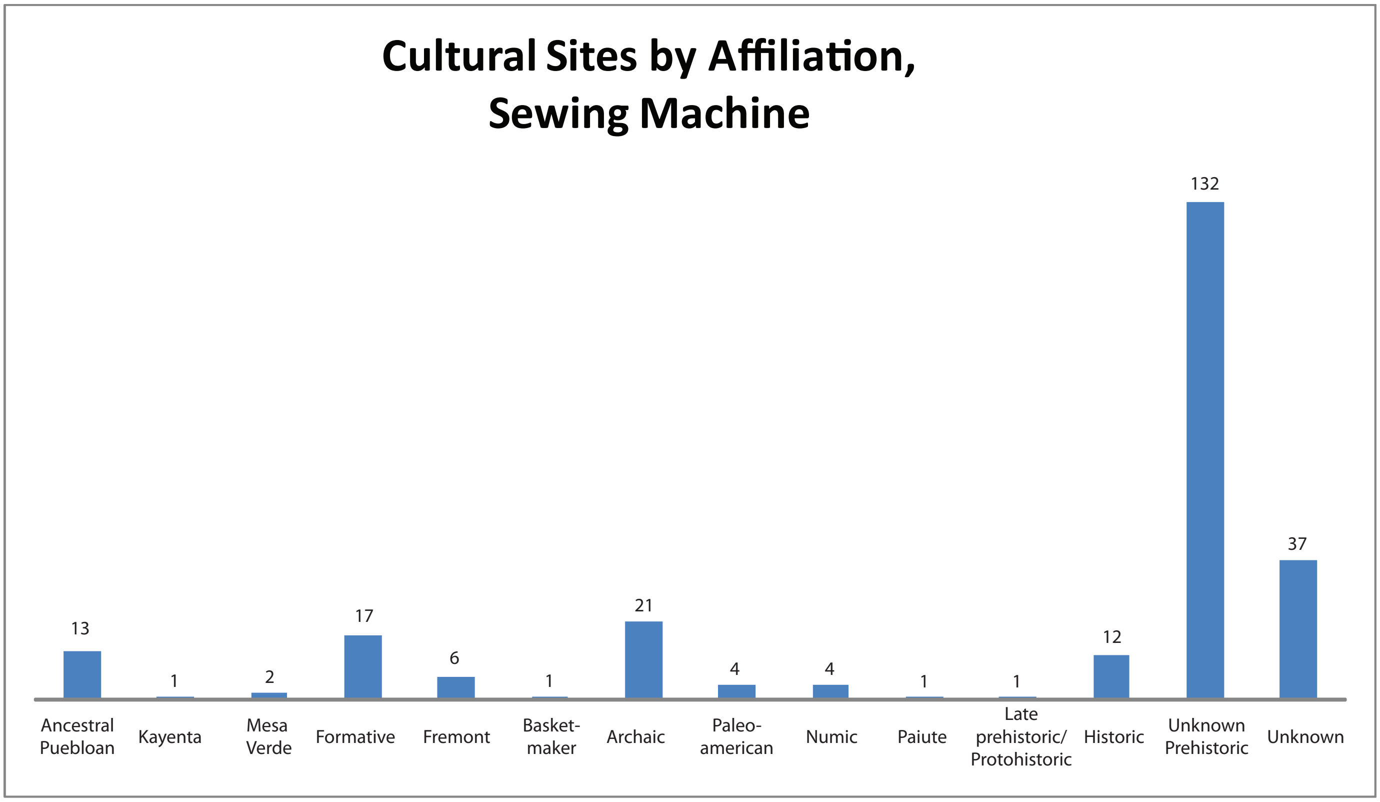
Accessibility:
County Hwy 633 crosses from the southwest to the northeast through the allotment, and County Hwys 730 and 731 pass east-west across the north portion of the allotment. Cataract Canyon of Lake Powell/ Colorado River forms the southern and western boundaries of the allotment, potentially allowing for boat access to the allotment. Camping is available at Dirty Devil campground and Hite, where a ranger station is also located.

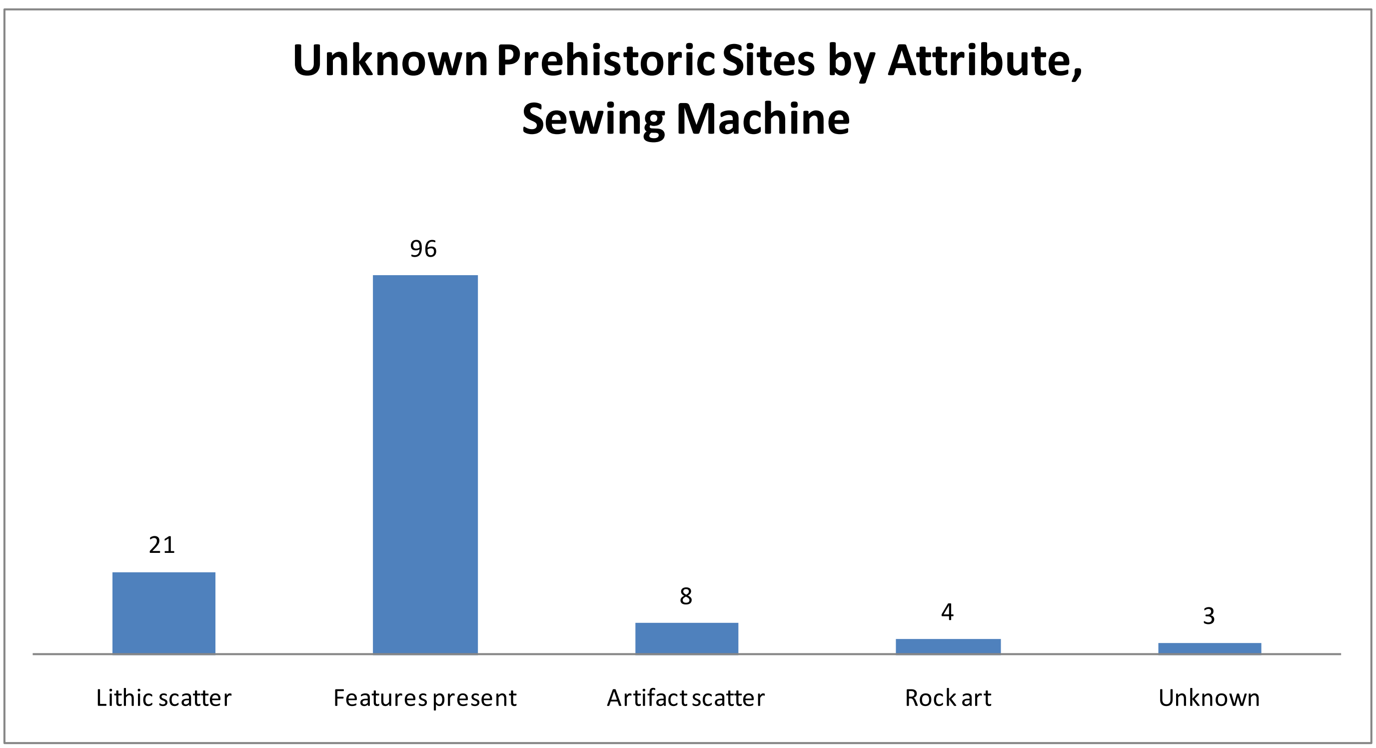
Fourmile Canyon and Twomile Canyon divide the north portion of the allotment from the south.

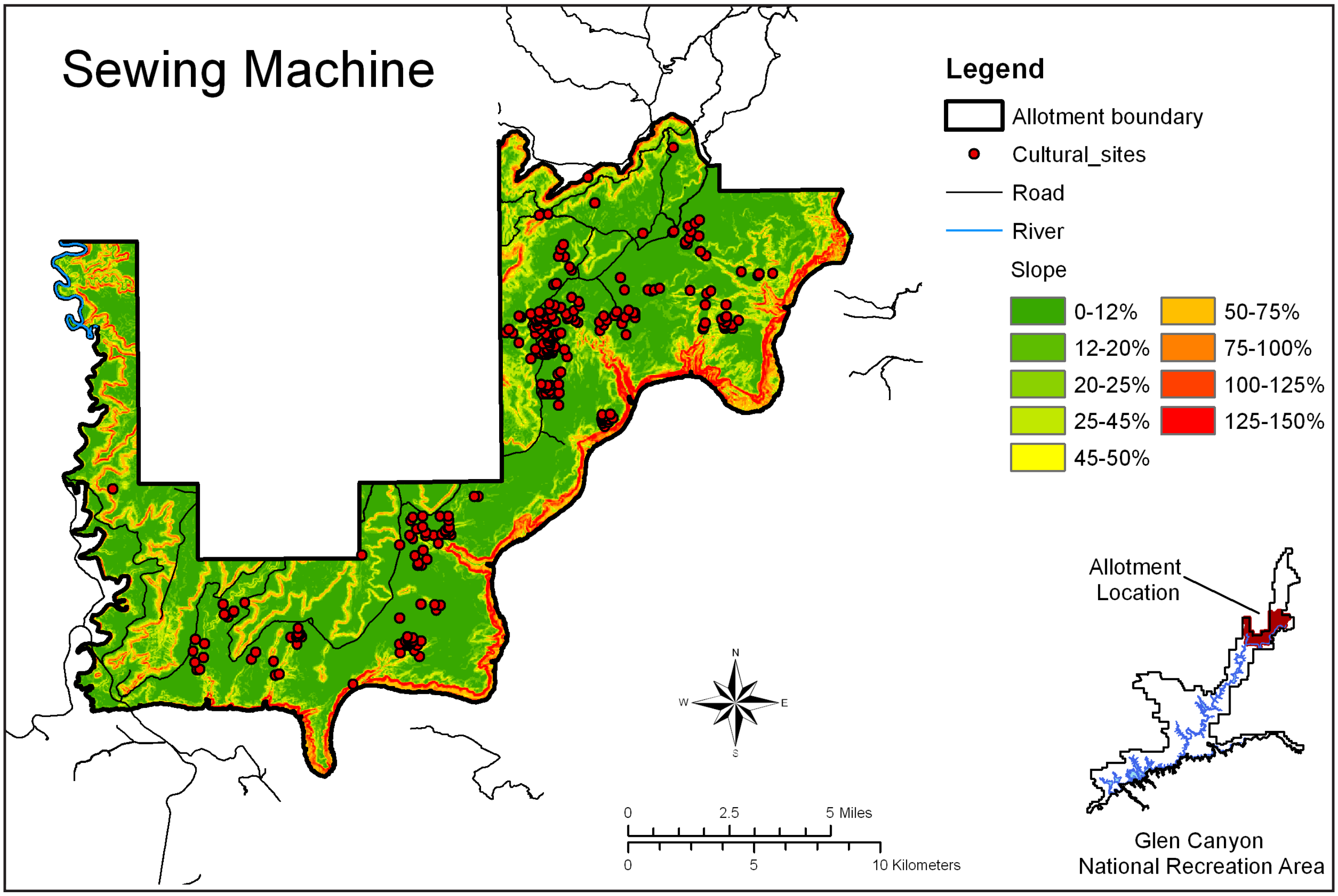
No. Cultural Sites: 252
Area surveyed: 3790.85 acres

Survey References:
Bungart (1990): 0.91 acres
Burchett (1998): 3.48 acres
Fairley and Geib (1986): 2972.26 acres
Geib and Bremer (1988): 1469.25 acres
Goetze (1995): 346.08 acres
Nickens (1986a): 27.62 acres

The figures on the subsequent page depict cultural sites by affiliation, and for those prehistoric sites for which affiliation is not known, site attributes.


Cultural Sites by Affiliation,
Sewing Machine
13
1
2
17
6
1
21
4
4
1
1
12
132
37
Ancestral Puebloan
Kayenta
Mesa Verde
Formative
Fremont
Basket-maker
Archaic
Paleo-american
Numic
Paiute
Late prehistoric/ Protohistoric
Historic
Unknown Prehistoric
Unknown


Unknown Prehistoric Sites by Attribute,
Sewing Machine
21
96
8
4
3
Lithic scatter
Features present
Artifact scatter
Rock art
Unknown



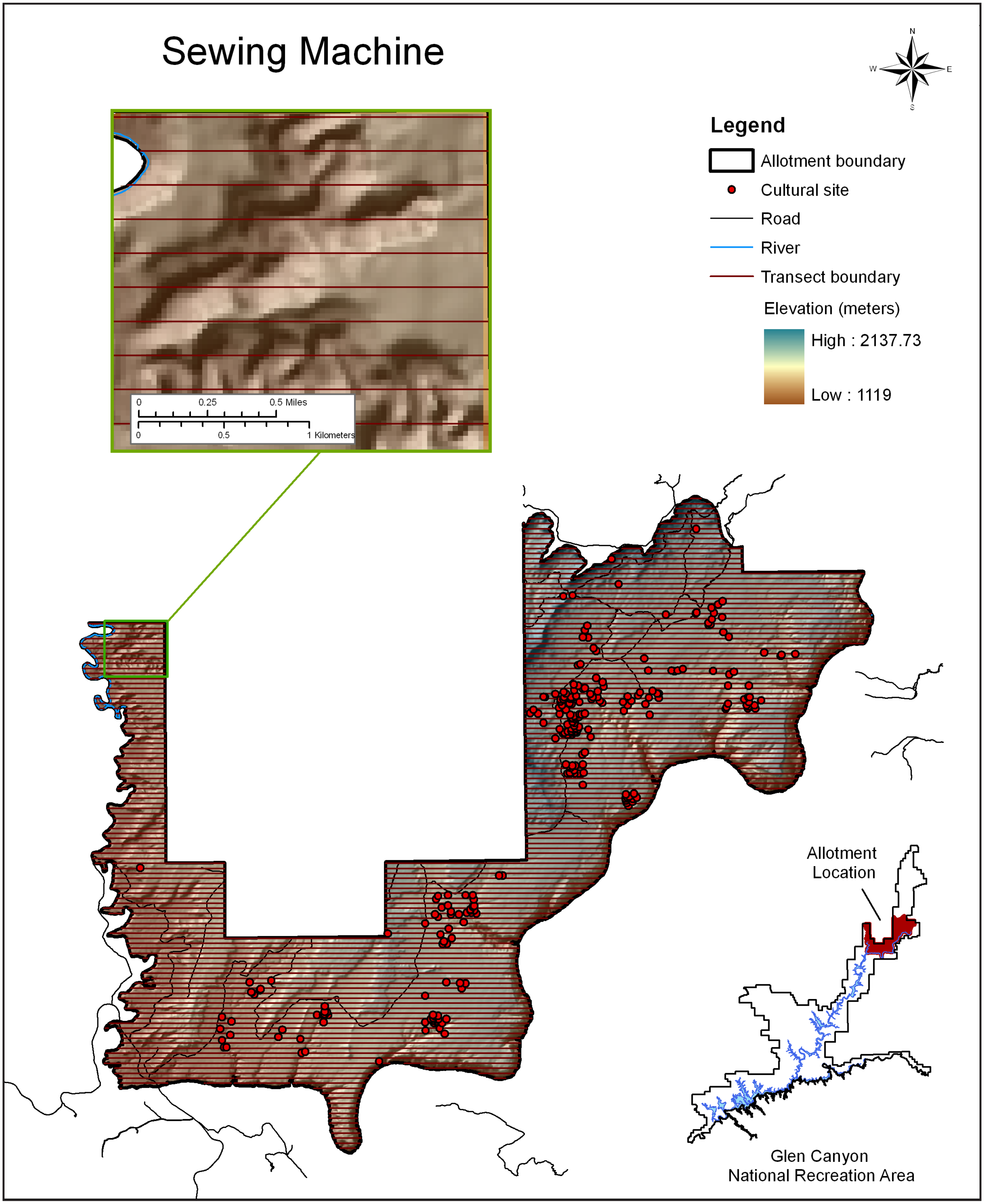
Slope Considerations:

Slope plays a large role in terrain accessibility, and may be used in the stratification of survey areas. For example, GCNRA may wish to assign catagories such as low, moderate, and high to specific slope gradients. Such assignations are most often dependent on the factors guiding archaeological survey work, and as such, are not included in this document. Included herein, however, are suggestions for basic transect orientation based on the presence of topographical barriers identified by the presence of excessive slope gradients.

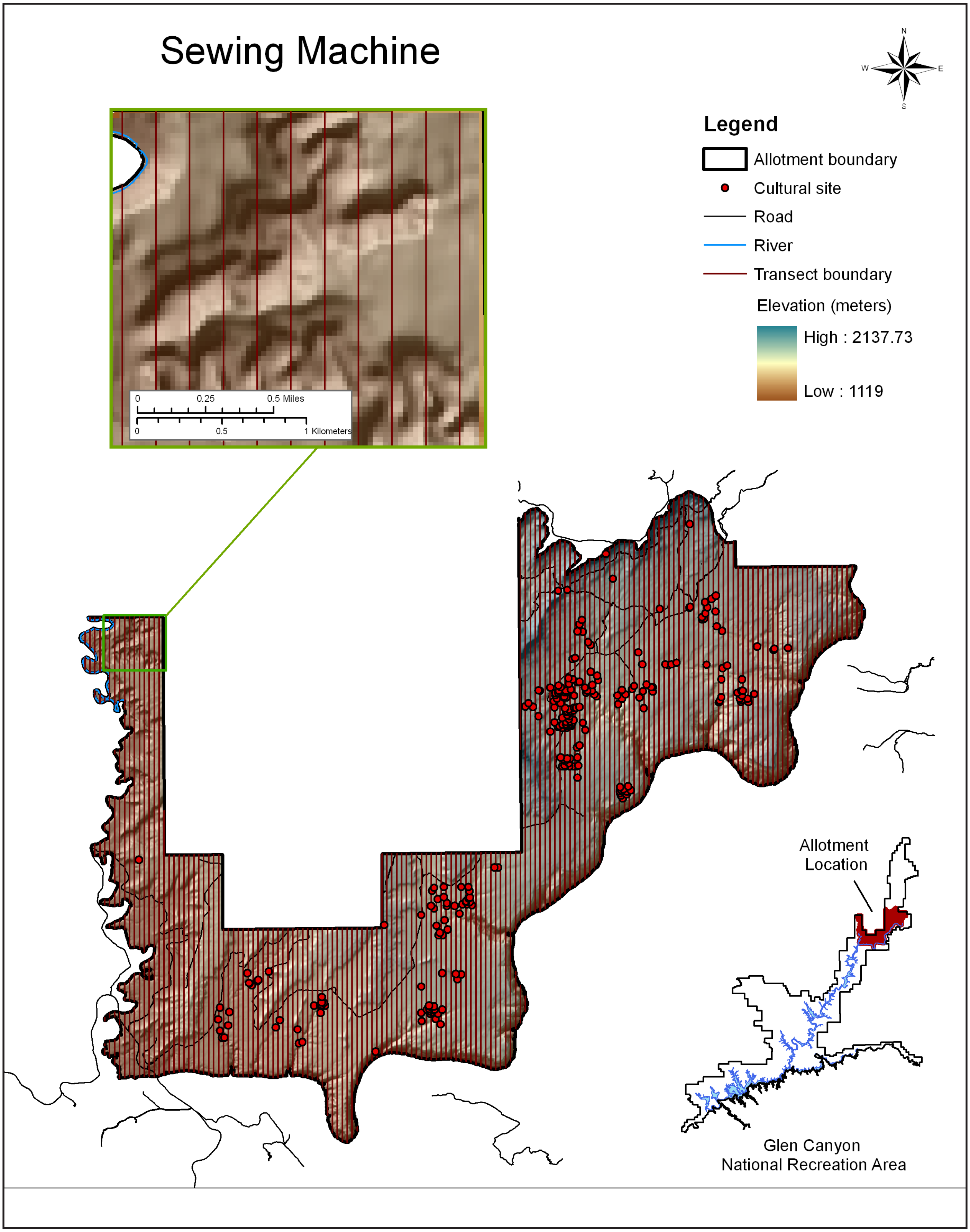
Survey Zones Dictated by Slope:

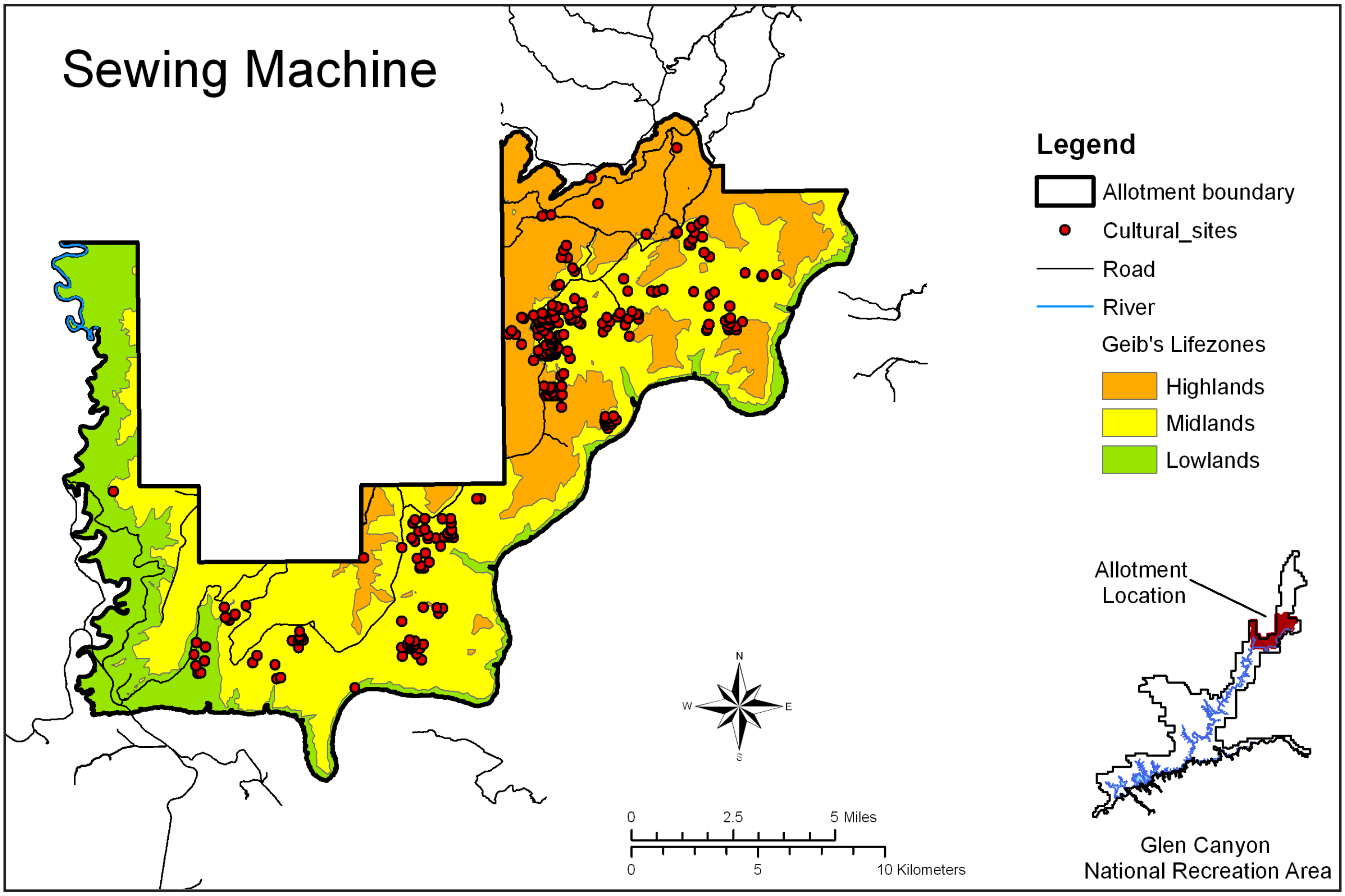
Steep escarpments along Cataract Canyon prevent direct access to Sewing Machine grazing allotment from Cataract Canyon (Lake Powell/ Colorado River). In addition, several escarpments run north-south through the allotment in the west, and are also present in the north. Roads tend to parallel the bases of these slopes, but laterals may also lead to the low-slope, higher-elevation locations. Recommended transects should be placed perpendicular to roadways when possible.

The 'fishnet' maps provided on the subsequent pages display transects spaced at 200 meter intervals for both east-west and north-south oriented pedestrian survey.



Sewing Machine
N
W
E
S
Legend
Allotment boundary
Cultural site
Road
River
Transect boundary
Elevation (meters)
High : 2137.73
Low : 1119
0
0.25
0.5 Miles
0
0.5
1 Kilometers
Allotment Location
Glen Canyon National Recreation Area


Sewing Machine
N
W
E
S
Legend
Allotment boundary
Cultural site
Road
River
Transect boundary
Elevation (meters)
High : 2137.73
Low : 1119
0
0.25
0.5 Miles
0
0.5
1 Kilometers
Allotment Location
Glen Canyon National Recreation Area



Area of Each Lifezone:

Highlands: 19,060.58 acres
Midlands: 34,922.30 acres
Lowlands:14,173.47 acres

No. Cultural Sites in Each Lifezone:

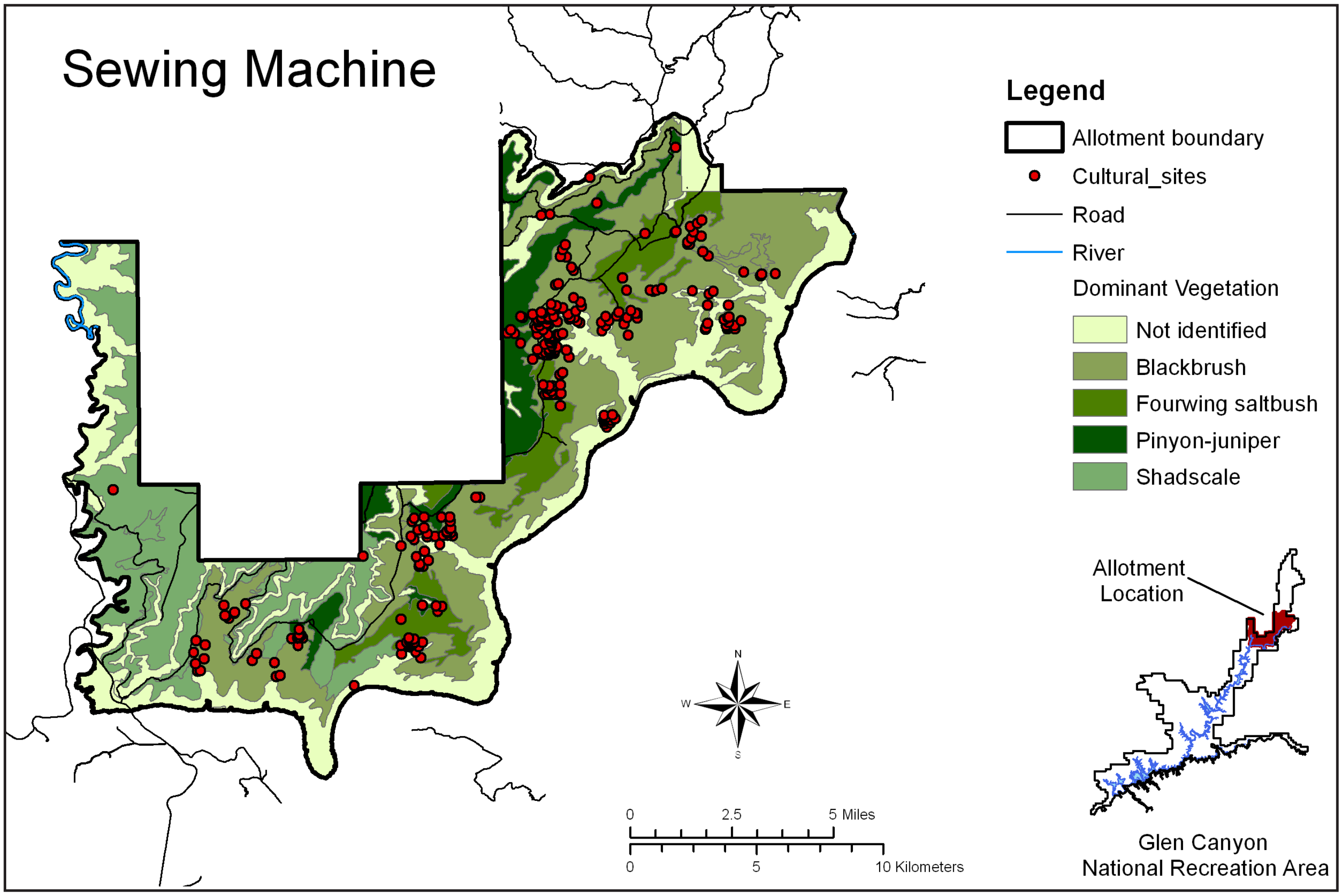
Highlands: 31
Midlands: 214
Lowlands: 7

Lifezone Significance and Known Cultural Sites:

Thirty-one (n = 31) sites are located in Geib's Highland zone. Geib describes the highlands as providing important foods, such as pinyon, deer, and rabbit, and suggests that the lower temperatures and increased precipitation of the highlands allowed for dry farming and later harvests than lower elevations. The majority of known sites (n = 214), however, are located in the Midland zone, described as providing important grasses, cacti, and game such as antelope to prehistoric populations. The remaining sites (n = 7) occur in the lowlands, described by Geib as hot and arid, with permanent water, arable alluvium, and long growing seasons suited to agriculture.

	Elevation	Characteristics	Environment	Significance to Humans
Lowlands	1219-1372 m (4000-4500 ft)	Hot and arid steep-walled sandstone canyons.	Riparian plants; big-horn sheep	Permanent water, arable alluvium, long growing season, diverse plant communities, natural shelters, quality siliceous stone from river gravels
Midlands	1372-1676 m (4500-5500 ft)	Arid slickrock and dune fields on benchlands and low plateaus.	Blackbrush, shadscale, grasses; antelope.	Grasses, including dropseed and ricegrass, prickly pear and shadscale; good antelope habitat, quality siliceous stone in certain locations.
Highlands	Above 1676 m (Above 5500 ft)	High elevation mesas and plateaus with cooler temperatures and greater precipitation.	Pinyon-juniper woodlands; deer and rabbit.	Higher elevation plant foods (i.e. pinyon); later harvests; dry-farming; abundant fuel, deer and rabbit.

Shading indicates lifezones present in allotment.



Area of Individual Vegetation Zones:

Dominant Species	Acres Covered	No. Sites
Not identified	19,608.73	25
Blackbrush (*Coleogyne ramosissima)*	25,196.26	200
Fourwing saltbush *(Atriplex canescens)*	5269.14	12
Pinyon-juniper *(Pinus edulis - Juniperus osteosperma)*	5223.17	9
Shadscale *(Atriplex confertifolia)*	12,939.02	6
Total	**68,264.32**	**252**

No. Cultural Sites in Each Vegetation Zone:
The majority of known sites (n = 200) in Sewing Machine grazing allotment are located in blackbrush. An additional 12 sites are located in fourwing saltbush, nine (n = 9) in pinyon juniper, and six (n = 6) in shadscale. The remaining sites (n = 25) are located in areas for which the dominant vegetation has not been identified.

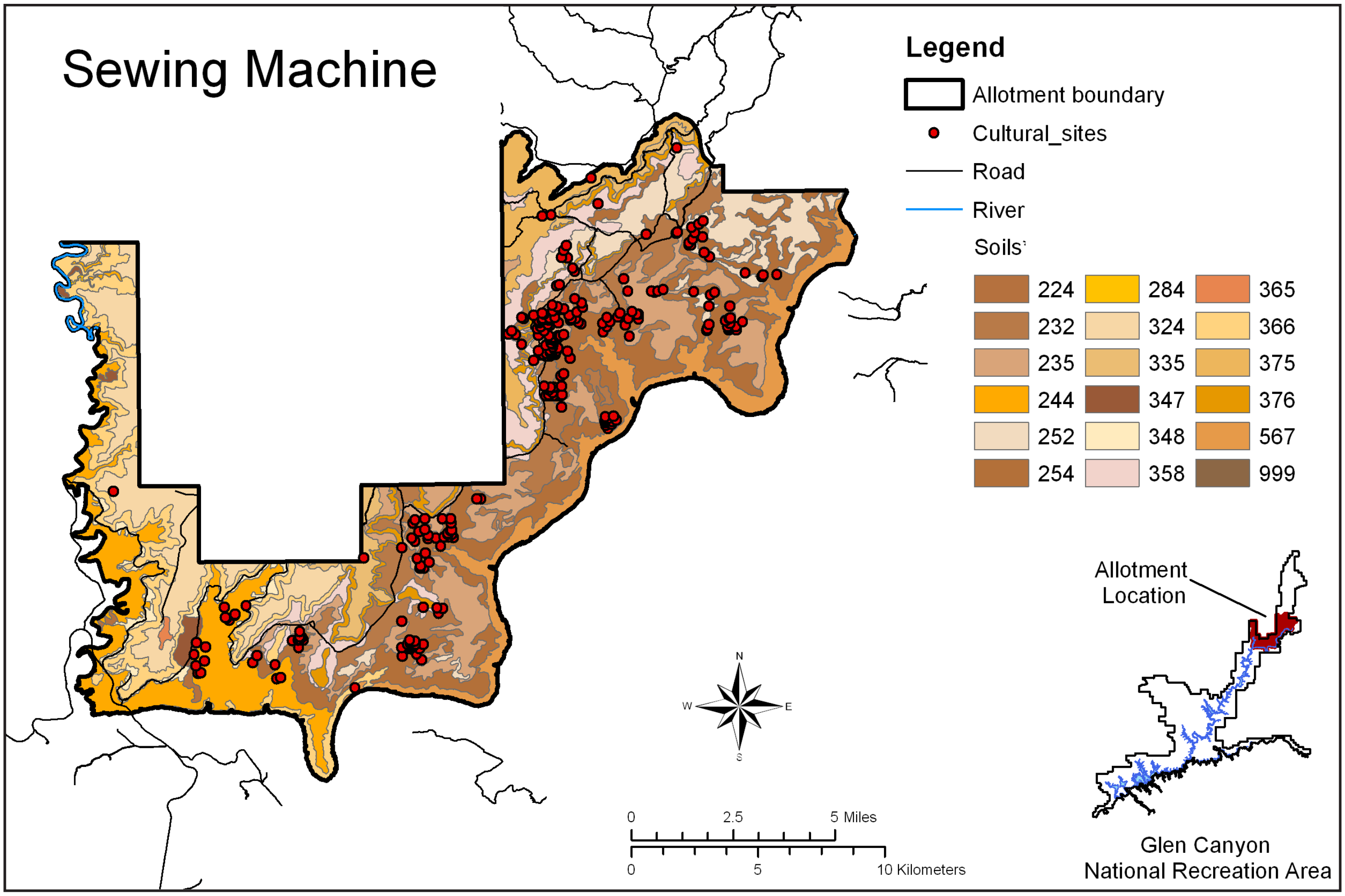
Visibility:
In general, the dominant vegetative communities of the allotment provide moderate - excellent ground visibility. However, in pinyon-juniper, ground visibility may be hampered by built-up organic material beneath the trees,

Summary:
The primary dominant vegetation zones within Sewing Machine grazing allotment include blackbrush (36.91 percent), fourwing saltbush (7.19 percent), pinyon-juniper (7.65 percent), and shadscale (18.95 percent). Dominant vegetation for the remainder of the allotment is not currently known.

Dominant Species:
Fourwing saltbush (*Atriplex canescens*)
Blackbrush *(Coleogyne ramosissima*)
Pinyon (*Pinus edulis*)
Juniper (*Juniperus osteosperma*)
Shadscale (*Atriplex confertifolia*)

Secondary Dominant Species:
Fremont cottonwood (*Populus fremontii*)

Associated Soils:
Blackbrush grows in shallow sandy loam and sandy loam. Fourwing saltbush occurs in sandy loam, often in association with Fremont cottonwood in semiwet saline streambanks. Finally, both pinyon-juniper and shadscale dominate in shallow sandy loam.



Allotment Divided by Soil Type (MUSYM):

Soil Type	Acres	Percent	No. Cultural Sites
224	159.01	0.23	0
232	5787.90	8.48	7
235	8529.49	12.49	39
244	7222.31	10.58	15
252	4613.94	6.76	11
254	12,294.44	18.01	160
284	89.03	0.13	0
324	5926.16	8.68	1
335	1608.45	2.36	2
347	474.13	0.69	1
348	1183.00	1.73	1
358	4113.13	6.03	8
365	88.86	0.13	0
366	5539.59	8.11	1
375	3014.86	4.42	2
376	2218.24	3.25	3
567	5242.10	7.68	1
999	159.67	0.23	0
Total	**68,264.31**	**99.99%**	**252**

Distribution of Cultural Sites by Soil Type:

Seven (n = 7) sites, including one historic site, one Paleoamerican site, one Formative site, one Numic site, and three prehistoric sites for which affiliation is currently not known, including two with features and one lithic scatter, are located in soil type 232. Thirty-nine (n = 39) sites, including one Ancestral Puebloan site, one historic site, seven Archaic sites, one Formative site, two Numic sites, one Paleoamerican site, 21 currently unaffiliated prehistoric sites, including one lithic scatter and 20 sites with features, and five sites for which attribute/affiliation information is currently unavailable are located in soil type 235. Fifteen (n = 15) sites, including two Ancestral Puebloan sites, two Archaic sites, one Formative site, and ten currently unaffiliated prehistoric sites, including two lithic scatters and eight sites with features, are located in soil type 244, which is often associated with Navajo Sandstone, or slickrock. Eleven (n = 11) sites, including two Formative sites, one historic site, seven unaffiliated prehistoric sites with features, and one site for which attribute/affiliation information is currently unknown, occur in soil type 252.

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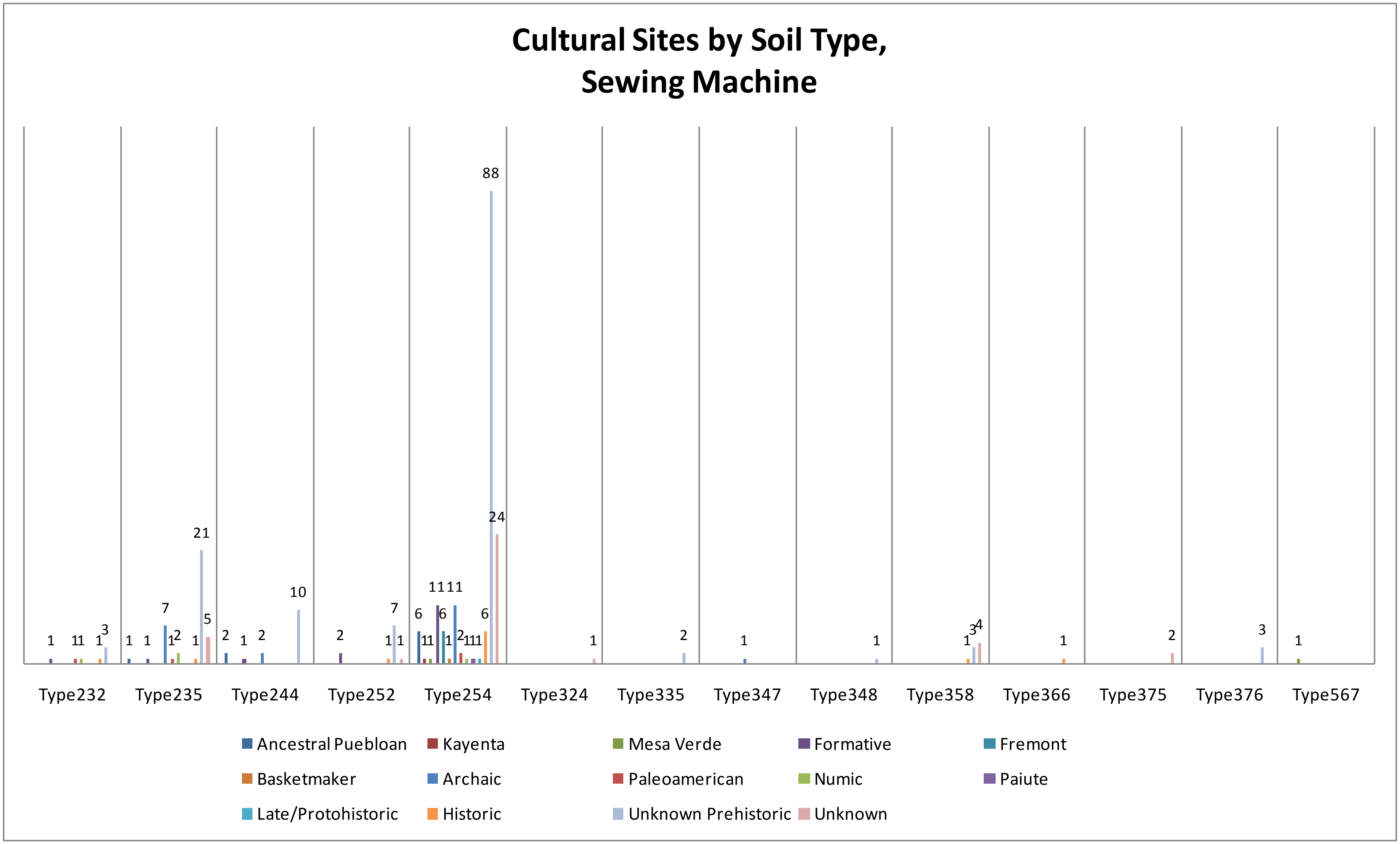
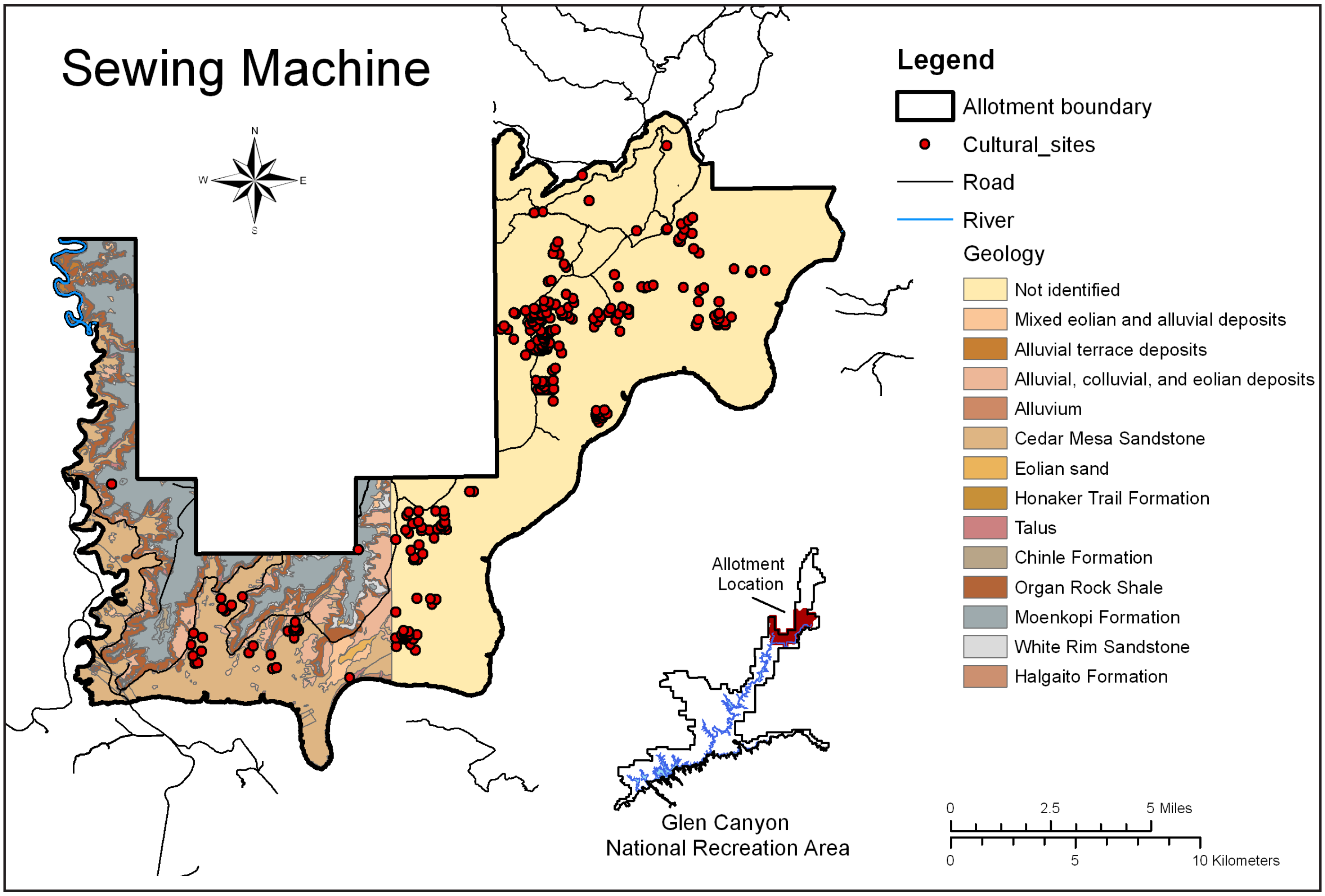
One hundred sixty (n = 160) sites are located in soil type 254. These sites include six Ancestral Puebloan sites, 11 Formative sites, six Fremont sites, one Kayenta site, one Mesa Verde site, 11 Archaic sites, one Basketmaker site, two Paleoamerican sites, one late prehistoric/ Protohistoric site, one Numic site, one Paiute suite, 88 currently unaffiliated prehistoric sites, of which 57 contain features, 20 are lithic scatters, five are artifact scatters, three consist of rock art, and three are currently lacking attribute information, six historic sites, and 24 sites for which attribute/ affiliation information is currently unavailable. A single (n = 1) site for which attribute/affiliation information is currently lacking is located in soil type 324. Two sites (n = 2), including one lithic scatter and one site with features, are located in soil type 335. A single (n = 1) Archaic site is located in soil type 347. A single (n = 1) currently unaffiliated prehistoric site with possible hearth is located in soil type 348. Eight (n = 8) sites, including one historic site, two sites with features, one rock art site with an associated artifact scatter, one lithic scatter, and four sites for which no attribute/affiliation information is currently available are located in soil type 358. A single (n = 1) historic site is located in soil type 366. Two (n = 2) sites for which attribute/affiliation information is currently not known are located in soil type 375. Three (n = 3) sites, including an artifact scatter and two lithic scatters are located in soil type 376. The remaining site (n = 1) consists of a Mesa Verde site located in soil type 567.

The figure on the subsequent page displays known cultural sites by affiliation and soil type.


Cultural Sites by Soil Type,
Sewing Machine
88
24
21
10
7
Type232
Type235
Type244
Type252
Type254
Type324
Type335
Type347
Type348
Type358
Type366
Type375
Type376
Type567
Ancestral Puebloan
Kayenta
Mesa Verde
Formative
Fremont
Basketmaker
Archaic
Paleoamerican
Numic
Paiute
Late/Protohistoric
Historic
Unknown Prehistoric
Unknown



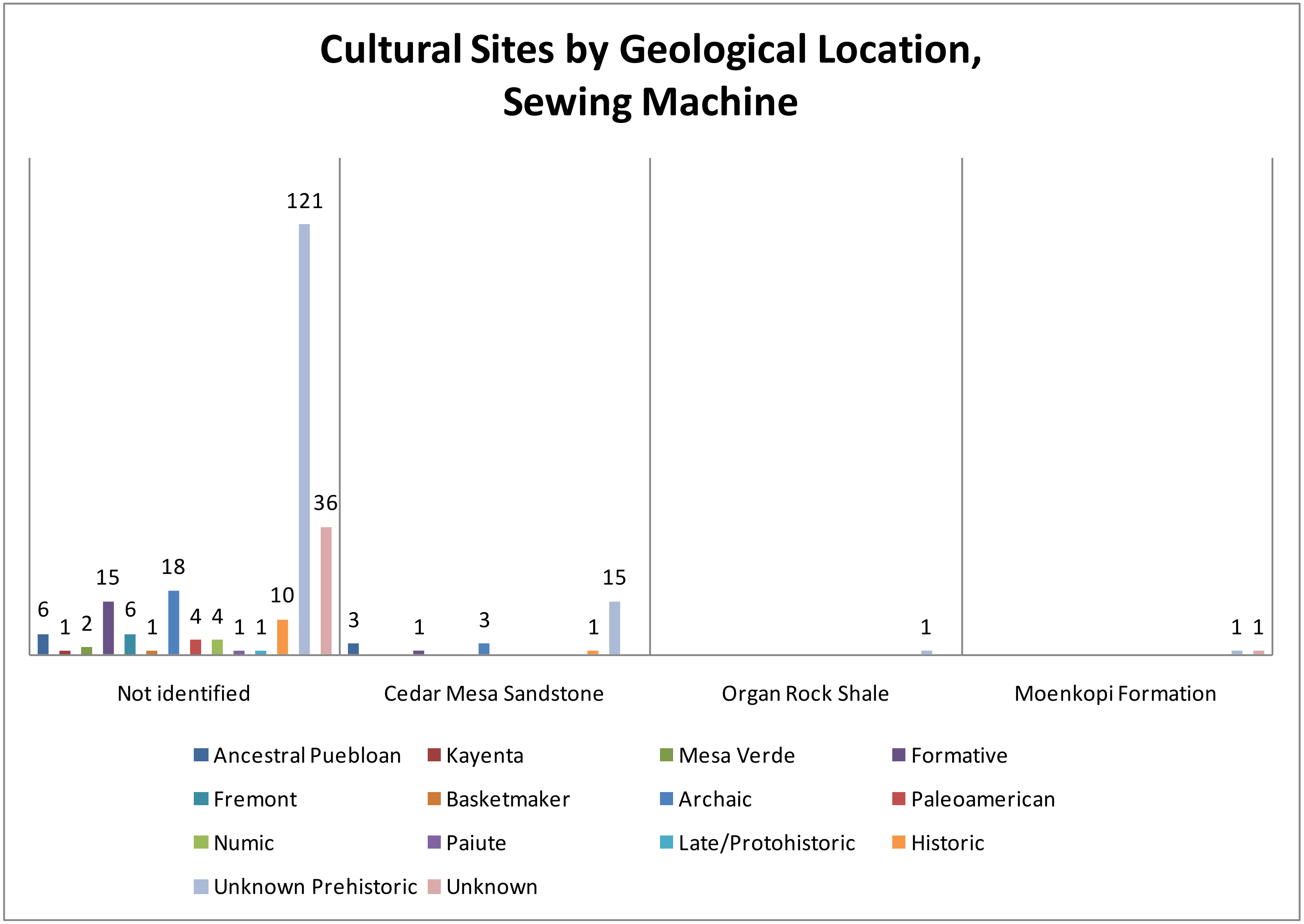
Allotment Divided by Geology:

Geology	Acres	Percent	No. Cultural Sites
Not identified	41,296.99	60.50	222
Mixed eolian and alluvial deposits	1033.69	1.51	0
Alluvial terrace deposits	158.81	0.23	0
Alluvial, colluvial, and eolian deposits	3068.94	4.50	0
Alluvium	84.81	0.12	0
Cedar Mesa Sandstone	9860.20	14.44	27
Eolian sand	129.16	0.19	0
Honaker Trail Formation	21.79	<0.00	0
Talus	273.46	0.40	0
Chinle Formation	62.33	<0.00	0
Organ Rock Shale	4115.81	6.03	1
Moenkopi Formation	6723.15	9.85	2
White Rim Sandstone	1283.06	1.88	0
Halgaito Formation	152.12	0.22	0
Total	**68,264.32**	**99.87%**	**252**

Distribution of Cultural Sites by Geological Location:

Twenty-seven (n = 27) sites, including three Ancestral Puebloan sites, three Archaic sites, one Formative site, one historic site, 15 prehistoric sites with features, two lithic scatters, one artifact scatter, and one rock art site are located on Cedar Mesa Sandstone. A dense artifact scatter (n = 1) with a possible hearth is located on Organ Rock Shale. Two sites (n = 2), including one lithic scatter and one site for which attribute/affiliation information is currently unknown lay on Moenkopi Formation geology. The remaining 222 sites are located in areas where the geology has not yet been identified.-

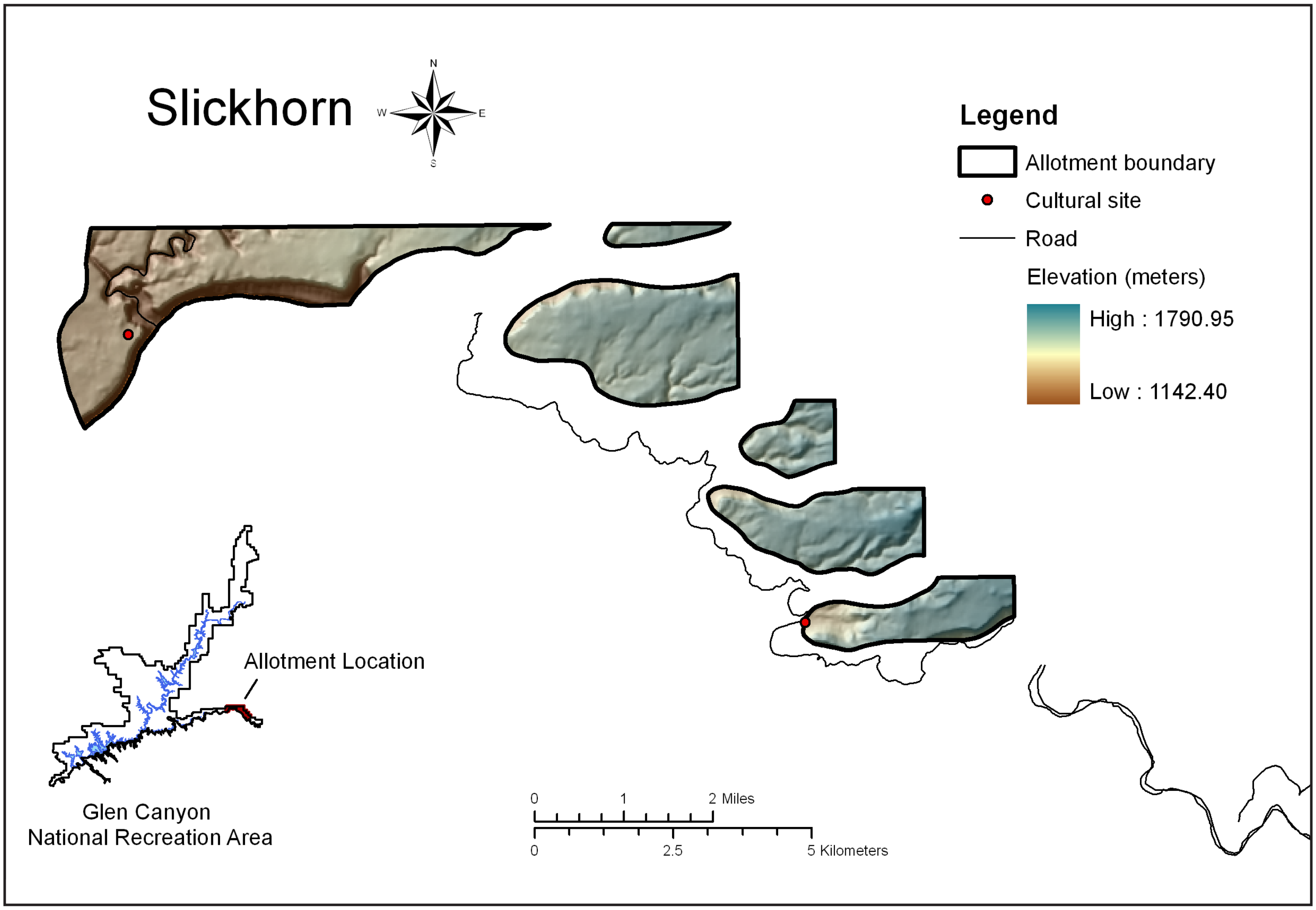
The figure on the subsequent page displays known cultural sites by affiliation and geological context.



Cultural Sites by Geological Location, Sewing Machine
6
1
2
15
6
1
18
4
4
1
1
10
121
36
3
1
3
1
15
1
1
1
Not identified
Cedar Mesa Sandstone
Organ Rock Shale
Moenkopi Formation
Ancestral Puebloan
Kayenta
Mesa Verde
Formative
Fremont
Basketmaker
Archaic
Paleoamerican
Numic
Paiute
Late/Protohistoric
Historic
Unknown Prehistoric
Unknown

Slickhorn

Map Panels



Total Area: 6906.80 acres

Sampling Fractions:
2 percent: 138.14 acres
5 percent: 345.34 acres
11 percent: 547.27 acres
16 percent: 1105.09 acres
20 percent: 1381.36 acres

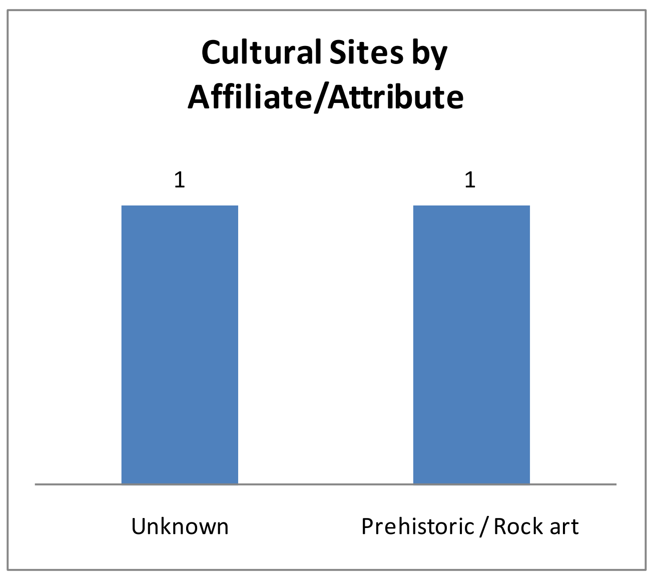
Elevation range amsl:
1142.40 – 1790.95 meters (3748.03 - 5875.82 feet)

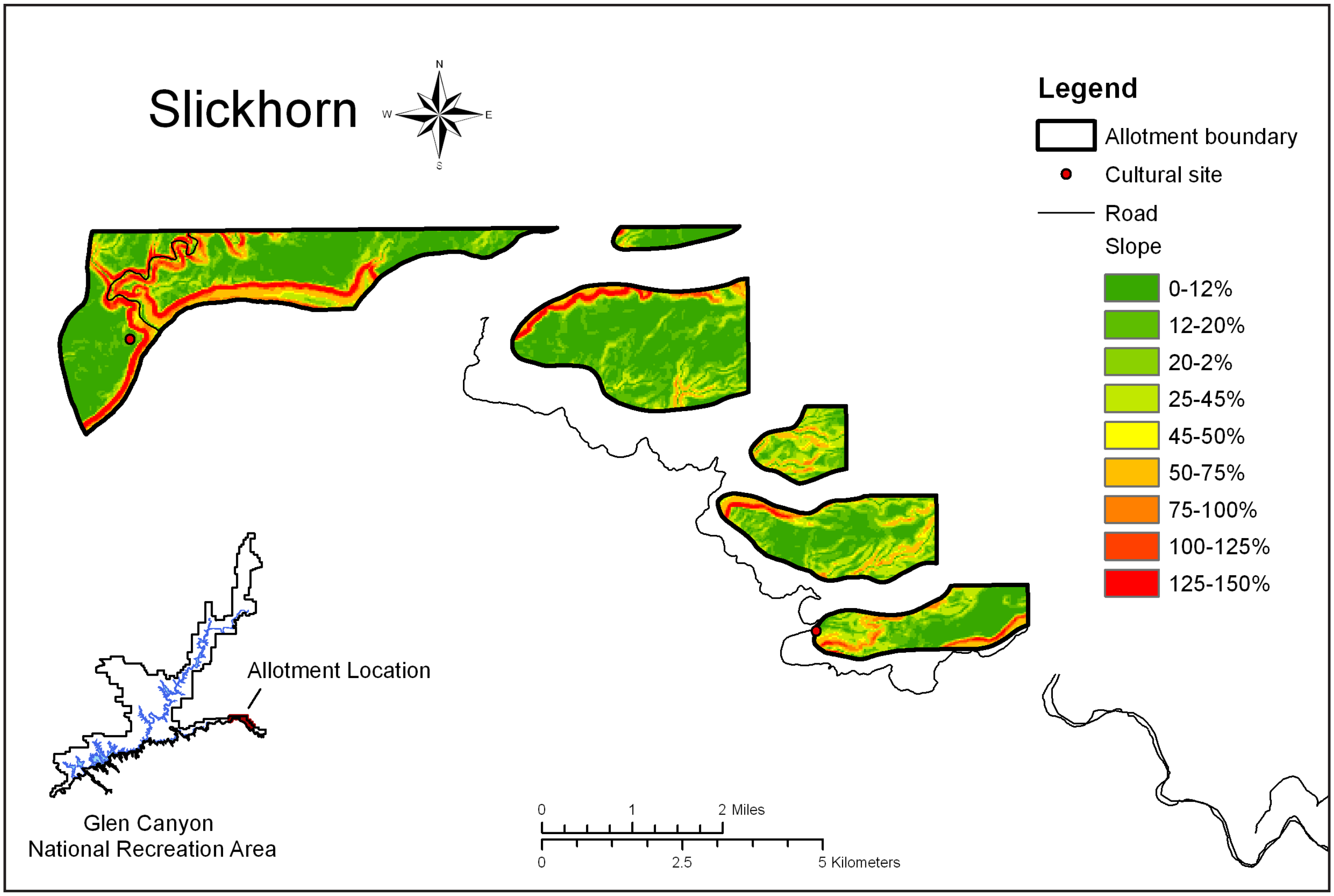
Rivers and Springs:
Ephemeral streams and creeks, those in Grand Gulch, Slickhorn Canyon, and John's Canyon divide portions of the allotment (streams not depicted).

Accessibility:
A lateral roadway parallels the southern border of Slickhorn allotment, and appears to run north of San Juan River. The lateral likely connects to County Hwy 431 southeast of the allotment. A road is also present in Grand Gulch in the northwest portion of the allotment.

No. Cultural Sites: 2
Area surveyed: 0.00 acres

The figure below depicts known cultural sites by affiliation/attribute. As the information available is minimal, only one figure is included for this allotment.





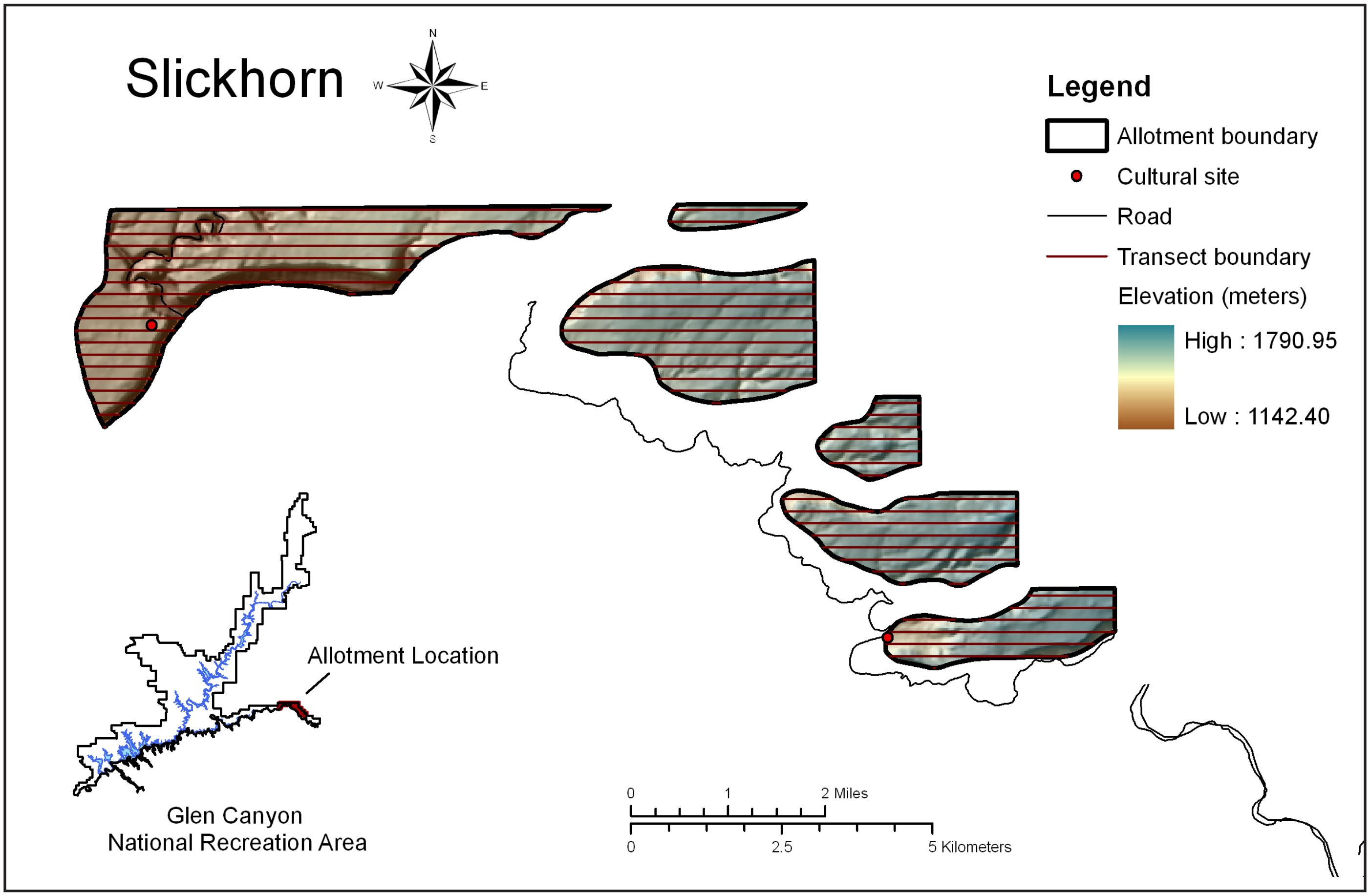
Slope Considerations:

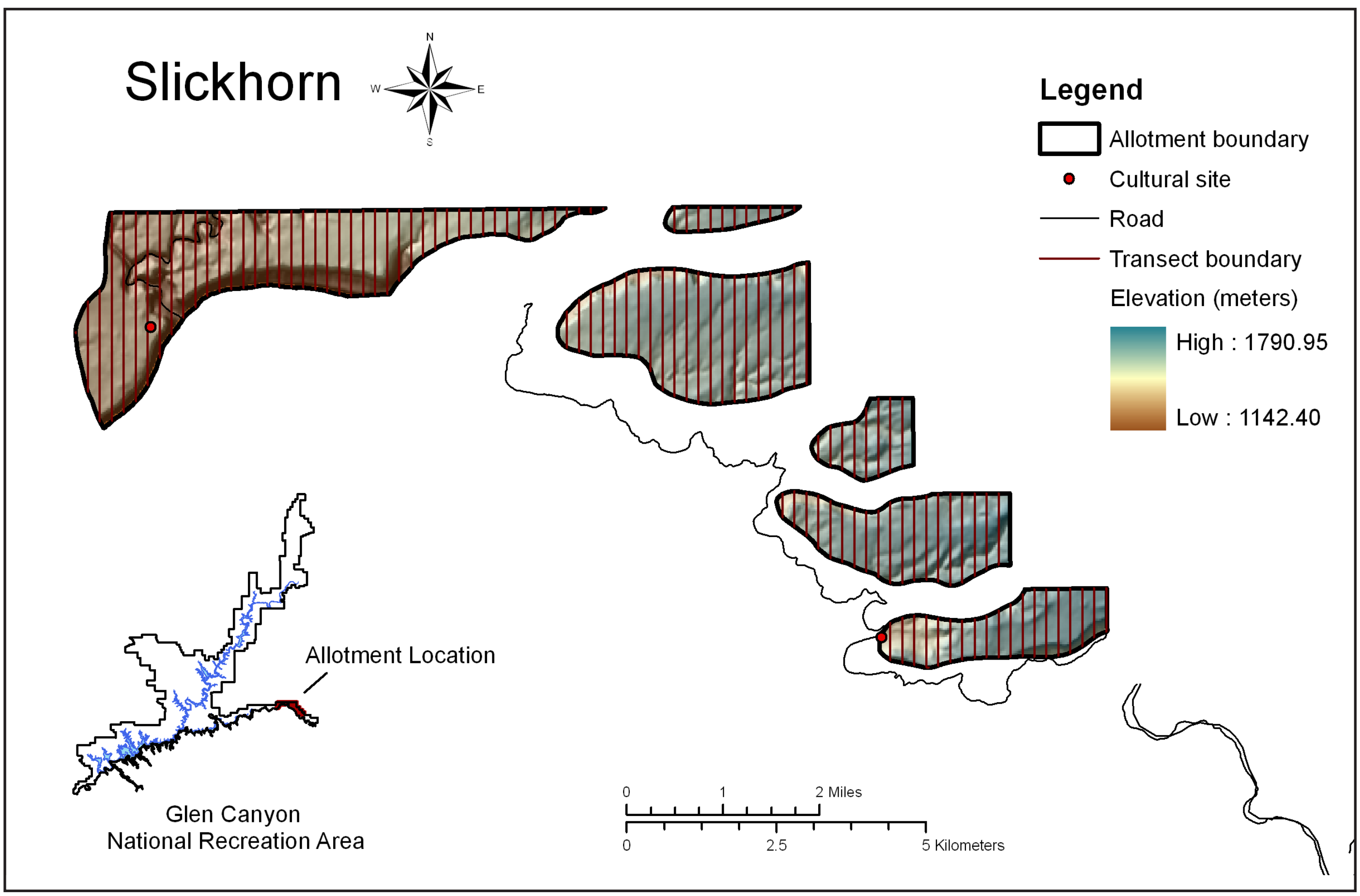
Slope plays a large role in terrain accessibility, and may be used in the stratification of survey areas. For example, GCNRA may wish to assign catagories such as low, moderate, and high to specific slope gradients. Such assignations are most often dependent on the factors guiding archaeological survey work, and as such, are not included in this document. Included herein, however, are suggestions for basic transect orientation based on the presence of topographical barriers identified by the presence of excessive slope gradients.

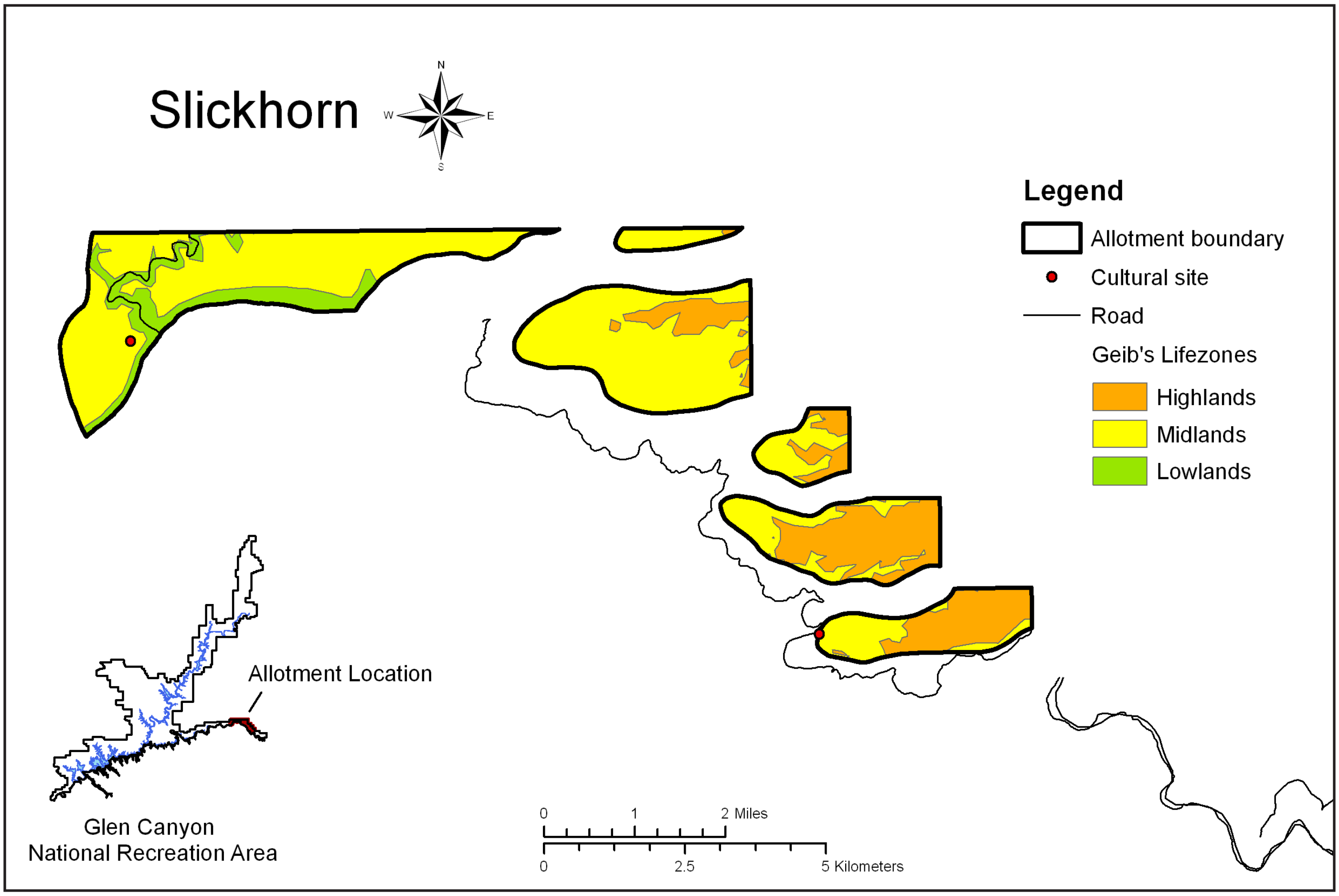
Survey Zones Dictated by Slope:

The majority of Slickhorn grazing allotment should be accessible by road. In these areas, transects should be placed perpendicular to the roadway wherever possible. However, slope orientation in the southeastern segments of the allotment may dictate east-west transects. Likewise, in the northern segments, north-south oriented transects may be preferable. Finally, the steep slopes of Grand Gulch, through which a lateral road runs, may prevent access to the higher elevation areas surveyable. It may be necessary to identify alternate access, or to survey this portion of the allotment aerially.

The 'fishnet' maps provided on the subsequent page display transects spaced at 200 meter intervals for both east-west and north-south oriented pedestrian survey.


Slickhorn
N
W
E
S
Legend
Allotment boundary
Cultural site
Road
Transect boundary
Elevation (meters)
High : 1790.95
Low : 1142.40
Allotment Location
Glen Canyon
National Recreation Area
0
1
2 Miles
0
2.5
5 Kilometers


Slickhorn
N
W
E
S
Legend
Allotment boundary
Cultural site
Road
Transect boundary
Elevation (meters)
High : 1790.95
Low : 1142.40
Allotment Location
Glen Canyon
National Recreation Area
0
1
2 Miles
0
2.5
5 Kilometers



Area of Each Lifezone:

Highlands:1618.68 acres
Midlands: 4658.87 acres
Lowlands: 612.15 acres

No. Cultural Sites in Each Lifezone:

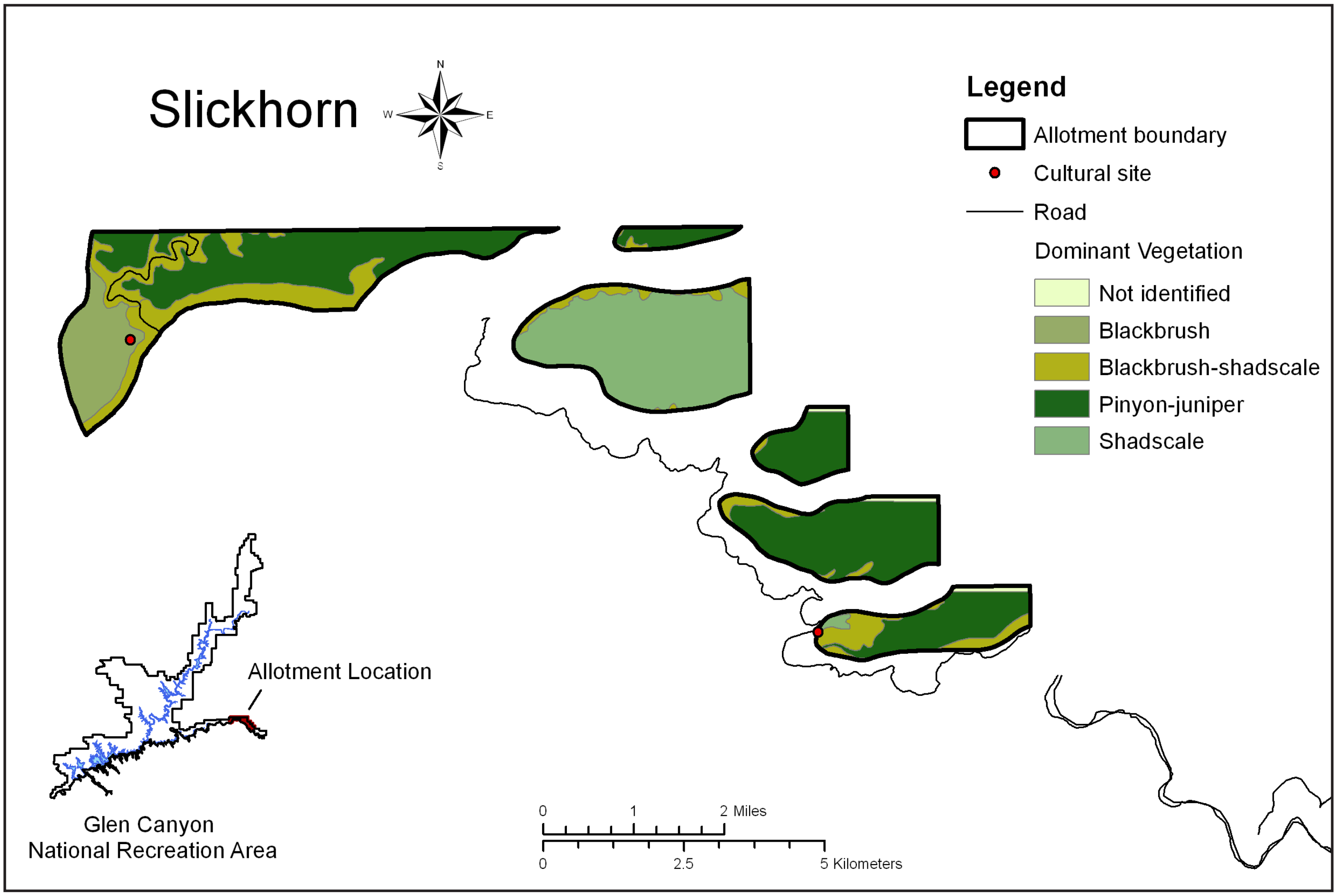
Highlands: 0
Midlands: 2
Lowlands: 0

Lifezone Significance and Known Cultural Sites:

Both known sites (n = 2) within Slickhorn allotment are located in Geib's Midland zone. Geib suggests that the Midland zone of the Glen Canyon area provided important grasses, cacti such as prickly pear, and shadscale to prehistoric people. In addition, Geib suggests the Midland lifezone provides excellent habitant for antelope, an important meat option in prehistoric times. Finally, quality raw material for stone tool manufacture may be found in select locations within the Midland zone.

	Elevation	Characteristics	Environment	Significance to Humans
Lowlands	1219-1372 m (4000-4500 ft)	Hot and arid steep-walled sandstone canyons.	Riparian plants; big-horn sheep	Permanent water, arable alluvium, long growing season, diverse plant communities, natural shelters, quality siliceous stone from river gravels
Midlands	1372-1676 m (4500-5500 ft)	Arid slickrock and dune fields on benchlands and low plateaus.	Blackbrush, shad-scale, grasses; antelope.	Grasses, including dropseed and ricegrass, prickly pear and shadscale; good antelope habitat, quality siliceous stone in certain locations.
Highlands	Above 1676 m (Above 5500 ft)	High elevation mesas and plateaus with cooler temperatures and greater precipitation.	Pinyon-juniper wood-lands; deer and rabbit.	Higher elevation plant foods (i.e. pinyon); later har-vests; dry-farming; abundant fuel, deer and rabbit.

Shading indicates lifezones present in allotment.



Area of Individual Vegetation Zones:

Dominant Species	Acres Covered	No. Sites
Not identified	107.89	0
Blackbrush ***(Coleogyne ramosissima)***	551.05	**1**
Blackbrush-shadscale ***(Coleogyne ramosissima - Atriplex confertifolia)***	1259.49	**0**
Pinyon-juniper ***(Pinus edulis - Juniperus osteosperma)***	3309.31	**1**
Shadscale ***(Atriplex confertifolia)***	1679.05	**0**
Total	**6906.79**	**2**

No. Cultural Sites in Each Vegetation Zone:
One (n = 1) site is located in blackbrush, and the other (n= 1) in shadscale.

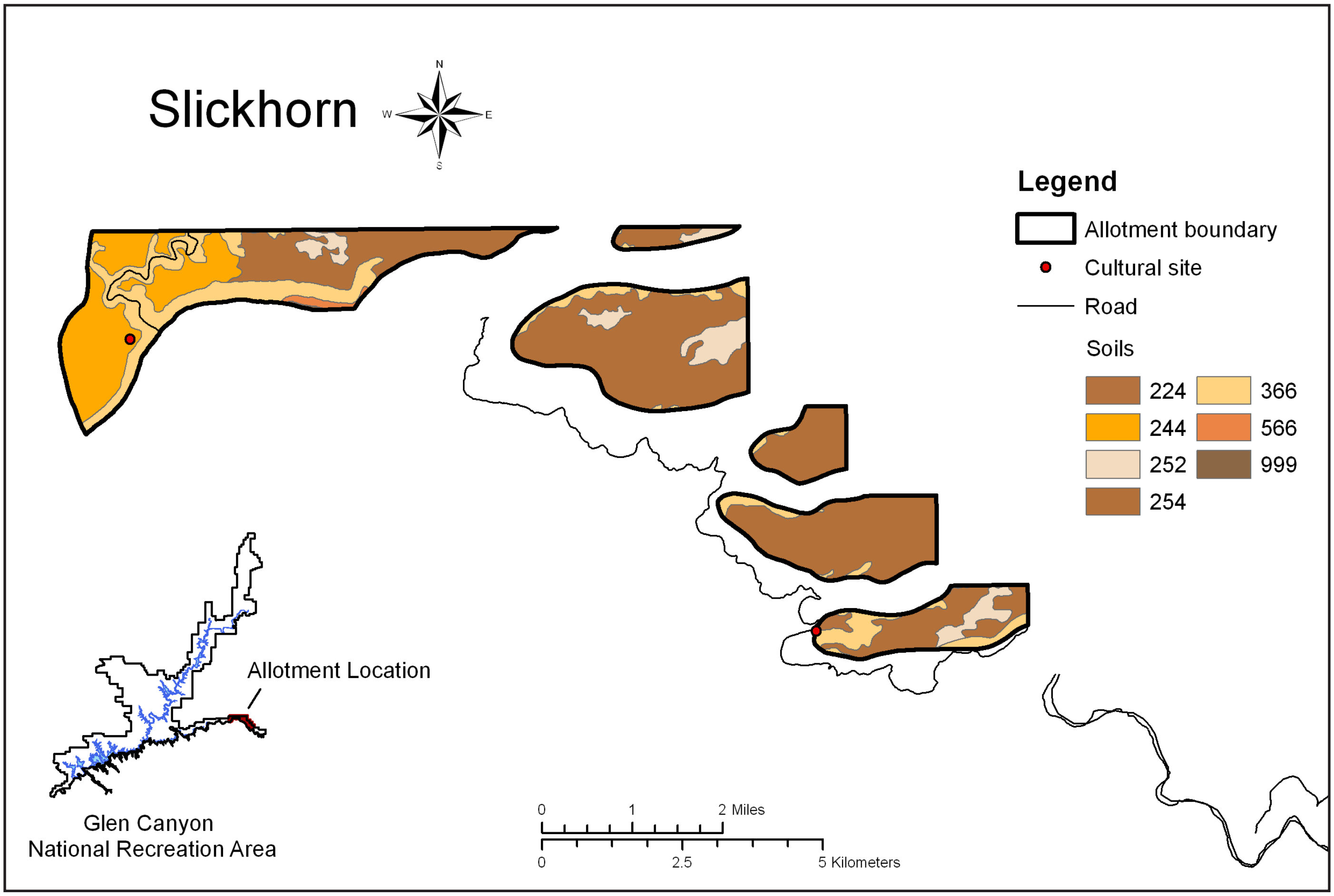
Visibility:
In general, the dominant vegetative communities of the allotment provide moderate - excellent ground visibility. However, in pinyon-juniper, ground visibility may be hampered by built-up organic material beneath the trees.

Summary:
Dominant vegetation for Slickhorn grazing allotment includes blackbrush (7.98 percent), blackbrush-shadscale (18.24 percent), pinyon-juniper (47.91 percent), and shadscale (24.31 percent).

Dominant Species:
Shadscale (*Atriplex confertifolia*)
Pinyon (*Pinus edulis*)
Juniper (*Juniperus osteosperma*)
Blackbrush (*Coleogyne ramosissima*)

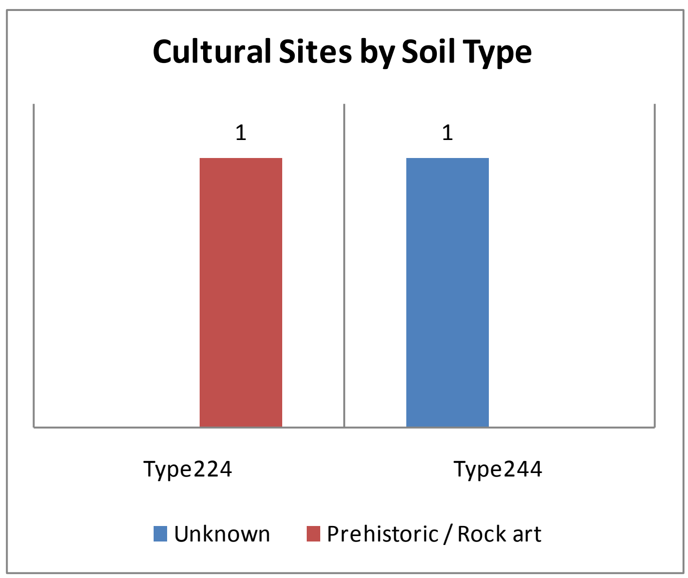
Secondary Dominant Species:
Unknown.

Associated Soils:
Blackbrush grows in shallow sandy loam. Blackbrush-shadscale dominates in talus. Pinyon-juniper occurs in shallow sandy loam, and finally, shadscale grows in both shallow loam and shallow sandy loam.



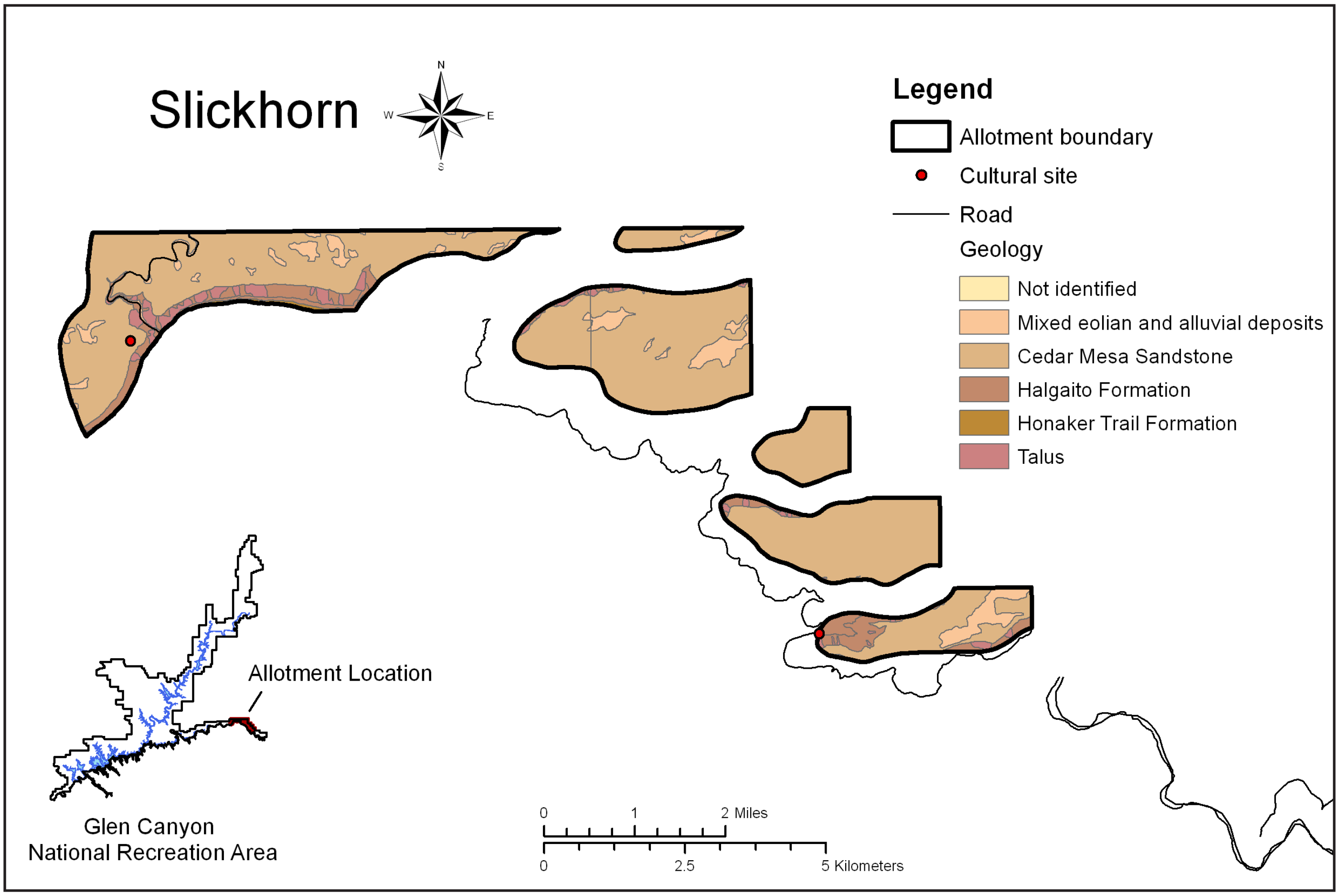
Allotment Divided by Soil Type (MUSYM):

Soil Type	Acres	Percent	No. Cultural Sites
224	34.46	0.50	1
244	994.47	14.40	1
252	423.74	6.14	0
254	4133.57	59.85	0
366	1260.89	18.26	0
566	45.29	0.66	0
999	14.38	0.21	0
Total	**6906.80**	**100.02%**	**2**



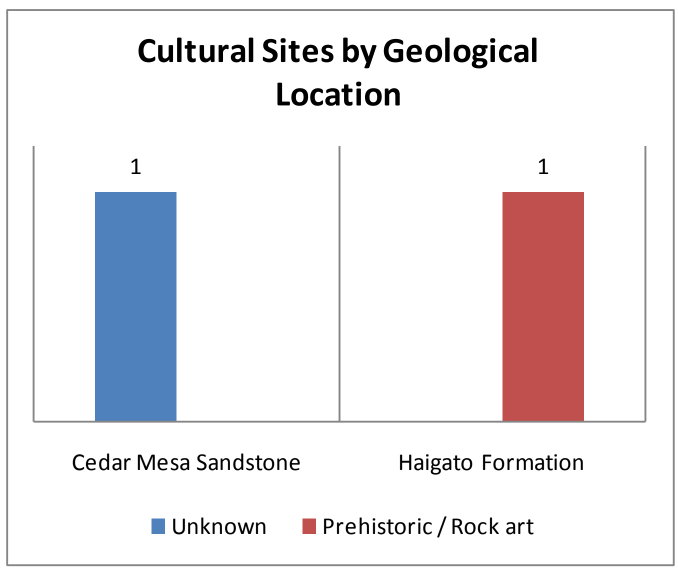
Distribution of Cultural Sites by Soil Type:

One (n = 1) prehistoric rock art site is located in soil type 224. The other site, for which no attribute/affiliation information is currently available, is located in soil type 244, which is often associated with Navajo sandstone, or slickrock.



Allotment Divided by Geology:

Geology	Acres	Percent	No. Cultural Sites
Not identified	1.65	0.02	0
Mixed eolian and alluvial deposits	481.03	6.96	0
Cedar Mesa Sandstone	5628.06	81.48	1
Halgaito Formation	531.82	7.70	1
Honaker Trail Formation	39.63	0.57	0
Talus	224.71	3.25	0
Total	**6906.90**	**99.98%**	**2**

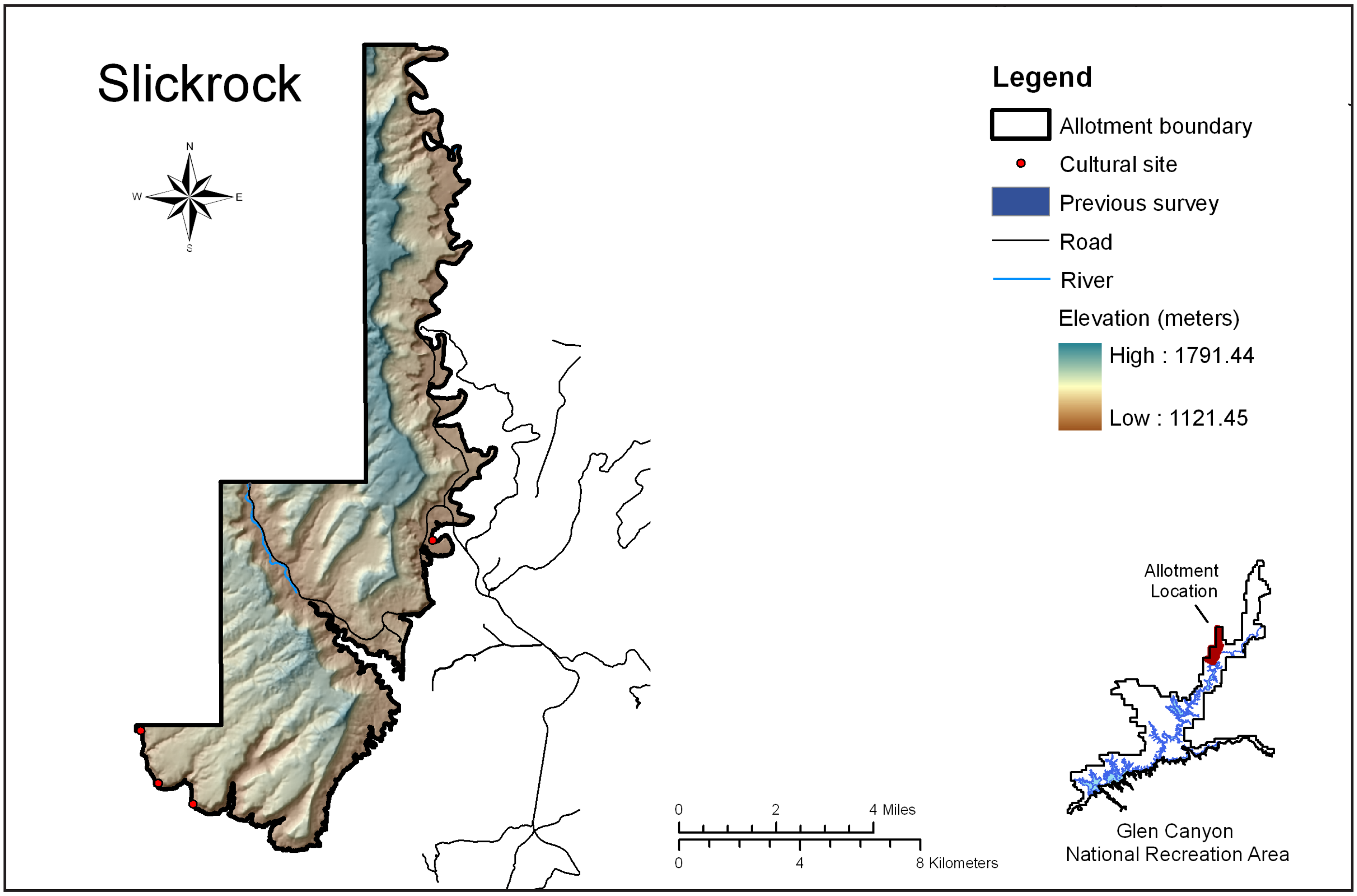


Distribution of Cultural Sites by Geological Location:

A prehistoric rock art site (n = 1) is located on Halgaito Formation geology. The remaining site (n = 1), for which affiliation/attribute information is currently unavailable, is located on Cedar Mesa Sandstone.

Slickrock

Map Panels



Total Area: 27,518.45 acres

Sampling Fractions:
2 percent: 550.37 acres
5 percent: 1375.92 acres
11 percent: 3027.03 acres
16 percent: 4402.95 acres
20 percent: 5503.69 acres

Elevation range amsl:
1121.45 – 1791.44 meters (3679.30 - 5877.43 feet)

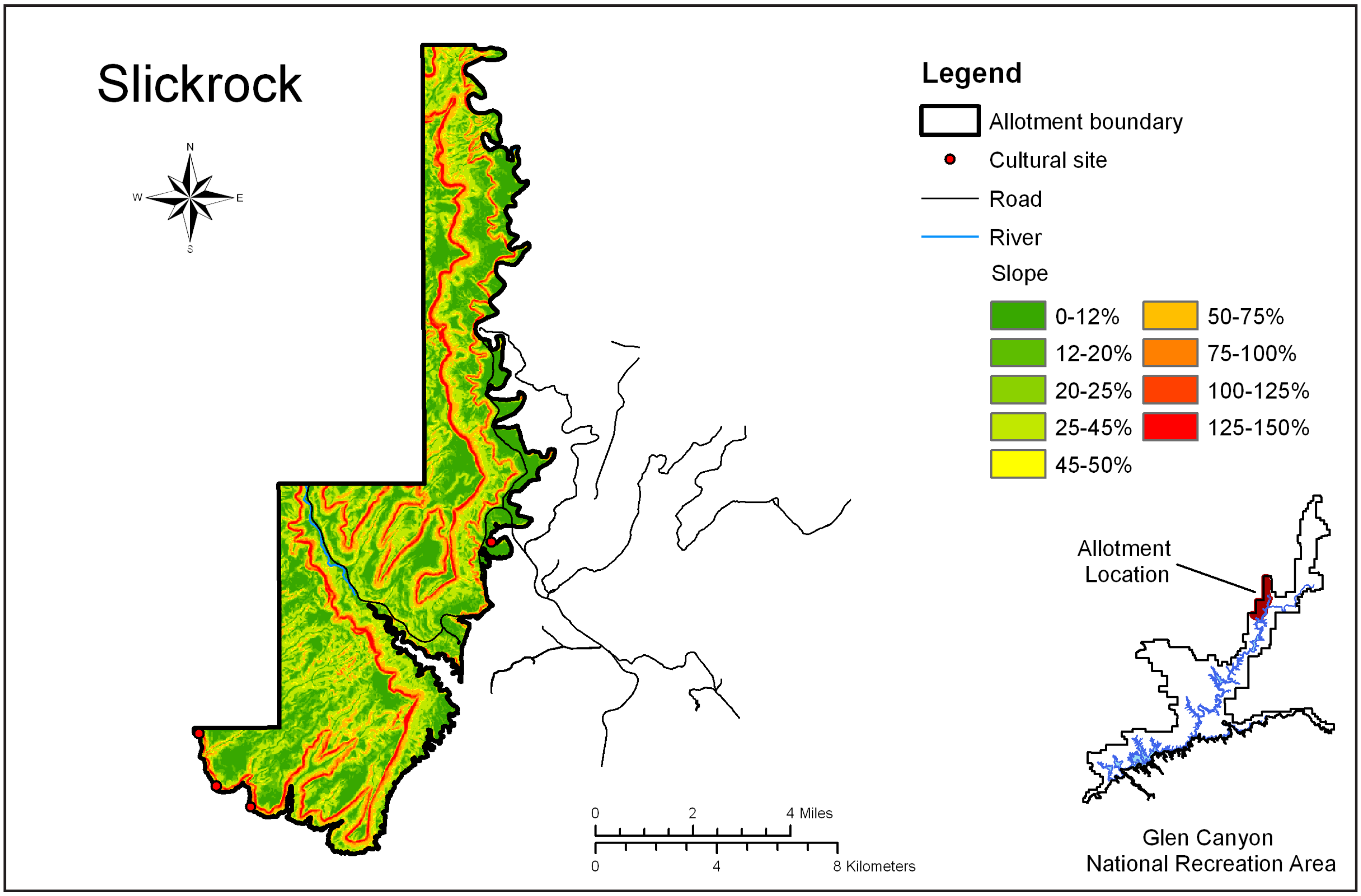
Rivers and Springs:
North Wash crosses Slickrock grazing allotment, Dirty Devil River (not depicted) forms the northeastern boundary, and Trachyte Creek (not depicted) forms the southwestern boundary of the allotment.

Accessibility:
State Hwy 95 provides access to Slickrock grazing allotment. Camping is available at Dirty Devil campground, and at Hite and Farley Canyon (located across Lake Powell to east). Lake Powell forms the east boundary of the allotment, allowing for boat access. Dirty Devil River enters Lake Powell at the northern east edge of the allotment, and Trachyte Creek appears to form the southwestern boundary.

No. Cultural Sites: 4
Area surveyed: 2.02 acres

Survey References:
Burchett (1996): 2.02 acres

All known cultural sites (n = 4) lack attribute/affiliation information at this time. No figure is provided.



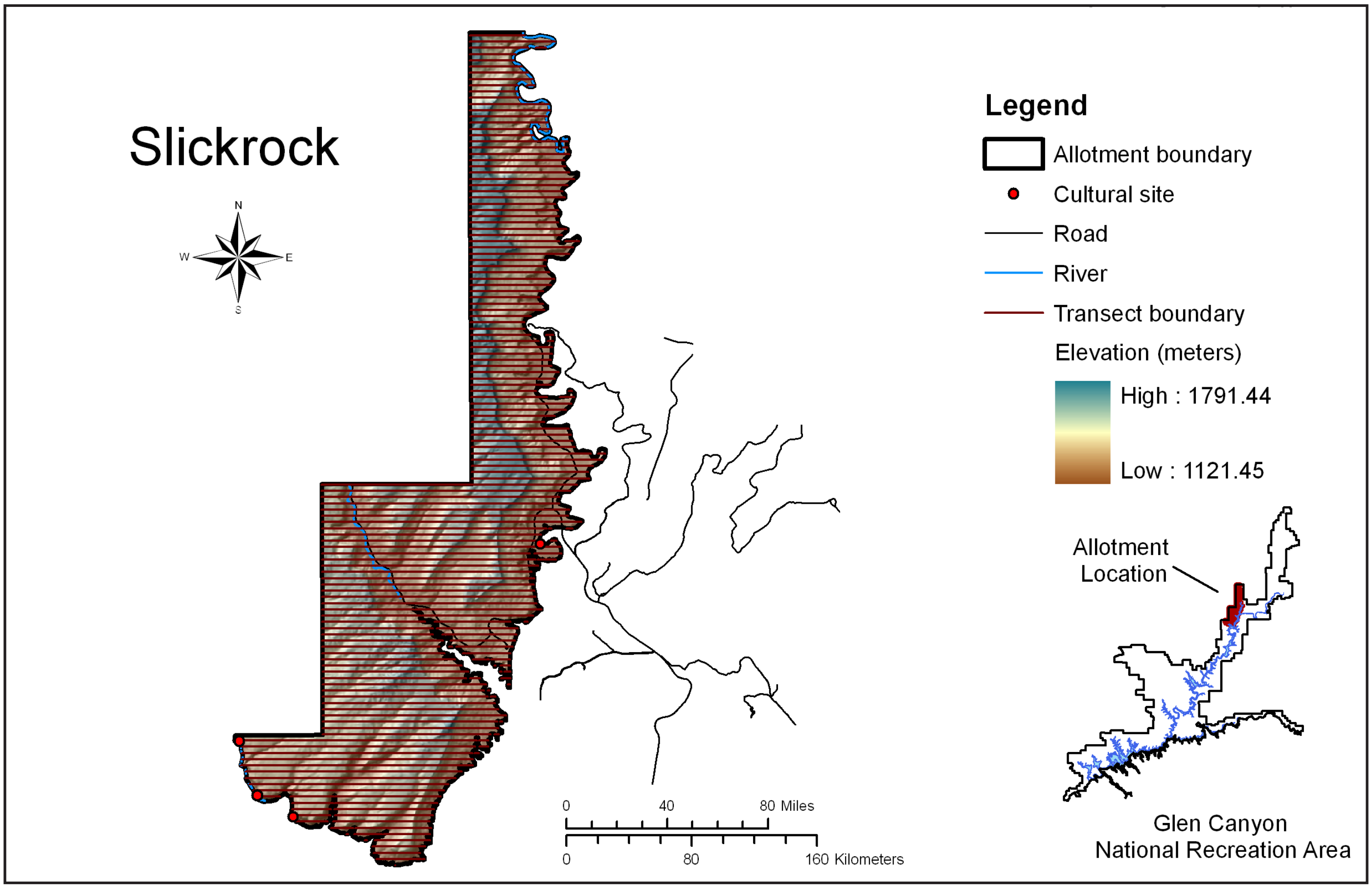
Slope Considerations:

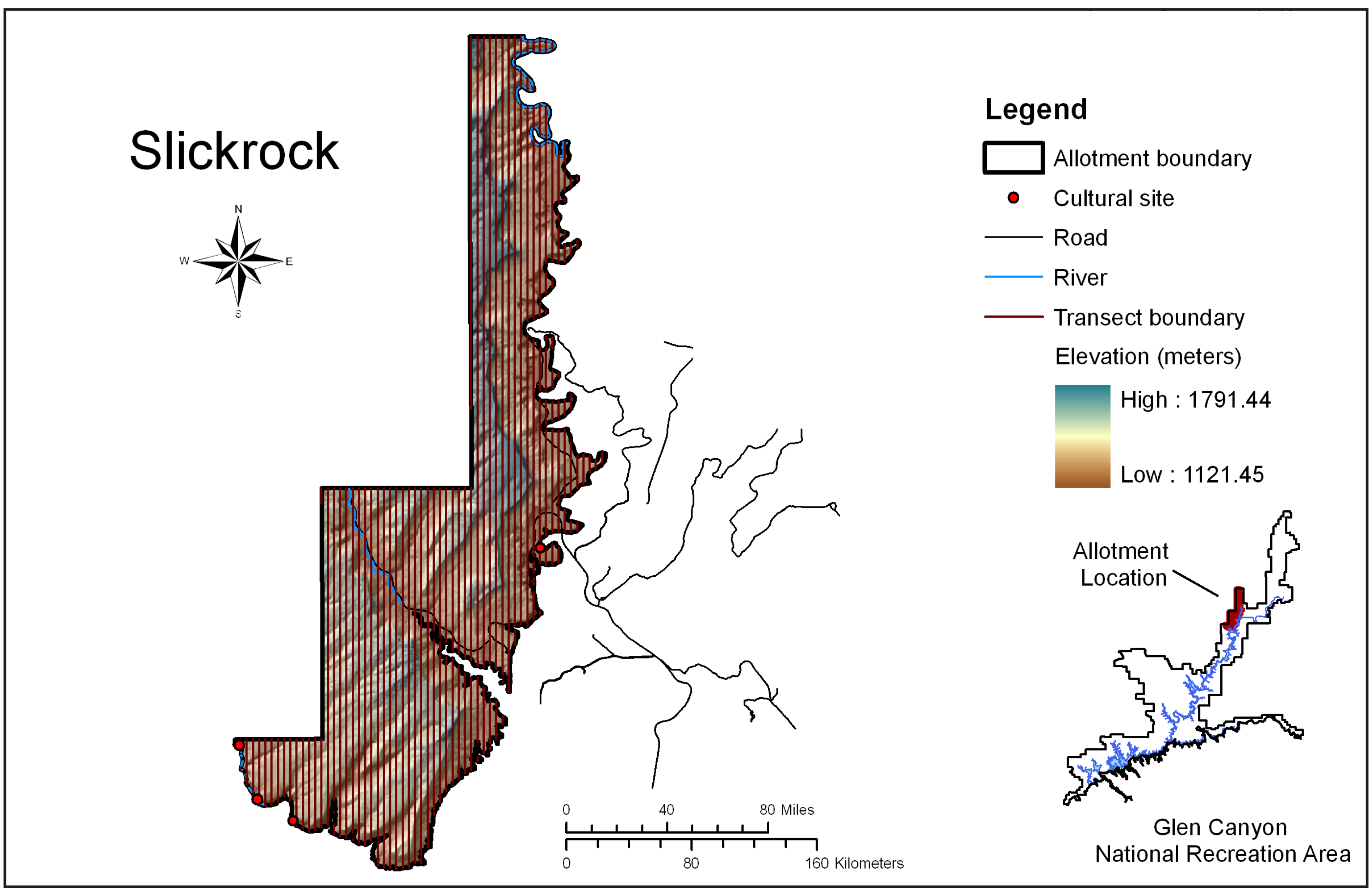
Slope plays a large role in terrain accessibility, and may be used in the stratification of survey areas. For example, GCNRA may wish to assign catagories such as low, moderate, and high to specific slope gradients. Such assignations are most often dependent on the factors guiding archaeological survey work, and as such, are not included in this document. Included herein, however, are suggestions for basic transect orientation based on the presence of topographical barriers identified by the presence of excessive slope gradients.

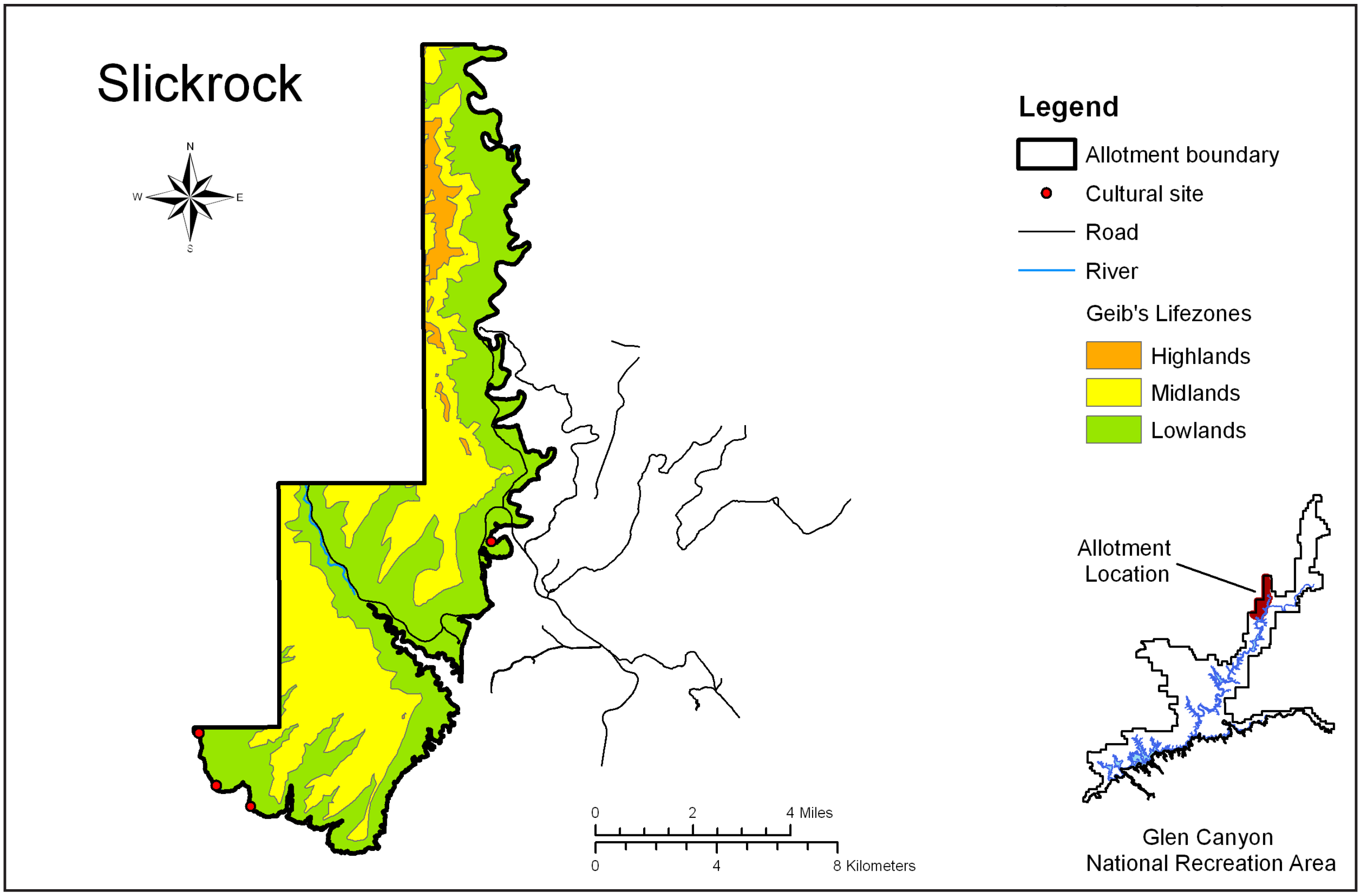
Survey Zones Dictated by Slope:

Steep escarpments throughout Slickrock allotment may provide accessibility problems for pedestrian crews. In the north, two parallel stepped escarpments divide the east and west. The east is accessible by lateral roadways and should be surveyed by transects set perpendicular to access points. In the south, once access is located, transects should be set in the direction providing the least encounters with steep slopes. Note an escarpment borders all but the western edge of the south, and several southwest-northeast trending canyons are present as well.

The 'fishnet' maps provided on the subsequent page display transects spaced at 200 meter intervals for both east-west and north-south oriented pedestrian survey.


Slickrock
N
W
E
S
Legend
Allotment boundary
Cultural site
Road
River
Transect boundary
Elevation (meters)
High : 1791.44
Low : 1121.45
Allotment Location
Glen Canyon
National Recreation Area
0
40
80 Miles
0
80
160 Kilometers


Slickrock
N
W
E
S
Legend
Allotment boundary
Cultural site
Road
River
Transect boundary
Elevation (meters)
High : 1791.44
Low : 1121.45
Allotment Location
Glen Canyon
National Recreation Area
0
40
80 Miles
0
80
160 Kilometers



Area of Each Lifezone:

Highlands:968.48 acres
Midlands: 11,644.92 acres
Lowlands: 14,825.12 acres

No. Cultural Sites in Each Lifezone:

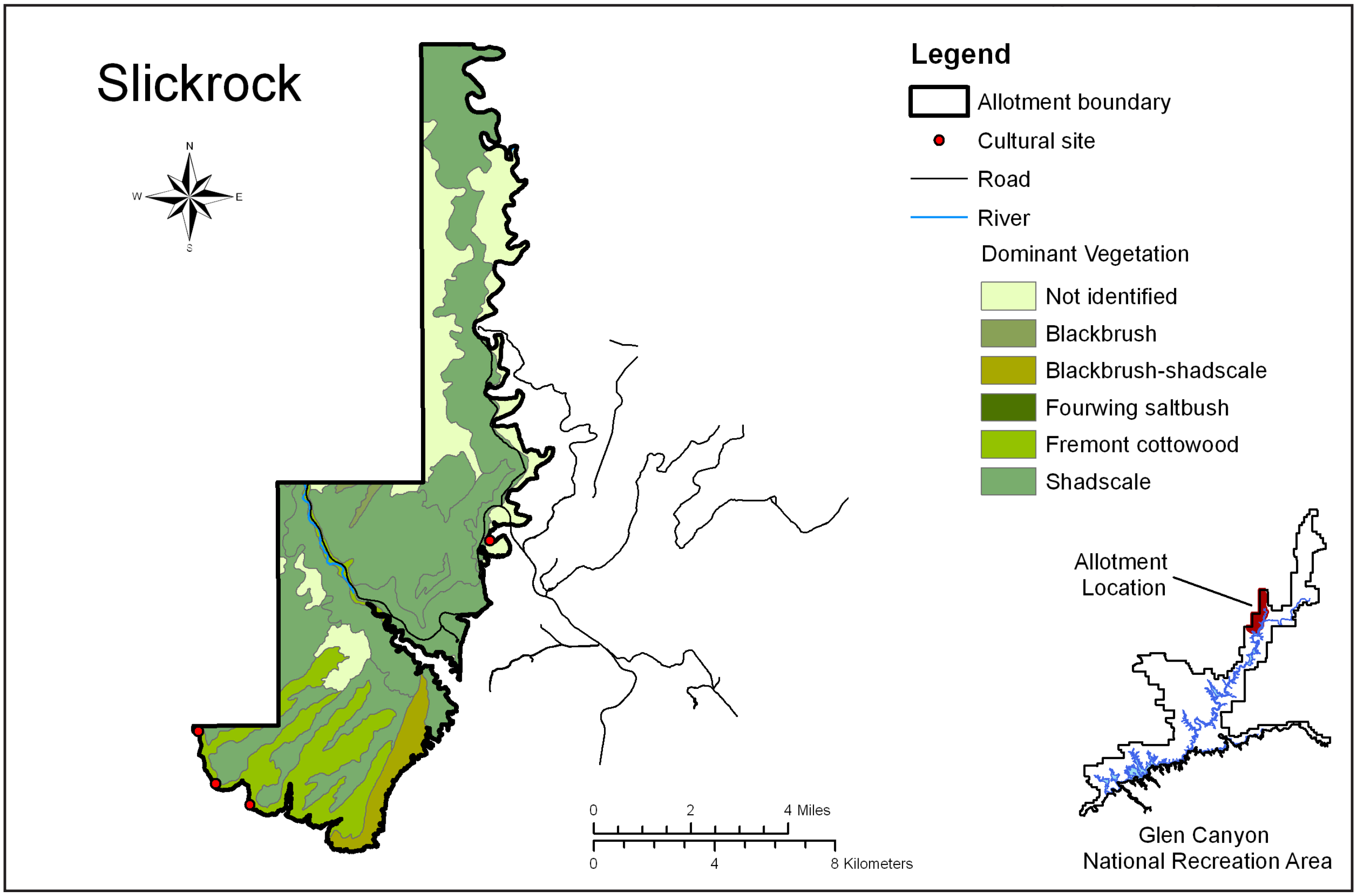
Highlands: 0
Midlands: 0
Lowlands: 4

Lifezone Significance and Known Cultural Sites:

Although all three of Geib's lifezones are present in Slickrock grazing allotment, all known cultural sites (n = 4) occur in Lowland zones. Geib characterizes the lowlands as hot and arid, with permanent water, arable alluvium, and long growing seasons ideal for agriculturalists. In addition, Geib describes the lowlands as having diverse plant communities, natural shelters, and quality raw material for manufacturing stone tools.

	Elevation	Characteristics	Environment	Significance to Humans
Lowlands	1219-1372 m (4000-4500 ft)	Hot and arid steep-walled sandstone canyons.	Riparian plants; big-horn sheep	Permanent water, arable alluvium, long growing season, diverse plant communities, natural shelters, quality siliceous stone from river gravels
Midlands	1372-1676 m (4500-5500 ft)	Arid slickrock and dune fields on benchlands and low plateaus.	Blackbrush, shadscale, grasses; antelope.	Grasses, including dropseed and ricegrass, prickly pear and shadscale; good antelope habitat, quality siliceous stone in certain locations.
Highlands	Above 1676 m (Above 5500 ft)	High elevation mesas and plateaus with cooler temperatures and greater precipitation.	Pinyon-juniper woodlands; deer and rabbit.	Higher elevation plant foods (i.e. pinyon); later harvests; dry-farming; abundant fuel, deer and rabbit.

Shading indicates lifezones present in allotment.



Area of Individual Vegetation Zones:

Dominant Species	Acres Covered	No. Sites
Not identified	5733.83	1
Blackbrush ***(Coleogyne ramosissima)***	127.58	**0**
Blackbrush-shadscale ***(Coleogyne ramosissima - Atriplex confertifolia)***	1049.14	**0**
Fourwing saltbush ***(Atriplex canescens)***	0.12	**0**
Fremont cottonwood ***(Populus fremontii)***	3691.09	**3**
Shadscale ***(Atriplex confertifolia)***	16,916.69	0
Total	**27,518.45**	**4**

No. Cultural Sites in Each Vegetation Zone:
Three sites (n = 3) are located in Fremont cottonwood, and the remaining site (n = 1) is located in an area for which dominant vegetation has not yet been identified.

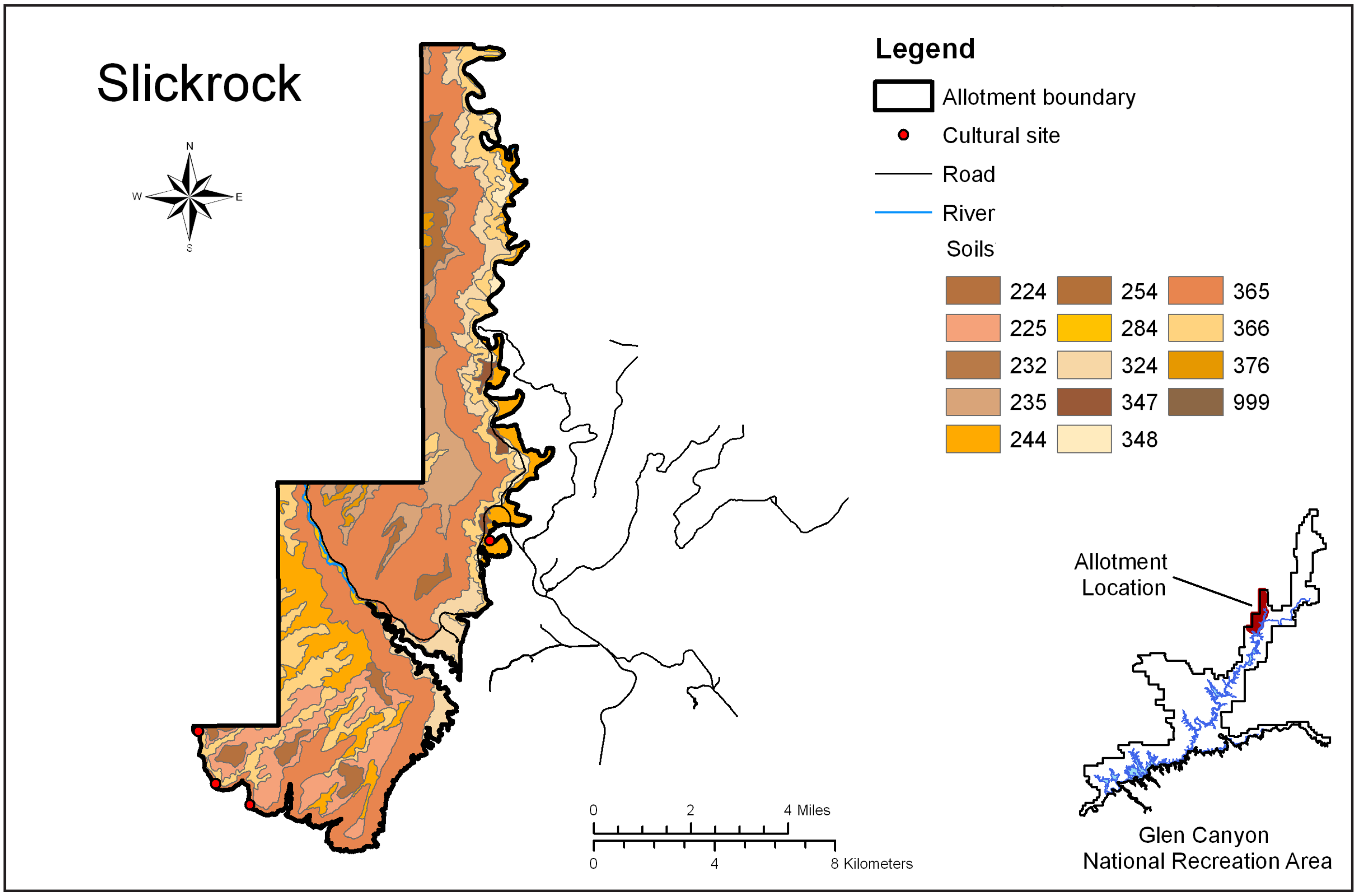
Visibility:
In general, the dominant vegetative communities of the allotment provide moderate - excellent ground visibility.

Summary:
Dominant vegetation for Slickrock grazing allotment includes blackbrush (0.46 percent), blackbrush-shadscale (7.62 percent), fourwing saltbush (<0.00 percent), Fremont cottonwood (13.41 percent), and shadscale (61.47 percent). Dominant vegetation for the remainder of the allotment has not yet been identified.

Dominant Species:
Shadscale (*Atriplex confertifolia*)
Fourwing saltbush (*Atriplex canescens*)
Fremont cottonwood (*Populus fremontii*)
Blackbrush (*Coleogyne ramosissima*)

Secondary Dominant Species:
Unknown.

Associated Soils:
Blackbrush brows in shallow sandy loam, and blackbrush-shadscale occurs in talus, where it may grow alongside shadscale in shallow sandy loam. Fourwing saltbush grows in sandy loam, alongside Fremont cottonwood in semiwet saline streambanks. Fremont cottonwood dominants in semiwet saline streambanks and may be associated with shadscale in stony loam. Finally, shadscale grows in shallow sandy loam, often alongside blackbrush.

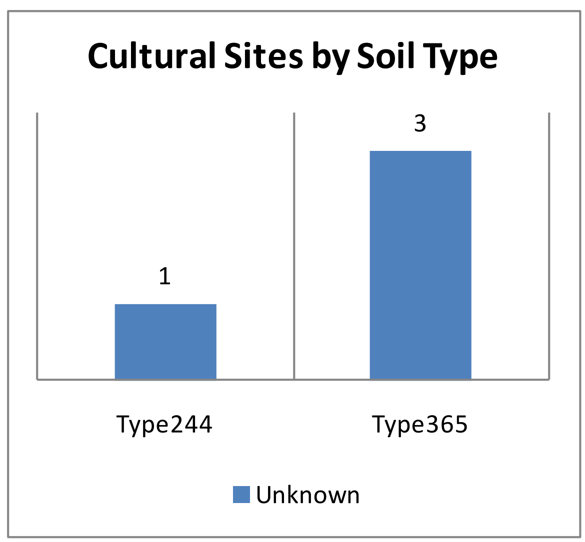


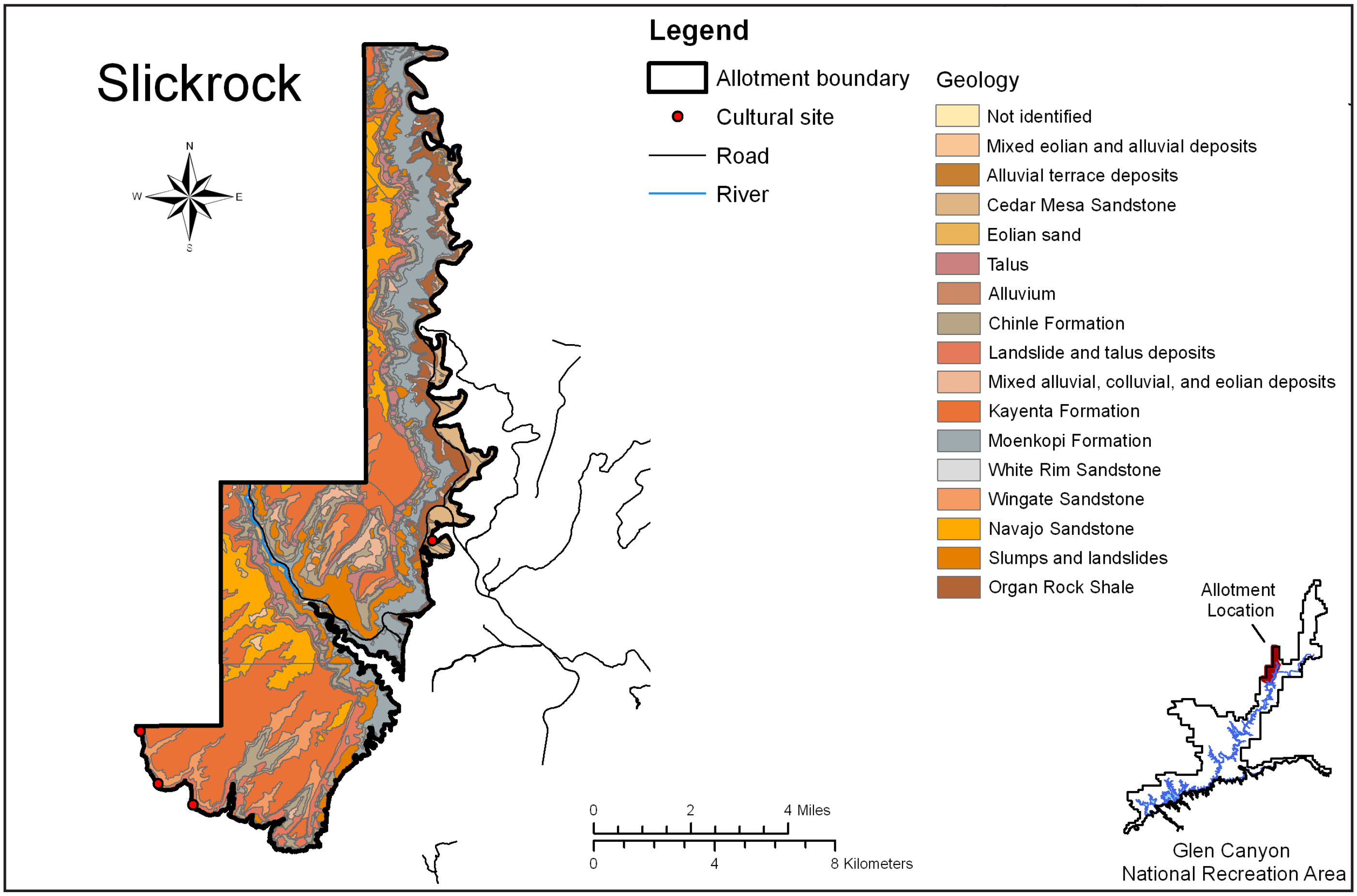
Allotment Divided by Soil Type (MUSYM):

Soil Type	Acres	Percent	No. Cultural Sites
224	601.79	2.19	0
225	2281.54	8.29	0
232	51.26	0.19	0
235	2018.48	7.34	0
244	3162.94	11.49	1
254	1093.97	3.98	0
284	266.18	0.97	0
324	2108.96	7.66	0
347	208.55	0.76	0
348	526.57	1.91	0
365	10,794.75	39.23	3
366	4041.47	14.69	0
376	227.42	0.83	0
999	134.58	0.49	0
Total	**27,518.46**	**100.02%**	**4**

Distribution of Cultural Sites by Soil Type:

One site is located on soil type 244, which is often associated with Navajo Sandstone, or slickrock. The remaining sites (n = 3) are located on soil type 365.



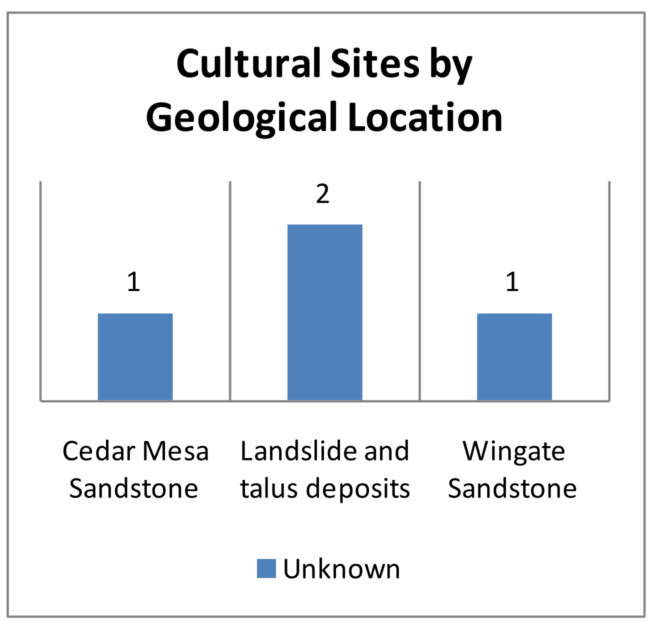


Allotment Divided by Geology:

Geology	Acres	Percent	No. Cultural Sites
Not identified	262.84	0.96	0
Mixed eolian and alluvial deposits	85.35	0.31	0
Alluvial terrace deposits	125.07	0.45	0
Cedar Mesa Sandstone	1094.67	3.98	1
Eolian sand	70.77	0.26	0
Talus	1181.55	4.29	0
Alluvium	215.97	0.78	0
Chinle Formation	3302.62	12.00	0
Landslide and talus deposits	633.37	2.30	2
Mixed alluvial, colluvial, and eolian deposits	736.81	2.68	0
Kayenta Formation	7156.00	26.00	0
Moenkopi Formation	3880.73	14.10	0
White Rim Sandstone	370.02	1.34	0
Navajo Sandstone	2752.31	10.00	0
Slumps and landslides	2185.16	7.94	0
Organ Rock Shale	1554.23	5.65	0
Wingate Sandstone	1910.55	6.94	1
Total	**27,518.02**	**99.98%**	**4**

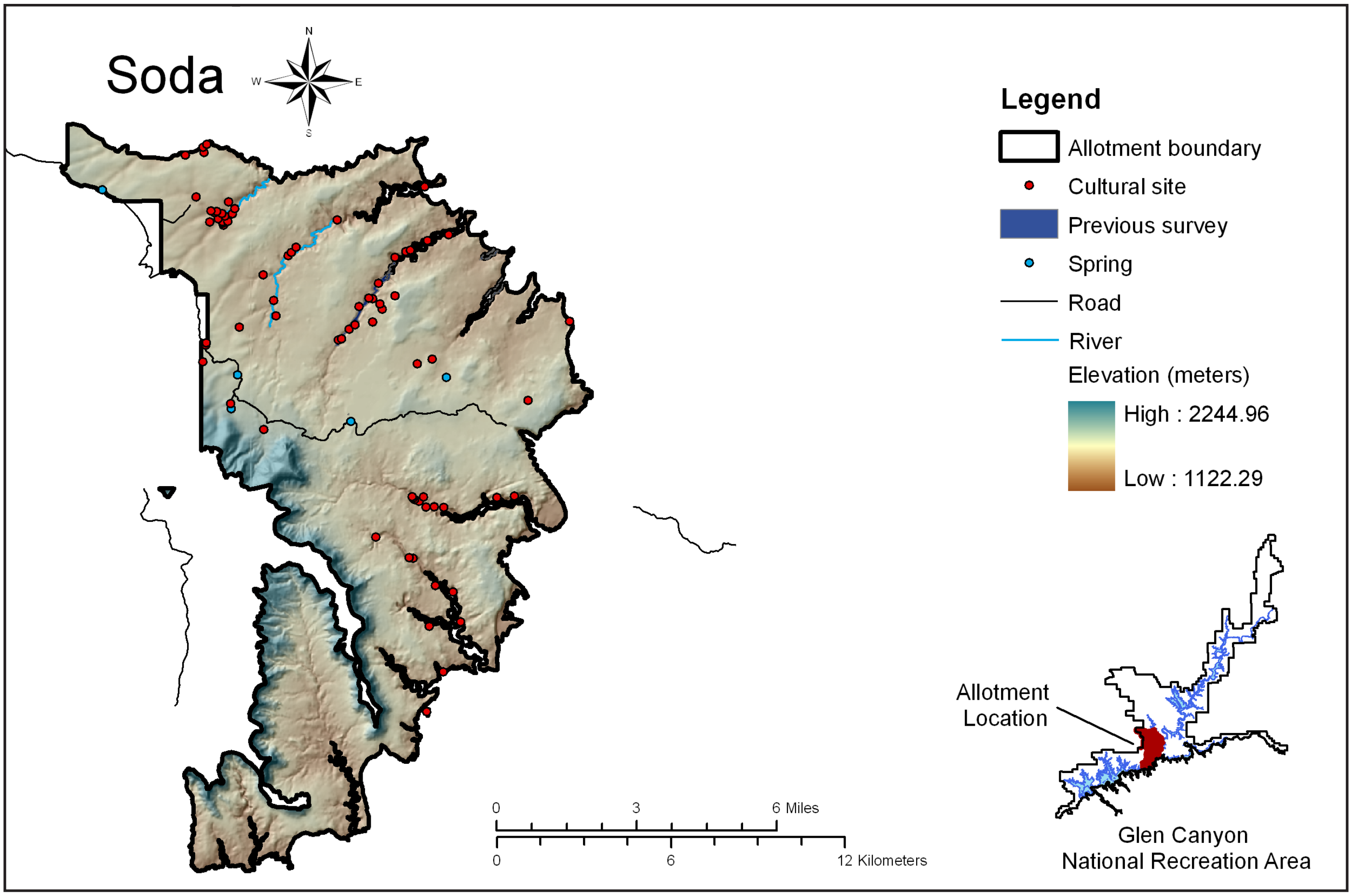
Distribution of Cultural Sites by Geological Location:

One site (n = 1) is located on Cedar Mesa Sandstone, two (n = 2) are on landslide and talus deposits, and the last (n = 1) is located on Wingate Sandstone.



Soda

Map Panels



Total Area: 53,449.37 acres

Sampling Fractions:
2 percent: 1069.99 acres
5 percent: 2674.97 acres
11 percent: 5884.93 acres
16 percent: 8559.90 acres
20 percent: 10699.87 acres

Elevation range amsl:
1122.29 – 2244.96 meters (3682.05 - 7365.35 feet)

Rivers and Springs:
Five springs, including Hole-in-the-Rock, Fiftymile, Cath in the Des (?), Soda, and Sooner Water are located in Soda grazing allotment, as are Fortymile Creek (not depicted), Fiftymile Creek, the ephemeral stream/creek in Davis Gulch, Clear Creek, and Indian Creek.

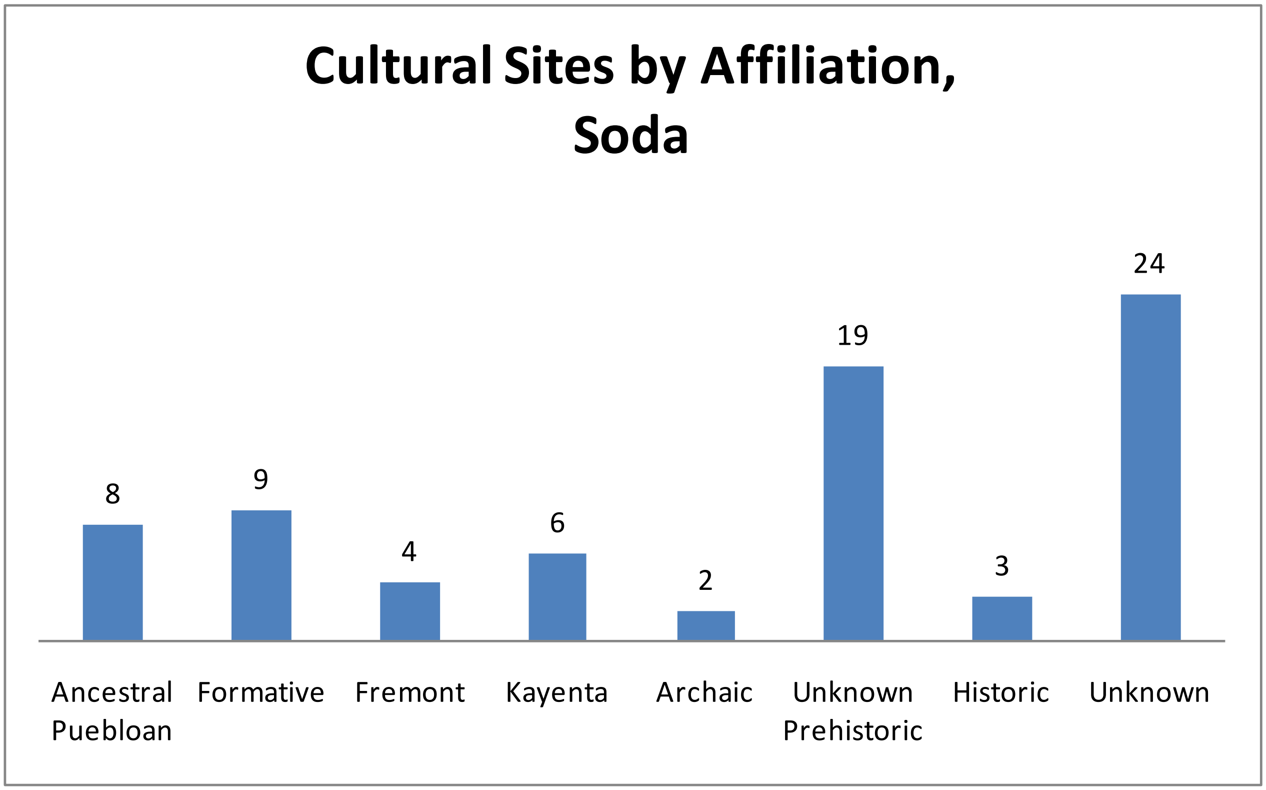
Accessibility:
County Hwy 330 (Hole-in-the-Rock Road) crosses east-west through the center of the allotment. Lake Powell, which serves as the eastern boundary of the allotment, may also provide access to Soda grazing allotment.

Fourmile Canyon and Twomile Canyon divide the north portion of the allotment from the south.

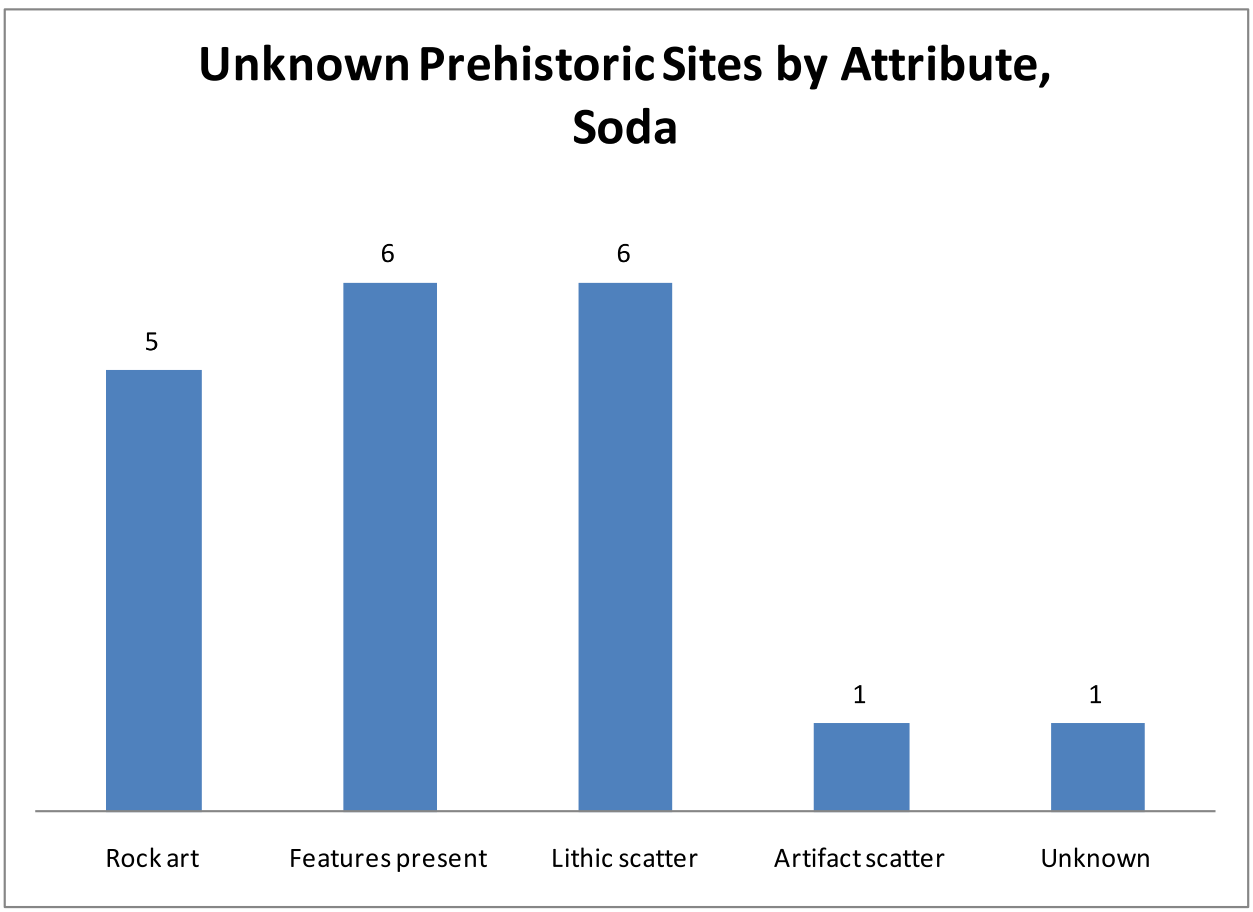
No. Cultural Sites: 74
Area surveyed: 171.36 acres

Survey References:
Schroedl (1981a): 171.06 acres
Unknown (n.d.): 0.30 acres

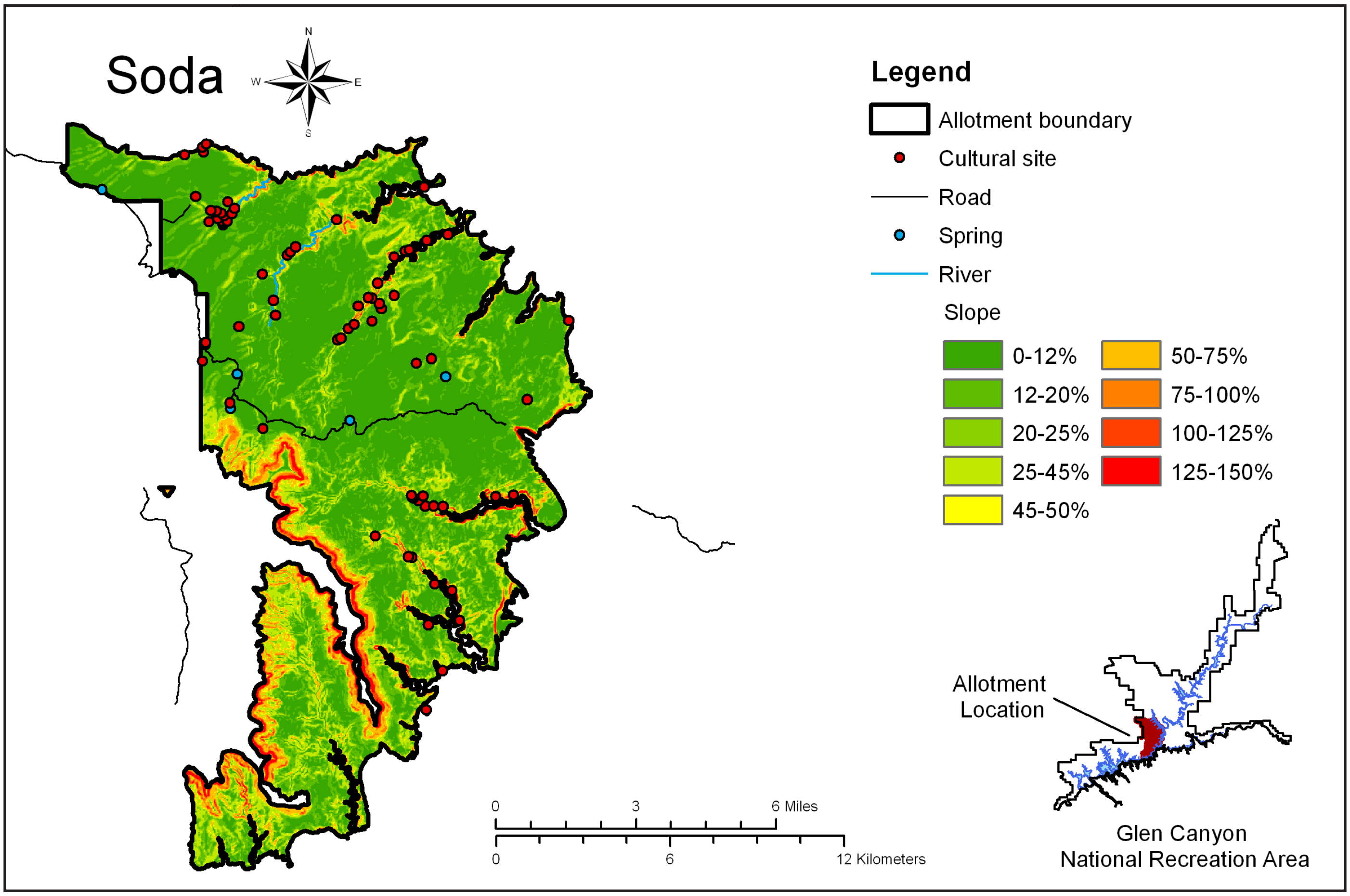
The figures on the subsequent page depict cultural sites by affiliation, and for those prehistoric sites for which affiliation is not known, site attributes.



Cultural Sites by Affiliation, Soda
8
9
4
6
2
19
3
24
Ancestral Puebloan
Formative
Fremont
Kayenta
Archaic
Unknown Prehistoric
Historic
Unknown



Unknown Prehistoric Sites by Attribute, Soda
5
6
6
1
1
Rock art
Features present
Lithic scatter
Artifact scatter
Unknown



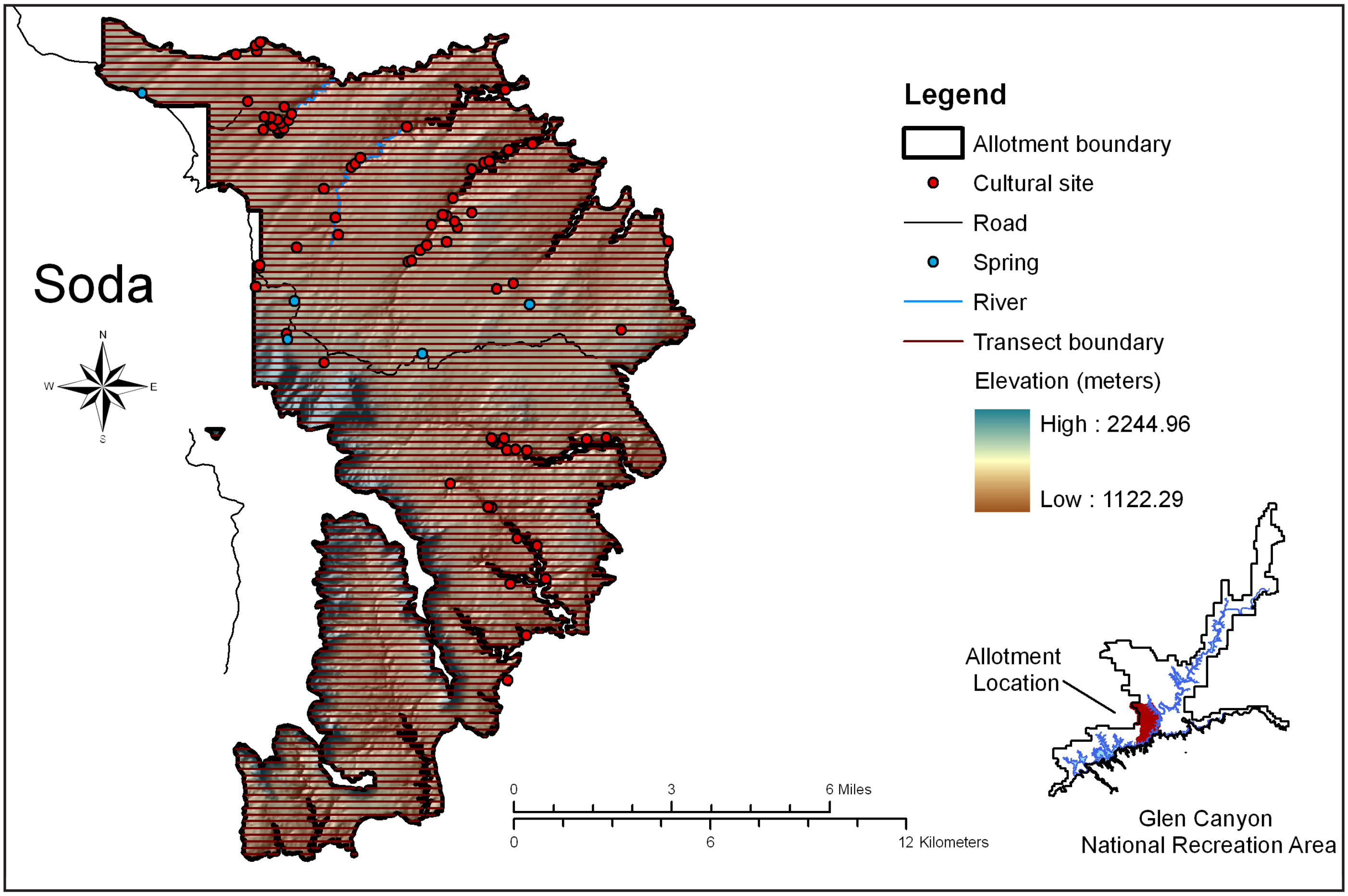
Slope Considerations:

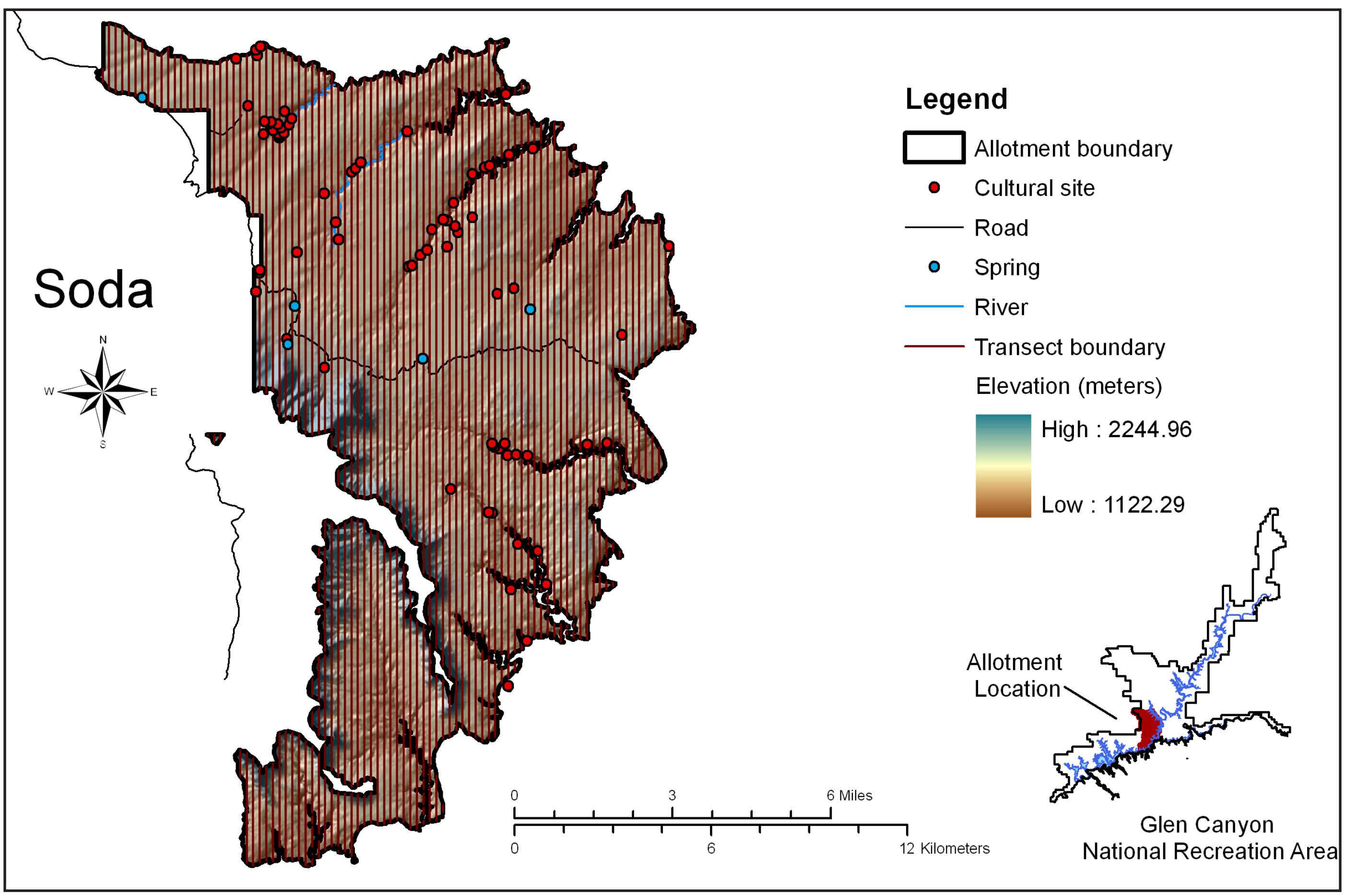
Slope plays a large role in terrain accessibility, and may be used in the stratification of survey areas. For example, GCNRA may wish to assign catagories such as low, moderate, and high to specific slope gradients. Such assignations are most often dependent on the factors guiding archaeological survey work, and as such, are not included in this document. Included herein, however, are suggestions for basic transect orientation based on the presence of topographical barriers identified by the presence of excessive slope gradients.

Survey Zones Dictated by Slope:

North of County Hwy 330 (Hole-in-the-Rock Road), slope within Soda grazing allotment is relatively level, and should not hinder survey access. A steep escarpment forms the southwestern boundary of the allotment. However, if a combination of road and lake access is utilized, this slope should not prohibit survey in the south. Recommended transects should be placed perpendicular to access points.

The 'fishnet' maps provided on the subsequent page display transects spaced at 200 meter intervals for both east-west and north-south oriented pedestrian survey.


Soda
N
W
E
S
Legend
Allotment boundary
Cultural site
Road
Spring
River
Transect boundary
Elevation (meters)
High : 2244.96
Low : 1122.29
Allotment
Location
Glen Canyon
National Recreation Area
0
3
6 Miles
0
6
12 Kilometers


Soda
N
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Legend
Allotment boundary
Cultural site
Road
Spring
River
Transect boundary
Elevation (meters)
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Location
Glen Canyon
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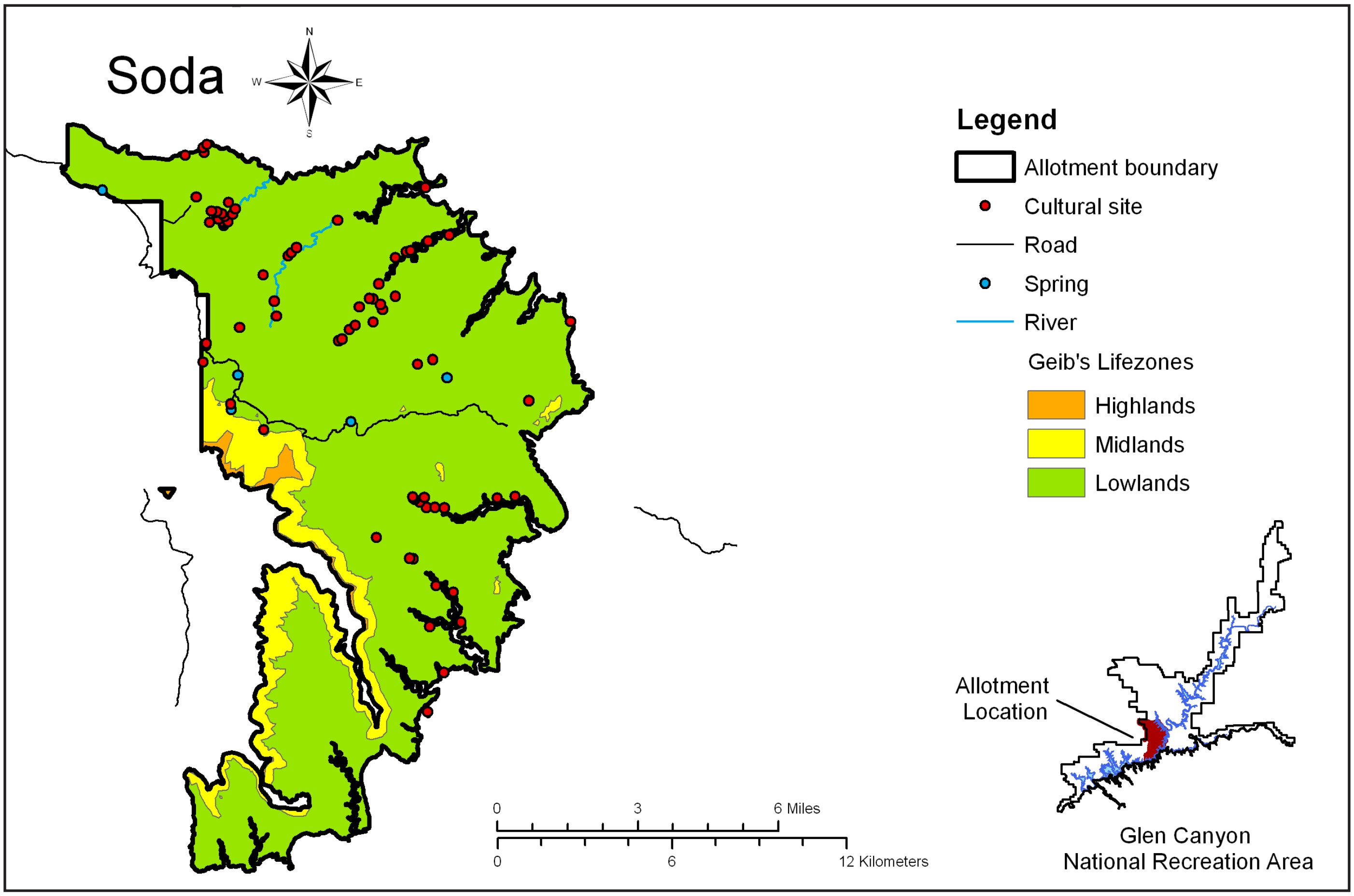
0
6
12 Kilometers



Area of Each Lifezone:

Highlands: 769.25 acres
Midlands: 4989.93 acres
Lowlands:47,608.89 acres

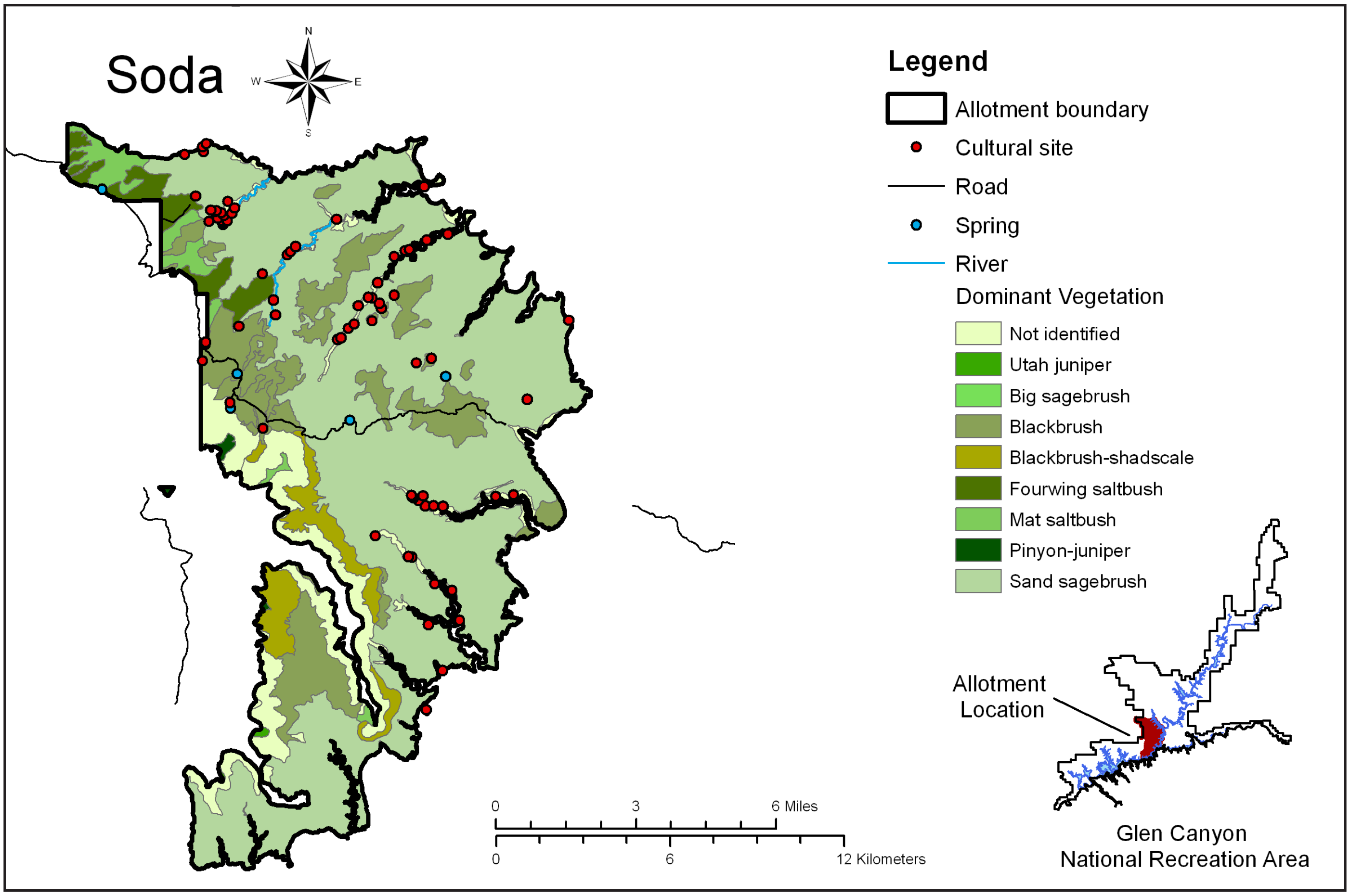
No. Cultural Sites in Each Lifezone:

Highlands: 0
Midlands: 2
Lowlands: 72

Lifezone Significance and Known Cultural Sites: Although all three of Geib's lifezones are present in Soda grazing allotment, all known sites are located in the Midlands (n = 2) and lowlands (n = 72). Geib describes the midlands as rich in grass and cacti resources, in addition to providing good habitant for antelope. The majority of the sites, however are located in the lowlands, described by Geib as hot and arid, with permanent water, arable alluvium, and long growing seasons needed for agricultural pursuits.

	Elevation	Characteristics	Environment	Significance to Humans
Lowlands	1219-1372 m (4000-4500 ft)	Hot and arid steep-walled sandstone canyons.	Riparian plants; bighorn sheep	Permanent water, arable alluvium, long growing season, diverse plant communities, natural shelters, quality siliceous stone from river gravels
Midlands	1372-1676 m (4500-5500 ft)	Arid slickrock and dune fields on benchlands and low plateaus.	Blackbrush, shadscale, grasses; antelope.	Grasses, including dropseed and ricegrass, prickly pear and shadscale; good antelope habitat, quality siliceous stone in certain locations.
Highlands	Above 1676 m (Above 5500 ft)	High elevation mesas and plateaus with cooler temperatures and greater precipitation.	Pinyon-juniper woodlands; deer and rabbit.	Higher elevation plant foods (i.e. pinyon); later harvests; dry-farming; abundant fuel, deer and rabbit.

Shading indicates lifezones present in allotment.



Area of Individual Vegetation Zones:

Dominant Species	Acres Covered	No. Sites
Not identified	6247.09	28
Utah juniper ***(Juniperus osteosperma)***	50.00	**0**
Big sagebrush ***(Artemisia tridenta)***	0.08	**0**
Blackbrush ***(Coleogyne ramosissima)***	7652.55	**9**
Blackbrush-shadscale ***(Coleogyne ramosissima - Atriplex confertifolia)***	2109.27	**0**
Fourwing saltbush ***(Atriplex canescens)***	1556.08	0
Mat saltbush ***(Atriplex corrugata)***	1372.66	0
Pinyon-juniper ***(Pinus edulis - Juniperus osteosperma)***	127.43	0
Sand sagebrush ***(Artemisia filifolia)***	34,334.21	37
Total	**53,449.37**	**74**

No. Cultural Sites in Each Vegetation Zone:
Twenty-eight (n = 28) sites are located in areas where the dominant vegetation has not yet been identified. Nine)n = 9) sites are located in blackbrush. The remaining sites (n = 37) are located in sand sagebrush.

Visibility:
In general, the dominant vegetation of Soda grazing allotment provide moderate - excellent visibility with large portions of the ground between plants bare of vegetation. However, a build-up of duff in the pinyon-juniper and Utah juniper zones may impede the visibility of small sites and isolated artifacts.

Continued on subsequent page...

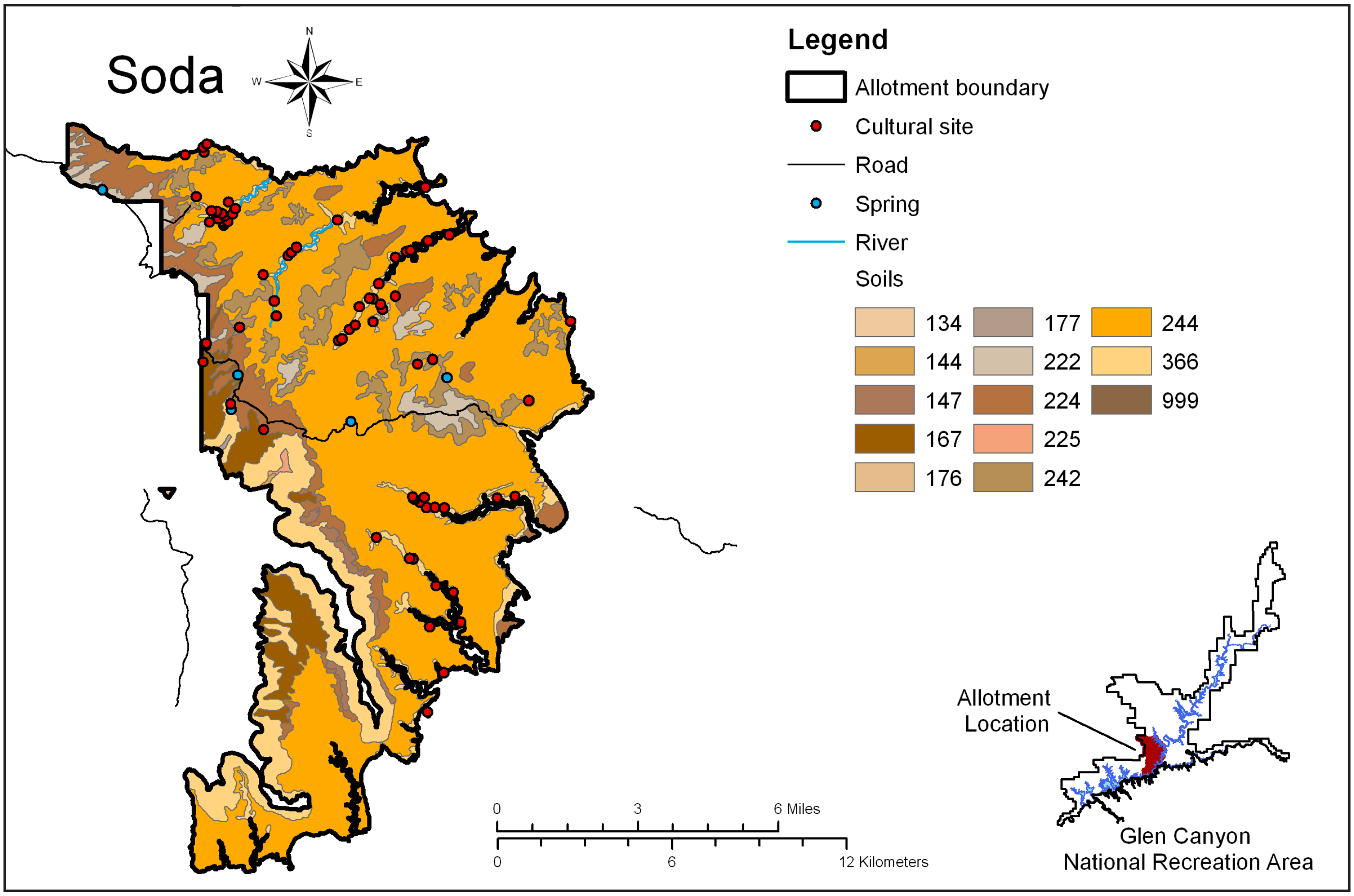
Continued from previous pag...

Summary:
The primary dominant vegetation zones within Rockies grazing allotment includes Utah juniper (<0.00 percent), big sagebrush (0.00 percent), blackbrush (14.32 percent), blackbrush -shadscale (3.95 percent), fourwing saltbush (2.91 percent), mat saltbush (2.57 percent), pinyon-juniper (0.24 percent), and sand sagebrush (64.24 percent). Dominant vegetation for the remainder of the allotment is not currently known.

Dominant Species:
Shadscale (*Atriplex confertifolia*)
Fourwing saltbush (*Atriplex canescens*)
Blackbrush (*Coleogyne ramosissima*)
Big sagebrush (*Artemisia tridenta*)
Mat saltbush (*Atriplex corrugata*)
Pinyon (*Pinus edulis*)
Juniper, Utah juniper (*Juniperus osteosperma*)
Sand sagebrush (*Artemisia filifolia*)

Secondary Dominant Species:
None known.

Associated Soils:
Big sagebrush grows in loam, often alongside pinyon-juniper in stony loam. Blackbrush grows in shallow sandy loam, and may occur with fourwing saltbush in sandy loam. Blackbrush also grows in sandy loam. Blackbrush-shadscale occurs in talus. Fourwing saltbush grows in sandy loam, and mat saltbush in sandy loam, where it may be associated with fourwing saltbush, and in shallow clay. Pinyon-juniper grows in shallow loam, very steep stony loam, loam, and gravelly loam. Sand sagebrush occurs in shallow sandy loam and may be associated with blackbrush. Finally, Utah juniper grows in stony loam, and may be associated with pinyon-juniper in gravelly loam.

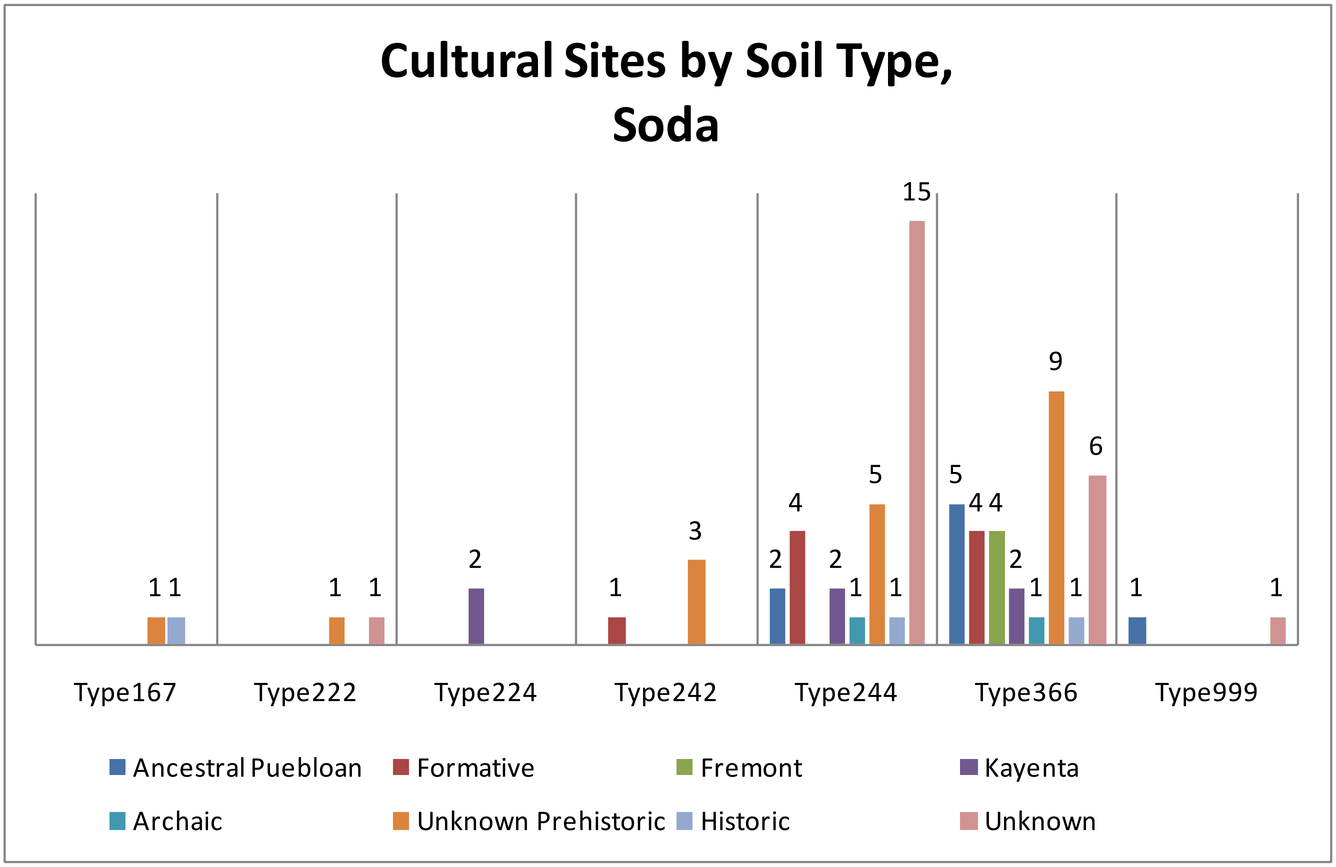


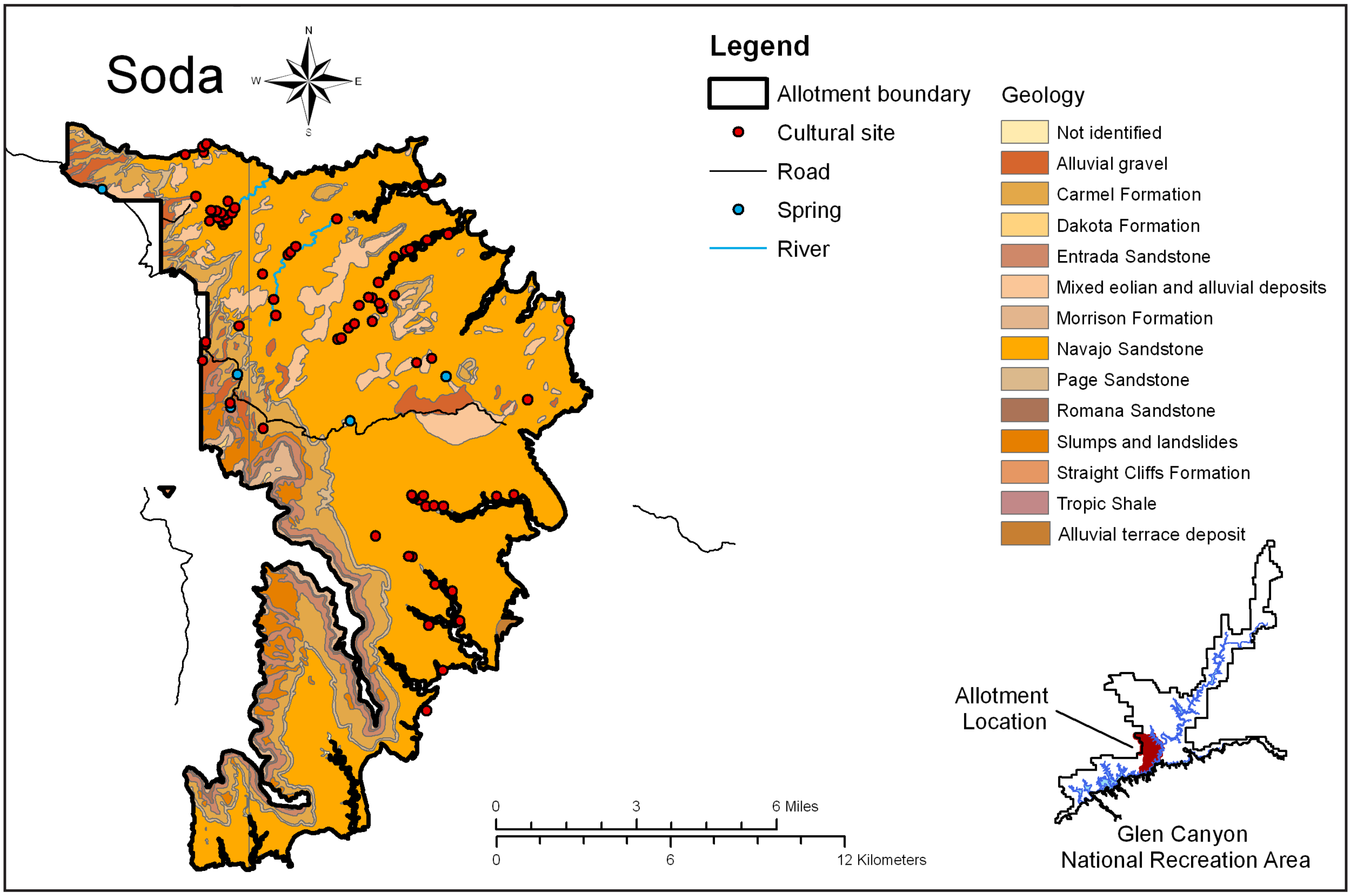
Allotment Divided by Soil Type (MUSYM):

Soil Type	Acres	Percent	No. Cultural Sites
134	0.20	<0.00	0
144	26.40	<0.00	0
147	400.24	0.75	0
167	2416.40	4.52	2
176	18.37	<0.00	0
177	39.72	<0.00	0
222	1651.41	3.09	2
224	4462.86	8.34	2
225	58.81	0.11	0
242	3333.19	6.23	4
244	32,651.86	61.03	30
366	8249.85	15.42	32
999	190.06	0.36	2
Total	**53,499.37**	**99.85%**	**74**

Distribution of Cultural Sites by Soil Type:

Two sites (n = 2), including a lithic scatter and a historic site, are located on soil type 167. Two sites (n = 2), including one lithic scatter and one site with no available attribute/affiliation information, are located in soil type 222. Two (n = 2) Kayenta sites are located on soil type 224. Four (n = 4) sites, including one Formative site, two prehistoric sites with structures, and one artifact scatter, are located on soil type 224. Thirty (n = 30) sites are located in soil type 244, which is often associated with Navajo Sandstone, or slickrock. These sites include two Ancestral Puebloan sites, one Archaic site, four Formative sites, two Kayenta sites, two prehistoric sites with features, three lithic scatters, one historic site, and 15 sites for which attribute/affiliation information is currently not available. Thirty-two (n = 32) sites are located in soil type 366. These sites include five Ancestral Puebloan sites, four Formative sites, four Fremont sites, two Kayenta sites, one Archaic site, one historic site, two prehistoric sites with features, one prehistoric site for which attribute information is unknown, one lithic scatter, five rock art sites, and six sites for which attribute/affiliation information is not available. The remaining two sites (n = 2) include one Ancestral Puebloan site and one site for which attribute


Cultural Sites by Soil Type, Soda
1 1
1 1
2
1
3
2 4 2 1 5 1 15
5 4 4 2 1 9 1 6
1 1
Type167
Type222
Type224
Type242
Type244
Type366
Type999
Ancestral Puebloan
Formative
Fremont
Kayenta
Archaic
Unknown Prehistoric
Historic
Unknown



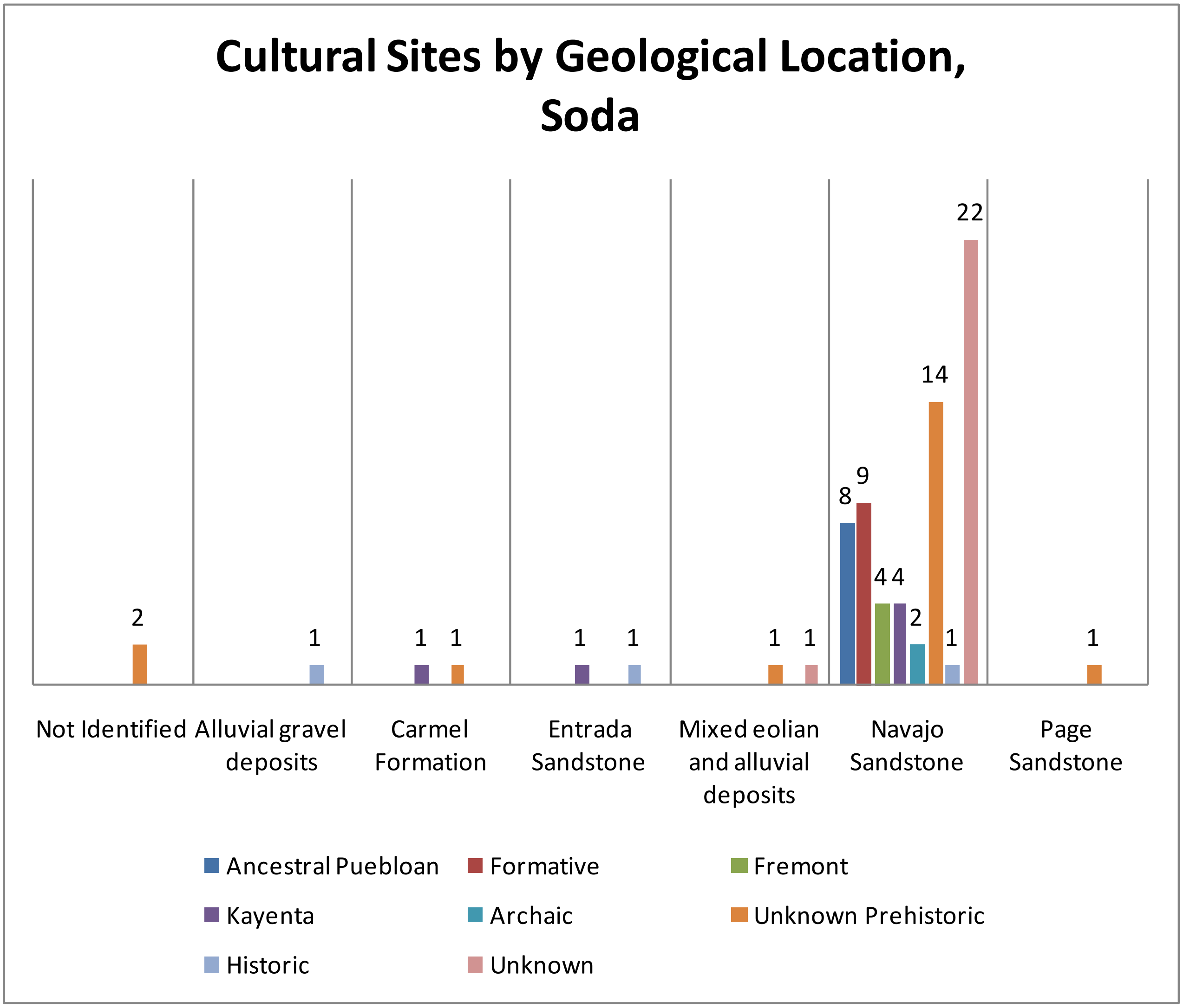
Allotment Divided by Geology:

Geology	Acres	Percent	No. Cultural Sites
Not identified	590.43	1.10	2
Alluvial gravel deposits	1446.95	2.70	1
Carmel Formation	5455.44	10.20	2
Dakota Formation	51.22	<0.00	0
Entrada Sandstone	2329.44	4.35	2
Mixed eolian and alluvial deposits	3459.20	6.47	2
Morrison Formation	1374.69	2.57	0
Navajo Sandstone	34,535.80	64.56	64
Page Sandstone	1662.01	3.11	1
Romana Sandstone	657.45	1.23	0
Slumps and landslides	1850.06	3.46	0
Straight Cliffs Formation	17.53	<0.00	0
Tropic Shale	1.17	<0.00	0
Alluvial terrace deposits	67.98	0.13	0
Total	**53,499.37**	**99.88%**	**74**

Distribution of Cultural Sites by Geological Location:

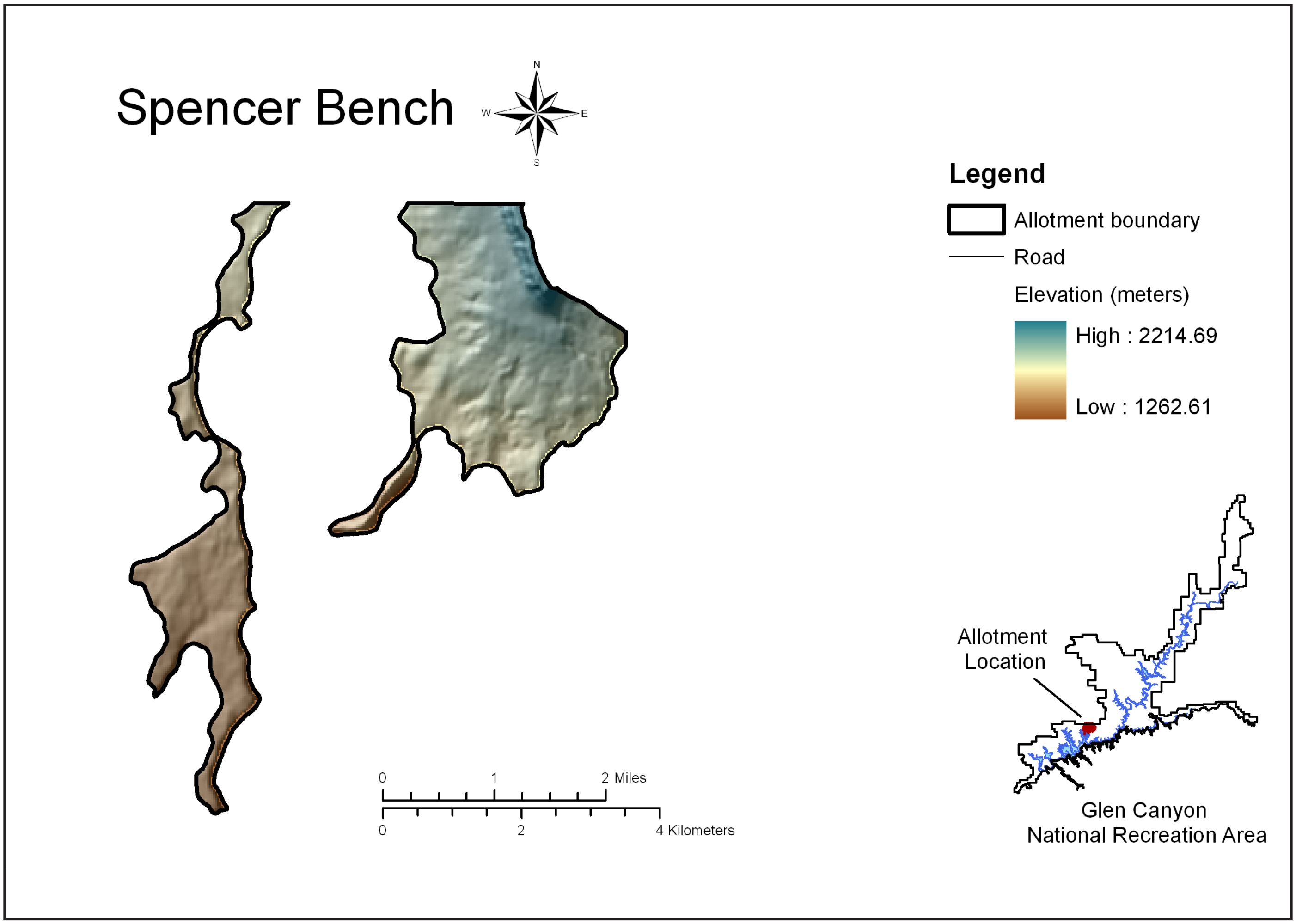
One historic site (n = 1) is located on alluvial gravel deposits. Two sites (n = 2), including one Kayenta site and one lithic scatter, are located on Carmel Formation geology. Two sites (n = 2), including one historic site and one Kayenta site, occur on Entrada Sandstone. Two sites (n = 2), including one artifact scatter and one site for which attribute/affiliation is currently unavailable. Sixty-four (n = 64) sites are located on Navajo Sandstone, or slick-rock. These sites include eight Ancestral Puebloan sites, two Archaic sites, nine Formative sites, four Fremont, four Kayenta sites, one historic site, five rock art sites, four lithic scatters, four prehistoric sites with features, one prehistoric site for which attribute information is unknown, and 22 sites for which attribute/affiliation information is currently unavailable. One lithic site (n = 1) is located on Page Sandstone. Two prehistoric sites (n = 2), both with features, occur on land for which the geology has not been identified.

The figure on the subsequent page displays known cultural sites by affiliation and geological context.


Cultural Sites by Geological Location, Soda
2
1
1
1
1
1
1
1
8
9
4
4
2
14
1
22
1
Not Identified
Alluvial gravel deposits
Carmel Formation
Entrada Sandstone
Mixed eolian and alluvial deposits
Navajo Sandstone
Page Sandstone
Ancestral Puebloan
Formative
Fremont
Kayenta
Archaic
Unknown Prehistoric
Historic
Unknown

Spencer Bench

Map Panels



Total Area: 3451.74 acres

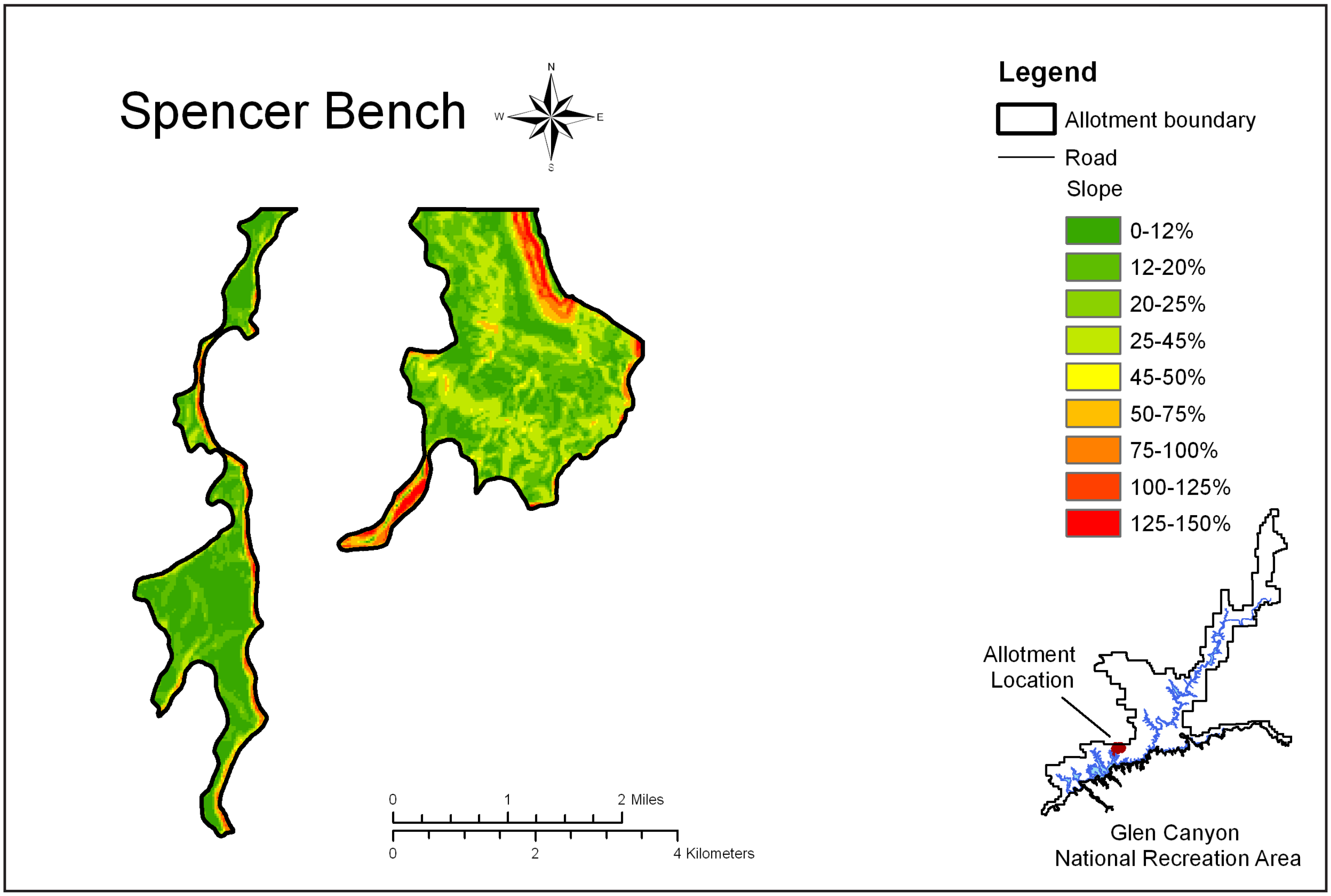
Sampling Fractions:
2 percent: 69.03 acres
5 percent: 172.59 acres
11 percent: 379.69 acres
16 percent: 552.28 acres
20 percent: 690.35 acres

Elevation range amsl:
1262.61 – 2214.69 meters (4142.42 - 7266.04 feet)

Rivers and Springs:
None known.

Accessibility:
County Hwy 262 travels north-south west of the allotment, but is separated from Spencer Bench by Rock Creek Bay and Rock Creek. A lateral roadway extending south from County Road 330 (Hole-in-the-Rock Road) is also separated from the allotment by Dry Rock Creek. The allotment is also divided by Middle Rock Creek, which passes north-south through the center of the allotment. Therefore, access from Lake Powell along the southern portion of the allotment may prove most feasible.

No. Cultural Sites: 0
Area surveyed: 0.00 acres



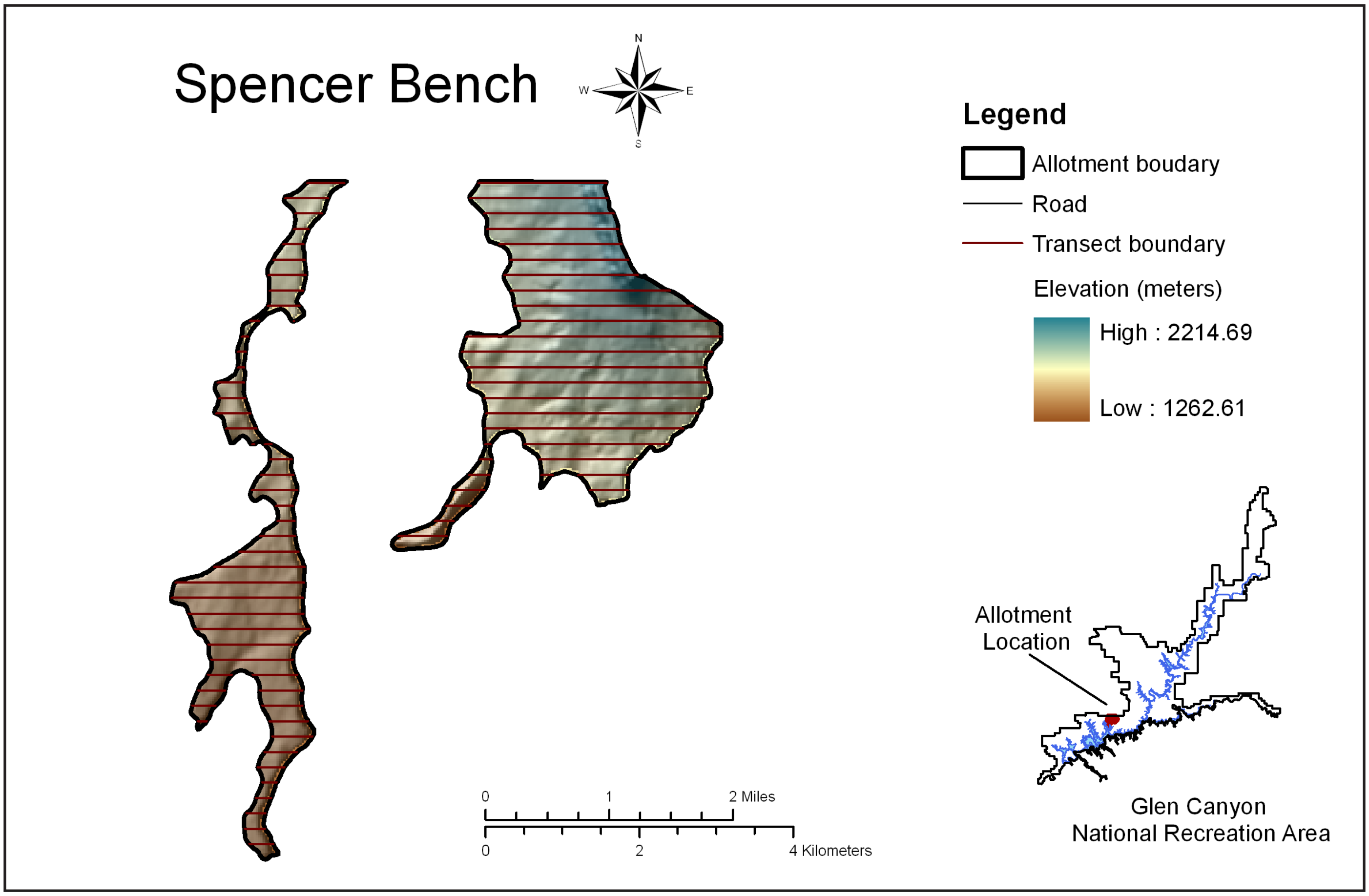
Slope Considerations:

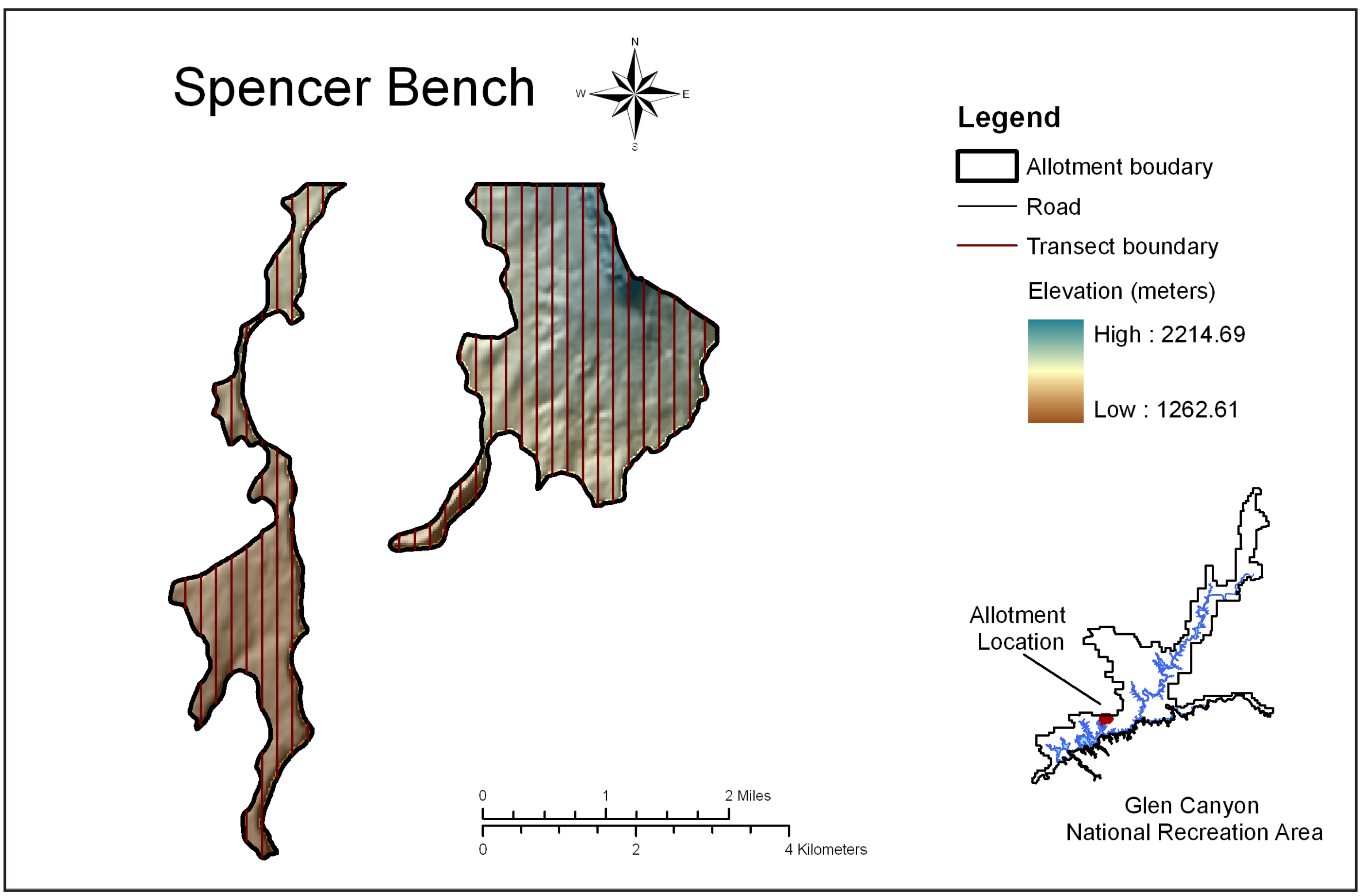
Slope plays a large role in terrain accessibility, and may be used in the stratification of survey areas. For example, GCNRA may wish to assign catagories such as low, moderate, and high to specific slope gradients. Such assignations are most often dependent on the factors guiding archaeological survey work, and as such, are not included in this document. Included herein, however, are suggestions for basic transect orientation based on the presence of topographical barriers identified by the presence of excessive slope gradients.

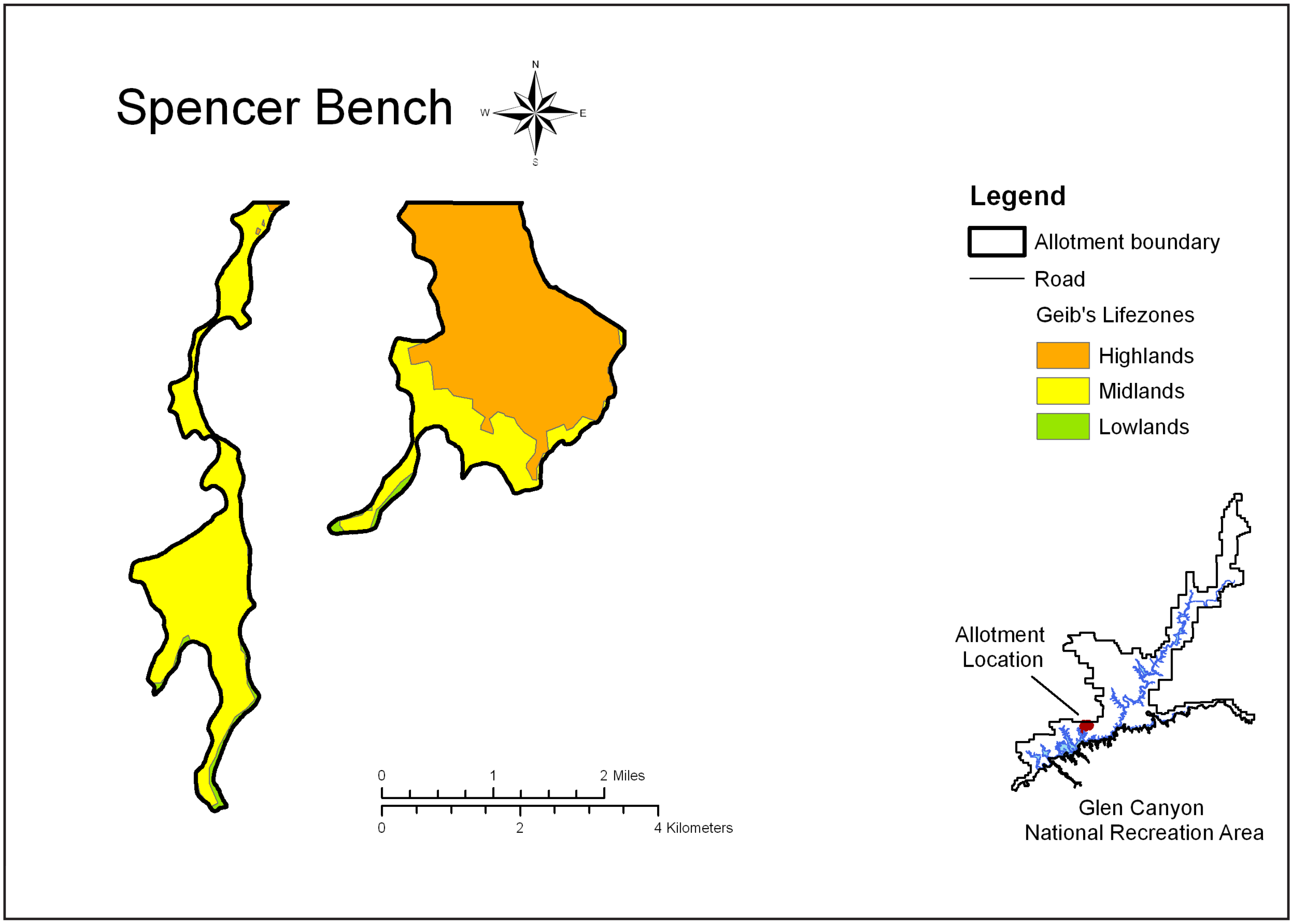
Survey Zones Dictated by Slope:

A steep escarpment borders the eastern edge of the west portion of the allotment. Likewise, escarpments frame the southwestern and northeastern portions of the eastern allotment half. Given the current lack of known access roads to Spencer Bench grazing allotment, transect orientation should be decided in the field.

The 'fishnet' maps provided on the subsequent page display transects spaced at 200 meter intervals for both east-west and north-south oriented pedestrian survey.


Spencer Bench
N
W
E
S
Legend
Allotment boudary
Road
Transect boundary
Elevation (meters)
High : 2214.69
Low : 1262.61
Allotment Location
Glen Canyon National Recreation Area
0
1
2 Miles
0
2
4 Kilometers


Spencer Bench
N
W
E
S
Legend
Allotment boudary
Road
Transect boundary
Elevation (meters)
High : 2214.69
Low : 1262.61
Allotment Location
Glen Canyon National Recreation Area
0
1
2 Miles
0
2
4 Kilometers



Area of Each Lifezone:

Highlands: 1700.81 acres
Midlands: 1640.99 acres
Lowlands: 92.83 acres

No. Cultural Sites in Each Lifezone:

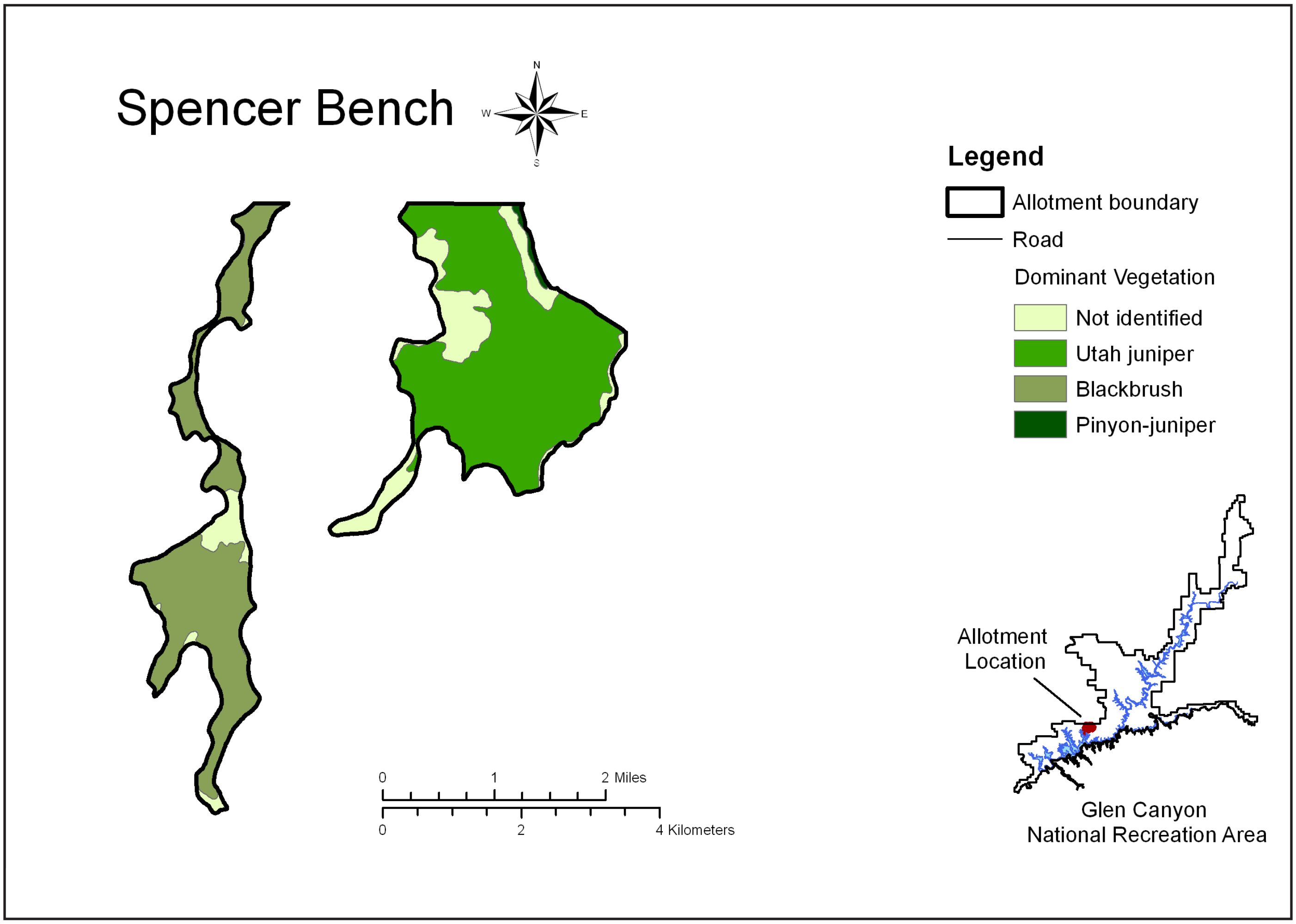
Highlands: 0
Midlands: 0
Lowlands: 0

Lifezone Significance and Known Cultural Sites:

No cultural sites are currently known for Spencer Bench grazing allotment.

	Elevation	Characteristics	Environment	Significance to Humans
Lowlands	1219-1372 m (4000-4500 ft)	Hot and arid steep-walled sandstone canyons.	Riparian plants; big-horn sheep	Permanent water, arable alluvium, long growing season, diverse plant communities, natural shelters, quality siliceous stone from river gravels
Midlands	1372-1676 m (4500-5500 ft)	Arid slickrock and dune fields on benchlands and low plateaus.	Blackbrush, shadscale, grasses; antelope.	Grasses, including dropseed and ricegrass, prickly pear and shadscale; good antelope habitat, quality siliceous stone in certain locations.
Highlands	Above 1676 m (Above 5500 ft)	High elevation mesas and plateaus with cooler temperatures and greater precipitation.	Pinyon-juniper woodlands; deer and rabbit.	Higher elevation plant foods (i.e. pinyon); later harvests; dry-farming; abundant fuel, deer and rabbit.

Shading indicates lifezones present in allotment.



Area of Individual Vegetation Zones:

Dominant Species	Acres Covered	No. Sites
Not identified	594.09	0
Utah juniper (*Juniperus osteosperma*)	1783.72	0
Blackbrush (*Coleogyne ramosissima*)	1048.04	0
Pinyon-juniper (*Pinus edulis - Juniperus osteosperma*)	25.89	0
Total	**3451.74**	**0**

No. Cultural Sites in Each Vegetation Zone:
No cultural sites are currently known for Nipple Bench grazing allotment.

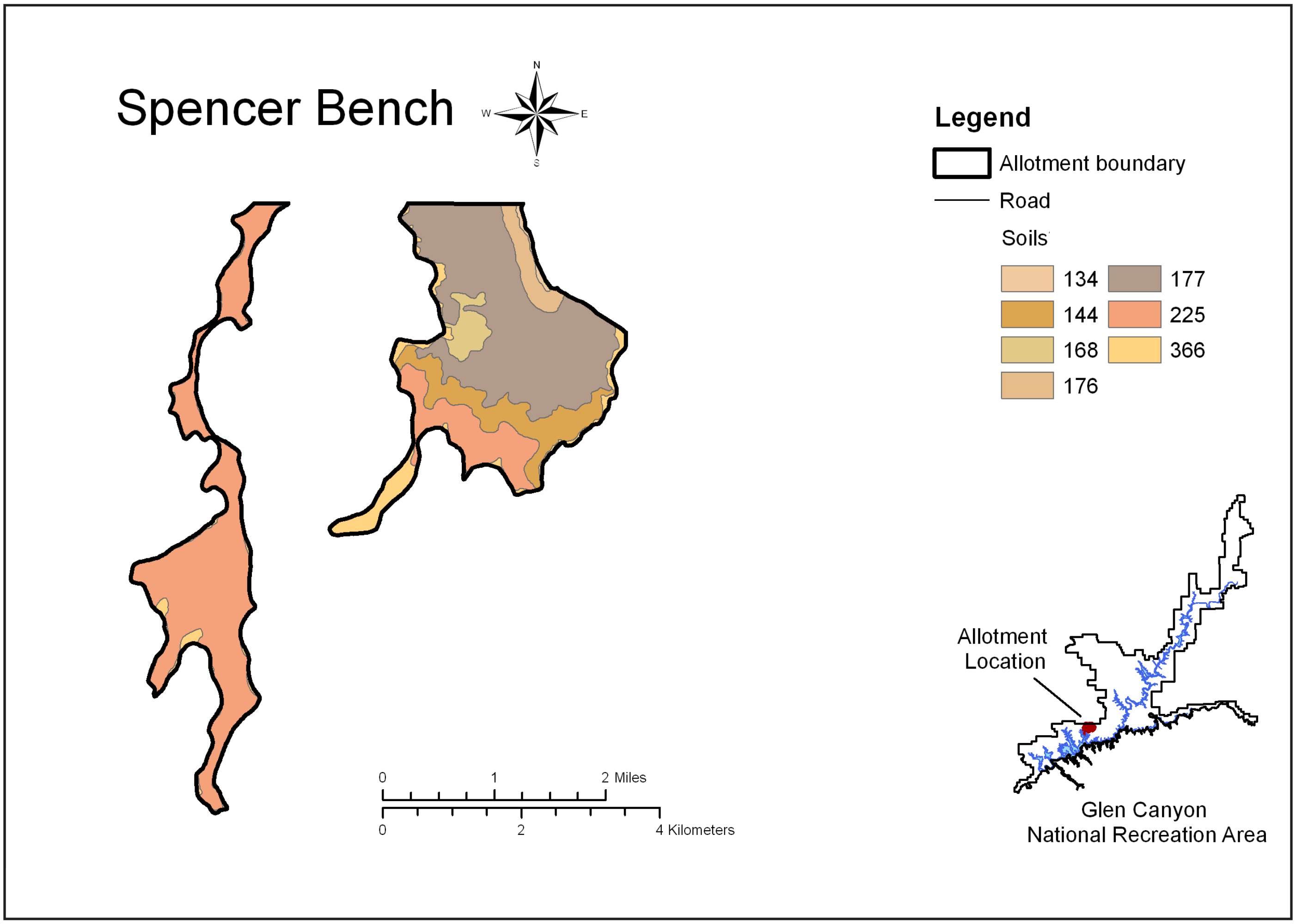
Visibility:
Although blackbrush typically provides moderate - excellent ground visibility, in juniper and pinyon-juniper dominated areas, the ground visibility may be greatly reduced by built-up organic materials beneath the trees.

Summary:
Dominant vegetation for Spencer Bench includes Utah juniper (51.68 percent), blackbrush (30.36 percent), and pinyon-juniper (0.75 percent). Dominant vegetation for the remainder of the allotment is not currently known.

Dominant Species:
Blackbrush (*Coleogyne ramosissima*)
Pinyon (*Pinus edulis*)
Juniper, Utah juniper (*Juniperus osteosperma*)

Secondary Dominant Species:
Fourwing saltbush (*Atriplex canescens*)

Associated Soils:
Blackbrush grows in shallow sandy loam, often alongside fourwing saltbush in sandy loam. Pinyon-juniper dominates in shallow loam and stony loam, and Utah juniper grows in stony loam, where pinyon-juniper may dominate in gravelly loam.

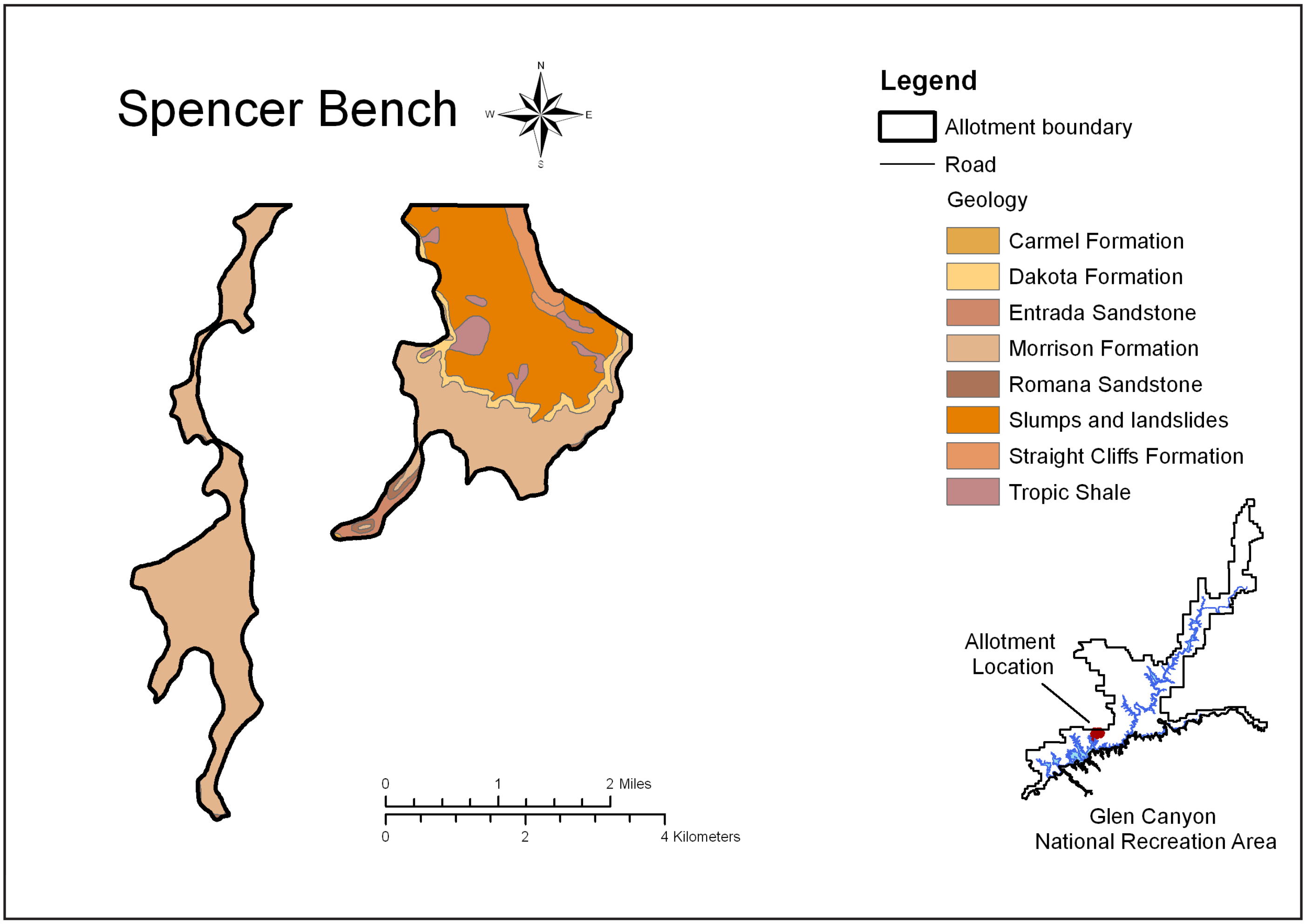


Allotment Divided by Soil Type (MUSYM):

Soil Type	Acres	Percent	No. Cultural Sites
134	21.09	0.61	0
144	317.51	9.20	0
168	95.57	2.77	0
176	107.29	3.12	0
177	1203.42	34.86	0
225	1375.81	39.86	0
366	331.05	9.59	0
Total	**3451.74**	**100.01%**	**0**

Distribution of Cultural Sites by Soil Type:

No cultural sites are known for Spencer Bench allotment at this time.



Allotment Divided by Geology:

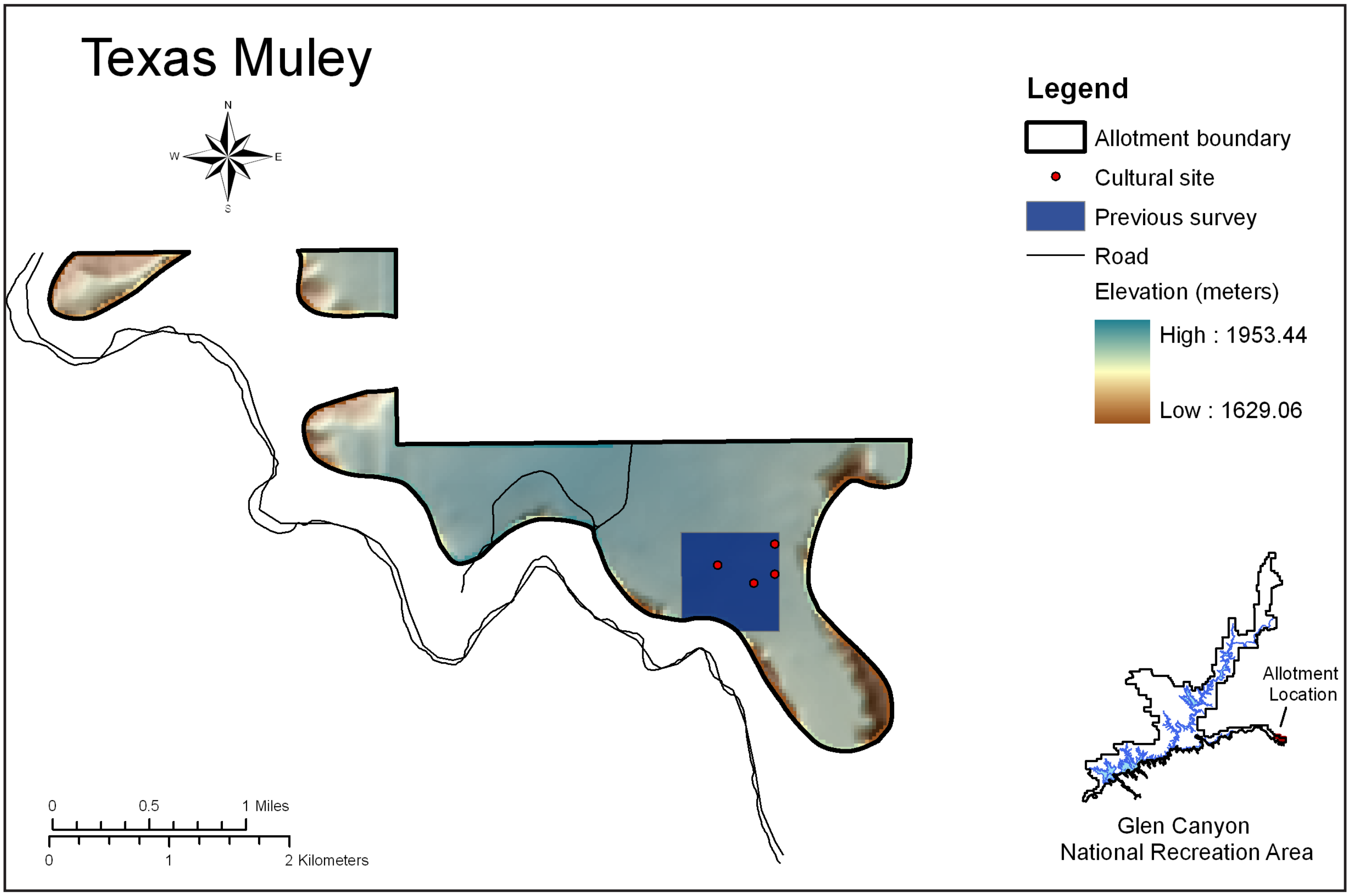
Geology	Acres	Percent	No. Cultural Sites
Carmel Formation	2.26	<0.00	0
Dakota Formation	133.95	3.88	0
Entrada Sandstone	58.29	1.69	0
Morrison Formation	1877.77	54.40	0
Romana Sandstone	54.10	1.57	0
Slumps and landslides	1085.27	31.44	0
Straight Cliffs Formation	114.83	3.33	0
Tropic Shale	125.26	3.63	0
Total	**3451.73**	**99.94%**	**0**

Distribution of Cultural Sites by Geological Location:

No cultural sites are known for Spencer Bench at this time.

Texas Muley

Map Panels



Total Area: 1542.44 acres

Sampling Fractions:
2 percent: 30.85 acres
5 percent: 77.12 acres
11 percent: 169.67 acres
16 percent: 246.79 acres
20 percent: 308.49 acres

Elevation range amsl:
1629.06 – 1953.44 meters (5344.69 - 6408.92 feet)

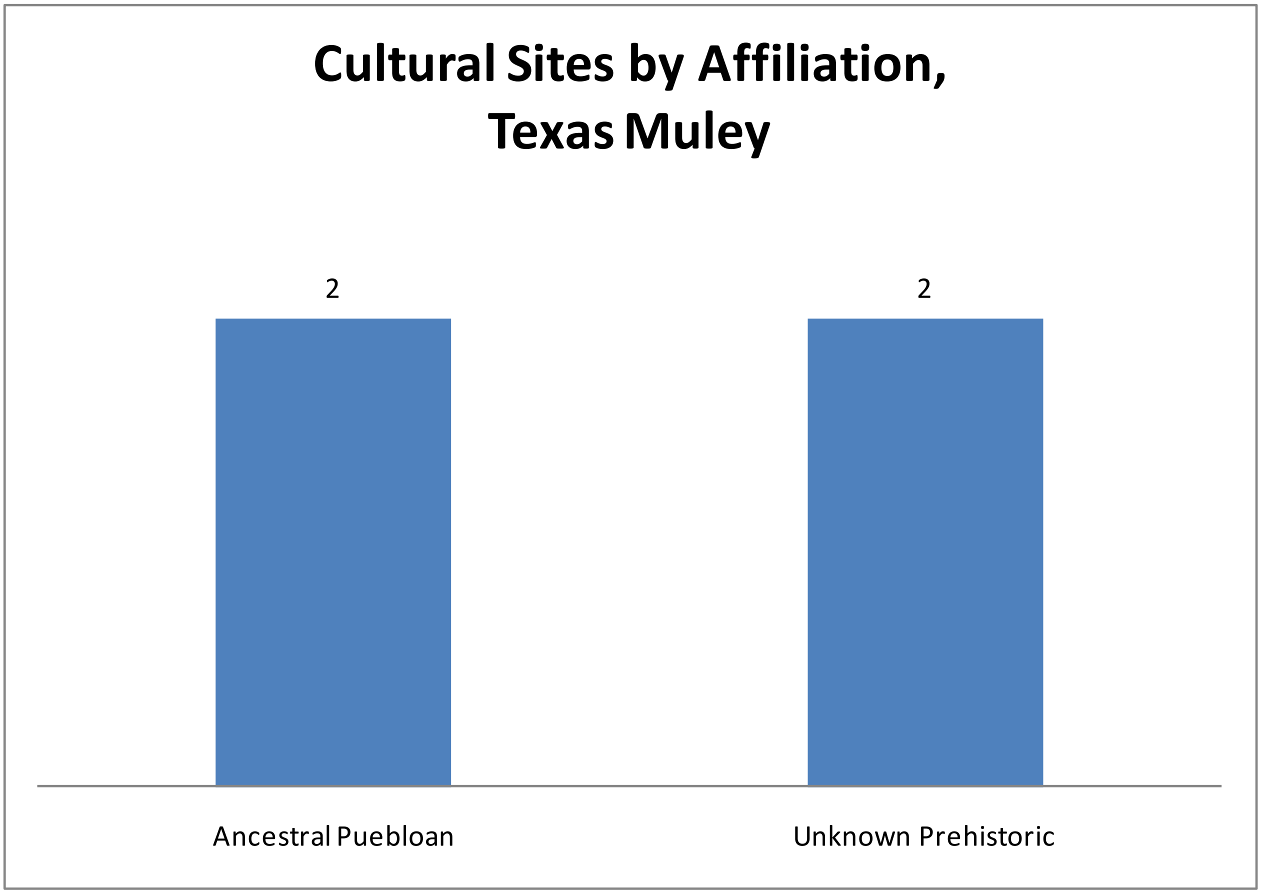
Rivers and Springs:
None known.

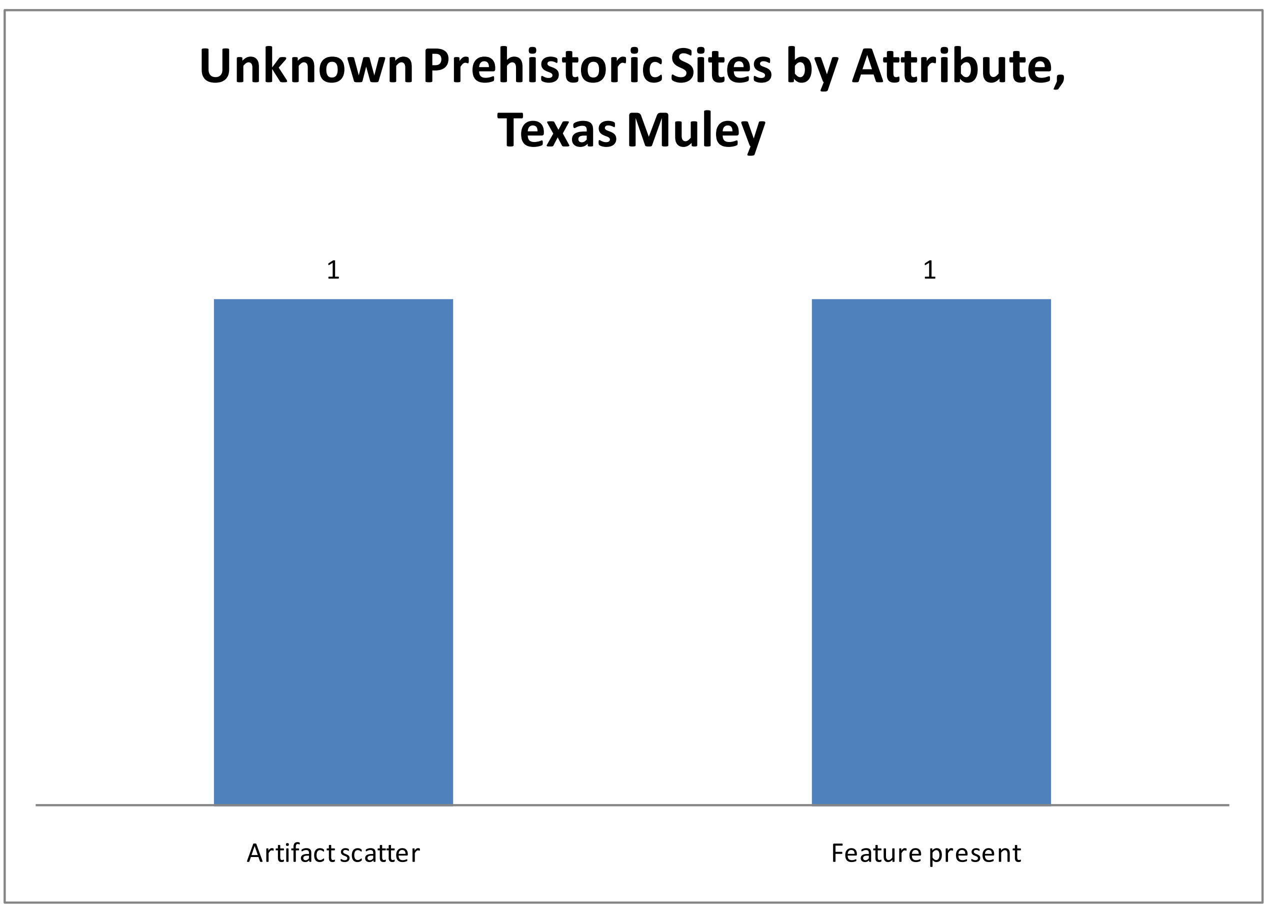
Accessibility:
County Hwy 431 provides access to the allotment from the north, and a lateral roadway travels roughly east-west between the southern allotment boundary and the San Juan River, providing access to the individual portions of the allotment.

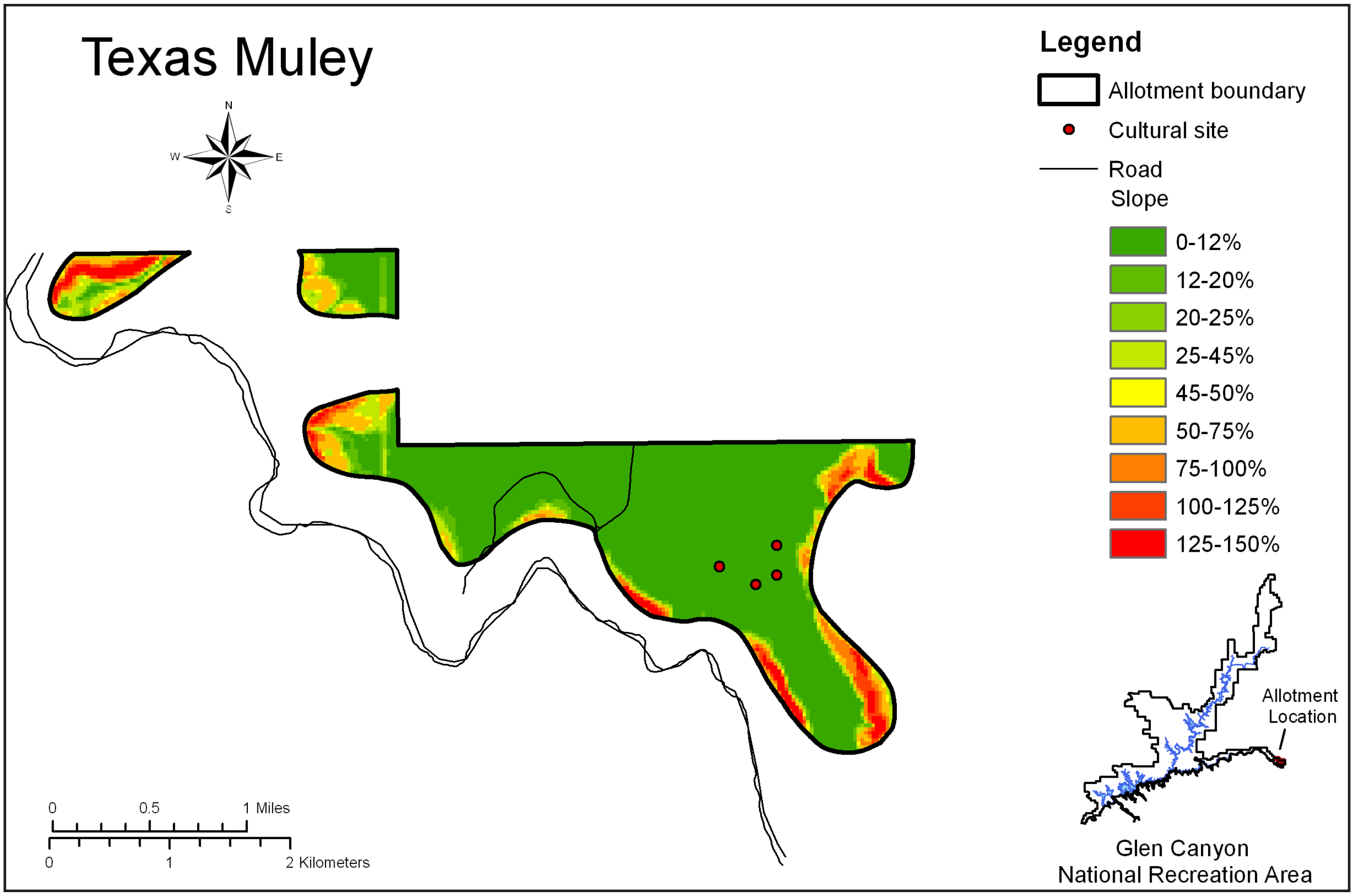
No. Cultural Sites: 4
Area surveyed: 156.12 acres

Survey References:
Geib and Fairley (1986): 156.12 acres

The figures on the subsequent page depict cultural sites by affiliation, and for those prehistoric sites for which affiliation is not known, site attributes.


Cultural Sites by Affiliation,
Texas Muley
2
2
Ancestral Puebloan
Unknown Prehistoric


Unknown Prehistoric Sites by Attribute,
Texas Muley
1
1
Artifact scatter
Feature present



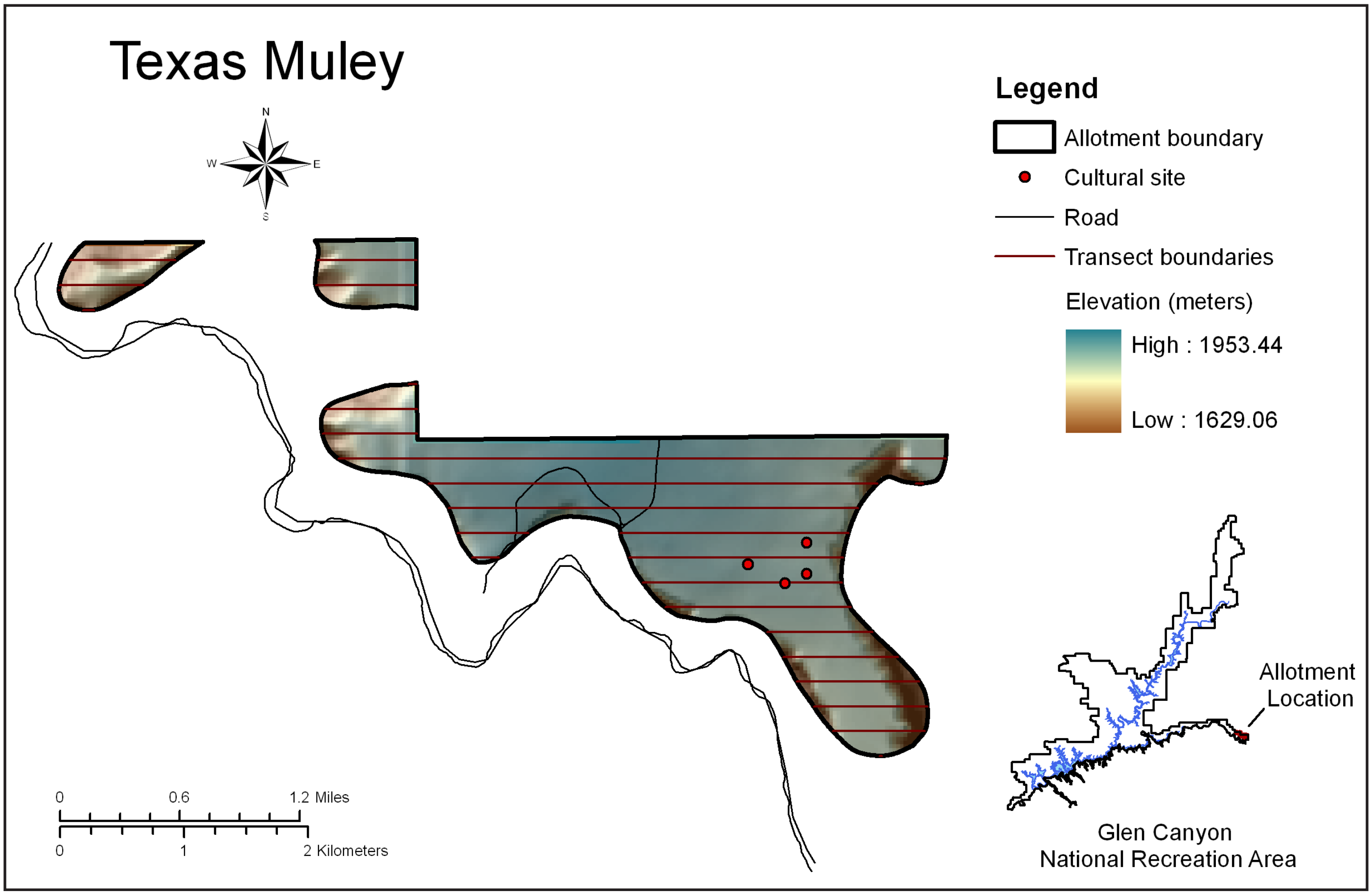
Slope Considerations:

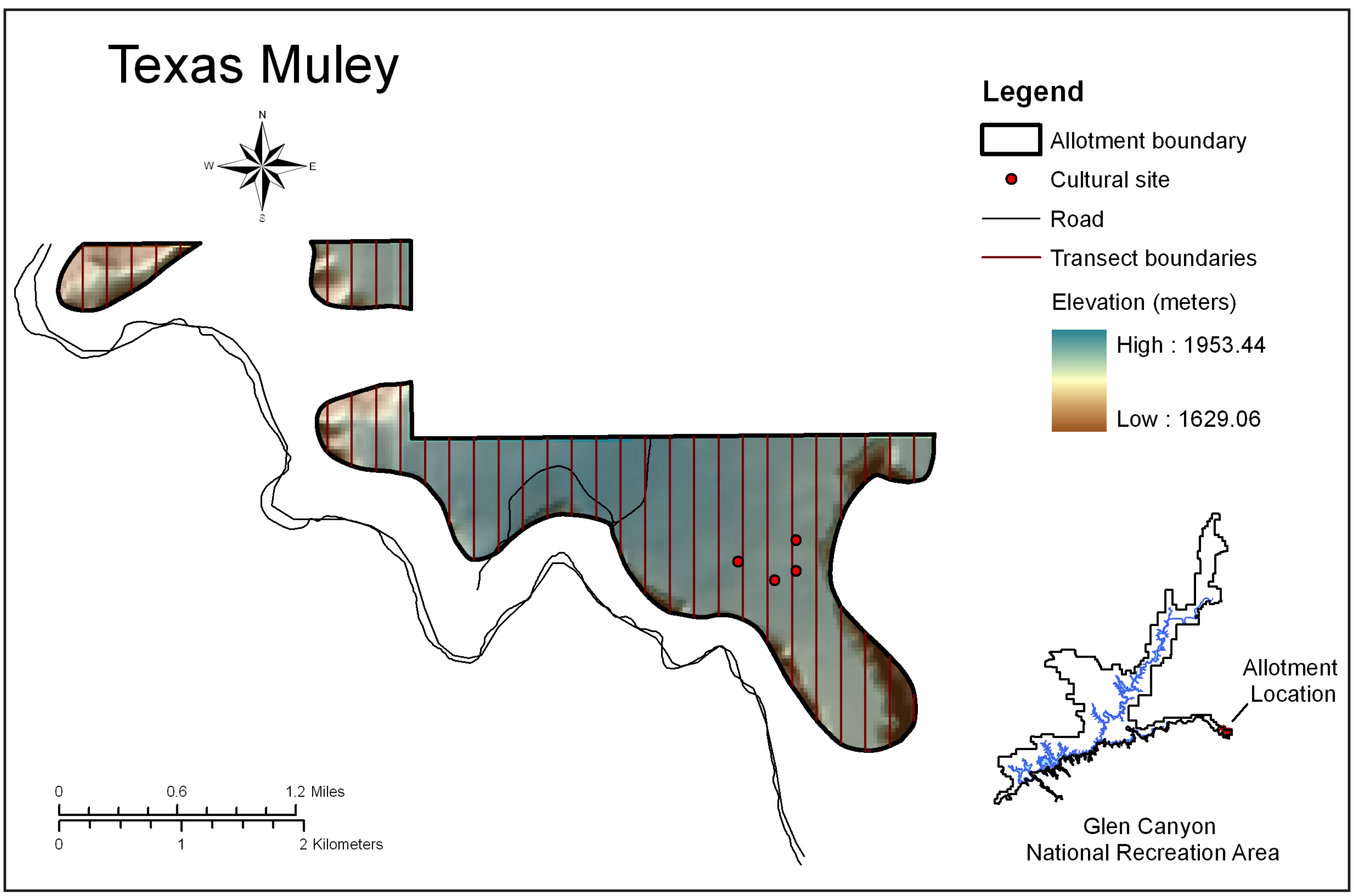
Slope plays a large role in terrain accessibility, and may be used in the stratification of survey areas. For example, GCNRA may wish to assign catagories such as low, moderate, and high to specific slope gradients. Such assignations are most often dependent on the factors guiding archaeological survey work, and as such, are not included in this document. Included herein, however, are suggestions for basic transect orientation based on the presence of topographical barriers identified by the presence of excessive slope gradients.

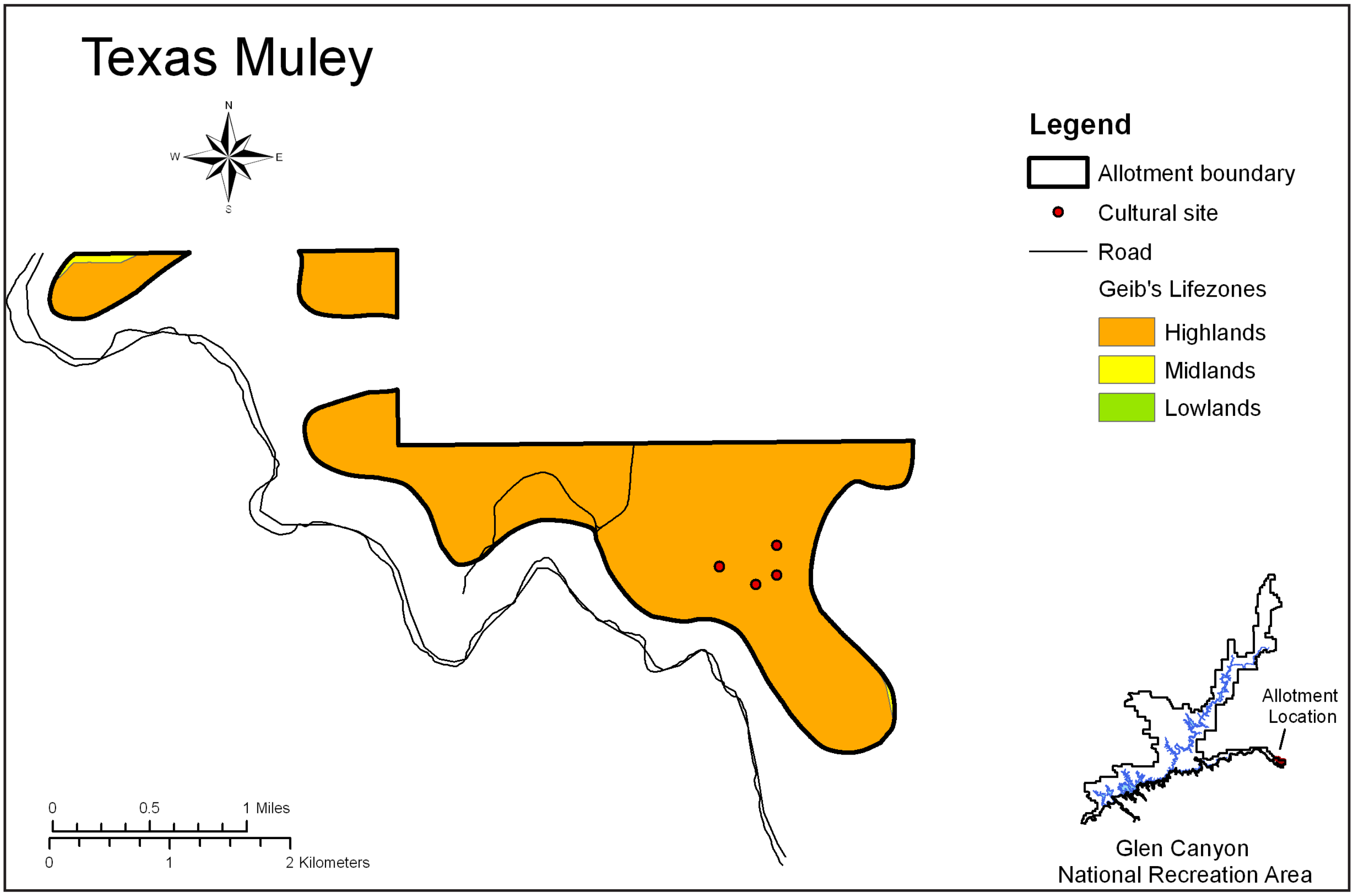
Survey Zones Dictated by Slope:

Areas with excessive slope are limited to the outer edges of the allotment, allowing for reasonable access to most of the allotment. Recommended transects should be placed perpendicular to access points (i.e. roads).

The 'fishnet' maps provided on the subsequent page display transects spaced at 200 meter intervals for both east-west and north-south oriented pedestrian survey.


Texas Muley
N
W
E
S
Legend
Allotment boundary
Cultural site
Road
Transect boundaries
Elevation (meters)
High : 1953.44
Low : 1629.06
Allotment Location
Glen Canyon
National Recreation Area
0
0.6
1.2 Miles
0
1
2 Kilometers


Texas Muley
N
W
E
S
Legend
Allotment boundary
Cultural site
Road
Transect boundaries
Elevation (meters)
High : 1953.44
Low : 1629.06
Allotment Location
Glen Canyon
National Recreation Area
0
0.6
1.2 Miles
0
1
2 Kilometers



Area of Each Lifezone:

Highlands: 1521.85 acres
Midlands: 13.92 acres
Lowlands:0.00 acres

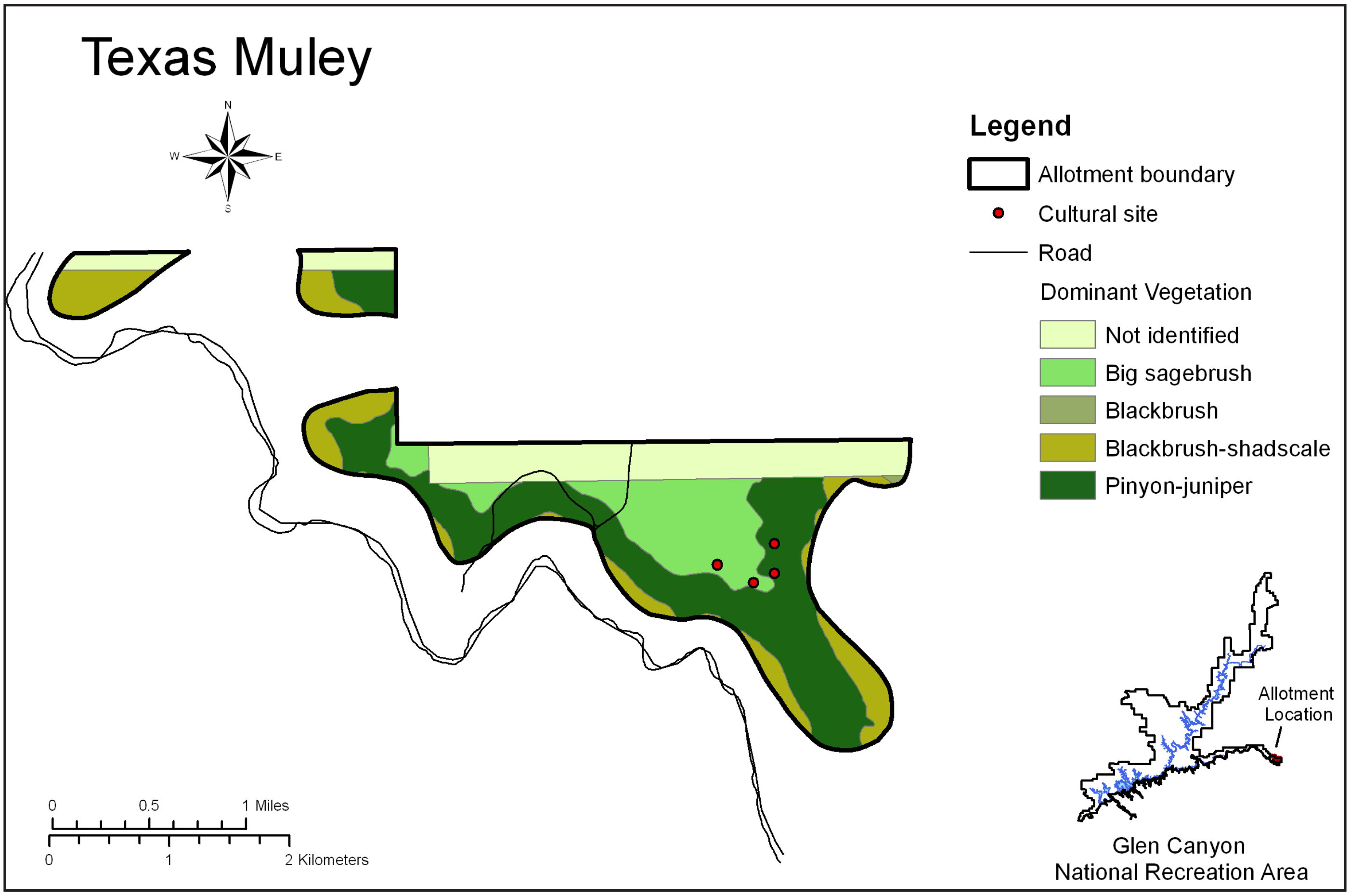
No. Cultural Sites in Each Lifezone:

Highlands: 4
Midlands: 0
Lowlands: 0

Lifezone Significance and Known Cultural Sites: Although both the midlands and highlands are present in Soda grazing allotment, all known sites are located in the highlands. Geib describes the highlands has having cooler temperatures and higher precipitation than lower elevations, allowing for dry farming and later harvests. In addition, Geib notes that the highlands provide important natural foods, including pinyon, deer, and rabbit. A total of four cultural sites are currently known for this allotment.

	Elevation	Characteristics	Environment	Significance to Humans
Lowlands	1219-1372 m (4000-4500 ft)	Hot and arid steep-walled sandstone canyons.	Riparian plants; bighorn sheep	Permanent water, arable alluvium, long growing season, diverse plant communities, natural shelters, quality siliceous stone from river gravels
Midlands	1372-1676 m (4500-5500 ft)	Arid slickrock and dune fields on benchlands and low plateaus.	Blackbrush, shadscale, grasses; antelope.	Grasses, including dropseed and ricegrass, prickly pear and shadscale; good antelope habitat, quality siliceous stone in certain locations.
Highlands	Above 1676 m (Above 5500 ft)	High elevation mesas and plateaus with cooler temperatures and greater precipitation.	Pinyon-juniper woodlands; deer and rabbit.	Higher elevation plant foods (i.e. pinyon); later harvests; dry-farming; abundant fuel, deer and rabbit.

Shading indicates lifezones present in allotment.



Area of Individual Vegetation Zones:

Dominant Species	Acres Covered	No. Sites
Not identified	375.83	0
Blackbrush *(Coleogyne ramosissima)*	271.12	**0**
Blackbrush-shadscale *(Coleogyne ramosissima - Atriplex confertifolia)*	2.41	**0**
Big sagebrush *(Artemisia tridents)*	279.21	**2**
Pinyon-juniper *(Pinus edulis - Juniperus osteosperma)*	613.87	**2**
Total	**1542.44**	**4**

No. Cultural Sites in Each Vegetation Zone:
Two sites (n = 2) are located in big sagebrush and two (n = 2) are located in pinyon-juniper.

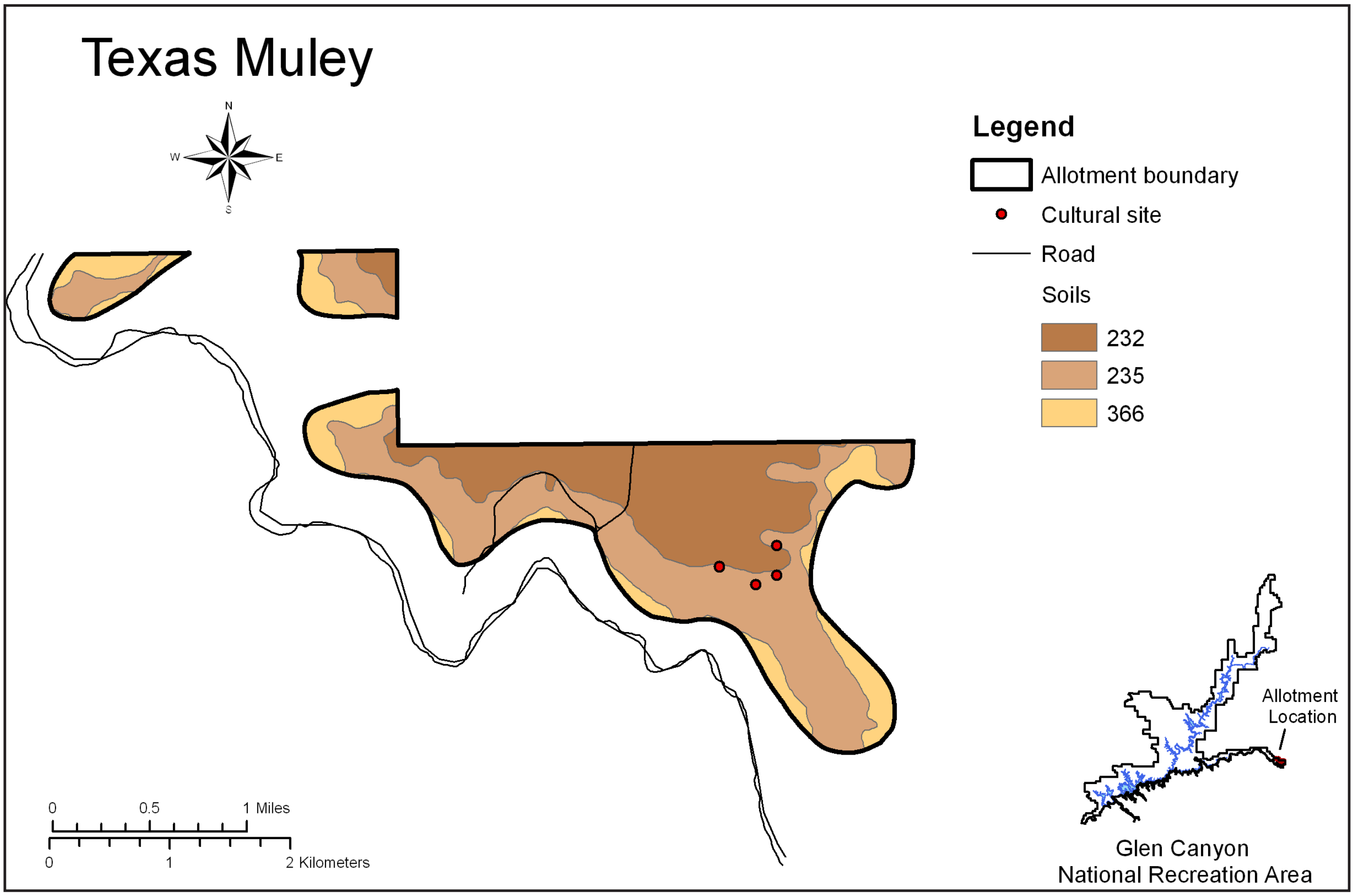
Visibility:
In general, the dominant vegetative communities of the allotment provide moderate - excellent ground visibility. However, in pinyon-juniper zones, built-up organic material beneath the trees may decrease ground visibility.

Summary:
Dominant vegetation for Slickrock grazing allotment includes blackbrush (17.58 percent), blackbrush-shadscale (0.16 percent), big sagebrush (18.10 percent), and pinyon-juniper (39.80 percent). Dominant vegetation for the remainder of the allotment has not yet been identified.

Dominant Species:
Shadscale (*Atriplex confertifolia*)
Blackbrush (*Coleogyne ramosissima*)
Big sagebrush *(Artemisia tridenta*)
Pinyon (*Pinus edulis*)
Juniper (*Juniperus osteosperma*)

Secondary Dominant Species:
Fourwing saltbush (*Atriplex canescens*)

Associated Soils:
Big sagebrush grows in loam, where it may be associated with pinyon-juniper in stony loam. Blackbrush occurs in sand and shallow sandy loam, where it may grow alongside fourwing saltbush in sandy loam. Blackbrush-shadscale occurs in talus, and finally, pinyon-juniper dominates in both shallow loam and stony loam.

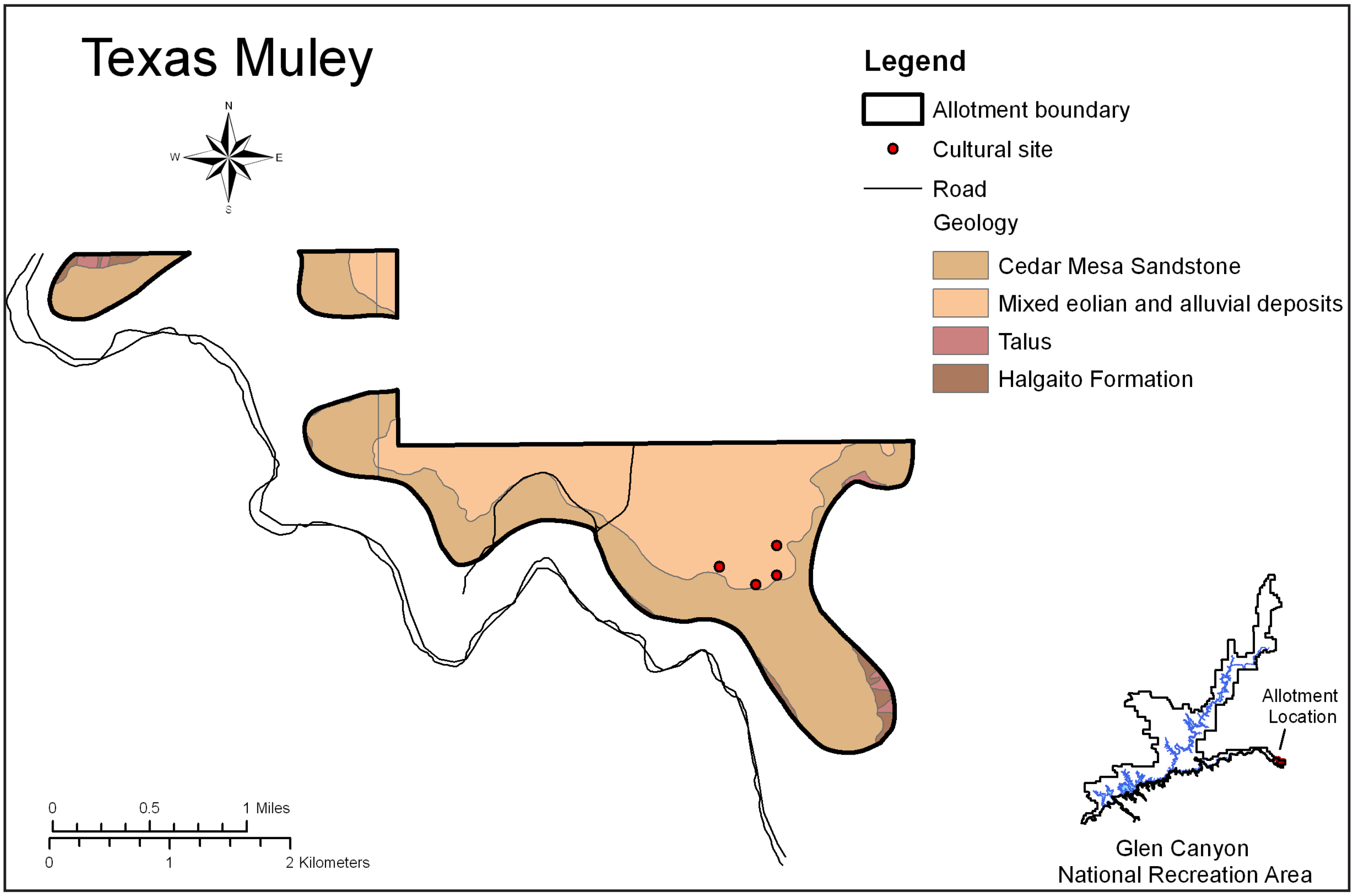


Allotment Divided by Soil Type (MUSYM):

Soil Type	Acres	Percent	No. Cultural Sites
232	522.64	33.88	0
235	724.95	47.00	4
366	294.85	19.12	0
Total	**1542.44**	**100%**	**4**

Distribution of Cultural Sites by Soil Type:

All known cultural sites (n = 4) are located in soil type 235.



Allotment Divided by Geology:

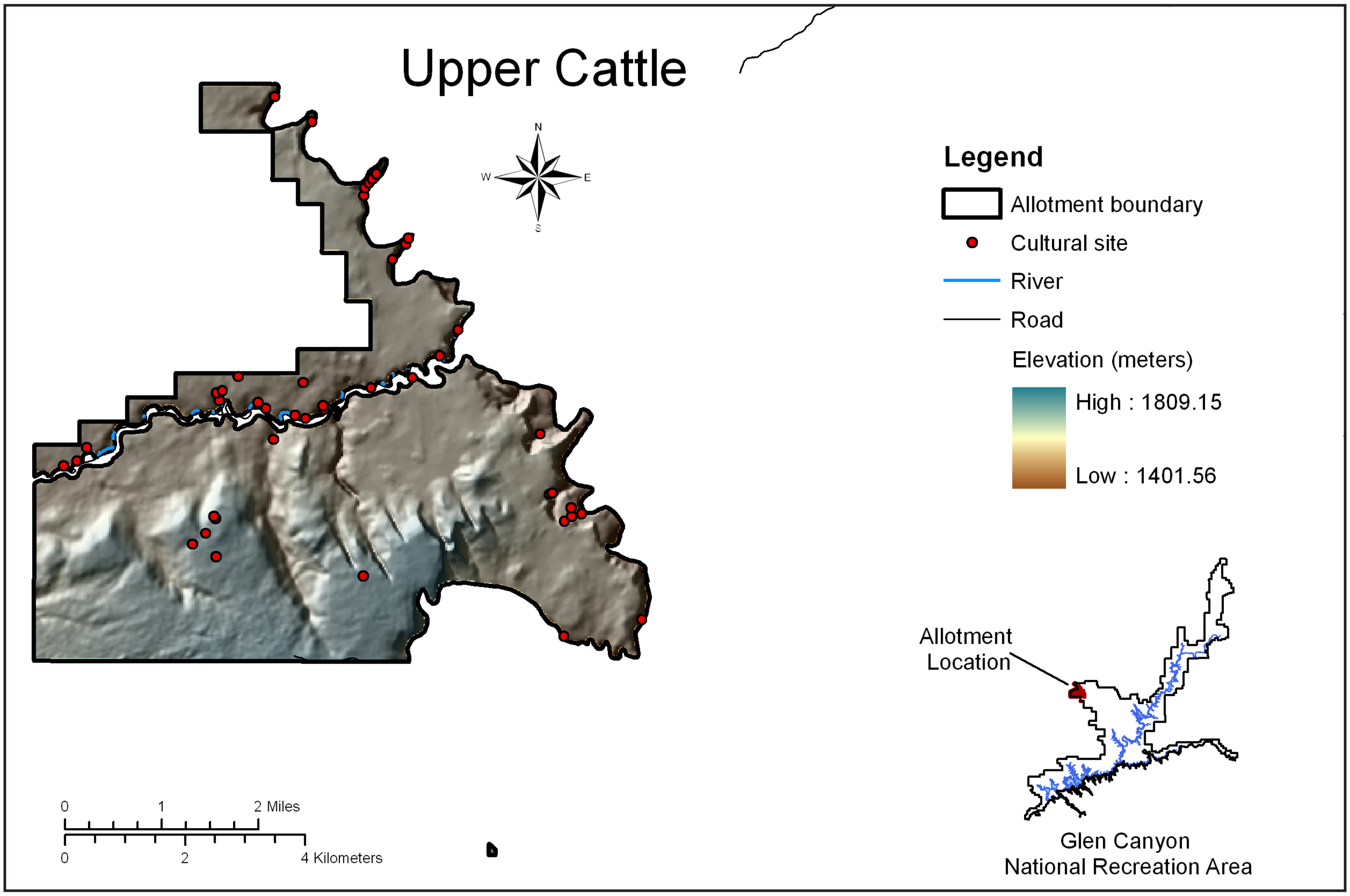
Geology	Acres	Percent	No. Cultural Sites
Cedar Mesa Sandstone	807.53	52.35	0
Mixed eolian and alluvial deposits	677.47	43.92	4
Talus	18.08	1.17	0
Halgaito Formation	39.36	2.55	0
Total	**1542.44**	**99.99%**	**4**

Distribution of Cultural Sites by Geological Location:

All known cultural sites (n = 4) in Texas Muley grazing allotment are located on mixed eolian and alluvial deposits.

Upper Cattle

Map Panels



Total Area: 11,279.85 acres

Sampling Fractions:
2 percent: 225.60 acres
5 percent: 563.99 acres
11 percent: 1240.78 acres
16 percent: 1804.78 acres
20 percent: 2255.97 acres

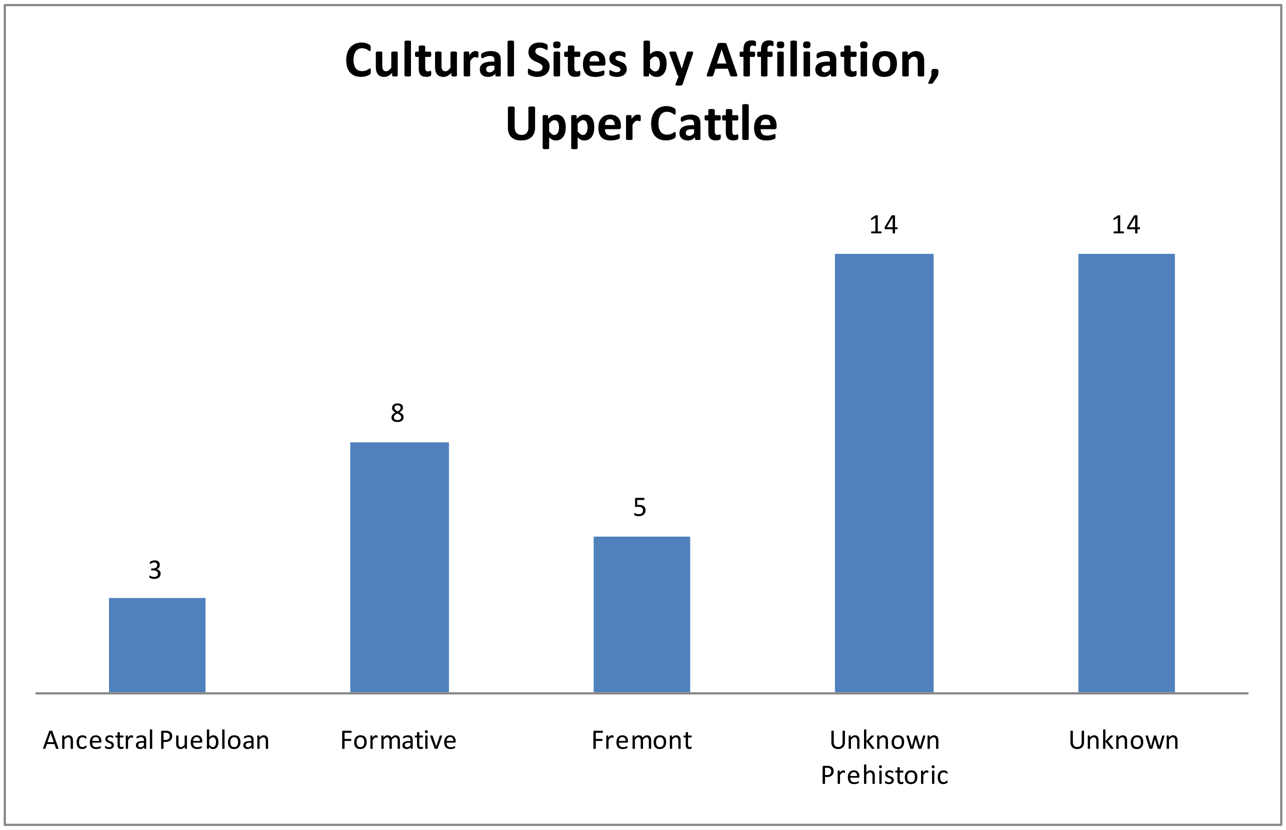
Elevation range amsl:
1401.56 – 1809.15 meters (4598.29 - 5935.53 feet)

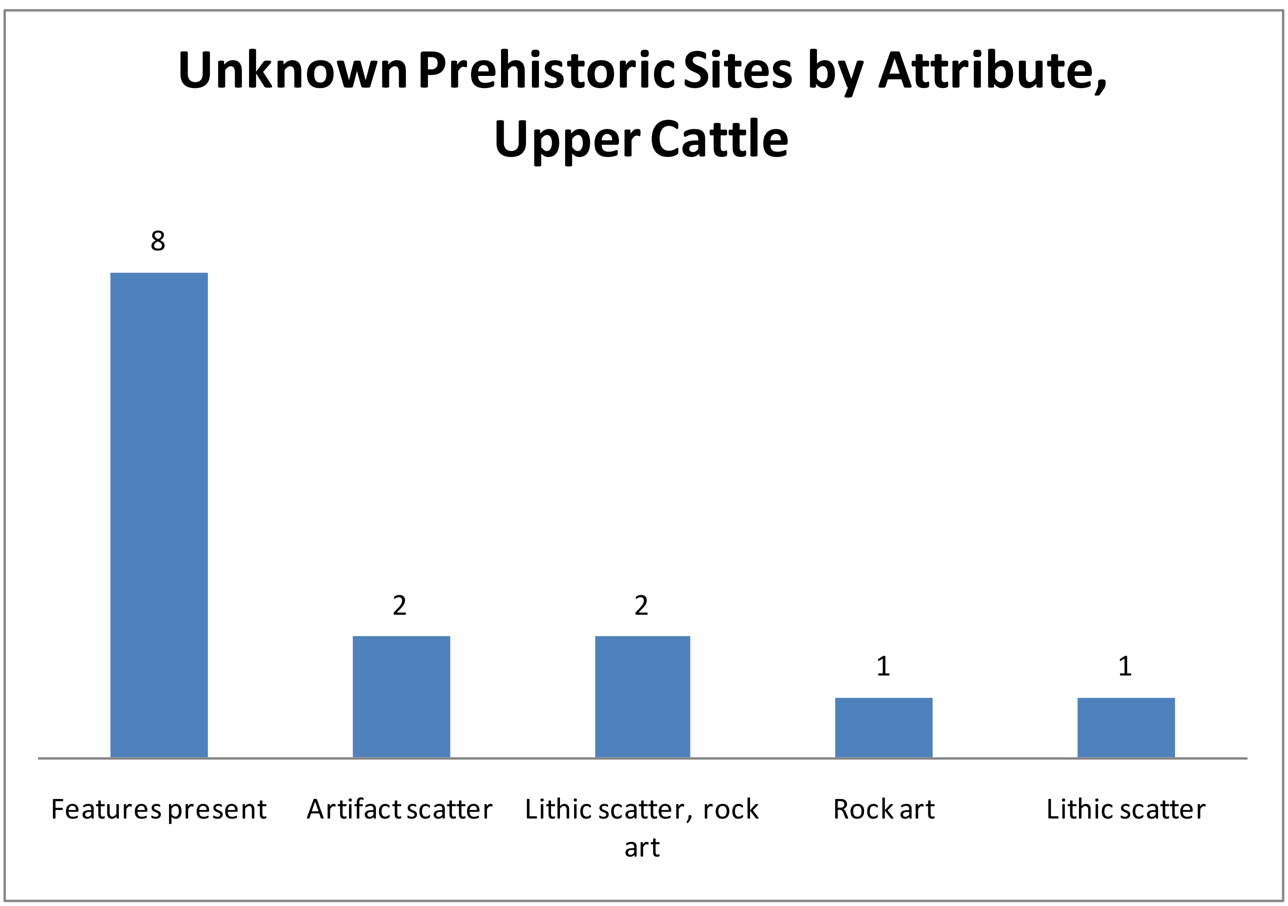
Rivers and Springs:
The Escalante River (not depicted) forms the eastern boundary of Upper Cattle grazing allotment, and Harris Wash divides the north portion from the south.

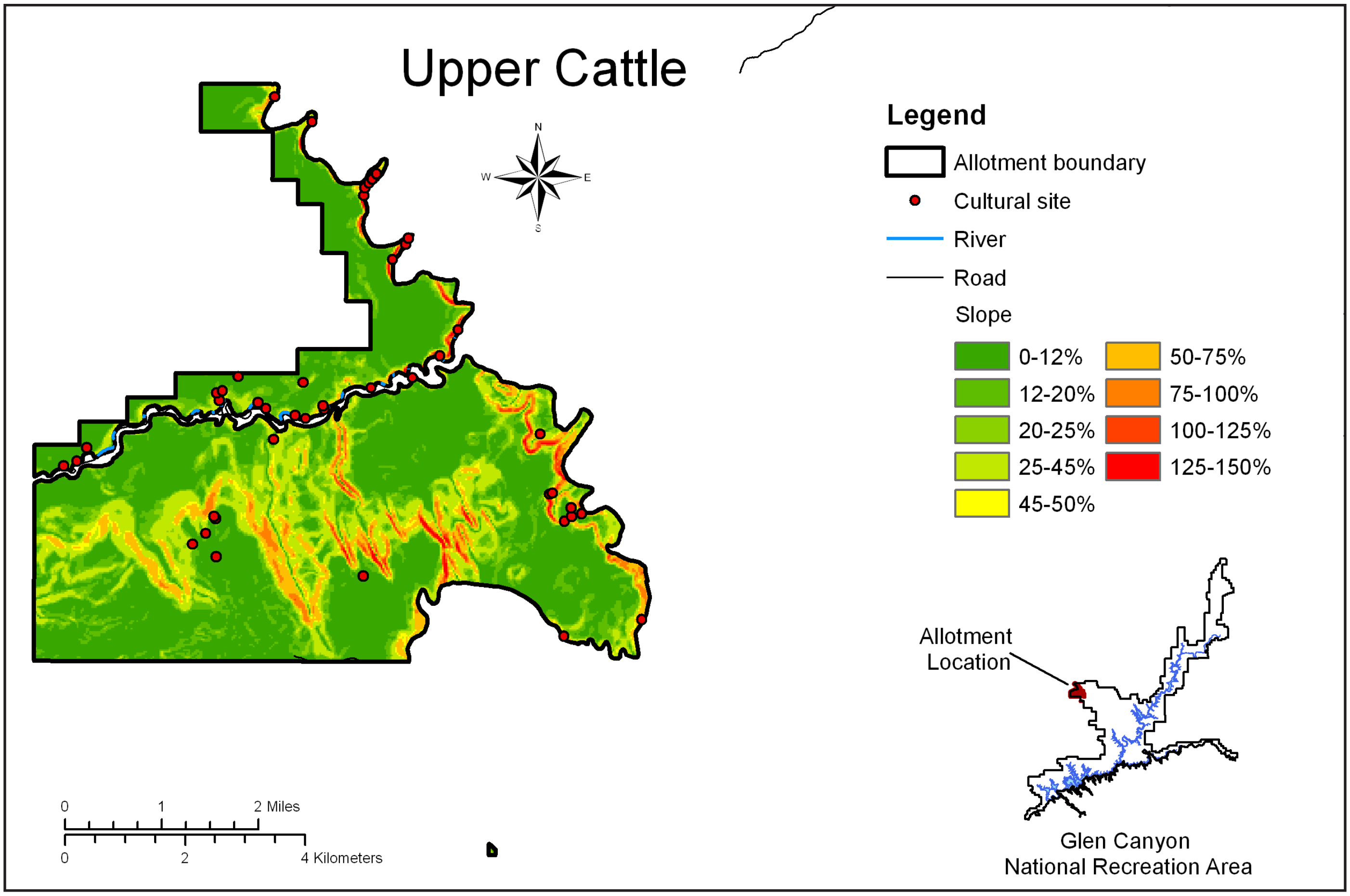
Accessibility:
A lateral roadway extends from County Hwy 330 (Hole-in-the-Rock Road) into Harris Wash, thereby providing access to both the north and south portions of the allotment. Another lateral extends from County Hwy 330, crossing Twentyfive Mile Wash, and ending at the southern allotment border. Finally, a lateral extending from County Hwy 332 (Moody Canyon Road) into Silver Falls Creek may provide access to the north portion of the allotment.

No. Cultural Sites: 44
Area surveyed: 0.00 acres

The figures on the subsequent page depict cultural sites by affiliation, and for those prehistoric sites for which affiliation is not known, site attributes.


Cultural Sites by Affiliation,
Upper Cattle
3
8
5
14
14
Ancestral Puebloan
Formative
Fremont
Unknown Prehistoric
Unknown


Unknown Prehistoric Sites by Attribute,
Upper Cattle
8
2
2
1
1
Features present
Artifact scatter
Lithic scatter, rock art
Rock art
Lithic scatter



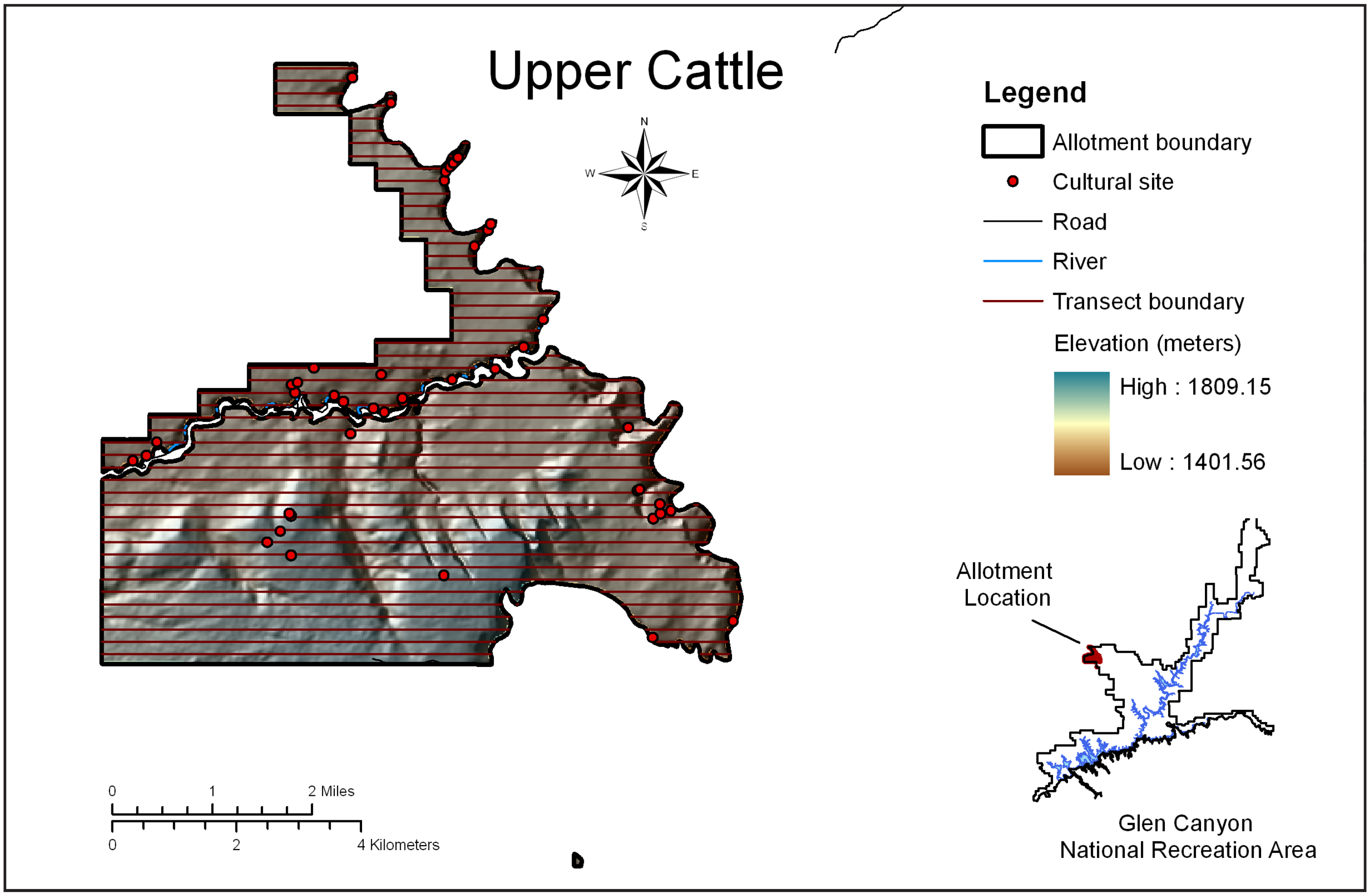
Slope Considerations:

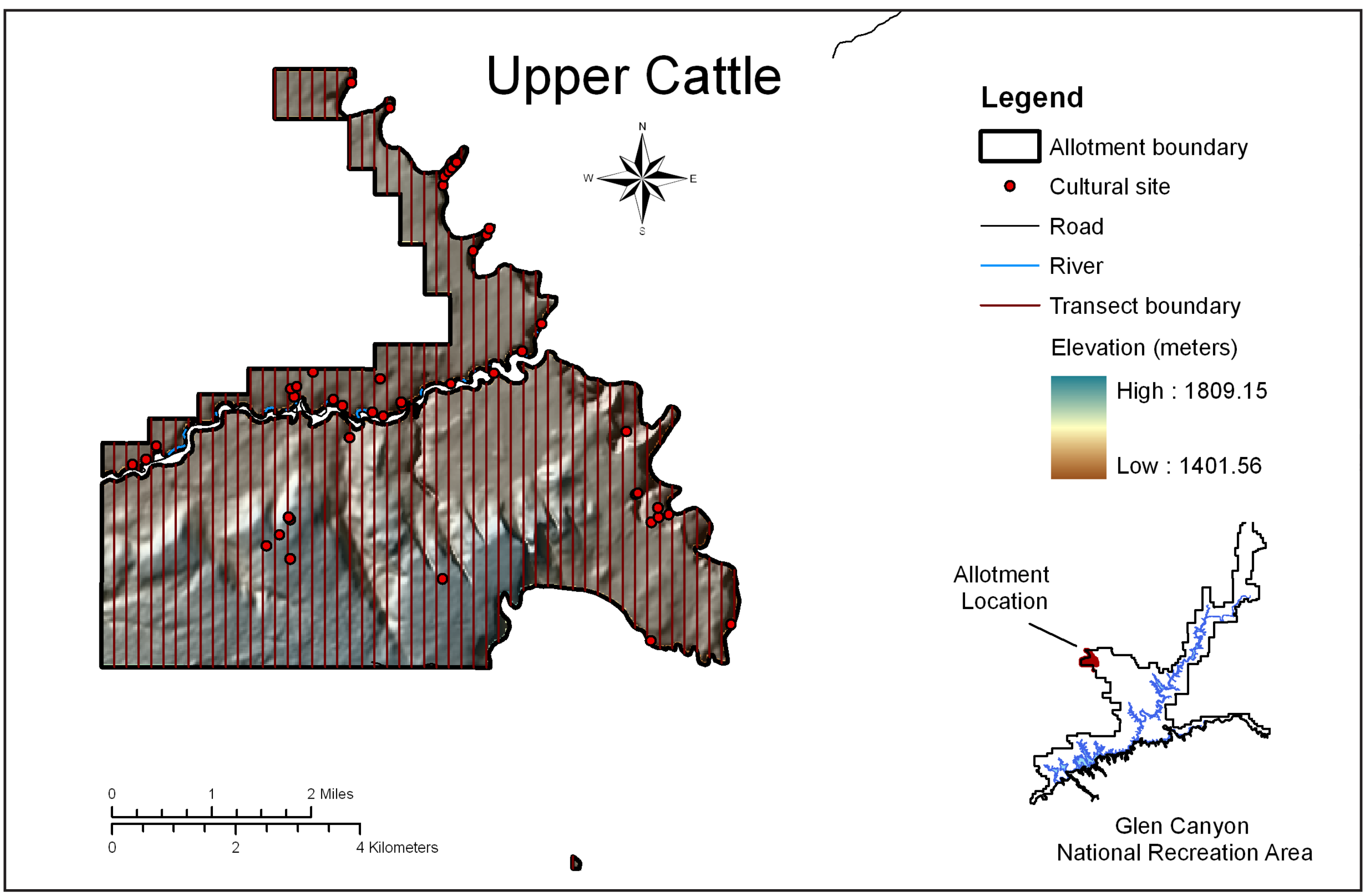
Slope plays a large role in terrain accessibility, and may be used in the stratification of survey areas. For example, GCNRA may wish to assign catagories such as low, moderate, and high to specific slope gradients. Such assignations are most often dependent on the factors guiding archaeological survey work, and as such, are not included in this document. Included herein, however, are suggestions for basic transect orientation based on the presence of topographical barriers identified by the presence of excessive slope gradients.

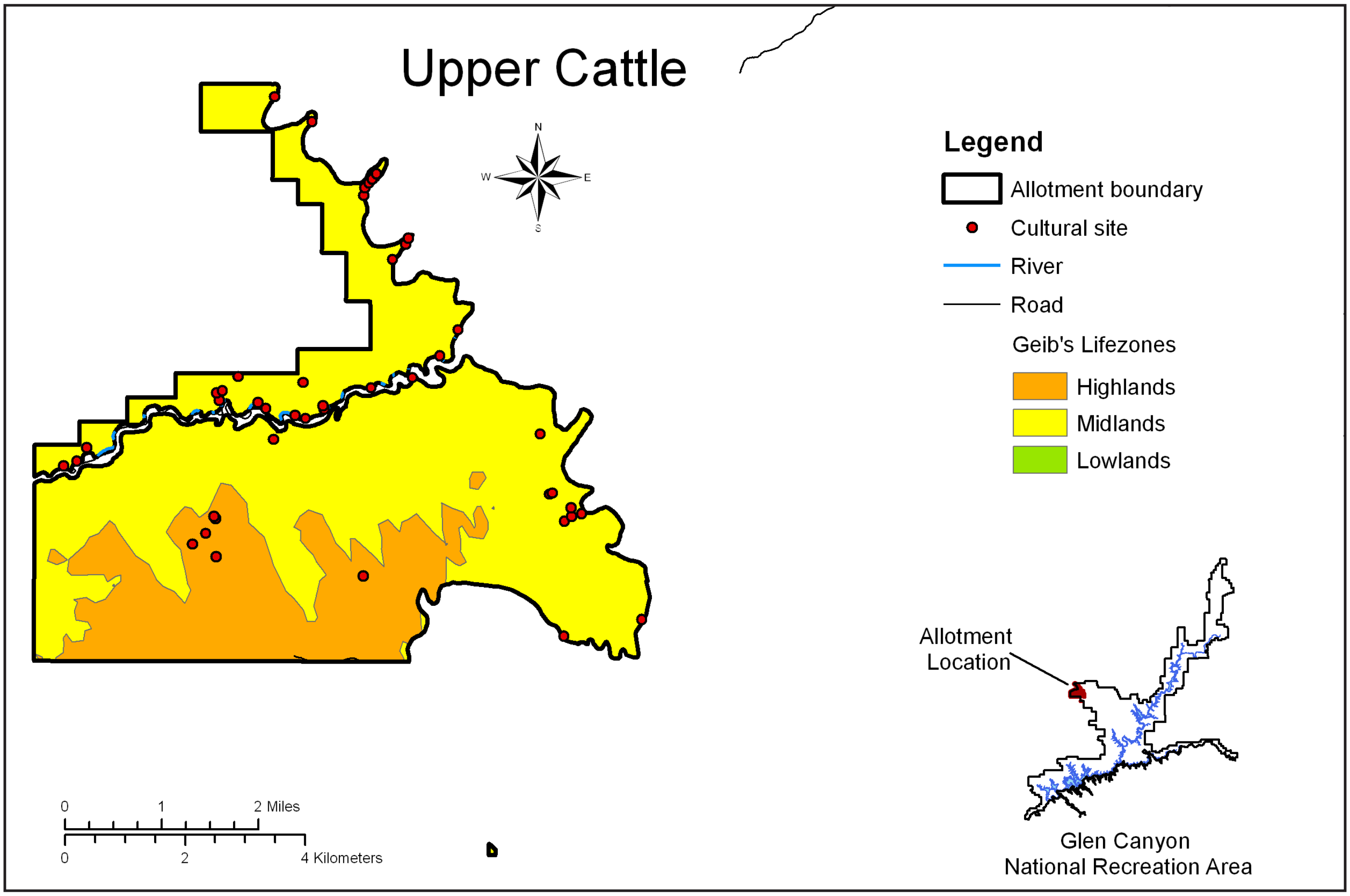
Survey Zones Dictated by Slope:

Steep east-west oriented slopes divide the north and south of the southern portion of Upper Cattle grazing allotment, and border the east along the Escalante River. Where the allotment parallels Harris Wash, access should be possible from the road extending through the bottom, and in these areas transects should be placed north-south. The southern, higher elevation portion of the allotment should be accessed from the south lateral roadway, and surveyed by north-south oriented transects.

The 'fishnet' maps provided on the subsequent page display transects spaced at 200 meter intervals for both east-west and north-south oriented pedestrian survey.


Upper Cattle
N
W
E
S
Legend
Allotment boundary
Cultural site
Road
River
Transect boundary
Elevation (meters)
High : 1809.15
Low : 1401.56
Allotment Location
Glen Canyon National Recreation Area
0
1
2 Miles
0
2
4 Kilometers


Upper Cattle
N
W
E
S
Legend
Allotment boundary
Cultural site
Road
River
Transect boundary
Elevation (meters)
High : 1809.15
Low : 1401.56
Allotment Location
Glen Canyon National Recreation Area
0
1
2 Miles
0
2
4 Kilometers



Area of Each Lifezone:

Highlands: 3029.95 acres
Midlands: 8196.09 acres
Lowlands:0.00 acres

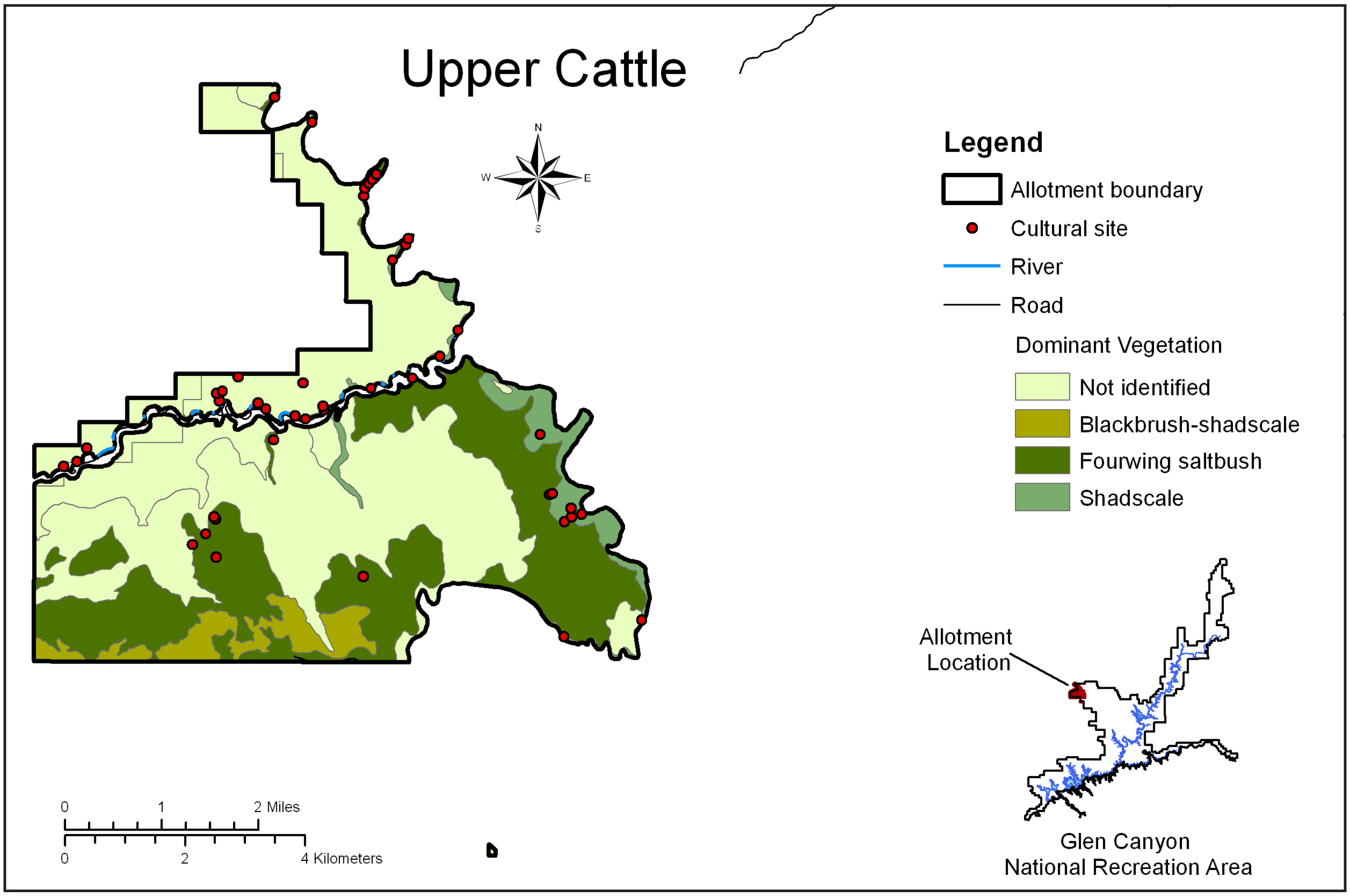
No. Cultural Sites in Each Lifezone:

Highlands: 6
Midlands: 38
Lowlands: 0

Lifezone Significance and Known Cultural Sites:
Thirty-eight (n = 38) sites are located in the midlands and six (n = 6) sites are located in the highlands. Midland locations provide important grasses, cacti, and hunting opportunities, particularly of antelope. Highlands include pinyon-juniper forests, which provide important food sources, as well as game animals such as deer and rabbit. Highlands also receive enough annual precipitation to allow for dry farming of agricultural products.

	Elevation	Characteristics	Environment	Significance to Humans
Lowlands	1219-1372 m (4000-4500 ft)	Hot and arid steep-walled sandstone canyons.	Riparian plants; bighorn sheep	Permanent water, arable alluvium, long growing season, diverse plant communities, natural shelters, quality siliceous stone from river gravels
Midlands	1372-1676 m (4500-5500 ft)	Arid slickrock and dune fields on benchlands and low plateaus.	Blackbrush, shadscale, grasses; antelope.	Grasses, including dropseed and ricegrass, prickly pear and shadscale; good antelope habitat, quality siliceous stone in certain locations.
Highlands	Above 1676 m (Above 5500 ft)	High elevation mesas and plateaus with cooler temperatures and greater precipitation.	Pinyon-juniper woodlands; deer and rabbit.	Higher elevation plant foods (i.e. pinyon); later harvests; dry-farming; abundant fuel, deer and rabbit.

Shading indicates lifezones present in allotment.



Area of Individual Vegetation Zones:

Dominant Species	Acres Covered	No. Sites
Not identified	6507.25	13
Blackbrush-shadscale ***(Coleogyne ramosissima - Atriplex confertifolia)***	566.54	**0**
Fourwing saltbush ***(Atriplex canescens)***	3634.05	**16**
Shadscale ***(Atriplex confertifolia)***	572.01	**15**
Total	**11,279.85**	**44**

No. Cultural Sites in Each Vegetation Zone:
Sixteen (n = 16) sites are located in fourwing saltbush. Fifteen sites (n = 15) are located in shadscale. The remaining sites (n = 13) are located in areas for which the dominant vegetation has not yet been identified.

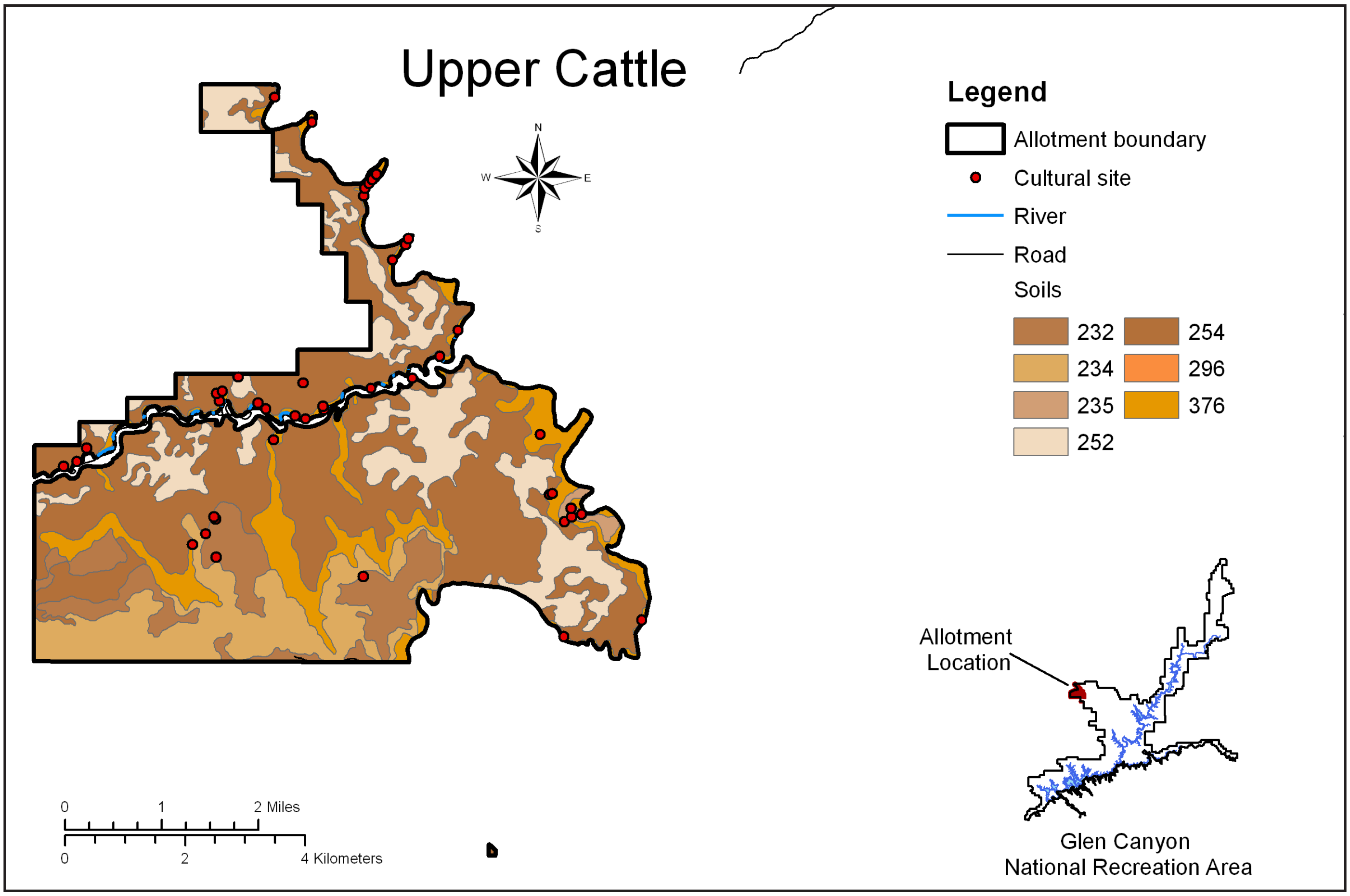
Visibility:
In general, the dominant vegetation of Soda grazing allotment provide moderate - excellent visibility with large portions of the ground between plants bare of vegetation.

Summary:
Dominant vegetation for Slickrock grazing allotment includes blackbrush-shadscale (5.02 percent), fourwing saltbush (32.22 percent), and shadscale (5.07 percent). Dominant vegetation for the remainder of the allotment has not yet been identified.

Dominant Species:
Shadscale (*Atriplex confertifolia*)
Blackbrush (*Coleogyne ramosissima*)
Fourwing saltbush (*Atriplex canescens*)

Secondary Dominant Species:
Fremont cottonwood (*Populus fremontii*)
Mat saltbush (*Atriplex corrugata*)
Cutler Mormon-tea (*Ephedra cutleri*)

Associated Soils:
Blackbrush-shadscale grows in talus, where it may be associated with mat saltbush in shallow clay. Fourwing saltbush grows in sandy bottoms where it may be associated with Fremont cottonwood in semiwet saline streambanks, and in sand, where it often grows alongside Cutler Mormon tea in shallow sand, and in sandy loam. Finally, shadscale dominates in shallow sandy loam.

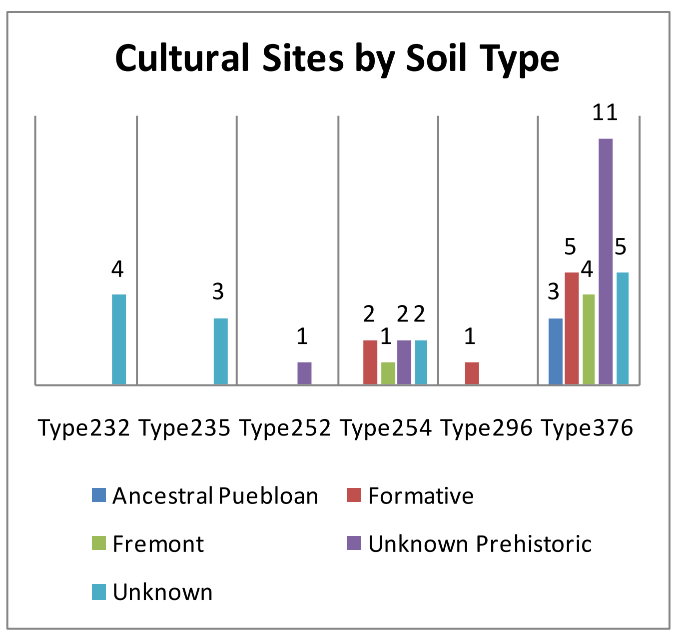


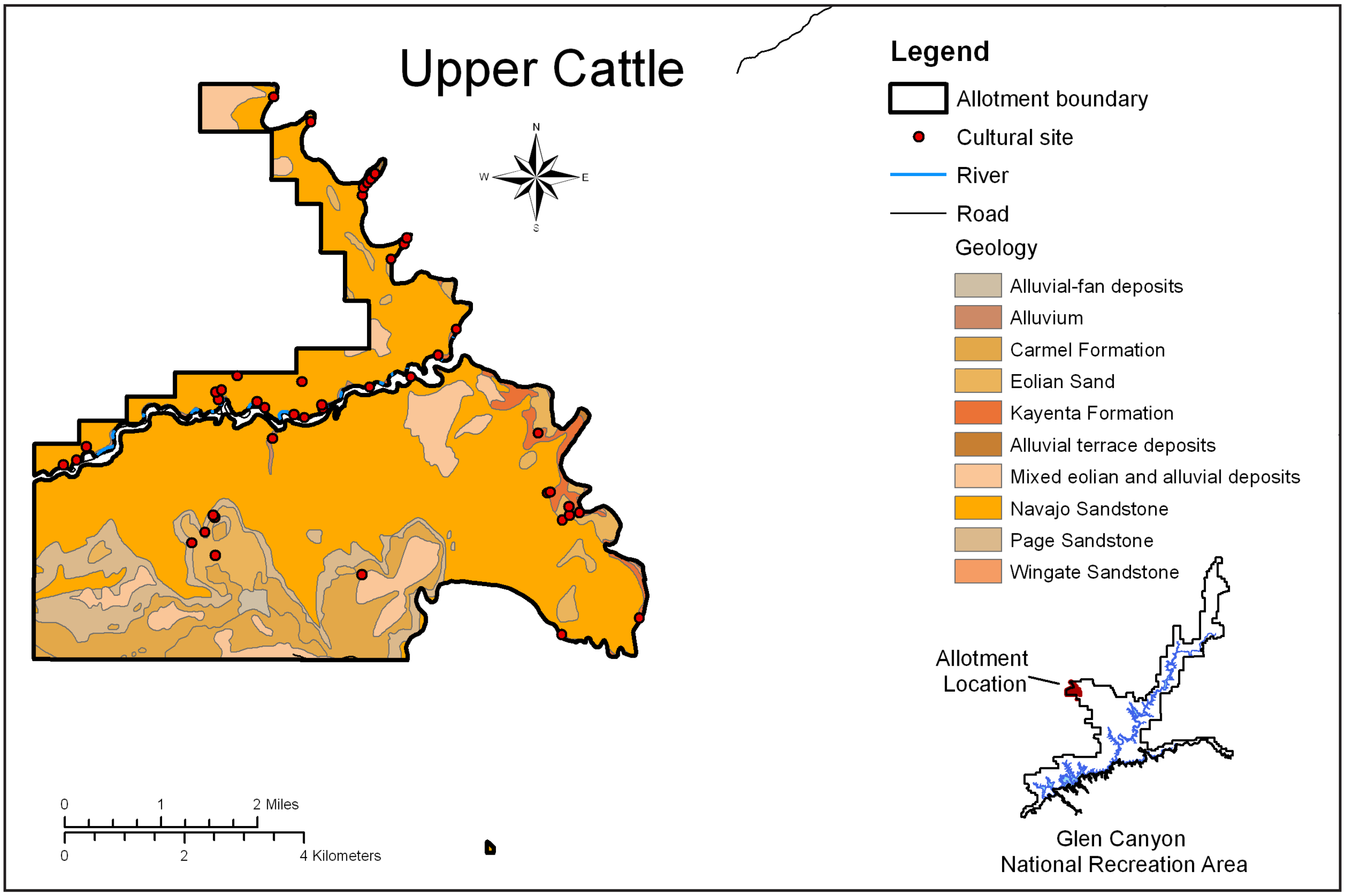
Allotment Divided by Soil Type (MUSYM):

Soil Type	Acres	Percent	No. Cultural Sites
232	1084.53	9.61	4
234	1465.62	12.99	0
235	68.76	0.61	3
252	1942.15	17.22	1
254	5213.91	46.22	7
296	33.96	0.30	1
376	1470.92	13.04	28
Total	**11,279.85**	**99.99%**	**44**

Distribution of Cultural Sites by Soil Type:

Four (n = 4) sites for which attribute/affiliation information is not available are located in soil type 232. Three sites (n = 3) for which attribute/affiliation information is not available are located on soil type 235. One artifact scatter (n = 1) is located on soil type 252. Seven sites (n = 7), including two Formative sites, one Fremont site, two prehistoric sites with features, and two sites for which affiliation/attribute information is not available, are located in soil type 254. One (n = 1) Formative sites is located on soil type 296. The remaining sites (n = 28) are located on soil type 376. These sites include three Ancestral Puebloan sites, five Formative sites, four Fremont sites, 11 currently unaffiliated prehistoric sites including six with features, three lithic scatters, two of which are associated with rock art, one rock art site, and one artifact scatter, as well as five sites for which affiliation/attribute information is currently not known.





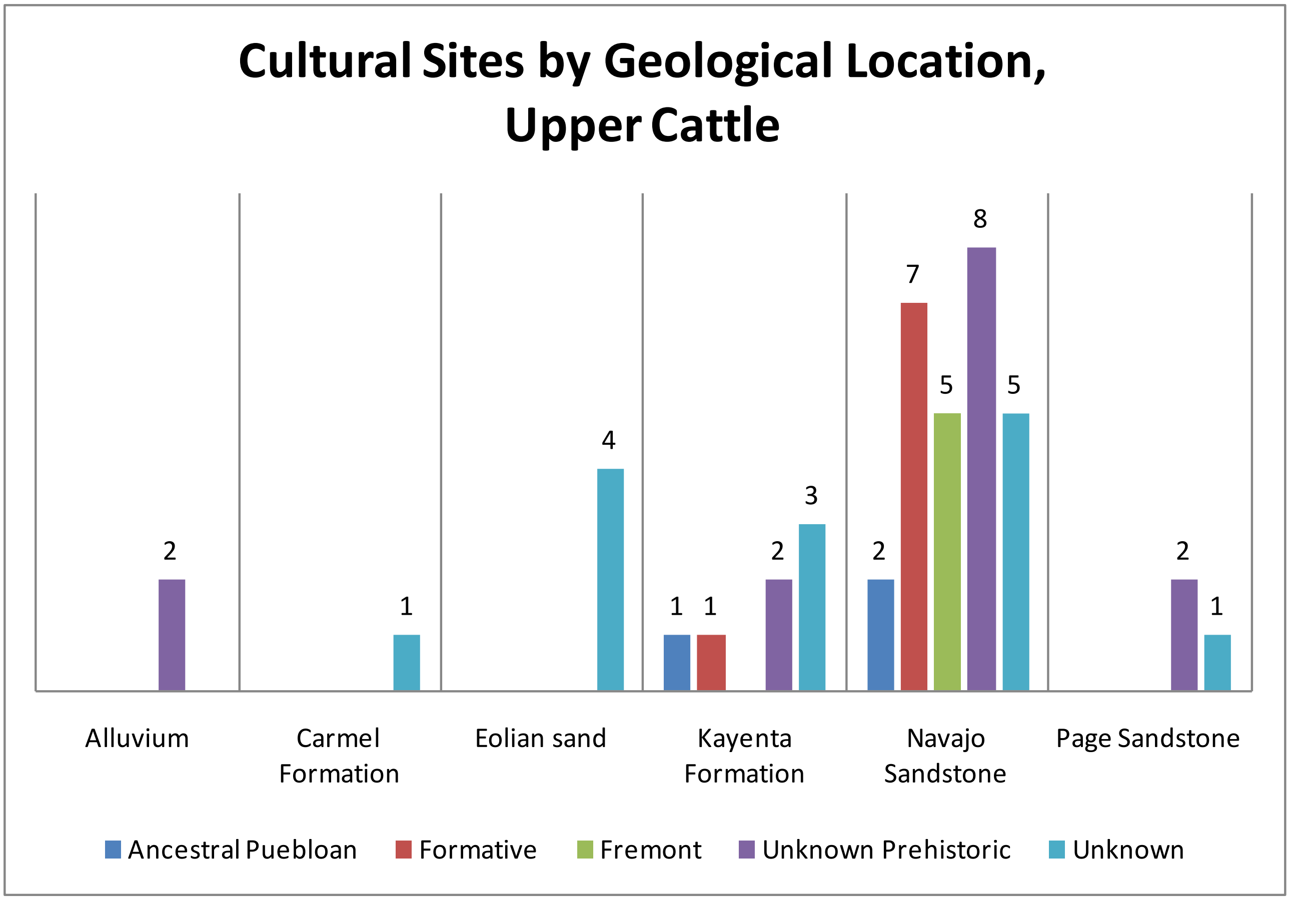
Allotment Divided by Geology:

Geology	Acres	Percent	No. Cultural Sites
Alluvial fan deposits	43.25	0.38	0
Alluvium	84.65	0.75	2
Carmel Formation	1276.28	11.31	1
Eolian sand	591.12	5.24	4
Kayenta Formation	238.68	2.12	7
Alluvial terrace deposits	9.05	<0.00	0
Mixed eolian and alluvial deposits	971.90	8.62	0
Navajo Sandstone	7165.27	63.52	27
Page Sandstone	887.55	7.87	3
Wingate Sandstone	11.78	0.10	0
Total	**11,279.53**	**99.91%**	**44**

Distribution of Cultural Sites by Geological Location:

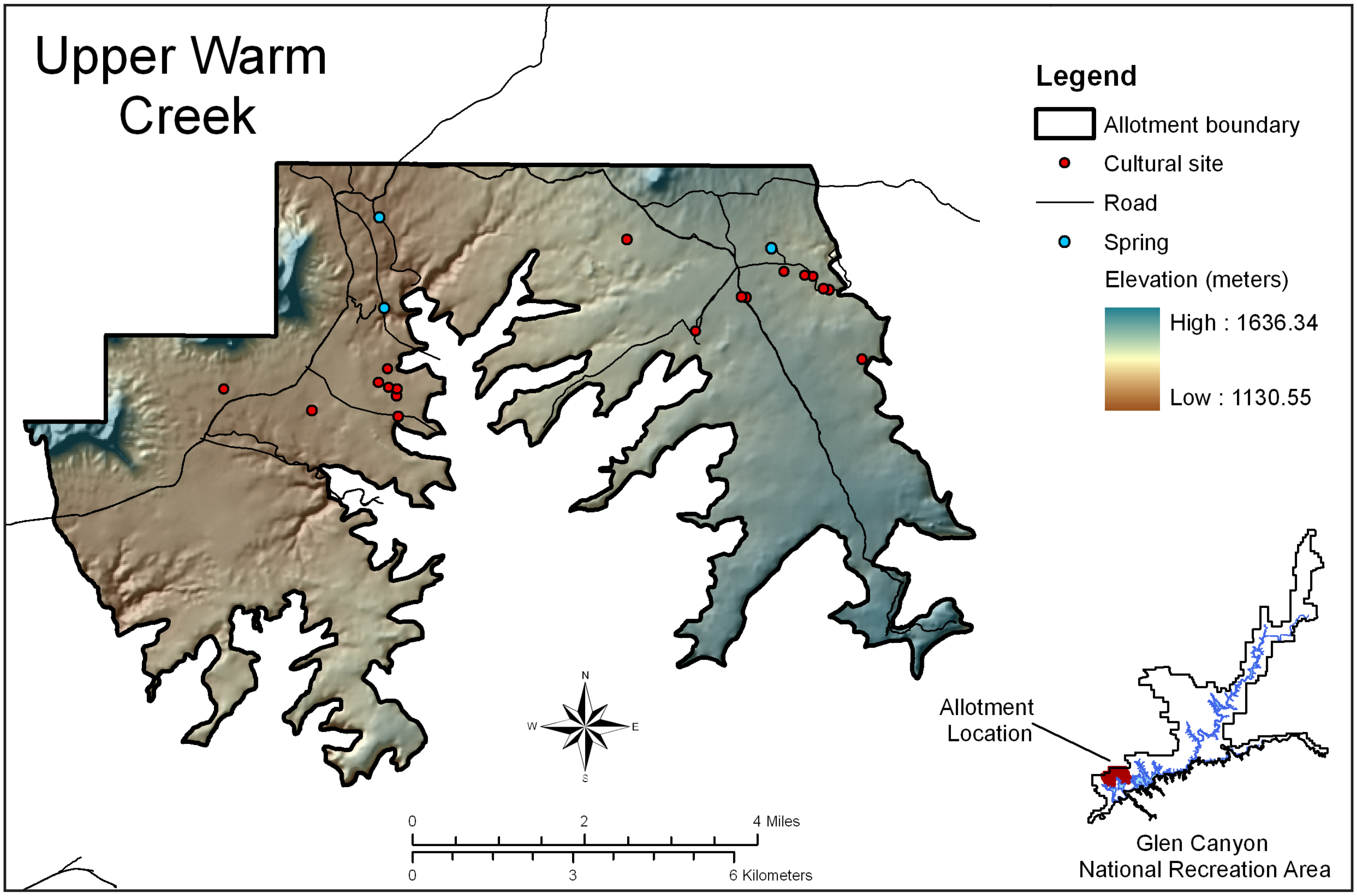
Two sites (n =2), including a lithic scatter and a prehistoric cist, are located on alluvium. One site (n = 1) for which attribute/affiliation information is not currently available is located on Carmel Formation geology. Four (n = 4) sites for which attribute/affiliation information is not available are located on eolian sand. Seven sites (n = 7), including one Ancestral Puebloan site, one Formative site, two prehistoric sites with features, and three sites for which attribute/affiliation information is currently lacking, are located on Kayenta Formation geology. Twenty-seven (n = 27) sites are located on Navajo Sandstone, or slickrock. These sites include two Ancestral Puebloan sites, seven Formative sites, five Fremont sites, eight currently unaffiliated prehistoric sites including three with features, two artifact scatters, two lithic scatters with associated rock art, and one rock art site, as well as five sites for which attribute/affiliation information is not currently known. Three sites (n = 3), including two prehistoric sites with features and one site for which attribute/affiliation information is not available, are located on Page Sandstone.

The figure on the subsequent page displays known cultural sites by affiliation and geologic context..


Cultural Sites by Geological Location, Upper Cattle
2
1
4
1
1
2
3
2
7
5
8
5
2
1
Alluvium
Carmel Formation
Eolian sand
Kayenta Formation
Navajo Sandstone
Page Sandstone
Ancestral Puebloan
Formative
Fremont
Unknown Prehistoric
Unknown

Upper Warm Creek

Map Panels



Total Area: 23,076.10 acres

No. Cultural Sites: 19
Area surveyed: 0.00 acres

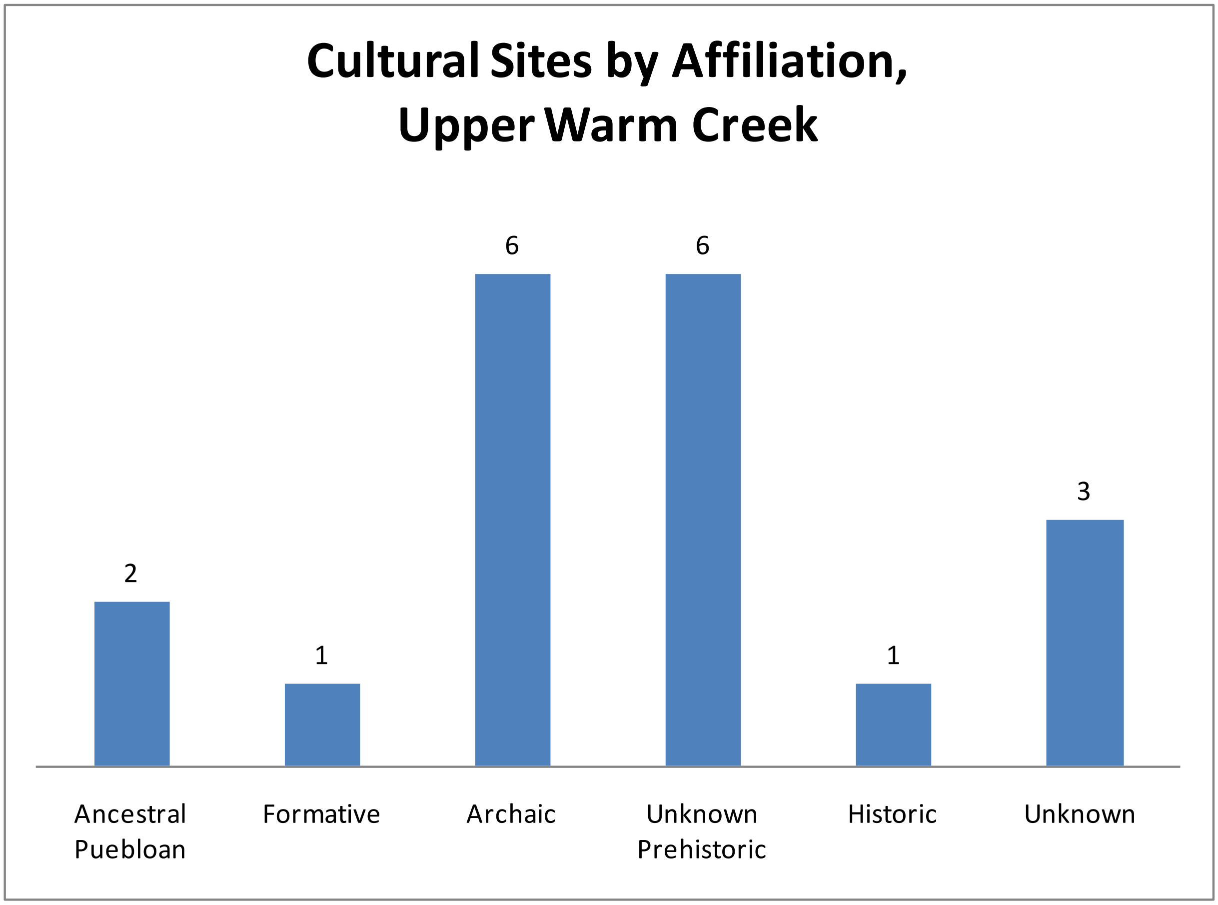
Sampling Fractions:
2 percent: 461.52 acres
5 percent: 1153.81 acres
11 percent: 2538.37 acres
16 percent: 3692.18 acres
20 percent: 4615.22 acres

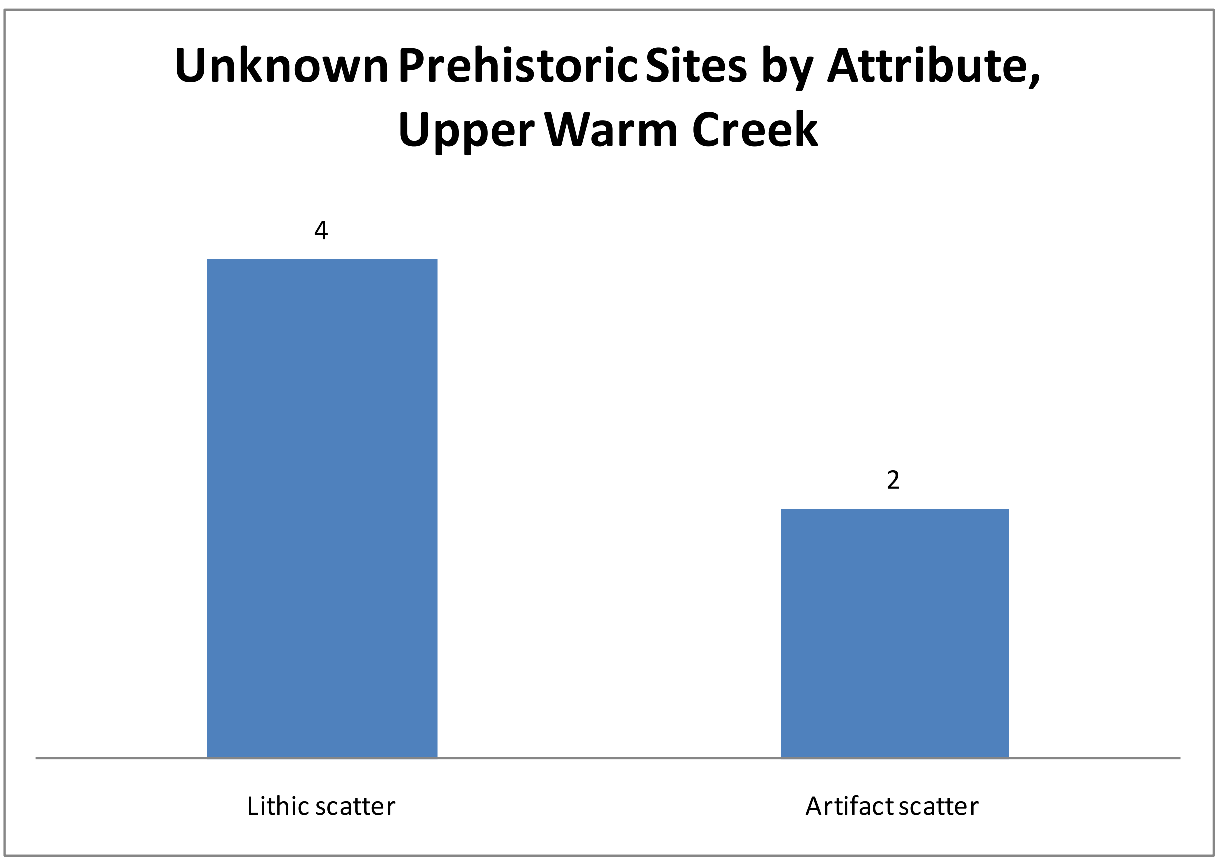
Elevation range amsl:
1130.55 – 1636.34 meters (3709.15 - 5368.57 feet)

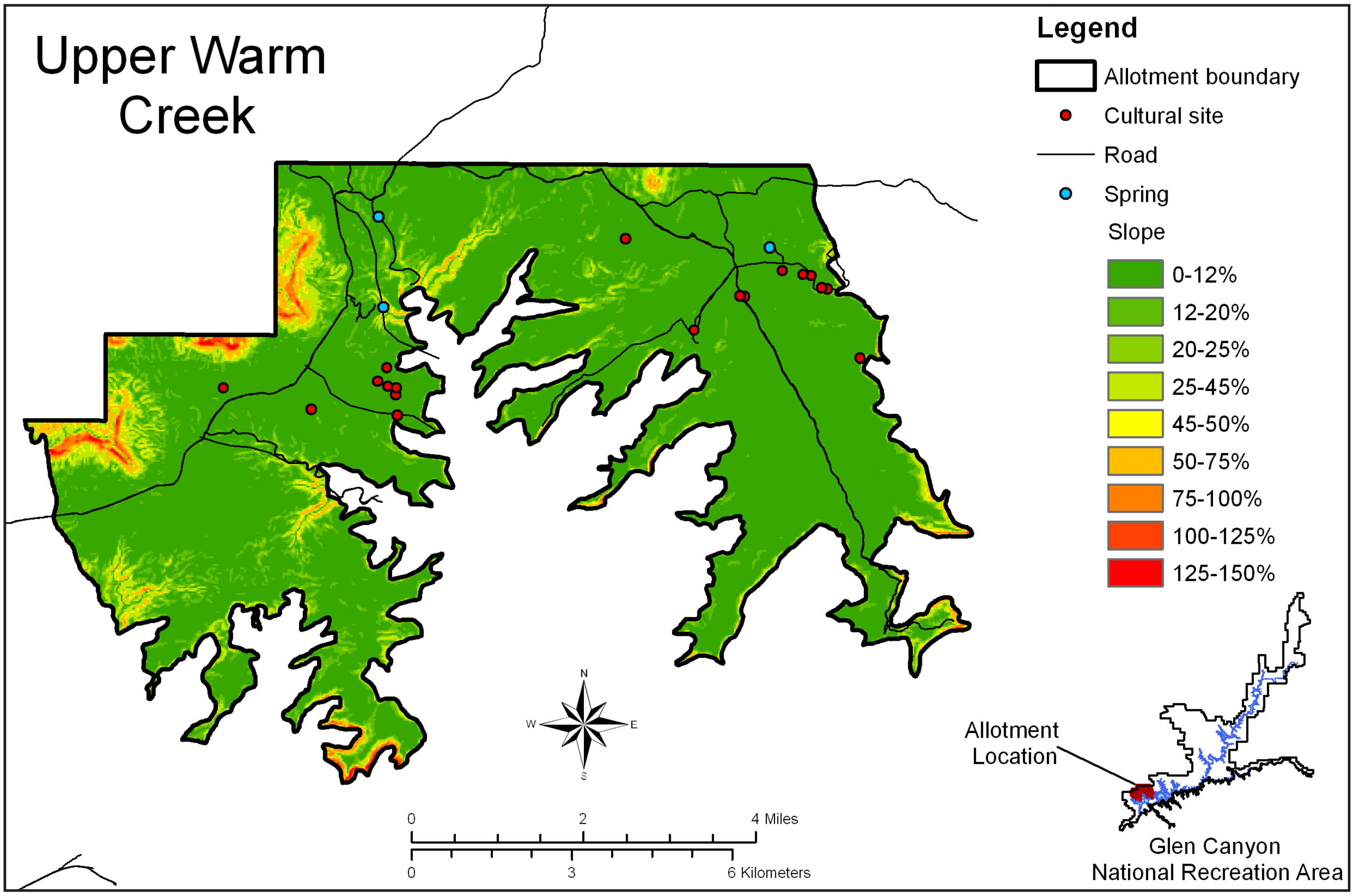
Rivers and Springs:
Three springs, including Dewey, are located in Upper Warm Creek allotment, as is Warm Creek (not depicted).

Accessibility:
Several county highways, including 231 in the west, 265 and 264 in the east, and 230 to the north, provide access to the allotment. Wahweap and Warm Creek bays of Lake Powell form the southern allotment boundary, so boat access may also be feasible.

The figures on the subsequent page depict cultural sites by affiliation, and for those prehistoric sites for which affiliation is not known, site attributes.


Cultural Sites by Affiliation,
Upper Warm Creek
2
1
6
6
1
3
Ancestral Puebloan
Formative
Archaic
Unknown Prehistoric
Historic
Unknown


Unknown Prehistoric Sites by Attribute,
Upper Warm Creek
4
2
Lithic scatter
Artifact scatter



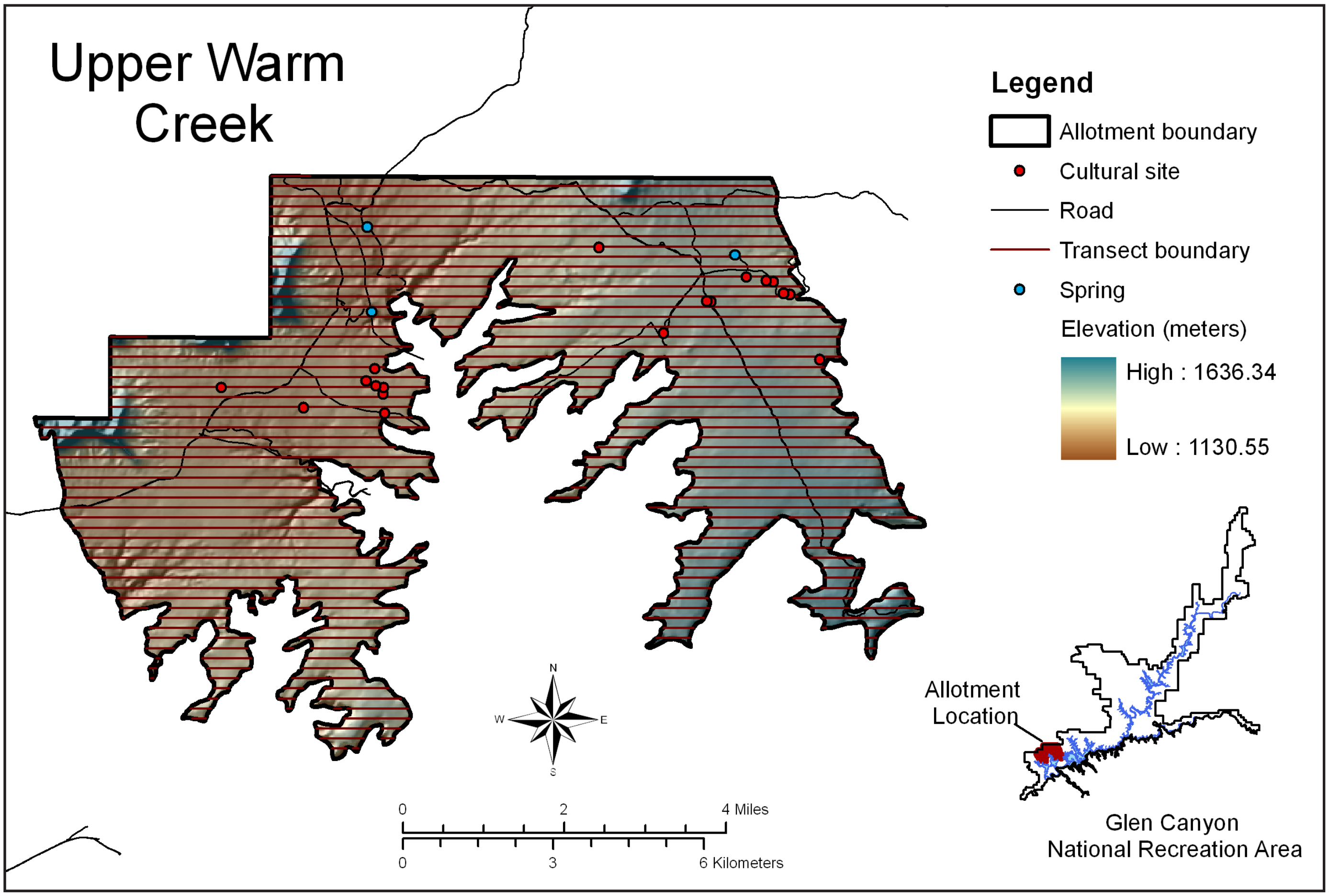
Slope Considerations:

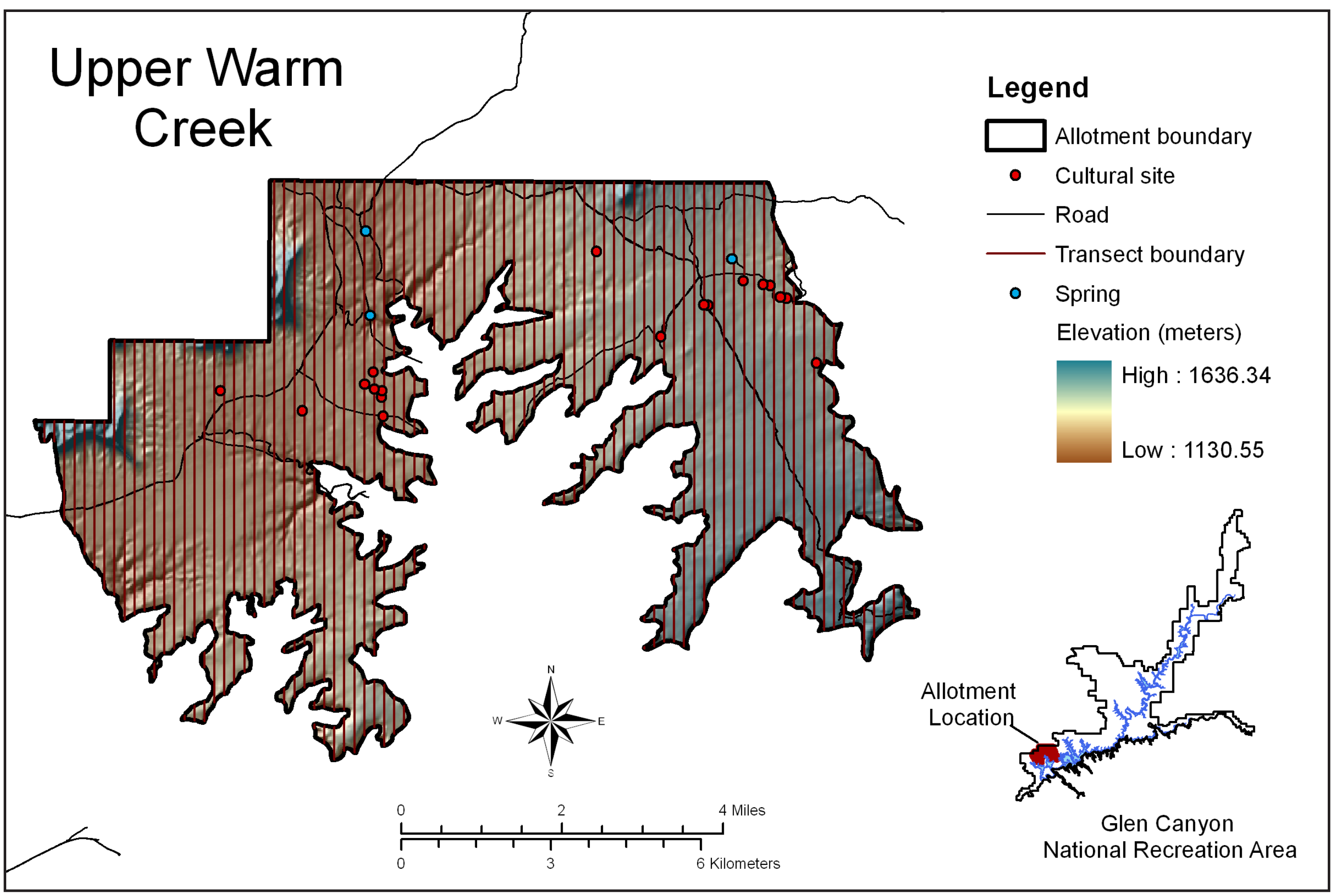
Slope plays a large role in terrain accessibility, and may be used in the stratification of survey areas. For example, GCNRA may wish to assign catagories such as low, moderate, and high to specific slope gradients. Such assignations are most often dependent on the factors guiding archaeological survey work, and as such, are not included in this document. Included herein, however, are suggestions for basic transect orientation based on the presence of topographical barriers identified by the presence of excessive slope gradients.

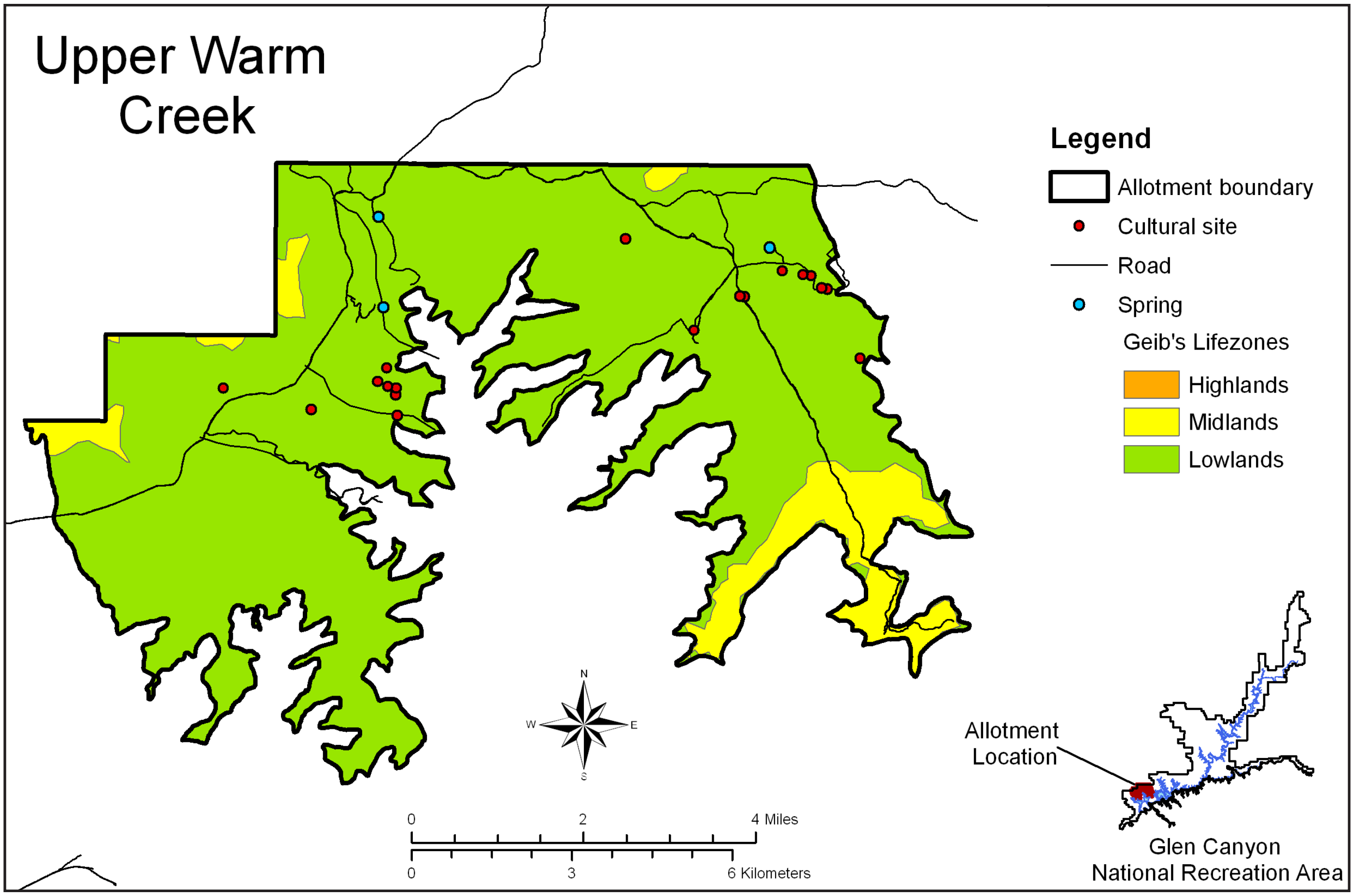
Survey Zones Dictated by Slope:

Slope poses few problems for potential surveys of Upper Warm Creek grazing allotment, and most of the allotment is accessible by both road and boat. As is usual, recommended transects should be placed perpendicular to access points.

The 'fishnet' maps provided on the subsequent page display transects spaced at 200 meter intervals for both east-west and north-south oriented pedestrian survey.


Upper Warm Creek
Legend
Allotment boundary
Cultural site
Road
Transect boundary
Spring
Elevation (meters)
High : 1636.34
Low : 1130.55
N
W
E
S
0
2
4 Miles
0
3
6 Kilometers
Allotment Location
Glen Canyon National Recreation Area


Upper Warm Creek
Legend
Allotment boundary
Cultural site
Road
Transect boundary
Spring
Elevation (meters)
High : 1636.34
Low : 1130.55
N
W
E
S
0
2
4 Miles
0
3
6 Kilometers
Allotment Location
Glen Canyon National Recreation Area



Area of Each Lifezone:

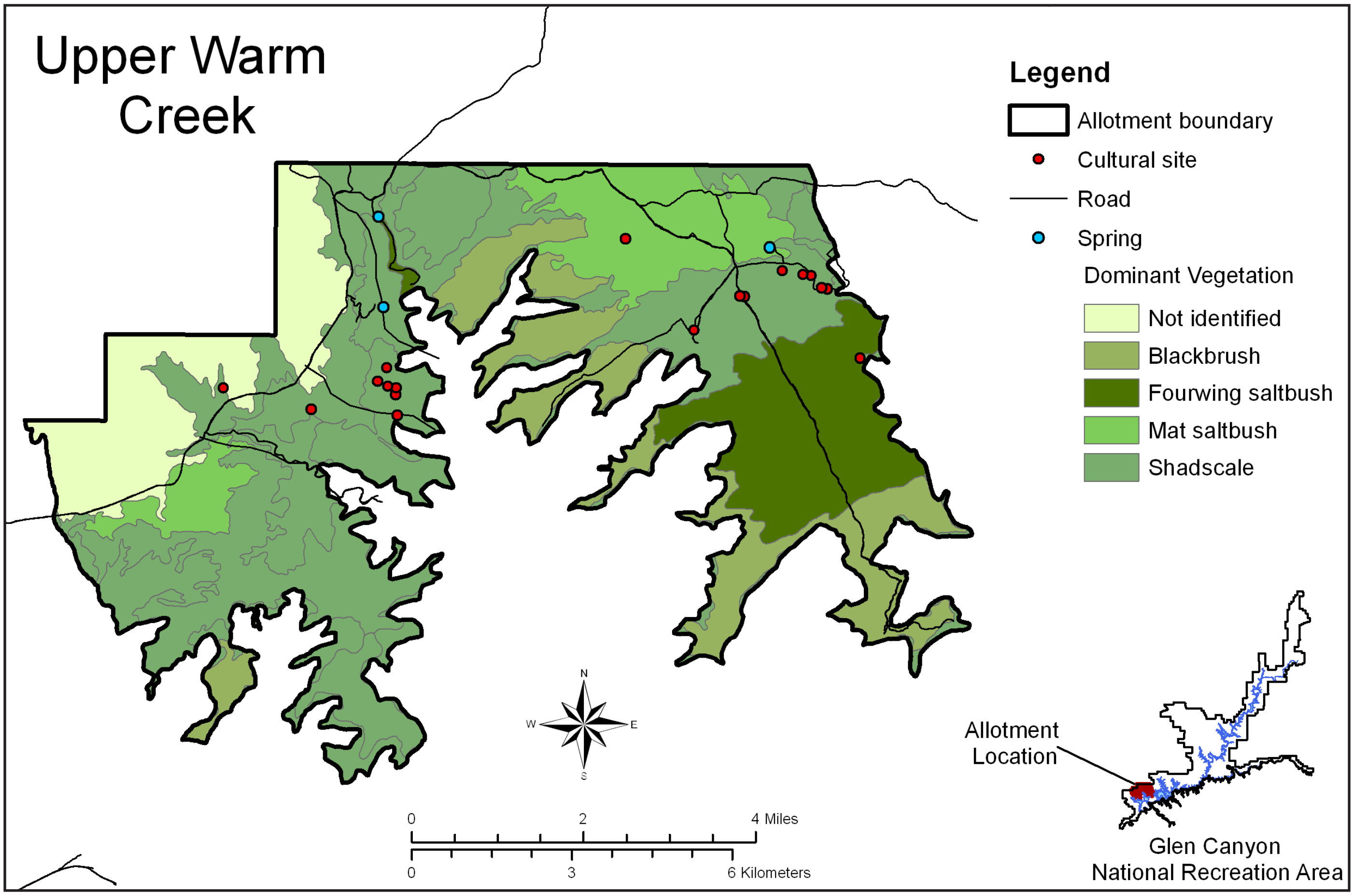
Highlands: 0.00 acres
Midlands: 2111.96 acres
Lowlands:20,955.36 acres

No. Cultural Sites in Each Lifezone:

Highlands: 0
Midlands: 0
Lowlands: 19

Lifezone Significance and Known Cultural Sites: Although both lowlands and midlands are present in Upper Warm Creek grazing allotment, all known cultural sites (n = 19) are located in Geib's Lowland zone. Geib describes the lowlands as hot and arid, but containing permanent water sources, arable alluvium, and long growing seasons suitable to agriculture. In addition, diverse plant communities, natural shelters, and raw materials suitable to the manufacture of stone tools were also available to prehistoric people in the lowlands.

	Elevation	Characteristics	Environment	Significance to Humans
Lowlands	1219-1372 m (4000-4500 ft)	Hot and arid steep-walled sandstone canyons.	Riparian plants; bighorn sheep	Permanent water, arable alluvium, long growing season, diverse plant communities, natural shelters, quality siliceous stone from river gravels
Midlands	1372-1676 m (4500-5500 ft)	Arid slickrock and dune fields on benchlands and low plateaus.	Blackbrush, shadscale, grasses; antelope.	Grasses, including dropseed and ricegrass, prickly pear and shadscale; good antelope habitat, quality siliceous stone in certain locations.
Highlands	Above 1676 m (Above 5500 ft)	High elevation mesas and plateaus with cooler temperatures and greater precipitation.	Pinyon-juniper woodlands; deer and rabbit.	Higher elevation plant foods (i.e. pinyon); later harvests; dry-farming; abundant fuel, deer and rabbit.
Shading indicates lifezones present in allotment.				



Area of Individual Vegetation Zones:

Dominant Species	Acres Covered	No. Sites
Not identified	2886.1	0
Blackbrush *(Coleogyne ramosissima)*	3362.64	0
Fourwing saltbush *(Atriplex canescens)*	2805.44	1
Mat saltbush *(Atriplex corrugata)*	2688.15	0
Shadscale *(Atriplex confertifolia)*	11,333.77	17
Total	23,076.10	19

No. Cultural Sites in Each Vegetation Zone:
One site (n = 1) is located in fourwing saltbush. One site (n = 1) is located in mat saltbush. The remaining sites (n = 17) are located in areas for which the dominant vegetation has not yet been identified.

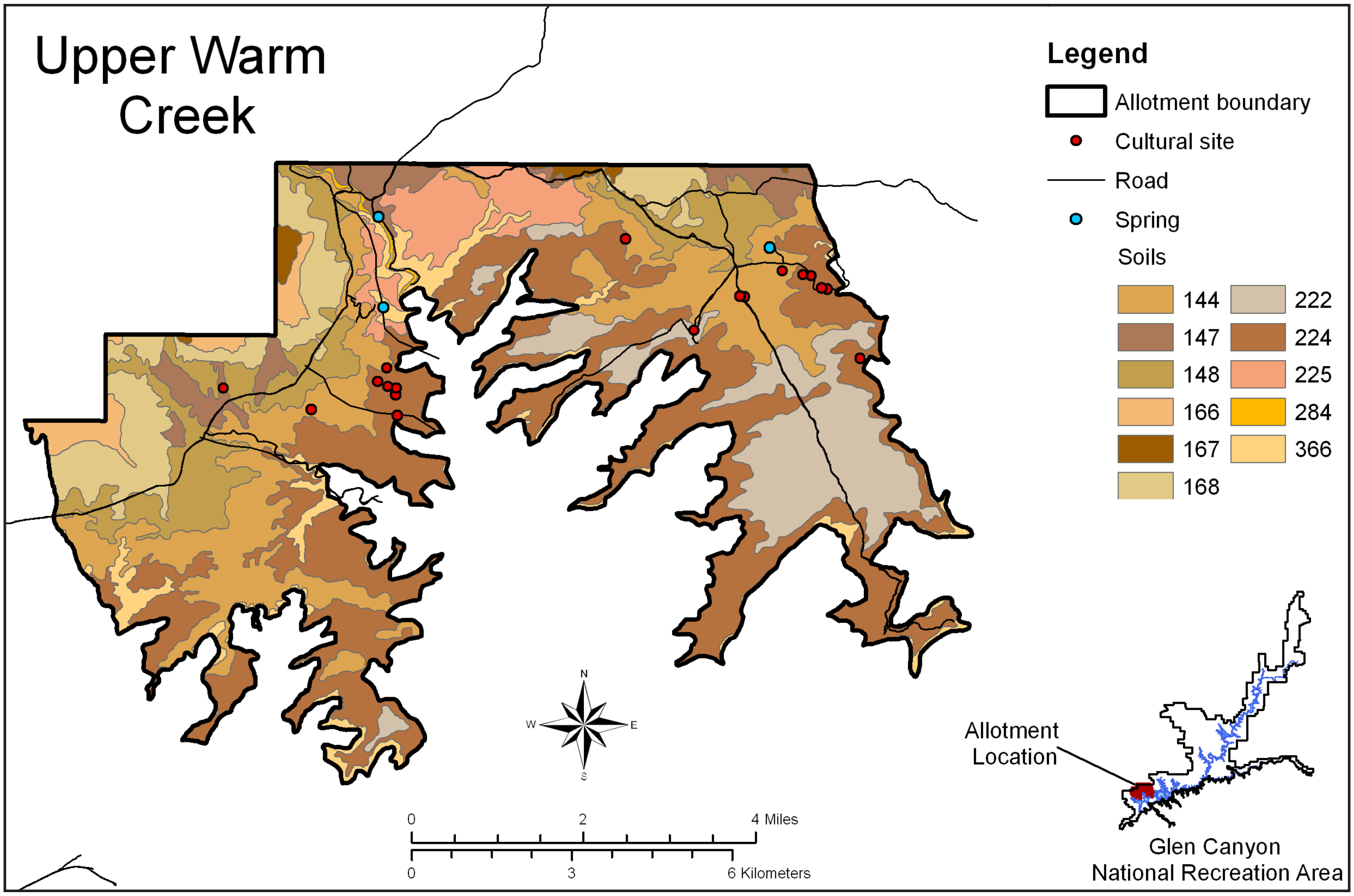
Visibility:
In general, the dominant vegetation of Soda grazing allotment provide moderate - excellent visibility with large portions of the ground between plants bare of vegetation.

Summary:
Dominant vegetation for Slickrock grazing allotment includes blackbrush-shadscale (5.02 percent), fourwing saltbush (32.22 percent), and shadscale (5.07 percent). Dominant vegetation for the remainder of the allotment has not yet been identified.

Dominant Species:
Shadscale (*Atriplex confertifolia*)
Blackbrush (*Coleogyne ramosissima*)
Fourwing saltbush (*Atriplex canescens*)
Mat saltbush (*Atriplex corrugata*)

Secondary Dominant Species:
Fremont cottonwood (*Populus fremontii*)
Sand sagebrush (*Artemisia filifolia*)
Torrey Mormon-tea (*Ephedra torreyana*)

Associated Soils:
Blackbrush grows in shallow sandy loam alongside fourwing saltbush in sandy loam. Fourwing saltbush grows in sandy bottom, where it often occurs with Fremont cottonwood in semiwet saline streambanks, and in sandy loam with sand sagebrush. Mat saltbush grows in shallow clay. Shadscale grows in shallow loam, where it often occurs with mat saltbush in shallow clay and Torrey Mormon tea in very shallow gypsum, and in stony loam.

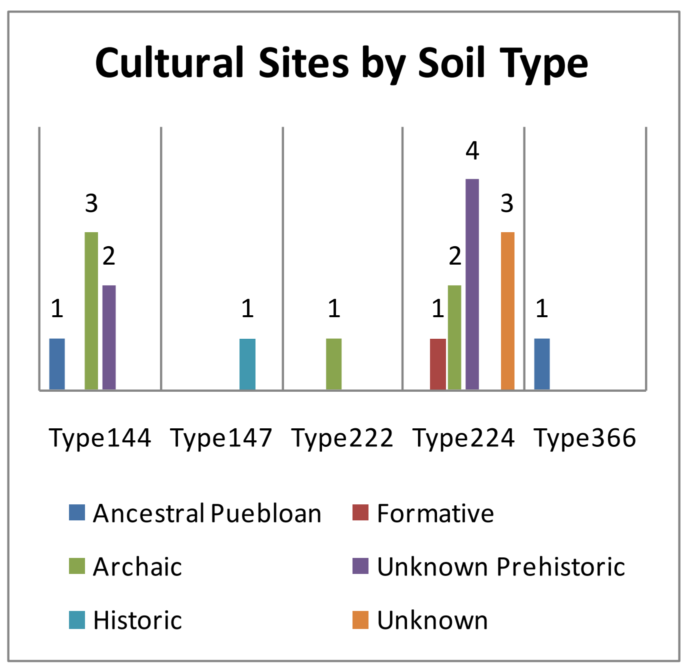


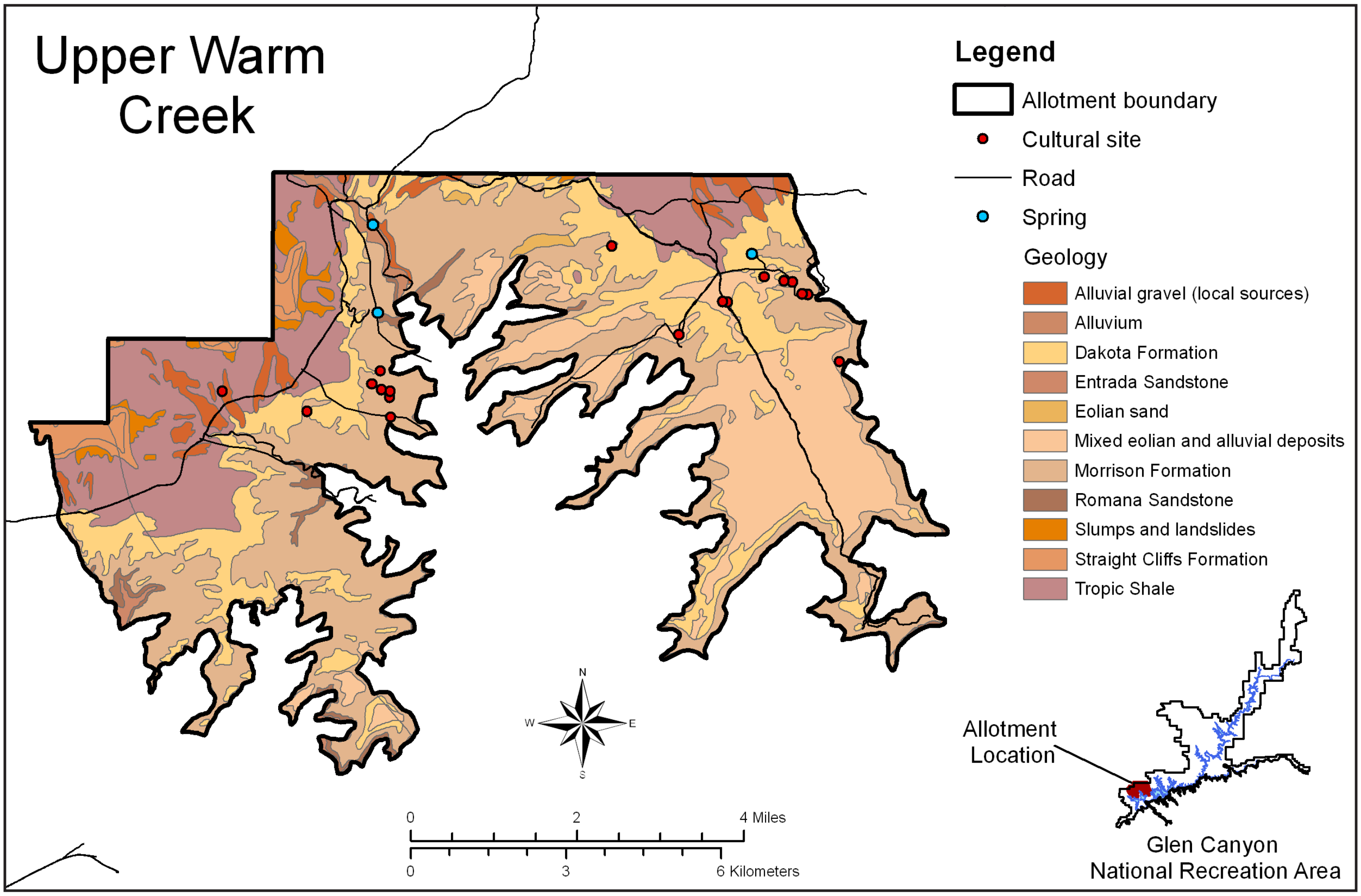
Allotment Divided by Soil Type (MUSYM):

Soil Type	Acres	Percent	No. Cultural Sites
144	4251.41	18.42	6
147	980.74	4.25	1
148	2375.67	10.29	0
166	470.24	2.04	0
167	186.71	0.81	0
168	1864.78	8.08	0
222	2622.06	11.36	1
224	7458.61	32.32	10
225	1177.23	5.10	0
284	65.78	0.29	0
366	1622.88	7.03	1
Total	**23,076.11**	**99.99%**	**19**

Distribution of Cultural Sites by Soil Type:

Six sites (n = 6), including one Ancestral Puebloan site, three Archaic sites, and two artifact scatters, are located on soil type 144. One historic mine site (n = 1) is located on soil type 147. One (n = 1) Archaic site is located on soil type 222. Ten sites (n = 10), including two Archaic sites, one Formative site, four lithic scatters, and three sites for which affiliation/attribute information is not currently available, are located in soil type 224. The remaining site (n = 1) consists of an Ancestral Puebloan site located on soil type 366.



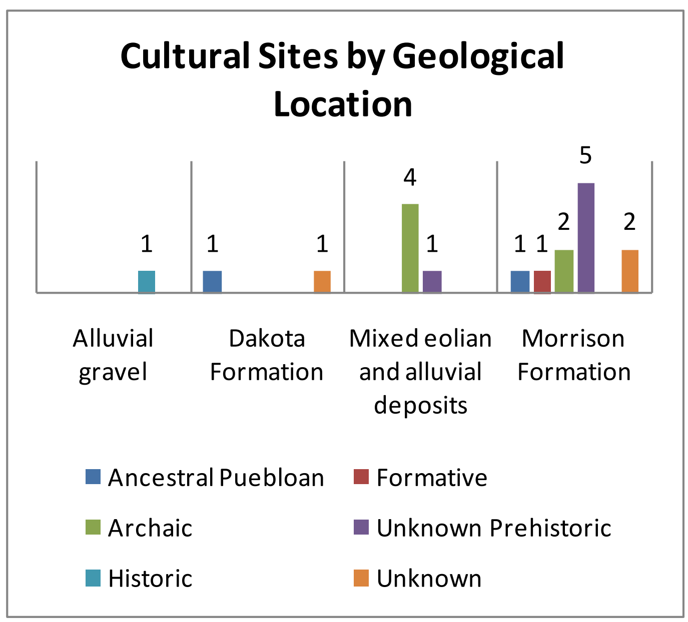


Allotment Divided by Geology:

Geology	Acres	Percent	No. Cultural Sites
Alluvial gravel (local sources)	753.64	3.27	1
Alluvium	152.05	0.67	0
Dakota Formation	4181.26	18.12	2
Entrada Sandstone	99.70	0.43	0
Eolian sand	82.72	0.36	0
Mixed eolian and alluvial deposits	3703.84	16.05	5
Morrison Formation	8807.72	38.17	11
Romana Sandstone	576.35	2.50	0
Slumps and landslides	309.34	1.34	0
Straight Cliffs Formation	495.07	2.15	0
Tropic Shale	3913.71	16.96	0
Total	**23,075.40**	**100.02%**	**19**

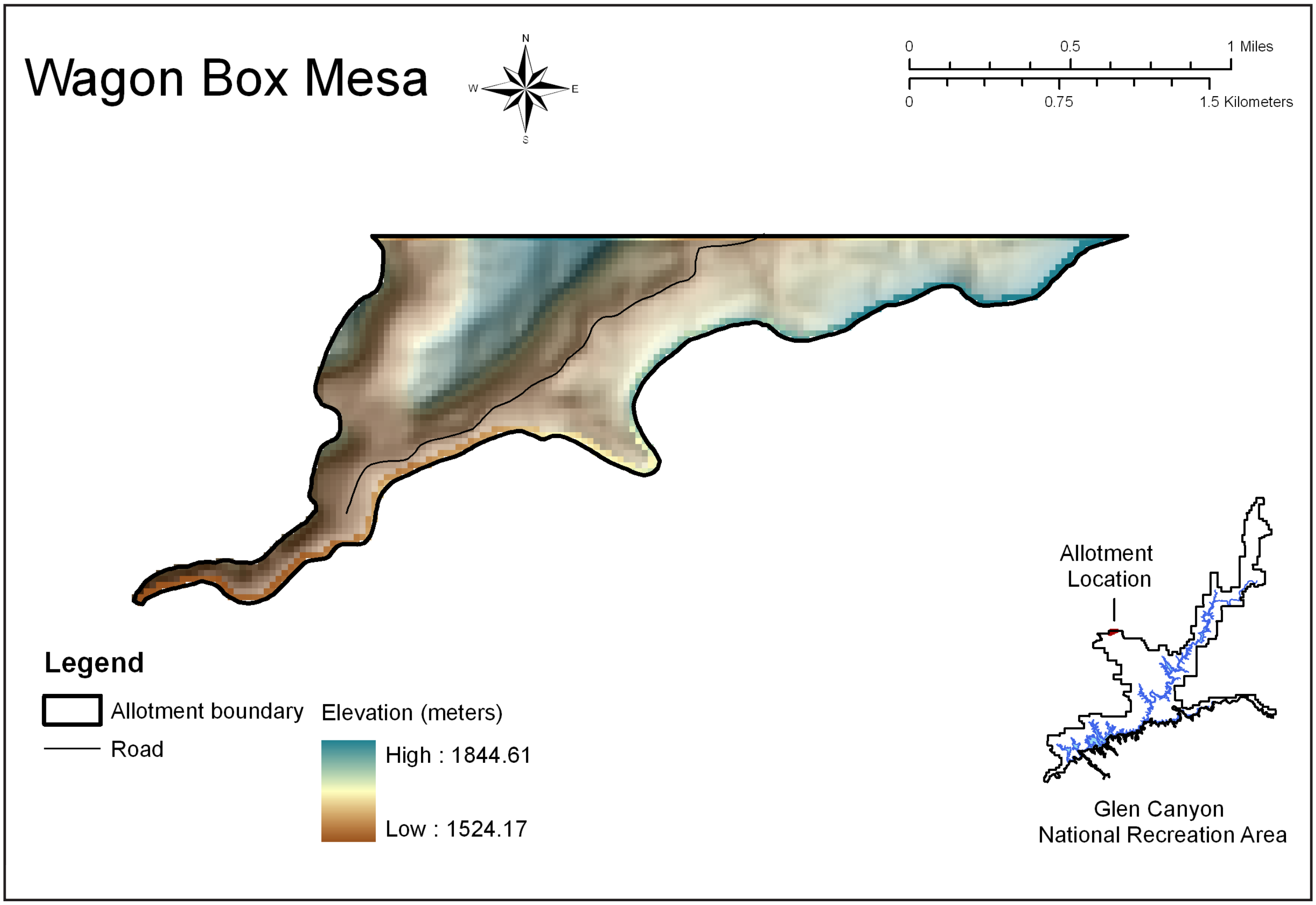
Distribution of Cultural Sites by Geological Location:

One historic site (n = 1) is located on alluvial gravel deposits. Two sites (n = 2), including one Ancestral Puebloan sites and one site for which attribute/affiliation information is not currently known, are located on Dakota Formation geology. Five sites (n = 5), including four Archaic sites and one artifact scatter, are located on mixed eolian and alluvial deposits. Eleven sites (n = 11) are located on Morrison Formation geology. These sites include one Ancestral Puebloan site, one Formative site, two Archaic sites, five lithic scatters, and two sites for which attribute/affiliation information is not currently available.



Wagon Box Mesa

Map Panels



Total Area: 692.78 acres

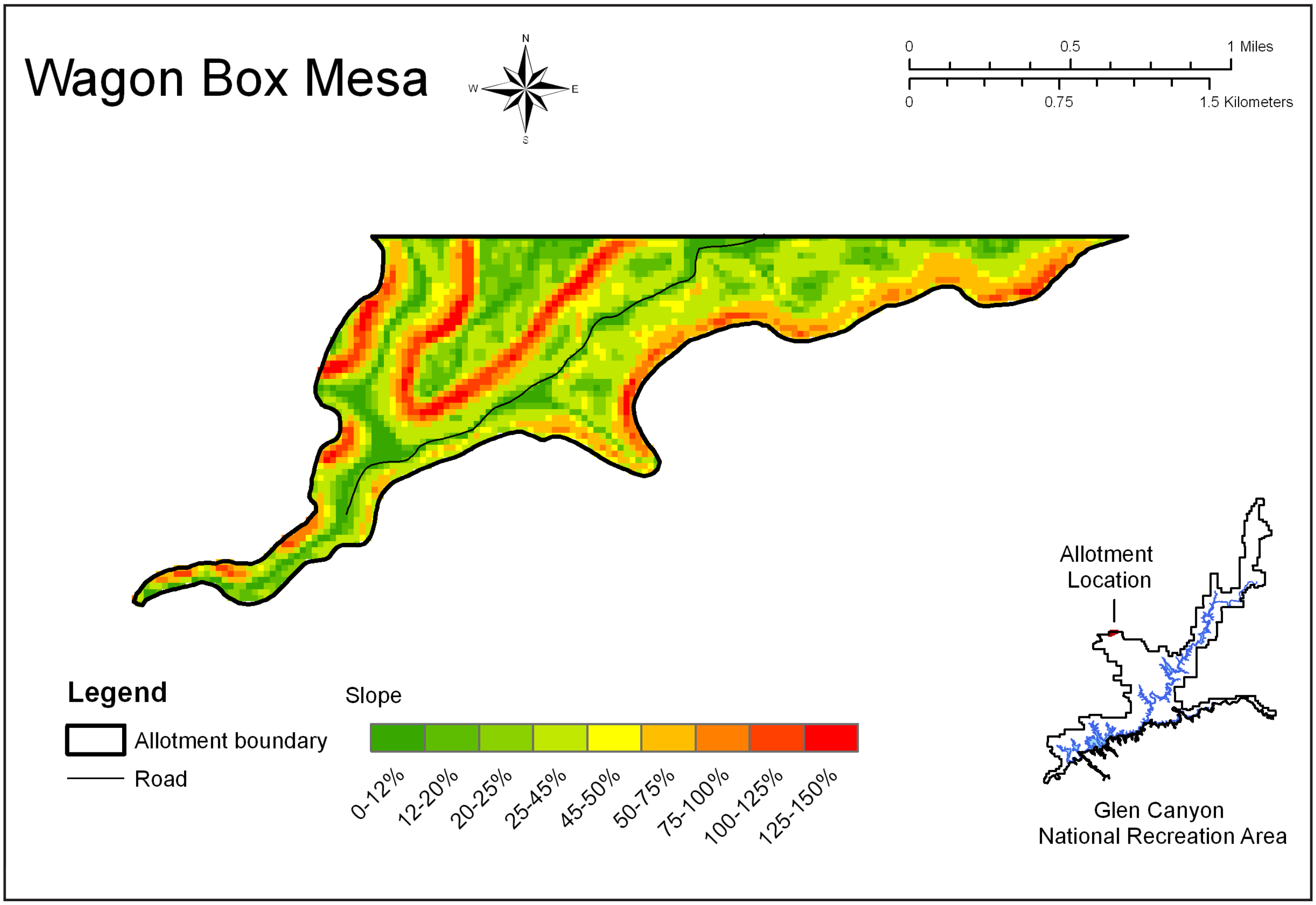
Sampling Fractions:
2 percent: 13.86 acres
5 percent: 34.64 acres
11 percent: 76.21 acres
16 percent: 110.84 acres
20 percent: 138.56 acres

Elevation range amsl:
1524.17 – 1844.61 meters (5000.56 - 6051.87 feet)

Rivers and Springs:
Silver Falls Creek (not depicted) is located in Wagon Box Mesa grazing allotment.

Accessibility:
A lateral roadway extending southwest from County Hwy 332 (Moody Canyon Road) and through Sliver Falls Creek provides access to the allotment.

No. Cultural Sites: 0
Area surveyed: 0.00 acres



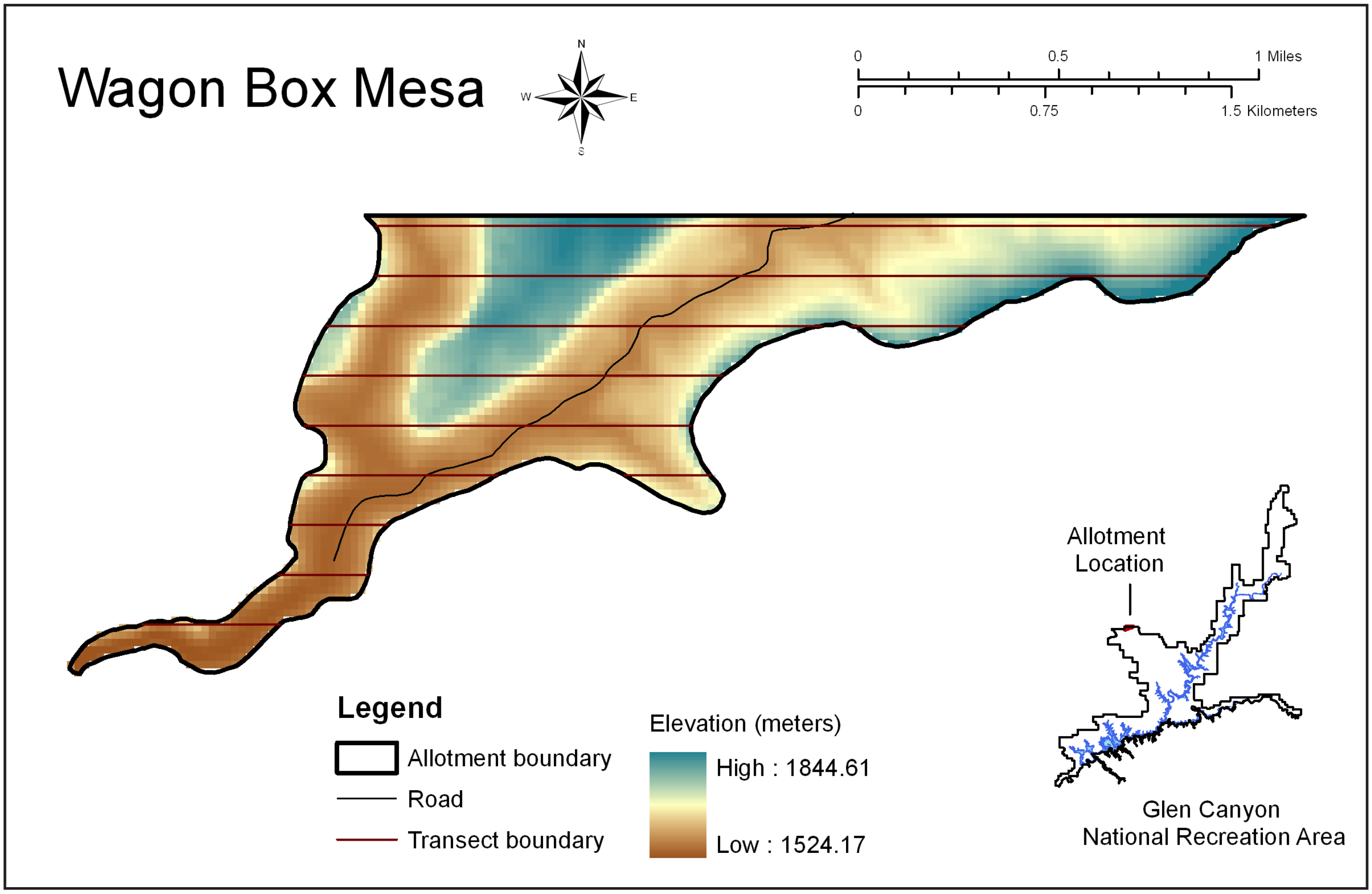
Slope Considerations:

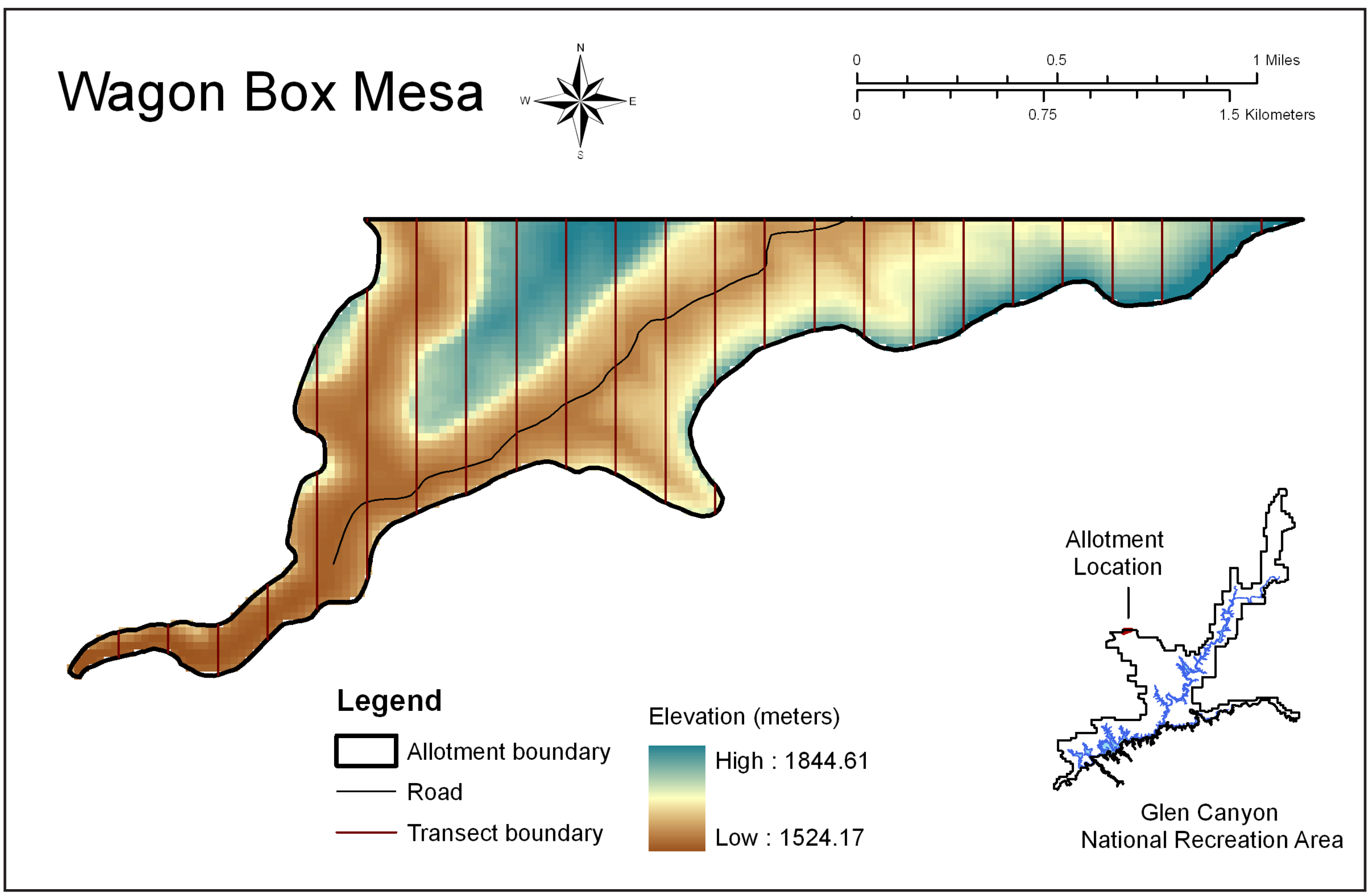
Slope plays a large role in terrain accessibility, and may be used in the stratification of survey areas. For example, GCNRA may wish to assign catagories such as low, moderate, and high to specific slope gradients. Such assignations are most often dependent on the factors guiding archaeological survey work, and as such, are not included in this document. Included herein, however, are suggestions for basic transect orientation based on the presence of topographical barriers identified by the presence of excessive slope gradients.

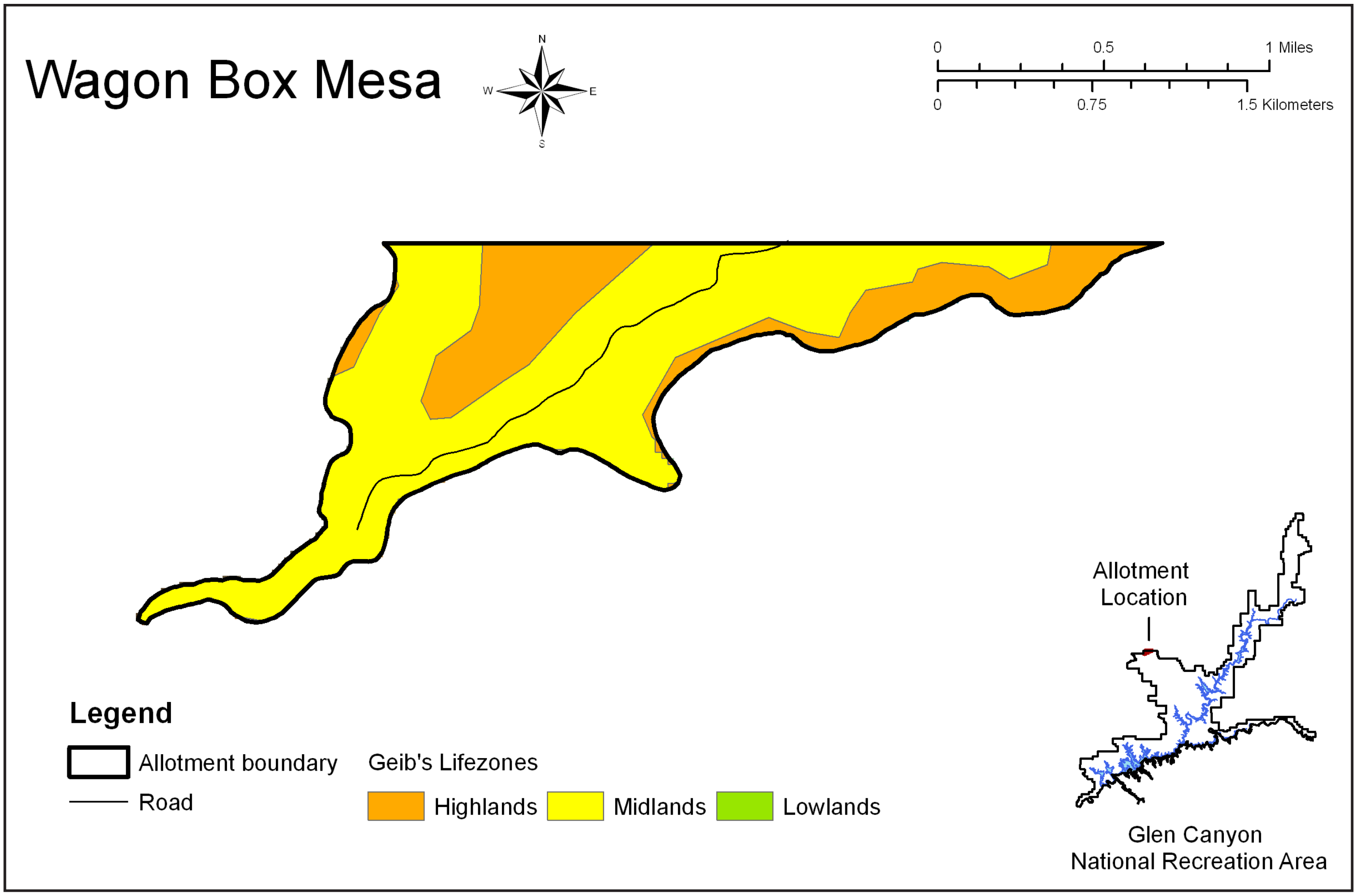
Survey Zones Dictated by Slope:

Access to the isolated mesa in the northwest portion of the allotment may prevent pedestrian survey of the top of the mesa. However, in the lower elevations, the road should provide access, and as is usual, transects should be placed perpendicular to the road wherever possible.

The 'fishnet' maps provided on the subsequent page display transects spaced at 200 meter intervals for both east-west and north-south oriented pedestrian survey.


Wagon Box Mesa
N
W
E
S
0
0.5
1 Miles
0
0.75
1.5 Kilometers
Allotment Location
Legend
Allotment boundary
Road
Transect boundary
Elevation (meters)
High : 1844.61
Low : 1524.17
Glen Canyon National Recreation Area


Wagon Box Mesa
N
W
E
S
0
0.5
1 Miles
0
0.75
1.5 Kilometers
Allotment Location
Legend
Allotment boundary
Road
Transect boundary
Elevation (meters)
High : 1844.61
Low : 1524.17
Glen Canyon National Recreation Area



Area of Each Lifezone:

Highlands:193.39 acres
Midlands: 495.72 acres
Lowlands: 0.00 acres

No. Cultural Sites in Each Lifezone:

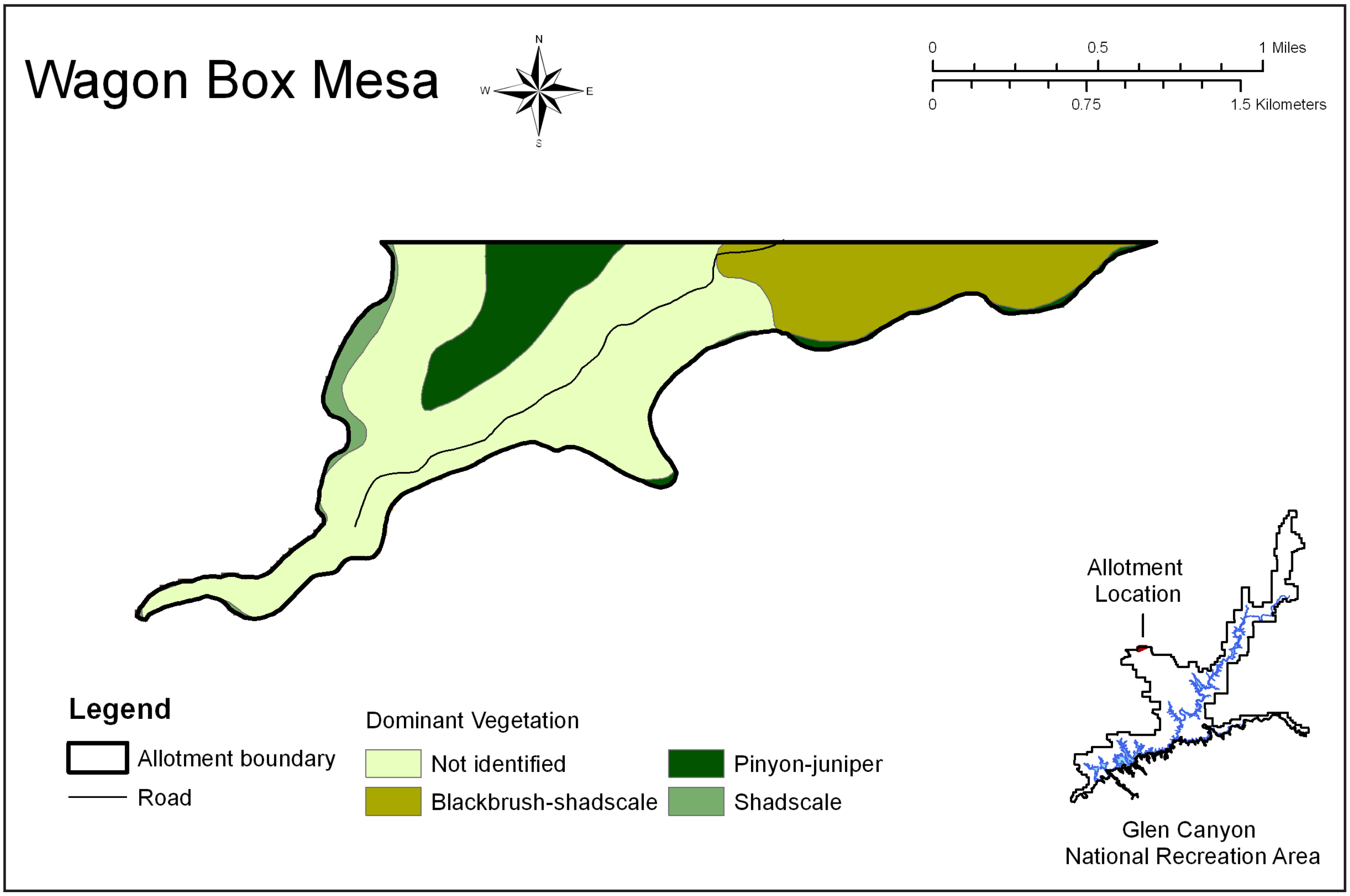
Highlands: 0
Midlands: 0
Lowlands: 0

Lifezone Significance and Known Cultural Sites:

No cultural sites are known for Wagon Box Mesa grazing allotment

	Elevation	Characteristics	Environment	Significance to Humans
Lowlands	1219-1372 m (4000-4500 ft)	Hot and arid steep-walled sandstone canyons.	Riparian plants; big-horn sheep	Permanent water, arable alluvium, long growing season, diverse plant communities, natural shelters, quality siliceous stone from river gravels
Midlands	1372-1676 m (4500-5500 ft)	Arid slickrock and dune fields on benchlands and low plateaus.	Blackbrush, shadscale, grasses; antelope.	Grasses, including dropseed and ricegrass, prickly pear and shadscale; good antelope habitat, quality siliceous stone in certain locations.
Highlands	Above 1676 m (Above 5500 ft)	High elevation mesas and plateaus with cooler temperatures and greater precipitation.	Pinyon-juniper woodlands; deer and rabbit.	Higher elevation plant foods (i.e. pinyon); later harvests; dry-farming; abundant fuel, deer and rabbit.

Shading indicates lifezones present in allotment.



Area of Individual Vegetation Zones:

Dominant Species	Acres Covered	No. Sites
Not identified	423.42	0
Blackbrush-shadscale *(Coleogyne ramosissima - Atriplex confertifolia)*	151.69	**0**
Pinyon-juniper *(Pinus edulis - Juniperus osteosperma)*	94.42	**0**
Shadscale *(Atriplex confertifolia)*	23.25	**0**
Total	**692.78**	**0**

No. Cultural Sites in Each Vegetation Zone:
No cultural sites are known for Wagon Box Mesa grazing allotment.

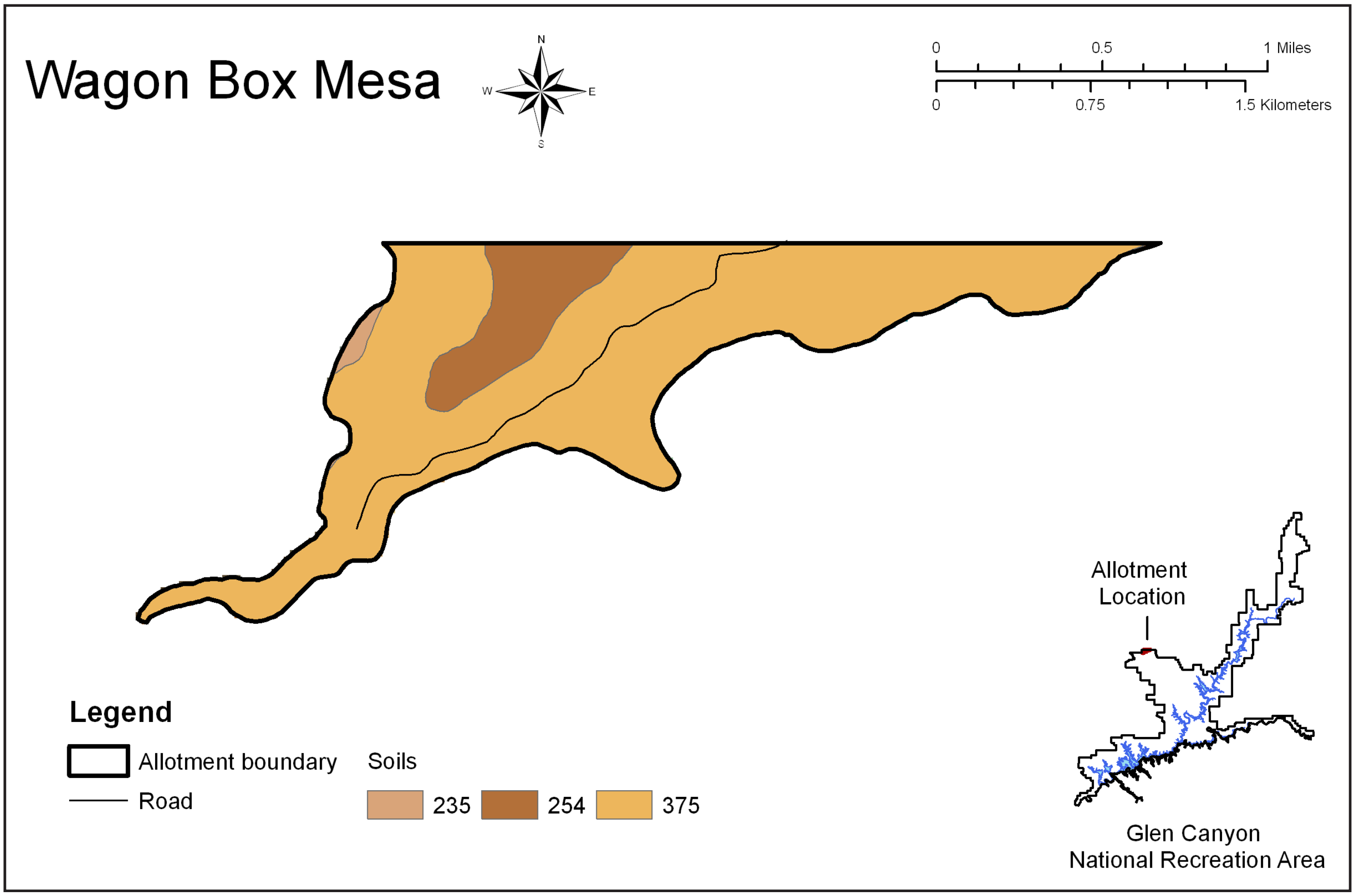
Visibility:
In general, the dominant vegetative communities of the allotment provide moderate - excellent ground visibility. However, in pinyon-juniper zones, built-up organic material beneath the trees may decrease ground visibility.

Summary:
Dominant vegetation for Slickrock grazing allotment includes blackbrush-shadscale (21.90 percent), pinyon-juniper (13.63 percent), and shadscale (3.36 percent). Dominant vegetation for the remainder of the allotment has not yet been identified.

Dominant Species:
Shadscale (*Atriplex confertifolia*)
Blackbrush (*Coleogyne ramosissima*)
Pinyon (*Pinus edulis*)
Juniper (*Juniperus osteosperma*)

Secondary Dominant Species:
Mat saltbush (*Atriplex corrugata*)

Associated Soils:
Blackbrush-shadscale dominates in talus, where it may be associated with mat saltbush in shallow clay. Pinyon-juniper occurs in sand loam, and shadscale grows in shallow sandy loam.

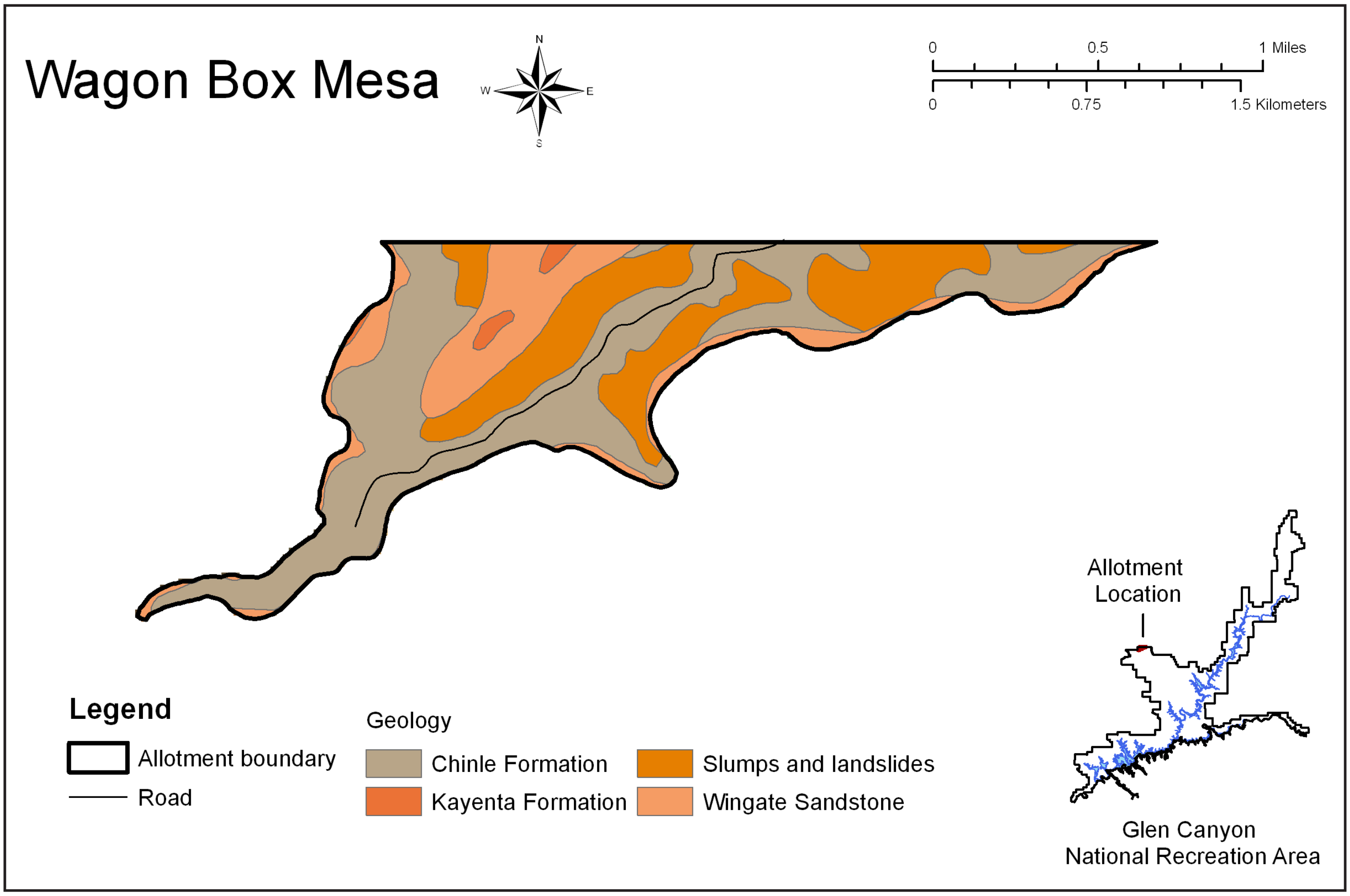


Allotment Divided by Soil Type (MUSYM):

Soil Type	Acres	Percent	No. Cultural Sites
235	7.16	1.03	0
254	85.40	12.33	0
375	600.22	86.64	0
Total	**692.78**	**100%**	**0**

Distribution of Cultural Sites by Soil Type:

No cultural sites are known for Wagon Box Mesa grazing allotment.



Allotment Divided by Geology:

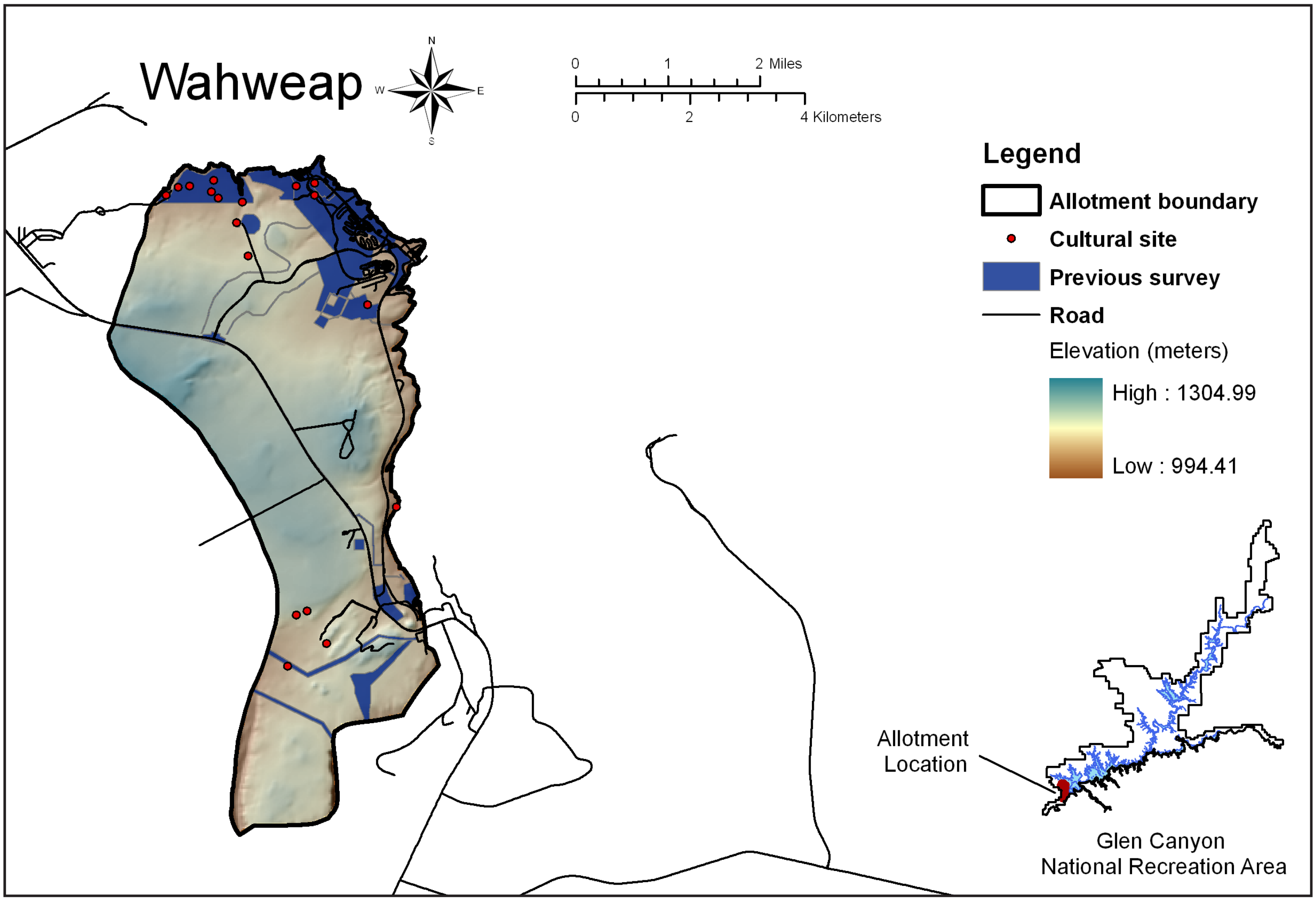
Geology	Acres	Percent	No. Cultural Sites
Chinle Formation	350.12	50.54	0
Kayenta Formation	9.27	1.34	0
Slumps and landslides	194.16	28.03	0
Wingate Sandstone	139.20	20.09	0
Total	**692.75**	**100%**	**0**

Distribution of Cultural Sites by Geological Location:

No cultural sites are known for Wagon Box Mesa at this time.

Wahweap

Map Panels



Total Area: 9199.52 acres

Sampling Fractions:
2 percent: 183.99 acres
5 percent: 459.98 acres
11 percent: 1011.95 acres
16 percent: 1471.92 acres
20 percent: 1839.90 acres

Elevation range amsl:
994.41 – 1304.99 meters (3262.5 - 4281.46 feet)

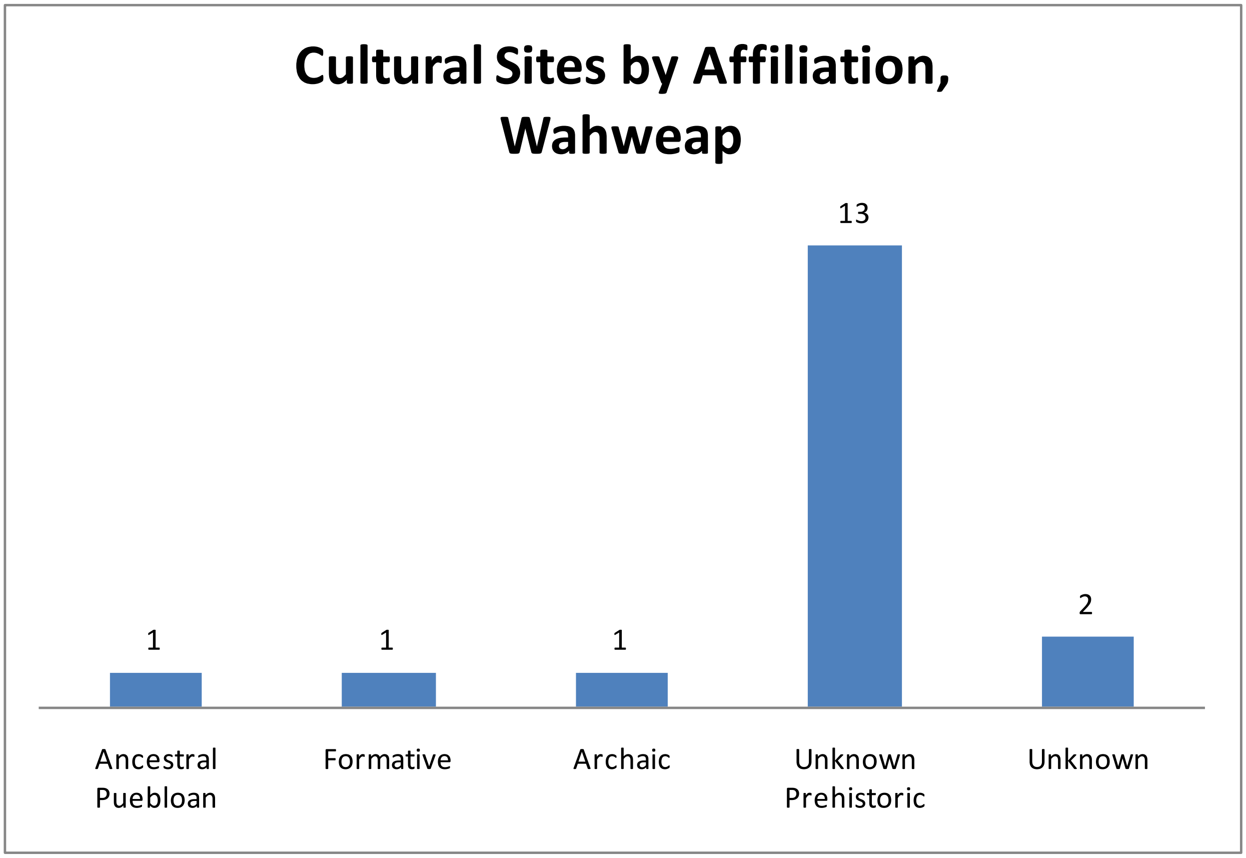
Rivers and Springs:
None known.

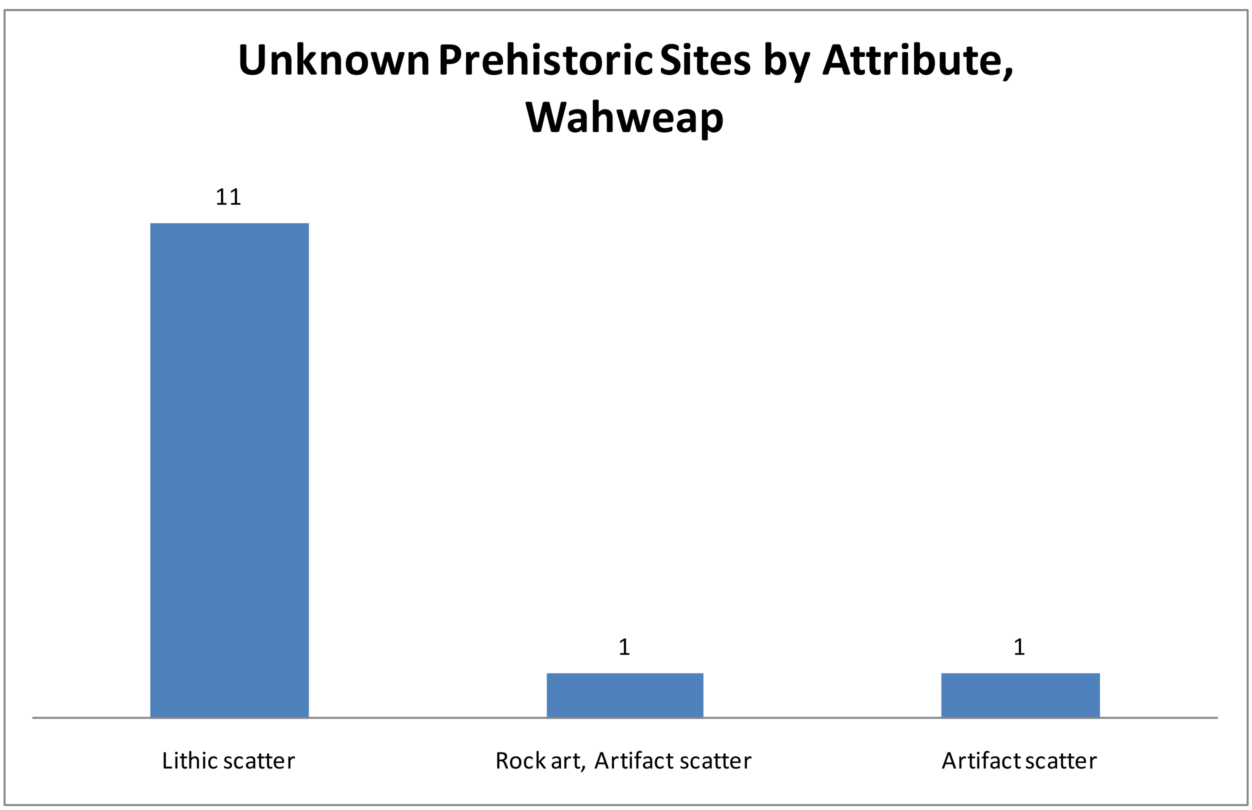
Accessibility:
State Hwy 89 and numerous lateral roadways provide access to Wahweap grazing allotment. Camping is available in Wahweap, where a ranger station and boat ramp are also present. Lake Powell serves as the eastern boundary of Wahweap, so boat access is also available.

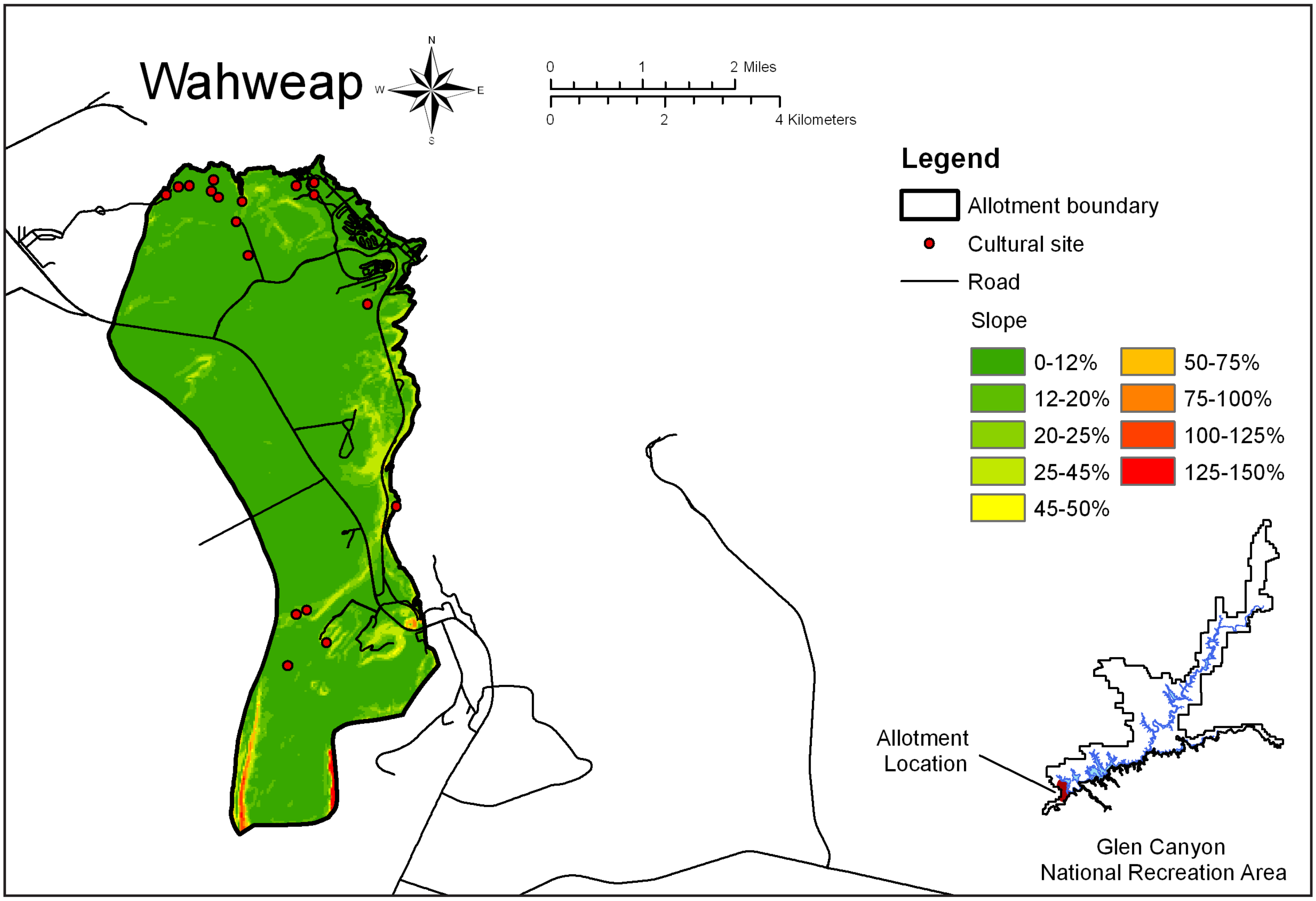
No. Cultural Sites: 18
Area surveyed: 1202.16 acres

Survey References:
Berg (1994): 7.68 acres
Dominguez and Vawser (??): 541.58 acres
Greenwald and Berg (??): 7.21 acres
Hagopian (2007): 53.17 acres
Johnson (2000): 61.04 acres
Kincaid and Goetze (??): 1.28 acres
Kincaid (1986d): 2.00 acres
Kincaid (1987): 56.90 acres
Kincaid (1988b): 0.73 acres
Kincaid (1988f): 3.17 acres
Kincaid (1989b): 21.87 acres
Kincaid (1989d): 0.89 acres
Moffitt et al. (1978): 25.37 acres
Nielson (1989): 47.86 acres
Phillips (1991): 74.25 acres
Tipps (1984): 37.84 acres
Tipps (1984b): 20.52 acres
Tipps (1987): 381.11 acres
Weaver (1990): 27.76 acres

The figures on the subsequent page depict cultural sites by affiliation, and for those prehistoric sites for which affiliation is not known, site attributes.


Cultural Sites by Affiliation, Wahweap
1
1
1
13
2
Ancestral Puebloan
Formative
Archaic
Unknown Prehistoric
Unknown


Unknown Prehistoric Sites by Attribute, Wahweap
11
1
1
Lithic scatter
Rock art, Artifact scatter
Artifact scatter



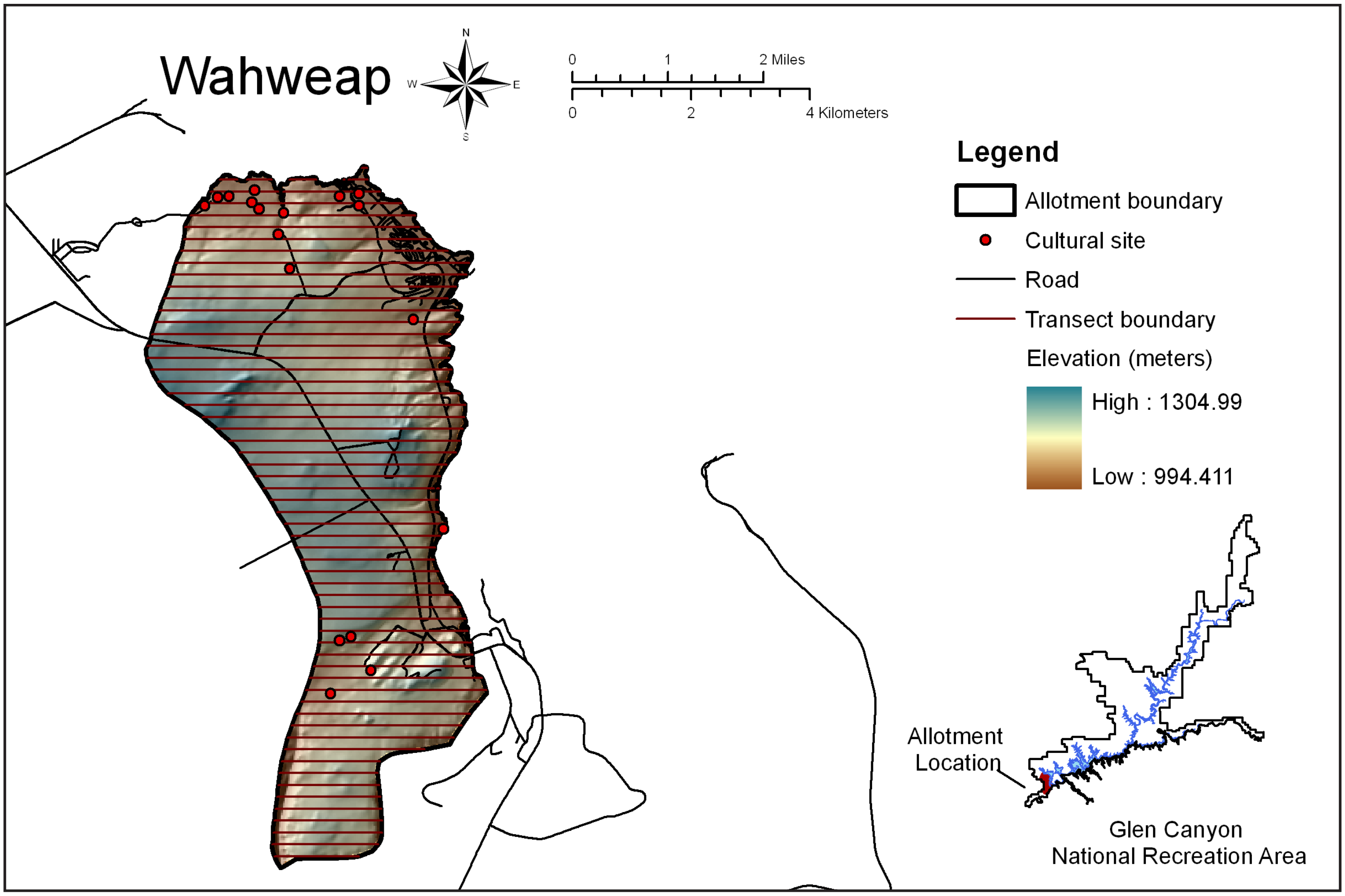
Slope Considerations:

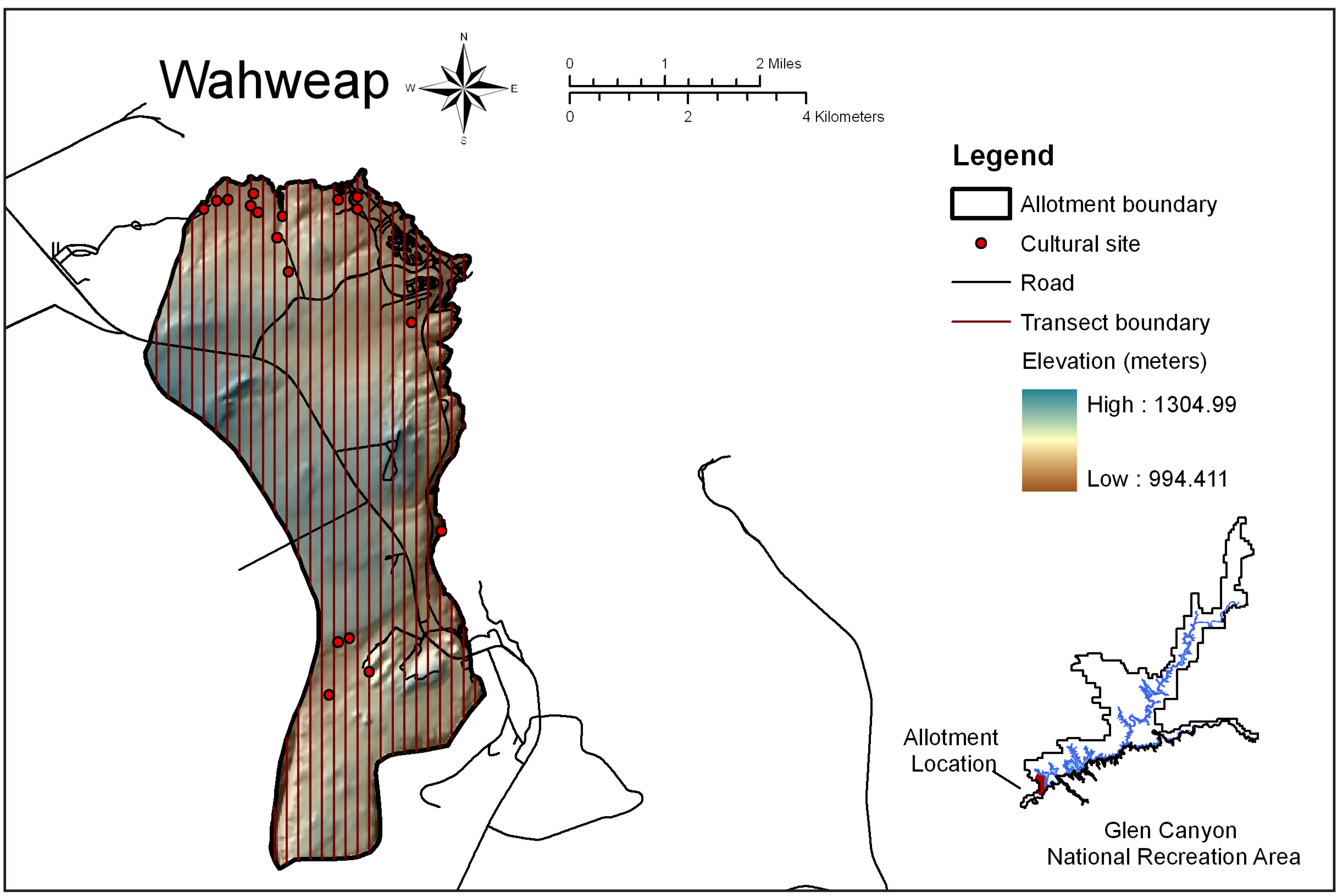
Slope plays a large role in terrain accessibility, and may be used in the stratification of survey areas. For example, GCNRA may wish to assign catagories such as low, moderate, and high to specific slope gradients. Such assignations are most often dependent on the factors guiding archaeological survey work, and as such, are not included in this document. Included herein, however, are suggestions for basic transect orientation based on the presence of topographical barriers identified by the presence of excessive slope gradients.

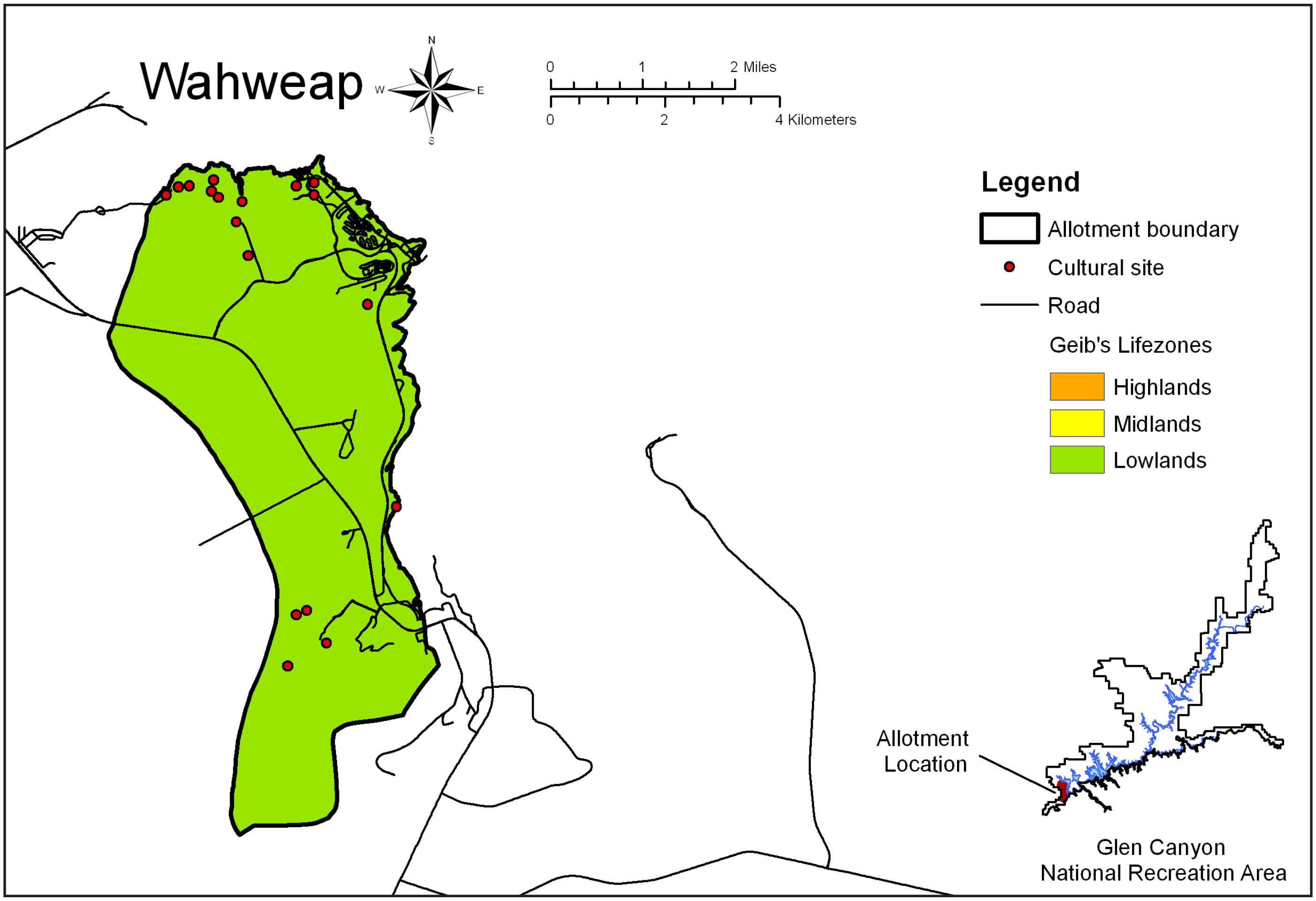
Survey Zones Dictated by Slope:

Slope does not provide access problems in Wahweap allotment. Roads provide access through the north and center of the allotment, and lake access is available along the southeast-east side of the allotment. As is usual, recommended transect orientation is perpendicular to the access points.

The 'fishnet' maps provided on the subsequent page display transects spaced at 200 meter intervals for both east-west and north-south oriented pedestrian survey.


Wahweap
N
W
E
S
0
1
2 Miles
0
2
4 Kilometers
Legend
Allotment boundary
Cultural site
Road
Transect boundary
Elevation (meters)
High : 1304.99
Low : 994.411
Allotment Location
Glen Canyon National Recreation Area


Wahweap
N
W
E
S
0
1
2 Miles
0
2
4 Kilometers
Legend
Allotment boundary
Cultural site
Road
Transect boundary
Elevation (meters)
High : 1304.99
Low : 994.411
Allotment Location
Glen Canyon National Recreation Area



Area of Each Lifezone:

Highlands: 0.00 acres
Midlands: 0.00 acres
Lowlands: 9199.52 acres

No. Cultural Sites in Each Lifezone:

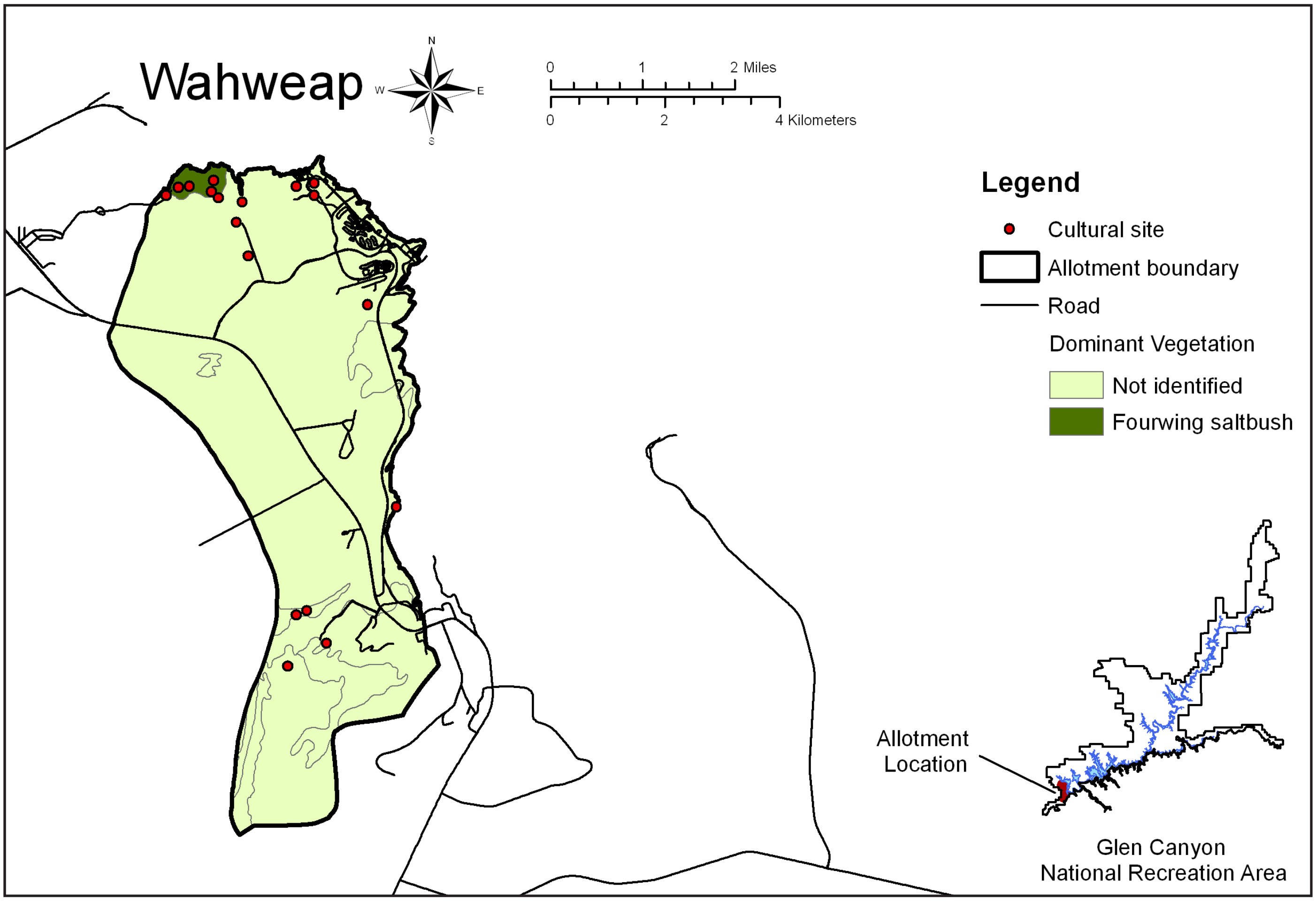
Highlands: 0
Midlands: 0
Lowlands: 18

Lifezone Significance and Known Cultural Sites:

All of Wahweap grazing allotment is located in Geib's Lowland lifezone. Geib describes the lowlands as hot and arid, but containing permanent water sources, arable alluvium, and long growing seasons suitable to agriculture. In addition, diverse plant communities, natural shelters, and raw materials suitable to the manufacture of stone tools were also available to prehistoric people in the lowlands. Eighteen sites (n = 18) are currently known for this allotment.

	Elevation	Characteristics	Environment	Significance to Humans
Lowlands	1219-1372 m (4000-4500 ft)	Hot and arid steep-walled sandstone canyons.	Riparian plants; big-horn sheep	Permanent water, arable alluvium, long growing season, diverse plant communities, natural shelters, quality siliceous stone from river gravels
Midlands	1372-1676 m (4500-5500 ft)	Arid slickrock and dune fields on benchlands and low plateaus.	Blackbrush, shadscale, grasses; antelope.	Grasses, including dropseed and ricegrass, prickly pear and shadscale; good antelope habitat, quality siliceous stone in certain locations.
Highlands	Above 1676 m (Above 5500 ft)	High elevation mesas and plateaus with cooler temperatures and greater precipitation.	Pinyon-juniper woodlands; deer and rabbit.	Higher elevation plant foods (i.e. pinyon); later harvests; dry-farming; abundant fuel, deer and rabbit.

Shading indicates lifezones present in allotment.



Area of Individual Vegetation Zones:

Dominant Species	Acres Covered	No. Sites
Not identified	9085.69	14
Fourwing saltbush *(Atriplex canescens)*	113.83	4
Total	**9199.52**	**18**

No. Cultural Sites in Each Vegetation Zone:
Four (n = 4) sites are located in fourwing saltbush, and the remainder (n = 14) are located in areas for which the dominant vegetation has not yet been identified.

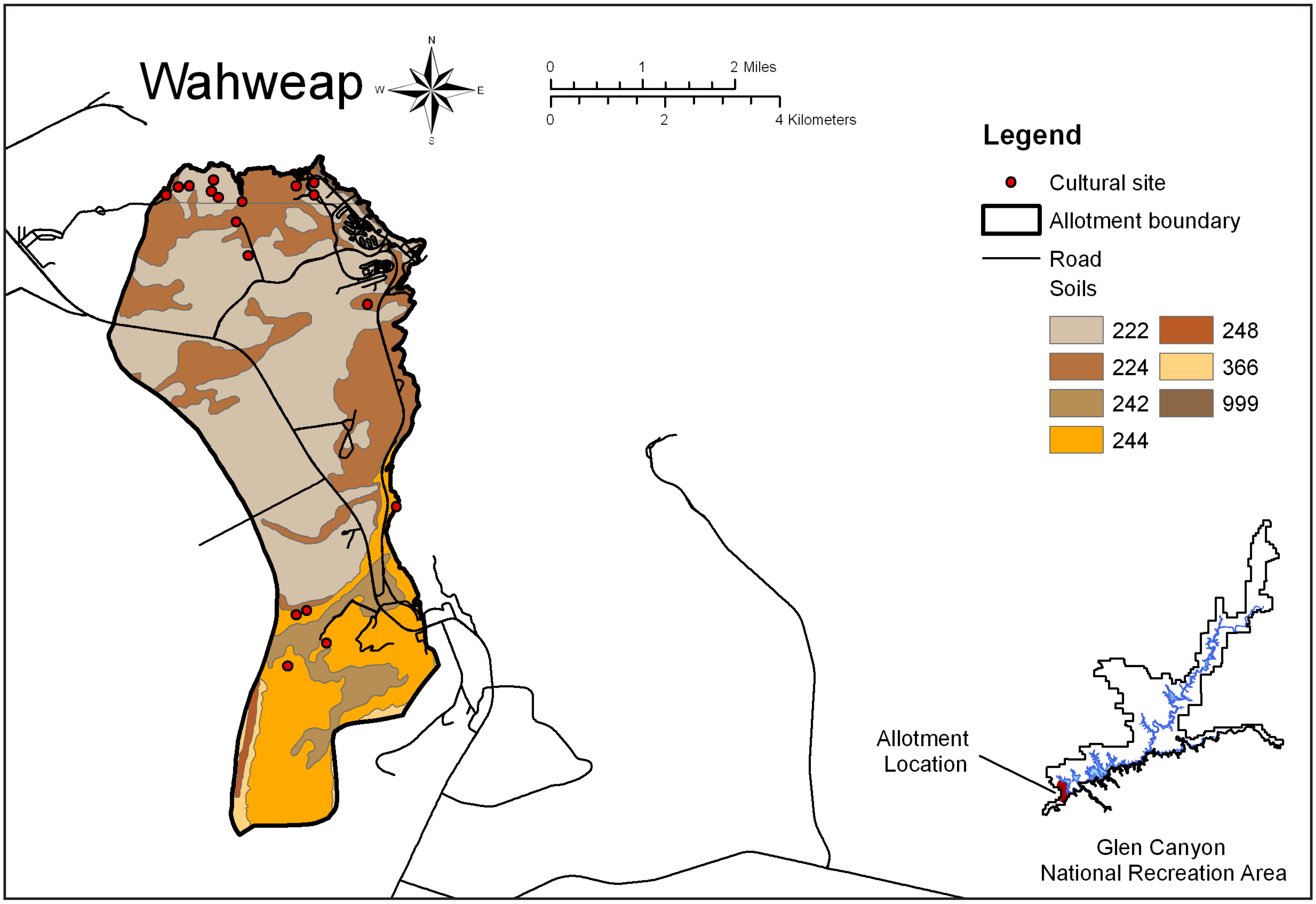
Visibility:
Although fourwing saltbush typically provides moderate - excellent ground visibility, the dominant vegetation, and therefore visibility, for the majority of the allotment is not currently known.

Summary:
Dominant vegetation for Wahweap grazing allotment includes fourwing saltbush (1.24 percent). Dominant vegetation for the majority (98.76 percent) of the allotment has not yet been identified.

Dominant Species:
Fourwing saltbush (*Atriplex canescens*)

Secondary Dominant Species:
Sand sagebrush (*Artemisia filifolia*)

Associated Soils:
Fourwing saltbush occurs in sandy loam, where it may be associated with sand sagebrush.

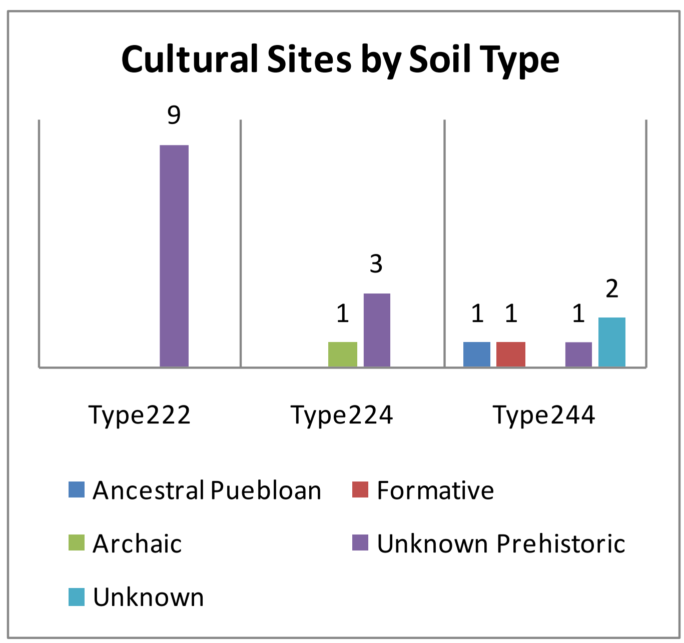


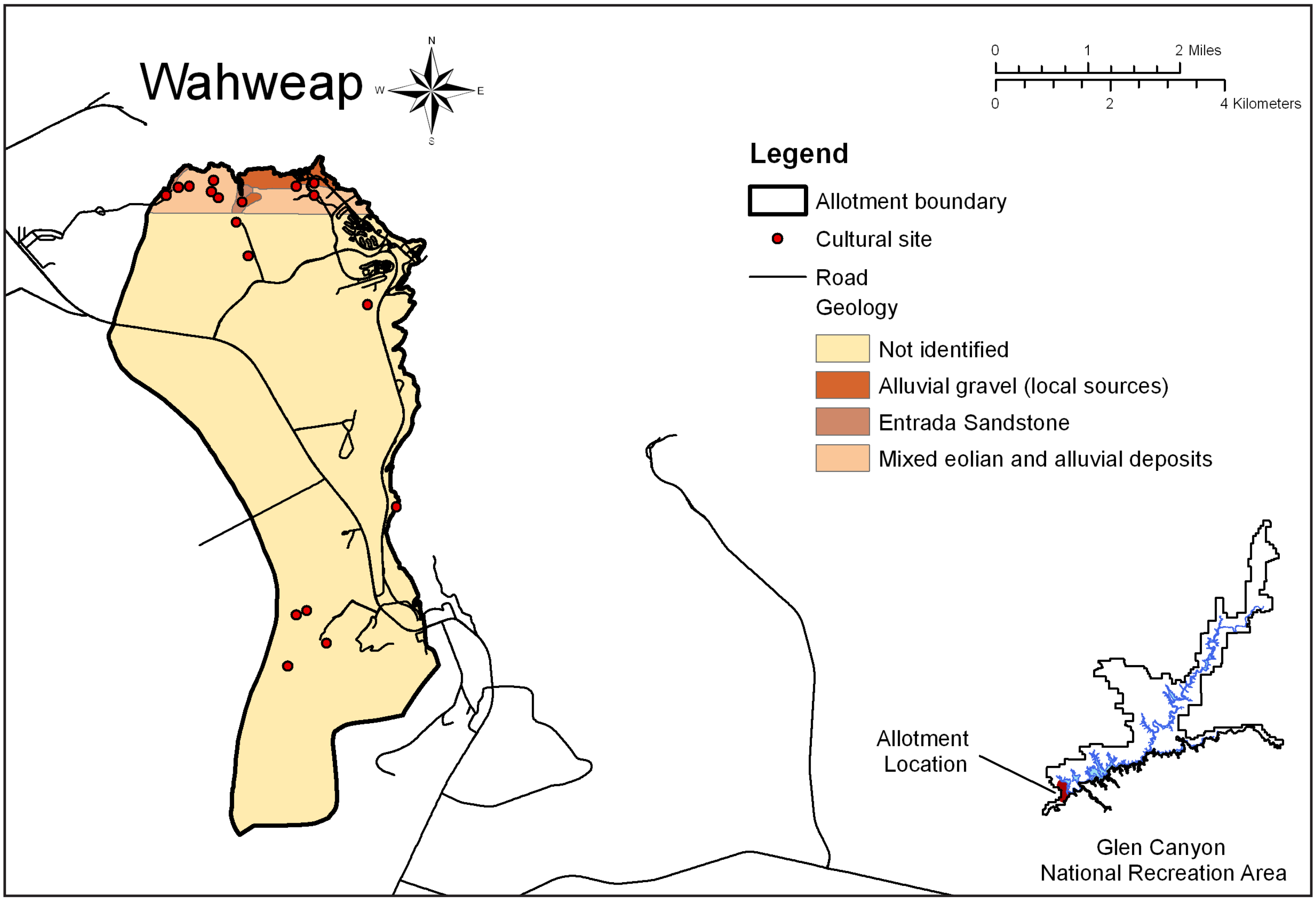
Allotment Divided by Soil Type (MUSYM):

Soil Type	Acres	Percent	No. Cultural Sites
222	4521.41	49.15	9
224	2096.04	22.78	4
242	546.46	5.94	0
244	1737.65	18.89	5
248	60.44	0.66	0
366	171.53	1.86	0
999	65.99	0.72	0
Total	**9199.52**	**100%**	**18**

Distribution of Cultural Sites by Soil Type:

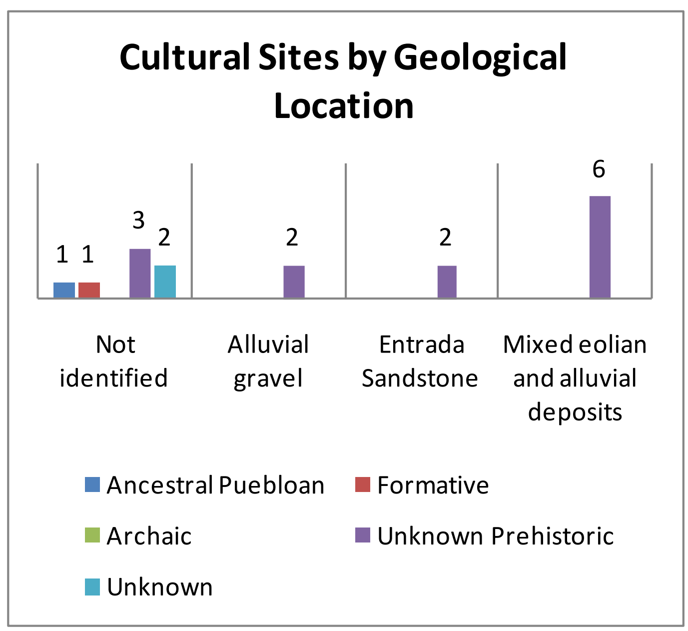
Nine (n = 9) sites, including eight lithic scatters and one artifact scatter, are located on soil type 222. Four (n = 4) sites, including one Archaic site and three lithic scatters, are located on soil type 224. Five sites (n = 5) are located on soil type 244, which is often associated with Navajo Sandstone, or slickrock. These sites include one Ancestral Puebloan site, one Formative site, one prehistoric groundstone scatter with associated rock art, and two sites for which attribute/affiliation information is currently not known.





Allotment Divided by Geology:

Geology	Acres	Percent	No. Cultural Sites
Not identified	8597.81	93.46	8
Alluvial gravel (local sources)	123.35	1.34	2
Entrada Sandstone	37.39	0.41	2
Mixed eolian and alluvial deposits.	440.97	4.79	6
Total	**9199.52**	**100%**	**18**

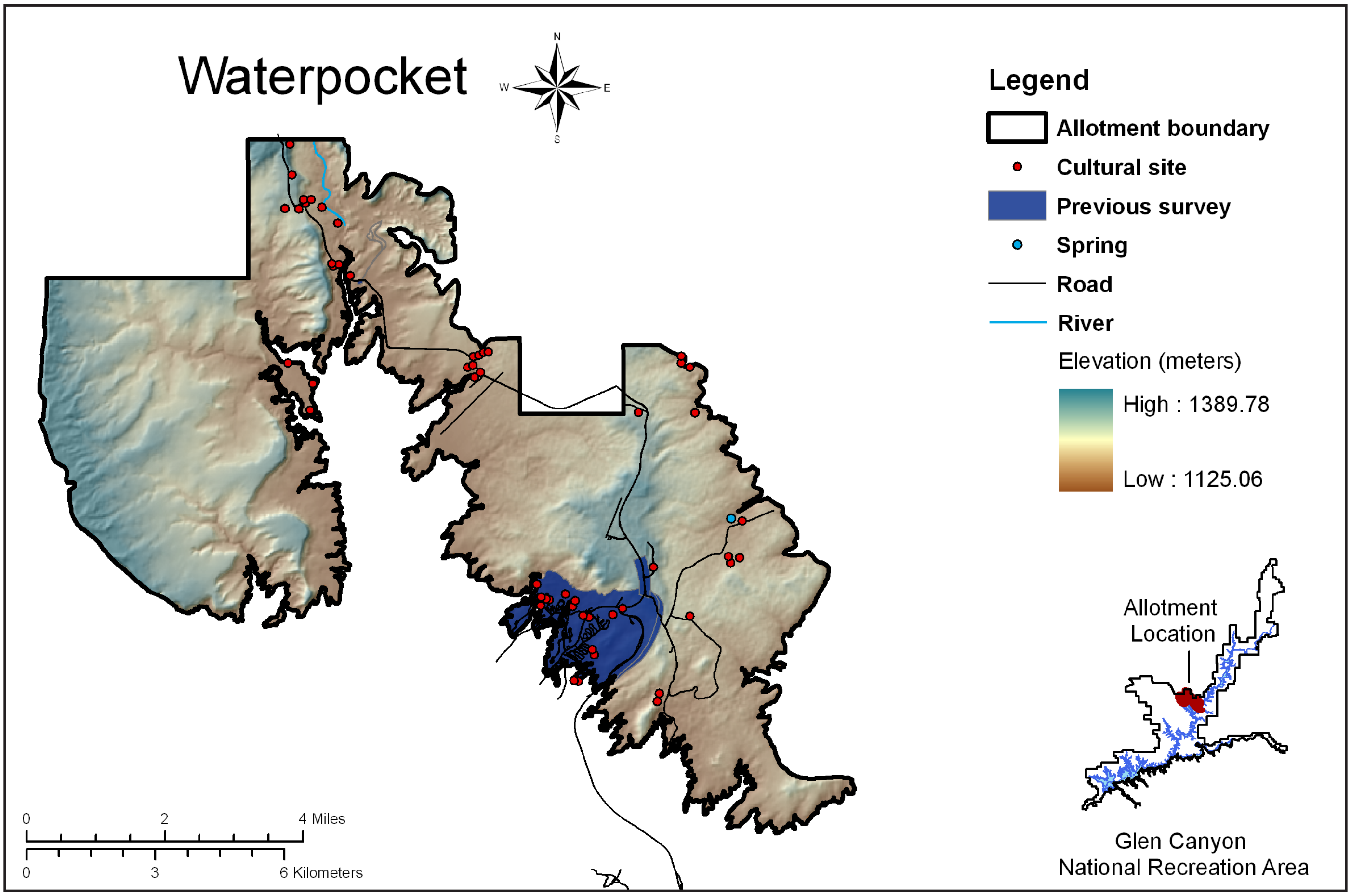


Distribution of Cultural Sites by Geological Location:

Two lithic scatters (n = 2) are located on alluvial gravel deposits. Two lithic scatters (n = 2) are located on Entrada Sandstone. Six sites (n = 6), including five lithic scatters and one artifact scatter, are located on mixed eolian and alluvial deposits. The remaining sites (n = 8) are located in areas for which the geology is not currently available.

Waterpocket

Map Panels



Total Area: 30,037.49 acres

Sampling Fractions:
2 percent: 600.75 acres
5 percent: 1501.87 acres
11 percent: 3304.12 acres
16 percent: 4806.00 acres
20 percent: 6007.50 acres

Elevation range amsl:
1125.06 – 1389.78 meters (3691.14 - 4559.65 feet)

Rivers and Springs:
Wolf Spring and Bullfrog Creek are located in Waterpocket grazing allotment.

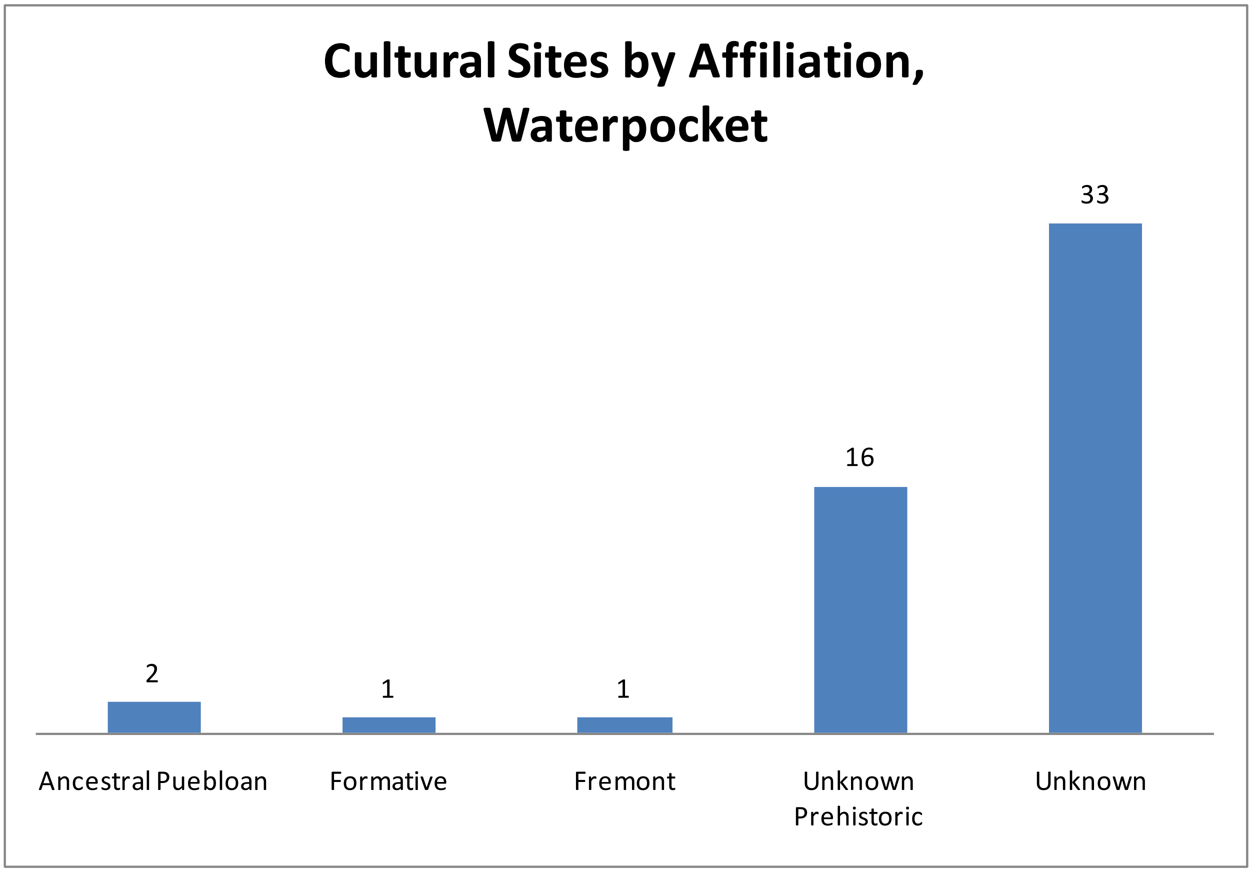
Accessibility:
County Hwy 531 provides the main access to Waterpocket grazing allotment. However, this road floods at lake elevation 3695 ft, and alternate access roads, including 533, 532, 530 and others may be needed. Camping is available at Bullfrog North, Bullfrog South, Bullfrog, and Stanton Creek. An airstrip is also located within allotment boundaries. Finally, Bullfrog Bay and Halls Creek Bay form the central and southwestern boundaries of the allotment, providing for potential lake access.

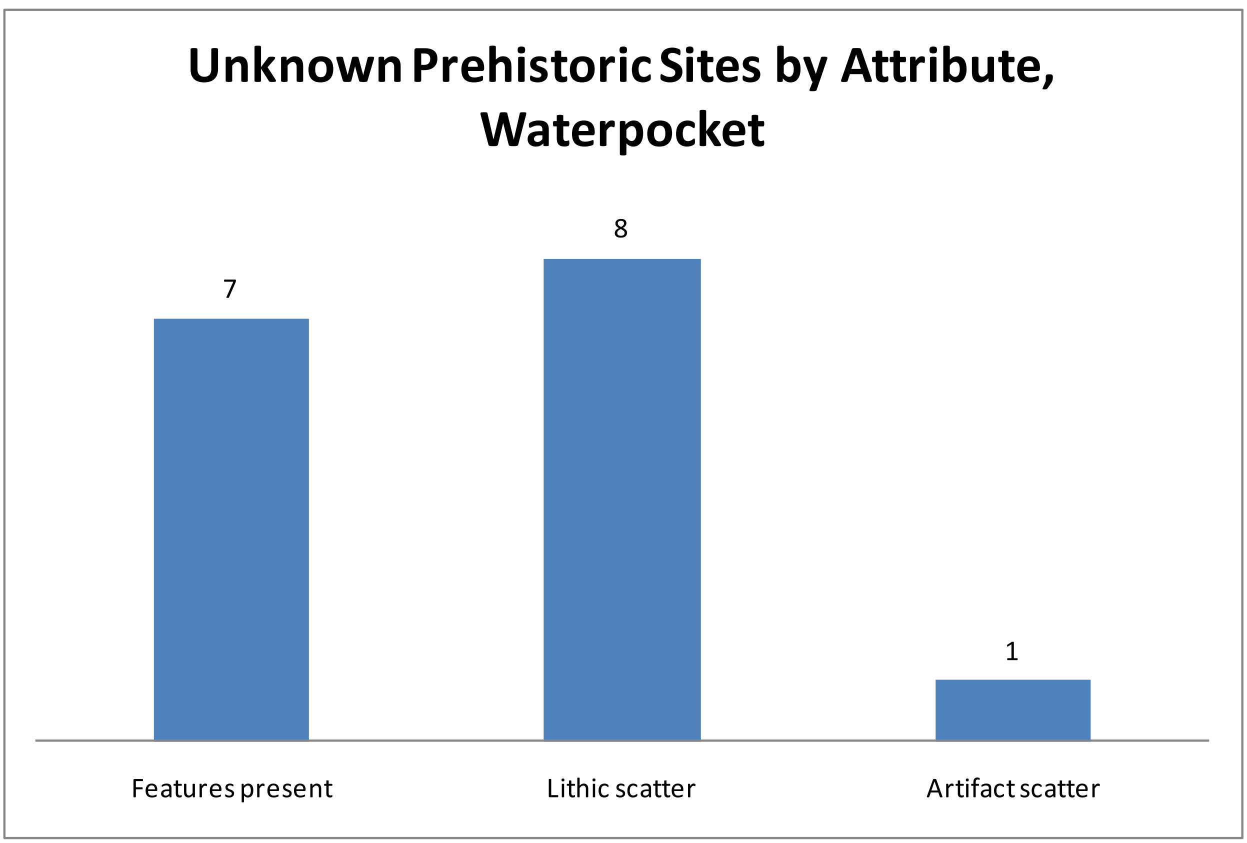
No. Cultural Sites: 53
Area surveyed: 1464.79 acres

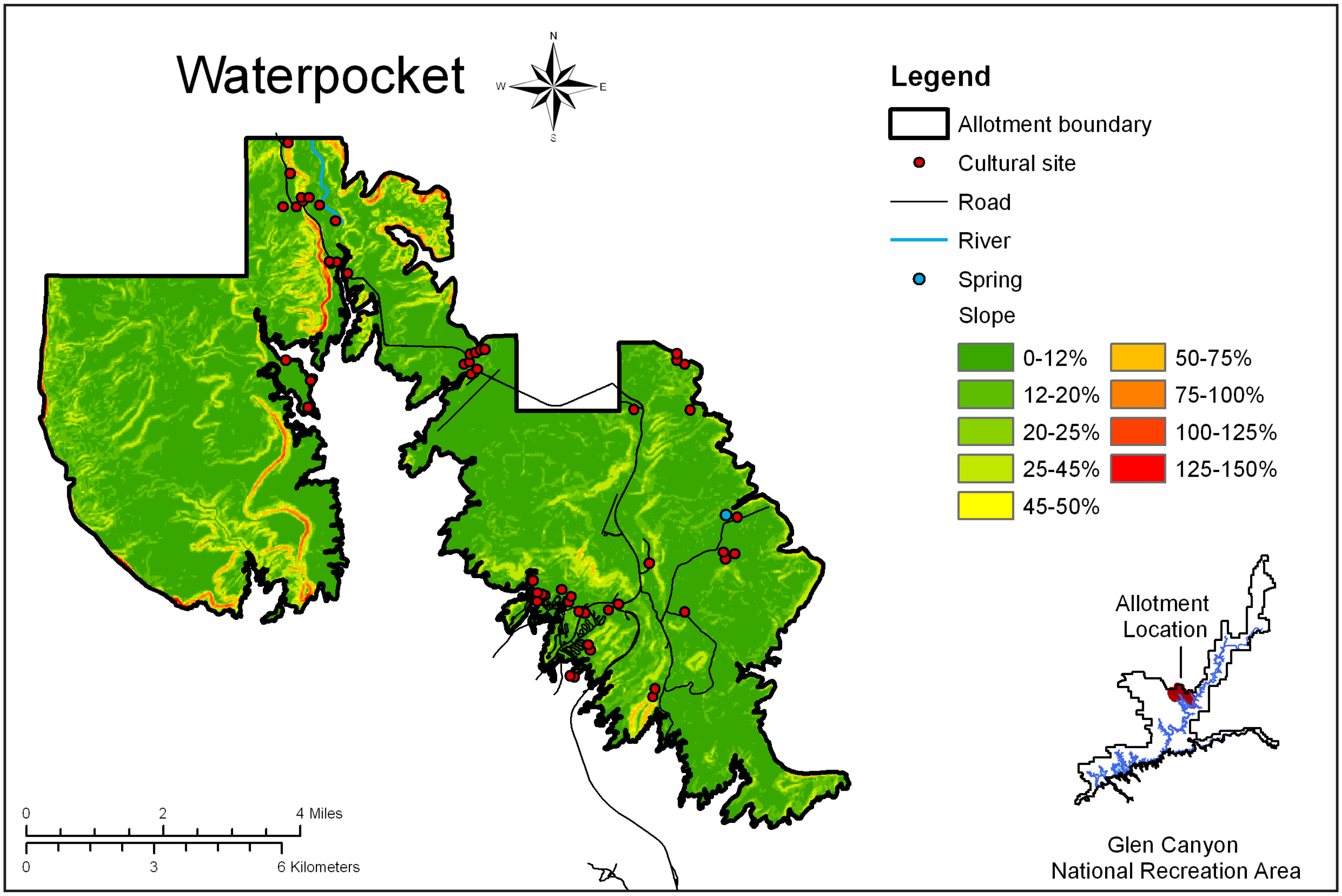
Survey References:
Baker (2004): 64.02 acres
Burchett (1996): 5.81 acres
Burchett and Goetze (??): 17.24 acres
Goetze and Hall (1994): 0.50 acres
Kincaid (1986a): 67.09 acres
Kincaid (1986b): 0.48 acres
Kincaid (1986c): 0.16 acres
Kincaid (1986i): 7.61 acres
Kincaid (1986j): 0.73 acres
Kincaid (1987a): 2.21 acres
Kincaid (1989a): 1.91 acres
Kincaid (1989b): 39.28 acres
Kincaid (1989c): 9.63 acres
Kincaid (1989d): 1.52 acres
Kincaid (1991b): 13.61 acres
Kincaid (1991c): 5.63 acres
Kincaid (1993a): 15.93 acres
Neal and Wenker (1997): 1333.29 acres*
SWCA (1997): 1347.43 acres*

The figures on the subsequent page depict cultural sites by affiliation, and for those prehistoric sites for which affiliation is not known, site attributes.

*Shape area differs slightly, but likely same project.


Cultural Sites by Affiliation, Waterpocket
2
1
1
16
33
Ancestral Puebloan
Formative
Fremont
Unknown Prehistoric
Unknown


Unknown Prehistoric Sites by Attribute, Waterpocket
7
8
1
Features present
Lithic scatter
Artifact scatter



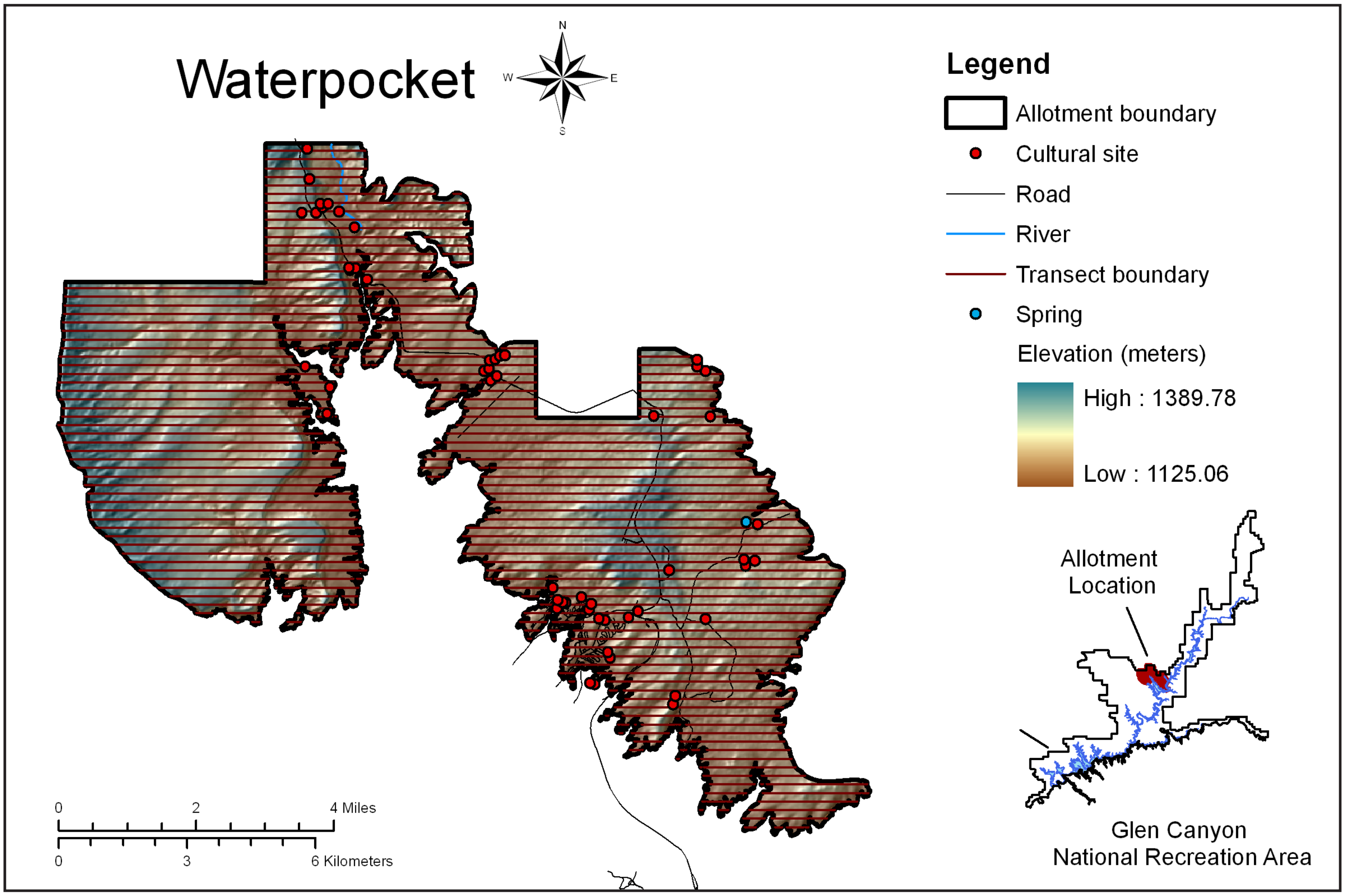
Slope Considerations:

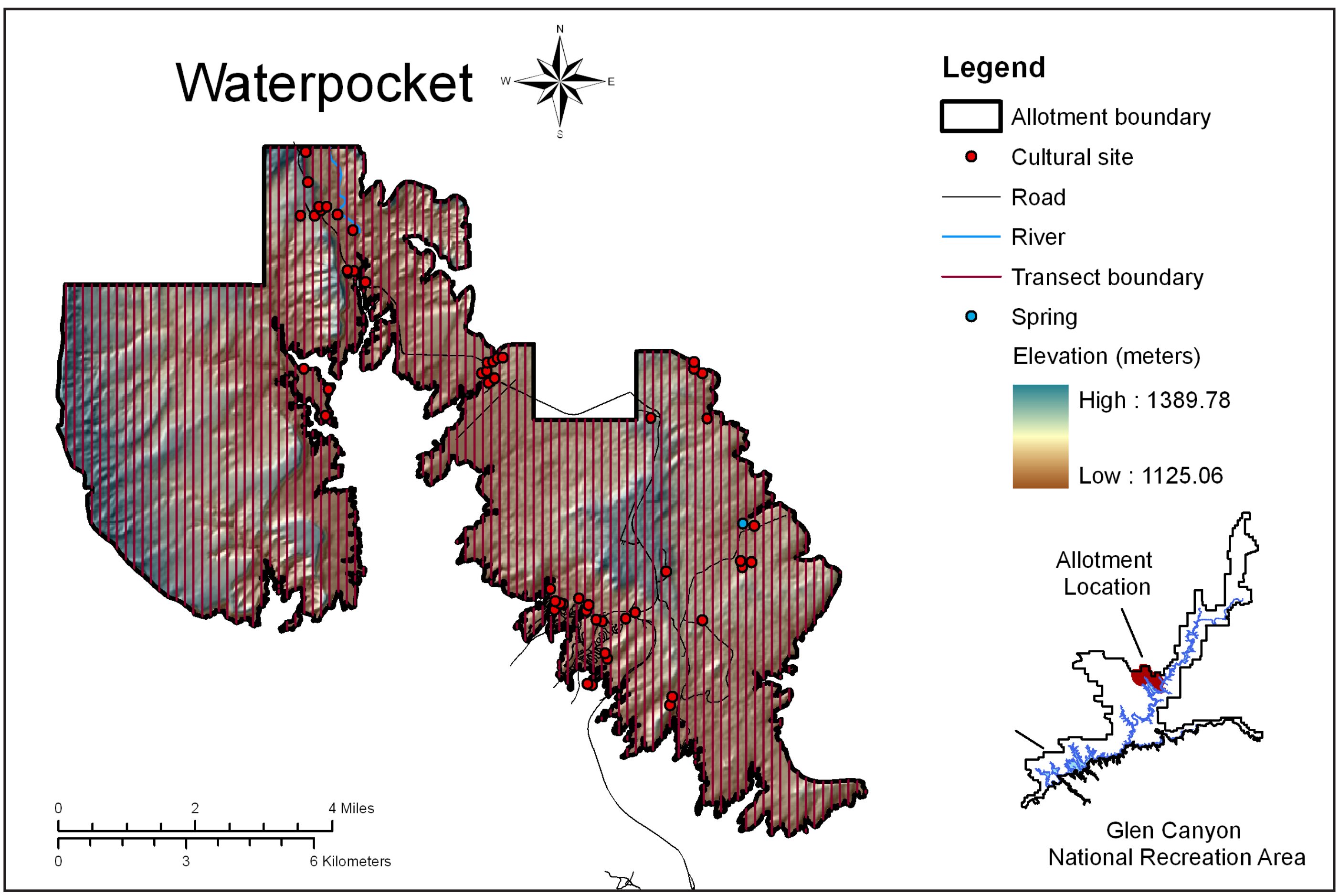
Slope plays a large role in terrain accessibility, and may be used in the stratification of survey areas. For example, GCNRA may wish to assign catagories such as low, moderate, and high to specific slope gradients. Such assignations are most often dependent on the factors guiding archaeological survey work, and as such, are not included in this document. Included herein, however, are suggestions for basic transect orientation based on the presence of topographical barriers identified by the presence of excessive slope gradients.

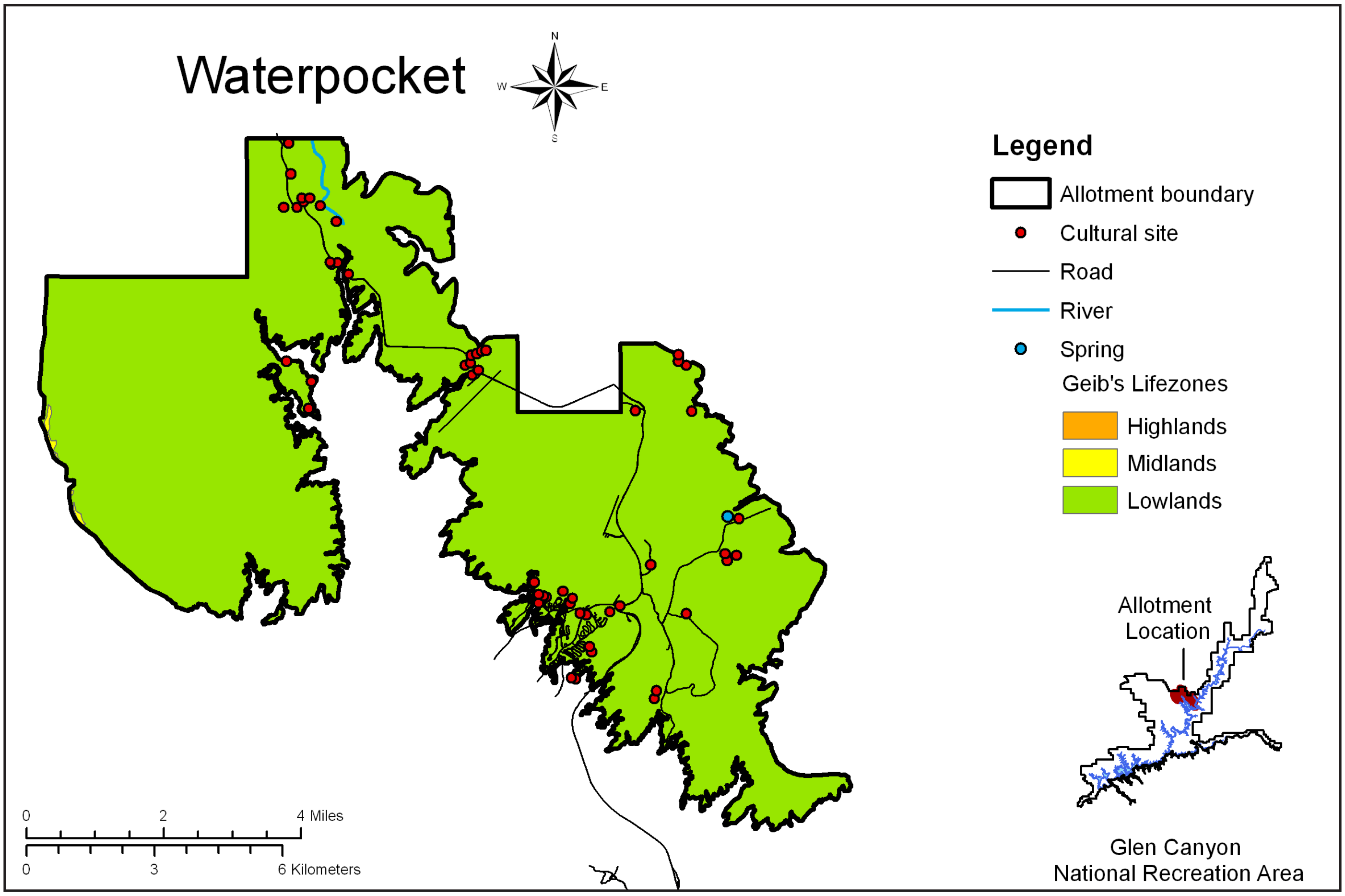
Survey Zones Dictated by Slope:

A steep north-south trending escarpment is present along the eastern edge of the western portion of the allotment. The west and east sides of the barrier will necessitate individual surveys. However, given that both roads and Lake Powell provide access to the allotment, this escarpment should not result in accessibility problems. Recommended transects should be set perpendicular to the access points (i.e. roads and Lake Powell).

The 'fishnet' maps provided on the subsequent page display transects spaced at 200 meter intervals for both east-west and north-south oriented pedestrian survey.


Waterpocket
N
W
E
S
Legend
Allotment boundary
Cultural site
Road
River
Transect boundary
Spring
Elevation (meters)
High : 1389.78
Low : 1125.06
Allotment Location
Glen Canyon National Recreation Area
0
2
4 Miles
0
3
6 Kilometers


Waterpocket
N
W
E
S
Legend
Allotment boundary
Cultural site
Road
River
Transect boundary
Spring
Elevation (meters)
High : 1389.78
Low : 1125.06
Allotment Location
Glen Canyon National Recreation Area
0
2
4 Miles
0
3
6 Kilometers



Area of Each Lifezone:

Highlands: 0.00 acres
Midlands: 39.32 acres
Lowlands: 29,853.83 acres

No. Cultural Sites in Each Lifezone:

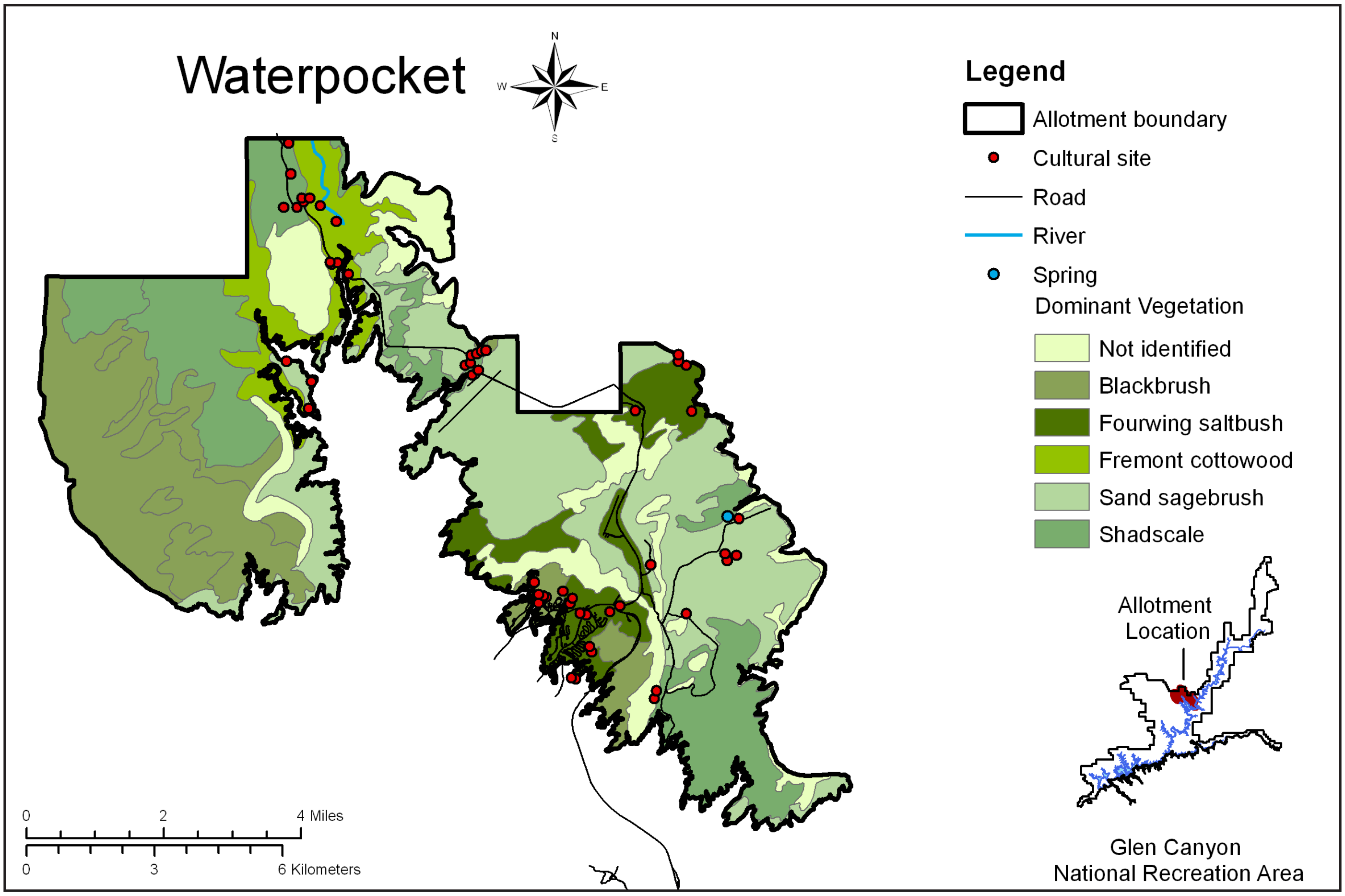
Highlands: 0
Midlands: 0
Lowlands: 53

Lifezone Significance and Known Cultural Sites:

Although both Lowland and Midland zones are present in Waterpocket, the lowlands dominate, and all known cultural sites (n = 53) are located in the lower elevations. Geib describes the lowlands as hot and arid, but containing permanent water sources, arable alluvium, and long growing seasons suitable to agriculture. In addition, diverse plant communities, natural shelters, and raw materials suitable to the manufacture of stone tools were also available to prehistoric people in the lowlands.

	Elevation	Characteristics	Environment	Significance to Humans
Lowlands	1219-1372 m (4000-4500 ft)	Hot and arid steep-walled sandstone canyons.	Riparian plants; bighorn sheep	Permanent water, arable alluvium, long growing season, diverse plant communities, natural shelters, quality siliceous stone from river gravels
Midlands	1372-1676 m (4500-5500 ft)	Arid slickrock and dune fields on benchlands and low plateaus.	Blackbrush, shadscale, grasses; antelope.	Grasses, including dropseed and ricegrass, prickly pear and shadscale; good antelope habitat, quality siliceous stone in certain locations.
Highlands	Above 1676 m (Above 5500 ft)	High elevation mesas and plateaus with cooler temperatures and greater precipitation.	Pinyon-juniper woodlands; deer and rabbit.	Higher elevation plant foods (i.e. pinyon); later harvests; dry-farming; abundant fuel, deer and rabbit.

Shading indicates lifezones present in allotment.



Area of Individual Vegetation Zones:

Dominant Species	Acres Covered	No. Sites
Not identified	3968.37	
Blackbrush ***(Coleogyne ramosissima)***	6721.92	7
Fourwing saltbush ***(Atriplex canescens)***	2493.48	
Fremont cottonwood ***(Populus fremontii)***	2098.24	
Sand sagebrush ***(Artemisia filifolia)***	8605.17	
Shadscale ***(Atriplex confertifolia)***	6150.31	
Total	**30,037.49**	**53**

No. Cultural Sites in Each Vegetation Zone:
Seven (n = 7) sites are located in blackbrush. Thirteen sites (n = 13) are located in fourwing saltbush. Seven sites (n = 7) are located in Fremont cottonwood. Fifteen (n = 15) sites are in sand sagebrush. Nine sites (n = 9) are located in shadscale, and the remainder (n = 2) are located in areas where the dominant vegetation has not yet been identified.

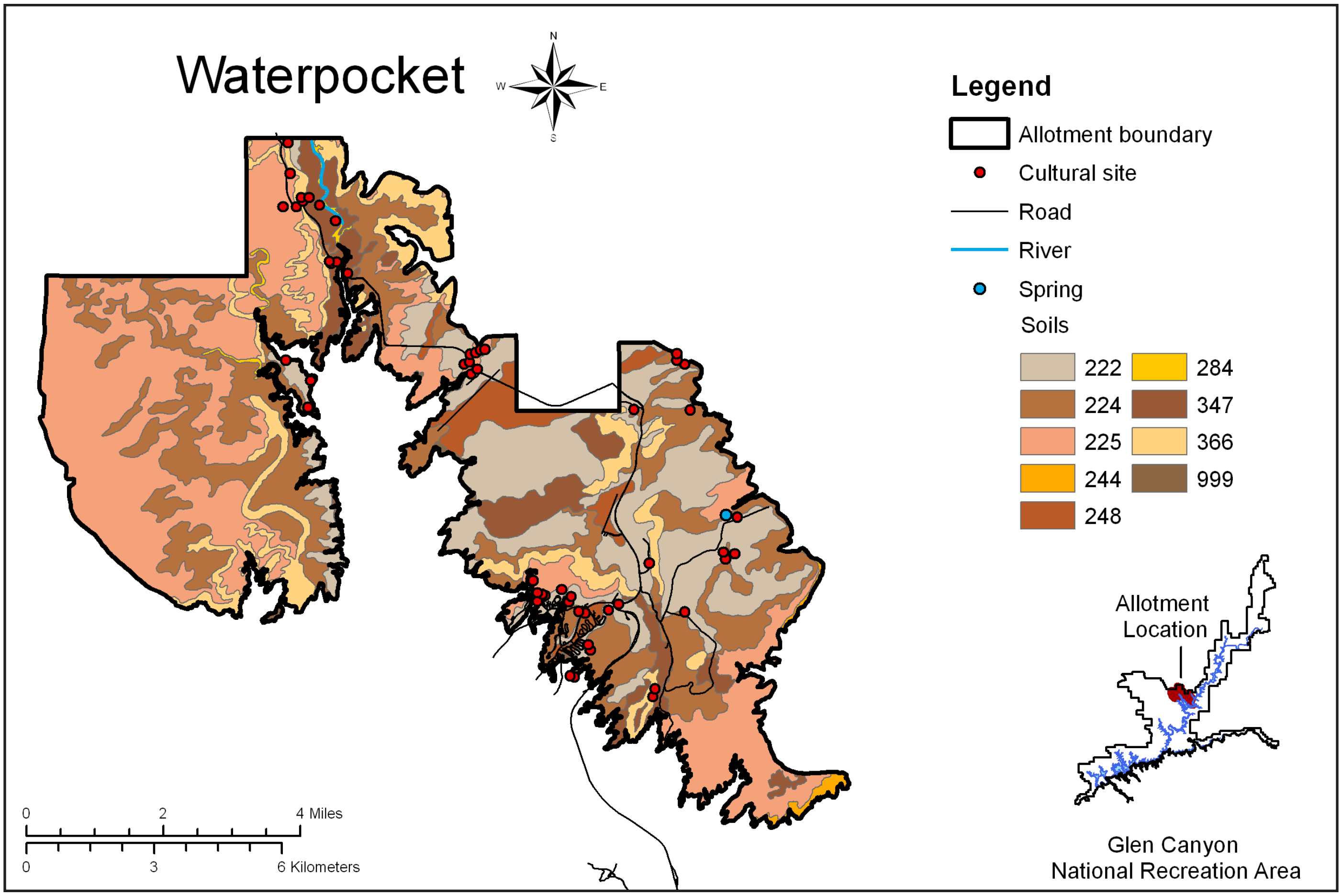
Visibility:
In general, the dominant vegetation of Soda grazing allotment provide moderate - excellent visibility with large portions of the ground between plants bare of vegetation.

Summary:
Dominant vegetation for Wahweap grazing allotment includes blackbrush (22.38 percent), fourwing saltbush (8.30 percent), Fremont cottonwood (6.99 percent), sand sagebrush (28.65 percent), and shadscale (20.48 percent). Dominant vegetation for t he remainder of the allotment has not been identified.

Dominant Species:
Blackbrush (*Coleogyne ramosissima*)
Fremont cottonwood (*Populus fremontii*)
Fourwing saltbush (*Atriplex canescens*)
Sand sagebrush (*Artemisia filifolia*)
Shadscale (*Atriplex confertifolia*)

Secondary Dominant Species:
Mat saltbush (*Atriplex corrugata*)

Associated Soils:
Blackbrush grows in stony loam, shallow sandy loam, and sandy loam. Fourwing saltbush grows in sandy bottoms, often in association with Fremont cottonwood in semiwet saline streambanks, and in sandy loam. Fremont cottonwood grows in semiwet saline streambanks, often alongside shadscale in stony loam. Sand sagebrush grows in sand, and shadscale occurs in shallow sandy loam alongside blackbrush in shallow sandy loam and mat saltbush in shallow clay.



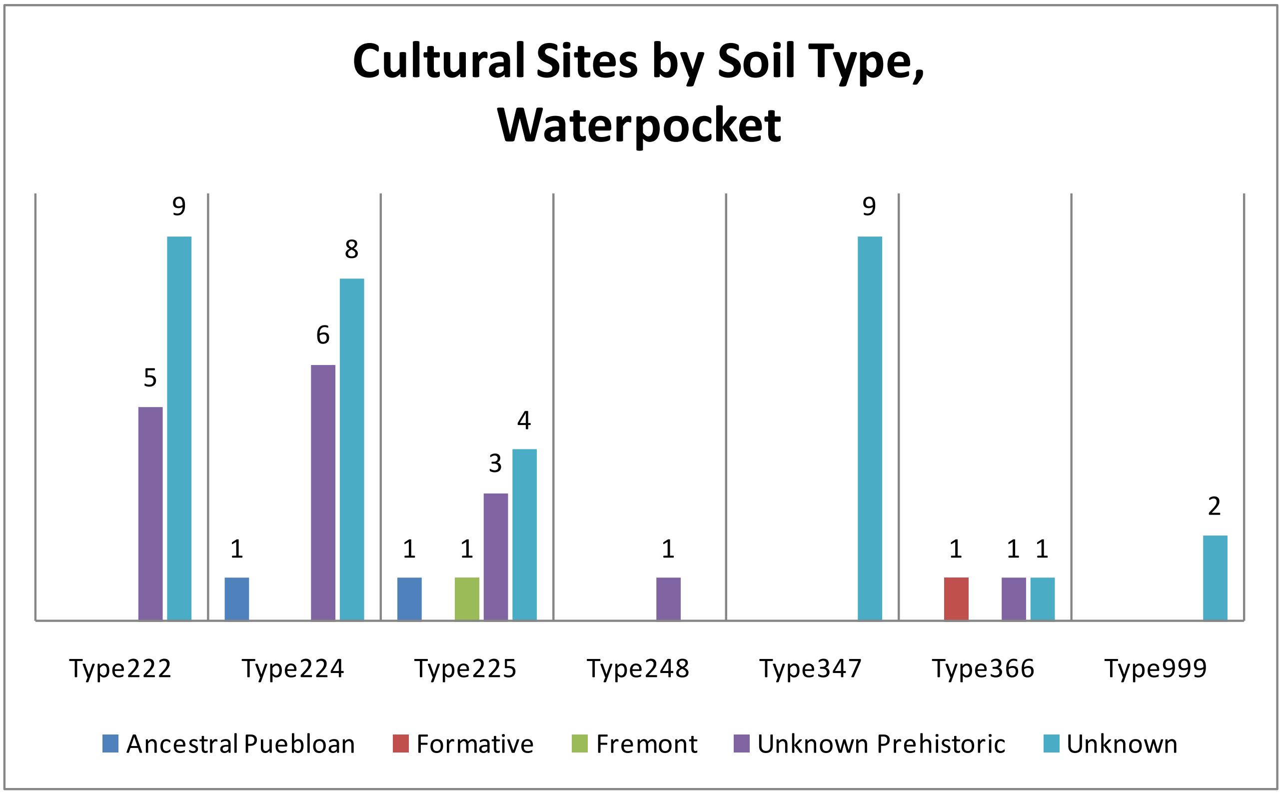
Allotment Divided by Soil Type (MUSYM):

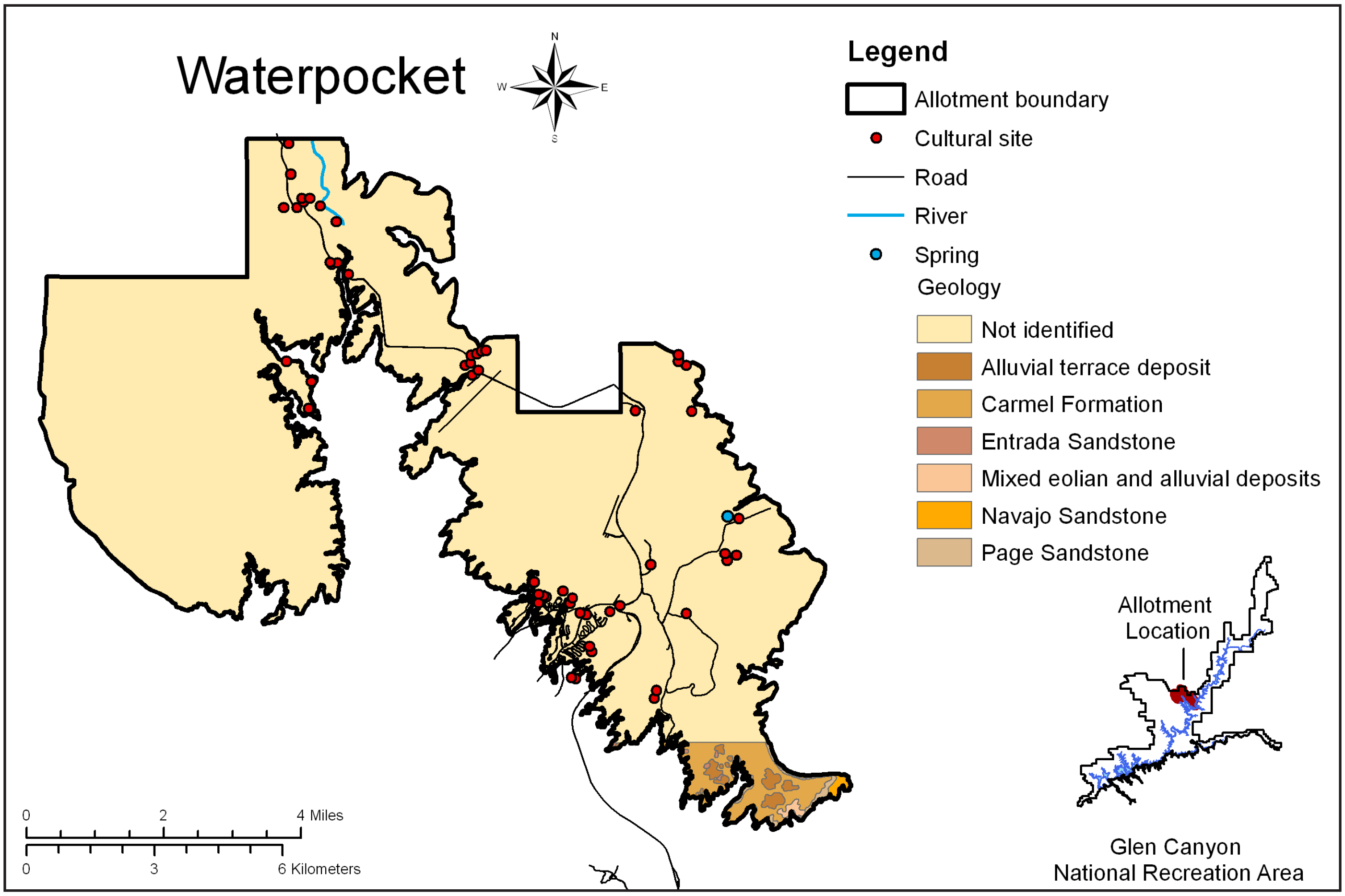
Soil Type	Acres	Percent	No. Cultural Sites
222	6027.35	20.07	14
224	7538.55	25.10	15
225	9806.58	32.65	9
244	195.37	0.65	0
248	965.50	3.21	1
284	136.69	0.46	0
347	1964.87	6.54	9
366	2956.35	9.84	3
999	445.94	1.48	2
Total	**30,037.20**	**100%**	**53**

Distribution of Cultural Sites by Soil Type:

Fourteen sites (n = 14), including five lithic scatters and nine sites for which attribute/affiliation information is currently unknown, are located in soil type 222. Fifteen (n = 15) sites, including one Ancestral Puebloan site, five prehistoric sites with features, one artifact scatter, and eight sites currently lacking attribute/affiliation information, are located in soil type 224. Nine sites (n = 9), including one Ancestral Puebloan site, one Fremont site, two lithic scatters, a rockshelter, and four sites for which attribute/affiliation information is currently unavailable, are located in soil type 225. One (n = 1) lithic scatter is located in soil type 248. Nine sites (n = 9) for which attribute/affiliation information is not available are located in soil type 347. Three sites (n = 3), including one Formative site, one site with a potential hearth, and one site for which attribute/affiliation information is not known, are located in soil type 366. The remaining sites (n = 2), for which attribute.affiliation information is not available, are located in soil type 999.

The figure on the following page displays known cultural sites by affiliation and soil type.


Cultural Sites by Soil Type, Waterpocket
9
8
6
5
4
3
1
1
1
1
1
1
1
9
2
Type222
Type224
Type225
Type248
Type347
Type366
Type999
Ancestral Puebloan
Formative
Fremont
Unknown Prehistoric
Unknown



Allotment Divided by Geology:

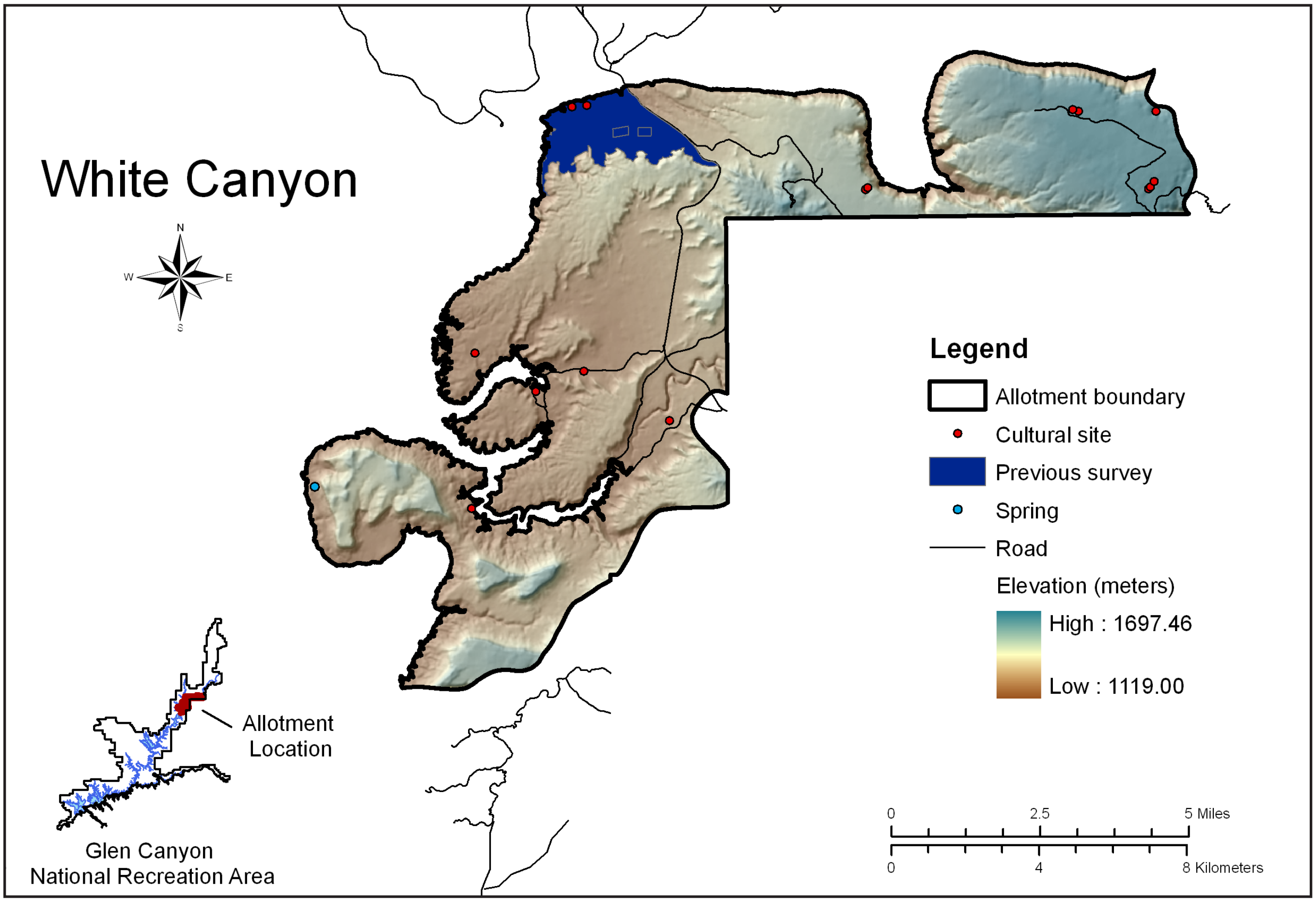
Geology	Acres	Percent	No. Cultural Sites
Not identified	28,940.19	96.35	53
Alluvial terrace deposits	145.07	0.48	0
Carmel Formation	736.34	2.45	0
Entrada Sandstone	17.88	<0.00	0
Mixed eolian and alluvial deposits	31.00	0.10	0
Navajo Sandstone	60.36	0.20	0
Page Sandstone	106.65	0.36	0
Total	**30,037.49**	**99.94%**	**53**

Distribution of Cultural Sites by Geological Location:

All known cultural sites (n = 53) are located in areas for which the geology is currently not available.

White Canyon

Map Panels



Total Area: 34,299.23 acres

Sampling Fractions:
2 percent: 685.98 acres
5 percent: 714.96 acres
11 percent: 3772.92 acres
16 percent: 5487.88 acres
20 percent: 3859.85 acres

Elevation range amsl:
1119.00 – 1697.46 meters (3671.26 - 5569.10 feet)

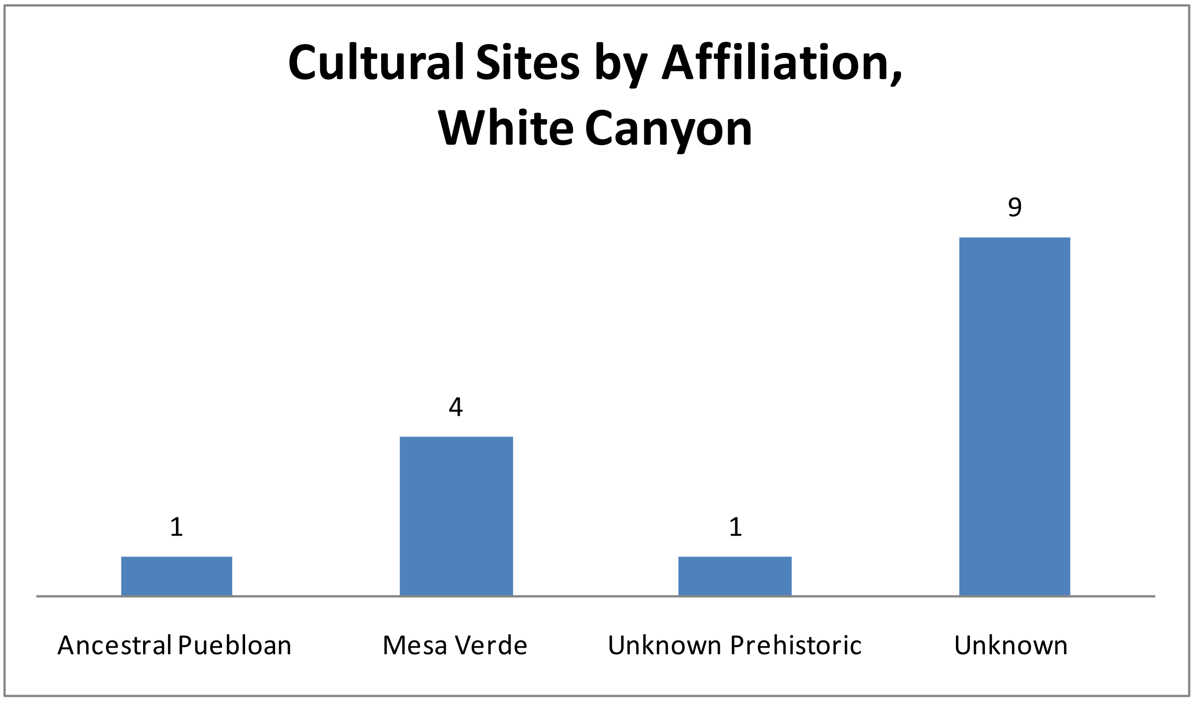
Rivers and Springs:
One unnamed spring is located in White Canyon grazing allotment.

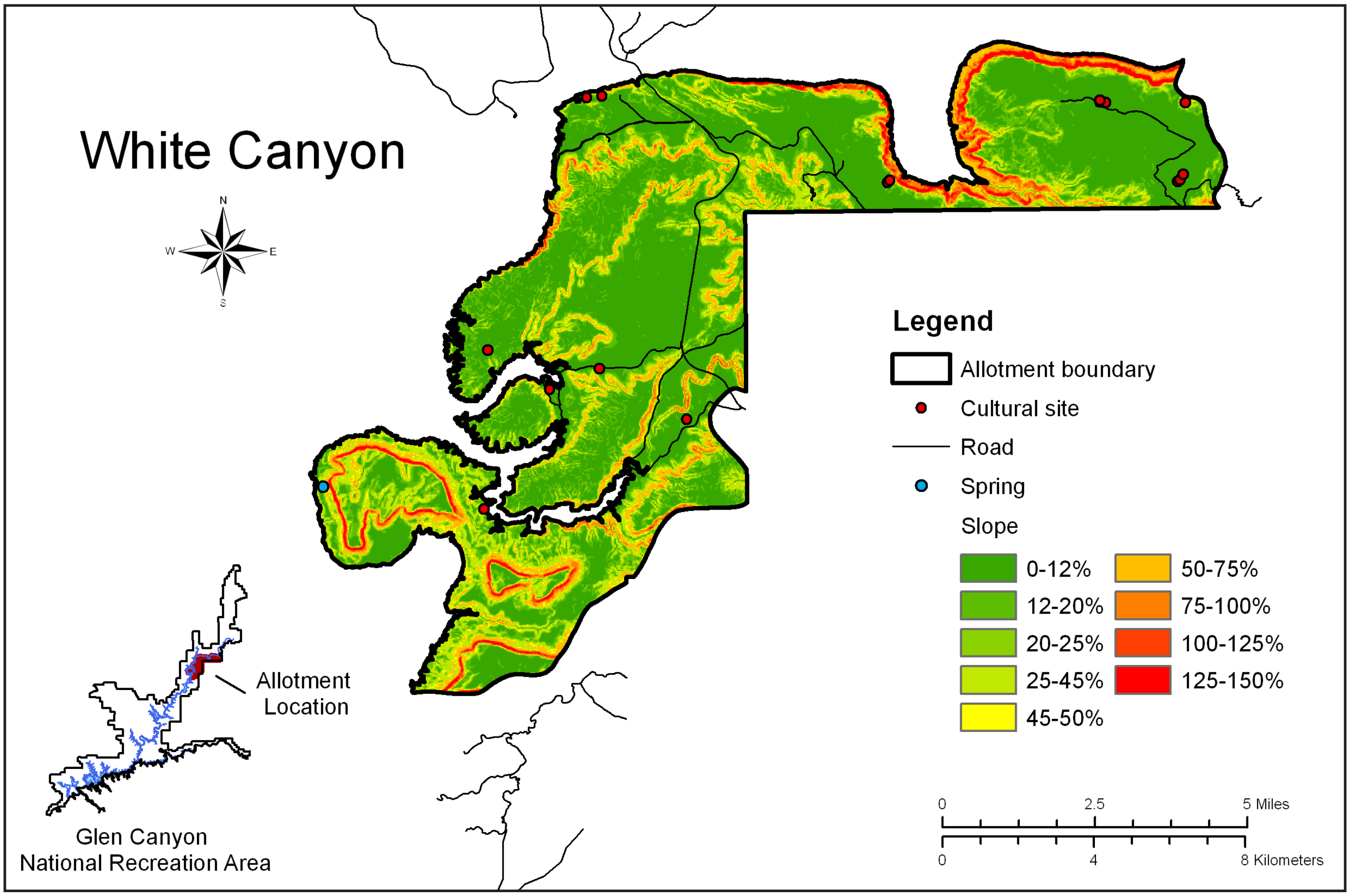
Accessibility:
State Hwy 95 and County Hwys 630, 657, 656, and 632 provide access to the interior of the allotment. In addition, County Hwy 651 bounds the south of White Canyon allotment. Camping is available at Hite, Fairley Canyon, and White Canyon. Lake Powell forms the west and southwest boundaries of the allotment, providing for boat access as well.

No. Cultural Sites: 15
Area surveyed: 1405.80 acres

Survey References:
Baker (2004): 44.09 acres
Bungart (1989): 0.47 acres
Kincaid (1986a): 0.60 acres
Kincaid (1986j): 0.45 acres
Kincaid (1986k): 6.34 acres
Kincaid (1987b): 10.75 acres
Zier et al. (2002): 1404.82 acres

The figure on the subsequent page depicts known cultural sites by affiliation/attribute. As the information available is minimal, only one figure is included for this allotment.


Cultural Sites by Affiliation,
White Canyon
1
4
1
9
Ancestral Puebloan
Mesa Verde
Unknown Prehistoric
Unknown



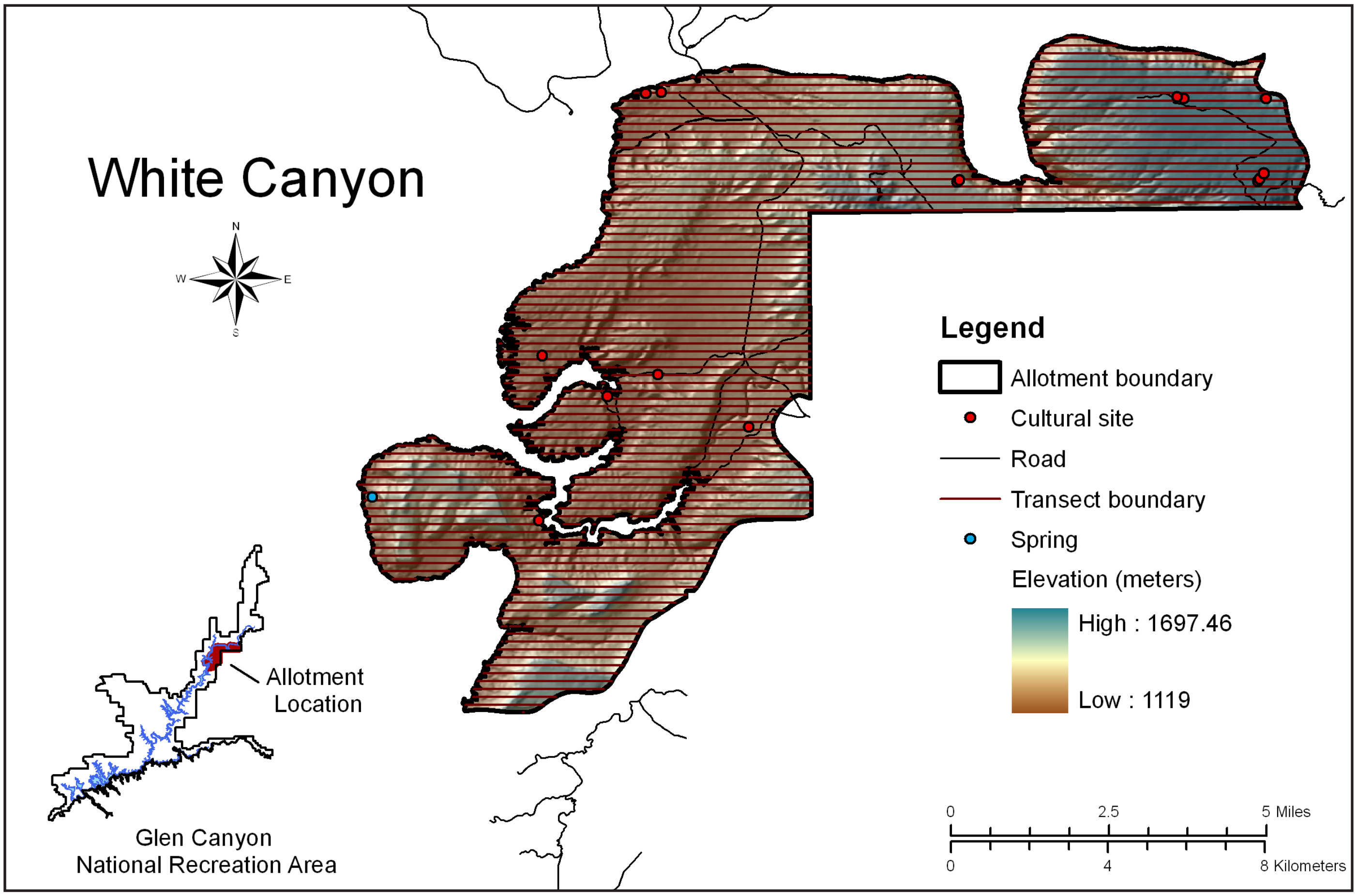
Slope Considerations:

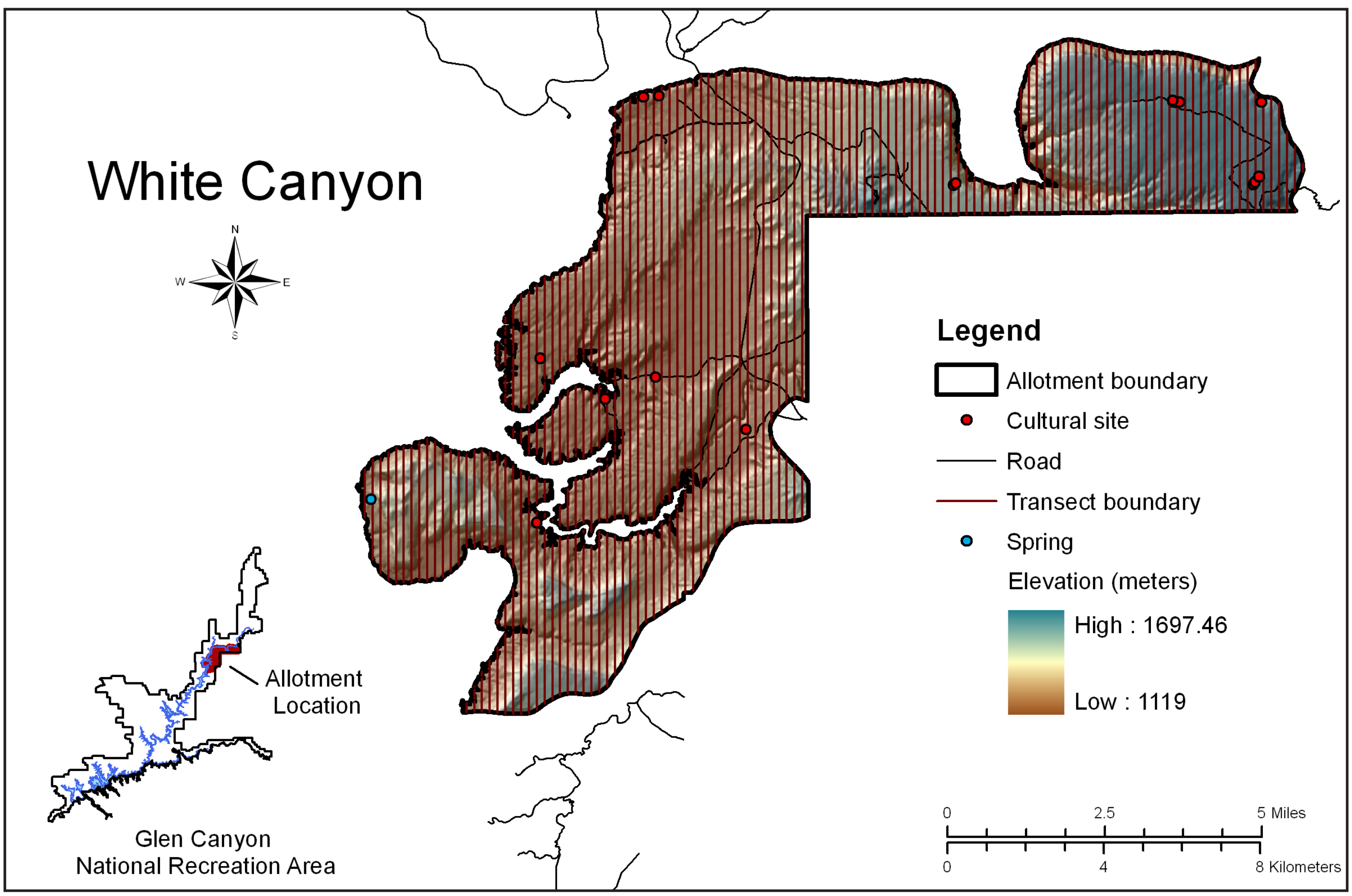
Slope plays a large role in terrain accessibility, and may be used in the stratification of survey areas. For example, GCNRA may wish to assign catagories such as low, moderate, and high to specific slope gradients. Such assignations are most often dependent on the factors guiding archaeological survey work, and as such, are not included in this document. Included herein, however, are suggestions for basic transect orientation based on the presence of topographical barriers identified by the presence of excessive slope gradients.

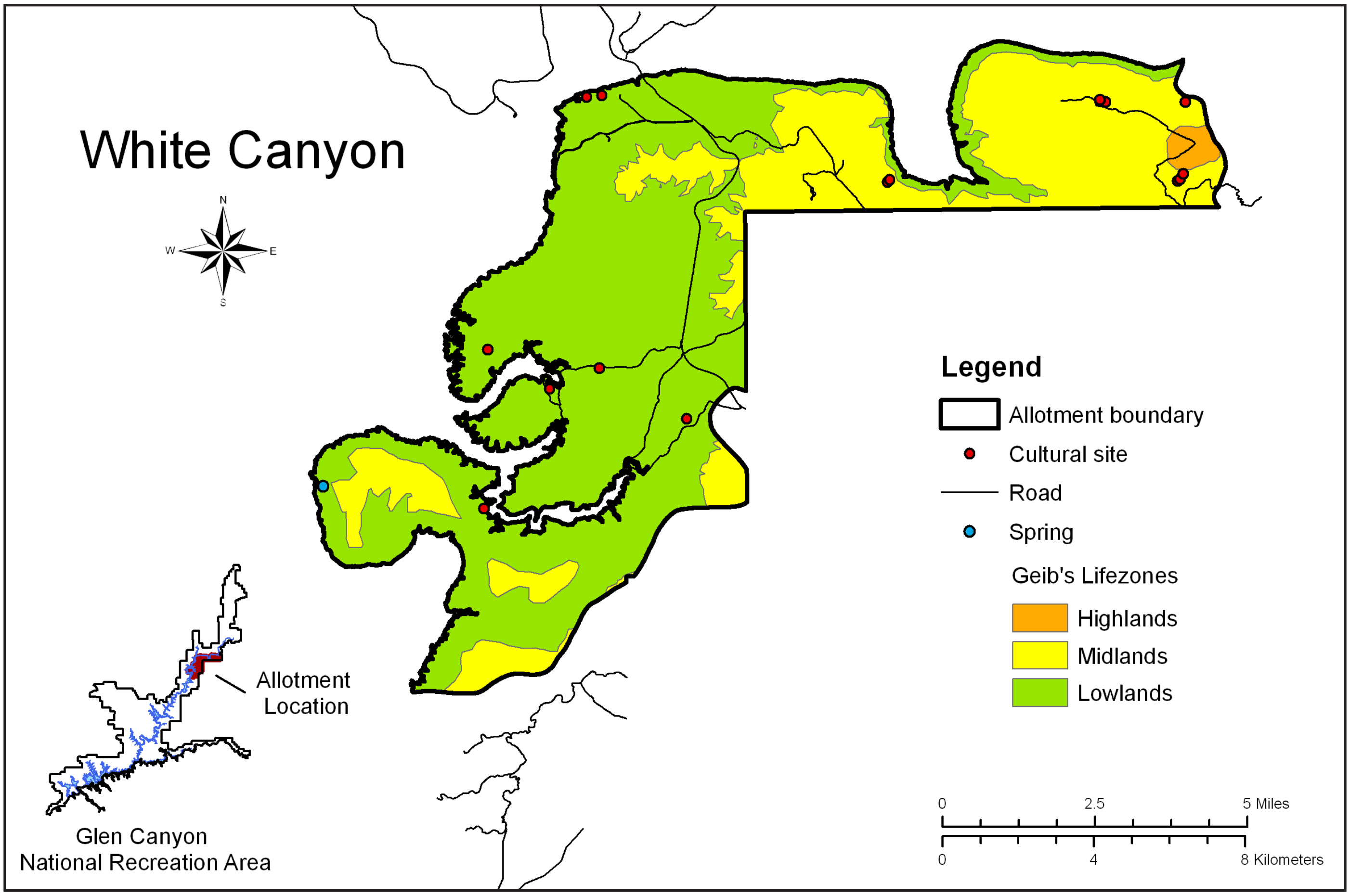
Survey Zones Dictated by Slope:

Steep slopes mark the northern boundary of White Canyon grazing allotment. In addition, southwest-northeast and east-west trending escarpments are located in the center of the allotment. Isolated mesas, including "The Horn," one east of Castle Butte and one north of Scorup canyon, are also located within the allotment and will need to be surveyed separately from the remainder of White Canyon. As is usual, recommended transects should be placed perpendicular to access points whenever possible, and in the most efficient manner for avoiding divisive slopes. For example, in the northwest corner of the allotment, the recommendation is as follows: north-south transects north of the road, north-south transects south of the road until the escarpment, and then east-west and/or north-south transects south of the escarpment using the lake as access.

The 'fishnet' maps provided on the subsequent page display transects spaced at 200 meter intervals for both east-west and north-south oriented pedestrian survey.


White Canyon
N
W
E
S
Legend
Allotment boundary
Cultural site
Road
Transect boundary
Spring
Elevation (meters)
High : 1697.46
Low : 1119
Allotment Location
Glen Canyon
National Recreation Area
0
2.5
5 Miles
0
4
8 Kilometers


White Canyon
N
W
E
S
Legend
Allotment boundary
Cultural site
Road
Transect boundary
Spring
Elevation (meters)
High : 1697.46
Low : 1119
Allotment Location
Glen Canyon
National Recreation Area
0
2.5
5 Miles
0
4
8 Kilometers



Area of Each Lifezone:

Highlands: 321.88 acres
Midlands: 11,531.82 acres
Lowlands: 22,329.34 acres

No. Cultural Sites in Each Lifezone:

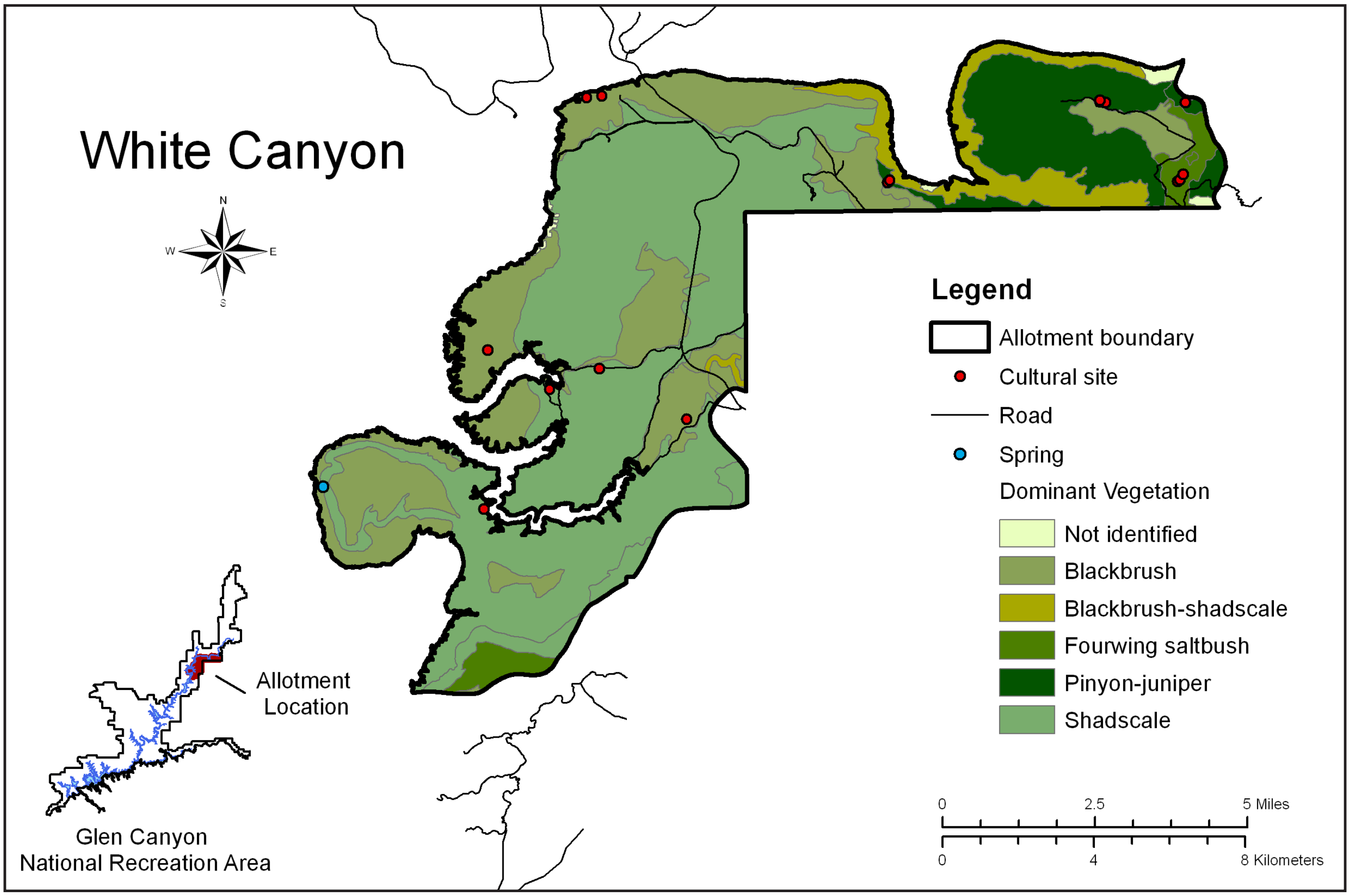
Highlands: 0
Midlands: 8
Lowlands: 7

Lifezone Significance and Known Cultural Sites:

Although both all three of Geib's lifezones are present in White Canyon grazing allotment, known cultural sites are limited to the Lowland (n = 7) and Midland (n = 8) zones. Geib describes the midlands as rich in grass and cacti resources, in addition to providing good habitant for antelope. The lowlands, according to Geib are hot and arid, with permanent water, arable alluvium, and long growing seasons needed for agricultural pursuits.

	Elevation	Characteristics	Environment	Significance to Humans
Lowlands	1219-1372 m (4000-4500 ft)	Hot and arid steep-walled sandstone canyons.	Riparian plants; bighorn sheep	Permanent water, arable alluvium, long growing season, diverse plant communities, natural shelters, quality siliceous stone from river gravels
Midlands	1372-1676 m (4500-5500 ft)	Arid slickrock and dune fields on benchlands and low plateaus.	Blackbrush, shadscale, grasses; antelope.	Grasses, including dropseed and ricegrass, prickly pear and shadscale; good antelope habitat, quality siliceous stone in certain locations.
Highlands	Above 1676 m (Above 5500 ft)	High elevation mesas and plateaus with cooler temperatures and greater precipitation.	Pinyon-juniper woodlands; deer and rabbit.	Higher elevation plant foods (i.e. pinyon); later harvests; dry-farming; abundant fuel, deer and rabbit.

Shading indicates lifezones present in allotment.



Area of Individual Vegetation Zones:

Dominant Species	Acres Covered	No. Sites
Not identified	346.48	4
Blackbrush ***(Coleogyne ramosissima)***	9434.40	4
Blackbrush-shadscale (Coleogyne ramosissima - Atriplex confertifolia)	2129.80	0
Fourwing saltbush ***(Atriplex canescens)***	992.15	3
Pinyon-juniper ***(Pinus edulis - Juniperus osteosperma)***	3918.76	5
Shadscale ***(Atriplex confertifolia)***	17,477.64	3
Total	**34,299.23**	**19**

No. Cultural Sites in Each Vegetation Zone:
Four (n = 4) sites are located in blackbrush. Three (n = 3) sites are located in fourwing saltbush. Five (n = 5) sites are located in pinyon-juniper. Three sites (n = 3) are located in shadscale, and the remaining sites (n = 4) are located in areas where the dominant vegetation has not been identified.

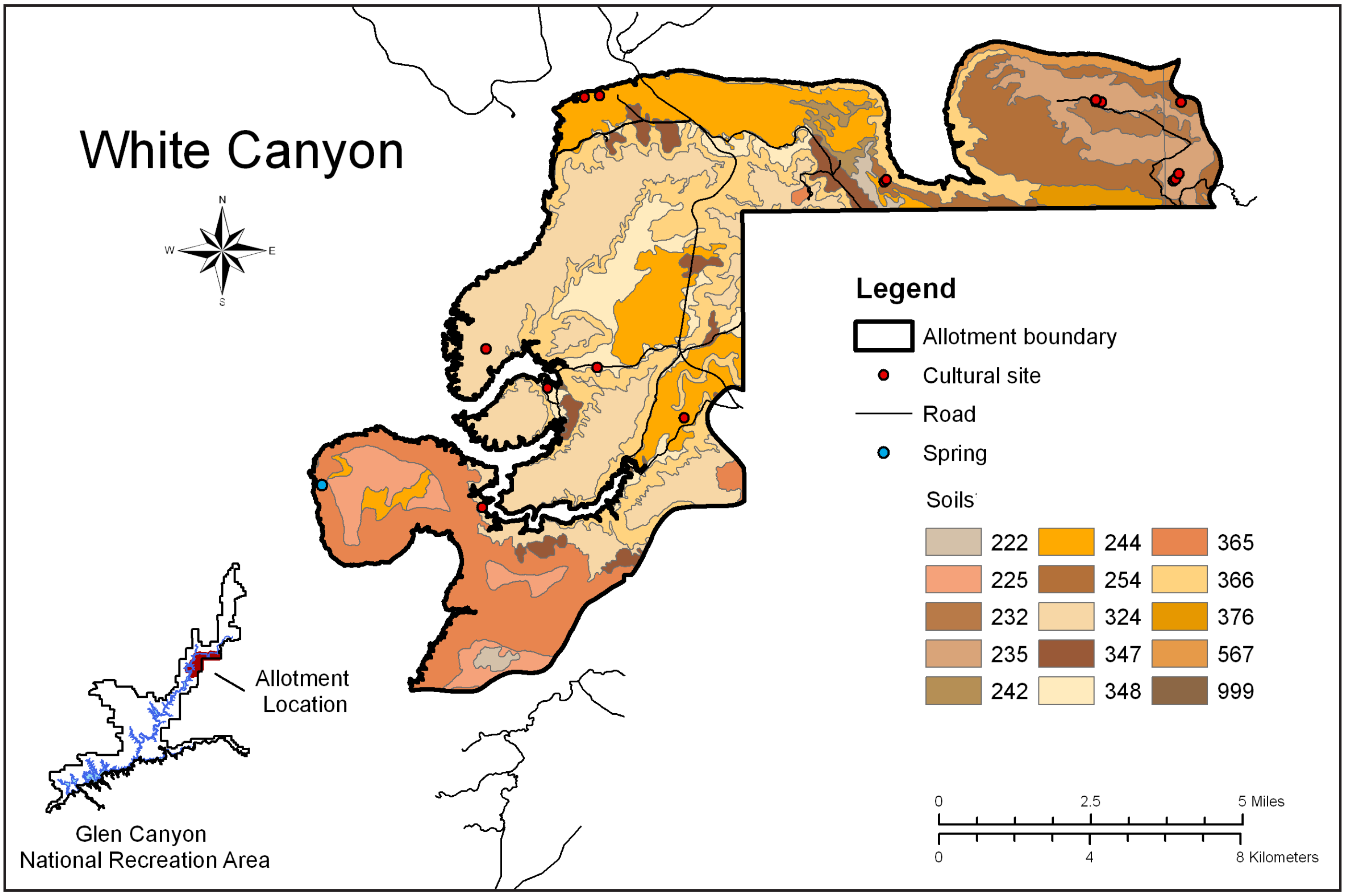
Visibility:
In general, the dominant vegetation of Soda grazing allotment provide moderate - excellent visibility. However, in pinyon-juniper, ground visibility may be lessened.

Summary:
Dominant vegetation for Wahweap grazing allotment includes blackbrush (27.51 percent), blackbrush-shadscale (6.21), fourwing saltbush (2.89 percent), pinyon-juniper (11.43 percent), and shadscale (50.96 percent). Dominant vegetation for the remainder of the allotment has not been identified.

Dominant Species:
Shadscale (*Atriplex confertifolia*)
Blackbrush (*Coleogyne ramosissima*)
Fourwing saltbush (*Atriplex canescens*)
Pinyon (*Pinus edulis*)
Juniper (*Juniperus osteosperma*)

Secondary Dominant Species:
Sand sagebrush (*Artemisia filifolia)*
Cutler Mormon-tea (*Ephedra cutleri*)

Associated Soils:
Blackbrush grows in sandy loam and shallow sandy loam, where it may occur with sand sagebrush in sandy loam. Blackbrush-shadscale occurs in talus. Fourwing saltbush grows in sandy loam, and may occur with Cutler Mormon tea in shallow sand. Pinyon-juniper grows in shallow sandy loam with blackbrush. Finally, shadscale grows in shallow sandy loam alongside blackbrush, in shallow loam, and in stony loam and loam with fourwing saltbush.



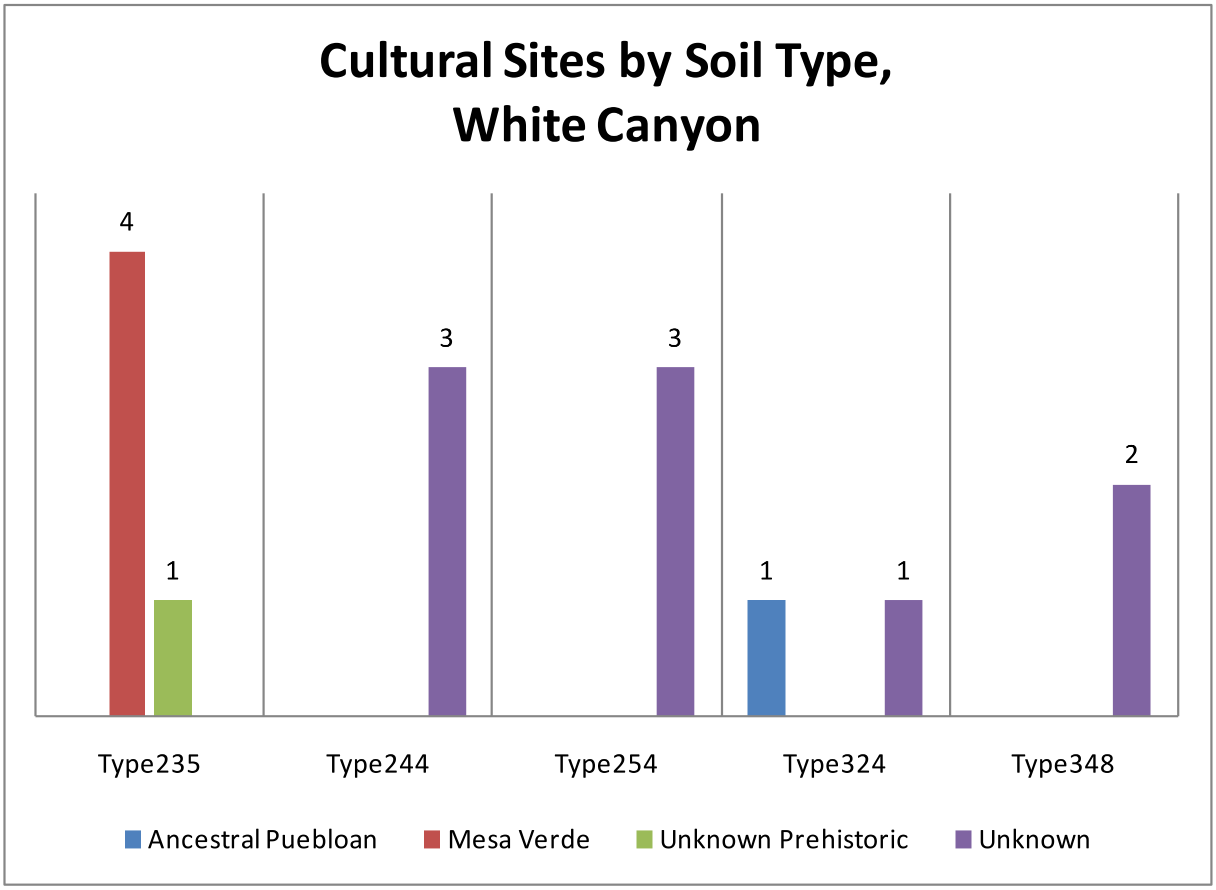
Allotment Divided by Soil Type (MUSYM):

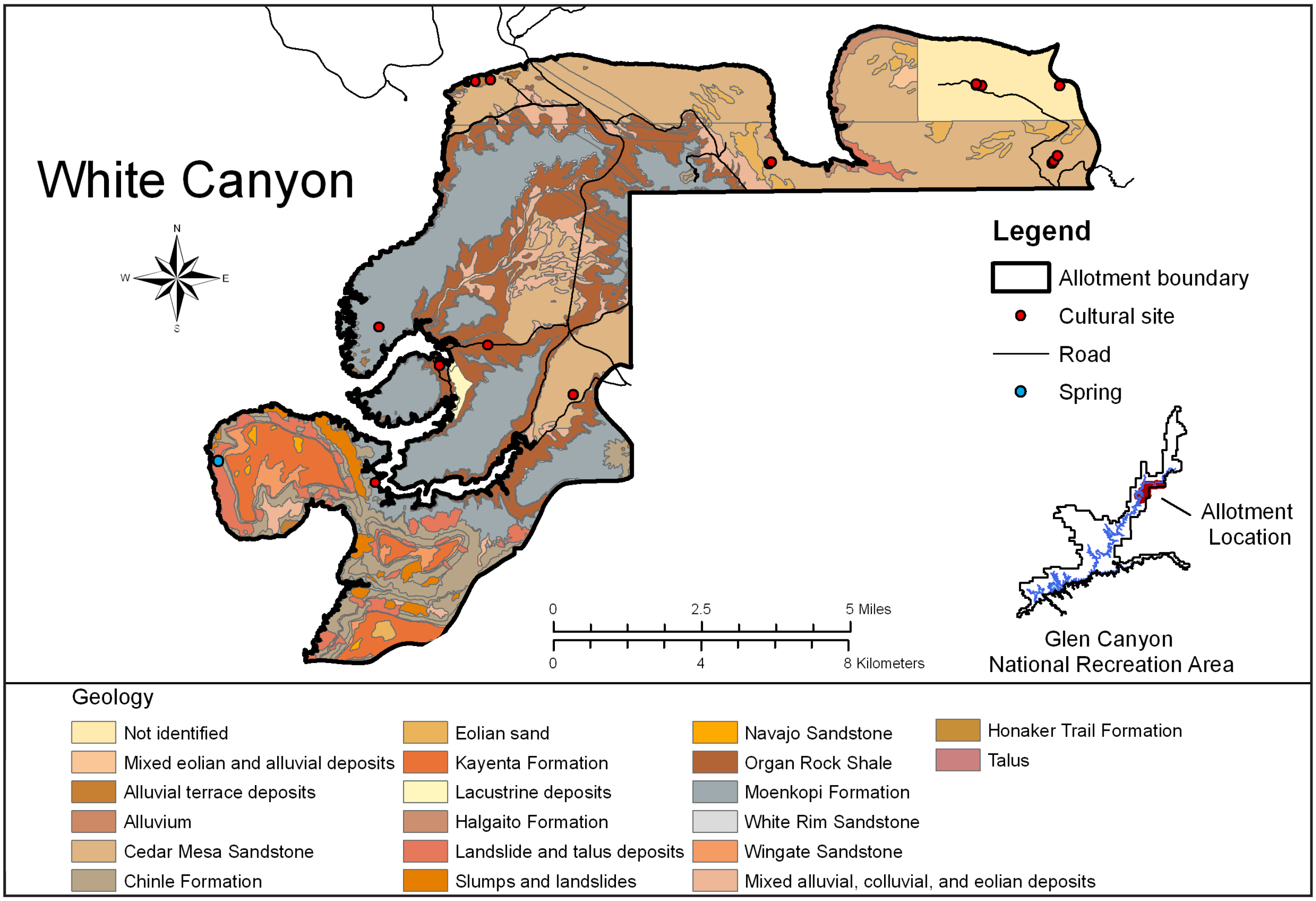
Soil Type	Acres	Percent	No. Cultural Sites
222	286.39	0.83	0
225	1446.04	4.22	0
232	434.50	1.27	0
235	1925.43	5.61	5
242	309.85	0.90	0
244	4938.69	14.40	3
254	2836.97	8.27	3
324	7546.43	22.00	2
347	971.91	2.83	0
348	2093.54	6.10	2
365	4550.80	13.27	0
366	5868.38	17.11	0
376	405.78	1.18	0
567	497.48	1.45	0
999	187.09	0.55	0
Total	**34,299.28**	**99.99%**	**15**

Distribution of Cultural Sites by Soil Type:

Five sites (n = 5), including four Mesa Verde sites and one prehistoric site with hearths, are located in soil type 235. Three sites (n = 3) for which attribute/affiliation information is not currently known are located in soil type 244, which is often associated with Navajo Sandstone, or slickrock. Three sites (n = 3) for which attribute/affiliation information is not available are located in soil type 254. Two sites (n = 2), including one Ancestral Puebloan site and one site for which attribute/affiliation information is not currently known, are located in soil type 324. Thee remaining sites (n = 2), for which attribute/affiliation information is not known, are located on soil type 348.

The figure on the subsequent page displays known cultural sites by affiliation and soil type


Cultural Sites by Soil Type,
White Canyon
4
1
3
3
1
1
2
Type235
Type244
Type254
Type324
Type348
Ancestral Puebloan
Mesa Verde
Unknown Prehistoric
Unknown



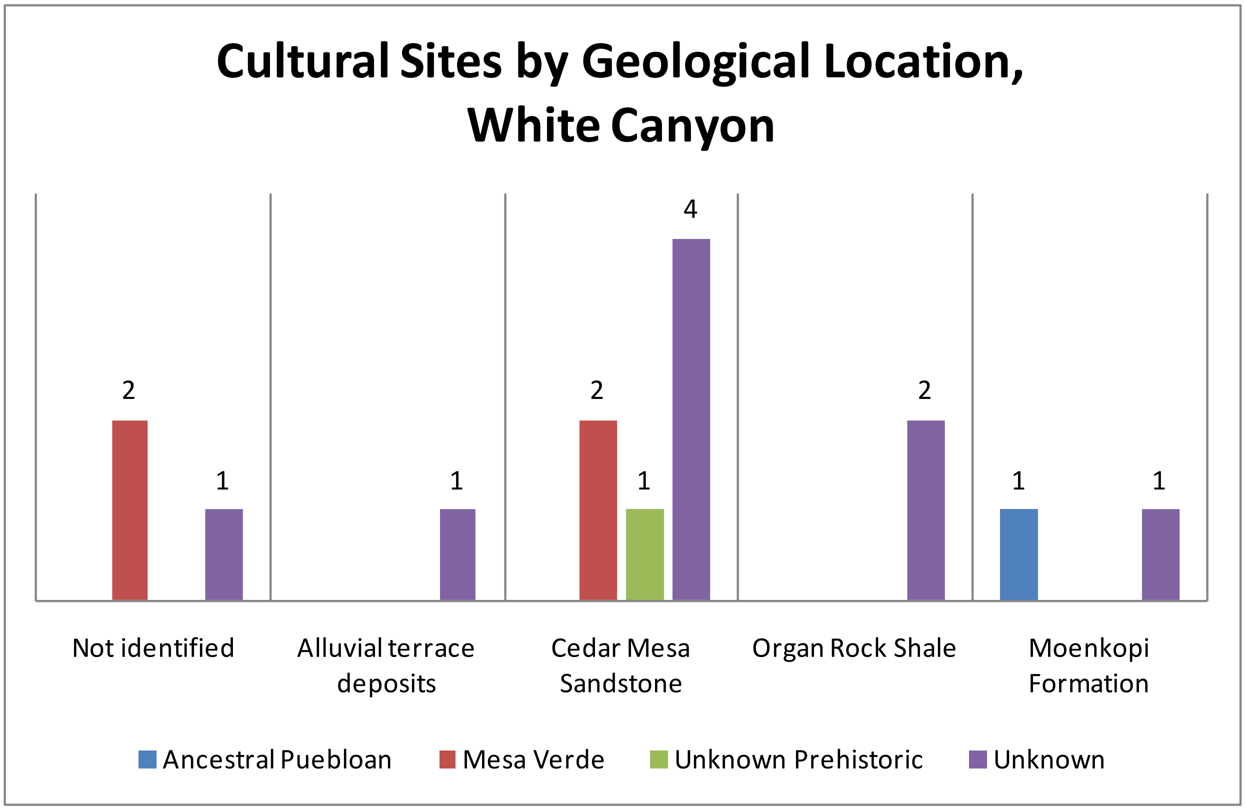
Allotment Divided by Geology:

Geology	Acres	Percent	No. Cultural Sites
Not identified	2214.34	6.46	3
Mixed eolian and alluvial deposits	151.33	0.44	0
Alluvial terrace deposits	111.03	0.32	1
Alluvium	26.15	<0.00	0
Cedar Mesa Sandstone	8926.15	26.02	7
Chinle Formation	2661.63	7.76	0
Eolian sand	757.92	2.21	0
Kayenta Formation	1436.14	4.19	0
Lacustrine deposits	162.34	0.47	0
Halgaito Formation	295.28	0.86	0
Landslide and talus deposits	984.12	2.87	0
Slumps and landslides	513.33	1.50	0
Navajo Sandstone	69.08	0.20	0
Organ Rock Shale	5168.69	15.07	2
Moenkopi Formation	7741.48	22.57	2
White Rim Sandstone	681.40	1.99	0
Wingate Sandstone	474.33	1.39	0
Mixed alluvial, colluvial and eolian deposits	1763.31	5.14	0
Honaker Trail Formation	22.76	<0.00	0
Talus	138.45	0.40	0
Total	**34,299.26**	**99.86**	**15**

Distribution of Cultural Sites by Geological Location:

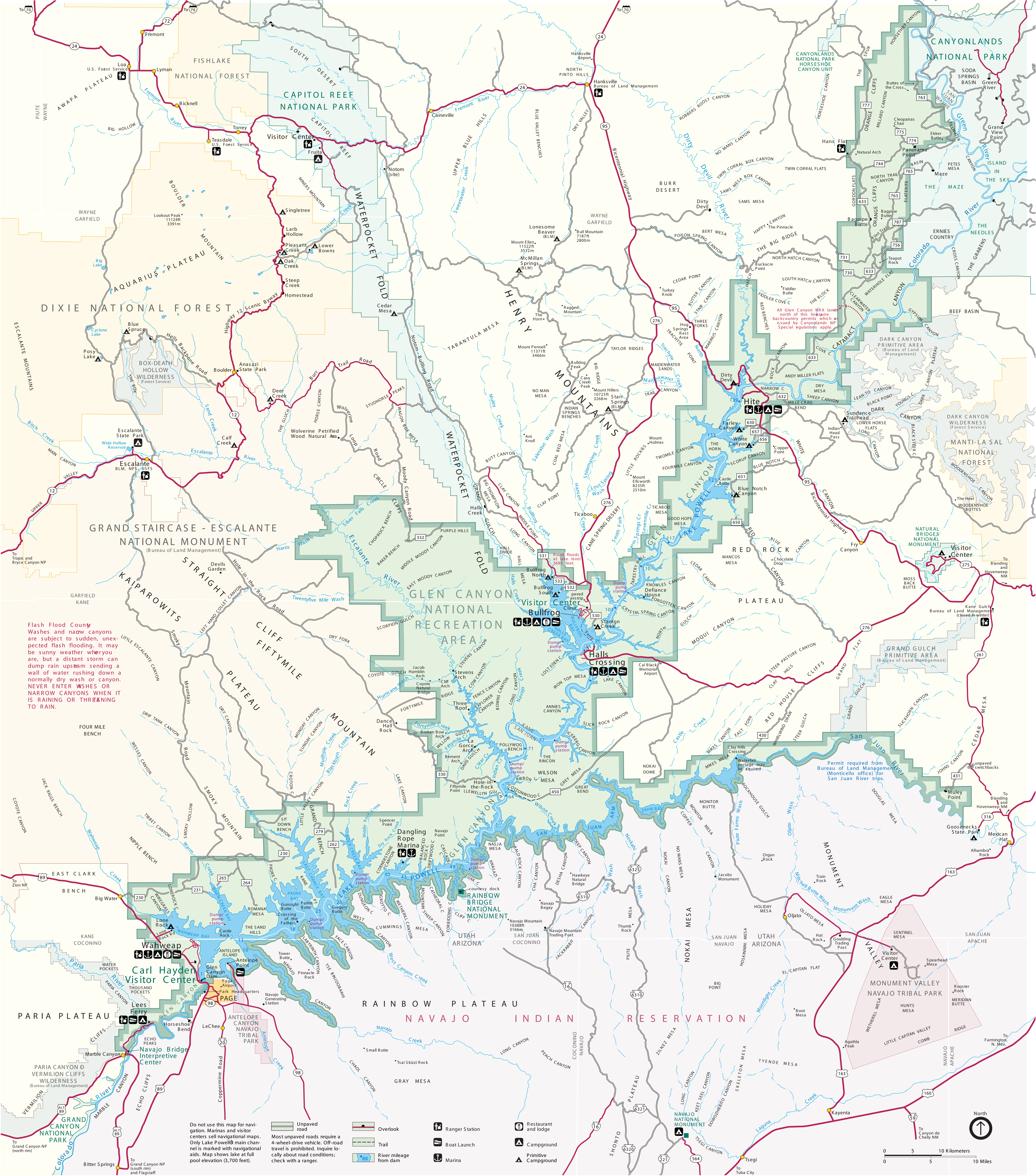
One site (n = 1) for which attribute/affiliation information is not known is located on alluvial terrace deposits. Seven sites (n = 7), including two Mesa Verde sites, one prehistoric site with hearths, and four sites for which attribute/affiliation information is not available, are located on Cedar Mesa Sandstone. Two sites (n = 2) currently lacking affiliation/attribute information are located on Organ Rock Shale. Two sites (n = 2), including one Ancestral Puebloan site and one site for which attribute/affiliation information is not currently available, are located on Moenkopi Formation geology. The remaining sites (n = 3), two of which are Mesa Verde sites, and one for which attribute/affiliation information is not available, are located in areas for which geological information is not available.

The figure on the subsequent page displays known cultural sites by affiliation and geologic context..


Cultural Sites by Geological Location,
White Canyon
2
1
1
4
2
1
2
1
1
Not identified
Alluvial terrace deposits
Cedar Mesa Sandstone
Organ Rock Shale
Moenkopi Formation
Ancestral Puebloan
Mesa Verde
Unknown Prehistoric
Unknown

Appendix A:

National Park Service Map of GCNRA

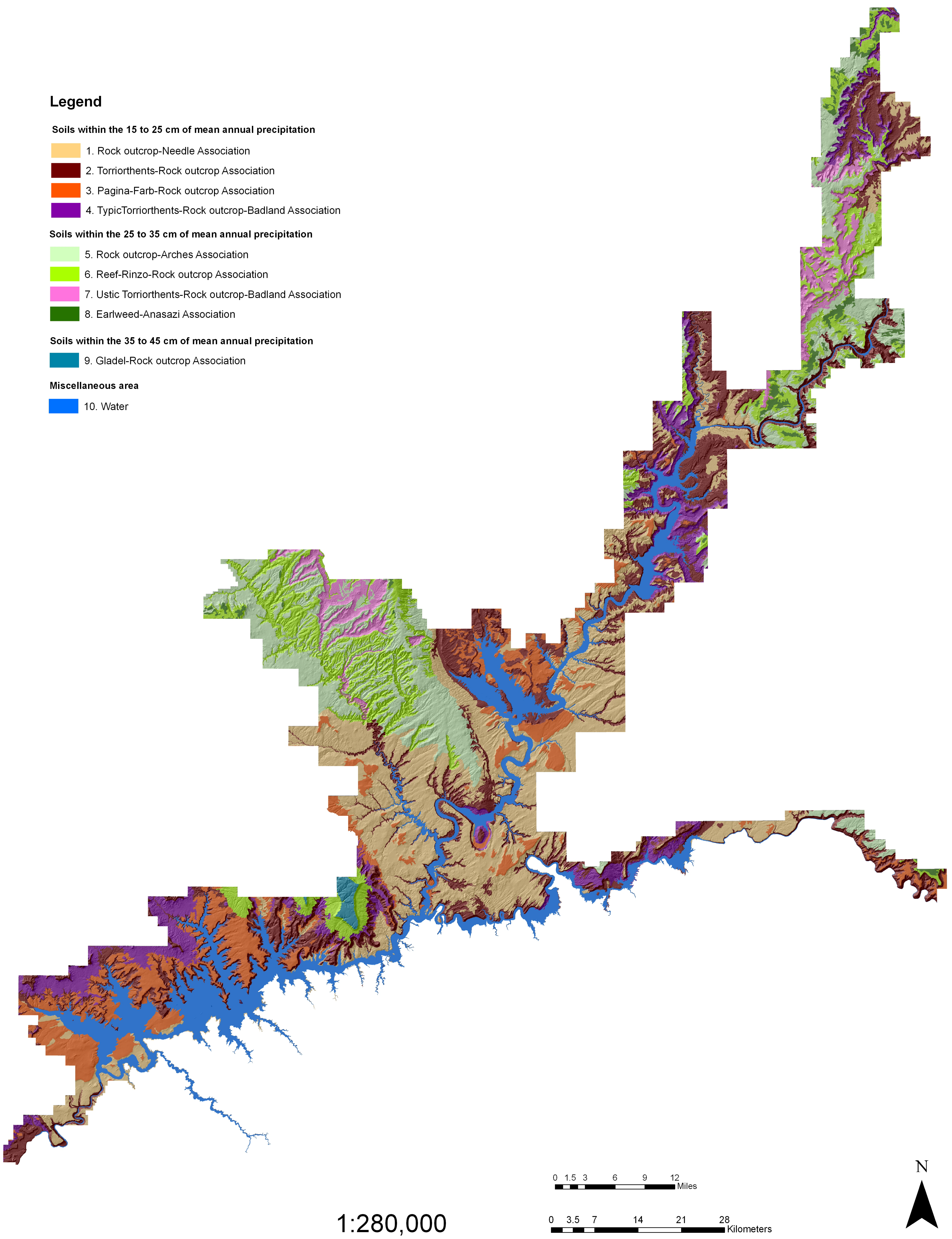


CAPITOL REEF NATIONAL PARK
CANYONLANDS NATIONAL PARK
CANYONLANDS NATIONAL PARK HORSESHOE CANYON UNIT
GLEN CANYON NATIONAL RECREATION AREA
GRAND STAIRCASE - ESCALANTE NATIONAL MONUMENT (Bureau of Land Management)
DIXIE NATIONAL FOREST
FISHLAKE NATIONAL FOREST
MANTI-LA SAL NATIONAL FOREST
RAINBOW BRIDGE NATIONAL MONUMENT
NATURAL BRIDGES NATIONAL MONUMENT
NAVAJO NATIONAL MONUMENT
GRAND CANYON NATIONAL PARK
MONUMENT VALLEY NAVAJO TRIBAL PARK
ANTELOPE CANYON NAVAJO TRIBAL PARK
PARIA CANYON-VERMILION CLIFFS WILDERNESS (Bureau of Land Management)
BOX-DEATH HOLLOW WILDERNESS (Forest Service)
DARK CANYON PRIMITIVE AREA (Bureau of Land Management)
DARK CANYON WILDERNESS (Forest Service)
GRAND GULCH PRIMITIVE AREA (Bureau of Land Management)
NAVAJO INDIAN RESERVATION
HENRY MOUNTAINS
KAIPAROWITS PLATEAU
RAINBOW PLATEAU
PARIA PLATEAU
AQUARIUS PLATEAU
LAKE POWELL
Visitor Center
Bullfrog
Halls Crossing
Hite
Dangling Rope Marina
Wahweap
Carl Hayden Visitor Center
Lees Ferry
Navajo Bridge Interpretive Center
PAGE
Escalante
Hanksville
Road floods at lake level 3695 feet.
All Glen Canyon NRA lands north of this line require backcountry permits which are issued by Canyonlands NP. Special regulations apply.
Permit required from Bureau of Land Management (Monticello office) for San Juan River trips.
Flash Flood Country
Washes and narrow canyons are subject to sudden, unexpected flash flooding. It may be sunny weather where you are, but a distant storm can dump rain upstream sending a wall of water rushing down a normally dry wash or canyon. NEVER ENTER WASHES OR NARROW CANYONS WHEN IT IS RAINING OR THREATENING TO RAIN.
Do not use this map for navigation. Marinas and visitor centers sell navigational maps. Only Lake Powell's main channel is marked with navigational aids. Map shows lake at full pool elevation (3,700 feet).
Unpaved road
Most unpaved roads require a 4-wheel-drive vehicle. Off-road travel is prohibited. Inquire locally about road conditions; check with a ranger.
Overlook
Trail
River mileage from dam
Ranger Station
Boat Launch
Marina
Restaurant and lodge
Campground
Primitive Campground
North
0 5 10 Kilometers
0 5 10 Miles
UTAH
ARIZONA

Appendix B:

Relevant Soil Information and Sourcing

Glen Canyon National Recreation Area
General Soil Map
(draft)



132—Parkelei-Gladel complex, 2 to 12 percent slopes, rocky

Map Unit Setting
Landform(s): plateaus
Elevation: 7,320 to 7,510 feet (2,230 to 2,290 meters)
Mean annual precipitation: 14 to 18 inches (350 to 450 millimeters)
Mean annual air temperature: 50 to 54 degrees Fahrenheit (10.0 to 12.0 degrees Celsius)
Mean annual soil temperature: 52 to 56 degrees Fahrenheit (11.1 to 13.1 degrees Celsius)
Frost-free period: 120 to 150 days
Major Land Resource Area: 35 - Colorado Plateau
Land Resource Unit: 35-6 Colorado Plateau Pinyon - Juniper - Sagebrush

Map Unit Composition
Parkelei and similar soils: 65 percent
Gladel and similar soils: 25 percent
Minor components: Shallow Kydestea soils on shoulders. Areas that have rock outcrop.

Soil Properties and Qualities
Parkelei soils
Taxonomic classification: Fine-loamy, mixed, superactive, mesic Aridic Haplustalfs
Geomorphic position: occurs on drainageways and swales between hills and mesas.
Parent material: eolian deposits and/or slope alluvium derived from sandstone
Slope: 2 to 12 percent
Biological crust
cyanobacteria: 2 percent
lichen: 0 percent
moss: 0 percent
Chemical crust
salt: 0 percent
gypsum: 0 percent
Physical cover
canopy plant cover: 48 percent
woody debris: 24 percent
bare soil: 26 percent
rock fragments: 0 percent
Drainage class: somewhat excessively drained
Ksat solum: 0.20 to 6.00 inches per hour (1.40 to 42.34 micrometers per second)
Available water capacity total inches: 8.2 (high)
Shrink-swell potential: about 4.5 LEP (moderate)
Flooding hazard: none
Runoff class: low
Hydrologic group: C
Ecological site name: Upland Loam (Basin Big Sagebrush)
Ecological site number: R035XY306UT
Present vegetation: Wyoming big sagebrush, muttongrass, pinyon, Utah juniper
Land capability (non irrigated): 6c

Typical Profile
Location
Geographic Coordinate System:
37° 13’ 51.50’’ north, 111° 2’ 37.30’’ west

A--0 to 2 inches (0 to 5 cm); brown (7.5YR 5/4) fine sandy loam, dark brown (7.5YR 3/4), moist; 10 percent clay; weak thin platy structure; loose, nonsticky and nonplastic; many fine roots throughout and many medium roots throughout; many fine dendritic tubular pores; 2 percent gravel; noneffervescent, by HCl, 1 normal; slightly alkaline, pH 7.4 by Cresol red; abrupt smooth boundary.

Bw--2 to 9 inches (5 to 23 cm); brown (7.5YR 4/4) sandy loam, dark brown (7.5YR 3/3), moist; 12 percent clay; weak fine subangular blocky structure; soft, friable, nonsticky and nonplastic; many fine roots throughout and many medium roots throughout; many fine dendritic tubular pores; 2 percent gravel; noneffervescent, by HCl, 1 normal; slightly alkaline, pH 7.4 by Cresol red; abrupt smooth boundary.

Bt1--9 to 17 inches (23 to 43 cm); strong brown (7.5YR 5/6) sandy loam, strong brown (7.5YR 4/6), moist; 16 percent clay; weak fine subangular blocky and weak medium subangular blocky structure; moderately hard, firm, slightly sticky and slightly plastic; many fine roots throughout and many medium roots throughout; many fine dendritic tubular pores; few distinct brown (7.5YR 5/4), dry, clay films on all faces of peds; 10 percent gravel; noneffervescent, by HCl, 1 normal; slightly alkaline, pH 7.6 by Cresol red; clear smooth boundary.

Bt2--17 to 28 inches (43 to 71 cm); strong brown (7.5YR 5/6) loam, strong brown (7.5YR 4/6), moist; 24 percent clay; moderate fine subangular blocky and moderate medium subangular blocky structure; very hard, very firm, slightly sticky and moderately plastic; common fine roots throughout and common medium roots throughout; many fine dendritic tubular pores; common distinct strong brown (7.5YR 4/6), dry, clay films on all faces of peds; 10 percent gravel; noneffervescent, by HCl, 1 normal; slightly alkaline, pH 7.6 by Cresol red; clear smooth boundary.

Bt3--28 to 41 inches (71 to 104 cm); yellowish red (5YR 5/6) clay loam, yellowish red (5YR 4/6), moist; 28 percent clay; moderate fine subangular blocky structure; hard, firm, slightly sticky and moderately plastic; common fine roots throughout; many fine dendritic tubular pores; common distinct yellowish red (5YR 4/6), dry, clay films on all faces of peds; 5 percent gravel; noneffervescent, by HCl, 1 normal; slightly alkaline, pH 7.6 by Cresol red; clear smooth boundary.

Bt4--41 to 62 inches (104 to 157 cm); yellowish red (5YR

5/6) loam, yellowish red (5YR 4/6), moist; 22 percent clay; weak fine subangular blocky structure; hard, firm, slightly sticky and moderately plastic; common fine roots throughout; many fine dendritic tubular pores; few distinct clay films on all faces of peds; 5 percent gravel; noneffervescent, by HCl, 1 normal; slightly alkaline, pH 7.6 by Cresol red.

Range in Characteristics
Reaction: 7.4 to 8.4 (slightly or moderately alkaline)

A Horizon
Value: 4 or 5 dry, 3 or 4 moist
Chroma: 4 to 6, dry or moist

Bw Horizons
Hue: 5YR or 7.5YR
Value: 4 or 5 dry, 3 or 4 moist
Chroma: 3 to 6, dry or moist
Texture: sandy loam, fine sandy loam
Clay: 10 to 18 percent
Rock fragments: 0 to 5 percent

Bt Horizons
Hue: 5YR or 7.5YR
Value: 4 or 5 dry, 3 or 4 moist
Chroma: 4 to 6, dry or moist
Texture: loam, clay loam, sandy loam, fine sandy loam
Clay: 18 to 30 percent
Rock fragments: 0 to 12 percent

Argillic horizon- the zone from 9 to 60 inches (Bt horizons)

Gladel soils
Taxonomic classification: Loamy, mixed, superactive, mesic Aridic Lithic Haplustepts
Geomorphic position: occurs on drainageways and swales between hills and mesas.
Parent material: slope alluvium and/or residuum weathered from sandstone
Slope: 2 to 12 percent
Biological crust
cyanobacteria: 2 percent
lichen: 0 percent
moss: 0 percent
Chemical crust
salt: 0 percent
gypsum: 0 percent
Physical cover
canopy plant cover: 48 percent
woody debris: 24 percent
bare soil: 26 percent
rock fragments: 0 percent
Depth to restrictive feature(s): 12 to 18 inches to bedrock, lithic
Drainage class: somewhat excessively drained
Ksat solum: 2.00 to 6.00 inches per hour (14.11 to 42.34 micrometers per second)
Ksat restrictive layer: 0.00 to 0.20 inches per hour (0.00 to 1.40 micrometers per second)
Available water capacity total inches: 1.8 (very low)
Shrink-swell potential: about 1.0 LEP (low)
Flooding hazard: none
Runoff class: high
Hydrologic group: D
Ecological site name: Upland Shallow Loam (Pinyon-Utah Juniper)
Ecological site number: R035XY315UT
Present vegetation: pinyon, Wyoming big sagebrush, Utah juniper, dwarf lousewort, Utah serviceberry, muttongrass
Land capability (non irrigated): 6c

Typical Profile
Location
Geographic Coordinate System:
37° 13’ 52.00’’ north, 111° 2’ 31.70’’ west

A--0 to 2 inches (0 to 5 cm); brown (7.5YR 5/4) fine sandy loam, brown (7.5YR 4/4), moist; 10 percent clay; weak fine granular parting to single grain structure; loose, nonsticky and nonplastic; many very fine roots throughout and many fine roots throughout; many fine dendritic tubular pores; very slightly effervescent, by HCl, 1 normal; slightly alkaline, pH 7.6 by Cresol red; abrupt smooth boundary.

Bk--2 to 9 inches (5 to 23 cm); brown (7.5YR 4/4) sandy loam, dark brown (7.5YR 3/4), moist; 12 percent clay; weak fine subangular blocky structure; soft, friable, nonsticky and nonplastic; many fine roots throughout and many medium roots throughout; many fine dendritic tubular pores; common fine carbonate masses; very slightly effervescent, by HCl, 1 normal; slightly alkaline, pH 7.6 by Cresol red; clear smooth boundary.

Bw--9 to 17 inches (23 to 43 cm); brown (7.5YR 4/3) sandy loam, dark brown (7.5YR 3/3), moist; 12 percent clay; moderate fine subangular blocky and moderate medium subangular blocky structure; slightly hard, friable, nonsticky and nonplastic; many fine roots throughout and common medium roots throughout; many fine dendritic tubular and many medium dendritic tubular pores; 5 percent gravel; very slightly effervescent, by HCl, 1 normal; slightly alkaline, pH 7.8 by Cresol red; abrupt wavy boundary.

R--17 to 27 inches (43 to 68 cm); unweathered, unfractured sandstone bedrock.

Range in Characteristics
Reaction: 7.4 to 8.4 (slightly or moderately alkaline)

A Horizon
Value: 4 or 5 dry, 3 or 4 moist

Chroma: 4 to 6, dry or moist

Bw or Bk Horizons
Hue: 5YR or 7.5YR
Value: 4 or 5 dry, 3 or 4 moist
Chroma: 3 to 6, dry or moist
Texture: fine sandy loamy, sandy loam
Clay: 6 to 18 percent
Rock fragments: 0 to 12 percent

Cambic horizon - the zone from 2 to 17 inches (Bw and Bk horizons)

134—Gladel-Rock outcrop complex, 4 to 22 percent slopes, bouldery

Map Unit Setting
Landform(s): plateaus
Elevation: 7,220 to 7,550 feet (2,200 to 2,300 meters)
Mean annual precipitation: 14 to 18 inches (350 to 450 millimeters)
Mean annual air temperature: 50 to 54 degrees Fahrenheit (10.0 to 12.0 degrees Celsius)
Mean annual soil temperature: 52 to 56 degrees Fahrenheit (11.1 to 13.1 degrees Celsius)
Frost-free period: 120 to 150 days
Major Land Resource Area: 35 - Colorado Plateau
Land Resource Unit: 35-6 Colorado Plateau Pinyon - Juniper - Sagebrush

Map Unit Composition
Gladel and similar soils: 50 percent
Rock outcrop: 30 percent
Minor components: Shallow Colskel soils on shoulders. Soils that are greater than 20 inches (50 cm) deep on more stable, less sloping areas.

Soil Properties and Qualities
Gladel soils
Taxonomic classification: Loamy, mixed, superactive, mesic Aridic Lithic Haplustepts
Geomorphic position: occurs on interfluves on bedrock controlled surfaces.
Parent material: eolian sands and/or residuum weathered from sandstone
Slope: 4 to 22 percent
Biological crust
cyanobacteria: 3 percent
lichen: 0 percent
moss: 0 percent
Chemical crust
salt: 0 percent
gypsum: 0 percent
Physical cover
canopy plant cover: 41 percent
woody debris: 70 percent
bare soil: 2 percent
rock fragments
gravel: 15 percent
cobble: 6 percent
stone: 1 percent
boulder: 1 percent
channer: 3 percent
Depth to restrictive feature(s): 9 to 17 inches to bedrock, lithic
Drainage class: somewhat excessively drained
Ksat solum: 2.00 to 6.00 inches per hour (14.11 to 42.34 micrometers per second)
Ksat restrictive layer: 0.00 to 0.20 inches per hour (0.00 to 1.40 micrometers per second)
Available water capacity total inches: 1.8 (very low)
Shrink-swell potential: about 1.5 LEP (low)
Flooding hazard: none
Runoff class: high
Hydrologic group: D
Ecological site name: Upland Shallow Loam (Pinyon-Utah Juniper)
Ecological site number: R035XY315UT
Present vegetation: pinyon, Wyoming big sagebrush, Utah juniper, dwarf lousewort, Utah serviceberry, muttongrass
Land capability (non irrigated): 6c

Typical Profile
Location
Geographic Coordinate System:
37° 11’ 25.50’’ north, 111° 1’ 49.10’’ west

A--0 to 2 inches (0 to 5 cm); brown (7.5YR 4/4) sandy loam, dark brown (7.5YR 3/4), moist; 10 percent clay; weak medium platy structure; soft, very friable, nonsticky and nonplastic; many very fine roots throughout and many fine roots throughout; very fine tubular and many fine tubular pores; 3 percent gravel; very slightly effervescent, by HCl, 1 normal; slightly alkaline, pH 7.8 by Cresol red; clear smooth boundary.

Bk--2 to 16 inches (5 to 41 cm); strong brown (7.5YR 4/6) sandy loam, brown (7.5YR 4/4), moist; 12 percent clay; moderate fine subangular blocky and moderate medium subangular blocky structure; moderately hard, friable, nonsticky and nonplastic; many very fine roots throughout and many fine roots throughout and many medium roots throughout; many very fine tubular and many fine tubular pores; common fine carbonate masses; 7 percent gravel and 3 percent cobble; strongly effervescent, by HCl, 1 normal; moderately alkaline, pH 8.2 by Cresol red; abrupt wavy boundary.

R--16 to 26 inches (41 to 66 cm); unweathered, unfractured sandstone bedrock.

Range in Characteristics
Reaction: 7.4 to 8.4 (slightly or moderately alkaline)

Percent clay: 8 to 16

A Horizon
Value: 4 or 5 dry, 3 or 4 moist
Chroma: 4 to 6, dry or moist

Bk Horizon
Hue: 5YR or 7.5YR
Value: 4 or 5 dry, 3 or 4 moist
Chroma: 4 to 6, dry or moist
Texture: fine sandy loamy, sandy loam
Calcium carbonate equivalent: 0 to 5 percent

Cambic horizon- the zone from 2 to 16 inches (Bk horizon)

Rock outcrop
Slope: unspecified

Range in Characteristics
Rock outcrop consists of exposures of sandstone bedrock.

136—Kydestea-Rock outcrop complex, 15 to 60 percent slopes, very bouldery

Map Unit Setting
Landform(s): plateaus
Elevation: 6,890 to 7,550 feet (2,100 to 2,300 meters)
Mean annual precipitation: 14 to 18 inches (350 to 450 millimeters)
Mean annual air temperature: 50 to 54 degrees Fahrenheit (10.0 to 12.0 degrees Celsius)
Mean annual soil temperature: 52 to 56 degrees Fahrenheit (11.1 to 13.1 degrees Celsius)
Frost-free period: 120 to 150 days
Major Land Resource Area: 35 - Colorado Plateau
Land Resource Unit: 35-6 Colorado Plateau Pinyon - Juniper - Sagebrush

Map Unit Composition
Kydestea and similar soils: 60 percent
Rock outcrop: 40 percent
Minor components: Soils with greater than 35 percent clay in the subsoil. Soils with less than 35 percent rock fragments throughout the soil profile.

Soil Properties and Qualities
Kydestea soils
Taxonomic classification: Loamy-skeletal, mixed, superactive, calcareous, mesic Aridic Lithic Ustorthents
Geomorphic position: occurs on side slopes on bedrock controlled surfaces.
Parent material: colluvium derived from sandstone and/or residuum weathered from sandstone
Slope: 15 to 60 percent
Biological crust
cyanobacteria: 3 percent
lichen: 0 percent
moss: 0 percent
Chemical crust
salt: 0 percent
gypsum: 0 percent
Physical cover
canopy plant cover: 34 percent
woody debris: 56 percent
bare soil: 8 percent
rock fragments
gravel: 14 percent
cobble: 7 percent
stone: 5 percent
boulder: 7 percent
channer: 3 percent
flagstone: 1 percent
Depth to restrictive feature(s): 9 to 18 inches to bedrock, lithic
Drainage class: well drained
Ksat solum: 0.60 to 6.00 inches per hour (4.23 to 42.34 micrometers per second)
Ksat restrictive layer: 0.00 to 0.20 inches per hour (0.00 to 1.40 micrometers per second)
Available water capacity total inches: 1.7 (very low)
Shrink-swell potential: about 4.5 LEP (moderate)
Flooding hazard: none
Runoff class: very high
Hydrologic group: D
Ecological site name: Upland Stony Loam (Pinyon-Utah Juniper)
Ecological site number: R035XY321UT
Present vegetation: pinyon, Utah juniper, Utah serviceberry, Wyoming big sagebrush, dwarf lousewort
Land capability (non irrigated): 6c

Typical Profile
Location
Geographic Coordinate System:
37° 11’ 47.60’’ north, 111° 1’ 58.10’’ west

A--0 to 1 inch (0 to 3 cm); brown (7.5YR 4/3) gravelly sandy loam, dark brown (7.5YR 3/3), moist; 14 percent clay; weak thin platy structure; soft, very friable, nonsticky and nonplastic; many very fine roots throughout; many very fine dendritic tubular pores; 10 percent gravel and 10 percent channer and 2 percent flagstone; slightly effervescent, by HCl, 1 normal; slightly alkaline, pH 7.8 by Cresol red; abrupt smooth boundary.

Bw--1 to 9 inches (3 to 23 cm); yellowish brown (10YR 5/4) flaggy sandy clay loam, brown (10YR 4/3), moist; 26 percent clay; moderate fine subangular blocky structure; moderately hard, friable, slightly sticky and slightly plastic; many very fine roots throughout and many fine roots throughout and many medium roots throughout; many very fine dendritic tubular pores; 5 percent gravel and 10 percent channer and 15 percent flagstone; strongly effervescent, by HCl, 1 normal; moderately alkaline, pH 8.0 by Cresol red; gradual smooth boundary.

Bk--9 to 16 inches (23 to 41 cm); yellowish brown (10YR 5/4) very flaggy sandy clay loam, brown (10YR 4/3), moist; 32 percent clay; weak fine subangular blocky structure; moderately hard, friable, slightly sticky and moderately plastic; many very fine roots throughout and many fine roots throughout; many very fine dendritic tubular pores; common carbonate masses; 5 percent gravel and 20 percent channer and 15 percent flagstone; violently effervescent, by HCl, 1 normal; moderately alkaline, pH 8.4 by Cresol red; abrupt wavy boundary.

R--16 to 26 inches (41 to 66 cm); unweathered, unfractured sandstone bedrock.

Range in Characteristics
Reaction: 7.4 to 8.4 (slightly or moderately alkaline)

A Horizon
Value: 4 or 5 dry, 3 or 4 moist
Chroma: 3 or 4, dry or moist

Bw or Bk Horizon
Hue: 7.5YR to 10YR
Value: 4 or 5 dry, 3 or 4 moist
Chroma: 3 to 6, dry or moist
Clay: 20 to 35 percent
Rock fragments: 20 to 60 percent

Cambic horizon- the zone from 1 to 16 inches (Bw and Bk horizons)

Rock outcrop
Slope: unspecified

Range in Characteristics
Rock outcrop consists of exposures of sandstone bedrock.

144—Juanalo family-Rock outcrop complex, 4 to 28 percent slopes, bouldery

Map Unit Setting
Landform(s): plateaus
Elevation: 3,840 to 4,590 feet (1,170 to 1,400 meters)
Mean annual precipitation: 6 to 10 inches (150 to 250 millimeters)
Mean annual air temperature: 54 to 57 degrees Fahrenheit (12.0 to 14.0 degrees Celsius)
Mean annual soil temperature: 56 to 59 degrees Fahrenheit (13.1 to 15.1 degrees Celsius)
Frost-free period: 150 to 180 days
Major Land Resource Area: 35 - Colorado Plateau
Land Resource Unit: 35-2 Colorado Plateau Shrub - Grasslands

Map Unit Composition
Juanalo family and similar soils: 75 percent
Rock outcrop: 15 percent
Minor components: Very deep Cowboy and shallow Claysprings soils are on stable, less sloping areas. Some areas have soils with more than 35 percent rock fragments throughout the profile.

Soil Properties and Qualities
Juanalo family soils
Taxonomic classification: Loamy, mixed, superactive, calcareous, mesic Lithic Torriorthents
Geomorphic position: occurs on interfluves on structural benches.
Parent material: colluvium and/or residuum weathered from sandstone
Slope: 4 to 28 percent
Biological crust
cyanobacteria: 13 percent
lichen: 5 percent
moss: 1 percent
Chemical crust
salt: 0 percent
gypsum: 0 percent
Physical cover
canopy plant cover: 11 percent
woody debris: 22 percent
bare soil: 20 percent
rock fragments
gravel: 17 percent
cobble: 1 percent
stone: 1 percent
boulder: 1 percent
channer: 14 percent
flagstone: 1 percent
Depth to restrictive feature(s): 4 to 19 inches to bedrock, lithic
Drainage class: well drained
Ksat solum: 0.60 to 6.00 inches per hour (4.23 to 42.34 micrometers per second)
Ksat restrictive layer: 0.00 to 0.20 inches per hour (0.00 to 1.40 micrometers per second)
Available water capacity total inches: 1.7 (very low)
Shrink-swell potential: about 1.5 LEP (low)
Flooding hazard: none
Runoff class: high
Hydrologic group: D
Ecological site name: Desert Shallow Sandy Loam (Shadscale)
Ecological site number: R035XY130UT
Present vegetation: shadscale saltbush, galleta, sixweeks

fescue
Land capability (non irrigated): 7c

Typical Profile
Location
Geographic Coordinate System:
37° 3' 51.90'' north, 111° 34' 5.60'' west

A--0 to 2 inches (0 to 5 cm); light olive brown (2.5Y 5/4) gravelly loam, olive brown (2.5Y 4/4), moist; 26 percent clay; weak thin platy structure; soft, very friable, moderately sticky and moderately plastic; common very fine roots throughout; many very fine dendritic tubular pores; 10 percent gravel and 10 percent channer; strongly effervescent, by HCl, 1 normal; slightly alkaline, pH 7.6 by Cresol red; clear wavy boundary.

By--2 to 10 inches (5 to 25 cm); light olive brown (2.5Y 5/4) gravelly loam, olive brown (2.5Y 4/4), moist; 22 percent clay; weak fine subangular blocky structure; soft, very friable, moderately sticky and slightly plastic; common very fine roots throughout; common very fine dendritic tubular pores; common fine gypsum masses; 15 percent gravel and 10 percent channer; strongly effervescent, by HCl, 1 normal, 1 percent gypsum; slightly alkaline, pH 7.6 by Cresol red; gradual wavy boundary.

2Cy--10 to 18 inches (25 to 46 cm); light brownish gray (2.5Y 6/2) coarse sandy loam, light olive brown (2.5Y 5/3), moist; 15 percent clay; massive; slightly hard, friable, slightly sticky and slightly plastic; many very fine roots throughout; many very fine dendritic tubular pores; common fine gypsum masses and many medium gypsum crystals; 10 percent fine gravel; strongly effervescent, by HCl, 1 normal, 14 percent calcium carbonate equivalent and 13 percent gypsum; slightly alkaline, pH 7.4 by Cresol red; clear wavy boundary.

2R--18 to 28 inches (46 to 71 cm); unweathered, unfractured sandstone bedrock.

Range in Characteristics
Reaction: 7.4 to 8.4 (slightly or moderately alkaline)

A Horizon
Value: 4 or 5 dry, 3 or 4 moist
Chroma: 3 or 4, dry or moist

By Horizon
Hue: 10YR or 2.5Y
Value: 4 or 5 dry, 3 or 4 moist
Chroma: 4 to 6, dry or moist
Texture: loam, sandy loam
Clay: 15 to 26 percent
Rock fragments: 0 to 30 percent

Cy Horizon
Hue: 10YR or 2.5Y
Value: 4 to 6 dry, 3 to 5 moist
Chroma: 2 to 6, dry or moist
Texture: coarse sandy loamy, sandy loam, loam
Clay: 12 to 18 percent
Rock fragments: 0 to 30 percent
Gypsum: 5 to 15 percent
Calcium carbonate equivalent: 5 to 15 percent

Rock outcrop
Slope: unspecified

Range in Characteristics
Rock outcrop consists of exposures of sandstone bedrock usually of the Dakota Formation.

147—Seeg gravelly loam, 4 to 24 percent slopes, bouldery

Map Unit Setting
Landform(s): plateaus
Elevation: 3,840 to 4,590 feet (1,170 to 1,400 meters)
Mean annual precipitation: 6 to 10 inches (150 to 250 millimeters)
Mean annual air temperature: 54 to 57 degrees Fahrenheit (12.0 to 14.0 degrees Celsius)
Mean annual soil temperature: 56 to 59 degrees Fahrenheit (13.1 to 15.1 degrees Celsius)
Frost-free period: 150 to 180 days
Major Land Resource Area: 35 - Colorado Plateau
Land Resource Unit: 35-2 Colorado Plateau Shrub - Grasslands

Map Unit Composition
Seeg and similar soils: 95 percent
Minor components: Shallow Clasprings soils near gully areas. A few areas of Riverwash are in drainageways.

Soil Properties and Qualities
Seeg soils
Taxonomic classification: Loamy-skeletal, mixed, superactive, mesic Typic Haplocalcids
Geomorphic position: occurs on base slopes on fan remnants.
Parent material: colluvium and/or slope alluvium derived from sandstone and shale
Slope: 4 to 24 percent
Biological crust
cyanobacteria: 2 percent
lichen: 1 percent
moss: 0 percent
Chemical crust
salt: 0 percent
gypsum: 0 percent
Physical cover

canopy plant cover: 13 percent
woody debris: 20 percent
bare soil: 15 percent
rock fragments
gravel: 26 percent
cobble: 2 percent
boulder: 2 percent
channer: 30 percent

Drainage class: well drained
Ksat solum: 0.60 to 6.00 inches per hour (4.23 to 42.34 micrometers per second)
Available water capacity total inches: 4.1 (low)
Shrink-swell potential: about 1.5 LEP (low)
Flooding hazard: none
Runoff class: medium
Hydrologic group: B
Ecological site name: Desert Stony Loam (Shadscale-Bud Sagebrush)
Ecological site number: R035XY136UT
Present vegetation: galleta, shadscale saltbush, rayless goldenhead
Land capability (non irrigated): 7c

Typical Profile
Location
Geographic Coordinate System:
37° 8' 6.30'' north, 111° 24' 15.40'' west

A--0 to 2 inches (0 to 5 cm); brown (7.5YR 5/4) gravelly loam, brown (7.5YR 4/4), moist; 26 percent clay; weak thin platy structure; slightly hard, very friable, slightly sticky and slightly plastic; many fine roots throughout; many fine dendritic tubular pores; 15 percent gravel and 2 percent cobble and 10 percent channer; strongly effervescent, by HCl, 1 normal; slightly alkaline, pH 7.8 by Cresol red; clear smooth boundary.

Bw--2 to 11 inches (5 to 28 cm); brown (7.5YR 5/4) very channery loam, brown (7.5YR 4/4), moist; 24 percent clay; weak fine subangular blocky and weak medium subangular blocky structure; slightly hard, very friable, slightly sticky and slightly plastic; many very fine roots throughout and many fine roots throughout; many very fine dendritic tubular and many fine dendritic tubular pores; 20 percent gravel and 5 percent cobble and 30 percent channer; strongly effervescent, by HCl, 1 normal; slightly alkaline, pH 7.8 by Cresol red; abrupt wavy boundary.

Bk--11 to 29 inches (28 to 74 cm); light yellowish brown (10YR 6/4) extremely gravelly loam, yellowish brown (10YR 5/6), moist; 16 percent clay; massive; soft, loose, slightly sticky and nonplastic; many fine roots throughout; many very fine dendritic tubular and many fine dendritic tubular and many medium dendritic tubular pores; many fine carbonate masses throughout; 35 percent gravel and 10 percent cobble and 5 percent stone and 20 percent channer; strongly effervescent, by HCl, 1 normal, 10 percent calcium carbonate equivalent; moderately alkaline, pH 8.2 by Cresol red; abrupt smooth boundary.

Ck--29 to 34 inches (74 to 86 cm); brown (7.5YR 5/4) gravelly sandy loam, brown (7.5YR 4/4), moist; 14 percent clay; massive; soft, loose, slightly sticky and nonplastic; many fine roots throughout; many very fine dendritic tubular and many fine dendritic tubular pores; common fine carbonate masses throughout; 20 percent gravel and 10 percent channer; strongly effervescent, by HCl, 1 normal, 13 percent calcium carbonate equivalent; slightly alkaline, pH 7.8 by Cresol red; clear smooth boundary.

Cky--34 to 60 inches (86 to 152 cm); brown (7.5YR 5/4) extremely gravelly sandy loam, brown (7.5YR 4/4), moist; 14 percent clay; massive; soft, loose, slightly sticky and nonplastic; many fine dendritic tubular pores; common fine carbonate masses and common fine gypsum crystals around rock fragments; 45 percent gravel and 10 percent cobble and 5 percent stone and 20 percent channer; strongly effervescent, by HCl, 1 normal, 9 percent calcium carbonate equivalent; slightly alkaline, pH 7.8 by Cresol red.

Range in Characteristics
Reaction: 7.4 to 8.4 (slightly or moderately alkaline)
Percent clay: 12 to 25

A Horizon
Value: 4 to 6 dry, 3 to 5 moist
Chroma: 3 or 4, dry or moist

Bw or Bk Horizons
Hue: 10YR or 7.5YR
Value: 4 to 6 dry, 3 to 5 moist
Chroma: 4 to 6, dry or moist
Texture: sandy loam, loam
Clay: 12 to 25 percent
Calcium carbonate equivalent: 5 to 20 percent
Rock fragments: 25 to 80 percent

Ck or Cky Horizons
Hue: 7.5YR to 2.5Y
Value: 4 to 6 dry, 3 to 5 moist
Chroma: 2 to 6, dry or moist
Texture: sandy loam, loam
Clay: 12 to 20 percent
Calcium carbonate equivalent: 5 to 10 percent
Rock fragments: 30 to 80 percent

Calcic Horizon- zone from 11 to 29 inches (Bk horizon)

148—Cowboy clay loam, 3 to 10 percent slopes

Map Unit Setting
Landform(s): plateaus
Elevation: 3,840 to 4,590 feet (1,170 to 1,400 meters)
Mean annual precipitation: 6 to 10 inches (150 to 250 millimeters)
Mean annual air temperature: 54 to 57 degrees Fahrenheit (12.0 to 14.0 degrees Celsius)
Mean annual soil temperature: 56 to 59 degrees Fahrenheit (13.1 to 15.1 degrees Celsius)
Frost-free period: 150 to 180 days
Major Land Resource Area: 35 - Colorado Plateau
Land Resource Unit: 35-2 Colorado Plateau Shrub - Grasslands

Map Unit Composition
Cowboy and similar soils: 85 percent
Minor components: Very deep Seeg soils and shallow Claysprings soils. These soils usually occur on higher more stable positions.

Soil Properties and Qualities
Cowboy soils
Taxonomic classification: Fine, smectitic, mesic Typic Haplogypsids
Geomorphic position: occurs on base slopes on hills and structural benches.
Parent material: alluvium and/or slope alluvium derived from calcareous shale
Slope: 3 to 10 percent
Biological crust
cyanobacteria: 19 percent
lichen: 2 percent
moss: 0 percent
Chemical crust
salt: 0 percent
gypsum: 0 percent
Physical cover
canopy plant cover: 10 percent
woody debris: 13 percent
bare soil: 53 percent
rock fragments
gravel: 6 percent
cobble: 1 percent
channer: 3 percent
Drainage class: well drained
Ksat solum: 0.06 to 2.00 inches per hour (0.42 to 14.11 micrometers per second)
Available water capacity total inches: 9.3 (high)
Shrink-swell potential: about 7.5 LEP (high)
Flooding hazard: none
Runoff class: high
Hydrologic group: C
Ecological site name: Desert Shallow Clay (Mat Saltbush)
Ecological site number: R035XY124UT
Present vegetation: mat saltbush, Native American pipeweed
Land capability (non irrigated): 7c

Typical Profile
Location
Geographic Coordinate System:
37° 4’ 24.50’’ north, 111° 24’ 15.40’’ west

A--0 to 2 inches (0 to 5 cm); light yellowish brown (2.5Y 6/3) clay loam, light olive brown (2.5Y 5/3), moist; 34 percent clay; weak thin platy structure; loose, slightly sticky and moderately plastic; common fine roots throughout; many fine dendritic tubular pores; common fine white (10YR 8/1), dry, salt masses throughout and common fine gypsum masses throughout; 2 percent channer; violently effervescent, by HCl, 1 normal; moderately alkaline, pH 8.4 by Cresol red; abrupt smooth boundary.

By1--2 to 6 inches (5 to 15 cm); light olive brown (2.5Y 5/4) sandy clay loam, olive brown (2.5Y 4/4), moist; 30 percent clay; weak fine subangular blocky structure; soft, very friable, slightly sticky and slightly plastic; common very fine roots throughout and common fine roots throughout; many very fine dendritic tubular pores; common fine white (10YR 8/1), dry, salt masses throughout and common fine gypsum masses throughout; 5 percent channer; violently effervescent, by HCl, 1 normal, 1 percent gypsum; moderately alkaline, pH 8.2 by Cresol red; abrupt smooth boundary.

By2--6 to 19 inches (15 to 48 cm); light olive brown (2.5Y 5/4) sandy clay loam, olive brown (2.5Y 4/4), moist; 34 percent clay; moderate medium prismatic structure; moderately hard, very friable, slightly sticky and moderately plastic; common fine roots throughout and common medium roots throughout; many fine dendritic tubular and many medium dendritic tubular pores; common fine gypsum crystals and common fine gypsum masses throughout and common fine white (10YR 8/1), dry, salt masses throughout; 10 percent channer; violently effervescent, by HCl, 1 normal, 8 percent calcium carbonate equivalent and 3 percent gypsum; moderately alkaline, pH 8.2 by Cresol red; clear smooth boundary.

By3--19 to 47 inches (48 to 119 cm); light olive brown (2.5Y 5/4) clay, light olive brown (2.5Y 5/3), moist; 45 percent clay; massive; hard, very friable, moderately sticky and very plastic; common fine roots throughout; many fine dendritic tubular pores; many fine white (10YR 8/1), dry, salt masses on faces of peds and common fine gypsum crystals; 2 percent channer; violently effervescent, by HCl, 1 normal, 11 percent calcium carbonate equivalent and 12 percent gypsum; moderately alkaline, pH 8.2 by Cresol red; gradual smooth boundary.

By4--47 to 56 inches (119 to 142 cm); light yellowish brown (2.5Y 6/4) clay loam, light yellowish brown (2.5Y 6/3), moist; 38 percent clay; massive; hard, friable, slightly sticky and moderately plastic; many fine dendritic tubular pores; many fine white (10YR 8/1), dry, salt masses on faces of peds and common fine gypsum crystals; 5 percent channer and 10 percent channer; violently effervescent, by HCl, 1 normal; moderately alkaline, pH 8.4 by Cresol red; clear smooth boundary.

By5--56 to 60 inches (142 to 152 cm); light olive brown (2.5Y 5/4) clay, light olive brown (2.5Y 5/3), moist; 45 percent clay; massive; moderately hard, friable, slightly sticky and moderately plastic; many very fine dendritic tubular and many fine dendritic tubular pores; many fine white (10YR 8/1), dry, salt masses on faces of peds and many fine gypsum crystals; 5 percent channer; violently effervescent, by HCl, 1 normal; moderately alkaline, pH 8.2 by Cresol red.

Range in Characteristics
The Cowboy series used in this survey is a taxadjunct to the official series. The official series classification is Fine, smectitic, mesic, Leptic Haplogypsids. This does not affect use and management.

Reaction: 7.9 to 9.0 (moderately to strongly alkaline)

A Horizon
Value: 5 or 6 dry, 4 or 5 moist
Chroma: 3 or 4, dry or moist

By Horizons
Hue: 10YR or 2.5Y
Value: 5 or 6 dry, 4 to 6 moist
Chroma: 3 or 4, dry or moist
Texture: sandy clay loam, clay, clay loam
Clay: 28 to 50 percent
Calcium carbonate equivalent: 0 to 15 percent
Gypsum: 0 to 15 percent
Rock fragments: 0 to 10 percent

Gypsic Horizon- the zone from 19 to 47 inches (By horizon)

166—Rock outcrop-Tsaya complex, 15 to 60 percent slopes, extremely bouldery

Map Unit Setting
Landform(s): plateaus
Elevation: 4,170 to 5,580 feet (1,270 to 1,700 meters)
Mean annual precipitation: 6 to 10 inches (150 to 250 millimeters)
Mean annual air temperature: 54 to 57 degrees Fahrenheit (12.0 to 14.0 degrees Celsius)
Mean annual soil temperature: 56 to 59 degrees Fahrenheit (13.1 to 15.1 degrees Celsius)
Frost-free period: 150 to 180 days
Major Land Resource Area: 35 - Colorado Plateau
Land Resource Unit: 35-2 Colorado Plateau Shrub - Grasslands

Map Unit Composition
Rock outcrop: 50 percent
Tsaya and similar soils: 40 percent
Minor components: Very deep Dient soils are on stable, less sloping areas. Some areas have clay percentages greater than 35%.

Soil Properties and Qualities
Rock outcrop
Slope: unspecified

Range in Characteristics
Rock outcrop consists of exposures of sandstone bedrock.

Tsaya soils
Taxonomic classification: Loamy-skeletal, mixed, superactive, calcareous, mesic Lithic Torriorthents
Geomorphic position: occurs on talus slopes and ledges on escarpments.
Parent material: gravelly talus derived from sandstone and shale
Slope: 15 to 60 percent
Biological crust
cyanobacteria: 0 percent
lichen: 0 percent
moss: 0 percent
Chemical crust
salt: 0 percent
gypsum: 0 percent
Physical cover
canopy plant cover: 12 percent
woody debris: 16 percent
bare soil: 6 percent
rock fragments
gravel: 33 percent
cobble: 17 percent
stone: 4 percent
boulder: 15 percent
channer: 7 percent
Depth to restrictive feature(s): 11 to 20 inches to bedrock, lithic
Drainage class: well drained
Ksat solum: 0.20 to 2.00 inches per hour (1.40 to 14.11 micrometers per second)
Ksat restrictive layer: 0.00 to 0.20 inches per hour (0.00 to 1.40 micrometers per second)
Available water capacity total inches: 1.3 (very low)
Shrink-swell potential: about 4.5 LEP (moderate)
Flooding hazard: none
Runoff class: very high
Hydrologic group: D

Ecological site name: Desert Very Steep Stony Loam (Shadscale)
Ecological site number: R035XY146UT
Present vegetation: shadscale saltbush, rayless goldenhead, rubber rabbitbrush, bottlebrush squirreltail
Land capability (non irrigated): 7c

Typical Profile
Location
Geographic Coordinate System:
37° 8' 9.90'' north, 111° 20' 26.40'' west

A--0 to 2 inches (0 to 5 cm); brown (10YR 5/3) gravelly loam, dark grayish brown (10YR 4/2), moist; 24 percent clay; weak thin platy structure; slightly hard, friable, slightly sticky and slightly plastic; many very fine roots throughout and many fine roots throughout; many fine dendritic tubular pores; 25 percent gravel and 5 percent channer; slightly effervescent, by HCl, 1 normal; moderately alkaline, pH 8.2 by Cresol red; abrupt smooth boundary.

C1--2 to 7 inches (5 to 18 cm); grayish brown (10YR 5/2) very gravelly clay loam, dark grayish brown (10YR 4/2), moist; 30 percent clay; weak fine subangular blocky structure; moderately hard, friable, slightly sticky and moderately plastic; many very fine roots throughout and many fine roots throughout; many fine dendritic tubular pores; 35 percent gravel and 10 percent channer; slightly effervescent, by HCl, 1 normal; moderately alkaline, pH 8.4 by Cresol red; clear smooth boundary.

C2--7 to 13 inches (18 to 33 cm); light brownish gray (10YR 6/2) extremely gravelly loam, dark grayish brown (10YR 4/2), moist; 22 percent clay; massive; slightly hard, friable, slightly sticky and slightly plastic; many very fine roots throughout and many fine roots throughout; many very fine dendritic tubular pores; 60 percent gravel and 5 percent cobble and 5 percent channer; slightly effervescent, by HCl, 1 normal; moderately alkaline, pH 8.2 by Cresol red; clear smooth boundary.

R--13 to 23 inches (33 to 58 cm); unweathered, unfractured sandstone bedrock.

Range in Characteristics
Reaction: 7.9 to 8.4 (moderately alkaline)

A Horizon
Value: 5 or 6 dry, 4 or 5 moist
Chroma: 2 to 4, dry or moist

C Horizons
Hue: 10YR or 2.5Y
Value: 4 to 6 dry, 3 to 5 moist
Chroma: 2 to 6, dry or moist
Texture: loam, clay loam
Clay: 16 to 32 percent
Calcium carbonate equivalent: 0 to 2 percent
Rock fragments: 35 to 80 percent

167—Dient-Claysprings, extremely gravelly, complex, 5 to 65 percent slopes, bouldery

Map Unit Setting
Landform(s): plateaus
Elevation: 3,970 to 5,540 feet (1,210 to 1,690 meters)
Mean annual precipitation: 6 to 10 inches (150 to 250 millimeters)
Mean annual air temperature: 54 to 57 degrees Fahrenheit (12.0 to 14.0 degrees Celsius)
Mean annual soil temperature: 56 to 59 degrees Fahrenheit (13.1 to 15.1 degrees Celsius)
Frost-free period: 150 to 180 days
Major Land Resource Area: 35 - Colorado Plateau
Land Resource Unit: 35-2 Colorado Plateau Shrub - Grasslands

Map Unit Composition
Dient and similar soils: 65 percent
Claysprings and similar soils: 30 percent
Minor components: A few areas of Badland and gullies.

Soil Properties and Qualities
Dient soils
Taxonomic classification: Loamy-skeletal, mixed, superactive, calcareous, mesic Typic Torriorthents
Geomorphic position: occurs on base slopes on alluvial fans and fan remnants.
Parent material: colluvium and/or slope alluvium derived from sandstone and shale
Slope: 5 to 65 percent
Biological crust
cyanobacteria: 6 percent
lichen: 4 percent
moss: 5 percent
Chemical crust
salt: 0 percent
gypsum: 0 percent
Physical cover
canopy plant cover: 28 percent
woody debris: 28 percent
bare soil: 5 percent
rock fragments
gravel: 35 percent
cobble: 5 percent
stone: 3 percent
boulder: 5 percent
channer: 9 percent
flagstone: 1 percent
Drainage class: well drained

Ksat solum: 0.60 to 6.00 inches per hour (4.23 to 42.34 micrometers per second)
Available water capacity total inches: 3.8 (low)
Shrink-swell potential: about 4.5 LEP (moderate)
Flooding hazard: none
Runoff class: high
Hydrologic group: B
Ecological site name: Desert Stony Loam (Blackbrush)
Ecological site number: R035XY139UT
Present vegetation: blackbrush, shadscale saltbush, galleta
Land capability (non irrigated): 7c

Typical Profile
Location
Geographic Coordinate System:
37° 8' 39.00'' north, 111° 20' 2.50'' west

A--0 to 2 inches (0 to 5 cm); brown (10YR 5/3) very gravelly loam, brown (10YR 4/3), moist; 26 percent clay; weak thin platy structure; soft, very friable, slightly sticky and nonplastic; many very fine roots throughout; many fine dendritic tubular pores; 40 percent gravel; strongly effervescent, by HCl, 1 normal; moderately alkaline, pH 8.4 by Cresol red; clear wavy boundary.

Bw--2 to 7 inches (5 to 18 cm); brown (10YR 5/3) very gravelly loam, brown (10YR 4/3), moist; 26 percent clay; moderate fine subangular blocky structure; soft, very friable, slightly sticky and nonplastic; many very fine roots throughout and many fine roots throughout; many fine dendritic tubular pores; 35 percent gravel and 5 percent cobble; strongly effervescent, by HCl, 1 normal; moderately alkaline, pH 8.4 by Cresol red; clear wavy boundary.

C1--7 to 15 inches (18 to 38 cm); brown (10YR 5/3) extremely cobbly sandy loam, brown (10YR 4/3), moist; 19 percent clay; weak fine subangular blocky structure; loose, slightly sticky and nonplastic; many very fine roots throughout and many fine roots throughout; many fine dendritic tubular pores; 40 percent gravel and 20 percent cobble and 5 percent stone; strongly effervescent, by HCl, 1 normal; moderately alkaline, pH 8.4 by Cresol red; clear wavy boundary.

C2--15 to 22 inches (38 to 56 cm); light yellowish brown (10YR 6/4) extremely stony sandy loam, yellowish brown (10YR 5/4), moist; 18 percent clay; massive; loose, nonsticky and nonplastic; many very fine roots throughout and many fine roots throughout; common fine dendritic tubular pores; 40 percent gravel and 10 percent cobble; strongly effervescent, by HCl, 1 normal; moderately alkaline, pH 8.4 by Cresol red; clear wavy boundary.

C3--22 to 60 inches (56 to 152 cm); light yellowish brown (10YR 6/4) extremely gravelly sandy loam, yellowish brown (10YR 5/4), moist; 18 percent clay; massive; loose, nonsticky and nonplastic; many very fine roots throughout and many fine roots throughout; 50 percent gravel and 20 percent cobble and 5 percent stone; strongly effervescent, by HCl, 1 normal; moderately alkaline, pH 8.0 by Cresol red.

Range in Characteristics
Reaction: 7.4 to 8.4 (slightly or moderately alkaline)

A Horizon
Value: 5 dry, 4 moist
Chroma: 3, dry or moist

Bw Horizon
Hue: 10YR or 2.5Y
Value: 4 or 5 dry, 3 or 4 moist
Chroma: 3, dry or moist
Texture: loam, sandy loam
Clay: 15 to 27 percent
Rock fragments: 35 to 55 percent

C Horizons
Hue: 10YR or 2.5Y
Value: 5 or 6 dry, 4 or 5 moist
Chroma: 3 or 4, dry or moist
Texture: sandy loam, loam
Clay: 12 to 27 percent
Rock fragments: 35 to 85 percent

Some pedons do not have a Bw horizon

Claysprings soils
Taxonomic classification: Clayey, mixed, superactive, calcareous, mesic, shallow Typic Torriorthents
Geomorphic position: occurs on base slopes on alluvial fans and fan remnants.
Parent material: gravelly colluvium derived from sandstone and shale over clayey residuum weathered from calcareous shale
Slope: 5 to 65 percent
Biological crust
cyanobacteria: 9 percent
lichen: 6 percent
moss: 1 percent
Chemical crust
salt: 0 percent
gypsum: 0 percent
Physical cover
canopy plant cover: 21 percent
woody debris: 22 percent
bare soil: 6 percent
rock fragments
gravel: 33 percent
cobble: 10 percent
channer: 18 percent
flagstone: 1 percent
Depth to restrictive feature(s): 7 to 20 inches to densic material

Drainage class: well drained
Ksat solum: 0.00 to 2.00 inches per hour (0.00 to 14.11 micrometers per second)
Available water capacity total inches: 2.8 (low)
Shrink-swell potential: about 7.5 LEP (high)
Flooding hazard: none
Runoff class: high
Hydrologic group: D
Ecological site name: Desert Shallow Clay (Mat Saltbush)
Ecological site number: R035XY124UT
Present vegetation: rayless goldenhead, blackbrush, galleta, Anderson wolfberry
Land capability (non irrigated): 7c

Typical Profile
Location
Geographic Coordinate System:
37° 9' 3.80'' north, 111° 20' 16.00'' west

A--0 to 2 inches (0 to 5 cm); brown (10YR 5/3) channery sandy clay loam, dark grayish brown (10YR 4/2), moist; 25 percent clay; weak thin platy structure; soft, very friable, moderately sticky and moderately plastic; many very fine dendritic tubular and common fine dendritic tubular pores; 3 percent channer; slightly effervescent, by HCl, 1 normal; moderately alkaline, pH 8.0 by Cresol red; abrupt smooth boundary.

2Cy1--2 to 6 inches (5 to 15 cm); light olive brown (2.5Y 5/3) clay loam, olive brown (2.5Y 4/3), moist; 35 percent clay; moderate coarse granular structure; slightly hard, friable, very sticky and very plastic; common very fine roots throughout; common fine gypsum masses; 3 percent channer; very slightly effervescent, by HCl, 1 normal; moderately alkaline, pH 8.0 by Cresol red; clear wavy boundary.

2Cy2--6 to 11 inches (15 to 28 cm); light olive brown (2.5Y 5/3) clay, olive brown (2.5Y 4/3), moist; 40 percent clay; weak fine subangular blocky structure; hard, firm, very sticky and very plastic; common very fine roots throughout and common fine roots throughout; common very fine tubular pores; common fine gypsum masses; very slightly effervescent, by HCl, 1 normal; moderately alkaline, pH 8.0 by Cresol red; clear wavy boundary.

2Cy3--11 to 18 inches (28 to 46 cm); light yellowish brown (2.5Y 6/3) clay, light olive brown (2.5Y 5/3), moist; 40 percent clay; massive; very hard, very firm, very sticky and very plastic; common very fine roots throughout; common very fine tubular pores; common fine gypsum crystals and common fine gypsum masses; 2 percent gravel; very slightly effervescent, by HCl, 1 normal; slightly alkaline, pH 7.8 by Cresol red; gradual wavy boundary.

2Cd--18 to 28 inches (46 to 71 cm); light yellowish brown (2.5Y 6/3) clay, light olive brown (2.5Y 5/3), moist; 40 percent clay; massive; extremely hard, very firm, very sticky and very plastic; common very fine roots throughout; common very fine tubular pores; common fine gypsum crystals and common fine gypsum masses; 2 percent gravel; very slightly effervescent, by HCl, 1 normal; slightly alkaline, pH 7.8 by Cresol red.

Range in Characteristics
The Claysprings series used in this survey is a taxadjunct to the official series because it has mixed mineralogy. The official series classification is Clayey, smectitic, calcareous, mesic, shallow Typic Torriorthents. This does not affect use and management.

Reaction: 7.4 to 8.4 (slightly or moderately alkaline)

A Horizon
Value: 5 or 6 dry, 4 to 6 moist
Chroma: 2 to 6, dry or moist

Cy Horizons
Hue: 2.5Y or 10YR
Value: 5 or 6 dry, 4 to 6 moist
Chroma: 3 to 8, dry or moist
Texture: clay loam, clay
Clay: 35 to 55 percent
Rock fragments: 0 to 5 percent

168—Claysprings-Badland complex, 2 to 40 percent slopes

Map Unit Setting
Landform(s): plateaus
Elevation: 3,870 to 5,050 feet (1,180 to 1,540 meters)
Mean annual precipitation: 6 to 10 inches (150 to 250 millimeters)
Mean annual air temperature: 54 to 57 degrees Fahrenheit (12.0 to 14.0 degrees Celsius)
Mean annual soil temperature: 56 to 59 degrees Fahrenheit (13.1 to 15.1 degrees Celsius)
Frost-free period: 150 to 180 days
Major Land Resource Area: 35 - Colorado Plateau
Land Resource Unit: 35-2 Colorado Plateau Shrub - Grasslands

Map Unit Composition
Claysprings and similar soils: 65 percent
Badland: 30 percent
Minor components: Some areas are moderately deep to paralithic bedrock. Very deep Cowboy soils in areas of deposition. Very deep Deint soils are on more sable areas.

Soil Properties and Qualities
Claysprings soils
Taxonomic classification: Clayey, mixed, superactive,

calcareous, mesic, shallow Typic Torriorthents
Geomorphic position: occurs on base slopes on hills and benches.
Parent material: residuum weathered from calcareous shale
Slope: 2 to 40 percent
Biological crust
cyanobacteria: 28 percent
lichen: 0 percent
moss: 0 percent
Chemical crust
salt: 6 percent
gypsum: 0 percent
Physical cover
canopy plant cover: 1 percent
woody debris: 1 percent
bare soil: 32 percent
rock fragments
gravel: 1 percent
channer: 11 percent
Depth to restrictive feature(s): 4 to 20 inches to bedrock, paralithic
Drainage class: well drained
Ksat solum: 0.06 to 0.20 inches per hour (0.42 to 1.40 micrometers per second)
Ksat restrictive layer: 0.00 to 0.20 inches per hour (0.00 to 1.40 micrometers per second)
Available water capacity total inches: 1.1 (very low)
Shrink-swell potential: about 4.5 LEP (moderate)
Flooding hazard: none
Runoff class: very high
Hydrologic group: D
Ecological site name: Desert Shallow Clay (Mat Saltbush)
Ecological site number: R035XY124UT
Present vegetation: mat saltbush, shadscale saltbush
Land capability (non irrigated): 7c

Typical Profile
Location
Geographic Coordinate System:
37° 4’ 55.60’’ north, 111° 34’ 10.20’’ west

A--0 to 1 inch (0 to 3 cm); light gray (5Y 7/2) clay, light olive gray (5Y 6/2), moist; 45 percent clay; weak thin platy structure; soft, very friable, very sticky and very plastic; common very fine roots throughout; common very fine dendritic tubular pores; violently effervescent, by HCl, 1 normal; moderately alkaline, pH 8.0 by Cresol red; abrupt wavy boundary.

Cy--1 to 7 inches (3 to 18 cm); light gray (5Y 7/2) clay, light olive gray (5Y 6/2), moist; 45 percent clay; massive; slightly hard, friable, very sticky and very plastic; common fine gypsum masses throughout; strongly effervescent, by HCl, 1 normal, 3 percent gypsum; moderately alkaline, pH 8.0 by Cresol red; abrupt wavy boundary.

Cr--7 to 17 inches (18 to 43 cm); weathered shale bedrock. bedrock.

Range in Characteristics
The Claysprings soils is a taxadjunct to the official series and classifies as a Clayey, mixed, superactive,calcareous, mesic, shallow Typic Torriorthents. The official series is a smectitic, calcareous, mesic, shallow Typic Torriorthents. This does not affect use and management.

Reaction: 7.9 to 8.4 (moderately alkaline)

A Horizon
Hue: 5Y or 2.5Y
Value: 5 to 7 dry, 4 to 6 moist
Chroma: 1 or 2, dry or moist

Cy Horizon
Hue: 5Y or 2.5Y
Value: 4 to 7 dry, 3 to 6 moist
Chroma: 1 or 2, dry or moist
Texture: clay, clay loam
Clay: 35 to 55 percent
Rock fragments: 0 to 12 percent

Badland
Slope: unspecified

Range in Characteristics
Badland is moderately steep to very steep barren land that is dissected by many intermittent drainage channels. These areas are cut into soft geologic material of Topic Shale.

176—Rock outcrop-Atchee complex, 24 to 60 percent slopes, extremely bouldery

Map Unit Setting
Landform(s): plateaus
Elevation: 5,410 to 7,550 feet (1,650 to 2,300 meters)
Mean annual precipitation: 10 to 14 inches (250 to 350 millimeters)
Mean annual air temperature: 52 to 55 degrees Fahrenheit (11.0 to 13.0 degrees Celsius)
Mean annual soil temperature: 54 to 57 degrees Fahrenheit (12.1 to 14.1 degrees Celsius)
Frost-free period: 135 to 165 days
Major Land Resource Area: 35 - Colorado Plateau
Land Resource Unit: 35-3 Colorado Plateau Sagebrush - Grasslands

Map Unit Composition
Rock outcrop: 55 percent
Atchee and similar soils: 35 percent
Minor components: Soils that are greater than 20 inches deep on more stable, less sloping areas; Soils with

less than 35 percent rock fragments throughout the soil profile.

Soil Properties and Qualities
Rock outcrop
Slope: unspecified

Range in Characteristics
Rock outcrop consists of exposures of bedrock usually of the Straight Cliffs Formation.

Atchee soils
Taxonomic classification: Loamy-skeletal, mixed, active, calcareous, mesic Lithic Ustic Torriorthents
Geomorphic position: occurs on talus slopes and ledges on escarpments.
Parent material: gravelly talus derived from sandstone
Slope: 24 to 60 percent
Biological crust
cyanobacteria: 3 percent
lichen: 0 percent
moss: 0 percent
Chemical crust
salt: 0 percent
gypsum: 0 percent
Physical cover
canopy plant cover: 26 percent
woody debris: 42 percent
bare soil: 11 percent
rock fragments
gravel: 11 percent
cobble: 8 percent
stone: 8 percent
boulder: 13 percent
channer: 3 percent
flagstone: 1 percent
Depth to restrictive feature(s): 4 to 17 inches to bedrock, lithic
Drainage class: somewhat excessively drained
Ksat solum: 2.00 to 6.00 inches per hour (14.11 to 42.34 micrometers per second)
Ksat restrictive layer: 0.00 to 0.20 inches per hour (0.00 to 1.40 micrometers per second)
Available water capacity total inches: 0.8 (very low)
Shrink-swell potential: about 1.5 LEP (low)
Flooding hazard: none
Runoff class: very high
Hydrologic group: D
Ecological site name: Semidesert Very Steep Stony Loam (Pinyon-Utah Juniper)
Ecological site number: R035XY263UT
Present vegetation: Utah serviceberry, Wyoming big sagebrush, bluebunch wheatgrass, alderleaf mountain-mahogany, muttongrass
Land capability (non irrigated): 6c

Typical Profile
Location
Geographic Coordinate System:
37° 22’ 20.60’’ north, 111° 1’ 30.20’’ west

A--0 to 1 inch (0 to 3 cm); yellowish brown (10YR 5/4) very channery sandy loam, brown (10YR 4/3), moist; 10 percent clay; weak thin platy structure; loose, nonsticky and nonplastic; many very fine roots throughout and many fine roots throughout; many fine dendritic tubular pores; 10 percent gravel and 20 percent channer and 5 percent flagstone; slightly effervescent, by HCl, 1 normal; moderately alkaline, pH 8.2 by Cresol red; clear smooth boundary.

Ck--1 to 16 inches (3 to 41 cm); light yellowish brown (10YR 6/4) very cobbly sandy loam, yellowish brown (10YR 5/4), moist; 10 percent clay; moderate fine subangular blocky structure; slightly hard, friable, nonsticky and nonplastic; many fine roots throughout and common medium roots throughout; many fine dendritic tubular pores; common carbonate masses; 10 percent gravel and 30 percent cobble and 10 percent flagstone; violently effervescent, by HCl, 1 normal, 22 percent calcium carbonate equivalent; moderately alkaline, pH 8.4 by Cresol red; abrupt wavy boundary.

R--16 to 26 inches (41 to 66 cm); unweathered, unfractured sandstone bedrock.

Range in Characteristics
Reaction: 7.9 to 8.4 (moderately alkaline)

A Horizon
Value: 5 or 6 dry, 4 or 5 moist
Chroma: 3 to 6 dry or moist

Ck Horizon
Value: 4 to 6 dry, 3 to 5 moist
Chroma: 4 to 6, dry or moist
Clay: 8 to 12 percent
Rock fragments: 35 to 60 percent
Calcium carbonate equivalent: 5 to 25 percent

177—Shoegame-Atchee complex, 8 to 60 percent slopes, extremely bouldery

Map Unit Setting
Landform(s): plateaus
Elevation: 4,100 to 6,730 feet (1,250 to 2,050 meters)
Mean annual precipitation: 10 to 14 inches (250 to 350 millimeters)
Mean annual air temperature: 52 to 55 degrees Fahrenheit (11.0 to 13.0 degrees Celsius)
Mean annual soil temperature: 54 to 57 degrees Fahrenheit (12.1 to 14.1 degrees Celsius)
Frost-free period: 135 to 165 days
Major Land Resource Area: 35 - Colorado Plateau

Land Resource Unit: 35-3 Colorado Plateau Sagebrush - Grasslands

Map Unit Composition
Shoegame and similar soils: 50 percent
Atchee and similar soils: 40 percent
Minor components: Soils that have less than 35 percent rock fragments throughout the profile; Soils with subsoil textures finer than sandy loam.

Soil Properties and Qualities
Shoegame soils
Taxonomic classification: Sandy-skeletal, mixed, mesic Ustic Haplocalcids
Geomorphic position: occurs on base slopes on fan remnants and structural benches.
Parent material: colluvium and/or slope alluvium derived from sandstone
Slope: 8 to 60 percent
Biological crust
cyanobacteria: 25 percent
lichen: 0 percent
moss: 1 percent
Chemical crust
salt: 0 percent
gypsum: 0 percent
Physical cover
canopy plant cover: 15 percent
woody debris: 26 percent
bare soil: 20 percent
rock fragments
gravel: 10 percent
cobble: 5 percent
stone: 3 percent
boulder: 5 percent
channer: 4 percent
Drainage class: excessively drained
Ksat solum: 6.00 to 20.00 inches per hour (42.34 to 141.14 micrometers per second)
Available water capacity total inches: 2.6 (low)
Shrink-swell potential: about 1.5 LEP (low)
Flooding hazard: none
Runoff class: medium
Hydrologic group: A
Ecological site name: Semidesert Stony Loam (Utah Juniper-Pinyon)
Ecological site number: R035XY246UT
Present vegetation: Utah juniper, grassy rockgoldenrod
Land capability (non irrigated): 6c

Typical Profile
Location
Geographic Coordinate System:
37° 13’ 17.60’’ north, 111° 0’ 29.80’’ west

A--0 to 2 inches (0 to 5 cm); yellowish brown (10YR 5/4) gravelly loamy sand, dark yellowish brown (10YR 3/4), moist; 8 percent clay; weak thin platy structure; loose, nonsticky and nonplastic; many very fine roots throughout; many fine dendritic tubular pores; 10 percent gravel and 10 percent channer; slightly effervescent, by HCl, 1 normal; moderately alkaline, pH 8.0 by Cresol red; clear smooth boundary.

Bw--2 to 12 inches (5 to 30 cm); yellowish brown (10YR 5/4) very gravelly loamy sand, dark yellowish brown (10YR 4/4), moist; 8 percent clay; weak fine subangular blocky structure; loose, nonsticky and nonplastic; many fine roots throughout and many medium roots throughout; many fine dendritic tubular pores; 25 percent gravel and 20 percent channer; strongly effervescent, by HCl, 1 normal; moderately alkaline, pH 8.2 by Cresol red; clear smooth boundary.

Bk1--12 to 28 inches (30 to 71 cm); light yellowish brown (10YR 6/4) extremely gravelly loamy coarse sand, yellowish brown (10YR 5/4), moist; 6 percent clay; weak fine subangular blocky structure; loose, nonsticky and nonplastic; many fine roots throughout and many medium roots throughout; common fine dendritic tubular pores; common irregular carbonate masses and common threadlike carbonate masses; 40 percent gravel and 10 percent cobble and 10 percent channer; strongly effervescent, by HCl, 1 normal, 10 percent calcium carbonate equivalent; moderately alkaline, pH 8.2 by Cresol red; gradual smooth boundary.

Bk2--28 to 44 inches (71 to 112 cm); light yellowish brown (10YR 6/4) very gravelly loamy sand, yellowish brown (10YR 5/4), moist; 6 percent clay; massive; loose, nonsticky and nonplastic; many fine roots throughout and common medium roots throughout; common fine dendritic tubular pores; common threadlike carbonate masses and common irregular carbonate masses; 25 percent gravel and 10 percent cobble and 5 percent channer; strongly effervescent, by HCl, 1 normal, 11 percent calcium carbonate equivalent; moderately alkaline, pH 8.4 by Cresol red; clear smooth boundary.

Ck--44 to 60 inches (112 to 152 cm); brownish yellow (10YR 6/6) gravelly loamy sand, dark yellowish brown (10YR 4/6), moist; 8 percent clay; massive; soft, very friable, nonsticky and nonplastic; many fine roots throughout; many fine dendritic tubular pores; common irregular carbonate masses; 25 percent gravel; strongly effervescent, by HCl, 1 normal; moderately alkaline, pH 8.2 by Cresol red.

Range in Characteristics
Reaction: 7.9 to 8.4 (moderately alkaline)

A Horizon
Value: 4 to 6 dry, 3 to 5 moist
Chroma: 3 or 4, dry or moist

Bw or Bk Horizons

Value: 5 or 6 dry, 3 to 5 moist
Chroma: 4 to 6, dry or moist
Texture: loamy coarse sand, loamy sand
Clay: 4 to 10 percent
Calcium carbonate equivalent: 0 to 15 percent
Rock fragments: 35 to 75 percent

Ck Horizon
Value: 4 to 6 dry, 3 to 5 moist
Chroma: 4 to 6, dry or moist
Clay: 5 to 10 percent
Calcium carbonate equivalent: 1 to 5 percent
Rock fragments: 15 to 30 percent

Calcic horizon- the zone from 12 to 44 inches (Bk horizons)

Atchee soils
Taxonomic classification: Loamy-skeletal, mixed, active, calcareous, mesic Lithic Ustic Torriorthents
Geomorphic position: occurs on base slopes on fan remnants and structural benches.
Parent material: colluvium and/or residuum weathered from sandstone
Slope: 8 to 60 percent
Biological crust
cyanobacteria: 3 percent
lichen: 0 percent
moss: 0 percent
Chemical crust
salt: 0 percent
gypsum: 0 percent
Physical cover
canopy plant cover: 26 percent
woody debris: 42 percent
bare soil: 11 percent
rock fragments
gravel: 11 percent
cobble: 8 percent
stone: 8 percent
boulder: 13 percent
channer: 3 percent
flagstone: 1 percent
Depth to restrictive feature(s): 6 to 17 inches to bedrock, lithic
Drainage class: somewhat excessively drained
Ksat solum: 2.00 to 6.00 inches per hour (14.11 to 42.34 micrometers per second)
Ksat restrictive layer: 0.00 to 0.20 inches per hour (0.00 to 1.40 micrometers per second)
Available water capacity total inches: 0.9 (very low)
Shrink-swell potential: about 1.5 LEP (low)
Flooding hazard: none
Runoff class: high
Hydrologic group: D
Ecological site name: Semidesert Very Steep Stony Loam (Pinyon-Utah Juniper)
Ecological site number: R035XY263UT
Present vegetation: Utah serviceberry, Wyoming big sagebrush, bluebunch wheatgrass, alderleaf mountain-mahogany, muttongrass
Land capability (non irrigated): 6c

Typical Profile
Location
Geographic Coordinate System:
37° 13’ 19.70’’ north, 111° 0’ 25.20’’ west

A--0 to 2 inches (0 to 5 cm); yellowish brown (10YR 5/4) gravelly sandy loam, dark yellowish brown (10YR 4/4), moist; 10 percent clay; weak thin platy structure; loose, nonsticky and nonplastic; many fine roots throughout; many fine dendritic tubular pores; 20 percent gravel and 10 percent channer; slightly effervescent, by HCl, 1 normal; moderately alkaline, pH 8.0 by Cresol red; clear smooth boundary.

Bw--2 to 6 inches (5 to 15 cm); yellowish brown (10YR 5/6) very gravelly sandy loam, dark yellowish brown (10YR 4/4), moist; 14 percent clay; moderate fine subangular blocky structure; soft, friable, slightly sticky and slightly plastic; many fine roots throughout and many medium roots throughout; many fine dendritic tubular pores; common carbonate masses; 30 percent gravel and 10 percent channer; strongly effervescent, by HCl, 1 normal; moderately alkaline, pH 8.2 by Cresol red; clear smooth boundary.

Ck--6 to 16 inches (15 to 41 cm); light yellowish brown (10YR 6/4) very gravelly sandy loam, yellowish brown (10YR 5/4), moist; 12 percent clay; weak fine subangular blocky structure; soft, very friable, slightly sticky and slightly plastic; many fine roots throughout and common medium roots throughout; many fine dendritic tubular pores; common carbonate masses; 30 percent gravel and 5 percent cobble and 15 percent channer; violently effervescent, by HCl, 1 normal; moderately alkaline, pH 8.2 by Cresol red; abrupt wavy boundary.

R--16 to 26 inches (41 to 66 cm); unweathered, unfractured sandstone bedrock.

Range in Characteristics
Reaction: 7.9 to 8.4 (moderately alkaline)

A Horizon
Value: 4 or 5 dry, 3 to 5 moist
Chroma: 4 to 6 dry or moist

Bw Horizon
Value: 4 to 6 dry, 4 or 5 moist
Chroma: 4 to 6, dry or moist
Clay: 8 to 14 percent
Rock fragments: 35 to 60 percent

Ck Horizon

Value: 4 to 6 dry, 4 or 5 moist
Chroma: 4 to 6, dry or moist
Clay: 8 to 14 percent
Rock fragments: 35 to 60 percent

221—Redhouse-Epikom families complex, 2 to 14 percent slopes

Map Unit Setting
Landform(s): plateaus
Elevation: 4,200 to 5,410 feet (1,280 to 1,650 meters)
Mean annual precipitation: 6 to 10 inches (150 to 250 millimeters)
Mean annual air temperature: 54 to 57 degrees Fahrenheit (12.0 to 14.0 degrees Celsius)
Mean annual soil temperature: 56 to 59 degrees Fahrenheit (13.1 to 15.1 degrees Celsius)
Frost-free period: 150 to 180 days
Major Land Resource Area: 35 - Colorado Plateau
Land Resource Unit: 35-2 Colorado Plateau Shrub - Grasslands

Map Unit Composition
Redhouse family and similar soils: 50 percent
Epikom family and similar soils: 35 percent
Minor components: Very deep Denazar soils in areas of deposition. Some areas have slopes greater than 14%.

Soil Properties and Qualities
Redhouse family soils
Taxonomic classification: Fine-loamy, mixed, superactive, mesic Typic Haplocalcids
Geomorphic position: occurs on interfluves on hills, mesas, and structural benches.
Parent material: eolian deposits and/or slope alluvium over residuum weathered from sandstone and shale
Slope: 2 to 14 percent
Biological crust
cyanobacteria: 42 percent
lichen: 0 percent
moss: 2 percent
Chemical crust
salt: 0 percent
gypsum: 0 percent
Physical cover
canopy plant cover: 21 percent
woody debris: 22 percent
bare soil: 5 percent
rock fragments
gravel: 23 percent
Depth to restrictive feature(s): 41 to 60 inches to bedrock, lithic
Drainage class: well drained
Ksat solum: 0.20 to 2.00 inches per hour (1.40 to 14.11 micrometers per second)
Ksat restrictive layer: 0.00 to 0.20 inches per hour (0.00 to 1.40 micrometers per second)
Available water capacity total inches: 9.7 (high)
Shrink-swell potential: about 4.5 LEP (moderate)
Flooding hazard: none
Runoff class: low
Hydrologic group: C
Ecological site name: Desert Sandy Loam (Blackbrush)
Ecological site number: R035XY121UT
Present vegetation: shadscale saltbush, broom snakeweed, blackbrush, galleta
Land capability (non irrigated): 7c

Typical Profile
Location
Geographic Coordinate System:
37° 12’ 58.00’’ north, 109° 58’ 0.70’’ west

A--0 to 1 inch (0 to 3 cm); yellowish red (5YR 5/6) loam, yellowish red (5YR 4/6), moist; 15 percent clay; moderate thin platy structure; soft, very friable, nonsticky and nonplastic; common very fine roots throughout; violently effervescent, by HCl, 1 normal; moderately alkaline, pH 8.2 by Cresol red; abrupt wavy boundary.

BA--1 to 9 inches (3 to 23 cm); reddish brown (5YR 5/4) loam, yellowish red (5YR 4/6), moist; 25 percent clay; moderate fine subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; many very fine roots throughout and common fine roots throughout; 2 percent gravel; violently effervescent, by HCl, 1 normal; moderately alkaline, pH 8.2 by Cresol red; clear wavy boundary.

Bk1--9 to 19 inches (23 to 48 cm); reddish brown (5YR 5/4) clay loam, yellowish red (5YR 4/6), moist; 33 percent clay; moderate fine subangular blocky structure; very hard, firm, moderately sticky and moderately plastic; many very fine roots throughout and common medium roots throughout; common fine carbonate masses in matrix; violently effervescent, by HCl, 1 normal, 25 percent calcium carbonate equivalent; moderately alkaline, pH 8.2 by Cresol red; gradual wavy boundary.

Bk2--19 to 27 inches (48 to 69 cm); light reddish brown (5YR 6/4) clay loam, yellowish red (5YR 4/6), moist; 29 percent clay; moderate medium subangular blocky structure; very hard, firm, moderately sticky and moderately plastic; common fine carbonate masses in matrix; violently effervescent, by HCl, 1 normal, 22 percent calcium carbonate equivalent; moderately alkaline, pH 8.2 by Cresol red; clear wavy boundary.

Bk3--27 to 46 inches (69 to 117 cm); light reddish brown (5YR 6/3) loam, reddish brown (5YR 4/4), moist; 26 percent clay; moderate fine subangular blocky structure; very hard, firm, moderately sticky and moderately plastic; many fine carbonate masses in matrix; 10 percent gravel;

violently effervescent, by HCl, 1 normal, 26 percent calcium carbonate equivalent; moderately alkaline, pH 8.2 by Cresol red; clear wavy boundary.

2Ck--46 to 57 inches (117 to 145 cm); light gray (5YR 7/1) clay loam, reddish brown (5YR 5/3), moist; 34 percent clay; massive; hard, firm, moderately sticky and moderately plastic; many fine carbonate masses in matrix; 5 percent gravel; violently effervescent, by HCl, 1 normal, 34 percent calcium carbonate equivalent; moderately alkaline, pH 8.2 by Cresol red; abrupt wavy boundary.

2R--57 to 67 inches (145 to 170 cm); unweathered, unfractured sandstone bedrock.

Range in Characteristics
Redhouse family differs from the series because the series is greater than 60 inches (152 cm) to lithic contact

Reaction: 7.4 to 8.4 (slightly or moderately alkaline)

A Horizon
Value: 5 or 6 dry, 3 to 6 moist
Chroma: 3 to 6, dry or moist

BA Horizons
Hue: 5YR or 7.5YR
Value: 5 to 6 dry, 4 to 6 moist
Chroma: 3 to 6, dry or moist
Texture: loam, clay loam
Clay: 18 to 27 percent
Rock fragments: 0 to 5 percent

Bk Horizons
Hue: 5YR or 7.5YR
Value: 5 to 6 dry, 4 to 6 moist
Chroma: 3 to 6, dry or moist
Texture: loam, clay loam, sandy clay loam
Clay: 23 to 35 percent
Calcium carbonate equivalent: 15 to 30 percent
Rock fragments: 0 to 10 percent

Ck Horizons
Hue: 5YR or 7.5YR
Value: 5 to 7 dry, 4 to 6 moist
Chroma: 1 to 6, dry or moist
Texture: loam, clay loam
Clay: 23 to 35 percent
Calcium carbonate equivalent: 15 to 35 percent
Rock fragments: 0 to 10 percent

Calcic horizon - the zone from 19 to 57 inches (Bk horizons)
Some pedons do not have a BA horizon

Epikom family soils
Taxonomic classification: Loamy, mixed, superactive, mesic Lithic Haplocambids
Geomorphic position: occurs on interfluves on hills, mesas, and structural benches.
Parent material: eolian deposits and/or residuum weathered from sandstone and shale
Slope: 2 to 14 percent
Biological crust
cyanobacteria: 42 percent
lichen: 0 percent
moss: 2 percent
Chemical crust
salt: 0 percent
gypsum: 0 percent
Physical cover
canopy plant cover: 21 percent
woody debris: 22 percent
bare soil: 5 percent
rock fragments
gravel: 23 percent
Depth to restrictive feature(s): 3 to 18 inches to bedrock, lithic
Drainage class: well drained
Ksat solum: 0.60 to 2.00 inches per hour (4.23 to 14.11 micrometers per second)
Ksat restrictive layer: 0.00 to 0.20 inches per hour (0.00 to 1.40 micrometers per second)
Available water capacity total inches: 1.6 (very low)
Shrink-swell potential: about 4.5 LEP (moderate)
Flooding hazard: none
Runoff class: high
Hydrologic group: D
Ecological site name: Desert Shallow Loam (Shadscale)
Ecological site number: R035XY122UT
Present vegetation: shadscale saltbush, broom snakeweed, blackbrush, galleta
Land capability (non irrigated): 7c

Typical Profile
Location
Geographic Coordinate System:
37° 12’ 55.10’’ north, 109° 57’ 59.00’’ west

A--0 to 1 inch (0 to 3 cm); yellowish red (5YR 5/6) loam, yellowish red (5YR 4/6), moist; 16 percent clay; weak thin platy structure; slightly hard, friable, slightly sticky and slightly plastic; common very fine roots throughout; common very fine tubular pores; 5 percent gravel; strongly effervescent, by HCl, 1 normal; moderately alkaline, pH 8.0 by Cresol red; abrupt wavy boundary.

Bk--1 to 8 inches (3 to 20 cm); yellowish red (5YR 5/6) loam, yellowish red (5YR 4/6), moist; 23 percent clay; moderate fine subangular blocky structure; moderately hard, friable, moderately sticky and moderately plastic; common very fine roots throughout; common very fine tubular and common medium tubular pores; common carbonate masses in matrix; 2 percent gravel; violently effervescent, by HCl, 1 normal, 12 percent calcium carbonate equivalent; moderately alkaline, pH 8.2 by Cresol red; clear wavy boundary.

Ck--8 to 11 inches (20 to 28 cm); yellowish red (5YR 5/6) loam, yellowish red (5YR 4/6), moist; 19 percent clay; massive; slightly hard, friable, slightly sticky and slightly plastic; common very fine roots throughout; common very fine tubular pores; common carbonate masses in matrix; 5 percent gravel; violently effervescent, by HCl, 1 normal, 24 percent calcium carbonate equivalent; moderately alkaline, pH 8.2 by Cresol red; abrupt wavy boundary.

R--11 to 21 inches (28 to 53 cm); unweathered, unfractured sandstone bedrock.

Range in Characteristics
Epikom family differs from the series because the series averages less than 18 percent clay in the control section

Reaction: 7.4 to 8.4 (slightly or moderately alkaline)

A Horizon
Value: 4 or 5 dry, 3 to 5 moist
Chroma: 4 to 6, dry or moist

Bk or Bw Horizons
Hue: 5YR or 7.5YR
Value: 5 or 6 dry, 4 or 5 moist
Chroma: 3 to 6, dry or moist
Texture: loam, very fine sandy loam
Clay: 18 to 27 percent
Calcium carbonate equivalent: 5 to 15 percent
Rock fragments: 0 to 10 percent

Ck Horizon
Hue: 5YR or 7.5YR
Value: 5 or 6 dry, 4 or 5 moist
Chroma: 3 to 6, dry or moist
Texture: loam, very fine sandy loam
Clay: 18 to 27 percent
Calcium carbonate equivalent: 15 to 30 percent
Rock fragments: 0 to 10 percent

Cambic horizon- the zone from 1 to 8 inches (Bk horizons)
Some pedons do not have a Ck horizon

222—Pagina-Denazar complex, 2 to 14 percent slopes

Map Unit Setting
Landform(s): plateaus
Elevation: 3,670 to 5,310 feet (1,120 to 1,620 meters)
Mean annual precipitation: 6 to 10 inches (150 to 250 millimeters)
Mean annual air temperature: 54 to 57 degrees Fahrenheit (12.0 to 14.0 degrees Celsius)
Mean annual soil temperature: 56 to 59 degrees Fahrenheit (13.1 to 15.1 degrees Celsius)
Frost-free period: 150 to 180 days
Major Land Resource Area: 35 - Colorado Plateau
Land Resource Unit: 35-2 Colorado Plateau Shrub - Grasslands

Map Unit Composition
Pagina and similar soils: 65 percent
Denazar and similar soils: 30 percent
Minor components: Some areas have soils that are less than 20 inches (51 cm) in depth. Small areas of rock outcrop occur on steeper side slopes. A few areas have slopes greater than 14%.

Soil Properties and Qualities
Pagina soils
Taxonomic classification: Coarse-loamy, mixed, superactive, mesic Typic Haplocalcids
Geomorphic position: occurs on interfluves on hills, mesas, and structural benches.
Parent material: eolian sands derived from sandstone and/or residuum weathered from sandstone and shale
Slope: 2 to 14 percent
Biological crust
cyanobacteria: 7 percent
lichen: 0 percent
moss: 0 percent
Chemical crust
salt: 0 percent
gypsum: 0 percent
Physical cover
canopy plant cover: 17 percent
woody debris: 25 percent
bare soil: 27 percent
rock fragments
gravel: 3 percent
Depth to restrictive feature(s): 26 to 38 inches to bedrock, paralithic
Drainage class: somewhat excessively drained
Ksat solum: 2.00 to 6.00 inches per hour (14.11 to 42.34 micrometers per second)
Ksat restrictive layer: 0.00 to 0.20 inches per hour (0.00 to 1.40 micrometers per second)
Available water capacity total inches: 3.6 (low)
Shrink-swell potential: about 4.5 LEP (moderate)
Flooding hazard: none
Runoff class: medium
Hydrologic group: B
Ecological site name: Desert Sandy Loam (Blackbrush)
Ecological site number: R035XY121UT
Present vegetation: blackbrush, broom snakeweed, mesa dropseed
Land capability (non irrigated): 7c

Typical Profile
Location
Geographic Coordinate System:
36° 58' 41.60'' north, 111° 34' 17.20'' west

A--0 to 1 inch (0 to 3 cm); strong brown (7.5YR 5/6) loamy fine sand, strong brown (7.5YR 4/6), moist; 8 percent clay; weak thin platy structure; loose, nonsticky and nonplastic; common very fine roots throughout; common very fine dendritic tubular pores; 3 percent gravel; very slightly effervescent, by HCl, 1 normal; slightly alkaline, pH 7.8 by Cresol red; clear smooth boundary.

Bw--1 to 12 inches (3 to 30 cm); yellowish red (5YR 5/6) loamy fine sand, yellowish red (5YR 4/6), moist; 10 percent clay; weak fine subangular blocky and weak medium subangular blocky structure; soft, loose, nonsticky and nonplastic; many very fine roots throughout and many fine roots throughout; many very fine dendritic tubular pores; 3 percent gravel; slightly effervescent, by HCl, 1 normal; moderately alkaline, pH 8.0 by Cresol red; clear smooth boundary.

Bk1--12 to 19 inches (30 to 48 cm); reddish yellow (5YR 6/6) fine sandy loam, yellowish red (5YR 4/6), moist; 12 percent clay; moderate medium subangular blocky and moderate fine subangular blocky structure; slightly hard, very friable, nonsticky and nonplastic; many very fine roots throughout and many fine roots throughout; many very fine dendritic tubular pores; common fine carbonate masses throughout; 3 percent gravel; strongly effervescent, by HCl, 1 normal, 12 percent calcium carbonate equivalent; moderately alkaline, pH 8.0 by Cresol red; clear smooth boundary.

2Bk2--19 to 27 inches (48 to 69 cm); pink (5YR 8/3) fine sandy loam, pink (5YR 7/4), moist; 12 percent clay; massive; hard, very friable, nonsticky and nonplastic; common very fine roots throughout and common fine roots throughout; many very fine dendritic tubular pores; many fine carbonate masses throughout; 10 percent gravel; violently effervescent, by HCl, 1 normal, 19 percent calcium carbonate equivalent; moderately alkaline, pH 8.2 by Cresol red; abrupt wavy boundary.

2Ck--27 to 34 inches (69 to 86 cm); pinkish white (5YR 8/2) fine sandy loam, pinkish gray (5YR 7/2), moist; 12 percent clay; massive; hard, very friable, nonsticky and nonplastic; common very fine roots throughout and common fine roots throughout; many very fine dendritic tubular pores; many fine carbonate masses throughout; 10 percent gravel; violently effervescent, by HCl, 1 normal, 23 percent calcium carbonate equivalent; moderately alkaline, pH 8.2 by Cresol red; clear wavy boundary.

2Cr--34 to 43.5 inches (86 to 111 cm); weathered sandstone bedrock.

Range in Characteristics
Reaction: 7.4 to 8.4 (slightly or moderately alkaline)

A Horizon
Value: 5 or 6 dry, 3 to 5 moist
Chroma: 3 to 6, dry or moist

Bw or Bk Horizons
Hue: 5YR or 7.5YR
Value: 5 to 8 dry, 4 to 7 moist
Chroma: 3 to 6, dry or moist
Texture: loamy fine sand, fine sandy loam, sandy loam
Clay: 2 to 15 percent
Calcium carbonate equivalent: 0 to 30 percent
Rock fragments: 0 to 10 percent

Ck Horizon
Hue: 5YR or 7.5YR
Value: 5 to 8 dry, 4 to 7 moist
Chroma: 1 to 4, dry or moist
Texture: fine sandy loam, loamy fine sand, sandy loam
Clay: 8 to 20 percent
Calcium carbonate equivalent: 15 to 30 percent
Rock fragments: 0 to 12 percent

Calcic horizon- the zone from 12 to 27 inches (Bk horizons)

Denazar soils
Taxonomic classification: Sandy, mixed, mesic Typic Haplocalcids
Geomorphic position: occurs on interfluves on hills, mesas, and structural benches as coppice mounds and dunes.
Parent material: eolian sands derived from sandstone and/or alluvium derived from sandstone
Slope: 2 to 14 percent
Biological crust
cyanobacteria: 41 percent
lichen: 1 percent
moss: 0 percent
Chemical crust
salt: 0 percent
gypsum: 0 percent
Physical cover
canopy plant cover: 18 percent
woody debris: 23 percent
bare soil: 27 percent
rock fragments
gravel: 1 percent
Drainage class: somewhat excessively drained
Ksat solum: 6.00 to 99.92 inches per hour (42.34 to 705.00 micrometers per second)
Available water capacity total inches: 3.6 (low)
Shrink-swell potential: about 1.0 LEP (low)
Flooding hazard: none

Runoff class: negligible
Hydrologic group: A
Ecological site name: Desert Sand (Sand Sagebrush)
Ecological site number: R035XY115UT
Present vegetation: mesa dropseed, gooseberryleaf globemallow, Cutler Mormon tea
Land capability (non irrigated): 7c

Typical Profile
Location
Geographic Coordinate System:
36° 58' 51.30'' north, 111° 34' 19.80'' west

A--0 to 1 inch (0 to 3 cm); brownish yellow (10YR 6/6) sand, dark yellowish brown (10YR 4/6), moist; 6 percent clay; weak thin platy and single grain structure; soft, very friable, nonsticky and nonplastic; common very fine roots throughout; common very fine dendritic tubular pores; 2 percent gravel; noneffervescent, by HCl, 1 normal; slightly alkaline, pH 7.6 by Cresol red; clear smooth boundary.

Bw--1 to 21 inches (3 to 53 cm); reddish yellow (7.5YR 6/6) sand, strong brown (7.5YR 5/6), moist; 6 percent clay; massive; soft, very friable, nonsticky and nonplastic; many very fine roots throughout and many fine roots throughout; common very fine dendritic tubular and common fine dendritic tubular pores; 5 percent gravel; slightly effervescent, by HCl, 1 normal; slightly alkaline, pH 7.8 by Cresol red; gradual smooth boundary.

Bk1--21 to 27 inches (53 to 69 cm); reddish yellow (7.5YR 6/6) sand, strong brown (7.5YR 4/6), moist; 7 percent clay; massive; slightly hard, friable, nonsticky and nonplastic; common very fine roots throughout and common fine roots throughout; common very fine dendritic tubular and common fine dendritic tubular pores; common fine carbonate masses; 5 percent gravel; slightly effervescent, by HCl, 1 normal; moderately alkaline, pH 8.0 by Cresol red; clear wavy boundary.

Bk2--27 to 41 inches (69 to 104 cm); yellowish red (5YR 5/6) loamy sand, 50 percent yellowish red (5YR 5/6) and 50 percent yellowish red (5YR 4/6), moist; 8 percent clay; massive; hard, friable, nonsticky and nonplastic; common very fine roots throughout and common fine roots throughout; many very fine dendritic tubular and many fine dendritic tubular pores; common fine carbonate masses; 12 percent gravel; strongly effervescent, by HCl, 1 normal, 6 percent calcium carbonate equivalent; moderately alkaline, pH 8.0 by Cresol red; clear wavy boundary.

Ck--41 to 60 inches (104 to 152 cm); reddish yellow (7.5YR 6/6) loamy sand, strong brown (7.5YR 5/6), moist; 8 percent clay; massive; soft, very friable, nonsticky and nonplastic; many very fine dendritic tubular pores; common fine carbonate masses; 5 percent gravel; strongly effervescent, by HCl, 1 normal, 7 percent calcium carbonate equivalent; slightly alkaline, pH 7.8 by Cresol red.

Range in Characteristics
Reaction: 7.4 to 8.4 (slightly or moderately alkaline)

A Horizon
Value: 5 or 6 dry, 3 or 4 moist
Chroma: 3 to 6, dry or moist

Bw or Bk Horizons
Hue: 5YR or 7.5YR
Value: 5 or 6 dry, 4 to 6 moist
Chroma: 3 to 6, dry or moist
Texture: loamy sand, loamy fine sand, sandy loam, sand
Clay: 5 to 10 percent
Calcium carbonate equivalent: 0 to 20 percent
Rock fragments: 0 to 12 percent

Ck Horizon
Hue: 5YR or 7.5YR
Value: 5 to 8 dry, 4 to 7 moist
Chroma: 1 to 6, dry or moist
Texture: loamy sand, loamy fine sand, fine sandy loam
Clay: 5 to 15 percent
Calcium carbonate equivalent: 5 to 20 percent
Rock fragments: 0 to 12 percent

Calcic horizon- the zone from 21 to 41 inches (Bk horizons)

224—Farb-Pagina-Rock outcrop complex, 4 to 20 percent slopes, bouldery

Map Unit Setting
Landform(s): plateaus
Elevation: 3,670 to 5,310 feet (1,120 to 1,620 meters)
Mean annual precipitation: 6 to 10 inches (150 to 250 millimeters)
Mean annual air temperature: 54 to 57 degrees Fahrenheit (12.0 to 14.0 degrees Celsius)
Mean annual soil temperature: 56 to 59 degrees Fahrenheit (13.1 to 15.1 degrees Celsius)
Frost-free period: 150 to 180 days
Major Land Resource Area: 35 - Colorado Plateau
Land Resource Unit: 35-2 Colorado Plateau Shrub - Grasslands

Map Unit Composition
Farb and similar soils: 35 percent
Pagina and similar soils: 30 percent
Rock outcrop: 25 percent

Minor components: A few areas have soils with clay greater than 18%. Some areas have slopes less than 4%.

Soil Properties and Qualities
Farb soils
Taxonomic classification: Loamy, mixed, superactive, calcareous, mesic Lithic Torriorthents
Geomorphic position: occurs on interfluves on hills, mesas, and structural benches.
Parent material: eolian sands derived from sandstone and/or residuum weathered from sandstone
Slope: 4 to 20 percent
Biological crust
cyanobacteria: 31 percent
lichen: 1 percent
moss: 1 percent
Chemical crust
salt: 0 percent
gypsum: 0 percent
Physical cover
canopy plant cover: 10 percent
woody debris: 8 percent
bare soil: 37 percent
rock fragments
gravel: 14 percent
boulder: 4 percent
channer: 1 percent
Depth to restrictive feature(s): 4 to 19 inches to bedrock, lithic
Drainage class: somewhat excessively drained
Ksat solum: 2.00 to 6.00 inches per hour (14.11 to 42.34 micrometers per second)
Ksat restrictive layer: 0.00 to 0.20 inches per hour (0.00 to 1.40 micrometers per second)
Available water capacity total inches: 1.0 (very low)
Shrink-swell potential: about 1.5 LEP (low)
Flooding hazard: none
Runoff class: high
Hydrologic group: D
Ecological site name: Desert Shallow Sandy Loam (Blackbrush)
Ecological site number: R035XY133UT
Present vegetation: blackbrush, galleta, broom snakeweed, plains pricklypear
Land capability (non irrigated): 7c

Typical Profile
Location
Geographic Coordinate System:
37° 4’ 12.70’’ north, 111° 24’ 27.60’’ west

A--0 to 1 inch (0 to 3 cm); light yellowish brown (10YR 6/4) fine sandy loam, yellowish brown (10YR 5/4), moist; 10 percent clay; weak thin platy structure; soft, very friable, nonsticky and nonplastic; many fine dendritic tubular pores; 3 percent gravel; slightly effervescent, by HCl, 1 normal; moderately alkaline, pH 8.0 by Cresol red; abrupt smooth boundary.

C--1 to 9 inches (3 to 23 cm); light yellowish brown (10YR 6/4) fine sandy loam, yellowish brown (10YR 5/4), moist; 10 percent clay; massive; soft, very friable, nonsticky and nonplastic; common fine dendritic tubular pores; 5 percent gravel; strongly effervescent, by HCl, 1 normal; moderately alkaline, pH 8.2 by Cresol red; abrupt wavy boundary.

R--9 to 19 inches (23 to 48 cm); unweathered, unfractured sandstone bedrock.

Range in Characteristics
Reaction: 7.9 to 8.4 (moderately alkaline)

A Horizon
Value: 5 to 7 dry, 4 to 6 moist
Chroma: 3 to 6, dry or moist

C Horizon
Hue: 10YR or 7.5YR
Value: 5 to 8 dry, 4 to 6 moist
Chroma: 2 to 6, dry or moist
Texture: fine sandy loam, sandy loam
Clay: 8 to 16 percent
Rock fragments: 0 to 12 percent

Pagina soils
Taxonomic classification: Coarse-loamy, mixed, superactive, mesic Typic Haplocalcids
Geomorphic position: occurs on interfluves on hills, mesas, and structural benches.
Parent material: eolian sands derived from sandstone and/or residuum weathered from sandstone and shale
Slope: 4 to 20 percent
Biological crust
cyanobacteria: 31 percent
lichen: 1 percent
moss: 1 percent
Chemical crust
salt: 0 percent
gypsum: 0 percent
Physical cover
canopy plant cover: 10 percent
woody debris: 8 percent
bare soil: 37 percent
rock fragments
gravel: 14 percent
boulder: 4 percent
channer: 1 percent
Depth to restrictive feature(s): 26 to 39 inches to bedrock, paralithic
Drainage class: somewhat excessively drained
Ksat solum: 2.00 to 6.00 inches per hour (14.11 to 42.34 micrometers per second)
Ksat restrictive layer: 0.00 to 0.20 inches per hour (0.00

to 1.40 micrometers per second)
Available water capacity total inches: 2.5 (very low)
Shrink-swell potential: about 1.5 LEP (low)
Flooding hazard: none
Runoff class: medium
Hydrologic group: B
Ecological site name: Desert Sandy Loam (Blackbrush)
Ecological site number: R035XY121UT
Present vegetation: blackbrush, galleta, broom snakeweed, plains pricklypear
Land capability (non irrigated): 7c

Typical Profile
Location
Geographic Coordinate System:
37° 4' 1.70'' north, 111° 24' 25.60'' west

A--0 to 1 inch (0 to 3 cm); brownish yellow (10YR 6/6) fine sandy loam, yellowish brown (10YR 5/4), moist; 11 percent clay; weak thin platy structure; soft, very friable, nonsticky and nonplastic; many very fine roots throughout and many fine roots throughout and common medium roots throughout; many fine dendritic tubular pores; 2 percent gravel; strongly effervescent, by HCl, 1 normal; slightly alkaline, pH 7.8 by Cresol red; clear smooth boundary.

Bw--1 to 8 inches (3 to 20 cm); reddish yellow (7.5YR 6/6) fine sandy loam, brown (7.5YR 5/4), moist; 12 percent clay; weak fine subangular blocky and weak medium subangular blocky structure; soft, very friable, nonsticky and nonplastic; many very fine roots throughout and many fine roots throughout and common medium roots throughout; many fine dendritic tubular pores; 2 percent gravel; strongly effervescent, by HCl, 1 normal; moderately alkaline, pH 8.0 by Cresol red; abrupt smooth boundary.

Bk1--8 to 12 inches (20 to 30 cm); brownish yellow (10YR 6/6) sandy loam, yellowish brown (10YR 5/4), moist; 14 percent clay; weak fine subangular blocky and weak medium subangular blocky structure; slightly hard, friable, nonsticky and nonplastic; many very fine roots throughout and many fine roots throughout and common medium roots throughout; many fine dendritic tubular pores; common fine carbonate masses; 10 percent gravel; strongly effervescent, by HCl, 1 normal, 14 percent calcium carbonate equivalent; moderately alkaline, pH 8.0 by Cresol red; clear smooth boundary.

Bk2--12 to 17 inches (30 to 43 cm); very pale brown (10YR 7/4) gravelly fine sandy loam, yellow (10YR 7/6), moist; 18 percent clay; massive; hard, firm, slightly sticky and slightly plastic; many very fine roots throughout and many fine roots throughout and common medium roots throughout; many fine dendritic tubular pores; common fine carbonate masses; 25 percent gravel; violently effervescent, by HCl, 1 normal, 27 percent calcium carbonate equivalent; moderately alkaline, pH 8.2 by Cresol red; clear smooth boundary.

Ck--17 to 26 inches (43 to 66 cm); light gray (10YR 7/2) gravelly fine sandy loam, yellow (10YR 7/6), moist; 16 percent clay; massive; very hard, firm, slightly sticky and slightly plastic; many fine roots throughout; many fine dendritic tubular pores; many fine carbonate masses; 30 percent gravel; violently effervescent, by HCl, 1 normal, 23 percent calcium carbonate equivalent; moderately alkaline, pH 8.2 by Cresol red; clear smooth boundary.

Cr--26 to 36 inches (66 to 91 cm); weathered sandstone bedrock.

Range in Characteristics
Reaction: 7.4 to 8.4 (slightly or moderately alkaline)

A Horizon
Value: 5 or 6 dry, 4 or 5 moist
Chroma: 4 to 6, dry or moist

Bw or Bk Horizons
Hue: 10YR or 7.5YR
Value: 5 to 7 dry, 4 to7 moist
Chroma: 4 to 6, dry or moist
Texture: sandy loam, fine sandy loam
Clay: 6 to 18 percent
Calcium carbonate equivalent: 0 to 30 percent
Rock fragments: 0 to 34 percent

Ck Horizons
Hue: 10YR or 7.5YR
Value: 5 to 7 dry, 4 to 7 moist
Chroma: 2 to 6, dry or moist
Texture: fine sandy loam, sandy loam
Clay: 10 to 18 percent
Calcium carbonate equivalent: 5 to 30 percent
Rock fragments: 5 to 34 percent

Calcic horizon- the zone from 8 to 17 inches (Bk horizons)

Rock outcrop
Slope: unspecified

Range in Characteristics
Rock outcrop consists of exposures of sandstone bedrock.

225—Moenkopie-Rock outcrop complex, 3 to 24 percent slopes

Map Unit Setting
Landform(s): plateaus

Elevation: 3,670 to 5,840 feet (1,120 to 1,780 meters)
Mean annual precipitation: 6 to 10 inches (150 to 250 millimeters)
Mean annual air temperature: 54 to 57 degrees Fahrenheit (12.0 to 14.0 degrees Celsius)
Mean annual soil temperature: 56 to 59 degrees Fahrenheit (13.1 to 15.1 degrees Celsius)
Frost-free period: 150 to 180 days
Major Land Resource Area: 35 - Colorado Plateau
Land Resource Unit: 35-2 Colorado Plateau Shrub - Grasslands

Map Unit Composition
Moenkopie and similar soils: 60 percent
Rock outcrop: 30 percent
Minor components: Moderately deep Pagina soils are on more stable areas. A few areas have soils with clay greater than 18%.

Soil Properties and Qualities
Moenkopie soils
Taxonomic classification: Loamy, mixed, superactive, calcareous, mesic Lithic Torriorthents
Geomorphic position: occurs on interfluves on hills, mesas, and structural benches.
Parent material: eolian sands derived from sandstone and/or residuum weathered from sandstone and shale
Slope: 3 to 24 percent
Biological crust
cyanobacteria: 0 percent
lichen: 0 percent
moss: 0 percent
Chemical crust
salt: 0 percent
gypsum: 0 percent
Physical cover
canopy plant cover: 10 percent
woody debris: 27 percent
bare soil: 36 percent
rock fragments
gravel: 30 percent
cobble: 3 percent
Depth to restrictive feature(s): 4 to 14 inches to bedrock, lithic
Drainage class: somewhat excessively drained
Ksat solum: 0.60 to 6.00 inches per hour (4.23 to 42.34 micrometers per second)
Ksat restrictive layer: 0.00 to 0.20 inches per hour (0.00 to 1.40 micrometers per second)
Available water capacity total inches: 0.8 (very low)
Shrink-swell potential: about 1.5 LEP (low)
Flooding hazard: none
Runoff class: high
Hydrologic group: D
Ecological site name: Desert Shallow Sandy Loam (Shadscale)
Ecological site number: R035XY130UT
Present vegetation: shadscale saltbush, blackbrush, pricklypear, Indian ricegrass, Cutler Mormon tea, galleta
Land capability (non irrigated): 7c

Typical Profile
Location
Geographic Coordinate System:
37° 38’ 29.20’’ north, 110° 32’ 16.30’’ west

A--0 to 2 inches (0 to 5 cm); light reddish brown (5YR 6/4) loamy fine sand, reddish brown (5YR 4/4), moist; 7 percent clay; weak thin platy structure; loose, nonsticky and nonplastic; common very fine roots throughout; many very fine dendritic tubular pores; 7 percent gravel; strongly effervescent, by HCl, 1 normal; slightly alkaline, pH 7.8 by Cresol red; abrupt smooth boundary.

C1--2 to 5 inches (5 to 13 cm); red (2.5YR 5/6) loam, dark red (2.5YR 3/6), moist; 17 percent clay; massive; soft, very friable, slightly sticky and nonplastic; many very fine roots throughout; many very fine dendritic tubular pores; 10 percent gravel; strongly effervescent, by HCl, 1 normal; moderately alkaline, pH 8.0 by Cresol red; abrupt smooth boundary.

C2--5 to 8 inches (13 to 20 cm); reddish brown (2.5YR 5/4) gravelly sandy loam, reddish brown (2.5YR 4/4), moist; 12 percent clay; massive; loose, nonsticky and nonplastic; many fine roots throughout and common medium roots throughout; common very fine dendritic tubular pores; 30 percent gravel; strongly effervescent, by HCl, 1 normal; moderately alkaline, pH 8.2 by Cresol red; abrupt wavy boundary.

R--8 to 18 inches (20 to 46 cm); unweathered, unfractured sandstone bedrock.

Range in Characteristics
Reaction: 7.4 to 8.4 (slightly alkaline to moderately alkaline)

A Horizon
Value: 5 to 6 dry, 4 to 6 moist
Chroma: 4 or 6, dry or moist

C Horizon
Hue: 5YR or 2.5YR
Value: 4 or 5 dry, 3 or 4 moist
Chroma: 4 or 6, dry or moist
Texture: loam, sandy loam, fine sandy loam
Clay: 10 to 18 percent
Rock fragments: 0 to 30 percent gravel

Rock outcrop
Slope: unspecified

Range in Characteristics
Rock outcrop consists of exposures of sandstone bedrock.

231—Sazi-Batterson complex, 2 to 15 percent slopes

Map Unit Setting
Landform(s): plateaus
Elevation: 4,150 to 6,270 feet (1,265 to 1,910 meters)
Mean annual precipitation: 10 to 14 inches (250 to 350 millimeters)
Mean annual air temperature: 52 to 55 degrees Fahrenheit (11.0 to 13.0 degrees Celsius)
Mean annual soil temperature: 54 to 57 degrees Fahrenheit (12.1 to 14.1 degrees Celsius)
Frost-free period: 135 to 165 days
Major Land Resource Area: 35 - Colorado Plateau
Land Resource Unit: 35-3 Colorado Plateau Sagebrush - Grasslands

Map Unit Composition
Sazi and similar soils: 50 percent
Batterson and similar soils: 30 percent
Minor Components: Lithic Rizno soils on shoulders. Some areas have rock fragments that average greater than 35 percent. A few places have rock outcrop.

Soil Properties and Qualities
Sazi soils
Taxonomic classification: Coarse-loamy, mixed, superactive, mesic Ustic Haplocalcids
Geomorphic position: occurs on interfluves on hills, mesas, and structural benches.
Parent material: eolian deposits
Slope: 2 to 15 percent
First Rain Drop Impact (% Cover)
Plant Canopy: 20-25
Litter *Depth to restrictive feature(s):* 20 to 40 inches to bedrock, lithic; 28 to 30 inches to bedrock, paralithic
Drainage class: well drained
Ksat solum: 2.00 to 6.00 inches per hour (14.11 to 42.34 micrometers per second)
Ksat restrictive layer: 0.00 to 0.60 inches per hour (0.00 to 4.20 micrometers per second)
Available water capacity total inches: 3.0 (low)
Shrink-swell potential: about 1.5 LEP (low)
Flooding hazard: none
Runoff class: high
Hydrologic group: B
Ecological site name: Semidesert Sandy Loam (Blackbrush)
Ecological site number: R035XY218UT
Present vegetation: blackbrush, galleta, Desert Princesplume, scarlet globemallow, shadscale saltbush, Indian ricegrass, broom snakeweed
Land capability (non irrigated): 6c

Typical Profile
Location
Geographic Coordinate System:
38° 14’ 18.70’’ north, 110° 0’ 41.60’’ west

A--0 to 3.5 inches (0 to 9 cm); reddish brown (5YR 4/4) fine sandy loam, dark reddish brown (5YR 3/4), moist; 10 percent clay; moderate very thick platy structure; soft, very friable, slightly sticky and nonplastic; common very fine and fine roots throughout; many very fine interstitial and common fine interstitial pores; common fine irregular carbonate masses in matrix; strongly effervescent, 8 percent calcium carbonate equivalent; moderately alkaline, pH 8.2; abrupt wavy boundary.

Bk1--3.5 to 10.5 inches (9 to 27 cm); yellowish red (5YR 5/6) fine sandy loam, yellowish red (5YR 4/6), moist; 10 percent clay; moderate coarse subangular blocky and moderate very thick platy structure; slightly hard, friable, slightly sticky and nonplastic; common very fine and fine roots throughout; many very fine interstitial and common fine interstitial pores; many medium irregular carbonate masses in matrix; violently effervescent, 11 percent calcium carbonate equivalent; moderately alkaline, pH 8.4; clear wavy boundary.

Bk2--10.5 to 27.5 inches (27 to 70 cm); light reddish brown (5YR 6/4) sandy loam, yellowish red (5YR 5/6), moist; 15 percent clay; moderate fine subangular blocky and moderate medium subangular blocky structure; extremely hard, slightly rigid, slightly sticky and nonplastic; common very fine and fine roots in cracks and common medium roots in cracks; common very fine interstitial and common fine interstitial pores; violently effervescent, 36 percent calcium carbonate equivalent; moderately alkaline, pH 8.4; clear wavy boundary.

2Cr--27.5 to 29.5 inches (70 to 75 cm); weathered, fractured sandstone bedrock; abrupt wavy boundary.

2R--29.5 to 43.5 inches (75 to 110 cm); unweathered, unfractured sandstone bedrock.

Range in Characteristics
Reaction: moderately alkaline or strongly alkaline (7.9 to 9.0)

Bk Horizon
Value: 4 to 6 dry, 3 to 5 moist
Chroma: 4 or 6, dry or moist
Texture: fine sandy loam, sandy loam, fine sand
Clay content: 1 to 15 percent
Calcium carbonate equivalent: 5 to 40 percent
Rock fragments: 0 to 5 percent gravel

Calcic horizon- the zone from 3 to 27 inches (Bk horizons)

Batterson soils
Taxonomic classification: Sandy, mixed, mesic Lithic Ustic Torriorthents
Geomorphic position: occurs on interfluves on hills, mesas, and structural benches.
Parent material: eolian deposits and/or residuum weathered from sandstone
Slope: 2 to 6 percent
Biological crust
cyanobacteria: 15 percent
lichen: 1 percent
moss: 1 percent
Chemical crust
salt: 0 percent
gypsum: 0 percent
Physical cover
canopy plant cover: 23 percent
woody debris: 3 percent
bare soil: 3 percent
rock fragments
gravel: 20 percent
channer: 50 percent
flagstone: 1 percent
Depth to restrictive feature(s): 4 to 20 inches to bedrock, lithic
Drainage class: excessively drained
Ksat solum: 2.00 to 20.00 inches per hour (14.11 to 141.14 micrometers per second)
Ksat restrictive layer: 0.00 to 0.20 inches per hour (0.00 to 1.40 micrometers per second)
Available water capacity total inches: 0.9 (very low)
Shrink-swell potential: about 1.5 LEP (low)
Flooding hazard: none
Runoff class: very high
Hydrologic group: D
Ecological site name: Semidesert Shallow Sandy Loam (Blackbrush)
Ecological site number: R035XY233UT
Present vegetation: blackbrush, Desert Princesplume, galleta, shadscale saltbush, Torrey's jointfir, Indian ricegrass
Land capability (non irrigated): 6c

Typical Profile
Location
Geographic Coordinate System:
38° 14' 12.50'' north, 110° 0' 19.20'' west

A--0 to 3 inches (0 to 8 cm); reddish brown (5YR 4/4) gravelly loamy coarse sand, dark reddish brown (5YR 3/4), moist; 2 percent clay; weak fine subangular blocky structure; soft, very friable, nonsticky and nonplastic; common very fine roots throughout and common fine roots throughout; common very fine tubular and common fine tubular pores; 20 percent gravel; strongly effervescent, 2 percent calcium carbonate equivalent; moderately alkaline, pH 8.0; abrupt smooth boundary.

C--3 to 10 inches (8 to 25 cm); reddish brown (5YR 4/4) sandy loam, dark reddish brown (5YR 3/4), moist; 8 percent clay; massive; soft, very friable, nonsticky and nonplastic; common very fine roots throughout and common fine roots throughout; common very fine tubular and common fine tubular pores; 10 percent gravel; violently effervescent, 5 percent calcium carbonate equivalent; moderately alkaline, pH 8.2; abrupt smooth boundary.

R--10 to 19.5 inches (25 to 50 cm); unweathered, unfractured sandstone bedrock.

Range in Characteristics
Reaction: moderately alkaline or strongly alkaline (7.9 to 9.0)

A Horizon
Value: 4 or 5 dry, 3 or 4 moist
Chroma: 3 or 4 dry

C Horizon
Value: 4 or 5 dry, 3 or 4 moist
Clay content: 8 to 15 percent
Calcium carbonate equivalent: 1 to 5 percent
Rock fragments: 10 to 40 percent gravel

232—Earlweed-Anasazi complex, 5 to 22 percent slopes

Map Unit Setting
Landform(s): plateaus
Elevation: 5,680 to 5,910 feet (1,730 to 1,800 meters)
Mean annual precipitation: 10 to 14 inches (250 to 350 millimeters)
Mean annual air temperature: 52 to 55 degrees Fahrenheit (11.0 to 13.0 degrees Celsius)
Mean annual soil temperature: 54 to 57 degrees Fahrenheit (12.1 to 14.1 degrees Celsius)
Frost-free period: 135 to 165 days
Major Land Resource Area: 35 - Colorado Plateau
Land Resource Unit: 35-3 Colorado Plateau Sagebrush - Grasslands

Map Unit Composition
Earlweed and similar soils: 60 percent
Anasazi and similar soils: 30 percent
Minor components: Soils that have a loamy very fine sand or a very fine sand texture; Soils that are less than 20 inches deep.

Soil Properties and Qualities
Earlweed soils

Taxonomic classification: Sandy, mixed, mesic Ustic Haplocalcids
Geomorphic position: occurs on interfluves on hills, mesas, and structural benches as coppice mounds and dunes.
Parent material: eolian deposits
Slope: 5 to 22 percent
Biological crust
cyanobacteria: 47 percent
lichen: 0 percent
moss: 0 percent
Chemical crust
salt: 0 percent
gypsum: 0 percent
Physical cover
canopy plant cover: 11 percent
woody debris: 29 percent
bare soil: 26 percent
rock fragments
gravel: 1 percent
Drainage class: excessively drained
Ksat solum: 2.00 to 6.00 inches per hour (14.11 to 42.34 micrometers per second)
Available water capacity total inches: 6.0 (moderate)
Shrink-swell potential: about 1.0 LEP (low)
Flooding hazard: none
Runoff class: medium
Hydrologic group: A
Ecological site name: Semidesert Sand (Fourwing Saltbush)
Ecological site number: R035XY212UT
Present vegetation: Utah juniper, Cutler Mormon tea, Indian ricegrass, galleta
Land capability (non irrigated): 6c

Typical Profile
Location
Geographic Coordinate System:
37° 37' 38.00'' north, 111° 15' 32.10'' west

A--0 to 1 inch (0 to 3 cm); yellowish red (5YR 5/6) loamy fine sand, dark reddish brown (5YR 3/4), moist; 7 percent clay; single grain; loose, nonsticky and nonplastic; many fine roots throughout; common very fine tubular pores; slightly effervescent, by HCl, 1 normal; moderately alkaline, pH 8.0 by Cresol red; abrupt smooth boundary.

Bw1--1 to 13 inches (3 to 33 cm); yellowish red (5YR 5/8) loamy fine sand, yellowish red (5YR 4/6), moist; 8 percent clay; weak fine subangular blocky structure; soft, very friable, nonsticky and nonplastic; common fine roots throughout and common medium roots throughout; common very fine tubular pores; slightly effervescent, by HCl, 1 normal; moderately alkaline, pH 8.2 by Cresol red; gradual wavy boundary.

Bw2--13 to 30 inches (33 to 76 cm); yellowish red (5YR 5/8) loamy fine sand, yellowish red (5YR 4/6), moist; 8 percent clay; weak medium subangular blocky structure; soft, very friable, nonsticky and nonplastic; common fine roots throughout; common very fine tubular pores; slightly effervescent, by HCl, 1 normal; moderately alkaline, pH 8.2 by Cresol red; gradual wavy boundary.

Bk1--30 to 44 inches (76 to 112 cm); yellowish red (5YR 5/8) loamy fine sand, yellowish red (5YR 4/6), moist; 8 percent clay; massive; soft, very friable, nonsticky and nonplastic; common fine roots throughout; common very fine tubular pores; common fine threadlike carbonate masses and common fine spherical carbonate masses; strongly effervescent, by HCl, 1 normal, 8 percent calcium carbonate equivalent; moderately alkaline, pH 8.2 by Cresol red; gradual wavy boundary.

Bk2--44 to 60 inches (112 to 152 cm); reddish yellow (5YR 6/6) loamy fine sand, yellowish red (5YR 4/6), moist; 6 percent clay; massive; loose, nonsticky and nonplastic; common fine threadlike carbonate masses and common medium spherical carbonate masses; strongly effervescent, by HCl, 1 normal; moderately alkaline, pH 8.2 by Cresol red.

Range in Characteristics
Reaction: 7.9 to 8.4 (moderately alkaline)

A Horizon
Value: 5 or 6 dry, 3 to 5 moist
Chroma: 4 or 6, dry or moist

Bw Horizons
Hue: 2.5YR or 5YR
Value: 4 or 5 dry, 3 or 4 moist
Chroma: 6 to 8, dry or moist
Texture: loamy fine sand, fine sand
Clay: 4 to 10 percent
Calcium carbonate equivalent: 0 to 2 percent

Bk Horizons
Hue: 2.5YR or 5YR
Value: 4 to 7 dry, 3 to 5 moist
Chroma: 3 to 8, dry or moist
Texture: loamy fine sand, fine sand
Clay: 4 to 10 percent
Calcium carbonate equivalent: 5 to 15 percent

Calcic horizon- the zone from 30 to 60 inches (Bk horizons)

Anasazi soils
Taxonomic classification: Coarse-loamy, mixed, superactive, mesic Ustic Haplocalcids
Geomorphic position: occurs on interfluves on hills, mesas, and structural benches.
Parent material: eolian deposits and/or residuum weathered from sandstone
Slope: 5 to 22 percent

Biological crust
 cyanobacteria: 5 percent
 lichen: 0 percent
 moss: 0 percent
Chemical crust
 salt: 0 percent
 gypsum: 0 percent
Physical cover
 canopy plant cover: 40 percent
 woody debris: 5 percent
 bare soil: 47 percent
  rock fragments
   gravel: 3 percent
Depth to restrictive feature(s): 20 to 35 inches to bedrock, lithic
Drainage class: somewhat excessively drained
Ksat solum: 2.00 to 6.00 inches per hour (14.11 to 42.34 micrometers per second)
Ksat restrictive layer: 0.00 to 0.20 inches per hour (0.00 to 1.40 micrometers per second)
Available water capacity total inches: 2.6 (low)
Shrink-swell potential: about 1.5 LEP (low)
Flooding hazard: none
Runoff class: medium
Hydrologic group: B
Ecological site name: Semidesert Sandy Loam (Blackbrush)
Ecological site number: R035XY218UT
Present vegetation: blackbrush, galleta, Cutler Mormon tea, Indian ricegrass, shadscale saltbush
Land capability (non irrigated): 6c

Typical Profile
Location
 Geographic Coordinate System:
  37° 37' 36.90'' north, 111° 15' 36.90'' west

A--0 to 1 inch (0 to 3 cm); reddish brown (5YR 5/4) fine sandy loam, yellowish red (5YR 4/6), moist; 8 percent clay; weak thin platy structure; loose, nonsticky and nonplastic; many very fine roots throughout; slightly effervescent, by HCl, 1 normal; moderately alkaline, pH 8.4 by Cresol red; abrupt smooth boundary.

Bw--1 to 8 inches (3 to 20 cm); reddish brown (5YR 5/4) loamy fine sand, yellowish red (5YR 4/6), moist; 7 percent clay; weak fine subangular blocky structure; soft, very friable, nonsticky and nonplastic; many very fine roots throughout and common medium roots throughout; common very fine dendritic tubular pores; strongly effervescent, by HCl, 1 normal; moderately alkaline, pH 8.4 by Cresol red; clear wavy boundary.

Bk1--8 to 17 inches (20 to 43 cm); reddish brown (5YR 5/4) loamy fine sand, yellowish red (5YR 4/6), moist; 7 percent clay; weak medium subangular blocky structure; soft, friable, nonsticky and nonplastic; many very fine roots throughout and common fine roots throughout; common very fine dendritic tubular and common fine dendritic tubular pores; common fine spherical carbonate masses; strongly effervescent, by HCl, 1 normal; moderately alkaline, pH 8.4 by Cresol red; clear wavy boundary.

Bk2--17 to 29 inches (43 to 74 cm); reddish brown (5YR 5/4) gravelly sandy loam, yellowish red (5YR 4/6), moist; 12 percent clay; massive; hard, firm, slightly sticky and slightly plastic; common very fine roots throughout; common carbonate masses around rock fragments and common fine spherical carbonate masses; 15 percent gravel; violently effervescent, by HCl, 1 normal, 18 percent calcium carbonate equivalent; moderately alkaline, pH 8.2 by Cresol red; abrupt smooth boundary.

R--29 to 39 inches (74 to 99 cm); unweathered, unfractured sandstone bedrock.

Range in Characteristics
Reaction: 7.9 to 8.4 (moderately alkaline)

A Horizon
 Value: 5 or 6 dry, 3 to 5 moist
 Chroma: 4 or 6, dry or moist

Bw or Bk Horizon(s)
 Hue: 2.5YR to 7.5YR
 Value: 4 or 5 dry, 3 or 4 moist
 Chroma: 4 to 6, dry or moist
 Texture: sandy loam, fine sandy loam, loamy fine sand
 Clay: 6 to 14 percent
 Calcium carbonate equivalent: 5 to 25 percent
 Rock fragments: 0 to 30 percent

Calcic horizon- the zone from 8 to 29 inches (Bk horizons)

234—Remorris family-Rock outcrop complex, 4 to 35 percent slopes, gullied

Map Unit Setting
Landform(s): plateaus
Elevation: 5,410 to 5,910 feet (1,650 to 1,800 meters)
Mean annual precipitation: 10 to 14 inches (250 to 350 millimeters)
Mean annual air temperature: 52 to 55 degrees Fahrenheit (11.0 to 13.0 degrees Celsius)
Mean annual soil temperature: 54 to 57 degrees Fahrenheit (12.1 to 14.1 degrees Celsius)
Frost-free period: 135 to 165 days
Major Land Resource Area: 35 - Colorado Plateau
Land Resource Unit: 35-3 Colorado Plateau Sagebrush - Grasslands

Map Unit Composition
Remorris family and similar soils: 75 percent
Rock outcrop: 10 percent
Minor components: Soils that have a clay subsoil texture. Soils that are greater than 20 inches deep on more stable, less sloping area.

Soil Properties and Qualities
Remorris family soils
Taxonomic classification: Loamy, mixed, superactive, calcareous, mesic, shallow Ustic Torriorthents
Geomorphic position: occurs on interfluves on hills, mesas, and structural benches.
Parent material: residuum weathered from sandstone and shale
Slope: 4 to 35 percent
Biological crust
cyanobacteria: 47 percent
lichen: 0 percent
moss: 0 percent
Chemical crust
salt: 0 percent
gypsum: 0 percent
Physical cover
canopy plant cover: 14 percent
woody debris: 13 percent
bare soil: 20 percent
rock fragments
gravel: 15 percent
Depth to restrictive feature(s): 5 to 19 inches to densic material
Drainage class: somewhat excessively drained
Ksat solum: 0.00 to 6.00 inches per hour (0.00 to 42.34 micrometers per second)
Available water capacity total inches: 2.0 (very low)
Shrink-swell potential: about 1.5 LEP (low)
Flooding hazard: none
Runoff class: very high
Hydrologic group: D
Ecological site name: Semidesert Shallow Sandy Loam (Utah Juniper-Blackbrush)
Ecological site number: R035XY236UT
Present vegetation: Utah juniper, galleta, narrowleaf yucca
Land capability (non irrigated): 6c

Typical Profile
Location
Geographic Coordinate System:
37° 37' 6.20'' north, 111° 15' 25.70'' west

A--0 to 1 inch (0 to 3 cm); 30 percent light reddish gray (2.5YR 7/1) and 70 percent red (2.5YR 5/6) fine sandy loam, reddish brown (2.5YR 4/4), moist; 16 percent clay; weak thin platy and weak medium subangular blocky structure; soft, very friable, slightly sticky and slightly plastic; many very fine roots throughout; common very fine tubular pores; violently effervescent, by HCl, 1 normal, 20 percent calcium carbonate equivalent; moderately alkaline, pH 8.0 by Cresol red; abrupt wavy boundary.

C1--1 to 7 inches (3 to 18 cm); red (2.5YR 5/6) fine sandy loam, reddish brown (2.5YR 4/4), moist; 16 percent clay; weak fine subangular blocky structure; soft, very friable, slightly sticky and slightly plastic; many very fine roots throughout and common fine roots throughout; common very fine dendritic tubular pores; violently effervescent, by HCl, 1 normal, 16 percent calcium carbonate equivalent; moderately alkaline, pH 8.2 by Cresol red; clear smooth boundary.

C2--7 to 17 inches (18 to 43 cm); 30 percent light reddish gray (2.5YR 7/1) and 70 percent red (2.5YR 5/6) fine sandy loam, reddish brown (2.5YR 4/4), moist; 16 percent clay; massive; slightly hard, friable, slightly sticky and slightly plastic; common very fine roots throughout and common medium roots throughout; common very fine dendritic tubular pores; violently effervescent, by HCl, 1 normal, 16 percent calcium carbonate equivalent; moderately alkaline, pH 8.2 by Cresol red; clear smooth boundary.

Cd--17 to 27 inches (43 to 68 cm); 30 percent light reddish gray (2.5YR 7/1) and 70 percent red (2.5YR 5/6) fine sandy loam, reddish brown (2.5YR 4/4), moist; 16 percent clay; slightly hard, friable, slightly sticky and slightly plastic; violently effervescent, by HCl, 1 normal, 16 percent calcium carbonate equivalent; moderately alkaline, pH 8.2 by Cresol red.

Range in Characteristics
Remorris family differs from the series because the series averages more than 18 percent clay in the control section.

Reaction: 7.9 to 8.4 (moderately alkaline)

A Horizon
Value: 5 to 7 dry, 3 to 5 moist
Chroma: 1 to 6, dry or moist

C Horizons
Hue: 2.5YR to 5YR
Value: 4 to 7 dry, 3 to 5 moist
Chroma: 1 to 6, dry or moist
Texture: fine sandy loam, loam
Clay: 12 to 18 percent
Calcium carbonate equivalent: 0 to 20 percent
Rock fragments: 0 to 25 percent

Rock outcrop
Slope: unspecified

Range in Characteristics
Rock outcrop consists of exposures of sandstone bedrock.

235—Rizno-Rock outcrop complex, 1 to 25 percent slopes

Map Unit Setting
Landform(s): plateaus
Elevation: 4,430 to 6,400 feet (1,350 to 1,950 meters)
Mean annual precipitation: 10 to 14 inches (250 to 350 millimeters)
Mean annual air temperature: 52 to 55 degrees Fahrenheit (11.0 to 13.0 degrees Celsius)
Mean annual soil temperature: 54 to 57 degrees Fahrenheit (12.1 to 14.1 degrees Celsius)
Frost-free period: 135 to 165 days
Major Land Resource Area: 35 - Colorado Plateau
Land Resource Unit: 35-3 Colorado Plateau Sagebrush - Grasslands

Map Unit Composition
Rizno and similar soils: 60 percent
Rock outcrop: 20 percent
Minor components: Lithic Batterson soils are on shoulders. Very deep Mido soils are on areas of deposition. A few areas have soils that are greater than 20 inches (50 cm).

Soil Properties and Qualities
Rizno soils
Taxonomic classification: Loamy, mixed, superactive, calcareous, mesic Lithic Ustic Torriorthents
Geomorphic position: occurs on interfluves on hills, mesas, and structural benches.
Parent material: residuum weathered from sandstone
Slope: 2 to 25 percent
Biological crust
cyanobacteria: 12 percent
lichen: 63 percent
moss: 7 percent
Chemical crust
salt: 0 percent
gypsum: 0 percent
Physical cover
canopy plant cover: 20 percent
woody debris: 3 percent
bare soil: 7 percent
rock fragments
gravel: 50 percent
Depth to restrictive feature(s): 4 to 10 inches to bedrock, paralithic; 5 to 20 inches to bedrock, lithic
Drainage class: well drained
Ksat solum: 2.00 to 6.00 inches per hour (14.11 to 42.34 micrometers per second)
Ksat restrictive layer: 0.00 to 0.60 inches per hour (0.00 to 4.20 micrometers per second)
Available water capacity total inches: 0.3 (very low)
Shrink-swell potential: about 1.5 LEP (low)
Flooding hazard: none
Runoff class: high
Hydrologic group: D
Ecological site name: Semidesert Shallow Sandy Loam (Utah Juniper-Blackbrush)
Ecological site number: R035XY236UT
Present vegetation: blackbrush, Utah juniper, twoneedle pinyon, broom snakeweed, green Mormon tea, plains pricklypear
Land capability (non irrigated): 6c

Typical Profile
Location
Geographic Coordinate System:
38° 29’ 23.10’’ north, 109° 49’ 52.80’’ west

A--0 to 2 inches (0 to 5 cm); yellowish red (5YR 5/6) gravelly sandy loam, yellowish red (5YR 4/6), moist; 10 percent clay; weak medium granular and weak fine subangular blocky structure; slightly hard, friable, slightly sticky and nonplastic; common fine roots throughout; common fine irregular pores; 25 percent gravel; strongly effervescent, 3 percent calcium carbonate equivalent; moderately alkaline, pH 8.2; abrupt wavy boundary.

Bw--2 to 4 inches (5 to 10 cm); reddish yellow (5YR 6/6) gravelly sandy loam, yellowish red (5YR 4/6), moist; 16 percent clay; weak medium subangular blocky structure; slightly hard, friable, slightly sticky and nonplastic; common fine roots throughout; common fine irregular pores; carbonate, finely disseminated throughout; 15 percent channer; violently effervescent, 10 percent calcium carbonate equivalent; moderately alkaline, pH 8.4; abrupt wavy boundary.

Cr--4 to 5.5 inches (10 to 14 cm); weathered, fractured sandstone bedrock; very abrupt wavy boundary.

R--5.5 to 15.5 inches (14 to 39 cm); unweathered, unfractured sandstone bedrock.

Range in Characteristics
Reaction: 7.9 to 8.4 (moderately alkaline)

A Horizon
Hue: 2.5YR or 5YR
Value: 4 or 5 dry, 3 or 4 moist
Chroma: 4 or 6 moist

Bw or C Horizon
Hue: 2.5YR or 5YR
Value: 4 to 6 dry, 3 or 4 moist
Chroma: 4 or 6, dry or moist
Clay content: 10 to 18 percent
Calcium carbonate equivalent: 10 to 25 percent
Rock fragments: 10 to 30 percent gravel

Rock outcrop
Slope: unspecified

Range in Characteristics
Rock outcrop consists of exposures of sandstone bedrock.

242—Needle-Sheppard complex, 2 to 12 percent slopes, very rocky

Map Unit Setting
Landform(s): plateaus
Elevation: 3,670 to 5,310 feet (1,120 to 1,620 meters)
Mean annual precipitation: 6 to 10 inches (150 to 250 millimeters)
Mean annual air temperature: 54 to 57 degrees Fahrenheit (12.0 to 14.0 degrees Celsius)
Mean annual soil temperature: 56 to 59 degrees Fahrenheit (13.1 to 15.1 degrees Celsius)
Frost-free period: 150 to 180 days
Major Land Resource Area: 35 - Colorado Plateau
Land Resource Unit: 35-2 Colorado Plateau Shrub - Grasslands

Map Unit Composition
Needle and similar soils: 50 percent
Sheppard and similar soils: 40 percent
Minor components: Areas have rock outcrop. A few areas have soils that have rock fragments throughout the profile. Some areas have slopes greater than 12 percent.

Soil Properties and Qualities
Needle soils
Taxonomic classification: Mixed, mesic Lithic Torripsamments
Geomorphic position: occurs on interfluves on hills, mesas, and structural benches as sandsheets.
Parent material: eolian sands and/or residuum weathered from sandstone
Slope: 2 to 12 percent
Biological crust
cyanobacteria: 27 percent
lichen: 0 percent
moss: 0 percent
Chemical crust
salt: 0 percent
gypsum: 0 percent
Physical cover
canopy plant cover: 23 percent
woody debris: 21 percent
bare soil: 40 percent
rock fragments: 0 percent
Depth to restrictive feature(s): 10 to 17 inches to bedrock, lithic
Drainage class: excessively drained
Ksat solum: 20.00 to 99.92 inches per hour (141.14 to 705.00 micrometers per second)
Ksat restrictive layer: 0.00 to 0.20 inches per hour (0.00 to 1.40 micrometers per second)
Available water capacity total inches: 0.7 (very low)
Shrink-swell potential: about 1.5 LEP (low)
Flooding hazard: none
Runoff class: high
Hydrologic group: D
Ecological site name: Sandstone Rockland 6-10” p.z.
Ecological site number: R035XB255AZ
Present vegetation: mesa dropseed, sand verbena, sand sagebrush, Ephedra cutleri
Land capability (non irrigated): 7c

Typical Profile
Location
Geographic Coordinate System:
36° 55’ 46.20’’ north, 111° 30’ 22.10’’ west

A--0 to 1 inch (0 to 3 cm); yellowish red (5YR 5/8) sand, yellowish red (5YR 4/6), moist; 6 percent clay; weak thin platy structure; loose, nonsticky and nonplastic; common fine roots throughout; common fine tubular pores; very slightly effervescent, by HCl, 1 normal; slightly alkaline, pH 7.8 by Cresol red; clear smooth boundary.

C--1 to 11 inches (3 to 28 cm); yellowish red (5YR 5/8) sand, yellowish red (5YR 4/6), moist; 6 percent clay; massive; loose, nonsticky and nonplastic; many fine roots throughout; common fine tubular pores; very slightly effervescent, by HCl, 1 normal; slightly alkaline, pH 7.8 by Cresol red; abrupt smooth boundary.

R--11 to 21 inches (28 to 53 cm); unweathered, unfractured sandstone bedrock.

Range in Characteristics
Reaction: 7.4 to 8.4 (slightly or moderately alkaline)

A Horizon
Value: 5 or 6 dry, 3 to 6 moist
Chroma: 4 to 8, dry or moist

C Horizon
Hue: 2.5YR or 5YR
Value: 4 to 6 dry, 3 to 6 moist
Chroma: 4 to 8, dry or moist
Texture: sand, fine sand
Clay: 2 to 7 percent
Rock fragments: 0 to 3 percent

Sheppard soils
Taxonomic classification: Mixed, mesic Typic Torripsamments
Geomorphic position: Occurs on interfluves on hills, mesas, and structural benches as dunes.
Parent material: eolian sands derived from sandstone and/or alluvium derived from sandstone
Slope: 2 to 12 percent
Biological crust

cyanobacteria: 27 percent
lichen: 0 percent
moss: 0 percent
Chemical crust
salt: 0 percent
gypsum: 0 percent
Physical cover
canopy plant cover: 23 percent
woody debris: 21 percent
bare soil: 40 percent
rock fragments: 0 percent
Drainage class: excessively drained
Ksat solum: 20.00 to 99.92 inches per hour (141.14 to 705.00 micrometers per second)
Available water capacity total inches: 3.6 (low)
Shrink-swell potential: about 1.5 LEP (low)
Flooding hazard: none
Runoff class: negligible
Hydrologic group: A
Ecological site name: Desert Sand (Sand Sagebrush)
Ecological site number: R035XY115UT
Present vegetation: mesa dropseed, sand verbena, sand sagebrush, Ephedra cutleri
Land capability (non irrigated): 7c

Typical Profile
Location
Geographic Coordinate System:
36° 55' 50.50'' north, 111° 30' 19.50'' west

A--0 to 1 inch (0 to 3 cm); yellowish red (5YR 5/6) sand, yellowish red (5YR 4/6), moist; 6 percent clay; weak thin platy structure; loose, nonsticky and nonplastic; common fine roots throughout; common very fine tubular pores; noneffervescent, by HCl, 1 normal; slightly alkaline, pH 7.8 by Cresol red; clear smooth boundary.

C1--1 to 8 inches (3 to 20 cm); yellowish red (5YR 5/6) sand, yellowish red (5YR 4/6), moist; 6 percent clay; massive; soft, loose, nonsticky and nonplastic; common fine roots throughout; many fine tubular pores; noneffervescent, by HCl, 1 normal; slightly alkaline, pH 7.8 by Cresol red; gradual smooth boundary.

C2--8 to 21 inches (20 to 53 cm); yellowish red (5YR 5/6) sand, yellowish red (5YR 4/6), moist; 6 percent clay; massive; slightly hard, very friable, nonsticky and nonplastic; many very fine roots throughout and many fine roots throughout; many fine tubular pores; noneffervescent, by HCl, 1 normal; slightly alkaline, pH 7.8 by Cresol red; gradual smooth boundary.

C3--21 to 60 inches (53 to 152 cm); yellowish red (5YR 5/8) sand, yellowish red (5YR 4/6), moist; 6 percent clay; single grain; loose, nonsticky and nonplastic; common fine roots throughout; common very fine tubular pores; very slightly effervescent, by HCl, 1 normal; slightly alkaline, pH 7.8 by Cresol red.

Range in Characteristics
Reaction: 7.4 to 8.4 (slightly or moderately alkaline)

A Horizon
Value: 5 or 6 dry, 3 to 6 moist
Chroma: 4 to 6, dry or moist

C Horizons
Hue: 2.5YR or 5YR
Value: 4 to 6 dry, 3 to 6 moist
Chroma: 4 to 8, dry or moist
Texture: sand, fine sand, loamy sand
Clay: 2 to 7 percent
Rock fragments: 0 to 3 percent

244—Rock outcrop-Needle complex, 2 to 30 percent slopes

Map Unit Setting
Landform(s): plateaus
Elevation: 3,670 to 5,310 feet (1,120 to 1,620 meters)
Mean annual precipitation: 6 to 10 inches (150 to 250 millimeters)
Mean annual air temperature: 54 to 57 degrees Fahrenheit (12.0 to 14.0 degrees Celsius)
Mean annual soil temperature: 56 to 59 degrees Fahrenheit (13.1 to 15.1 degrees Celsius)
Frost-free period: 150 to 180 days
Major Land Resource Area: 35 - Colorado Plateau
Land Resource Unit: 35-2 Colorado Plateau Shrub - Grasslands

Map Unit Composition
Rock outcrop: 60 percent
Needle and similar soils: 35 percent
Minor components: Some areas have soils that have rock fragments throughout the profile. A few areas have soil profiles greater than 20 inches deep.

Soil Properties and Qualities
Rock outcrop
Slope: unspecified

Range in Characteristics
Rock outcrop consists of exposures of sandstone bedrock.

Needle soils
Taxonomic classification: Mixed, mesic Lithic Torripsamments
Geomorphic position: occurs on interfluves on hills, mesas, and structural benches as sandsheets.
Parent material: eolian sands derived from sandstone
Slope: 2 to 30 percent
Biological crust
cyanobacteria: 3 percent

lichen: 0 percent
moss: 0 percent
Chemical crust
salt: 0 percent
gypsum: 0 percent
Physical cover
canopy plant cover: 7 percent
woody debris: 8 percent
bare soil: 19 percent
rock fragments
gravel: 7 percent
channer: 5 percent
Depth to restrictive feature(s): 4 to 12 inches to bedrock, lithic
Drainage class: excessively drained
Ksat solum: 20.00 to 99.92 inches per hour (141.14 to 705.00 micrometers per second)
Ksat restrictive layer: 0.00 to 0.20 inches per hour (0.00 to 1.40 micrometers per second)
Available water capacity total inches: 0.7 (very low)
Shrink-swell potential: about 5.0 LEP (moderate)
Flooding hazard: none
Runoff class: high
Hydrologic group: D
Ecological site name: Sandstone Rockland 6-10” p.z.
Ecological site number: R035XB255AZ
Present vegetation: blackbrush, broom snakeweed, black grama
Land capability (non irrigated): 7c

Typical Profile
Location
Geographic Coordinate System:
36° 55’ 19.30’’ north, 111° 30’ 40.70’’ west

A--0 to 1 inch (0 to 3 cm); yellowish red (5YR 5/6) sand, yellowish red (5YR 4/6), moist; 6 percent clay; weak thin platy structure; soft, loose, nonsticky and nonplastic; many fine roots throughout; common fine tubular pores; very slightly effervescent, by HCl, 1 normal; slightly alkaline, pH 7.8 by Cresol red; clear smooth boundary.

C--1 to 11 inches (3 to 28 cm); yellowish red (5YR 5/6) sand, yellowish red (5YR 4/6), moist; 6 percent clay; massive; soft, loose, nonsticky and nonplastic; many very fine roots throughout and many fine roots throughout; many fine tubular pores; very slightly effervescent, by HCl, 1 normal; moderately alkaline, pH 8.0 by Cresol red; abrupt smooth boundary.

R--11 to 21 inches (28 to 53 cm); unweathered, unfractured sandstone bedrock.

Range in Characteristics
Reaction: 7.4 to 8.4 (slightly or moderately alkaline)

A Horizon
Value: 5 or 6 dry, 3 to 6 moist
Chroma: 4 to 6, dry or moist

C Horizon
Hue: 2.5YR or 5YR
Value: 5 or 6 dry, 4 to 6 moist
Chroma: 4 to 6, dry or moist
Texture: sand, fine sand
Clay: 2 to 7 percent
Rock fragments: 0 to 3 percent

248—Sheppard sand, 2 to 15 percent slopes

Map Unit Setting
Landform(s): plateaus
Elevation: 3,670 to 5,310 feet (1,120 to 1,620 meters)
Mean annual precipitation: 6 to 10 inches (150 to 250 millimeters)
Mean annual air temperature: 54 to 57 degrees Fahrenheit (12.0 to 14.0 degrees Celsius)
Mean annual soil temperature: 56 to 59 degrees Fahrenheit (13.1 to 15.1 degrees Celsius)
Frost-free period: 150 to 180 days
Major Land Resource Area: 35 - Colorado Plateau
Land Resource Unit: 35-2 Colorado Plateau Shrub - Grasslands

Map Unit Composition
Sheppard and similar soils: 85 percent
Minor components: Some areas have slopes greater than 15 percent. Some soils have calcic horizon. A few areas have soils that have rock fragments throughout the profile.

Soil Properties and Qualities
Sheppard soils
Taxonomic classification: Mixed, mesic Typic Torripsamments
Geomorphic position: occurs on interfluves on hills, mesas, and structural benches as dunes.
Parent material: eolian sands derived from sandstone and/or alluvium derived from sandstone
Slope: 2 to 15 percent
Biological crust
cyanobacteria: 18 percent
lichen: 0 percent
moss: 0 percent
Chemical crust
salt: 0 percent
gypsum: 0 percent
Physical cover
canopy plant cover: 21 percent
woody debris: 16 percent
bare soil: 55 percent
rock fragments: 0 percent
Drainage class: excessively drained

Ksat solum: 6.00 to 99.92 inches per hour (42.34 to 705.00 micrometers per second)
Available water capacity total inches: 3.6 (low)
Shrink-swell potential: about 1.5 LEP (low)
Flooding hazard: none
Runoff class: very low
Hydrologic group: A
Ecological site name: Desert Sand (Sand Sagebrush)
Ecological site number: R035XY115UT
Present vegetation: alkali jimmyweed, sand sagebrush, scurfpea
Land capability (non irrigated): 7c

Typical Profile
Location
Geographic Coordinate System:
36° 56' 15.00'' north, 111° 31' 17.60'' west

A--0 to 1 inch (0 to 3 cm); yellowish red (5YR 5/6) sand, yellowish red (5YR 4/6), moist; 6 percent clay; weak thin platy structure; soft, loose, nonsticky and nonplastic; common fine roots throughout; many fine tubular pores; slightly effervescent, by HCl, 1 normal; moderately alkaline, pH 8.0 by Cresol red; abrupt wavy boundary.

C1--1 to 9 inches (3 to 23 cm); yellowish red (5YR 5/6) sand, yellowish red (5YR 4/6), moist; 6 percent clay; massive; soft, loose, nonsticky and nonplastic; common fine roots throughout; many fine tubular pores; slightly effervescent, by HCl, 1 normal; moderately alkaline, pH 8.0 by Cresol red; clear wavy boundary.

C2--9 to 39 inches (23 to 99 cm); yellowish red (5YR 5/6) sand, yellowish red (5YR 4/6), moist; 6 percent clay; massive; slightly hard, very friable, nonsticky and nonplastic; many very fine roots throughout and many fine roots throughout; many fine tubular pores; very slightly effervescent, by HCl, 1 normal; slightly alkaline, pH 7.8 by Cresol red; diffuse wavy boundary.

C3--39 to 60 inches (99 to 152 cm); yellowish red (5YR 5/8) loamy sand, yellowish red (5YR 4/6), moist; 8 percent clay; massive; slightly hard, very friable, nonsticky and nonplastic; common fine roots throughout; common fine tubular pores; slightly effervescent, by HCl, 1 normal; slightly alkaline, pH 7.8 by Cresol red.

Range in Characteristics
Reaction: 7.4 to 8.4 (slightly or moderately alkaline)

A Horizon
Value: 5 or 6 dry, 4 to 6 moist
Chroma: 4 to 6, dry or moist

C Horizons
Hue: 2.5YR or 5YR
Value: 5 or 6 dry, 4 to 6 moist
Chroma: 4 to 8, dry or moist
Texture: sand, fine sand, loamy sand
Clay: 2 to 8 percent
Rock fragments: 0 to 3 percent

252—Arches-Mido-Rock outcrop complex, 2 to 15 percent slopes

Map Unit Setting
Landform(s): plateaus
Elevation: 4,590 to 5,250 feet (1,400 to 1,600 meters)
Mean annual precipitation: 10 to 14 inches (250 to 350 millimeters)
Mean annual air temperature: 52 to 55 degrees Fahrenheit (11.0 to 13.0 degrees Celsius)
Mean annual soil temperature: 54 to 57 degrees Fahrenheit (12.1 to 14.1 degrees Celsius)
Frost-free period: 135 to 165 days
Major Land Resource Area: 35 - Colorado Plateau
Land Resource Unit: 35-3 Colorado Plateau Sagebrush - Grasslands

Map Unit Composition
Arches and similar soils: 40 percent
Mido and similar soils: 35 percent
Rock outcrop: 25 percent

Soil Properties and Qualities
Arches soils
Taxonomic classification: Mixed, mesic Lithic Torripsamments
Geomorphic position: occurs on interfluves on hills, mesas, and structural benches as sandsheets.
Parent material: eolian sands and/or residuum weathered from sandstone
Slope: 2 to 15 percent
Biological crust
cyanobacteria: 4 percent
lichen: 0 percent
moss: 0 percent
Chemical crust
salt: 0 percent
gypsum: 0 percent
Physical cover
canopy plant cover: 3 percent
woody debris: 5 percent
bare soil: 17 percent
rock fragments
gravel: 14 percent
cobble: 2 percent
Depth to restrictive feature(s): 7 to 12 inches to bedrock, lithic
Drainage class: excessively drained
Ksat solum: 5.95 to 19.98 inches per hour (42.00 to 141.00 micrometers per second)
Ksat restrictive layer: 0.00 to 0.20 inches per hour (0.00 to 1.40 micrometers per second)

Available water capacity total inches: 0.7 (very low)
Shrink-swell potential: about 1.0 LEP (low)
Flooding hazard: none
Runoff class: very high
Hydrologic group: D
Ecological site name: Semidesert Shallow Sand (Utah Juniper-Pinyon)
Ecological site number: R035XY227UT
Present vegetation: mesa dropseed, Utah juniper, Cutler Mormon tea, crispleaf buckwheat
Land capability (non irrigated): 6c

Typical Profile
Location
Geographic Coordinate System:
37° 35' 58.60'' north, 111° 11' 17.30'' west

A--0 to 1 inch (0 to 3 cm); yellowish red (5YR 5/6) fine sand, yellowish red (5YR 4/6), moist; 4 percent clay; weak thin platy structure; loose, nonsticky and nonplastic; many very fine roots throughout; common fine tubular pores; very slightly effervescent, by HCl, 1 normal; moderately alkaline, pH 8.0 by Cresol red; clear smooth boundary.

C--1 to 12 inches (3 to 30 cm); yellowish red (5YR 5/6) fine sand, yellowish red (5YR 4/6), moist; 5 percent clay; massive; loose, nonsticky and nonplastic; many very fine roots throughout and many fine roots throughout; many fine tubular pores; 3 percent fine gravel; noneffervescent, by HCl, 1 normal; moderately alkaline, pH 8.2 by Cresol red; abrupt wavy boundary.

R--12 to 21.5 inches (30 to 55 cm); unweathered, unfractured sandstone bedrock.

Range in Characteristics
Reaction: 7.9 to 8.4 (slightly or moderately alkaline)

A Horizon
Value: 4 or 5 dry, 3 to 5 moist
Chroma: 4 to 8, dry or moist

C Horizon
Value: 4 or 5 dry, 3 to 5 moist
Chroma: 4 to 8, dry or moist
Texture: sand, fine sand, loamy fine sand
Clay: 3 to 6 percent
Rock fragments: 0 to 5 percent

Mido soils
Taxonomic classification: Mixed, mesic Ustic Torripsamments
Geomorphic position: occurs on interfluves on hills, mesas, and structural benches as dunes.
Parent material: eolian sands derived from sandstone and/or alluvium derived from sandstone
Slope: 2 to 15 percent
Biological crust
cyanobacteria: percent
lichen: 0 percent
moss: 0 percent
Chemical crust
salt: 0 percent
gypsum: 0 percent
Physical cover
canopy plant cover: percent
woody debris: percent
bare soil: percent
rock fragments: 0 percent
Drainage class: excessively drained
Ksat solum: 5.95 to 19.98 inches per hour (42.00 to 141.00 micrometers per second)
Available water capacity total inches: 3.6 (low)
Shrink-swell potential: about 1.0 LEP (low)
Flooding hazard: none
Runoff class: low
Hydrologic group: A
Ecological site name: Semidesert Sand (Fourwing Saltbush)
Ecological site number: R035XY212UT
Present vegetation: Resinbush, Utah juniper, rosemary mint, mesa dropseed
Land capability (non irrigated): 6c

Typical Profile
Location
Geographic Coordinate System:
37° 36' 1.70'' north, 111° 11' 26.00'' west

A--0 to 1 inch (0 to 3 cm); yellowish red (5YR 5/6) fine sand, reddish brown (5YR 4/4), moist; 3 percent clay; weak thin platy structure; loose, nonsticky and nonplastic; many very fine roots throughout and many fine roots throughout; many fine tubular pores; noneffervescent, by HCl, 1 normal; slightly alkaline, pH 7.8 by Cresol red; clear smooth boundary.

C1--1 to 16 inches (3 to 41 cm); yellowish red (5YR 5/6) fine sand, reddish brown (5YR 4/4), moist; 3 percent clay; massive; loose, nonsticky and nonplastic; many very fine roots throughout and many fine roots throughout; many fine tubular pores; very slightly effervescent, by HCl, 1 normal; slightly alkaline, pH 7.8 by Cresol red; clear smooth boundary.

C2--16 to 60 inches (41 to 152 cm); yellowish red (5YR 5/6) fine sand, reddish brown (5YR 4/4), moist; 4 percent clay; massive; loose, nonsticky and nonplastic; many very fine roots throughout and many fine roots throughout; many fine tubular pores; noneffervescent, by HCl, 1 normal; moderately alkaline, pH 8.0 by Cresol red.

Range in Characteristics
Reaction: 7.4 to 8.4 (slightly or moderately alkaline)

A Horizon
Value: 4 or 5 dry, 3 to 5 moist
Chroma: 4 to 6, dry or moist

C Horizons
Value: 4 or 5 dry, 3 to 5 moist
Chroma: 4 to 8, dry or moist
Texture: sand, fine sand
Clay: 3 to 6 percent

Rock outcrop
Slope: unspecified

Range in Characteristics
Rock outcrop consists of exposures of sandstone bedrock.

254—Rock outcrop-Arches complex, 2 to 60 percent slopes

Map Unit Setting
Landform(s): plateaus
Elevation: 4,590 to 5,580 feet (1,400 to 1,700 meters)
Mean annual precipitation: 10 to 14 inches (250 to 350 millimeters)
Mean annual air temperature: 52 to 55 degrees Fahrenheit (11.0 to 13.0 degrees Celsius)
Mean annual soil temperature: 54 to 57 degrees Fahrenheit (12.1 to 14.1 degrees Celsius)
Frost-free period: 135 to 165 days
Major Land Resource Area: 35 - Colorado Plateau
Land Resource Unit: 35-3 Colorado Plateau Sagebrush - Grasslands

Map Unit Composition
Rock outcrop: 60 percent
Arches and similar soils: 30 percent
Minor components: Some areas have soils that have rock fragments throughout the profile. A few areas have soil profiles greater than 20 inches deep.

Soil Properties and Qualities
Rock outcrop
Slope: unspecified

Range in Characteristics
Rock outcrop consists of exposures of sandstone bedrock.

Arches soils
Taxonomic classification: Mixed, mesic Lithic Torripsamments
Geomorphic position: occurs on interfluves on hills, mesas, and structural benches as sandsheets.
Parent material: eolian sands and/or residuum weathered from sandstone
Slope: 2 to 60 percent
Biological crust
cyanobacteria: 4 percent
lichen: 0 percent
moss: 0 percent
Chemical crust
salt: 0 percent
gypsum: 0 percent
Physical cover
canopy plant cover: 3 percent
woody debris: 5 percent
bare soil: 17 percent
rock fragments
gravel: 14 percent
cobble: 2 percent
Depth to restrictive feature(s): 4 to 11 inches to bedrock, lithic
Drainage class: excessively drained
Ksat solum: 5.95 to 19.98 inches per hour (42.00 to 141.00 micrometers per second)
Ksat restrictive layer: 0.00 to 0.20 inches per hour (0.00 to 1.40 micrometers per second)
Available water capacity total inches: 0.7 (very low)
Shrink-swell potential: about 1.0 LEP (low)
Flooding hazard: none
Runoff class: very high
Hydrologic group: D
Ecological site name: Semidesert Shallow Sand (Utah Juniper-Pinyon)
Ecological site number: R035XY227UT
Present vegetation: mesa dropseed, Utah juniper, Cutler Mormon tea, crispleaf buckwheat
Land capability (non irrigated): 6c

Typical Profile
Location
Geographic Coordinate System:
37° 35’ 28.60’’ north, 111° 12’ 7.10’’ west

A--0 to 1 inch (0 to 3 cm); yellowish red (5YR 5/6) fine sand, reddish brown (5YR 4/4), moist; 4 percent clay; single grain; loose, nonsticky and nonplastic; many very fine roots throughout and many fine roots throughout; common fine tubular pores; 5 percent fine gravel; very slightly effervescent, by HCl, 1 normal; slightly alkaline, pH 7.8 by Cresol red; clear smooth boundary.

C--1 to 11 inches (3 to 28 cm); yellowish red (5YR 5/6) fine sand, reddish brown (5YR 4/4), moist; 5 percent clay; massive; loose, nonsticky and nonplastic; many very fine roots throughout and many fine roots throughout; common fine tubular pores; 2 percent fine gravel; noneffervescent, by HCl, 1 normal; slightly alkaline, pH 7.8 by Cresol red; abrupt wavy boundary.

R--11 to 21 inches (28 to 53 cm); unweathered, unfractured sandstone bedrock.

Range in Characteristics
Reaction: 7.4 to 7.8 (slightly alkaline)

A Horizon
Value: 4 or 5 dry, 3 to 5 moist
Chroma: 4 to 8, dry or moist

C Horizon
Value: 4 or 5 dry, 3 to 5 moist
Chroma: 4 to 8, dry or moist
Texture: sand, fine sand, loamy fine sand
Clay: 3 to 6 percent
Rock fragments: 0 to 5 percent

284—Razito-Riverwash complex, 1 to 4 percent slopes, rarely flooded

Map Unit Setting
Landform(s): flood plains
Elevation: 3,150 to 4,460 feet (960 to 1,360 meters)
Mean annual precipitation: 6 to 10 inches (150 to 250 millimeters)
Mean annual air temperature: 54 to 57 degrees Fahrenheit (12.0 to 14.0 degrees Celsius)
Mean annual soil temperature: 56 to 59 degrees Fahrenheit (13.1 to 15.1 degrees Celsius)
Frost-free period: 150 to 180 days
Major Land Resource Area: 35 - Colorado Plateau
Land Resource Unit: 35-2 Colorado Plateau Shrub - Grasslands

Map Unit Composition
Razito and similar soils: 55 percent
Riverwash: 40 percent
Minor components: Soils that have stratified layers of rock fragments and/or textures finer than fine sand.

Soil Properties and Qualities
Razito soils
Taxonomic classification: Mixed, mesic Typic Torripsamments
Geomorphic position: occurs on flood plains.
Parent material: sandy alluvium
Slope: 1 to 4 percent
Biological crust
cyanobacteria: 15 percent
lichen: 0 percent
moss: 0 percent
Chemical crust
salt: 4 percent
gypsum: 0 percent
Physical cover
canopy plant cover: 13 percent
woody debris: 15 percent
bare soil: 37 percent
rock fragments
gravel: 15 percent
cobble: 11 percent
stone: 1 percent
boulder: 1 percent
channer: 1 percent
Drainage class: excessively drained
Ksat solum: 6.00 to 99.92 inches per hour (42.34 to 705.00 micrometers per second)
Available water capacity total inches: 3.6 (low)
Shrink-swell potential: about 1.0 LEP (low)
Flooding hazard: rare
Runoff class: very low
Hydrologic group: A
Ecological site name: Sandy Wash 6-10” p.z.
Ecological site number: R035XB216AZ
Present vegetation: China tamarisk, rubber rabbitbrush
Land capability (non irrigated): 7c

Typical Profile
Location
Geographic Coordinate System:
37° 7’ 41.20’’ north, 111° 29’ 21.40’’ west

A--0 to 1 inch (0 to 3 cm); light olive brown (2.5Y 5/3) sand, olive brown (2.5Y 4/3), moist; 3 percent clay; weak thin platy structure; soft, very friable, nonsticky and nonplastic; common very fine roots throughout and common fine roots throughout; many fine dendritic tubular pores; slightly effervescent, by HCl, 1 normal; slightly alkaline, pH 7.8 by Cresol red; clear smooth boundary.

C1--1 to 5 inches (3 to 13 cm); light yellowish brown (2.5Y 6/3) sand, olive brown (2.5Y 4/3), moist; 3 percent clay; massive; soft, very friable, nonsticky and nonplastic; many very fine roots throughout and many fine roots throughout; many fine dendritic tubular pores; slightly effervescent, by HCl, 1 normal; moderately alkaline, pH 8.0 by Cresol red; abrupt smooth boundary.

C2--5 to 7 inches (13 to 18 cm); light olive brown (2.5Y 5/3) fine sand, olive brown (2.5Y 4/3), moist; 4 percent clay; massive; soft, very friable, nonsticky and nonplastic; common fine roots throughout and common medium roots throughout; many fine dendritic tubular and many medium dendritic tubular pores; 3 percent gravel; strongly effervescent, by HCl, 1 normal; moderately alkaline, pH 8.0 by Cresol red; abrupt smooth boundary.

C3--7 to 36 inches (18 to 91 cm); light yellowish brown (2.5Y 6/3) fine sand, olive brown (2.5Y 4/3), moist; 3 percent clay; massive; soft, very friable, nonsticky and nonplastic; many fine roots throughout and many medium roots throughout; many fine dendritic tubular and many medium dendritic tubular pores; 2 percent gravel; strongly effervescent, by HCl, 1 normal; moderately alkaline, pH 8.0 by Cresol red; clear smooth boundary.

C4--36 to 40 inches (91 to 102 cm); light yellowish brown (2.5Y 6/3) fine sand, olive brown (2.5Y 4/3), moist; 3 percent clay; massive; moderately hard, friable, nonsticky and nonplastic; common fine roots throughout and common medium roots throughout; common fine dendritic tubular and common medium dendritic tubular pores; 3 percent gravel; strongly effervescent, by HCl, 1 normal; moderately alkaline, pH 8.2 by Cresol red; clear smooth boundary.

C5--40 to 60 inches (102 to 152 cm); light yellowish brown (2.5Y 6/3) sand, olive brown (2.5Y 4/3), moist; 2 percent clay; massive; moderately hard, friable, nonsticky and nonplastic; common fine roots throughout; common fine dendritic tubular pores; common fine carbonate masses along lamina or strata surfaces; strongly effervescent, by HCl, 1 normal; moderately alkaline, pH 8.0 by Cresol red.

Range in Characteristics
Reaction: 7.4 to 8.4 (slightly to moderately alkaline)

A Horizon
Value: 5 or 6 dry, 4 to 6 moist
Chroma: 3 or 4, dry or moist

C Horizons
Hue: 10YR or 2.5Y
Value: 5 or 6 dry, 4 to 6 moist
Chroma: 3 or 4, dry or moist
Texture: sand, fine sand, loamy sand
Clay: 1 to 8 percent
Rock fragments: 0 to 34 percent

Riverwash
Slope: unspecified

Range in Characteristics
Riverwash is unstabilized sandy and/or gravelly sediment that is frequently flooded, washed, and reworked.

286—Oxyaquic Torripsamments, 1 to 3 percent slopes, occasionally flooded

Map Unit Setting
Landform(s): flood plains
Elevation: 3,770 to 4,490 feet (1,150 to 1,370 meters)
Mean annual precipitation: 6 to 10 inches (150 to 250 millimeters)
Mean annual air temperature: 54 to 57 degrees Fahrenheit (12.0 to 14.0 degrees Celsius)
Mean annual soil temperature: 56 to 59 degrees Fahrenheit (13.1 to 15.1 degrees Celsius)
Frost-free period: 150 to 180 days
Major Land Resource Area: 35 - Colorado Plateau
Land Resource Unit: 35-2 Colorado Plateau Shrub - Grasslands

Map Unit Composition
Oxyaquic Torripsamments and similar soils: 90 percent
Minor components: Soils that have stratified layers of rock fragments and/or textures finer than loamy sand. A few areas of Riverwash near stream channel.

Soil Properties and Qualities
Oxyaquic Torripsamments soils
Taxonomic classification: Oxyaquic Torripsamments
Geomorphic position: occurs on flood plains.
Parent material: sandy alluvium
Slope: 1 to 3 percent
Biological crust
cyanobacteria: 8 percent
lichen: 0 percent
moss: 0 percent
Chemical crust
salt: 0 percent
gypsum: 0 percent
Physical cover
canopy plant cover: 59 percent
woody debris: 30 percent
bare soil: 32 percent
rock fragments: 0 percent
Drainage class: moderately well drained
Ksat solum: 6.00 to 20.00 inches per hour (42.34 to 141.14 micrometers per second)
Available water capacity total inches: 3.9 (low)
Shrink-swell potential: about 1.5 LEP (low)
Flooding hazard: occasional
Seasonal water table minimum depth: about 40 to 60 inches
Runoff class: very low
Hydrologic group: A
Ecological site name: Semiwet Saline Streambank (Fremont Cottonwood)
Ecological site number: R035XY012UT
Present vegetation: Fremont cottonwood, scouringrush horsetail, Goodding's willow
Land capability (non irrigated): 7c

Typical Profile
Location
Geographic Coordinate System:
37° 43' 11.25'' north, 111° 11' 57.21'' west

A--0 to 1 inch (0 to 3 cm); reddish yellow (7.5YR 6/6) loamy sand, strong brown (7.5YR 4/6), moist; 4 percent clay; weak thin platy structure; loose, nonsticky and nonplastic; common very fine roots; common fine dendritic tubular pores; strongly effervescent, by HCl, 1 normal; slightly alkaline, pH 7.8 by Cresol red; abrupt smooth boundary.

C1--1 to 11 inches (3 to 28 cm); reddish yellow (7.5YR 6/6) loamy sand, strong brown (7.5YR 4/6), moist; 4 percent clay; massive; loose, nonsticky and nonplastic; common very fine roots; many fine dendritic tubular pores; strongly effervescent, by HCl, 1 normal; slightly alkaline, pH 7.8 by Cresol red; gradual smooth boundary.

C2--11 to 31 inches (28 to 79 cm); reddish yellow (7.5YR 6/6) loamy sand, strong brown (7.5YR 4/6), moist; 4 percent clay; massive; soft, very friable, nonsticky and nonplastic; many very fine roots and many fine roots and common medium roots; many fine dendritic tubular pores; strongly effervescent, by HCl, 1 normal; slightly alkaline, pH 7.8 by Cresol red; clear smooth boundary.

C3--31 to 52 inches (79 to 132 cm); very pale brown (10YR 7/4) loamy sand, brown (7.5YR 5/4), moist; 4 percent clay; massive; soft, very friable, nonsticky and nonplastic; many very fine roots and many fine roots and common medium roots; many fine dendritic tubular pores; strongly effervescent, by HCl, 1 normal; slightly alkaline, pH 7.8 by Cresol red; clear smooth boundary.

C4--52 to 65 inches (132 to 165 cm); light brown (7.5YR 6/4) and brown (7.5YR 5/4) loamy sand, very dark brown (10YR 2/2) and dark yellowish brown (10YR 4/6), moist; 6 percent clay; massive; slightly hard, friable, nonsticky and nonplastic; common very fine roots and common fine roots and common medium roots; many fine dendritic tubular pores; strongly effervescent, by HCl, 1 normal; moderately alkaline, pH 8.0 by Cresol red.

Range in Characteristics
Oxyaquic Torripsamments have soil properties that vary greater than family class limits.

Reaction: 7.4 to 8.4 (slightly or moderately alkaline)

A Horizon
Value: 5 or 6 dry, 4 to 6 moist
Chroma: 4 to 6, dry or moist

C Horizons
Hue: 7.5YR or 10YR
Value: 5 or 7 dry, 4 to 6 moist
Chroma: 2 to 6, dry or moist
Texture: loamy sand, sand
Clay: 3 to 10 percent
Rock fragments: 0 to 12 percent

Redoximorphic features- greater than 40 inches

296—Oxyaquic Torrifluvents, 1 to 4 percent slopes, occasionally flooded

Map Unit Setting
Landform(s): flood plains
Elevation: 4,000 to 4,790 feet (1,220 to 1,460 meters)
Mean annual precipitation: 10 to 14 inches (250 to 350 millimeters)
Mean annual air temperature: 52 to 55 degrees Fahrenheit (11.0 to 13.0 degrees Celsius)
Mean annual soil temperature: 54 to 57 degrees Fahrenheit (12.1 to 14.1 degrees Celsius)
Frost-free period: 135 to 165 days
Major Land Resource Area: 35 - Colorado Plateau
Land Resource Unit: 35-3 Colorado Plateau Sagebrush - Grasslands

Map Unit Composition
Oxyaquic Torrifluvents and similar soils: 80 percent
Minor components: Soils that have stratified layers of rock fragments. A few areas of Riverwash near stream channel.

Soil Properties and Qualities
Oxyaquic Torrifluvents soils
Taxonomic classification: Oxyaquic Torrifluvents
Geomorphic position: occurs on flood plains.
Parent material: alluvium
Slope: 1 to 4 percent
Biological crust
cyanobacteria: 0 percent
lichen: 0 percent
moss: 0 percent
Chemical crust
salt: 0 percent
gypsum: 0 percent
Physical cover
canopy plant cover: 39 percent
woody debris: 61 percent
bare soil: 39 percent
rock fragments: 0 percent
Drainage class: moderately well drained
Ksat solum: 0.60 to 20.00 inches per hour (4.23 to 141.14 micrometers per second)
Available water capacity total inches: 7.0 (moderate)
Shrink-swell potential: about 1.5 LEP (low)
Flooding hazard: occasional
Seasonal water table minimum depth: about 32 to 60 inches
Runoff class: low
Hydrologic group: C
Ecological site name: Semiwet Saline Streambank (Fremont Cottonwood)
Ecological site number: R035XY012UT
Present vegetation: cottonwood, willow, saltcedar tamarisk
Land capability (non irrigated): 6c

Typical Profile
Location
Geographic Coordinate System:
37° 36’ 45.30’’ north, 111° 10’ 45.80’’ west

A--0 to 2 inches (0 to 5 cm); yellowish red (5YR 5/6) loamy fine sand, yellowish red (5YR 4/6), moist; 6 percent clay; weak thin platy structure; loose, nonsticky and nonplastic; common very fine roots; common fine dendritic tubular pores; very slightly effervescent, by HCl, 1 normal; moderately alkaline, pH 8.0 by Cresol red; abrupt smooth boundary.

C1--2 to 8 inches (5 to 20 cm); light brown (7.5YR 6/4) very fine sandy loam, brown (7.5YR 4/4), moist; 12 percent clay; massive; soft, very friable, nonsticky and nonplastic; many very fine roots and many fine roots and many medium roots; many fine dendritic tubular pores; slightly effervescent, by HCl, 1 normal; moderately alkaline, pH 8.2 by Cresol red; clear smooth boundary.

C2--8 to 25 inches (20 to 64 cm); yellowish red (5YR 5/8) fine sand, yellowish red (5YR 4/6), moist; 4 percent clay; massive; loose, nonsticky and nonplastic; many very fine roots and many fine roots; common fine dendritic tubular pores; very slightly effervescent, by HCl, 1 normal; moderately alkaline, pH 8.0 by Cresol red; clear smooth boundary.

C3--25 to 32 inches (64 to 81 cm); reddish yellow (7.5YR 6/6) loamy fine sand, strong brown (7.5YR 4/6), moist; 6 percent clay; massive; soft, very friable, nonsticky and nonplastic; many very fine roots and many fine roots; many fine dendritic tubular pores; slightly effervescent, by HCl, 1 normal; moderately alkaline, pH 8.2 by Cresol red; abrupt smooth boundary.

C4--32 to 60 inches (81 to 152 cm); light brown (7.5YR 6/4) loam, brown (7.5YR 4/4), moist; 19 percent clay; moderate fine subangular blocky and moderate medium subangular blocky structure; hard, friable, moderately sticky and slightly plastic; many fine roots and many medium roots; many fine dendritic tubular pores; 2 percent fine pale brown (10YR 6/3) iron depletions and 3 percent fine yellowish red (5YR 5/8) iron-manganese masses; strongly effervescent, by HCl, 1 normal; moderately alkaline, pH 8.2 by Cresol red.

Range in Characteristics
Oxyaquic Torriorthents have soil properties that vary greater than family class limits.

Reaction: 7.4 to 8.4 (slightly alkaline or moderately alkaline)

A Horizon
Value: 5 or 6 dry, 4 or 5 moist
Chroma: 4 to 8, dry or moist

C Horizons
Hue: 5YR or 7.5YR
Value: 5 or 7 dry, 4 to 6 moist
Chroma: 4 to 8, dry or moist
Texture: fine sand, loamy fine sand, very fine sandy loam, loam
Clay: 3 to 20 percent
Rock fragments: 0 to 10 percent
Redoximorphic features- greater than 30 inches

324—Tsaya-Rock outcrop complex, 2 to 18 percent slopes

Map Unit Setting
Landform(s): plateaus
Elevation: 3,180 to 5,250 feet (970 to 1,600 meters)
Mean annual precipitation: 6 to 10 inches (150 to 250 millimeters)
Mean annual air temperature: 54 to 57 degrees Fahrenheit (12.0 to 14.0 degrees Celsius)
Mean annual soil temperature: 56 to 59 degrees Fahrenheit (13.1 to 15.1 degrees Celsius)
Frost-free period: 150 to 180 days
Major Land Resource Area: 35 - Colorado Plateau
Land Resource Unit: 35-2 Colorado Plateau Shrub - Grasslands

Map Unit Composition
Tsaya and similar soils: 65 percent
Rock outcrop: 20 percent
Minor components: Soils that are greater than 20 inches (50 cm) deep. Some areas have slopes greater than 18 percent.

Soil Properties and Qualities
Tsaya soils
Taxonomic classification: Loamy-skeletal, mixed, superactive, calcareous, mesic Lithic Torriorthents
Geomorphic position: occurs on interfluves on hills, mesas, and structural benches.
Parent material: gravelly residuum weathered from sandstone and shale
Slope: 2 to 18 percent
Biological crust
cyanobacteria: 5 percent
lichen: 0 percent
moss: 0 percent
Chemical crust
salt: 0 percent
gypsum: 0 percent
Physical cover
canopy plant cover: 10 percent
woody debris: 8 percent
bare soil: 42 percent
rock fragments
gravel: 38 percent
Depth to restrictive feature(s): 6 to 16 inches to bedrock, lithic
Drainage class: well drained
Ksat solum: 0.20 to 2.00 inches per hour (1.40 to 14.11 micrometers per second)
Ksat restrictive layer: 0.00 to 0.20 inches per hour (0.00 to 1.40 micrometers per second)
Available water capacity total inches: 1.0 (very low)

Shrink-swell potential: about 4.5 LEP (moderate)
Flooding hazard: none
Runoff class: high
Hydrologic group: D
Ecological site name: Desert Shallow Sandy Loam (Blackbrush)
Ecological site number: R035XY133UT
Present vegetation: blackbrush, shadscale saltbush, skeletonweed buckwheat
Land capability (non irrigated): 7c

Typical Profile
Location
Geographic Coordinate System:
37° 51' 48.20'' north, 110° 19' 45.00'' west

A--0 to 1 inch (0 to 3 cm); red (2.5YR 4/6) gravelly sandy clay loam, dark red (2.5YR 3/6), moist; 31 percent clay; weak medium platy structure; slightly hard, friable, very sticky and very plastic; common fine roots throughout; many fine dendritic tubular pores; 10 percent gravel and 10 percent channer; strongly effervescent, by HCl, 1 normal; moderately alkaline, pH 8.0 by Cresol red; abrupt smooth boundary.

C1--1 to 4 inches (3 to 10 cm); red (2.5YR 4/6) very cobbly clay loam, dark red (2.5YR 3/6), moist; 29 percent clay; massive; moderately hard, friable, very sticky and very plastic; many fine roots throughout; many very fine dendritic tubular and many fine dendritic tubular and common medium dendritic tubular pores; 10 percent cobble and 5 percent stone and 25 percent channer; strongly effervescent, by HCl, 1 normal; moderately alkaline, pH 8.2 by Cresol red; clear smooth boundary.

C2--4 to 9 inches (10 to 23 cm); red (2.5YR 4/6) very cobbly sandy clay loam, dark red (2.5YR 3/6), moist; 26 percent clay; massive; moderately hard, friable, very sticky and moderately plastic; many fine roots throughout; common very fine dendritic tubular and common fine dendritic tubular pores; 10 percent cobble and 5 percent stone and 20 percent channer; strongly effervescent, by HCl, 1 normal; moderately alkaline, pH 8.2 by Cresol red; abrupt smooth boundary.

R--9 to 19 inches (23 to 48 cm); unweathered, unfractured sandstone bedrock.

Range in Characteristics
Reaction: 7.4 to 8.4 (slightly or moderately alkaline)

A Horizon
Value: 4 or 5 dry, 3 or 4 moist
Chroma: 4 or 6, dry or moist

C Horizons
Hue: 2.5YR to 7.5YR
Value: 4 to 6 dry, 3 to 6 moist
Chroma: 3 to 6, dry or moist
Texture: sandy clay loam, clay loam
Clay: 20 to 35 percent
Rock fragments: 35 to 60 percent

Rock outcrop
Slope: unspecified

Range in Characteristics
Rock outcrop consists of exposures of sandstone bedrock.

334—Rizno-Rock outcrop complex, 2 to 15 percent slopes

Map Unit Setting
Landform(s): plateaus
Elevation: 5,150 to 6,990 feet (1,570 to 2,130 meters)
Mean annual precipitation: 10 to 14 inches (250 to 350 millimeters)
Mean annual air temperature: 52 to 55 degrees Fahrenheit (11.0 to 13.0 degrees Celsius)
Mean annual soil temperature: 54 to 57 degrees Fahrenheit (12.1 to 14.1 degrees Celsius)
Frost-free period: 135 to 165 days
Major Land Resource Area: 35 - Colorado Plateau
Land Resource Unit: 35-3 Colorado Plateau Sagebrush - Grasslands

Map Unit Composition
Rizno and similar soils: 40 percent
Rock outcrop: 25 percent
Minor components: Lithic Reef soils on shoulders. Lithic Batterson soils. Some areas have soils that are greater than 20 inches (50 cm) deep.

Soil Properties and Qualities
Rizno soils
Taxonomic classification: Loamy, mixed, superactive, calcareous, mesic Lithic Ustic Torriorthents
Geomorphic position: occurs on interfluves on hills, mesas, and structural benches.
Parent material: residuum weathered from sandstone and/or slope alluvium derived from sandstone
Slope: 2 to 15 percent
Biological crust
cyanobacteria: 12 percent
lichen: 63 percent
moss: 7 percent
Chemical crust
salt: 0 percent
gypsum: 0 percent
Physical cover
canopy plant cover: 20 percent
woody debris: 3 percent
bare soil: 7 percent
rock fragments: 0 percent

Depth to restrictive feature(s): 4 to 20 inches to bedrock, lithic
Drainage class: well drained
Ksat solum: 2.00 to 6.00 inches per hour (14.11 to 42.34 micrometers per second)
Ksat restrictive layer: 0.00 to 0.20 inches per hour (0.00 to 1.40 micrometers per second)
Available water capacity total inches: 0.7 (very low)
Shrink-swell potential: about 1.5 LEP (low)
Flooding hazard: none
Runoff class: very high
Hydrologic group: D
Ecological site name: Semidesert Shallow Sandy Loam (Utah Juniper-Blackbrush)
Ecological site number: R035XY236UT
Present vegetation: Utah juniper, twoneedle pinyon, broom snakeweed, fourwing saltbush, Mormon tea, cliffrose, plains pricklypear
Land capability (non irrigated): 6c

Typical Profile
Location
Geographic Coordinate System:
38° 10’ 3.80’’ north, 110° 3’ 0.30’’ west

A--0 to 1 inch (0 to 3 cm); reddish brown (5YR 5/4) fine sandy loam, reddish brown (5YR 4/4), moist; 12 percent clay; weak fine granular structure; soft, very friable, slightly sticky and nonplastic; many very fine roots throughout; many very fine irregular pores; slightly effervescent, 2 percent calcium carbonate equivalent; moderately alkaline, pH 8.4 Report error: not bedrock or cemented material!; abrupt wavy boundary.

Bw--1 to 5.5 inches (3 to 14 cm); reddish brown (5YR 5/4) fine sandy loam, reddish brown (5YR 4/4), moist; 14 percent clay; weak medium subangular blocky structure; slightly hard, friable, slightly sticky and nonplastic; common very fine roots throughout; many very fine irregular pores; strongly effervescent, 3 percent calcium carbonate equivalent; moderately alkaline, pH 8.4; abrupt wavy boundary.

R--5.5 to 15.5 inches (14 to 39 cm).

Range in Characteristics
Reaction: 7.4 to 8.4 (moderately alkaline)

A horizon
Value: 4 or 5, dry or moist
Clay content: 8 to 12 percent
Calcium carbonate equivalent: 1 to 5 percent
Rock fragments: 0 to 5 percent gravel

Bw horizon
Value: 5 or 6 dry
Texture: sandy loam, fine sandy loam, very fine sandy loam
Clay content: 10 to 15 percent
Calcium carbonate equivalent: 3 to 5 percent
Rock fragments: 0 to 5 percent gravel

Rock outcrop
Slope: unspecified

Range in Characteristics
Rock outcrop consists of exposures of sandstone bedrock.

335—Westmion-Rock outcrop complex, 4 to 18 percent slopes

Map Unit Setting
Landform(s): plateaus
Elevation: 5,090 to 6,730 feet (1,550 to 2,050 meters)
Mean annual precipitation: 10 to 14 inches (250 to 350 millimeters)
Mean annual air temperature: 52 to 55 degrees Fahrenheit (11.0 to 13.0 degrees Celsius)
Mean annual soil temperature: 54 to 57 degrees Fahrenheit (12.1 to 14.1 degrees Celsius)
Frost-free period: 135 to 165 days
Major Land Resource Area: 35 - Colorado Plateau
Land Resource Unit: 35-3 Colorado Plateau Sagebrush - Grasslands

Map Unit Composition
Westmion and similar soils: 60 percent
Rock outcrop: 25 percent
Minor components: Lithic Arches soils on shoulders. Some areas have soils that are greater than 20 inches (50 cm) deep. A few areas have more than 35 percent rock fragments throughout the profile. Some places have slopes greater than 18 percent.

Soil Properties and Qualities
Westmion soils
Taxonomic classification: Clayey, mixed, superactive, calcareous, mesic Lithic Ustic Torriorthents
Geomorphic position: occurs on interfluves on hills and structural benches.
Parent material: residuum weathered from sandstone and/or slope alluvium derived from sandstone and shale
Slope: 4 to 18 percent
Biological crust
cyanobacteria: 0 percent
lichen: 0 percent
moss: 0 percent
Chemical crust
salt: 0 percent
gypsum: 0 percent
Physical cover
canopy plant cover: 28 percent
woody debris: 24 percent

bare soil: 12 percent
rock fragments
gravel: 30 percent
stone: 14 percent
channer: 10 percent
flagstone: 12 percent

Depth to restrictive feature(s): 4 to 16 inches to bedrock, lithic
Drainage class: well drained
Ksat solum: 0.06 to 6.00 inches per hour (0.42 to 42.34 micrometers per second)
Ksat restrictive layer: 0.00 to 0.20 inches per hour (0.00 to 1.40 micrometers per second)
Available water capacity total inches: 2.2 (very low)
Shrink-swell potential: about 4.5 LEP (moderate)
Flooding hazard: none
Runoff class: very high
Hydrologic group: D
Ecological site name: Semidesert Shallow Clay (Shadscale-Utah Juniper)
Ecological site number: R035XY239UT
Present vegetation: Utah juniper, blackbrush, Mormon tea, broom snakeweed, roundleaf buffaloberry
Land capability (non irrigated): 6c

Typical Profile
Location
Geographic Coordinate System:
38° 3' 57.30'' north, 110° 10' 33.70'' west

A--0 to 1 inch (0 to 3 cm); brown (7.5YR 5/4) gravelly sandy loam, brown (7.5YR 4/4), moist; 18 percent clay; weak thin platy structure; soft, very friable, nonsticky and slightly plastic; common fine roots throughout; common fine dendritic tubular pores; 15 percent gravel and 5 percent channer; strongly effervescent, by HCl, 1 normal; moderately alkaline, pH 8.2 by Cresol red; abrupt smooth boundary.

C1--1 to 7 inches (3 to 18 cm); brown (7.5YR 5/4) and yellowish brown (10YR 5/4) clay, brown (7.5YR 4/4) and dark yellowish brown (10YR 4/4), moist; 46 percent clay; moderate medium prismatic parting to massive structure; moderately hard, friable, moderately sticky and very plastic; many fine roots throughout and many medium roots throughout; many very fine dendritic tubular and many fine dendritic tubular pores; common fine carbonate nodules; 2 percent gravel; strongly effervescent, by HCl, 1 normal; moderately alkaline, pH 8.4 by Cresol red; clear smooth boundary.

C2--7 to 14 inches (18 to 36 cm); yellowish brown (10YR 5/4) and brown (7.5YR 5/4) clay loam, dark yellowish brown (10YR 4/4) and brown (7.5YR 4/4), moist; 38 percent clay; massive; hard, friable, slightly sticky and moderately plastic; common fine roots throughout and common medium roots throughout; many fine dendritic tubular pores; common fine carbonate nodules; 10 percent gravel and 2 percent channer; violently effervescent, by HCl, 1 normal; moderately alkaline, pH 8.4 by Cresol red; abrupt wavy boundary.

R--14 to 24 inches (36 to 61 cm); unweathered, unfractured sandstone bedrock.

Range in Characteristics
The Westmion series used in this survey is a taxadjunct to the official series. The official series classification is Clayey, mixed, superactive, calcareous, mesic, shallow Ustic Torriorthents. This does not affect use and management.

Reaction: 7.4 to 8.4 (slightly or moderately alkaline)

A Horizon
Hue: 7.5YR to 10YR
Value: 4 or 5 dry or moist
Chroma: 3 or 4, dry or moist

C Horizons
Hue: 2.5Y to 7.5YR
Value: 5 to 7 dry, 4 to 6 moist
Chroma: 2 to 4, dry or moist
Texture: sandy clay loam, clay loam, clay, loam
Clay: 20 to 50 percent
Rock fragments: 0 to 30 percent

Rock outcrop
Slope: unspecified

Range in Characteristics

347—Myton very gravelly sandy loam, 5 to 18 percent slopes, very bouldery

Map Unit Setting
Landform(s): plateaus
Elevation: 3,150 to 4,000 feet (960 to 1,220 meters)
Mean annual precipitation: 6 to 10 inches (150 to 250 millimeters)
Mean annual air temperature: 54 to 57 degrees Fahrenheit (12.0 to 14.0 degrees Celsius)
Mean annual soil temperature: 56 to 59 degrees Fahrenheit (13.1 to 15.1 degrees Celsius)
Frost-free period: 150 to 180 days
Major Land Resource Area: 35 - Colorado Plateau
Land Resource Unit: 35-2 Colorado Plateau Shrub - Grasslands

Map Unit Composition
Myton and similar soils: 95 percent
Minor components: Shallow Somorent family soils in a few areas. Some areas have slopes greater than 18

percent. A few areas have soils with textures finer than loam.

Soil Properties and Qualities
Myton soils
Taxonomic classification: Loamy-skeletal, mixed, superactive, calcareous, mesic Typic Torriorthents
Geomorphic position: occurs on base slopes on fan remnants.
Parent material: colluvium and/or slope alluvium derived from sandstone and shale
Slope: 5 to 18 percent
Biological crust
cyanobacteria: 4 percent
lichen: 0 percent
moss: 0 percent
Chemical crust
salt: 0 percent
gypsum: 0 percent
Physical cover
canopy plant cover: 13 percent
woody debris: 13 percent
bare soil: 17 percent
rock fragments
gravel: 50 percent
cobble: 5 percent
stone: 1 percent
boulder: 3 percent
channer: 5 percent
Drainage class: somewhat excessively drained
Ksat solum: 0.60 to 20.00 inches per hour (4.23 to 141.14 micrometers per second)
Available water capacity total inches: 3.5 (low)
Shrink-swell potential: about 1.0 LEP (low)
Flooding hazard: none
Runoff class: low
Hydrologic group: A
Ecological site name: Desert Stony Loam (Shadscale-Bud Sagebrush)
Ecological site number: R035XY136UT
Present vegetation: shadscale saltbush, galleta, fluffgrass, gooseberryleaf globemallow
Land capability (non irrigated): 7c

Typical Profile
Location
Geographic Coordinate System:
36° 50' 56.20'' north, 111° 37' 47.70'' west

A--0 to 2 inches (0 to 5 cm); reddish brown (5YR 5/4) very gravelly sandy loam, reddish brown (5YR 4/4), moist; 12 percent clay; massive; loose, nonsticky and nonplastic; common very fine roots throughout and common fine roots throughout; common very fine dendritic tubular pores; 35 percent gravel and 5 percent cobble; slightly effervescent, by HCl, 1 normal; moderately alkaline, pH 8.2 by Cresol red; clear wavy boundary.

C1--2 to 7 inches (5 to 18 cm); reddish brown (5YR 5/4) gravelly sandy loam, reddish brown (5YR 4/4), moist; 10 percent clay; massive; soft, very friable, nonsticky and nonplastic; many very fine roots throughout and common fine roots throughout; 20 percent gravel; slightly effervescent, by HCl, 1 normal; moderately alkaline, pH 8.0 by Cresol red; clear wavy boundary.

C2--7 to 30 inches (18 to 76 cm); reddish brown (5YR 5/4) extremely gravelly loamy sand, reddish brown (5YR 4/4), moist; 8 percent clay; massive; moderately hard, friable, nonsticky and nonplastic; 50 percent gravel and 15 percent cobble and 5 percent stone; strongly effervescent, by HCl, 1 normal; slightly alkaline, pH 7.8 by Cresol red; clear wavy boundary.

C3--30 to 47 inches (76 to 119 cm); reddish brown (5YR 5/4) very gravelly loamy coarse sand, reddish brown (5YR 4/4), moist; 7 percent clay; massive; hard, friable, nonsticky and nonplastic; 30 percent gravel and 5 percent cobble and 5 percent stone; strongly effervescent, by HCl, 1 normal; slightly alkaline, pH 7.8 by Cresol red; gradual wavy boundary.

C4--47 to 60 inches (119 to 152 cm); reddish brown (5YR 5/4) very gravelly loam, reddish brown (5YR 4/4), moist; 16 percent clay; massive; slightly hard, very friable, slightly sticky and slightly plastic; 35 percent gravel; slightly effervescent, by HCl, 1 normal; moderately alkaline, pH 8.0 by Cresol red; clear wavy boundary.

C5--60 to 64 inches (152 to 163 cm); reddish brown (5YR 5/4) very stony sandy loam, reddish brown (5YR 4/4), moist; 12 percent clay; massive; slightly hard, friable, nonsticky and nonplastic; 10 percent gravel and 10 percent cobble and 10 percent stone; slightly effervescent, by HCl, 1 normal; moderately alkaline, pH 8.0 by Cresol red.

Range in Characteristics
Reaction: 7.4 to 8.4 (slightly or moderatley alkaline)

A Horizon
Value: 5 or 6 dry, 4 or 5 moist
Chroma: 4 to 6, dry or moist

C Horizons
Hue: 5YR or 7.5YR
Value: 5 or 6 dry, 4 to 6 moist
Chroma: 4 to 6, dry or moist
Texture: sandy loam, loamy sand, loamy coarse sand, loam
Clay: 4 to 18 percent
Rock fragments: 35 to 75 percent

348—Somorent family-Rock outcrop complex, 5 to 12 percent slopes

Map Unit Setting
Landform(s): plateaus
Elevation: 3,120 to 4,000 feet (950 to 1,220 meters)
Mean annual precipitation: 6 to 10 inches (150 to 250 millimeters)
Mean annual air temperature: 54 to 57 degrees Fahrenheit (12.0 to 14.0 degrees Celsius)
Mean annual soil temperature: 56 to 59 degrees Fahrenheit (13.1 to 15.1 degrees Celsius)
Frost-free period: 150 to 180 days
Major Land Resource Area: 35 - Colorado Plateau
Land Resource Unit: 35-2 Colorado Plateau Shrub - Grasslands

Map Unit Composition
Somorent family and similar soils: 85 percent
Rock outcrop: 10 percent
Minor components: Soils greater than 20 inches deep. Soils that have more than 35 percent rock fragments throughout the profile. Soils that have lithic contact within 20 inches.

Soil Properties and Qualities
Somorent family soils
Taxonomic classification: Loamy, mixed, superactive, calcareous, mesic, shallow Typic Torriorthents
Geomorphic position: occurs on interfluves on hills, mesas, structural benches.
Parent material: eolian sands and/or residuum weathered from sandstone and shale
Slope: 5 to 12 percent
Biological crust
cyanobacteria: 10 percent
lichen: 0 percent
moss: 0 percent
Chemical crust
salt: 0 percent
gypsum: 0 percent
Physical cover
canopy plant cover: 6 percent
woody debris: 3 percent
bare soil: 25 percent
rock fragments
gravel: 22 percent
channer: 38 percent
flagstone: 1 percent
Depth to restrictive feature(s): 7 to 15 inches to bedrock, paralithic
Drainage class: somewhat excessively drained
Ksat solum: 2.00 to 6.00 inches per hour (14.11 to 42.34 micrometers per second)
Ksat restrictive layer: 0.00 to 0.20 inches per hour (0.00 to 1.40 micrometers per second)
Available water capacity total inches: 0.7 (very low)
Shrink-swell potential: about 1.0 LEP (low)
Flooding hazard: none
Runoff class: high
Hydrologic group: D
Ecological site name: Desert Shallow Sandy Loam (Shadscale)
Ecological site number: R035XY130UT
Present vegetation: skeletonweed buckwheat, shadscale saltbush, crispleaf buckwheat
Land capability (non irrigated): 7c

Typical Profile
Location
Geographic Coordinate System:
36° 51' 18.00'' north, 111° 37' 2.20'' west

A--0 to 2 inches (0 to 5 cm); reddish brown (2.5YR 4/4) channery sandy loam, dark reddish brown (2.5YR 3/4), moist; 17 percent clay; weak thin platy structure; loose, slightly sticky and slightly plastic; 25 percent channer; slightly effervescent, by HCl, 1 normal; slightly alkaline, pH 7.8 by Cresol red; abrupt smooth boundary.

Cy--2 to 7 inches (5 to 18 cm); red (2.5YR 4/6) parachannery sandy loam, dark red (2.5YR 3/6), moist; 15 percent clay; massive; soft, very friable, slightly sticky and slightly plastic; common very fine roots throughout; many very fine dendritic tubular pores; common gypsum nests; 5 percent gravel and 20 percent channer; strongly effervescent, by HCl, 1 normal; slightly alkaline, pH 7.8 by Cresol red; abrupt smooth boundary.

Cr--7 to 17 inches (18 to 43 cm); weathered sandstone bedrock.

Range in Characteristics
Somorent family differs from the series because the series has hue color yellower than 5YR.

Reaction: 7.4 to 8.4 (slightly or moderately alkaline)

A Horizon
Value: 4 to 6 dry, 3 or 5 moist
Chroma: 4 or 6, dry or moist

Cy Horizon
Hue: 2.5YR to 7.5YR
Value: 4 or 5 dry, 3 to 6 moist
Chroma: 4 to 6, dry or moist
Texture: sandy loam, loam
Clay: 12 to 28 percent
Rock fragments: 0 to 12

Rock outcrop
Slope: unspecified

Range in Characteristics
Rock outcrop consists of exposures of sandstone bedrock.

358—Reef-Rock outcrop complex, 2 to 30 percent slopes

Map Unit Setting
Landform(s): plateaus
Elevation: 4,890 to 5,970 feet (1,490 to 1,820 meters)
Mean annual precipitation: 10 to 14 inches (250 to 350 millimeters)
Mean annual air temperature: 52 to 55 degrees Fahrenheit (11.0 to 13.0 degrees Celsius)
Mean annual soil temperature: 54 to 57 degrees Fahrenheit (12.1 to 14.1 degrees Celsius)
Frost-free period: 135 to 165 days
Major Land Resource Area: 35 - Colorado Plateau
Land Resource Unit: 35-3 Colorado Plateau Sagebrush - Grasslands

Map Unit Composition
Reef and similar soils: 60 percent
Rock outcrop: 15 percent
Minor Components: Lithic Rizno soils. A few areas have soils greater the 20 inches (50 cm) deep.

Soil Properties and Qualities
Reef soils
Taxonomic classification: Loamy-skeletal, mixed, superactive, calcareous, mesic Lithic Ustic Torriorthents
Geomorphic position: occurs on side slopes and interfluves on hills, mesas and structural benches.
Parent material: residuum weathered from sandstone and shale
Slope: 2 to 30 percent
Biological crust
cyanobacteria: 10 percent
lichen: 15 percent
moss: 6 percent
Chemical crust
salt: 0 percent
gypsum: 0 percent
Physical cover
canopy plant cover: 27 percent
woody debris: 6 percent
bare soil: 7 percent
rock fragments
gravel: 10 percent
channer: 30 percent
Depth to restrictive feature(s): 4 to 5 inches to bedrock, paralithic; 4 to 20 inches to bedrock, lithic
Drainage class: well drained
Ksat solum: 2.00 to 6.00 inches per hour (14.11 to 42.34 micrometers per second)
Ksat restrictive layer: 0.00 to 0.60 inches per hour (0.00 to 4.20 micrometers per second)
Available water capacity total inches: 0.2 (very low)
Shrink-swell potential: about 1.5 LEP (low)
Flooding hazard: none
Runoff class: very high
Hydrologic group: D
Ecological site name: Semidesert Shallow Sandy Loam (Utah Juniper-Blackbrush)
Ecological site number: R035XY236UT
Present vegetation: blackbrush, Utah juniper, pinyon, roundleaf buffaloberry, galleta, rubber rabbitbrush
Land capability (non irrigated): 6c

Typical Profile
Location
Geographic Coordinate System:
38° 10’ 3.80’’ north, 109° 58’ 51.00’’ west

C--0 to 4 inches (0 to 10 cm); light red (2.5YR 7/6) very gravelly coarse sandy loam, red (2.5YR 5/6), moist; 10 percent clay; massive; slightly hard, friable, slightly sticky and nonplastic; few very fine roots throughout; common very fine interstitial pores; 10 percent fine gravel and 40 percent gravel; strongly effervescent, 15 percent calcium carbonate equivalent; moderately alkaline, pH 8.4; abrupt wavy boundary.

Cr--4 to 4.5 inches (10 to 12 cm); few very fine roots in cracks; weathered, fractured shale bedrock; abrupt wavy boundary.

R--4.5 to 14.5 inches (12 to 37 cm); few fine roots top of horizon; unweathered, unfractured shale bedrock.

Range in Characteristics
Reaction: moderately alkaline or strongly alkaline (7.9 to 9.0)

C Horizon
Value: 4 to 7, dry, 4 or 5, moist
Chroma: 4 or 6, dry or moist
Texture: coarse sandy loam, sandy loam
Clay content: 9 to 14 percent
Rock fragments: 30 to 60 percent

Rock outcrop
Slope: unspecified

Range in Characteristics
Rock outcrop consists of exposures of sandstone and/or shale bedrock.

365—Typic Torriorthents-Rock outcrop-Badland complex, 4 to 64 percent slopes, extremely bouldery

Map Unit Setting
Landform(s): plateaus
Elevation: 3,580 to 5,710 feet (1,090 to 1,740 meters)

Mean annual precipitation: 6 to 10 inches (150 to 250 millimeters)
Mean annual air temperature: 54 to 57 degrees Fahrenheit (12.0 to 14.0 degrees Celsius)
Mean annual soil temperature: 56 to 59 degrees Fahrenheit (13.1 to 15.1 degrees Celsius)
Frost-free period: 150 to 180 days
Major Land Resource Area: 35 - Colorado Plateau
Land Resource Unit: 35-2 Colorado Plateau Shrub - Grasslands

Map Unit Composition
Typic Torriorthents and similar soils: 45 percent
Rock outcrop: 35 percent
Badland: 20 percent

Soil Properties and Qualities
Typic Torriorthents soils
Taxonomic classification: Typic Torriorthents
Geomorphic position: occurs on talus slopes, side slopes and structural benches.
Parent material: slope alluvium and/or colluvium derived from sandstone and shale
Slope: 4 to 64 percent
Biological crust
cyanobacteria: 6 percent
lichen: 1 percent
moss: 1 percent
Chemical crust
salt: 0 percent
gypsum: 0 percent
Physical cover
canopy plant cover: 5 percent
woody debris: 6 percent
bare soil: 2 percent
rock fragments
gravel: 28 percent
cobble: 5 percent
stone: 7 percent
boulder: 32 percent
channer: 6 percent
flagstone: 7 percent
Drainage class: well drained
Ksat solum: 0.60 to 2.00 inches per hour (4.23 to 14.11 micrometers per second)
Available water capacity total inches: 5.3 (moderate)
Shrink-swell potential: about 4.5 LEP (moderate)
Flooding hazard: none
Runoff class: high
Hydrologic group: B
Ecological site name: Desert Very Steep Stony Loam (Shadscale)
Ecological site number: R035XY146UT
Present vegetation: shadscale saltbush, cheatgrass
Land capability (non irrigated): 7c

Typical Profile
Location
Geographic Coordinate System:
37° 43’ 40.00’’ north, 110° 24’ 12.50’’ west

A--0 to 1 inch (0 to 3 cm); red (2.5YR 5/6) very gravelly sandy clay loam, red (2.5YR 4/6), moist; 26 percent clay; weak thin platy structure; loose, friable, moderately sticky and moderately plastic; common fine roots throughout; common very fine tubular pores; 25 percent gravel and 5 percent cobble and 5 percent stone; violently effervescent, by HCl, 1 normal; moderately alkaline, pH 8.0 by Cresol red; abrupt wavy boundary.

C1--1 to 7 inches (3 to 18 cm); yellowish red (5YR 5/6) very cobbly sandy clay loam, yellowish red (5YR 4/6), moist; 30 percent clay; massive; moderately hard, firm, very sticky and moderately plastic; many fine roots throughout; common very fine tubular and common fine tubular pores; 20 percent gravel and 15 percent cobble and 5 percent stone; violently effervescent, by HCl, 1 normal; moderately alkaline, pH 8.2 by Cresol red; clear smooth boundary.

C2--7 to 44 inches (18 to 112 cm); yellowish red (5YR 5/6) very stony sandy clay loam, yellowish red (5YR 4/6), moist; 33 percent clay; massive; hard, very firm, very sticky and moderately plastic; common very fine roots throughout and common fine roots throughout; common very fine tubular pores; 20 percent gravel and 10 percent cobble and 20 percent stone; strongly effervescent, by HCl, 1 normal; moderately alkaline, pH 8.2 by Cresol red; gradual smooth boundary.

C3--44 to 60 inches (112 to 152 cm); yellowish red (5YR 5/6) extremely stony sandy clay loam, yellowish red (5YR 4/6), moist; 30 percent clay; massive; very hard, very firm, very sticky and moderately plastic; common very fine roots throughout; common very fine tubular pores; 20 percent gravel and 20 percent cobble and 30 percent stone; strongly effervescent, by HCl, 1 normal; moderately alkaline, pH 8.2 by Cresol red.

Range in Characteristics
Torriorthents have soil properties that vary greater than family class limits.

Reaction: 7.9 to 8.4 (moderately alkaline)

A Horizon
Hue: 2.5YR to 7.5YR
Value: 5 to 6 dry, 4 to 6 moist
Chroma: 2 to 6, dry or moist

C Horizon
Hue: 5YR to 10YR
Value: 4 to 7 dry, 3 or 6 moist
Chroma: 2 or 6, dry or moist
Texture: sandy clay loam, sandy loam, loamy sand
Clay: 10 to 34 percent

Rock fragments: 15 to 70 percent

Rock outcrop
Slope: unspecified

Range in Characteristics
Rock outcrop consists of exposures of sandstone bedrock.

Badland
Slope: unspecified

Range in Characteristics
Badland is moderately steep to very steep barren land that is dissected by many intermittent drainage channels. These areas are cut into soft geologic material of the Chinle Formation.

366—Rock outcrop-Torriorthents complex, 20 to 65 percent slopes, extremely bouldery

Map Unit Setting
Landform(s): plateaus
Elevation: 3,120 to 4,200 feet (950 to 1,280 meters)
Mean annual precipitation: 6 to 10 inches (150 to 250 millimeters)
Mean annual air temperature: 54 to 57 degrees Fahrenheit (12.0 to 14.0 degrees Celsius)
Mean annual soil temperature: 56 to 59 degrees Fahrenheit (13.1 to 15.1 degrees Celsius)
Frost-free period: 150 to 180 days
Major Land Resource Area: 35 - Colorado Plateau
Land Resource Unit: 35-2 Colorado Plateau Shrub - Grasslands

Map Unit Composition
Rock outcrop: 60 percent
Torriorthents and similar soils: 40 percent

Soil Properties and Qualities
Rock outcrop
Slope: unspecified

Range in Characteristics
Rock outcrop consists of exposures of sandstone bedrock.

Torriorthents soils
Taxonomic classification: Torriorthents
Geomorphic position: occurs on talus slopes.
Parent material: sandy and gravelly talus derived from sandstone and shale
Slope: 20 to 65 percent
Biological crust
cyanobacteria: 2 percent
lichen: 0 percent
moss: 0 percent
Chemical crust
salt: 0 percent
gypsum: 0 percent
Physical cover
canopy plant cover: 4 percent
woody debris: 2 percent
bare soil: 27 percent
rock fragments
gravel: 13 percent
cobble: 7 percent
stone: 3 percent
boulder: 12 percent
channer: 28 percent
flagstone: 1 percent
Depth to restrictive feature(s): 4 to 20 inches to bedrock, paralithic
Drainage class: somewhat excessively drained
Ksat solum: 0.60 to 6.00 inches per hour (4.23 to 42.34 micrometers per second)
Ksat restrictive layer: 0.00 to 0.20 inches per hour (0.00 to 1.40 micrometers per second)
Available water capacity total inches: 1.4 (very low)
Shrink-swell potential: about 1.0 LEP (low)
Flooding hazard: none
Runoff class: very high
Hydrologic group: D
Ecological site name: Talus Slope (Blackbrush-Shadscale)
Ecological site number: R035XY018UT
Present vegetation: fourwing saltbush, galleta, skeletonweed buckwheat, Torrey Mormon tea
Land capability (non irrigated): 7c

Typical Profile
Location
Geographic Coordinate System:
36° 50’ 21.80’’ north, 111° 38’ 32.90’’ west

A--0 to 2 inches (0 to 5 cm); reddish brown (2.5YR 5/4) channery loam, dark reddish brown (2.5YR 3/4), moist; 18 percent clay; moderate fine granular structure; soft, very friable, slightly sticky and nonplastic; common very fine roots throughout; common very fine tubular pores; 5 percent channer and 25 percent channer; slightly effervescent, by HCl, 1 normal; slightly alkaline, pH 7.8 by Cresol red; clear wavy boundary.

C1--2 to 10 inches (5 to 25 cm); reddish brown (5YR 5/4) very flaggy coarse sandy loam, dark reddish brown (5YR 3/4), moist; 10 percent clay; massive; loose, nonsticky and nonplastic; common very fine roots throughout and common fine roots throughout; 10 percent channer and 20 percent channer and 20 percent flagstone; slightly effervescent, by HCl, 1 normal; slightly alkaline, pH 7.6 by Cresol red; clear irregular boundary.

C2--10 to 17 inches (25 to 43 cm); reddish brown (2.5YR

4/4) extremely parachannery coarse sandy loam, dark reddish brown (2.5YR 3/4), moist; 10 percent clay; massive; loose, nonsticky and nonplastic; many very fine roots throughout and common fine roots throughout; 60 percent channer; strongly effervescent, by HCl, 1 normal; slightly alkaline, pH 7.8 by Cresol red; clear wavy boundary.

Cr--17 to 27 inches (43 to 68 cm); weathered sandstone bedrock.

Range in Characteristics
Torriorthents have soil properties that vary greater than family class limits.

Reaction: 7.4 to 8.4 (slightly alkaline to moderately alkaline)

A Horizon
Hue: 2.5YR to 10YR
Value: 5 to 7 dry, 3 to 6 moist
Chroma: 3 or 4, dry or moist

C Horizon
Hue: 2.5YR to 10YR
Value: 5 to 7 dry, 3 to 6 moist
Chroma: 4 or 6, dry or moist
Texture: coarse sandy loam, sandy loam
Clay: 8 to 12 percent
Rock fragments: 10 to 65 percent

375—Ustic Torriorthents-Rock outcrop-Badland complex, 4 to 54 percent slopes, extremely bouldery

Map Unit Setting
Landform(s): plateaus
Elevation: 4,200 to 7,050 feet (1,280 to 2,150 meters)
Mean annual precipitation: 10 to 14 inches (250 to 350 millimeters)
Mean annual air temperature: 52 to 55 degrees Fahrenheit (11.0 to 13.0 degrees Celsius)
Mean annual soil temperature: 54 to 57 degrees Fahrenheit (12.1 to 14.1 degrees Celsius)
Frost-free period: 135 to 165 days
Major Land Resource Area: 35 - Colorado Plateau
Land Resource Unit: 35-3 Colorado Plateau Sagebrush - Grasslands

Map Unit Composition
Ustic Torriorthents and similar soils: 45 percent
Rock outcrop: 30 percent
Badland: 25 percent

Soil Properties and Qualities
Ustic Torriorthents soils
Taxonomic classification: Ustic Torriorthents
Geomorphic position: occurs on talus slopes, side slopes, and structural benches.
Parent material: colluvium and/or slope alluvium derived from sandstone and shale
Slope: 4 to 54 percent
Biological crust
cyanobacteria: 0 percent
lichen: 0 percent
moss: 0 percent
Chemical crust
salt: 0 percent
gypsum: 0 percent
Physical cover
canopy plant cover: 5 percent
woody debris: 12 percent
bare soil: 12 percent
rock fragments
gravel: 46 percent
cobble: 12 percent
stone: 3 percent
boulder: 10 percent
Depth to restrictive feature(s): 20 to 40 inches to bedrock, lithic
Drainage class: somewhat excessively drained
Ksat solum: 2.00 to 6.00 inches per hour (14.11 to 42.34 micrometers per second)
Ksat restrictive layer: 0.00 to 0.20 inches per hour (0.00 to 1.40 micrometers per second)
Available water capacity total inches: 1.4 (very low)
Shrink-swell potential: about 1.5 LEP (low)
Flooding hazard: none
Runoff class: high
Hydrologic group: B
Ecological site name: Semidesert Very Steep Stony Loam (Pinyon-Utah Juniper)
Ecological site number: R035XY263UT
Present vegetation: Utah juniper, pinyon, broom snakeweed, Ephedra cutleri, Indian ricegrass
Land capability (non irrigated): 6c

Typical Profile
Location
Geographic Coordinate System:
38° 7’ 37.50’’ north, 110° 6’ 29.50’’ west

A--0 to 1 inch (0 to 3 cm); reddish brown (2.5YR 5/4) cobbly sandy loam, reddish brown (2.5YR 4/4), moist; 14 percent clay; weak thin platy structure; loose, slightly sticky and nonplastic; many fine roots throughout; common fine dendritic tubular pores; 10 percent gravel and 10 percent cobble; strongly effervescent, by HCl, 1 normal; slightly alkaline, pH 7.6 by Cresol red; clear smooth boundary.

C1--1 to 8 inches (3 to 20 cm); reddish brown (2.5YR 5/4) cobbly sandy loam, reddish brown (2.5YR 4/3), moist; 12 percent clay; massive; slightly hard, very friable, nonsticky and nonplastic; many fine roots throughout and common medium roots throughout; many fine dendritic tubular pores; 10 percent gravel and 10 percent cobble and 5 percent stone; strongly effervescent, by HCl, 1 normal; moderately alkaline, pH 8.0 by Cresol red; clear smooth boundary.

C2--8 to 23 inches (20 to 58 cm); reddish brown (2.5YR 5/4) very stony sandy loam, reddish brown (2.5YR 4/4), moist; 16 percent clay; massive; moderately hard, friable, slightly sticky and slightly plastic; many fine roots throughout and many medium roots throughout; many fine dendritic tubular pores; 10 percent gravel and 10 percent cobble and 30 percent stone; strongly effervescent, by HCl, 1 normal; moderately alkaline, pH 8.0 by Cresol red; abrupt wavy boundary.

R--23 to 33 inches (58 to 84 cm); unweathered, unfractured sandstone bedrock.

Range in Characteristics
Torriorthents have soil properties that vary greater than family class limits.

Reaction: 7.4 to 8.4 (slightly alkaline to moderately alkaline)

A Horizon
Hue: 2.5YR to 7.5YR
Value: 4 or 5 dry, 3 to 5 moist
Chroma: 3 to 6, dry or moist

C Horizon
Hue: 2.5YR to 7.5YR
Value: 4 to 6 dry, 3 or 5 moist
Chroma: 3 or 6, dry or moist
Texture: sandy clay loam, sandy loam
Clay: 10 to 25 percent
Rock fragments: 15 to 55 percent

Rock outcrop
Slope: unspecified

Range in Characteristics
Rock outcrop consists of exposures of sandstone bedrock.

Badland
Slope: unspecified

Range in Characteristics
Badland is moderately steep to very steep barren land that is dissected by many intermittent drainage channels. These areas are cut into soft geologic material of the Chinle Formation.

376—Reef-Rock outcrop complex, 30 to 60 percent slopes, bouldery

Map Unit Setting
Landform(s): plateaus
Elevation: 4,950 to 7,180 feet (1,510 to 2,190 meters)
Mean annual precipitation: 10 to 14 inches (250 to 350 millimeters)
Mean annual air temperature: 52 to 55 degrees Fahrenheit (11.0 to 13.0 degrees Celsius)
Mean annual soil temperature: 54 to 57 degrees Fahrenheit (12.1 to 14.1 degrees Celsius)
Frost-free period: 135 to 165 days
Major Land Resource Area: 35 - Colorado Plateau
Land Resource Unit: 35-3 Colorado Plateau Sagebrush - Grasslands

Map Unit Composition
Reef and similar soils: 65 percent
Rock outcrop: 30 percent
Minor Components: Lithic Rizno soils. Some areas have soils with textures coarser than fine sandy loam.

Soil Properties and Qualities
Reef soils
Taxonomic classification: Loamy-skeletal, mixed, superactive, calcareous, mesic Lithic Ustic Torriorthents
Geomorphic position: occurs on talus slopes.
Parent material: sandy and gravelly talus derived from sandstone and shale
Slope: 15 to 60 percent
Biological crust
cyanobacteria: 1 percent
lichen: 1 percent
moss: 1 percent
Chemical crust
salt: 0 percent
gypsum: 0 percent
Physical cover
canopy plant cover: 37 percent
woody debris: 3 percent
bare soil: 7 percent
rock fragments
gravel: 10 percent
cobble: 5 percent
stone: 10 percent
boulder: 20 percent
channer: 20 percent
flagstone: 15 percent
Depth to restrictive feature(s): 4 to 20 inches to bedrock, lithic
Drainage class: somewhat excessively drained
Ksat solum: 0.60 to 2.00 inches per hour (4.23 to 14.11 micrometers per second)
Ksat restrictive layer: 0.00 to 1.98 inches per hour (0.00 to 14.00 micrometers per second)

Available water capacity total inches: 0.4 (very low)
Shrink-swell potential: about 1.5 LEP (low)
Flooding hazard: none
Runoff class: very high
Hydrologic group: D
Ecological site name: Semidesert Very Steep Stony Loam (Pinyon-Utah Juniper)
Ecological site number: R035XY263UT
Present vegetation: singleleaf ash, Utah juniper, Utah serviceberry, Desert Princesplume, sumac, desert needlegrass
Land capability (non irrigated): 6c

Typical Profile
Location
Geographic Coordinate System:
38° 13' 57.00'' north, 110° 0' 46.70'' west

C--0 to 4 inches (0 to 10 cm); reddish brown (5YR 4/4) very channery loam, dark reddish brown (5YR 3/4), moist; 15 percent clay; massive; slightly hard, friable, moderately sticky and slightly plastic; common very fine and fine roots throughout; many very fine interstitial and common fine interstitial pores; 50 percent channer; slightly effervescent, 2 percent calcium carbonate equivalent; moderately alkaline, pH 8.4; clear wavy boundary.

R1--4 to 13 inches (10 to 33 cm); common fine roots in cracks; unweathered, fractured sandstone bedrock.

R2--13 to 23 inches (33 to 58 cm); common medium roots top of horizon; unweathered, unfractured sandstone bedrock.

Range in Characteristics
Reaction: 7.9 to 8.4 (moderately alkaline)

C horizon:
Hue: 2.5YR or 5YR
Value: 4 or 5 dry, 3 or 4 moist
Chroma: 3 or 4, dry or moist
Texture: loam, fine sandy loam
Clay content: 8 to 18 percent
Rock fragments: 35 to 75 percent

Rock outcrop
Slope: unspecified

Range in Characteristics
Rock outcrop consists of exposures of sandstone bedrock.

444—Pennell cobbly loam, 3 to 10 percent slopes

Map Unit Setting
Landform(s): plateaus
Elevation: 3,120 to 3,610 feet (950 to 1,100 meters)
Mean annual precipitation: 6 to 10 inches (150 to 250 millimeters)
Mean annual air temperature: 54 to 57 degrees Fahrenheit (12.0 to 14.0 degrees Celsius)
Mean annual soil temperature: 56 to 59 degrees Fahrenheit (13.1 to 15.1 degrees Celsius)
Frost-free period: 150 to 180 days
Major Land Resource Area: 35 - Colorado Plateau
Land Resource Unit: 35-2 Colorado Plateau Shrub - Grasslands

Map Unit Composition
Pennell and similar soils: 85 percent
Minor Components: Soils that are deeper than 20 inches (50 cm). Some areas have slopes that greater than 10 percent.

Soil Properties and Qualities
Pennell soils
Taxonomic classification: Loamy, mixed, superactive, mesic Lithic Haplocalcids
Geomorphic position: occurs on interfluves on hills and structural benches.
Parent material: slope alluvium and/or residuum weathered from limestone and sandstone
Slope: 3 to 10 percent
Biological crust
cyanobacteria: 3 percent
lichen: 1 percent
moss: 0 percent
Chemical crust
salt: 0 percent
gypsum: 0 percent
Physical cover
canopy plant cover: 65 percent
woody debris: 5 percent
bare soil: 35 percent
rock fragments
gravel: 10 percent
cobble: 20 percent
stone: 1 percent
Depth to restrictive feature(s): 10 to 20 inches to bedrock, lithic
Drainage class: well drained
Ksat solum: 0.60 to 6.00 inches per hour (4.23 to 42.34 micrometers per second)
Ksat restrictive layer: 0.00 to 0.57 inches per hour (0.00 to 4.00 micrometers per second)
Available water capacity total inches: 1.6 (very low)

Shrink-swell potential: about 1.5 LEP (low)
Flooding hazard: none
Runoff class: very high
Hydrologic group: D
Ecological site name: Desert Shallow Loam (Shadscale)
Ecological site number: R035XY122UT
Present vegetation: shadscale saltbush, Pleuraphis jamesii, Indian ricegrass
Land capability (non irrigated): 7c

Typical Profile

Location
Geographic Coordinate System:
36° 41' 25.50'' north, 111° 44' 49.80'' west

A--0 to 4 inches (0 to 10 cm); yellowish red (5YR 4/6) cobbly loam, reddish brown (5YR 4/4), moist; 15 percent clay; weak thin platy structure; soft, very friable; common very fine roots throughout; many medium irregular pores; 11 percent gravel and 19 percent cobble; slightly effervescent; moderately alkaline, pH 8.2; abrupt smooth boundary.

Bw--4 to 7 inches (10 to 18 cm); yellowish red (5YR 5/6) sandy loam, yellowish red (5YR 4/6), moist; 13 percent clay; weak fine subangular blocky structure; soft, very friable; common very fine roots throughout; many very fine tubular pores; 10 percent gravel and 2 percent cobble; strongly effervescent; moderately alkaline, pH 8.2; clear wavy boundary.

Bk1--7 to 14 inches (18 to 36 cm); yellowish red (5YR 5/6) very gravelly sandy loam, yellowish red (5YR 4/6), moist; 13 percent clay; weak fine subangular blocky structure; soft, very friable; common very fine roots throughout; many very fine tubular pores; common fine carbonate masses; 38 percent gravel and 2 percent cobble; violently effervescent; moderately alkaline, pH 8.2; clear wavy boundary.

2Bk2--14 to 19 inches (36 to 48 cm); pink (5YR 7/4) sandy loam, light reddish brown (5YR 6/4), moist; 13 percent clay; massive; soft, very friable; common very fine roots throughout; many very fine tubular pores; common carbonate masses around rock fragments; 10 percent gravel and 2 percent cobble; violently effervescent; moderately alkaline, pH 8.2; abrupt smooth boundary.

3R--19 to 28.5 inches (48 to 73 cm); unweathered, unfractured limestone bedrock.

Range in Characteristics

The National Park Service restricted any access to this area, therefore, no pedon could be excavated and described for the Glen Canyon National Recreation Area. This description is the joining typical pedon from the Soil Survey of Coconino County Area, Arizona, North Kaibab Part and adequately represents what is expected to be found in the park

Rock fragments average less than 35 percent

Reaction: 7.9 to 8.4 (moderately alkaline)

A Horizon
Value: 4 to 6, dry or moist
Chroma: 3 to 6, dry or moist

Bw or Bk Horizons
Hue: 5YR or 7.5YR
Value: 5 to 8 dry, 4 to 7 moist
Chroma: 4 to 6, dry or moist
Texture: sandy loam, fine sandy loam
Clay: 10 to 15 percent
Calcium carbonate equivalent: 5 to 30 percent
Rock fragments: 5 to 45 percent

Calcic horizon- the zone from 7 to 19 inches (Bk1 and 2Bk2 horizons)

447—Goblin very gravelly sandy loam, 6 to 45 percent slopes

Map Unit Setting

Landform(s): plateaus
Elevation: 3,940 to 5,220 feet (1,200 to 1,590 meters)
Mean annual precipitation: 6 to 10 inches (150 to 250 millimeters)
Mean annual air temperature: 54 to 57 degrees Fahrenheit (12.0 to 14.0 degrees Celsius)
Mean annual soil temperature: 56 to 59 degrees Fahrenheit (13.1 to 15.1 degrees Celsius)
Frost-free period: 150 to 180 days
Major Land Resource Area: -
Land Resource Unit: 35-2 Colorado Plateau Shrub - Grasslands

Map Unit Composition

Goblin and similar soils: 90 percent
Minor Component: A few areas of Rock outcrop. Some areas have soils deeper than 20 inches (50cm).

Soil Properties and Qualities

Goblin soils

Taxonomic classification: Loamy-skeletal, gypsic, mesic Lithic Haplogypsids
Geomorphic position: occurs on side slopes on hills and structural benches.
Parent material: gypsiferous residuum weathered from sandstone
Slope: 6 to 45 percent
Biological crust
cyanobacteria: 10 percent
lichen: 35 percent
moss: 3 percent
Chemical crust
salt: 0 percent
gypsum: 7 percent
Physical cover
canopy plant cover: 27 percent
woody debris: 7 percent
bare soil: 3 percent
rock fragments
gravel: 20 percent
cobble: 5 percent
Depth to restrictive feature(s): 6 to 16 inches to bedrock, lithic
Drainage class: somewhat excessively drained
Ksat solum: 2.00 to 6.00 inches per hour (14.11 to 42.34 micrometers per second)
Ksat restrictive layer: 0.00 to 0.20 inches per hour (0.00 to 1.40 micrometers per second)
Available water capacity total inches: 0.4 (very low)
Shrink-swell potential: about 1.5 LEP (low)
Flooding hazard: none
Runoff class: very high
Hydrologic group: D
Ecological site name: Desert Very Shallow Gypsum (Torrey's Jointfir)
Ecological site number: R035XY142UT
Present vegetation: shadscale saltbush, rubber rabbitbrush, galleta, Torrey Mormon tea, scarlet globemallow, buckwheat
Land capability (non irrigated): 7c

Typical Profile
Location
Geographic Coordinate System:
38° 14' 17.30'' north, 110° 2' 22.30'' west

By1--0 to 3 inches (0 to 8 cm); light yellowish brown (10YR 6/4) very gravelly sandy loam, yellowish brown (10YR 5/6), moist; 10 percent clay; massive; slightly hard, friable, slightly sticky and nonplastic; common very fine roots throughout and common fine roots throughout; common very fine tubular and common fine tubular pores; many fine irregular gypsum crystals in matrix; 40 percent gravel; slightly effervescent, 2 percent calcium carbonate equivalent and 25 percent gypsum; moderately alkaline, pH 8.0; abrupt wavy boundary.

By2--3 to 9 inches (8 to 23 cm); light yellowish brown (10YR 6/4) extremely channery sandy loam, yellowish brown (10YR 5/6), moist; 11 percent clay; massive; slightly hard, friable, slightly sticky and nonplastic; common very fine roots throughout; common very fine tubular pores; many fine irregular gypsum crystals in matrix; 70 percent channer; very slightly effervescent, 1 percent calcium carbonate equivalent and 30 percent gypsum; moderately alkaline, pH 8.0; abrupt wavy boundary.

R--9 to 19 inches (23 to 48 cm); unweathered, unfractured sandstone bedrock.

Range in Characteristics
The Goblin series is a taxadjunct to the official series because it contains more than 35 percent rock fragments and has a layer of secondary gypsum accumulation. The official series classification is Loamy, gypsic, mesic, shallow Typic Torriorthents. This does not affect use and management.

By horizon:
Value: 6 or 7 dry, 3 to 5 moist
Chroma: 4 or 6 dry
Texture: sandy loam, sandy loam, fine sandy loam
Clay content: 10 to 15 percent
Calcium carbonate equivalent: 1 to 5 percent
Gypsum: 20 to 40 percent
Rock fragments: 35 to 70 percent

566—Moepitz family-Moenkopie-Rock outcrop complex, 12 to 64 percent slopes, extremely bouldery

Map Unit Setting
Landform(s): plateaus
Elevation: 3,870 to 5,310 feet (1,180 to 1,620 meters)
Mean annual precipitation: 6 to 10 inches (150 to 250 millimeters)
Mean annual air temperature: 54 to 57 degrees Fahrenheit (12.0 to 14.0 degrees Celsius)
Mean annual soil temperature: 56 to 59 degrees Fahrenheit (13.1 to 15.1 degrees Celsius)
Frost-free period: 150 to 180 days
Major Land Resource Area: 35 - Colorado Plateau
Land Resource Unit: 35-2 Colorado Plateau Shrub - Grasslands

Map Unit Composition
Moepitz family and similar soils: 60 percent
Moenkopie and similar soils: 25 percent
Rock outcrop: 15 percent

Soil Properties and Qualities
Moepitz family soils

Taxonomic classification: Coarse-loamy, mixed, superactive, calcareous, mesic Typic Torriorthents
Geomorphic position: occurs on talus slopes.
Parent material: sandy and gravelly colluvium derived from limestone, sandstone, and shale
Slope: 12 to 64 percent
Biological crust
cyanobacteria: 7 percent
lichen: 0 percent
moss: 0 percent
Chemical crust
salt: 0 percent
gypsum: 0 percent
Physical cover
canopy plant cover: 17 percent
woody debris: 25 percent
bare soil: 27 percent
rock fragments
gravel: 25 percent
cobble: 15 percent
stone: 17 percent
boulder: 13 percent
channer: 2 percent
Depth to restrictive feature(s): 40 to 60 inches to bedrock, lithic
Drainage class: somewhat excessively drained
Ksat solum: 2.00 to 6.00 inches per hour (14.11 to 42.34 micrometers per second)
Ksat restrictive layer: 0.00 to 0.20 inches per hour (0.00 to 1.40 micrometers per second)
Available water capacity total inches: 4.5 (low)
Shrink-swell potential: about 4.5 LEP (moderate)
Flooding hazard: none
Runoff class: medium
Hydrologic group: A
Ecological site name: Desert Stony Loam (Blackbrush)
Ecological site number: R035XY139UT
Present vegetation: blackbrush, shadscale saltbush
Land capability (non irrigated): 7c

Typical Profile
Location
Geographic Coordinate System:
37° 12’ 39.00’’ north, 109° 58’ 17.60’’ west

A--0 to 1 inch (0 to 3 cm); yellowish red (5YR 5/6) very gravelly fine sandy loam, yellowish red (5YR 4/6), moist; 12 percent clay; weak thin platy structure; soft, very friable, nonsticky and nonplastic; common very fine roots throughout and common fine roots throughout; many very fine dendritic tubular pores; 30 percent gravel and 5 percent cobble; slightly effervescent, by HCl, 1 normal; moderately alkaline, pH 8.0 by Cresol red; abrupt smooth boundary.

Bw--1 to 6 inches (3 to 15 cm); yellowish red (5YR 5/6) very gravelly fine sandy loam, yellowish red (5YR 4/6), moist; 10 percent clay; weak fine subangular blocky structure; slightly hard, friable, nonsticky and nonplastic; many very fine roots throughout and many fine roots throughout and many medium roots throughout; many very fine dendritic tubular and many fine dendritic tubular pores; 30 percent gravel and 5 percent cobble and 5 percent stone; strongly effervescent, by HCl, 1 normal; moderately alkaline, pH 8.0 by Cresol red; abrupt smooth boundary.

Ck1--6 to 19 inches (15 to 48 cm); red (2.5YR 5/6) gravelly fine sandy loam, red (2.5YR 4/6), moist; 12 percent clay; moderate medium subangular blocky and moderate fine subangular blocky structure; slightly hard, friable, slightly sticky and nonplastic; many very fine roots throughout and many fine roots throughout and common medium roots throughout; many very fine dendritic tubular pores; common carbonate masses; 20 percent gravel and 5 percent cobble; strongly effervescent, by HCl, 1 normal, 37 percent calcium carbonate equivalent; moderately alkaline, pH 8.0 by Cresol red; gradual smooth boundary.

Ck2--19 to 31 inches (48 to 79 cm); light red (2.5YR 6/6) sandy loam, red (2.5YR 5/6), moist; 10 percent clay; moderate fine subangular blocky and moderate medium subangular blocky structure; moderately hard, friable, slightly sticky and nonplastic; many very fine roots throughout and many fine roots throughout; many very fine dendritic tubular pores; common carbonate masses; 10 percent gravel; strongly effervescent, by HCl, 1 normal, 32 percent calcium carbonate equivalent; moderately alkaline, pH 8.2 by Cresol red; clear smooth boundary.

Ck3--31 to 48 inches (79 to 122 cm); yellowish red (5YR 5/6) sandy loam, yellowish red (5YR 4/6), moist; 10 percent clay; moderate fine subangular blocky and moderate medium subangular blocky structure; hard, firm, nonsticky and nonplastic; common fine roots throughout; common very fine dendritic tubular pores; many carbonate masses; 3 percent gravel; strongly effervescent, by HCl, 1 normal, 35 percent calcium carbonate equivalent; moderately alkaline, pH 8.2 by Cresol red; abrupt wavy boundary.

R--48 to 58 inches (122 to 147 cm); unweathered, unfractured sandstone bedrock.

Range in Characteristics
Moepitz family differs from the series because the series is less than 40 inches (102 cm) to lithic contact.

Reaction: 7.4 to 8.4 (slightly or moderately alkaline)

A Horizon
Value: 5 or 6 dry, 4 or 5 moist
Chroma: 4 or 6, dry or moist

Bw Horizon
Hue: 5YR or 7.5YR
Value: 4 or 5 dry, 3 or 4 moist
Chroma: 4 to 6, dry or moist
Texture: sandy loam, fine sandy loam
Clay: 8 to 15 percent
Rock fragments: 25 to 60 percent

Ck Horizons
Hue: 2.5YR to 7.5YR
Value: 4 or 6 dry, 3 to 6 moist
Chroma: 4 to 6, dry or moist
Texture: sandy loam, fine sandy loam
Clay: 8 to 15 percent
Calcium carbonate equivalent: 5 to 40 percent
Rock fragments: 0 to 35 percent

Moenkopie soils
Taxonomic classification: Loamy, mixed, superactive, calcareous, mesic Lithic Torriorthents
Geomorphic position: occurs on talus slopes and structural benches.
Parent material: sandy and gravelly colluvium and/or residuum weathered from limestone and sandstone
Slope: 12 to 64 percent
Biological crust
cyanobacteria: 7 percent
lichen: 0 percent
moss: 0 percent
Chemical crust
salt: 0 percent
gypsum: 0 percent
Physical cover
canopy plant cover: 17 percent
woody debris: 25 percent
bare soil: 27 percent
rock fragments
gravel: 25 percent
cobble: 15 percent
stone: 17 percent
boulder: 13 percent
channer: 2 percent
Depth to restrictive feature(s): 4 to 12 inches to bedrock, lithic
Drainage class: somewhat excessively drained
Ksat solum: 2.00 to 6.00 inches per hour (14.11 to 42.34 micrometers per second)
Ksat restrictive layer: 0.00 to 0.20 inches per hour (0.00 to 1.40 micrometers per second)
Available water capacity total inches: 0.4 (very low)
Shrink-swell potential: about 4.5 LEP (moderate)
Flooding hazard: none
Runoff class: high
Hydrologic group: D
Ecological site name: Desert Shallow Sandy Loam (Shadscale)
Ecological site number: R035XY130UT
Present vegetation: shadscale saltbush, blackbrush, Jones's pepperweed
Land capability (non irrigated): 7c

Typical Profile
Location
Geographic Coordinate System:
37° 12' 38.90'' north, 109° 58' 16.90'' west

A--0 to 1 inch (0 to 3 cm); yellowish red (5YR 5/6) gravelly fine sandy loam, yellowish red (5YR 4/6), moist; 10 percent clay; weak thin platy structure; soft, very friable, nonsticky and nonplastic; common very fine roots throughout; many very fine dendritic tubular pores; 20 percent gravel and 5 percent channer; strongly effervescent, by HCl, 1 normal; moderately alkaline, pH 8.2 by Cresol red; abrupt smooth boundary.

Ck--1 to 6 inches (3 to 15 cm); yellowish red (5YR 5/6) gravelly sandy loam, yellowish red (5YR 4/6), moist; 12 percent clay; massive; slightly hard, very friable, nonsticky and slightly plastic; common very fine roots throughout and common fine roots throughout; many very fine dendritic tubular and many fine dendritic tubular pores; common fine carbonate masses; 15 percent gravel and 5 percent channer; violently effervescent, by HCl, 1 normal, 28 percent calcium carbonate equivalent; moderately alkaline, pH 8.2 by Cresol red; abrupt wavy boundary.

R--6 to 16 inches (15 to 41 cm); unweathered, unfractured sandstone bedrock.

Range in Characteristics
Reaction: 7.4 to 8.4 (slightly or moderately alkaline)

A Horizon
Value: 5 or 6 dry, 3 or 5 moist
Chroma: 4 or 6, dry or moist

Ck Horizon
Hue: 2.5YR to 7.5YR
Value: 4 or 5 dry, 3 to 6 moist
Chroma: 4 or 6, dry or moist
Texture: sandy loam, fine sandy loam
Clay: 8 to 15 percent
Calcium carbonate equivalent: 5 to 40 percent
Rock fragments: 15 to 35 percent

Rock outcrop
Slope: unspecified

Range in Characteristics
Rock outcrop consists of exposures of sandstone and/or limestone bedrock.

567—Torriorthents-Rock outcrop complex, 35 to 70 percent slopes, bouldery

Map Unit Setting
Landform(s): plateaus
Elevation: 3,740 to 5,580 feet (1,140 to 1,700 meters)
Mean annual precipitation: 6 to 10 inches (150 to 250 millimeters)
Mean annual air temperature: 54 to 57 degrees Fahrenheit (12.0 to 14.0 degrees Celsius)
Mean annual soil temperature: 56 to 59 degrees Fahrenheit (13.1 to 15.1 degrees Celsius)
Frost-free period: 150 to 180 days
Major Land Resource Area: 35 - Colorado Plateau
Land Resource Unit: 35-2 Colorado Plateau Shrub - Grasslands

Map Unit Composition
Torriorthents and similar soils: 50 percent
Rock outcrop: 40 percent
Minor Components: Areas that have 10 to 14 inches (250 to 350mm) of annual precipitation.

Soil Properties and Qualities
Torriorthents soils
Taxonomic classification: Torriorthents
Geomorphic position: occurs on talus slopes.
Parent material: sandy and gravelly colluvium derived from limestone, sandstone, and shale
Slope: 35 to 70 percent
Biological crust
cyanobacteria: 7 percent
lichen: 0 percent
moss: 0 percent
Chemical crust
salt: 0 percent
gypsum: 0 percent
Physical cover
canopy plant cover: 17 percent
woody debris: 25 percent
bare soil: 27 percent
rock fragments
gravel: 10 percent
stone: 10 percent
boulder: 10 percent
channer: 25 percent
Depth to restrictive feature(s): 4 to 40 inches to bedrock, lithic
Drainage class: well drained
Ksat solum: 2.00 to 6.00 inches per hour (14.11 to 42.34 micrometers per second)
Ksat restrictive layer: 0.00 to 0.20 inches per hour (0.00 to 1.40 micrometers per second)
Available water capacity total inches: 3.2 (low)
Shrink-swell potential: about 1.5 LEP (low)
Flooding hazard: none
Runoff class: very high
Hydrologic group: B
Ecological site name: Desert Very Steep Stony Loam (Shadscale)
Ecological site number: R035XY146UT
Present vegetation: needle and thread, galleta, mat saltbush, roundleaf buffaloberry, green Mormon tea, Utah juniper, fourwing saltbush
Land capability (non irrigated): 7c

Typical Profile
Location
Geographic Coordinate System:
38° 9’ 19.20’’ north, 109° 54’ 14.70’’ west

A--0 to 4.5 inches (0 to 11 cm); reddish yellow (5YR 6/6) fine sandy loam, yellowish red (5YR 5/6), moist; 14 percent clay; weak very fine subangular blocky structure; soft, very friable, slightly sticky and nonplastic; common very fine roots throughout; common very fine irregular pores; strongly effervescent, 15 percent calcium carbonate equivalent; moderately alkaline, pH 8.4; clear wavy boundary.

2C1--4.5 to 15.5 inches (11 to 40 cm); brown (7.5YR 4/4) fine sandy loam, strong brown (7.5YR 5/6), moist; 17 percent clay; massive; hard, firm, slightly sticky and slightly plastic; common fine roots throughout; common fine irregular pores; 4 percent gravel and 10 percent channer; violently effervescent, 20 percent calcium carbonate equivalent; strongly alkaline, pH 8.6; gradual wavy boundary.

2C2--15.5 to 33 inches (40 to 84 cm); reddish yellow (7.5YR 7/6) gravelly fine sandy loam, strong brown (7.5YR 5/6), moist; 19 percent clay; massive; hard, firm, slightly sticky and slightly plastic; common fine roots throughout; common very fine irregular pores; 20 percent gravel and 2 percent stone; violently effervescent, 20 percent calcium carbonate equivalent; strongly alkaline, pH 8.6; clear wavy boundary.

2R--33 to 43 inches (84 to 109 cm); unweathered, unfractured limestone bedrock.

Range in Characteristics
Torriorthents have soil properties that vary greater than family class limits.

Reaction: moderately alkaline or strongly alkaline (pH 7.9 to 9.0)

A or surface C horizon:
Hue: 5YR or 7.5YR
Value: 5 to 7 dry, 4 or 5 moist
Chroma: 4 or 6, dry or moist

C horizon:
Hue: 2.5YR to 7.5YR

Value: 4 to 7 dry, 3 to 5 moist
Chroma: 4 or 6, dry or moist
Texture: fine sandy loam, sandy loam, sandy clay loam, loamy sand, loamy coarse sand
Clay content: 10 to 35 percent
Calcium carbonate equivalent: 10 to 25 percent
Rock fragments: 0 to 60 percent

Bw horizons are present in some horizons, but are too thin to qualify as cambic horizons.

Rock outcrop
Slope: unspecified

Range in Characteristics
Rock outcrop consists of exposures of sandstone and/or limestone bedrock.

606—Tsaya family-Moenkopie complex, 2 to 15 percent slopes

Map Unit Setting
Landform(s): plateaus
Elevation: 3,920 to 5,380 feet (1,195 to 1,640 meters)
Mean annual precipitation: 6 to 10 inches (150 to 250 millimeters)
Mean annual air temperature: 54 to 57 degrees Fahrenheit (12.0 to 14.0 degrees Celsius)
Mean annual soil temperature: 56 to 59 degrees Fahrenheit (13.1 to 15.1 degrees Celsius)
Frost-free period: 150 to 180 days
Major Land Resource Area: 35 - Colorado Plateau
Land Resource Unit: 35-2 Colorado Plateau Shrub - Grasslands

Map Unit Composition
Tsaya family and similar soils: 50 percent
Moenkopie and similar soils: 40 percent
Minor Components - Areas of rock outcrop. Some areas have soils with depths greater than 20 inches (50 cm).

Soil Properties and Qualities
Tsaya family soils
Taxonomic classification: Loamy-skeletal, mixed, superactive, calcareous, mesic Lithic Torriorthents
Geomorphic position: occurs on side slopes on hills and structural benches.
Parent material: residuum weathered from sandstone and/or slope alluvium derived from sandstone
Slope: 2 to 15 percent
Biological crust
cyanobacteria: 2 percent
lichen: 2 percent
moss: 2 percent
Chemical crust
salt: 0 percent
gypsum: 0 percent
Physical cover
canopy plant cover: 47 percent
woody debris: 3 percent
bare soil: 7 percent
rock fragments
gravel: 45 percent
channer: 40 percent
Depth to restrictive feature(s): 10 to 20 inches to bedrock, lithic
Drainage class: well drained
Ksat solum: 2.00 to 6.00 inches per hour (14.11 to 42.34 micrometers per second)
Ksat restrictive layer: 0.00 to 0.20 inches per hour (0.00 to 1.40 micrometers per second)
Available water capacity total inches: 1.2 (very low)
Shrink-swell potential: about 1.5 LEP (low)
Flooding hazard: none
Runoff class: very high
Hydrologic group: D
Ecological site name: Desert Shallow Sandy Loam (Shadscale)
Ecological site number: R035XY130UT
Present vegetation: galleta, shadscale saltbush, Torrey Mormon tea
Land capability (non irrigated): 7c

Typical Profile
Location
Geographic Coordinate System:
38° 23' 12.20'' north, 109° 59' 39.50'' west

A--0 to 3.5 inches (0 to 9 cm); reddish brown (5YR 5/4) sandy loam, reddish brown (5YR 4/4), moist; 11 percent clay; weak fine subangular blocky and moderate medium platy structure; slightly hard, friable, slightly sticky and nonplastic; common fine roots throughout; common fine tubular pores; 5 percent fine gravel and 2 percent channer; strongly effervescent, 3 percent calcium carbonate equivalent; moderately alkaline, pH 8.2; clear wavy boundary.

Bw--3.5 to 9 inches (9 to 23 cm); reddish brown (5YR 4/4) coarse sandy loam, dark reddish brown (5YR 3/4), moist; 14 percent clay; moderate fine subangular blocky and weak medium subangular blocky structure; slightly hard, friable, slightly sticky and nonplastic; common fine roots throughout; common fine tubular pores; 10 percent fine gravel; violently effervescent, 5 percent calcium carbonate equivalent; moderately alkaline, pH 8.4; abrupt wavy boundary.

C--9 to 16 inches (23 to 41 cm); reddish brown (5YR 4/4) extremely channery sandy loam, dark reddish brown (5YR 3/4), moist; 15 percent clay; massive; very hard, extremely firm, slightly sticky and nonplastic; common fine roots in cracks; common fine tubular pores; 70

percent channer; violently effervescent, 5 percent calcium carbonate equivalent; moderately alkaline, pH 8.4; abrupt wavy boundary.

R--16 to 26 inches (41 to 66 cm); unweathered, unfractured sandstone bedrock.

Range in Characteristics
Tsaya family differs from the series because the clay content throughout the profile varies to a greater degree than allowed in the official series.

Reaction: 7.9 to 8.4 (moderately alkaline)

A Horizon
 Value: 4 or 5 dry, 3 or 4 moist
 Chroma: 4 or 6 dry, 3 to 6 moist

Bw Horizon
 Hue: 2.5YR or 5YR
 Value: 4 or 5 dry, 3 or 4 moist
 Chroma: 4 or 6 dry, 3 to 6 moist
 Texture: sandy loam, loamy coarse sand
 Clay content: 8 to 18 percent
 Rock fragments: 15 to 70 percent

C Horizon
 Hue: 2.5YR or 5YR
 Value: 4 dry, 3 moist
 Chroma: 4 or 6 dry, 3 or 4 moist
 Texture: coarse sandy loam, sandy loam
 Clay content: 10 to 20 percent
 Rock fragments: 35 to 80 percent

Moenkopie soils
Taxonomic classification: Loamy, mixed, superactive, calcareous, mesic Lithic Torriorthents
Geomorphic position: ccurs on side slopes on hills and structural benches.
Parent material: slope alluvium and/or residuum weathered from sandstone
Slope: 2 to 15 percent
Biological crust
 cyanobacteria: 2 percent
 lichen: 2 percent
 moss: 2 percent
Chemical crust
 salt: 0 percent
 gypsum: 0 percent
Physical cover
 canopy plant cover: 47 percent
 woody debris: 3 percent
 bare soil: 7 percent
  rock fragments
   channer: 55 percent
Depth to restrictive feature(s): 8 to 20 inches to bedrock, lithic
Drainage class: well drained
Ksat solum: 2.00 to 20.00 inches per hour (14.11 to 141.14 micrometers per second)
Ksat restrictive layer: 0.00 to 0.20 inches per hour (0.00 to 1.40 micrometers per second)
Available water capacity total inches: 0.6 (very low)
Shrink-swell potential: about 1.5 LEP (low)
Flooding hazard: none
Runoff class: very high
Hydrologic group: D
Ecological site name: Desert Shallow Sandy Loam (Shadscale)
Ecological site number: R035XY130UT
Present vegetation: shadscale saltbush, galleta, cheatgrass, Torrey Mormon tea, broom snakeweed, Indian ricegrass
Land capability (non irrigated): 7c

Typical Profile
Location
 Geographic Coordinate System:
  38° 24’ 31.80’’ north, 109° 46’ 14.50’’ west

A--0 to 2.5 inches (0 to 6 cm); yellowish red (5YR 5/6) loamy sand, yellowish red (5YR 4/6), moist; 9 percent clay; moderate coarse granular and moderate fine subangular blocky structure; soft, very friable, nonsticky and nonplastic; common fine roots throughout; common very fine irregular pores; 10 percent channer; strongly effervescent, 7 percent calcium carbonate equivalent; moderately alkaline, pH 8.2; clear wavy boundary.

2C--2.5 to 8 inches (6 to 20 cm) channery sandy loam; 13 percent clay; massive; moderately hard, firm, slightly sticky and nonplastic; common fine roots throughout; common very fine irregular pores; 20 percent channer; slightly effervescent, 3 percent calcium carbonate equivalent; moderately alkaline, pH 8.2; clear wavy boundary.

2R--8 to 17.5 inches (20 to 45 cm); unweathered, unfractured sandstone bedrock.

Range in Characteristics
Reaction: 7.9 to 8.4 (moderately alkaline)

A Horizon
 Hue: 2.5YR or 5YR
 Value: 4 or 5 dry, 3 or 4 moist
 Chroma: 4 or 6, dry or moist

C Horizon
 Hue: 2.5YR or 5YR
 Value: 4 or 5 dry, 3 or 4 moist
 Chroma: 4 or 6, dry or moist
 Texture: sandy loam, sandy loam
 Clay content: 10 to 18 percent
 Rock fragments: 10 to 35 percent

Bw horizons are present in some pedons.

627—Bluechief-Needle complex, 2 to 15 percent slopes

Map Unit Setting
Landform(s): plateaus
Elevation: 3,940 to 5,300 feet (1,200 to 1,615 meters)
Mean annual precipitation: 6 to 10 inches (150 to 250 millimeters)
Mean annual air temperature: 54 to 57 degrees Fahrenheit (12.0 to 14.0 degrees Celsius)
Mean annual soil temperature: 56 to 59 degrees Fahrenheit (13.1 to 15.1 degrees Celsius)
Frost-free period: 150 to 180 days
Major Land Resource Area: 35 - Colorado Plateau
Land Resource Unit: 35-2 Colorado Plateau Shrub - Grasslands

Map Unit Composition
Bluechief and similar soils: 45 percent
Needle and similar soils: 40 percent
Minor Components: Lithic Moenkopie soils on shoulders. Very deep Sheppard soils in depositional areas.

Soil Properties and Qualities
Bluechief soils
Taxonomic classification: Coarse-loamy, mixed, superactive, mesic Typic Haplocalcids
Geomorphic position: occurs on side slopes on structural benches.
Parent material: eolian deposits derived from sandstone and/or residuum weathered from sandstone
Slope: 2 to 8 percent
Biological crust
cyanobacteria: 25 percent
lichen: 7 percent
moss: 3 percent
Chemical crust
salt: 0 percent
gypsum: 0 percent
Physical cover
canopy plant cover: 45 percent
woody debris: 3 percent
bare soil: 23 percent
rock fragments
channer: 5 percent
Depth to restrictive feature(s): 20 to 40 inches to bedrock, lithic
Drainage class: well drained
Ksat solum: 2.00 to 20.00 inches per hour (14.11 to 141.14 micrometers per second)
Ksat restrictive layer: 0.00 to 0.20 inches per hour (0.00 to 1.40 micrometers per second)
Available water capacity total inches: 3.0 (low)
Shrink-swell potential: about 1.5 LEP (low)
Flooding hazard: none
Runoff class: high
Hydrologic group: B
Ecological site name: Desert Sandy Loam (Blackbrush)
Ecological site number: R035XY121UT
Present vegetation: blackbrush, Indian ricegrass, galleta, Torrey Mormon tea
Land capability (non irrigated): 7c

Typical Profile
Location
Geographic Coordinate System:
38° 21' 53.00'' north, 109° 54' 51.30'' west

A--0 to 2.5 inches (0 to 6 cm); reddish yellow (5YR 6/6) fine sand, yellowish red (5YR 5/6), moist; 2 percent clay; weak fine subangular blocky structure; soft, very friable, nonsticky and nonplastic; common very fine roots throughout; many very fine interstitial pores; very slightly effervescent, 2 percent calcium carbonate equivalent; moderately alkaline, pH 8.2; abrupt wavy boundary.

Bw--2.5 to 6.5 inches (6 to 17 cm); yellowish red (5YR 5/6) loamy fine sand, yellowish red (5YR 4/6), moist; 6 percent clay; moderate medium and coarse subangular blocky structure; slightly hard, friable, nonsticky and nonplastic; common fine roots throughout; common very fine irregular pores; 2 percent fine gravel; strongly effervescent, 4 percent calcium carbonate equivalent; moderately alkaline, pH 8.2; clear wavy boundary.

Bk1--6.5 to 13.5 inches (17 to 34 cm); reddish yellow (5YR 6/8) fine sandy loam, yellowish red (5YR 5/8), moist; 13 percent clay; moderate fine and medium subangular blocky structure; moderately hard, firm, slightly sticky and nonplastic; common fine roots throughout; common very fine irregular pores; common prominent irregular carbonate masses in matrix; 8 percent fine gravel; violently effervescent, 12 percent calcium carbonate equivalent; moderately alkaline, pH 8.4; clear wavy boundary.

Bk2--13.5 to 34.5 inches (34 to 87 cm); reddish yellow (5YR 6/6) gravelly fine sandy loam, reddish yellow (5YR 6/8), moist; 15 percent clay; moderate fine and medium subangular blocky structure; moderately hard, firm, slightly sticky and nonplastic; common fine roots throughout; common very fine irregular pores; many prominent irregular carbonate masses in matrix; 20 percent fine gravel; violently effervescent, 28 percent calcium carbonate equivalent; moderately alkaline, pH 8.4; abrupt wavy boundary.

2R--34.5 to 44 inches (87 to 112 cm); unweathered, unfractured sandstone bedrock.

Range in Characteristics
Needle soils
Taxonomic classification: Mixed, mesic Lithic Torripsamments
Geomorphic position: occurs on side slopes on structural

benches.
Parent material: eolian sands derived from sandstone
Slope: 2 to 15 percent
Biological crust
cyanobacteria: 25 percent
lichen: 7 percent
moss: 3 percent
Chemical crust
salt: 0 percent
gypsum: 0 percent
Physical cover
canopy plant cover: 45 percent
woody debris: 3 percent
bare soil: 23 percent
rock fragments
gravel: 1 percent
Depth to restrictive feature(s): 5 to 20 inches to bedrock, lithic
Drainage class: excessively drained
Ksat solum: 6.00 to 20.00 inches per hour (42.34 to 141.14 micrometers per second)
Ksat restrictive layer: 0.00 to 0.20 inches per hour (0.00 to 1.40 micrometers per second)
Available water capacity total inches: 0.3 (very low)
Shrink-swell potential: about 1.5 LEP (low)
Flooding hazard: none
Runoff class: very high
Hydrologic group: D
Ecological site name: Desert Shallow Sandy Loam (Blackbrush)
Ecological site number: R035XY133UT
Present vegetation: blackbrush, rubber rabbitbrush, Indian ricegrass, Douglas rabbitbrush, Torrey Mormon tea, broom snakeweed, desert trumpet buckwheat, galleta, gooseberryleaf globemallow
Land capability (non irrigated): 7c

Typical Profile
Location
Geographic Coordinate System:
38° 22' 26.40'' north, 110° 1' 8.40'' west

C--0 to 5 inches (0 to 13 cm); reddish brown (5YR 5/4) fine sand, yellowish red (5YR 4/6), moist; 1 percent clay; weak medium subangular blocky structure; soft, very friable, nonsticky and nonplastic; common fine roots throughout; many fine irregular pores; 1 percent gravel; slightly effervescent; moderately alkaline, pH 8.0; abrupt wavy boundary.

2R--5 to 15 inches (13 to 38 cm); unweathered, unfractured sandstone bedrock.

Range in Characteristics

639—Sheppard-Tsaya-Bluechief families complex, 2 to 15 percent slopes

Map Unit Setting
Landform(s): plateaus
Elevation: 3,970 to 5,220 feet (1,210 to 1,590 meters)
Mean annual precipitation: 6 to 10 inches (150 to 250 millimeters)
Mean annual air temperature: 54 to 57 degrees Fahrenheit (12.0 to 14.0 degrees Celsius)
Mean annual soil temperature: 56 to 59 degrees Fahrenheit (13.1 to 15.1 degrees Celsius)
Frost-free period: 150 to 180 days
Major Land Resource Area: 35 - Colorado Plateau
Land Resource Unit: 35-2 Colorado Plateau Shrub - Grasslands

Map Unit Composition
Sheppard family and similar soils: 30 percent
Tsaya family and similar soils: 30 percent
Bluechief family and similar soils: 20 percent
Minor components: Shallow Goblin soils. A few areas of Rock outcrop.

Soil Properties and Qualities
Sheppard family soils
Taxonomic classification: Mixed, mesic Typic Torripsamments
Geomorphic position: occurs on side slopes on structural benches.
Parent material: eolian sands derived from sandstone
Slope: 2 to 15 percent
Biological crust
cyanobacteria: 25 percent
lichen: 8 percent
moss: 3 percent
Chemical crust
salt: 0 percent
gypsum: 0 percent
Physical cover
canopy plant cover: 45 percent
woody debris: 3 percent
bare soil: 23 percent
rock fragments
gravel: 1 percent
Depth to restrictive feature(s): 20 to 40 inches to bedrock, lithic
Drainage class: somewhat excessively drained
Ksat solum: 2.00 to 20.00 inches per hour (14.11 to 141.14 micrometers per second)
Ksat restrictive layer: 0.00 to 0.20 inches per hour (0.00 to 1.40 micrometers per second)
Available water capacity total inches: 2.7 (low)
Shrink-swell potential: about 1.5 LEP (low)
Flooding hazard: none
Runoff class: very high
Hydrologic group: B

Ecological site name: Desert Sandy Loam (Blackbrush)
Ecological site number: R035XY121UT
Present vegetation: blackbrush, Indian ricegrass, shadscale saltbush, Torrey Mormon tea, desert trumpet buckwheat, galleta
Land capability (non irrigated): 7c

Typical Profile
Location
Geographic Coordinate System:
38° 13' 55.50'' north, 110° 1' 52.00'' west

A--0 to 3.5 inches (0 to 9 cm); reddish brown (5YR 5/4) fine sand, reddish brown (5YR 4/4), moist; 1 percent clay; weak fine and medium subangular blocky structure; soft, very friable, nonsticky and nonplastic; common very fine roots throughout and common fine roots throughout; many very fine interstitial and common fine interstitial pores; slightly effervescent, 20 percent calcium carbonate equivalent; moderately alkaline, pH 8.2; gradual wavy boundary.

Bk1--3.5 to 19.5 inches (9 to 50 cm); yellowish red (5YR 5/6) loamy fine sand, yellowish red (5YR 4/6), moist; 7 percent clay; moderate medium subangular blocky structure; slightly hard, friable, nonsticky and nonplastic; common very fine roots throughout and common fine roots throughout; many very fine interstitial and common fine interstitial pores; common medium irregular carbonate masses in matrix; 3 percent gravel; strongly effervescent, 20 percent calcium carbonate equivalent; moderately alkaline, pH 8.2; clear wavy boundary.

Bk2--19.5 to 29.5 inches (50 to 75 cm); yellowish red (5YR 5/6) loamy fine sand, yellowish red (5YR 4/6), moist; 9 percent clay; moderate medium subangular blocky structure; slightly hard, friable, slightly sticky and nonplastic; common very fine roots throughout and common fine roots throughout; common very fine interstitial and common fine interstitial pores; common medium irregular carbonate masses in matrix; 10 percent gravel; violently effervescent, 20 percent calcium carbonate equivalent; moderately alkaline, pH 8.2; clear wavy boundary.

2R--29.5 to 39.5 inches (75 to 100 cm); unweathered, unfractured sandstone bedrock.

Range in Characteristics
Sheppard family differs from the series because the depth to hard bedrock ranges from 20 to 40 inches.

Reaction: 7.9 to 8.4 (moderately alkaline)

A horizon:
Hue: 5YR or 7.5YR
Value: 4 or 5, dry or moist
Chroma: 4 or 6, dry or moist

Bk horizon:
Hue: 5YR to 10YR
Value: 5 or 6 dry, 4 or 5 moist
Chroma: 4 or 6, dry or moist
Texture: loamy fine sand, fine sand
Clay content: 2 to 10 percent
Calcium carbonate equivalent: 5 to 25 percent
Rock fragments: 0 to 12 percent gravel

2C horizon (where present):
Hue: 7.5YR or 10YR
Value: 5 or 6 dry, 4 or 5 moist
Chroma: 4 or 6, dry or moist
Texture: loamy fine sand, fine sand, sand
Clay content: 2 to 10 percent
Calcium carbonate equivalent: 5 to 25 percent
Rock fragments: 10 to 20 percent

The Bk horizon lacks sufficient secondary carbonate accumulation to qualify as a calcic.

Tsaya family soils
Taxonomic classification: Loamy-skeletal, mixed, superactive, calcareous, mesic Lithic Torriorthents
Geomorphic position: occurs on side slopes on structural benches.
Parent material: residuum weathered from sandstone
Slope: 2 to 15 percent
Biological crust
cyanobacteria: 12 percent
lichen: 3 percent
moss: 3 percent
Chemical crust
salt: 0 percent
gypsum: 0 percent
Physical cover
canopy plant cover: 40 percent
woody debris: 3 percent
bare soil: 25 percent
rock fragments
gravel: 40 percent
channer: 10 percent
flagstone: 5 percent
Depth to restrictive feature(s): 4 to 20 inches to bedrock, lithic
Drainage class: well drained
Ksat solum: 2.00 to 6.00 inches per hour (14.11 to 42.34 micrometers per second)
Ksat restrictive layer: 0.00 to 0.20 inches per hour (0.00 to 1.40 micrometers per second)
Available water capacity total inches: 0.9 (very low)
Shrink-swell potential: about 1.5 LEP (low)
Flooding hazard: none
Runoff class: very high
Hydrologic group: D
Ecological site name: Desert Shallow Sandy Loam (Blackbrush)

Ecological site number: R035XY133UT
Present vegetation: blackbrush, Torrey Mormon tea, galleta, Brenda's yellow cryptantha, broom snakeweed, rubber rabbitbrush
Land capability (non irrigated): 7c

Typical Profile
Location
Geographic Coordinate System:
38° 13' 53.50'' north, 110° 1' 49.20'' west

A--0 to 3 inches (0 to 8 cm); brown (7.5YR 5/4) fine sandy loam, strong brown (7.5YR 4/6), moist; 11 percent clay; weak fine subangular blocky structure; soft, very friable, slightly sticky and nonplastic; common very fine roots throughout; common very fine irregular pores; 5 percent gravel; violently effervescent, 10 percent calcium carbonate equivalent; moderately alkaline, pH 8.4; abrupt wavy boundary.

C--3 to 10 inches (8 to 25 cm); strong brown (7.5YR 5/6) very gravelly fine sandy loam, strong brown (7.5YR 4/6), moist; 9 percent clay; massive; slightly hard, friable, slightly sticky and nonplastic; common very fine roots throughout; common very fine irregular pores; common fine irregular gypsum crystals in matrix; 55 percent gravel; violently effervescent, 10 percent calcium carbonate equivalent; moderately alkaline, pH 8.4; abrupt wavy boundary.

R--10 to 19.5 inches (25 to 50 cm); unweathered sandstone bedrock.

Range in Characteristics
Tsaya family differs from the series because it contains less than 18 percent clay in the particle size control section.

Reaction: 7.9 to 8.4 (moderately alkaline)

A horizon:
Hue: 5YR or 7.5YR
Value: 4 or 5, dry or moist
Chroma: 4 or 6, dry or moist

C horizon:
Hue: 5YR to 10YR
Value: 4 or 5, dry or moist
Chroma: 4 or 6, dry or moist
Texture: sandy loam, fine sandy loam
Clay content: 8 to 15 percent
Calcium carbonate equivalent: 5 to 15 percent
Gypsum: 0 to 10 percent
Rock fragments: 40 to 65 percent

Bluechief family soils
Taxonomic classification: Coarse-loamy, mixed, superactive, mesic Typic Haplocalcids
Geomorphic position: occurs on side slopes on structural benches.
Parent material: residuum weathered from sandstone
Slope: 2 to 8 percent
Biological crust
cyanobacteria: 25 percent
lichen: 7 percent
moss: 3 percent
Chemical crust
salt: 0 percent
gypsum: 0 percent
Physical cover
canopy plant cover: 45 percent
woody debris: 3 percent
bare soil: 23 percent
rock fragments
gravel: 40 percent
channer: 10 percent
flagstone: 5 percent
Depth to restrictive feature(s): 20 to 40 inches to bedrock, lithic
Drainage class: well drained
Ksat solum: 2.00 to 6.00 inches per hour (14.11 to 42.34 micrometers per second)
Ksat restrictive layer: 0.00 to 0.20 inches per hour (0.00 to 1.40 micrometers per second)
Available water capacity total inches: 1.8 (very low)
Shrink-swell potential: about 1.5 LEP (low)
Flooding hazard: none
Runoff class: high
Hydrologic group: B
Ecological site name: Desert Shallow Sandy Loam (Blackbrush)
Ecological site number: R035XY133UT
Present vegetation: blackbrush, Torrey Mormon tea, galleta, Brenda's yellow cryptantha, broom snakeweed, rubber rabbitbrush
Land capability (non irrigated): 7c

Typical Profile
Location
Geographic Coordinate System:
38° 27' 3.00'' north, 110° 1' 18.60'' west

A--0 to 4 inches (0 to 10 cm); reddish brown (5YR 5/4) gravelly sandy loam, reddish brown (5YR 4/4), moist; 15 percent clay; moderate fine subangular blocky structure; soft, very friable, slightly sticky and nonplastic; common very fine roots throughout and common fine roots throughout; common very fine tubular pores; 30 percent gravel; violently effervescent, 7 percent calcium carbonate equivalent and 3 percent gypsum; moderately alkaline, pH 8.0; abrupt wavy boundary.

Bk--4 to 22 inches (10 to 56 cm); reddish brown (5YR 5/4) channery sandy loam, reddish brown (5YR 4/4), moist; 13 percent clay; weak medium subangular blocky structure; slightly hard, friable, slightly sticky and nonplastic; common very fine roots throughout; common very fine tubular pores; few fine irregular gypsum crystals in matrix and common medium irregular carbonate masses in matrix; 30 percent channer; violently effervescent, 12 percent calcium carbonate equivalent and 3 percent gypsum; moderately alkaline, pH 8.4; abrupt wavy boundary.

R--22 to 32 inches (56 to 81 cm); unweathered, sandstone bedrock.

Range in Characteristics
Bluechief family differs from the series because it contains greater than 20 percent coarse fragments in the Bk and C horizons.

Reaction: 7.9 to 8.4 (moderately alkaline)

A horizon:
Value: 4 or 5, dry or moist

Bk horizon:
Value: 4 or 5 dry, 3 or 4 moist
Chroma: 3 or 4, dry or moist
Clay content: 8 to 15 percent
Calcium carbonate equivalent: 5 to 10 percent
Rock fragments: 0 to 30 percent

C horizon (where present):
Hue: 5YR to 10YR
Value: 5 to 7 dry, 4 or 5 moist
Clay content: 10 to 15 percent
Calcium carbonate equivalent: 10 to 15 percent
Rock fragments: 25 to 40 percent

647—Monue-Trail-Nepalto complex, 1 to 6 percent slopes

Map Unit Setting
Landform(s): flood plains
Elevation: 3,870 to 4,760 feet (1,180 to 1,450 meters)
Mean annual precipitation: 6 to 10 inches (150 to 250 millimeters)
Mean annual air temperature: 54 to 57 degrees Fahrenheit (12.0 to 14.0 degrees Celsius)
Mean annual soil temperature: 56 to 59 degrees Fahrenheit (13.1 to 15.1 degrees Celsius)
Frost-free period: 150 to 180 days
Major Land Resource Area: 35 - Colorado Plateau
Land Resource Unit: 35-2 Colorado Plateau Shrub - Grasslands

Map Unit Composition
Monue and similar soils: 30 percent
Trail and similar soils: 30 percent
Nepalto and similar soils: 25 percent
Minor components: Some areas have soil textures of loamy fine sand or coarser throughout the profile.

Soil Properties and Qualities
Monue soils
Taxonomic classification: Coarse-loamy, mixed, superactive, mesic Typic Haplocambids
Geomorphic position: occurs on stream terraces.
Parent material: alluvium derived from sandstone
Slope: 1 to 6 percent
Biological crust
cyanobacteria: 0 percent
lichen: 0 percent
moss: 7 percent
Chemical crust
salt: 0 percent
gypsum: 0 percent
Physical cover
canopy plant cover: 55 percent
woody debris: 3 percent
bare soil: 35 percent
rock fragments: 0 percent
Drainage class: well drained
Ksat solum: 0.60 to 99.92 inches per hour (4.23 to 705.00 micrometers per second)
Available water capacity total inches: 6.2 (moderate)
Shrink-swell potential: about 1.5 LEP (low)
Flooding hazard: rare
Runoff class: very low
Hydrologic group: B
Ecological site name: Alkali Bottom (Greasewood)
Ecological site number: R035XY003UT
Present vegetation: sand dropseed, greasewood, seepweed, fourwing saltbush, Indian ricegrass, russian thistle
Land capability (non irrigated): 7c

Typical Profile
Location
Geographic Coordinate System:
38° 27' 1.40'' north, 110° 1' 18.20'' west

A--0 to 4.5 inches (0 to 11 cm); reddish brown (5YR 5/4) loamy very fine sand, reddish brown (5YR 4/4), moist; 5 percent clay; weak fine subangular blocky and moderate thick platy structure; slightly hard, very friable, nonsticky and nonplastic; few fine roots throughout; common very fine interstitial and few fine interstitial pores; slightly effervescent, 6 percent calcium carbonate equivalent; moderately alkaline, pH 8.2; clear wavy boundary.

Bw--4.5 to 31.5 inches (11 to 80 cm); reddish brown (5YR 5/4) very fine sandy loam, reddish brown (5YR 4/4), moist; 13 percent clay; weak thick platy and weak medium subangular blocky structure; slightly hard, friable, slightly sticky and nonplastic; common very fine and fine roots throughout and few medium roots throughout; common very fine tubular and few fine tubular pores; strongly effervescent, 14 percent calcium carbonate equivalent; moderately alkaline, pH 8.4; clear wavy boundary.

C--31.5 to 60 inches (80 to 152 cm); reddish brown (5YR 4/4) gravelly sand, dark reddish brown (5YR 3/4), moist; 1 percent clay; massive; slightly hard, friable, nonsticky and nonplastic; common very fine roots throughout and common fine roots throughout; common very fine interstitial and few fine interstitial pores; 15 percent gravel; slightly effervescent, 16 percent calcium carbonate equivalent; moderately alkaline, pH 8.4.

Range in Characteristics
Reaction: 7.4 to 8.4 (slightly alkaline to moderately alkaline)

A horizon:
Value: 4 or 5 dry, 3 or 4 moist
Chroma: 4 or 6, dry or moist

Bw horizon:
Value: 4 or 5, dry or moist
Chroma: 4 or 6, dry or moist
Texture: very fine sandy loam, fine sandy loam
Clay content: 10 to 15 percent
Calcium carbonate equivalent: 10 to 15 percent
Rock fragments: 0 to 10 percent

C horizons:
Value: 4 or 5 dry, 3 or 4 moist
Chroma: 4 or 6, dry or moist
Texture: sand, loamy sand, loamy fine sand
Clay content: 1 to 10 percent
Calcium carbonate equivalent: 10 to 20 percent
Rock fragments: 0 to 30 percent

Trail soils
Taxonomic classification: Sandy, mixed, mesic Typic Torrifluvents
Geomorphic position: occurs on flood plain steps.
Parent material: alluvium derived from sandstone and/or slope alluvium derived from sandstone
Slope: 1 to 6 percent
Biological crust
cyanobacteria: 0 percent
lichen: 0 percent
moss: 7 percent
Chemical crust
salt: 0 percent
gypsum: 0 percent
Physical cover
canopy plant cover: 55 percent
woody debris: 3 percent
bare soil: 35 percent
rock fragments: 0 percent
Drainage class: somewhat excessively drained
Ksat solum: 2.00 to 6.00 inches per hour (14.11 to 42.34 micrometers per second)
Available water capacity total inches: 7.1 (high)
Shrink-swell potential: about 1.5 LEP (low)
Flooding hazard: rare
Runoff class: very low
Hydrologic group: A
Ecological site name: Desert Sandy Loam (Fourwing Saltbush)
Ecological site number: R035XY118UT
Present vegetation: seepweed, fourwing saltbush, plains pricklypear, russian thistle
Land capability (non irrigated): 7c

Typical Profile
Location
Geographic Coordinate System:
38° 27' 3.00'' north, 110° 1' 19.00'' west

A--0 to 3 inches (0 to 7 cm); reddish brown (5YR 5/4) loamy fine sand, reddish brown (5YR 4/4), moist; 6 percent clay; moderate medium platy structure; soft, very friable, nonsticky and nonplastic; common very fine roots throughout; common very fine irregular pores; strongly effervescent, 2 percent calcium carbonate equivalent; moderately alkaline, pH 8.2; clear wavy boundary.

Bw--3 to 15.5 inches (7 to 40 cm); reddish brown (5YR 5/4) loamy fine sand, reddish brown (5YR 4/4), moist; 7 percent clay; weak medium subangular blocky structure; soft, very friable, nonsticky and nonplastic; common very fine roots throughout; common very fine irregular pores; strongly effervescent, 2 percent calcium carbonate equivalent; moderately alkaline, pH 8.2; clear wavy boundary.

C1--15.5 to 43.5 inches (40 to 110 cm); yellowish red (5YR 5/6) loamy fine sand, yellowish red (5YR 4/6), moist; 6 percent clay; massive; slightly hard, very friable, nonsticky and nonplastic; common very fine roots throughout; common very fine irregular pores; strongly effervescent, 2 percent calcium carbonate equivalent; moderately alkaline, pH 8.2; clear wavy boundary.

C2--43.5 to 71 inches (110 to 180 cm); yellowish red (5YR 5/6) loamy fine sand, yellowish red (5YR 4/6), moist; 6 percent clay; massive; slightly hard, very friable, nonsticky and nonplastic; common very fine roots throughout; common very fine irregular pores; strongly effervescent, 2 percent calcium carbonate equivalent; moderately alkaline, pH 8.4.

Range in Characteristics
Reaction: 7.4 to 8.4 (slightly alkaline to moderately alkaline)
A horizon:
Value: 4 or 5 dry, 3 or 4 moist

Bw horizon:
Value: 4 or 5 dry, 3 or 4 moist
Texture: loamy fine sand, loamy sand
Clay content: 5 to 10 percent
Calcium carbonate equivalent: 1 to 5 percent

Rock fragments: 0 to 5 percent

C horizons:
Value: 4 or 5 dry, 3 or 4 moist
Chroma: 4 or 6, dry or moist
Texture: coarse sand, sand, fine sand, loamy fine sand
Clay content: 1 to 10 percent
Calcium carbonate equivalent: 1 to 5 percent
Rock fragments: 0 to 10 percent

Bw is too coarse to qualify as a cambic horizon.

Nepalto soils
Taxonomic classification: Sandy-skeletal, mixed, mesic Typic Torriorthents
Geomorphic position: occurs on flood plain steps.
Parent material: slope alluvium derived from sandstone
Slope: 1 to 6 percent
Biological crust
cyanobacteria: 0 percent
lichen: 0 percent
moss: 0 percent
Chemical crust
salt: 0 percent
gypsum: 0 percent
Physical cover
canopy plant cover: 35 percent
woody debris: 6 percent
bare soil: 50 percent
rock fragments
gravel: 15 percent
cobble: 5 percent
Drainage class: excessively drained
Ksat solum: 20.00 to 99.92 inches per hour (141.14 to 705.00 micrometers per second)
Available water capacity total inches: 1.9 (very low)
Shrink-swell potential: about 1.5 LEP (low)
Flooding hazard: very rare
Runoff class: very low
Hydrologic group: A
Ecological site name: Desert Stony Loam (Shadscale-Bud Sagebrush)
Ecological site number: R035XY136UT
Present vegetation: sand sagebrush, shadscale saltbush, Indian ricegrass, sand dropseed, Torrey Mormon tea, galleta
Land capability (non irrigated): 7c

Typical Profile
Location
Geographic Coordinate System:
38° 28' 35.70'' north, 110° 0' 22.30'' west

C1--0 to 3.5 inches (0 to 9 cm); reddish brown (5YR 5/4) sand, reddish brown (5YR 4/4), moist; 4 percent clay; single grain; loose, nonsticky and nonplastic; common very fine roots throughout; many very fine interstitial pores; 5 percent gravel; strongly effervescent, 6 percent calcium carbonate equivalent; moderately alkaline, pH 8.4; clear wavy boundary.

C2--3.5 to 10 inches (9 to 25 cm); reddish brown (5YR 5/4) very gravelly sand, reddish brown (5YR 4/4), moist; 4 percent clay; single grain; loose, nonsticky and nonplastic; common very fine roots throughout; many very fine interstitial pores; 50 percent gravel; strongly effervescent, 6 percent calcium carbonate equivalent; moderately alkaline, pH 8.4; clear wavy boundary.

C3--10 to 60 inches (25 to 152 cm); reddish brown (5YR 5/4) very gravelly sand, reddish brown (5YR 4/4), moist; 4 percent clay; single grain; loose, nonsticky and nonplastic; common very fine roots throughout; many very fine interstitial pores; 50 percent gravel; strongly effervescent, 6 percent calcium carbonate equivalent; moderately alkaline, pH 8.4; clear wavy boundary.

Range in Characteristics
Reaction: 7.4 to 8.4 (slightly alkaline to moderately alkaline)

A horizon (where present):
Value: 4 or 5, dry or moist

C horizons:
Value: 4 or 5, dry or moist
Texture: sand, loamy sand
Clay content: 2 to 8 percent
Calcium carbonate equivalent: 5 to 10 percent
Rock fragments: 35 to 70 percent

999—Water

Map Unit Setting
Landform(s): plateaus
Elevation: 3,130 to 3,700 feet (955 to 1,128 meters)
Mean annual precipitation: 6 to 10 inches (150 to 250 millimeters)
Mean annual air temperature: 54 to 57 degrees Fahrenheit (12.0 to 14.0 degrees Celsius)
Mean annual soil temperature: 56 to 59 degrees Fahrenheit (13.1 to 15.1 degrees Celsius)
Frost-free period: 150 to 180 days
Major Land Resource Area: 35 - Colorado Plateau
Land Resource Unit: 35-2 Colorado Plateau Shrub - Grasslands

Map Unit Composition
Water: 100 percent

Soil Properties and Qualities

Water

Range in Characteristics